Communication and Broadcast Engineering

VOL. 3 NO. 12

Broadcast Transmission

Recording

Sound Projection

Television

Facsimile

Aeronautical Radio

Police Radio

Marine Radio

Carrier Transmission

Beam Transmission

Radio Telegraphy

Radio Telephony

Wire and Cable Telegraphy

Wire and Cable Telephony

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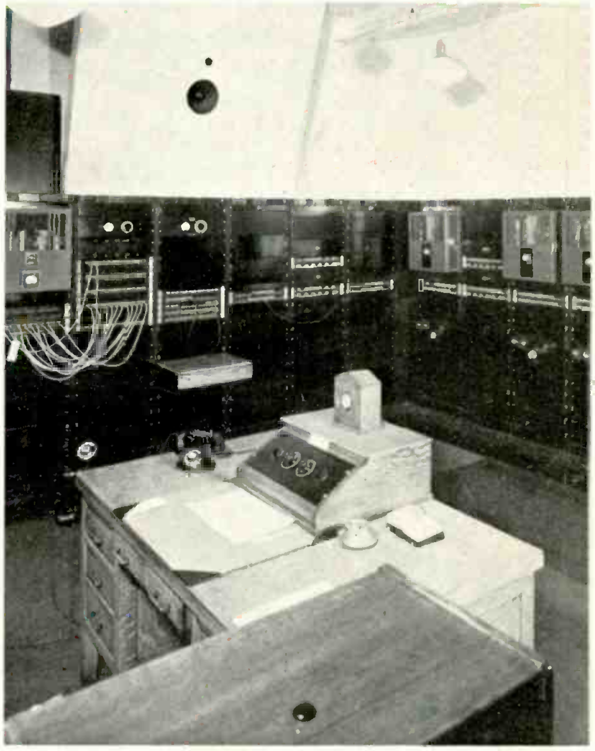

The Journal of World Communication

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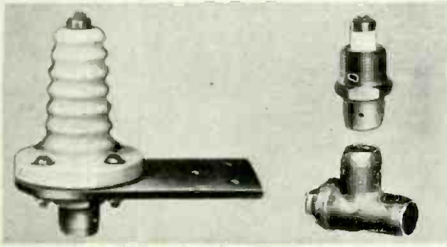
FROM

TRANSMITTER TO *Antenna*

A Complete Installation with ISOLANTITE COAXIAL TRANSMISSION LINE

WESTERN ELECTRIC ultra high frequency Police Radio Transmitter, Station W2XEM, Newark, N. J.



National Newark and Essex Bank Building, Showing location of transmitter and antenna connected by ISOLANTITE COAXIAL TRANSMISSION LINE.

In the rapidly developing technique of radio communication engineers recognize the coaxial transmission line as the most efficient means of conducting radio frequency energy from point to point and from transmitter to antenna.

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Editor

F. WALEN
Associate Editor

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EDITORIAL

BLANKET FIELD-INTENSITY HEARING

THE FEDERAL COMMUNICATIONS COMMISSION has invited all organizations and persons interested in broadcast allocations to discuss the subject of blanket field intensity at an informal hearing which has been called for January 18.

At the broadcast allocation hearing, which began on October 5, representatives of the radio industry presented testimony to the effect that the field intensity now taken as the limit of the blanket area of a broadcast station should be increased. The intensity now used as a reference for allocation problems is from 125 to 175 mv/m, but certain engineering groups, in view of the developments in broadcast receivers during the last few years, recommended that a field intensity of 1 v/m be selected as the reference.

The engineering department of the FCC is not satisfied that sufficient evidence was presented in support of the 1 v/m recommendation, nor that sufficient evidence was presented to determine just what value of field intensity should be employed. The FCC have therefore called the meeting of January 18 in order to obtain further information on this subject from organizations not present at the former hearing but which have intimate contact with the field problems involved.

It is sincerely hoped that broadcast stations, broadcast system engineering departments, receiver manufacturers, and other interested parties will cooperate with the FCC. It should be to the advantage of everyone.

NINETEEN THIRTY-SEVEN

THE RADIO INDUSTRY has made a great deal of progress during 1936, and with the greatly improved business conditions that now exist, it is only logical to assume that more advancement will be made in 1937.

Within the next two months a great deal will appear in print concerning the developments during 1936. While this is as it should be, COMMUNICATION AND BROADCAST ENGINEERING prefers to look ahead. Hence, in order to obtain as broad a view as possible, we have contacted many of the leaders in the fields of broadcasting, television, aeronautical radio, police radio, recording, public address, etc., and have asked them what they anticipate for 1937.

The result of this survey appears on following pages and we believe that everyone will find it of interest. Your comments and suggestions will be appreciated.

SINGLE-SIDEBAND TRANSMISSION FOR TELEVISION

IN OUR EDITORIAL for September, 1936, we pointed out some of the advantages to be obtained from the utilization of single-sideband transmission for television. We also pointed out that no method of producing a single-sideband-modulated wave had been devised for use at ultra-high frequencies.

It is interesting to note that while discussing the proposed television standards at the recent Rochester Fall Meeting, A. F. Murray, acting-chairman of the RMA Committee on Television, pointed out that with ordinary double-sideband transmission it is impossible to transmit 441 lines with full detail, since the bandwidth for picture transmission is directly proportional to the frame frequency and the amount of information to be transmitted (i.e., $f = \frac{1}{2} ANn^2$, where A = aspect ratio, N = number of complete pictures scanned per second, and where n = number of lines). Mr. Murray, however, expressed hopes that satisfactory single-sideband transmission in the ultra-high-frequency band would some day be realized.

At present television engineers are trying to secure better definition by tuning the transmitter and receiver to one sideband and partially attenuating the other sideband. By this method it may be possible to secure sufficient reduction of the undesired sideband to permit closer spacing between the television carrier and the sound carrier in the next channel.

In any case it is gratifying to know that the possibilities of applying single-sideband transmission to television is receiving consideration. While we do not wish to predict, it does seem plausible that this form of transmission will be employed in the television system of the future.

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This time with the console type SPEECH INPUT EQUIPMENT

Broadcasters needed a complete, single unit speech input equipment. First to meet this need was Western Electric—with the 23A, announced last July. What happened? The same thing that happened with the eight-ball mike, the 23A transmitter and other Western Electric pace-setters!

Broadcasters accepted the new unit immediately. They knew it was *right in design*—developed by Bell Telephone Laboratories. *Right in workmanship*—made by the leader in sound-transmission apparatus. Tests proved it was *right in performance.*

This compact unit—more than 60 of which have been ordered—gives a rare combination of flexibility, simplicity of operation and high quality performance. It is especially suitable for studio installations and with the new 23A transmitter.

For full details: Graybar Electric, Graybar Building, New York—or Graybar's nearest branch.

Western Electric

Distributed by GRAYBAR Electric Co. *In Canada: Northern Electric Co., Ltd.*

RADIO TELEPHONE BROADCASTING EQUIPMENT

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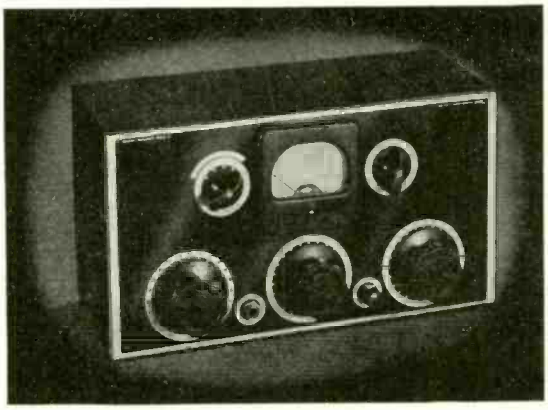
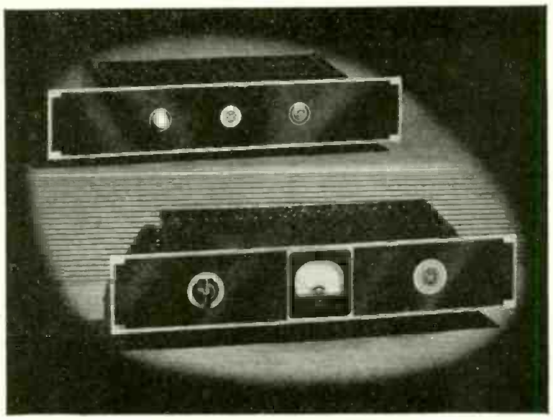
Broadcast Speech Input Components



Jewel Box Remote Amplifier

MODEL 2A—The UTC remote amplifier is an ideal unit for all types of remo service. This unit includes a three position mixer . . . isolation transformers for each input to prevent cross talk . . . a four stage high gain amplifier . . . a single meter for checking all plate currents and volume indication. The frequency response is uniform from 30 to 14,000 cycles and the power output is plus 7 DB. The Jewel Box Remote Amplifier is housed in a leather finish lightweight case with removable latched cover. A case is also obtainable for the separate power supply.

Net price to broadcast stations and recording studios for Model 2A semi-wired remote amplifier kit, less tubes and pads **$70**



Studio Preamplifier

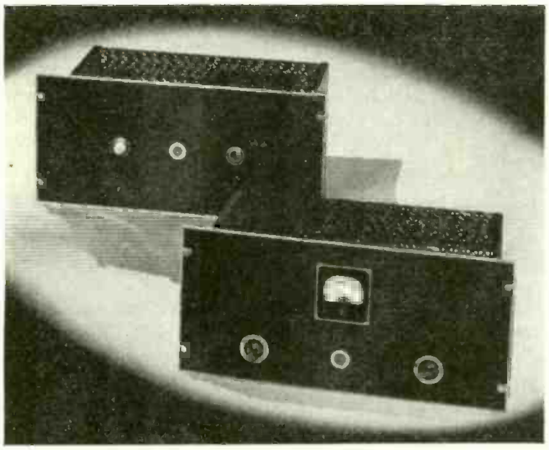
MODEL 5A—The UTC 5A preamplifier kit permits assembly as a two stage, three stage, or four stage amplifier. The relative gains under these respective conditions are 55 DB, 77 DB and 100 DB. A tri-alloy shielded input transformer plus additional design features developed in the UTC Laboratories effect extremely low hum level. The frequency response is uniform from 30 to 14,000 cycles and the power output is plus 7 DB. A switch and milliameter are provided to permit checking plate current of all tubes.

Net price to broadcast stations and recording studios for Model 5A preamplifier kit, semi-wired, less tubes **$65**

Power Supply

MODEL 6A—This is a highly filtered power supply for use with the 5A preamplifier. 250 Volts at 15 ma is provided and 6 Volts at 1.2A.

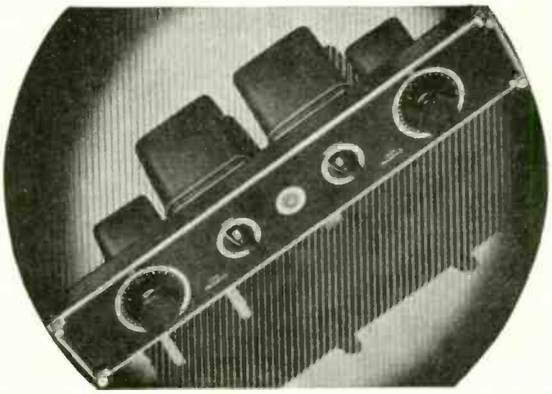
Net price to broadcast stations and recording studios **$35**



Studio-Monitoring Amplifier

MODEL 7A—WITH MODEL 8A POWER SUPPLY—This amplifier is suitable for all medium power broadcast applications including driver service. It provides 15 watts power output using pushpull 2A3's or 300 A's. Three pushpull stages effect 85 DB gain with hum level 50 DB below normal ouput. A switch and meter are provided on the audio panel to check plate current of all tubes, and a control is provided to balance the plate current of the output tubes. The power supply panel incorporates a pilot light and fuse. The frequency response of this unit is uniform from 30 to 14,000 cycles. All critical circuits are prewired and tested making it possible to complete this amplifier kit without difficulty.

Net price of Model 7A Amplifier with Model 8A Power Supply, semi-wired, less tubes **$135**



Equalizer

MODEL 3A—The UTC universal equalizer will equalize telephone lines, recording systems, pickups and cutters, microphones and all other broadcast equipment. It is accurately calibrated and quickly adjustable for both low and high frequency equalization. Low frequency controls permit maximum equalization at 25, 50 or 100 cycles with zero to 25 DB control. The high frequency end permits maximum equalization at 4000, 6000, 8000, or 10,000 cycles with zero to 25 DB control.

Net price to broadcast stations and recording studios **$85**

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COMMUNICATION & BROADCAST ENGINEERING

FOR DECEMBER, 1936

TERMINATING R-F LINES

By J. L. POTTER

Instructor

STATE UNIVERSITY OF IOWA

IT IS NECESSARY that r-f transmission lines be properly terminated if power is to be delivered to the antenna with high efficiency and at the same time prevent appreciable radiation from the line itself. It is the purpose here to develop some formulas for antenna-coupling systems and outline a method for making proper adjustments.

When a line is properly terminated, no standing waves will be produced on the line. This is accomplished when the line is terminated into its characteristic impedance Z_o. In most cases r-f transmission lines are assumed to be electrically long, but physically short, so that the resistance and leakage of the line can be neglected.

With the above assumptions

$$Z_o = \left(\frac{L}{C} \right)^{1/2}$$

where L and C are the distributed inductance and capacitance of the line.

The characteristic impedance can be calculated just about as accurately as it can be measured in most cases. Formulas for calculating the characteristic impedance are given at the end of this article.

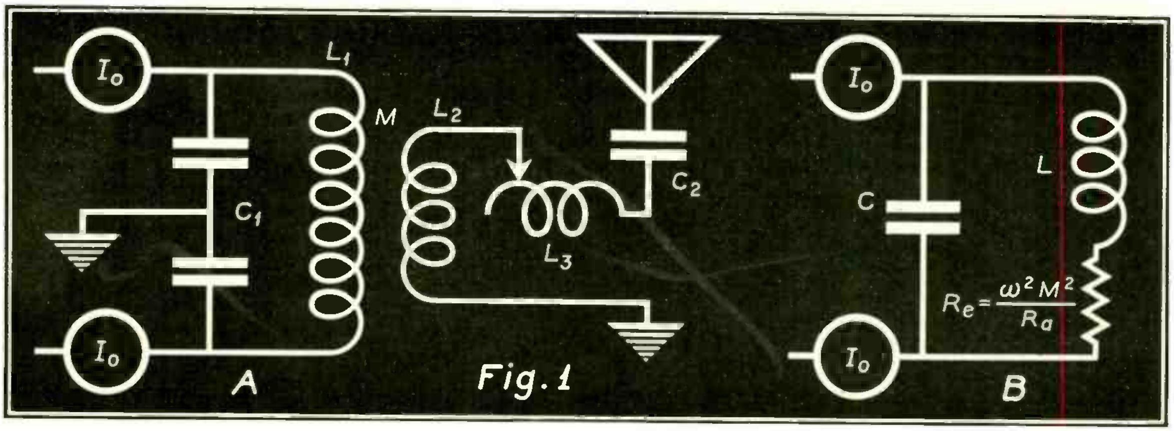
A COMMON SYSTEM

Fig. 1-A is a common type of coupling system used for coupling a transmission line to an antenna. It is generally desirable to make the ratio of volt-amperes, in the tank, to power in the vicinity of four. This is controlled by the L/C ratio of the tank circuit. When the ratio volt-amperes to watts is made large, the power loss in the tank circuit is usually greater and hence less efficient, but the magnitude of the harmonics is kept small; while if the ratio is made small better efficiency results, but the reduction in harmonic radiation is less.

The value of C to be used can be determined in the following manner for any ratio of volt-amperes to watts desired. When a line is properly terminated the line current

$$I_o = \left(\frac{\text{watts}}{Z_o} \right)^{1/2} \quad \text{(1)}$$

That is, $I^2 Z_o =$ watts, since Z_o is assumed a pure resistance. The voltage across the line will be $I_o Z_o$. The



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condenser C is connected directly across the line, hence, the current

$$I_c = I_o Z_o 2\pi fC 10^{-9}$$

where f is expressed in kc and C in micromicrofarads.

$$\frac{I_c}{I_o} = 2\pi fC Z_o 10^{-9} = \frac{Z_o}{X_c} = \frac{\text{volt-amperes}}{\text{watts}} \quad \ldots\ldots (2)$$

$$C = \frac{\text{volt-amperes } 10^{-9}}{\text{watts } 2\pi f Z_o} \text{ micromicrofarads} \quad \ldots\ldots (3)$$

If the antenna circuit, composed of L_2, L_3, and C_2, is timed to the operating frequency and coupled into L_1, a resistance

$$R_e = \frac{\omega^2 M^2}{R_a}$$

is reflected in series with L_1, R_a being the antenna resistance. The antenna resistance should be measured as this aids in making adjustments and gives an idea as to the amount of power being delivered to the antenna.

The resonant condition for the equivalent circuit, Fig. 1-B, will occur when the resultant susceptance of the circuit is equal to zero (the condition for unity power factor).

The admittances are

$$Y_c = +j\frac{1}{X_c} \quad \ldots\ldots (4)$$

assuming resistance of condenser is neglected.

$$Y_L = \frac{1}{R_e + jX_L} = \frac{R_e}{R_e^2 + X_L^2} - j\frac{X_L}{R_e^2 + X_L^2} \quad \ldots\ldots (5)$$

Total admittance

$$Y_c + Y_L = Y_T = \frac{R_e}{R_e^2 + X_L^2} - j\frac{X_L}{R_e^2 + X_L^2} + j\frac{1}{X_c} \quad \ldots\ldots (6)$$

where

$$X_L = 2\pi fL \text{ and } X_c = \frac{1}{2\pi fC}$$

For parallel resonance the resultant susceptance should be zero.

Setting the j components equal to zero

$$\frac{1}{X_c} = \frac{X_L}{R_e^2 + X_L^2} \text{ or } X_L X_C = R_e^2 + X_L^2 \quad \ldots\ldots (7)$$

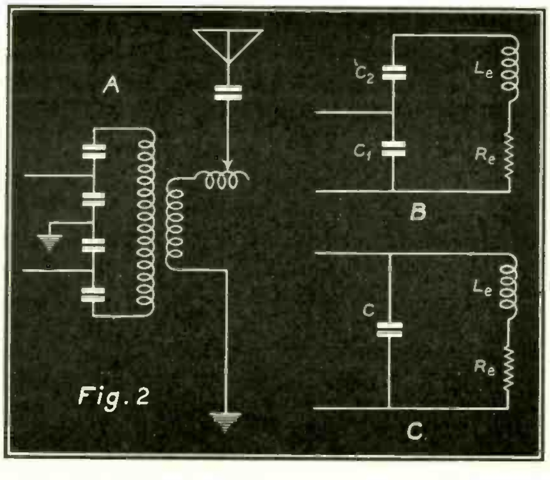

Fig. 2

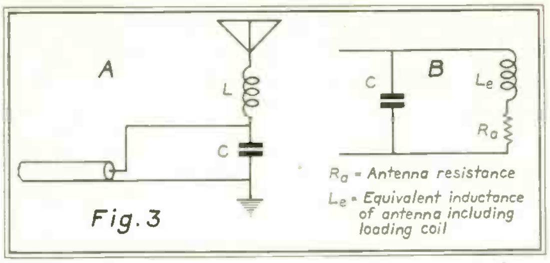

Fig. 3

Under these conditions the real part is the conductance of the circuit and should be made equal to the reciprocal of the line impedance Z_o, or

$$Z_o = \frac{R_e^2 + X_L^2}{R_e}$$

Substituting $X_L X_C$ for $R_e^2 + X_L^2$ from equation (7):

$$Z_o = \frac{X_L X_C}{R_e} \text{ or } R_e = \frac{X_L X_C}{Z_o} \quad \ldots\ldots (8)$$

Eliminating R_e by substituting equation (8) in equation (7):

$$X_L X_C = \frac{X_L^2 X_C^2}{Z_o^2} + X_L^2$$

or

$$X_L = \frac{X_C Z_o^2}{Z_o^2 + X_C^2} \quad \ldots\ldots (9)$$

Then

$$L = \frac{X_L \times 10^3}{2\pi f} \text{ microhenries} \quad \ldots\ldots (10)$$

where f is in kc.

The ratio of current in the inductance to line current is

$$\frac{I_L}{I_o} = \frac{Z_o}{\sqrt{X_L X_C}} \quad \ldots\ldots (11)$$

The antenna current is

$$I_A = \left(\frac{\text{watts}}{R_a}\right)^{1/2} \quad \ldots\ldots (12)$$

From equations (1) and (12)

$$\frac{I_A}{I_o} = \left(\frac{Z_o}{R_a}\right)^{1/2} \quad \ldots\ldots (13)$$

The ratio between currents in equations (11) and (13) is useful in adjusting the circuit.

ADJUSTMENT OF THE CIRCUIT

(1) Couple in a few turns of coil L_2, open the tank circuit L_1C_1. Tune antenna to resonance at the operating frequency with a portable oscillator (10 watts or larger) and a good wavemeter. Use a thermogalvanometer to indicate resonance of antenna.

(2) Open antenna circuit, disconnect transmission line from L_1C_1 and tune L C circuit to a frequency

$$f_1 = \frac{10^6}{2\pi (LC)^{1/2}}.$$

This is the resonant frequency of tank circuit when unloaded, f_1 being in kc, L in microhenries, and C equal to the total tank capacitance in micromicrofarads. The

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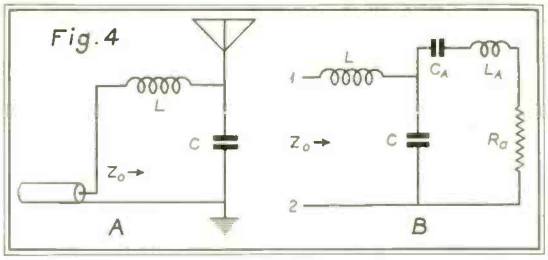


value of L is determined by equations (9) and (10).

Do not change the tuning of this circuit after it is set to the frequency determined above. This frequency will be slightly higher than the operating frequency.

(3) Replace transmission line and connect antenna circuit. Check I_o, I_L, and I_A for proper ratios as determined in equations (11) and (13).

(4) Adjust coupling to antenna until the desired current ratios are obtained. Antenna must be retuned to resonance each time the coupling is changed. Be sure to open tank circuit when returning antenna.

(5) Make final adjustment by measuring line currents at each end of line. Adjust coupling until currents read the same within about 15 percent or less. The current should be measured at odd quarter-wave points along the line.

OTHER CIRCUITS

Fig. 2 shows a type of circuit sometimes used for terminations where it is necessary to match high-impedance antennas to low-impedance transmission lines and still maintain a high ratio of volt-amperes to watts.

This circuit may be treated exactly as the circuit in Fig. 1 by setting $X_{L_e} = X_L - X_{C_2}$ and is considered the equivalent inductance.

$$X_{L_e} = \frac{X_{C_1} Z_o^2}{Z_o^2 + X_{C_1}^2} \quad \text{(see equation (9))}$$

$$X_L = X_{L_e} + X_{C_2}$$

$$L = \frac{X_L 10^3}{2\pi f} \text{ microhenries} \qquad (14)$$

where f is in kc

$$f_1 = \frac{10^6}{2\pi (LC)^{1/2}}$$

where

$$C = \frac{C_1 C_2}{C_1 + C_2} \qquad (15)$$

Referring to circuit of Fig. 2-B, C is capacitance of condensers connected in series, expressed in micromicrofarads, while L is in microhenries from equation (14). Use preceding instructions for adjusting this circuit.

Fig. 3 shows a terminating system that is most suitable for concentric-tube transmission lines. This system gives the same equivalent circuit as Figs. 1 and 2, but differs in calculation in that C must be the variable in order to match the antenna to the line instead of mutual coupling between coils. Using equation (7) and substituting R_a the antenna resistance for R_c

$$X_L X_C = R_a^2 + X_{L_e}^2 \qquad (7a)$$

To properly match line

$$Z_o = \frac{X_c X_{L_e}}{R_a} \qquad (8a)$$

Since the matching of impedance is determined by C, it is desirable to substitute for X_{L_e} in terms of X_c.

From equation (8a)

$$X_{L_e} = \frac{Z_o R_a}{X_c} \qquad (16)$$

Substituting for X_{L_e} in equation (7a)

$$Z_o R_a = R_a^2 + \frac{Z_o^2 R_a^2}{X_c^2}$$

Solving for X_c

$$X_c = \pm \frac{Z_o}{\left(\frac{Z_o}{R_a} - 1\right)^{1/2}} \qquad (17)$$

The above equation is used to determine the reactance of the terminating capacitance.

Or

$$C = \frac{\left(\frac{Z_o}{R_a} - 1\right)^{1/2}}{2\pi f Z_o} 10^9 \text{ micromicrofarads} \qquad (18)$$

Thus the terminating capacitance can be determined just as accurately as Z_o and R_a are known.

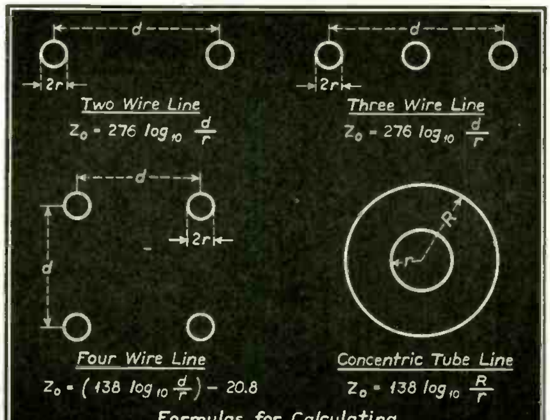
The antenna is tuned to resonance by the loading coil.

The system is used where Z_o is greater than R_a.

The ± sign indicates that either inductance or capacity reactance may be used. Capacitance is generally used since it will reduce harmonics.

When Z_o is less than R_a, such as a concentric-tube line matching a high-impedance antenna, the system shown in Fig. 4 may be used. (It is assumed in the following equations that C_A and L_A are so adjusted that the antenna is in resonance without L and C being inserted.) This is considered a series circuit from terminals 1 and 2, with a condenser shunted by the antenna resistance.

(*Continued on page 23*)



Formulas for Calculating Characteristic Impedance of Lines

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SUPER-POWER
PUBLIC-ADDRESS INSTALLATIONS

By JOHN P. TAYLOR

NOT SO LONG AGO broadcast engineers were accustomed to look down their collective nose at public-address engineering. Viewing the cheap equipments then in vogue, and the skimpiness of the usual job, they were inclined to think of it as pretty small potatoes. Developments of the past two years have, however, either completely reversed this attitude, or have made it—in the case of the few diehards who stick to it—entirely fallacious. For "public address," growing out of the "home-made" stage, has become an important field, with well-defined trends and increasingly-exacting standards.

THE PARALLEL TO BROADCAST DEVELOPMENT

This development of public address, from a novelty to a necessity, parallels, in many striking respects, developments which have taken place, or are taking place in the broadcast field. Not only in the more general features, such as the well-defined trend toward higher quality, but also in many details, such as microphone, amplifier and mixer types, is there a close correspondence. As broadcasting has had its super-power installation, so, very recently, has public address. A preliminary survey to determine coverage requirements—now an accepted practice in broadcasting—has recently been employed successfully in pre-determining the necessary volume for a public-address system. Even in the problem of one large distributing point versus many smaller ones, can be found a similarity with the broadcast problem of a few high-power stations versus a large number of locals.

AUDIO ENGINEERING ON A LARGE SCALE

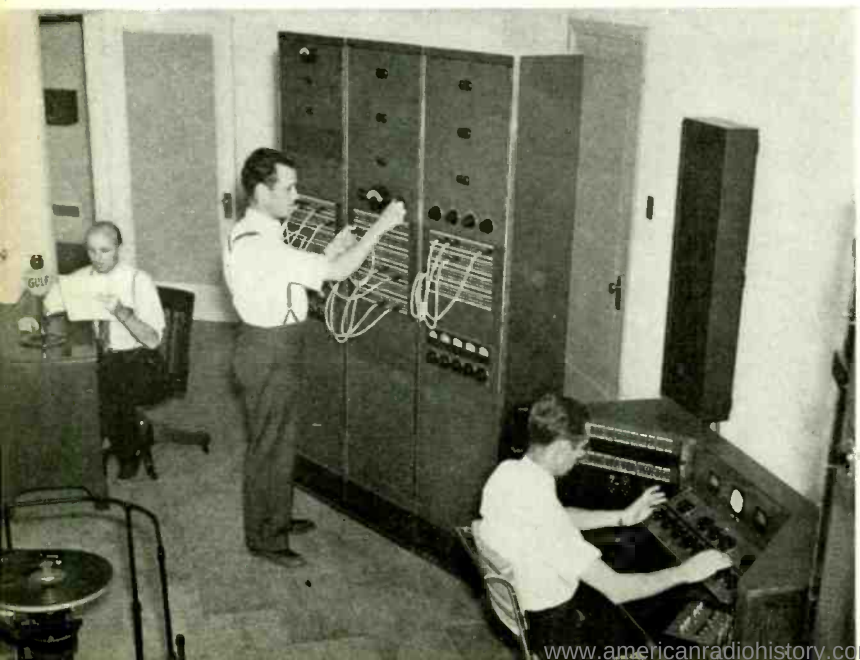
It requires no more than a brief look at modern public-address installations to convince one that this is a field in which broadcast engineers can find new room for the application of their talents—and that, moreover, the opportunities presented are ones which they can hardly afford to overlook. Those who have been paying little or no attention to this field will be surprised to find that it not only includes features closely akin to those to which they are accustomed, but also that—at least in the larger installations—it often involves facilities as extensive as those of the largest broadcast installations. In fact, recent installations at the various exhibits and fairs have reached proportions to which only the larger network studios could compare in extent of facilities.

A TYPICAL MULTIPLE-CHANNEL LAYOUT

Public-address installations, like broadcast installations, vary considerably in arrangement and extent—and like the latter are never entirely identical. However, the larger installations have of late followed a typical pattern which can be reduced to a standard sequence similar to that followed in broadcast installations. Fig. 1 shows the simplified layout of a large-scale installation of this kind. Switching circuits, most of the jacks, and other details, are omitted for the sake of clarity—but, in general, these are utilized in the same manner as in most broadcast systems, and the overall operation should, therefore, be amply clear to those acquainted with broadcast methods.

Photo courtesy Collins Radio Co.
FIG. 3. A TYPICAL A-C OPERATED PORTABLE PICKUP AMPLIFIER.

FIG. 4. THE CONTROL ROOM OF THE PUBLIC-ADDRESS INSTALLATION AT THE TEXAS CENTENNIAL. THE EQUIPMENT AND FUNCTION ARE NEARLY IDENTICAL TO THOSE OF A BROADCAST CONTROL ROOM.



THE PICKUP POINTS

As in a broadcast chain, the first element of a public-address system is the microphone, and the first consideration the equipment immediately associated with the pickup point. Generally speaking, the types of pickups involved are identical to those in broadcasting. How-

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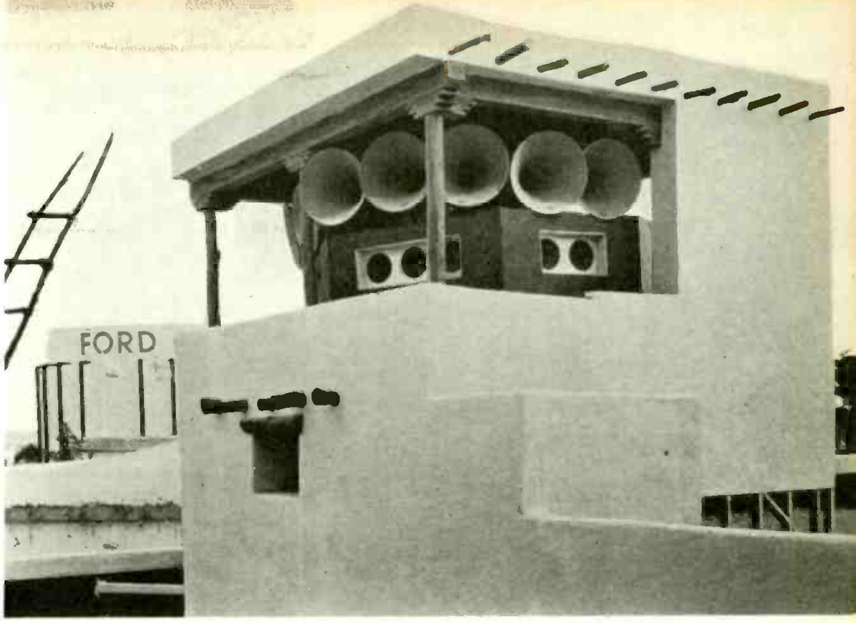
ever, the distribution of these is somewhat different, in that the proportion of studio, to outside, programs is approximately reversed. In small public-address jobs there are, of course, no studio programs at all. However, in large installations (fairs and exhibits extending over several months or years) it is usually found desirable to provide one or two fully-equipped and correctly-designed studios. In Fig. 1 two studios are shown. The equipment used in these is, in the case of high-quality installations, very similar to that of broadcast installations. In this particular setup, separate control booths are shown, but these may, of course (as is done in many broadcast stations) be combined with the main control room.



Photos courtesy Western Electric

FIG. 5. TYPICAL LOUDSPEAKER INSTALLATION. EXPONENTIAL HORNS PROVIDE THE HIGH FREQUENCIES AND CONES MOUNTED ON BAFFLES THE LOWER REGISTER.

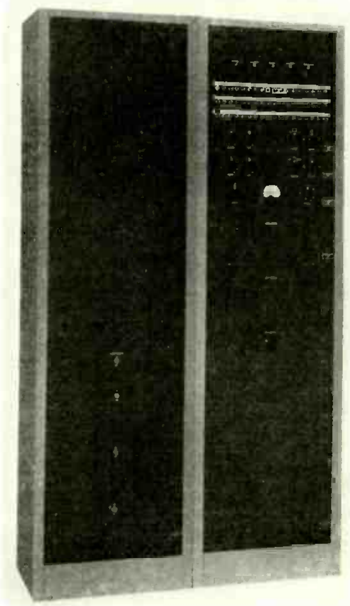


Photo courtesy Collins Radio Co.

FIG. 2. A RACK AND PANEL ASSEMBLY OF EQUIPMENT SUCH AS WOULD BE USED IN THE CONTROL INDICATED IN FIG. 1. THE ESSENTIAL UNITS ARE THE SAME AS THOSE SHOWN IN THE DIAGRAM.

In most such public-address installations, however, the majority of the programs will originate from auditoriums, concert and pageant stages, and the like, scattered about the grounds. The equipment installed as these points may, so far as pickup is required, be similar to the studio equipment. However, an additional requirement must often be considered, viz., that of providing sound reinforcing at the pickup point itself. While this could be accomplished by separate systems, it is obviously desirable to combine the two. A suitable arrangement for this is shown in Fig. 1. It consists, simply, of bridging the necessary power amplifiers across the line at the point where the monitoring amplifier is connected.

In addition to the pickup points such as those just described, there will be others as, for instance, in small night clubs, eating places, and the like, where sound reenforcing is not required. At such points, small portable equipments of the a-c operated type, such as that shown in Fig. 3, can be permanently set up, and used exactly like rack and panel equipment.

In addition to the regular pickup points where equipment of one or another of the above types is permanently installed, there are likely to be occasional calls from many other points. These are satisfactorily provided for by arranging line pairs terminating at these points. Thus, portable pickup equipment can be quickly set up for use at these points.

Finally, to provide for unexpected calls from any other point on the grounds—and particularly from outside

FIG. 1. A BLOCK DIAGRAM INDICATING THE GENERAL ARRANGEMENT OF PUBLIC-ADDRESS EQUIPMENT FOR A LARGE FAIR, EXHIBITION, OR THE LIKE. THE FACILITIES SHOWN ARE TYPICAL ONLY, AND WOULD BE MODIFIED TO MEET CONDITIONS OF ANY PARTICULAR SITUATION.

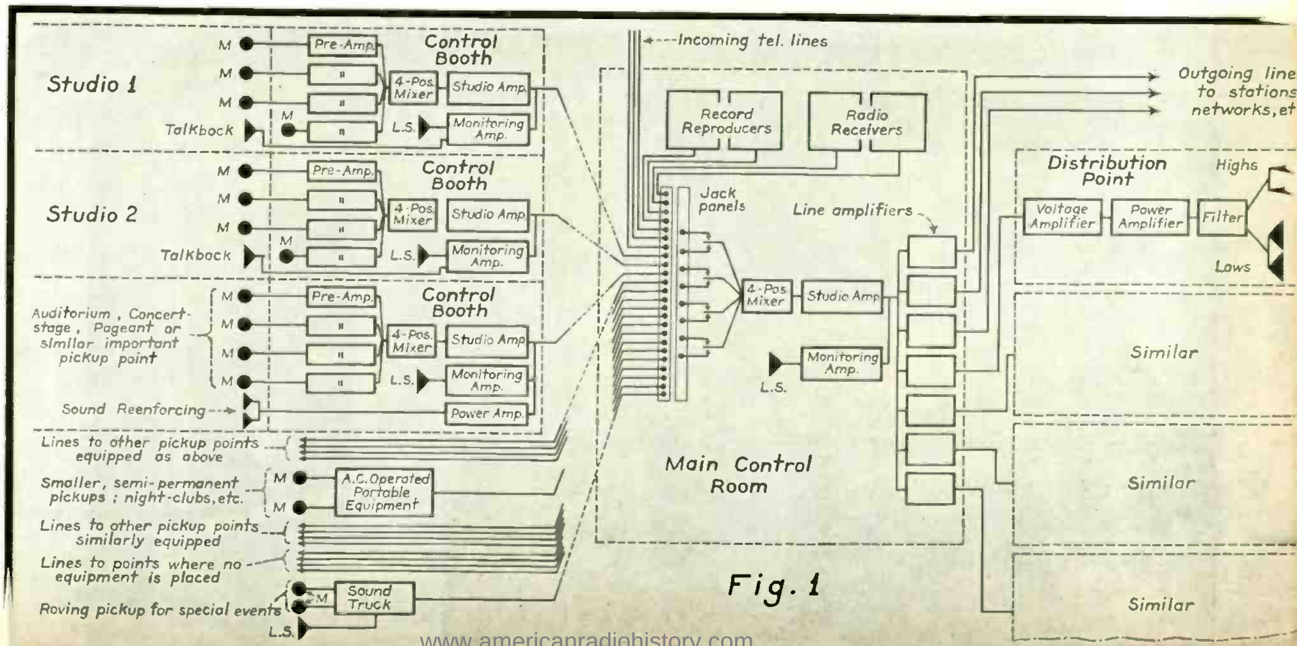


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FIG. 6. THE LOUDSPEAKER INSTALLATION AT ROOSEVELT RACEWAYS. NINETEEN 1000-WATT UNITS AT THE TOP OF THE TOWER PROVIDE GENERAL COVERAGE, WHILE TWELVE SMALLER UNITS, FURTHER DOWN, COVER THE GRANDSTAND DIRECTLY IN FRONT.

points—it is usual to have available one or more sound trucks. These should be complete with the usual arrangements, not only for pickup, but for providing local sound reenforcing.

CONTROL ROOM

The control room of a public-address installation (Fig. 4) functions in a manner practically equivalent to that of the main control room of a large station or network installation. As shown in Fig. 1, lines from the adjacent studios, and from the permanent and temporary outside pickup points, are terminated on a convenient jack panel (Fig. 2). Also brought to this point are lines from the record reproducers, one or more receivers and lines from outside the grounds. A multiple-position mixer panel is ordinarily used, with the inputs to these positions also terminated on jacks, so that any of the incoming lines may be conveniently connected into it. The mixing inputs may be provided with two-way switches, thus providing twice as many input connections and making it possible to set up combinations in advance. As a rule, the complicated relay systems used to accomplish switching in some broadcast-studio installations are not so much used, for the reason that it is seldom possible, in designing an installation of this kind, to predict the combinations which will be most required, and—since all outputs are fed the same program—the switching is, in any event, a relatively simple matter.

From the control room the program may be fed not only to the various distributing points, but also to lines to broadcast stations, networks and other points outside the grounds. Some amplification must be provided on these outgoing lines. While one or two amplifiers would furnish the necessary level, there is considerable advantage in providing an amplifier for each output line. This minimizes the effect of failures and prevents all possibility of reaction of one service on another.

THE SOUND DISTRIBUTING POINTS

The one element of a large public-address installation which differs materially from the broadcasting situation is the operation of the distributing points. In function these are analagous to the transmitters on a radio network. At that point, however, the parallel ends. Looking at Fig. 1, it will be seen that the equipment at these points—which in number may be anywhere from three or four to a score—consists of a voltage or driver amplifier and the necessary power amplifiers to excite several loudspeakers. In most of the installations used to date it has been found necessary to use one type of speaker—exponential horns—to reproduce the higher frequencies, and another—cone speakers mounted on baffles—to reproduce the lower range (Fig. 5). In this case a filter network is inserted—the crossover point usually being in the vicinity of 800 cycles.

PLANNING A MODERN INSTALLATION

The arangement diagrammed in Fig. 1, and described above, is, of course, a general plan, and in any particular instance will be modified in various degree to suit the particular problem. Such modifications will affect both the extent of the flexibility and overall power requirements. A typical example will best serve to illustrate this. The most interesting for this purpose—because it is the most recent, as well as the highest powered—is probably the system recently installed at the new Roosevelt Raceway. The outstanding problem in this installation was that of over-riding the roar of a score of automobiles racing around an unusually concentrated track. This necessitated production of truly tremendous sound power—a total far in excess of anything previously undertaken.

A SOUND-INTENSITY SURVEY

Since the power required would obviously be far greater than anything before encountered, and since the efficacy of available equipment in providing this power was not a well-defined factor, the whole installation necessitated unusual procedures. As a first step, the Western Electric engineers confronted with this problem undertook to measure the noise levels that would be encountered. Since these varied over the ground to be covered, it was necessary to make measurements at many points. These were then tabulated, and from them contours of sound intensity were drawn on a map of the race course. From such contours the sound intensity required at the various points could be deter-

FIG. 8. FOUR BAYS OF 1000-WATT AMPLIFIERS, FIVE TO A BAY, ARE HOUSED IN A SEALED AIR-CONDITIONED BUILDING NEAR THE BASE OF THE TOWER.

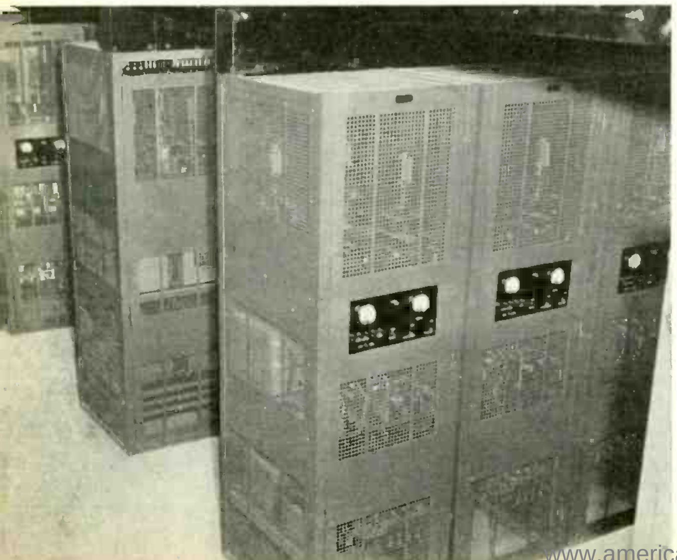
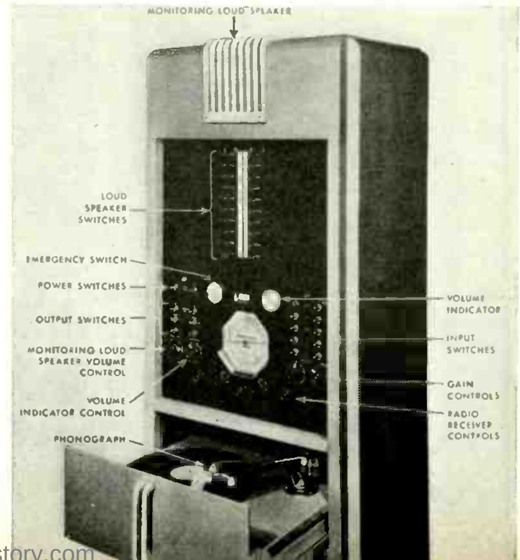


FIG. 10. THE 14-A CONTROL CABINET WITH THE VARIOUS INPUT AND CONTROL FEATURES INDICATED.



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mined. Next they set up a single speaker of the type intended for use, and, orienting it in various directions measured the sound power delivered at important points. From the knowledge gained by these tests—that is of the sound power required at each point, and of the power possible to deliver at each point with a single speaker—they were able to determine directly, and accurately, the necessary number of speaker units as well as the proper location and orientation of these.

A SINGLE DISTRIBUTING POINT

This accurate determination of requirements was only one of the features of this installation. Another was the decision to distribute all of the sound from a single point. This was entirely contrary to previous installations—which has almost invariably utilized speaker units placed at a number of more or less separated points. The disadvantage of these previous systems was the patchy distribution of sound obtained, and the fact that points of interference were caused if adjacent distributing points were too-closely spaced, and dead spots if they were too-widely spaced. The single concentration of speakers at one distributing point overcame these difficulties. Obviously such a system is not suited to all applications—just as in broadcasting the separate fields of clear-channel and local stations are now recognized. However, for such applications as it does fit, this type of distribution will undoubtedly be widely used in the future.

THE 1000-WATT "THROATS"

The determinations of the sound intensity required indicated that a total of approximately 10,000 acoustic watts would be needed—or an electrical output of 20,000 watts. Fortunately, speakers capable of handling up to 1,000 watts had recently been developed—and 19 of these awe-inspiring metal throats—commonly referred to as "bull-horns"—were mounted on the top of a 100-foot steel tower to provide the main "voice." Twelve "sea-sled" speakers, taking a total of 1,000 watts additional were mounted at a lower point on the tower to take care of the grandstand directly in front. This unique installation is shown in Fig. 6.

THE AMPLIFYING EQUIPMENT

The arrangement of amplifiers used to drive this battery of speakers can be seen from Fig. 7—which is a simplified block diagram of the complete installation. Each of the "bull-horn" speakers is driven by a separate 1,000-watt power-amplifier—while the twentieth amplifier, of identical design, drives the twelve "sea-sled" speakers. These twenty amplifiers are arranged in four bays of five amplifiers each, as shown in Fig. 8. Each of them utilizes four 308-B tubes in push-pull parallel. They are self-contained, since each includes a power supply utilizing three 249-C rectifier tubes, in three-phase half-wave, to furnish plate voltage, and two 274-B rectifier tubes, in single-phase full-wave, to furnish bias voltage.

Electrically, the twenty amplifiers are arranged in two groups of ten—and each of these groups is driven by a Type 99-A amplifier. These latter employ four 284-D tubes each, and are provided with a power supply utilizing four 249-C rectifier tubes. They are mounted in the right-hand cabinet of Fig. 9, while the cabinet at the left contains the compressor and input control units—also arranged in duplicate. These two cabinets containing the low-power units, together with the twenty high-power amplifier units, are located in a special amplifier house located close to the base of the speaker tower.

The comparison of this audio-amplifier arrangement with the audio system

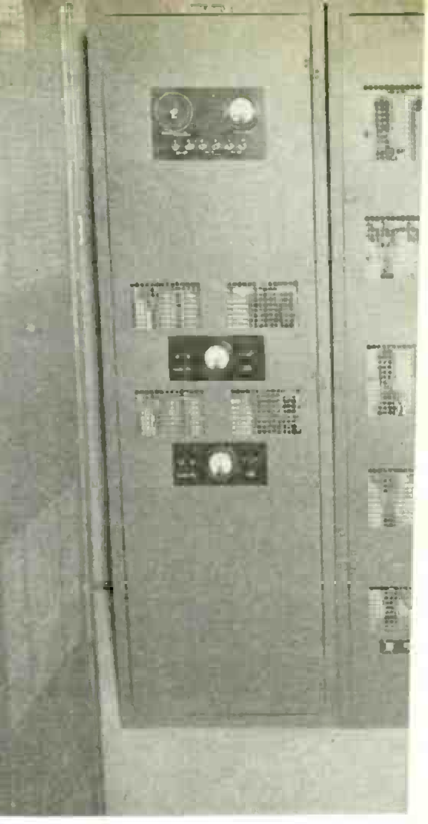
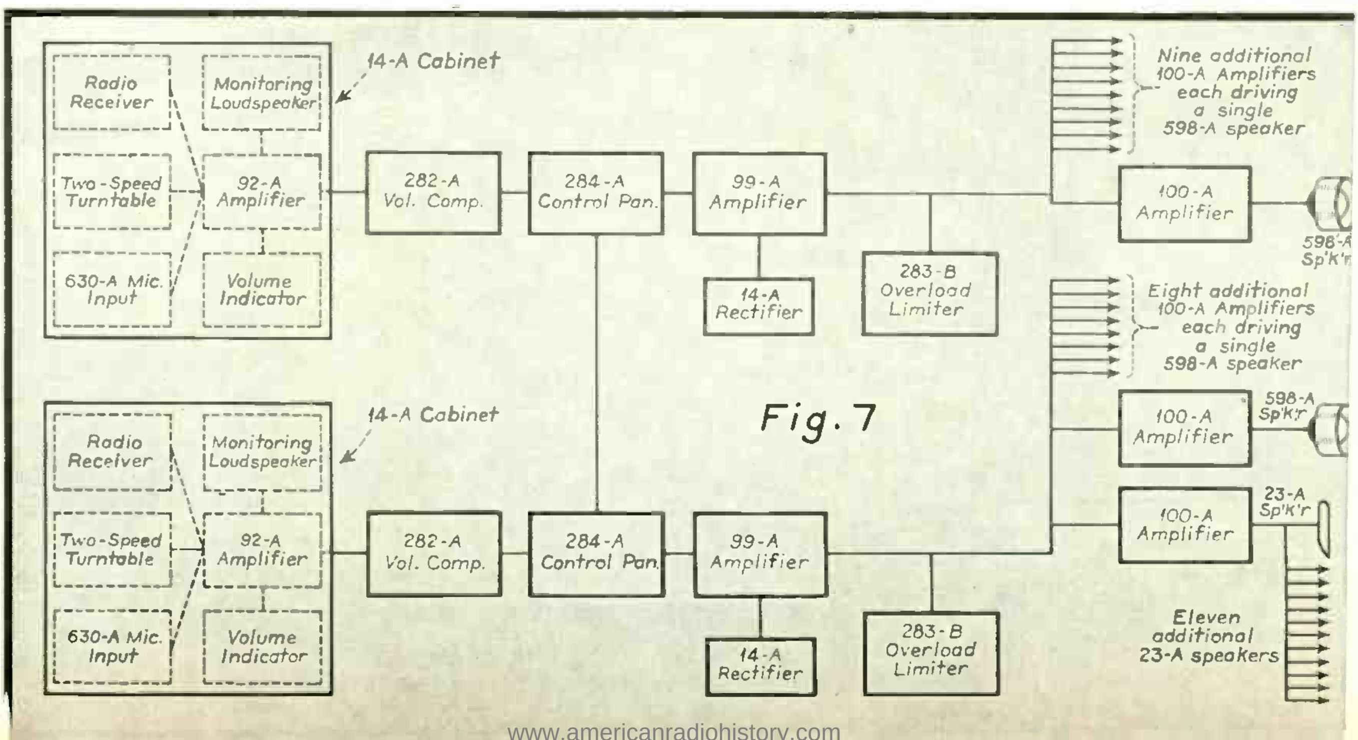


FIG. 9. THE INPUT CONTROL PANELS (LE AND THE TWO DRIVER AMPLIFIERS (RI EACH OF WHICH DRIVES TEN OF THE PO AMPLIFIERS SHOWN IN FIG. 8.

of a high-power broadcast station is teresting. While the total audio po is comparable to that developed i 50-kw transmitter, it is obtained quite different fashion—for wl "good practice" in broadcast design tates as few tubes as possible, it wil seen that this super-power sound tr mitter goes to the opposite extre The output stage alone uses ei audio tubes, and a total of no less t one hundred and eighty tubes if the tifiers are included. The answer to apparent contradiction is partly on economy. In a broadcast transmi a source of high-voltage power is ready available, and hence the us high-voltage tubes in the audio st provides the greatest economy. In sound-power installation, on the o

(*Continued on page* 25)

FIG. 7. BLOCK DIAGRAM OF THE 20-KW SOUND SYSTEM INSTALLED BY WESTERN ELECTRIC AT ROOSEVELT RACEWAYS.



LOOKING

LAWRENCE C. F. HORLE

BROADCASTING

NINETEEN THIRTY-SEVEN will be the year in which we can say that broadcasting has really "arrived."

The trend toward bigger programs, better programs, and cleaner programs will continue. Nineteen thirty-seven will be a year of mammoth productions on the air.

As more and more advertisers recognize broadcasting as a major media, and competition for the radio audience increases, no expense will be spared to attract listeners with the world's best musical, dramatic, comedy and variety shows.

However, the great network shows will not eliminate local productions and especially local personalities. On the contrary the big programs will increase the radio audience and thereby increase the audience for local shows.

The station which takes an active part in civic affairs and retains its identity by presenting the best local talent will be recognized as a power in its community. Stations which have no network affiliation are at no disadvantage in this respect.

Organized education on the air will advance in 1937. As federal, state and community educational boards learn how to use radio as a teacher and present efficient program services, so-called controversies between educational factions and commercial radio should disappear.

ALBERT F. MURRAY

Nineteen thirty-seven will be a year of standardization of policies and trade practices among radio stations. Rate schedules will be simplified and stations which have "local" and "general" or "national" rates will reach a more general understanding as to how these rates should be applied. This will further simplify the selection of stations by advertising agencies.

C. W. MYERS
President, KOIN, Inc.
President, National Association of Broadcasters

NINETEEN THIRTY-SEVEN should prove to be a year of increased, optimistic activity in the fields of broadcasting and communication. Not only will the growth of the established services in these fields continue unabated, but the generally improved business conditions, and the return of public confidence should give added impetus to the enlargement of those activities already established, which are no longer thought of as luxuries, but as necessities of everyday life.

If, to this, we add the opportunities likely to result from any introduction into general public usage of such relatively new developments as ultra-high-frequency broadcasting, television, or facsimile transmission, we have sufficient material upon which to base the opinion of confidence already expressed.

E. K. COHAN
Director of Engineering
Columbia Broadcasting System, Inc.

DURING THE COMING YEAR all eyes will be turned on the Federal Communications Commission. Two long public hearings have been held in Washington and some of the best thoughts on the problem of allocation of broadcast stations and of other radio services, particularly television, have been presented to the Commission. One of the most interesting outcomes of these hearings has been a clarification of the viewpoints of the various interests that hope

DR. ALFRED N. GOLDSMITH

RAYMOND M. WILMOTTE

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AHEAD

to earn a living from the operation of the various radio services. It is no exaggeration to say that the development of radio during the next few years will in no small way depend on the action of the Commission during 1937. It is a difficult job that confronts them, for mistakes are not easily rectified. Will the Commission submit to the ever-increasing pressure for more and more stations, which, in many cases, means a reduction in the possible area of good service? Or will it try to provide every opportunity for our engineers, their inventiveness and technical ability? Will these engineers be confronted with an allocation situation which is so tight that it is difficult or unremunerative to apply technical improvements (such as synchronization, directive antennas and whatever the future has in store for us)? Or will they have full opportunity to provide the country with the best possible service?

However difficult it may be, it would probably be easier to forecast what our engineers will develop for the industry than what the Commission will do to help the application of these developments.

Increases in power will probably be the order of the day during 1937. There are many points where increases in power would produce markedly increased service and coverage. There are others where the increase is merely to increase an already excellent signal without giving more coverage. Directional antennas also are likely to be applied more generally. Here again their use depends on the Commission. They may be used to increase the number of stations, and, in many such cases, reduce

HARADEN PRATT

E. K. COHAN

the flexibility for future changes, or they may be used to improve the signal and area of service of existing stations, and there are few places indeed in the broadcast band where such improvements would not be beneficial.

What may also develop during 1937 and may become the most important trend is a demand by the public for good high-class programs transmitted with high fidelity to the full satisfaction of a real music lover and critic, not with the bass amplified to hide the lack of, or distortion in, the high notes.

RAYMOND M. WILMOTTE
Consultant

COOPERATION

IF ONE were to attempt to characterize the future of the radio industry in a single word, that word would doubtless

H. H. BEVERAGE

be "cooperation:" not only the further development of cooperation within the industry itself but the development of cooperation with those branches of the arts and sciences on which it was founded and only along with which it can grow, as well as the development of cooperation with the many industries with which it is associated.

The radio industry is particularly well illustrative of the advantages flowing from cooperation. Its first field of operations, that of communications, by its very name and nature was possible only as cooperative action, national and international, was developed. Broadcasting, both national and international, became satisfactorily possible only by intimate and detailed cooperation. And now the manufacturing sections of the industry are carrying this same spirit of cooperation for the general good further into the fabric of the nation's industry.

DAVID SARNOFF

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To all of this the radio engineer has made no small contribution in his labors in the work of the many cooperative standardizing groups which he has provided for the solution of many of the technical problems within and without the radio industry. His work in the development of generally acceptable nomenclature and definitions has made possible the ready interchange of information not only between groups using the English language but between groups occupied with radio problems throughout the world. His work in the development of universally applicable units and methods of measurement had made readily possible the interchange of important scientific data gathered by groups separated not only by continents and oceans but even further separated by viewpoint and temperament.

To this he is now adding the development of standardization of product through cooperation both within the radio industry and with the industries on which the radio industry draws for so many of its component elements and materials.

These are not the accomplishments of a day or a year or even a decade. Radio communications is approaching its fortieth birthday and has much to boast of in its world-wide yet intangible network of coordination. Radio broadcasting, having been born out of the travail of the World War has yet to celebrate its twentieth birthday but can well be proud of its accomplished cooperation. There is yet much to be done jointly by those factors in the industry which devote themselves to the problem of supplying the nation with its radio equipment and even more still to be done jointly by these with the associated industries. That the cooperation needed for the healthy growth of the industry is developing can not be doubted since all signs point to an increasing general appreciation of the fact that only as all factors in the industry direct their combined efforts toward providing ever-increasingly effective radio equipment for the American dollar will all concerned be best served.

Hence, for the coming year, product standardization through cooperation, and for the long future, cooperation and more cooperation.

LAWRENCE C. F. HORLE
Consulting Engineer

RADIO COMMUNICATION

RADIO COMMUNICATION in 1937 will see increased development of direct international connections, with the additions of further areas in remote sections of the world to the general communication network not now enjoying modern facilities. Radio telephony, in particular, will branch out. Ultra-high-frequency links will provide additional connections across short natural barriers and improve rapid communications to many places.

The international aspect of broadcasting and the relaying of broadcasts from country to country will be receiving more attention than ever before. The current improvement in business and trade will stimulate greater effort in research and development during the coming year and improved equipment and operating practices are bound to follow.

HARADEN PRATT
Vice-President and Chief Engineer
Mackay Radio and Telegraph Co.

DURING THE PAST FEW YEARS there have been certain definite trends in the development of point-to-point and mobile-radio communication which may be expected to expand further during 1937.

In the point-to-point services, transmitter frequency stability is being rapidly improved due to improvements in piezoelectric crystal oscillators and also through improvements in alternative methods such as low-loss resonant-line circuits. The improvement in transmitter stability makes it possible to increase the selectivity of the receivers, resulting in less interference and an improved signal-to-noise ratio. Transmitters of higher power are also in evidence. One short-wave telegraph transmitter of 200 kw went on the air during 1936. All of these factors are effective in increasing the reliability of long-distance telegraph and telephone communication during adverse transmission conditions, such as magnetic storms.

P. S. GATES

As the circuits become more reliable, it is logical to use more and more automatic terminal equipment for transcribing the messages. Several long-distance circuits are now using simplex teletype printers. Other circuits are using multiplex systems with two or three channels. A two-channel multiplex printer circuit has been in operation between New York and London for some years. It is probable that the use of printer and multiplex operation will be materially extended during 1937.

Ultra-high frequencies are being used successfully over short distances for controlling transmitters from a central office. Another interesting application of ultra-high frequencies is the automatic, unattended two-way relay circuit between New York and Philadelphia which is equipped to carry two facsimile channels in addition to several printer and telegraph channels. In this system, the receivers operate continuously, but the transmitters at the relay points are started and stopped from the terminal points. Ultra-high frequencies continue to give good service for inter-connecting telephone networks, such as between the islands of the Hawaiian group, between Green Harbor and Provincetown, Mass., and between England and Ireland.

The ultra-high frequencies will undoubtedly find further application to special point-to-point communication problems similar to those mentioned above.

H. H. BEVERAGE
Chief Research Engineer
RCA Communications, Inc.
President
Institute of Radio Engineers

PROGRESS

THE YEAR 1936 has been marked by many milestones of progress and achievements in radio.

In the field of international communications, there has been a substantial increase in volume of traffic over 1935. The opening of the high-frequency circuit between New York and Philadelphia, with two intermediate automatic radio relays, demonstrated a new conquest of short waves both for the accurate and rapid transmission of facsimile pictures and messages, and for practical usefulness in telegraphic commerce.

The year 1936 has also witnessed the continued growth, both in magnitude and importance of operations, of radio's services to safety of navigation and convenience of travel of ships at sea and planes in the air.

The tenth anniversary of one of radio's nation-wide broadcasting networks called the world's attention to a perfection of program transmission and reception which was hardly conceivable ten short years ago. Program planning and studio technique have kept pace with the steady improvement in the instrumentalities of broadcasting.

The fact that 45,000,000 voters, a record number, cast ballots in the recent Presidential election—as compared with 27,000,000 in 1920, before the advent of radio broadcasting—has been attributed by many disinterested observers to the educational influence of radio.

During the year 1936, also, the new art of television moved out of the research laboratory into the field of engi-

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neering experiments under actual service conditions. The experimental television field tests will be continued during 1937 with many improvements.

There is every reason to believe that during the year 1937 the progress of radio, so significantly demonstrated during the twelve months just passed, will continue with accelerated vigor.

DAVID SARNOFF
President
Radio Corporation of America

WE MAY EXPECT continued progress in radio during 1937, both in existing services and in new developments. It is expected that better use will be made of the ultra-high frequencies for all types of radio service, particularly aviation, police and broadcasting.

It is also expected that during the coming year existing broadcast services will be improved from the standpoint of allocation as well as from the standpoint of receivers, which will have in-

T. A. M. CRAVEN

corporated therein the latest developments of the laboratories.

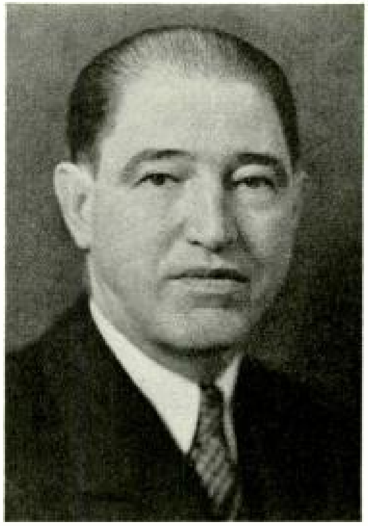
Much progress is expected in the development of facsimile and television, both for broadcast and communication purposes, but it is not expected that during 1937 television broadcasting will be established on more than an experimental scale.

The use of the ultra-short waves by aviation services will enhance safety of air navigation and will be of great assistance to aircraft landing in fogs.

T. A. M. CRAVEN
Chief Engineer
Federal Communications Commission

TELEVISION

TELEVISION DEVELOPMENT during 1937 promises to gather momentum to the



C. W. MYERS

point where a smooth transition to commercial television broadcasting in later years will become practicable. General agreement on television standards, more nearly continuous operation of experimental television stations, improvements in model receiver construction, study of the commercial receiver sales possibilities, and some development of television program technique may be expected during 1937. All of these steps will be helpful elements contributing to a sound basis for later regular television broadcasting.

DR. ALFRED N. GOLDSMITH
Consulting Engineer

BEFORE LOOKING FORWARD into 1937 let us ask the question "How far has television progressed at the end of 1936?"

In the United States two large radio manufacturers are carrying on field

C. P. CUSHWAY

tests, one in New York City, one in Philadelphia. These tests, which indicate that high-definition television pictures can be broadcast and received *outside* of the laboratory, will continue into and probably throughout 1937.

Indications are that progress next year will be made along the following lines:

(1) Field tests will continue. Service and also interference areas will be determined.

(2) Leading experimenters will change their transmitting equipment to conform with RMA television standards. This means 441-line pictures. Studio and transmitting equipment will be refined.

(3) Experimental receivers will be improved, simplified. Costs will be somewhat reduced, making possible a price nearer what the man-in-the-street will pay when commercial television arrives. Some improvement in picture

W. E. JACKSON

size and brightness may be expected.

ALBERT F. MURRAY
In Charge of Television
Philco Radio & Television Corp.

IT IS ANTICIPATED that during 1937 one or two new experimental television stations will start tests in the New York-Philadelphia area.

Flickerless black and white reproductions will be the general rule, with high fidelity finally replacing the indistinct pictures of past years.

Considerable progress has been made toward standardization of scanning rates and other transmission features should take definite form in 1937.

A. H. BROLLY
Chief Engineer
Farnsworth Television, Inc.

(*Continued on page 21*)

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Balanced Amplifiers

PART VI

By ALBERT PREISMAN

Head of The Department of Audio-Frequency Engineering

RCA INSTITUTES, INC.

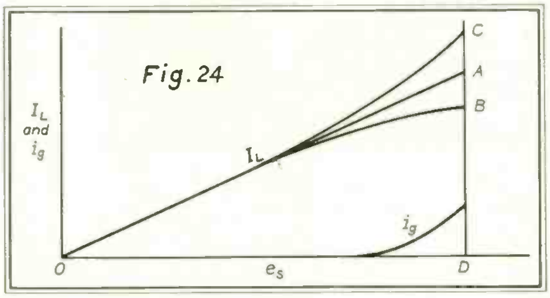

Fig. 24

XXII. PLATE-CIRCUIT DISTORTION PRODUCTS

WE ARE NOW READY to attack the second half of our problem. We first assume that the driver internal impedance is zero. In this case, the actual signal voltage e_s is identical with the known voltage generated within the driver despite the fact that grid current flows. Thus, the load line for I_L shown in Fig. 24 represents at the same time a plot between the load current and the generated voltage of the driver. If this load line is straight, then, as mentioned previously, the load current is an exact copy of the generated driver voltage and no distortion results. However, this graph is usually not straight for the entire range of grid swing so that we know that distortion will be present. Our problem is to determine, at least approximately, the amount of distortion corresponding to a certain degree of departure of this load line from linearity. In the case of a triode operating Class AB, the top end of the load line rises above the linear line OA, Fig. 24, and is called an overshoot. In the case of a pentode, it is quite possible for the load line to be below OA, namely OB. Such a load line may be said to have an undershoot.

To determine the distortion products in either load line, we assume a power-series relation between I_L and e_s, to wit:

$$I_L = ae_s + ce_s^3 \quad \text{(50)}$$

It will be noted that the square term is missing. It has been shown (September, 1936, COMMUNICATION AND BROADCAST ENGINEERING) that there can be no even power terms in this power series for a perfectly balanced amplifier. As a fairly satisfactory approximation, we assume that no terms above the third are present. This means that we assume that all the distortion is third harmonic if e_s is sinusoidal in form. If the coefficient c is positive then the plot of this curve gives rise to load line OC, Fig. 24, whereas, if negative, it gives rise to load line OB. We therefore see that by choosing the proper sign for c we can represent to a fair degree of accuracy, load lines having overshoots and load lines having undershoots. In the case of a linear load line it is evident that c is zero.

Now let

$$e_s = E_s \sin \omega t \quad \text{(51)}$$

Substituting equation (51) in equation (50) we obtain

$$I_L = aE_s \sin \omega t + cE_s^3 \sin^3 \omega t \quad \text{(52)}$$

From trigonometry, we know:

$$\sin^3 \omega t = \tfrac{3}{4} \sin \omega t - \tfrac{1}{4} \sin 3\omega t \quad \text{(53)}$$

Substituting equation (53) in equation (52) we finally obtain:

$$I_L = (aE_s + \tfrac{3}{4} cE_s^3) \sin \omega t - \tfrac{1}{4} cE_s^3 \sin 3\omega t \quad \text{(54)}$$

The quantity $\frac{3}{4}cE_s^3 \sin \omega t$ represents the contribution of the third-order or cubic term to the fundamental frequency. If c is positive it represents an increase in the fundamental component over that given by a linear load line; if negative, it represents a decrease. The remaining term $\frac{1}{4}cE_s^3 \sin 3\omega t$ represents third-harmonic distortion produced by the third-order term.

XXIII. GEOMETRIC INTERPRETATION

Referring once again to equation (50) it will be evident that the quantity cE_s^3 is represented in Fig. 24 by distances CA or AB if c is positive or negative respectively, and at the moment when e_s is at its peak value. The different wave shapes are shown in Fig. 25, (A) (B) (C). (A) shows the wave shape for an overshoot. The broken line shows the actual peak wave shape and the solid line superimposed on it shows the amplitude of the fundamental component whose peak is ¼ CA below the peak of the actual wave. The third-harmonic distortion is shown in its proper phase about the axis. Its peak amplitude is ¼ CA. In (B) the actual wave shape and fundamental component are identical and the third-harmonic component is zero. In (C) the actual wave (broken line) has a peak amplitude ¼ AB below the fundamental peak and the latter in turn is ¾ AB

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below the fundamental peak of (B). The third-harmonic distortion in the last example has a peak amplitude ¼ AB and its phase is reversed with respect to that of (A) because the sign of c is reversed (negative for undershoot).

It is therefore evident that the departure of the load line from linearity enables us to estimate the third-harmonic distortion produced thereby and conversely, if the permissible amount of third-harmonic distortion is specified, the departure from linearity at the peak can be found.

The effect of internal driver resistance is to cause a flattening of the load current at its peak. It may therefore be regarded as equivalent to the case of a zero resistance driver and a load-current undershoot. That is, we can either regard the driver resistance as zero and the terminal (actual grid voltage) and generated voltages as being identical, and the load current having a plot such as OB, Fig. 24, or we may consider (as is actually the case) that the load line is OA or possibly even OC but that the terminal or grid voltage is flattened from the generated sinusoidal shape due to the voltage drop produced by the grid current flowing through the internal resistance of the driver. Either viewpoint will give the same peak load current at the end of the first quarter of the cycle when the generated driver voltage has reached its maximum. Externally, the effect of driver resistance is to convert a tube that might otherwise exhibit an overshoot into a tube that exhibits an undershoot. We are now in a position to determine the permissible driver internal resistance.

XXIV. DETERMINATION OF DRIVER RESISTANCE

Let P_o = desired fundamental power output
I_{LF} = peak fundamental current which, flowing through
R_L = plate-to-plate load resistance, gives rise to P_o
n = permissible percentage of distortion (assumed all third harmonic). It is therefore the ratio of peak third-harmonic current to I_{LF}.

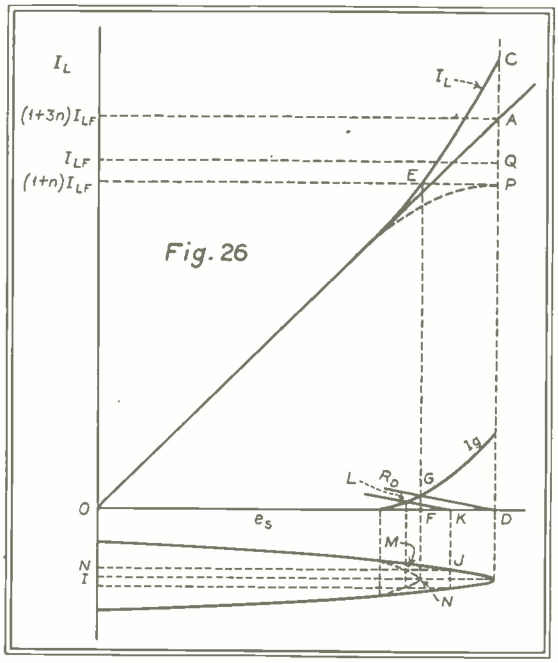

Fig. 26

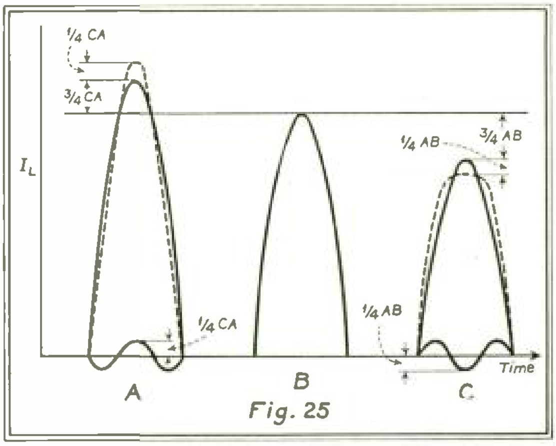

Fig. 25

Then

$$P_o = (I_{LF})^2 \frac{R_L}{2} \quad (55)$$

or

$$I_{LF} = \sqrt{\frac{2P_o}{R_L}} \quad (56)$$

which determines I_{LF} for a given P_o and R_L.

Suppose (Fig. 26) OC represents the load line for the load current. Through O a straight line OA is drawn. This should coincide as closely as possible with the lower end of OC. In the October, 1936, issue of this magazine there was shown that for a parabolic tube the load line is straight up to the point of cut-off of one tube from which point it rises parabolically, since from then on the load current and the plate current of the other tube are identical. Hence, the load line is straight up to the cut-off value of the signal voltage and then an overshoot occurs. In actual tubes this condition is approximated so that it is usually possible to draw a line OA which coincides with the lower portion of OC. Next, a horizontal line is drawn through the ordinate I_{LF} determined by equation (55). Then another horizontal line is drawn through the ordinate $(1 + 3n)I_{LF}$. Thirdly, a horizontal line is drawn through the ordinate $(1 - n)I_{LF}$. As shown in Fig. 26, the horizontal line through $(1 + 3n)I_{LF}$ intersects OA in A. OD is the peak value of the generated grid swing. The horizontal line through $(1 - n)I_{LF}$ intersects OC in E which corresponds to a grid voltage OF. EF intersects the grid current curve in G. Then GD is the load line for the total driver resistance R_D. IH is the terminal or actual peak grid-to-cathode voltage of the tube which is at that moment drawing grid current. At some other moment of the generated grid-voltage cycle such as point J, the terminal voltage is found by drawing LK parallel to GD and then projecting this down to the grid-voltage wave in point M. NM represents the terminal or grid voltage at that instant. In this way the terminal grid-voltage wave shape can be determined as shown by the broken line. This broken line evidently coincides with the solid line for the grid signal voltage to the left of where the grid-current curve begins to rise above the e_s-axis.

A study of Fig. 26 will show that the value of R_D will fulfill the requirements if the power series of equation (50) is sufficiently accurate. For, the load line for I_L may be assumed to be OP instead of OC, as far as peak load current is concerned in the actual circuit.

(Continued on page 23)

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TELECOMMUNICATION

PANORAMA OF PROGRESS IN THE FIELDS OF COMMUNICATION AND BROADCASTING

ANTI-STATIC ANTENNA

ENGINEERS of the United Air Lines have recently designed and successfully tested a new anti-static type antenna which enables radio receivers aboard planes to function without interference from rain and snow static. As may be seen from the accompanying illustration, the antenna is mounted on the nose of the plane.

Consisting of a circular copper tube, 1½ feet in diameter, in which is coiled 100 feet of wire, this antenna is longer than United's standard straight-wire type.

Engineers mounted the antenna directly on the nose of the plane after tests of various locations showed that the front was the most advantageous place from the standpoint of accuracy and efficiency.

Mr. W. A. Patterson, president of United Air Lines, stated that the development of the anti-static antenna was carried on concurrently with the work done by company engineers on perfecting a radio-instrument landing system, on which tests were recently completed in Oakland, California.

NBC TELEVISION DEMONSTRATION

TELEVISION PROGRAM TRANSMISSION was demonstrated on Friday, November 6, by the National Broadcasting Company in a 40-minute program illustrating RCA experimental developments. The pictures were broadcast from the transmitter on top of the Empire State Building, and were received on the 62nd floor of the RCA Building.

The demonstration possessed four features not included in previous demonstrations of television. It was the first made by RCA and the National Broadcasting Company for the press under practical working conditions, although previous demonstrations of laboratory television have been given.* It represented the first showing of a complete program built for entertainment value as well as a demonstration of transmission. It also included the first showing of a new 12-inch receiving tube, which reproduces a picture on a 7½ by 10-inch screen.

A fourth feature of the demonstration was a television tour behind the scenes. By means of an especially prepared moving-picture film, the guests were conducted through the NBC television studios in the RCA Building and the transmitter station at the top of the Empire State Building.

Half of the units shown in the accompanying view of the television-transmitting room in the Empire State Building are audio transmitters, half are video transmitters. In the pipes which coil beneath the ceiling the audio and video signals are combined in what is called the antenna filter which makes it possible to transmit both sound and picture simultaneously from the same antenna.

*See page 23, May, 1936, COMMUNICATION AND BROADCAST ENGINEERING.

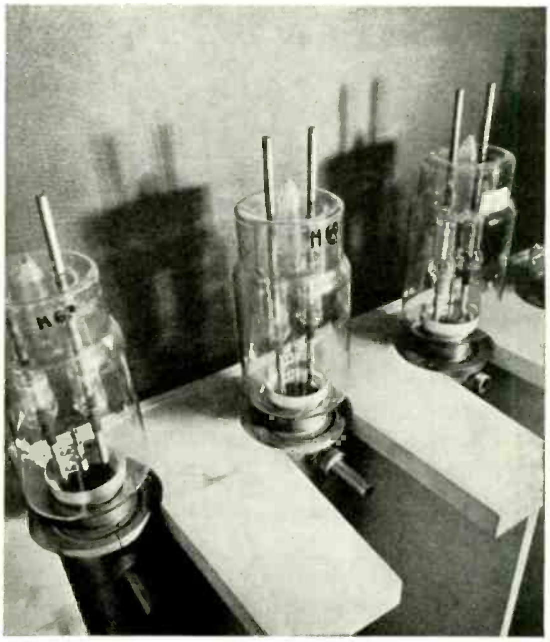
SOUND-EFFECTS APPARATUS

SOUND EFFECTS, properly produced, add considerable appeal and realism to a radio production. The desired reaction of a listening audience to various situations and scene transitions depends to a large extent upon the effectiveness of the created atmosphere.

To meet this situation Jenkins and Adair, have designed the sound-effects apparatus shown in the accompanying

THE NEW ANTI-STATIC RING-TYPE ANTENNA DEVELOPED BY ENGINEERS OF THE UNITED AIR LINES BEING INSPECTED BY PILOT CARL RECKNAGEL AND STEWARDESS MILDRED RAPER.

THE THREE TUBES SHOWN BELOW ARE VIDEO AMPLIFIERS. THEY ARE A PART OF THE 220 TUBES WHICH ARE KEPT IN RESERVE AT RCA'S EMPIRE STATE TELEVISION TRANSMITTER.



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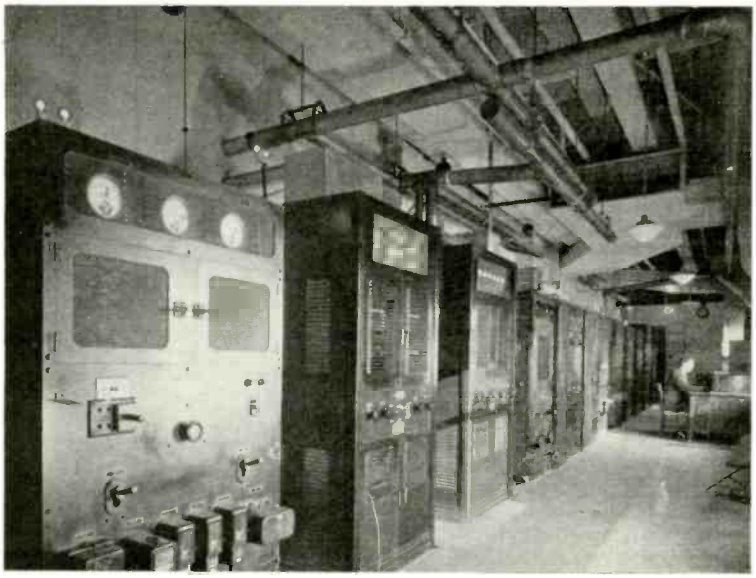
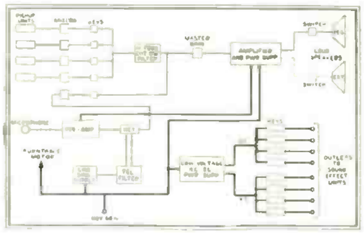


THE TELEVISION TRANSMITTING ROOM IN THE EMPIRE STATE BUILDING.



illustrations. The complete machine consists of a well-constructed cabinet with the following equipment: three continuously-variable-speed turntables which operate from approximately 10 to 125 rpm, four crystal-type reproducing heads associated with the turntables, and an illuminated, adjustable script holder which also illuminates the turntable positions.

On the control panel, five mixing and one master gain controls are provided. These controls, left to right, are "microphone," four "crystal reproducing heads," and "master gain control." Just to the left of the microphone mixing control is a microphone input receptacle.

Directly above this microphone position is a 3-position key marked "rural," "city" and "announcer." When this key is in the rural position, the filter cuts off both the low and high frequencies and imposes a line sing in the microphone circuit. This gives the effect of a rural or toll telephone call when the microphone is used. When the key is in the city position, a slightly different frequency band is transmitted from that of the rural position and no line sing is introduced. The effect is to simulate a city telephone call. When the key is in announcer position, high-quality transmission is accomplished.

Directly above the master gain control is a 4-position switch which is associated with a filter for providing high-frequency cut-offs at 3000, 4000 or 5000 cycles. The fourth position of this key entirely removes the filter from the circuit.

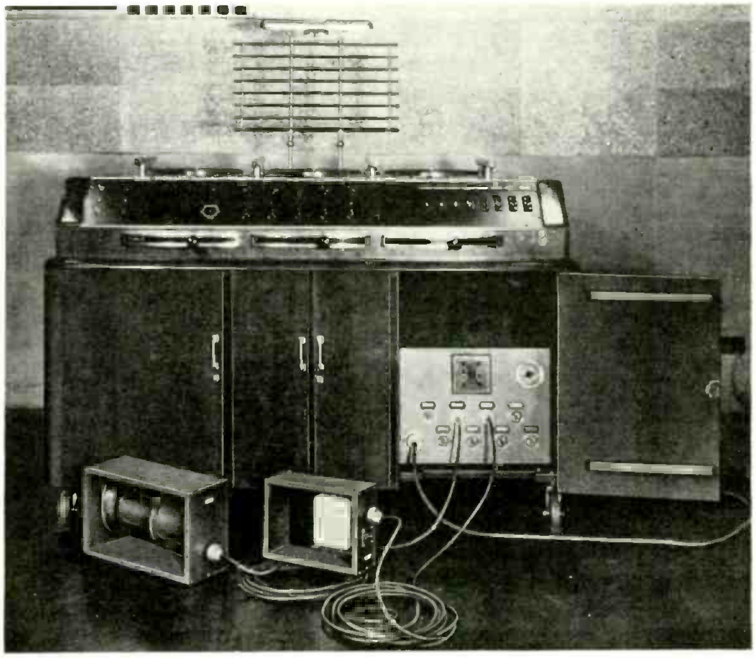
Each of the mixing channels is provided with a cut-off key for completely removing any channel from the input circuit.

At the right-hand end of the control panel, eight switches are provided for the electrical control of external, electrically-operated sound-effect units which are connected to the machine by the use of extension cables. Four of these switches provide a-c and the other four d-c. At the left-hand end of the panel there are three switches with pilot lamps. These switches are associated with the turntable motor, the audio amplifier and the power supply for providing current for the external sound-effect units.

Immediately below the control panel and in front of each of the turntables are three laterally-operated speed-control levers. These levers control a planetary transmission associated with each of the turntables giving continuously variable speed from an off position at the left-hand side to approximately 125 rpm when moved to the extreme right.

The lower part of the cabinet is divided into three compartments. The left-hand compartment contains the driving motor for operating the turntables through their individual planetary transmissions. The middle compartment contains all the necessary audio-frequency amplifiers, while the right-hand compartment contains the power unit for supplying direct and alternating current for the external sound-effect units.

SOUND-EFFECTS APPARATUS DESCRIBED IN TEXT. BLOCK DIAGRAM IS SHOWN ABOVE.



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IRE ROCHESTER FALL MEETING[1]

SPECIAL MEETINGS of the Institute of Radio Engineers have been held in Rochester, New York, for many years and they have become known as the Rochester Fall Meetings. The 1936 Fall Meeting was held at the Hotel Sagamore from November 16-18.

The attendance at this year's gathering was the largest in the history of the meetings. It was outstanding as well in the large number of localities represented and the enthusiasm displayed on every hand.

The technical sessions began with an interesting paper on the methods and equipment used in making measurements of loudspeaker response. This paper, which was delivered by S. V. Perry, also included a description of a semi-automatic response-measuring setup. It was shown that by calibrating a microphone amplifier by means of the voltage on the loudspeaker during the response measurement, the measured response is made independent of meter calibration and amplifier gains. By this means the overall variations in the performance of the equipment is confined to narrow limits, as was illustrated by actual test records.

The theory and the application of acoustic networks in radio-receiver cabinets was dealt with in considerable detail by Hugh S. Knowles, while B. Olney presented the results of investigations of the Acoustical Labyrinth. The first description of the Acoustical-Labyrinth method of controlling the back radiation of a dynamic cone loudspeaker was first presented before the IRE Fall Meeting at Rochester in 1935.

In a system of broadcasting the conditions under which there is freedom from interference depend upon the characteristics of receivers in use and upon the frequency allocation and power of transmitters. Seven types of interference were described by Arthur Van Dyck and Dudley E. Foster who also gave data on the susceptibility of present receivers to each type. Their paper also included quantitative conclusions and specifications covering the relations between signal input, frequency separation and receiver performance.

An interesting paper on "Current Measurements at Ultra-High Frequencies" was presented by John H. Miller. For the most part this paper dealt with errors in thermocouple instruments at frequencies in the vicinity of 100 mc. Apparently the errors resulting from skin effect are the dominant ones, experimental findings on a group of instruments of different makes showing the errors to be rather large. The use of a tubular heater was considered, and fine platinum alloy tubes with a one-mil wall have been obtained. A five-ampere instrument constructed with a tube twenty-eight mils in diameter with a one-mil wall has a correction factor of 0.95 at 80 mc, and according to Mr. Miller this probably approaches a satisfactory solution, since the theoretical correction is 0.98 and the circuit contours appear to account for the remaining errors.

B. J. Thompson's and D. O. North's paper, entitled "Shot Effect in Space-Charge-Limited Vacuum Tubes," presented a new physical picture of the nature of plate-current fluctuations in the presence of space charge, together with rigorous analyses of the space-charge-limited fluctuations in the cathode current of a vacuum tube and of the fluctuations in the distribution of current between positive electrodes.

The first analysis showed that in the case of normal operating conditions with oxide-coated cathodes the cathode-current fluctuations were approximately the same as the thermal agitation in a resistor having a resistance equal to the cathode resistance and a temperature equal to six tenths of the cathode temperature.

The second analysis explained the results of Seeley and Barden and predicted quantitatively that in a practical case where the space-charge depression of cathode-current fluctuations is considerable, and where the screen current is a considerable fraction of the plate current, the plate-current fluctuations are greater than the cathode-current fluctuations and are approximately equal to the fluctuations in a temperature-limited current equal to the screen current.

The subject of television received a good deal of attention at this convention, with papers being presented by Dr. Alfred N. Goldsmith, Albert F. Murray, and W. J. Poch and D. W. Epstein.

In the paper on "Commercial Television—and Its Needs," Dr. Goldsmith pointed out that "commercial television broadcasting, to win general public acceptance and to enjoy a healthy growth, must be built on the basis of a group of necessary elements. These are a constructive Governmental attitude implemented by corresponding regulation, an active group of television broadcasting stations at least partly interconnected into national networks for program syndication, forward-looking program-building organizations, careful engineering and manufacturing methods rendered effective by suitable merchandising practices and satisfactory servicing, an enthusiastic and numerous group of home lookers, and finally a number of broadcast advertisers willing and able to secure the part-time attention of the home audience. To just the extent that any of these elements are missing from the television picture, the day of widespread public acceptance of telephone-television broadcasting will be delayed and the success of the radio industry reduced." While Dr. Goldsmith was optimistic about the future of television, he stressed the fact that a full measure of success could not be obtained without careful planning.

Another very interesting paper on television was presented by Albert F. Murray who discussed the latest television standards that have been proposed by the RMA*. The latest recom-

*See "RMA's Television Report," page 9, July, 1936, COMMUNICATION AND BROADCAST ENGINEERING.

mended television standards are as follows:

1. Frequency allocation
   Lower limit .... 42 mc
   Upper limit .... 90 mc
   An experimental band starting at .... 120 mc
2. Channel width .... 6 mc
3. Spacing between television and sound carriers ....3.25 mc
4. Relation of sound carrier to television carrier.......Sound carrier higher in frequency
5. Polarity of transmission....Negative
6. Number of lines................441
7. Frame frequency.......30 per second
   Field frequency......60 per second, interlaced
8. Aspect ratio 4:3
9. Percentage of television signal devoted to synchronizing signal....Not less than 20%
10. Synchronizing signal
    (a) Duration of horizontal and blanking signals.....Approx. 1-1/10 of time to scan one line, 1/10 of time to scan one field, respectively
    (b) Position of synchronizing impulse in regard to blanking signal.......At leading edge (approx.)

Mr. Murray also discussed the desirability of single-sideband transmission for television and pointed out the difficulties to be overcome before this type of transmission can be used. According to Mr. Murray, further, the worst enemies of television reception are auto-ignition interference, interference from electrical equipment, and the very undesirable interference caused by ultra-high-frequency diathermy apparatus.

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LOOKING AHEAD

(*Continued from page* 15)

RECORDING

DURING NINETEEN THIRTY-SIX instantaneous recording has made rapid strides both in technical improvements and acceptance by radio stations, schools, and the general public.

Many broadcast stations are now making their own recordings, some of such quality that they are being used on the air. Recordings of programs are being shown regularly to advertisers and agencies by station salesmen.

A number of schools and colleges installed recording equipment during 1936 as aids in teaching correct speech, acting and music. Recordings also played an important part in the political campaigns.

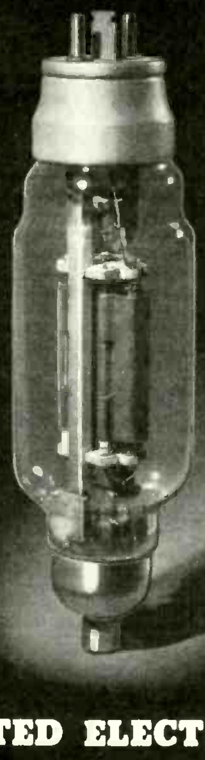
New uses for recordings are being suggested daily and a considerable expansion of the industry should take place during 1937.

S. SHOLES
President
Presto Recording Corporation

(*Continued on page* 23)

Consider
UNITED
TUBES
one by one

TYPE
949



A progressive engineering policy is reflected in the styling of the UNITED '49. It is a refinement of our own handiwork, which in 1933 revolutionized power tube design.

The UNITED 949 is today the most recently improved tube of its type.

The improved UNITED construction in the 949 embraces an element assembly completely mounted on two channel members running from end to end. This unit assembly permits exact fixation of grid, plate and filament and enables us to produce tube after tube with uniformity impossible in the older construction. It assures constant maintenance of the precise electrical characteristics.

Approved for Broadcast use by the FCC under Rule 127.

PRICE $160.00

UNITED ELECTRONICS COMPANY
42 SPRING ST., NEWARK, N. J.

www.americanradiohistory.com

A REMOTE-CONTROL AMPLIFIER

By WILFRED H. WOOD

Chief Engineer

WMBG

INCREASED BUSINESS at WMBG necessitated the addition of another remote-control amplifier. It was decided to create a composite unit which would be a-c or battery operated and which would mix three crystal microphones.

A new amplifier was constructed along these lines. It was mounted in a split-type carrying case (Figs. 1 and 2) which contained the amplifier in one part and the power supply in the other. A duplicate of the side containing the power supply was made for batteries so that the amplifier could be used at points where utility current was not available. All microphones plug into the stands and are removed and placed inside of the case for transportation.

FIG. 1. FRONT VIEW OF REMOTE AMPLIFIER.

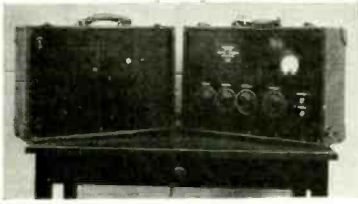


FIG. 2. THE AMPLIFIER (RIGHT) AND THE POWER SUPPLY (LEFT) ARE MOUNTED IN A SPLIT-TYPE CARRYING CASE.

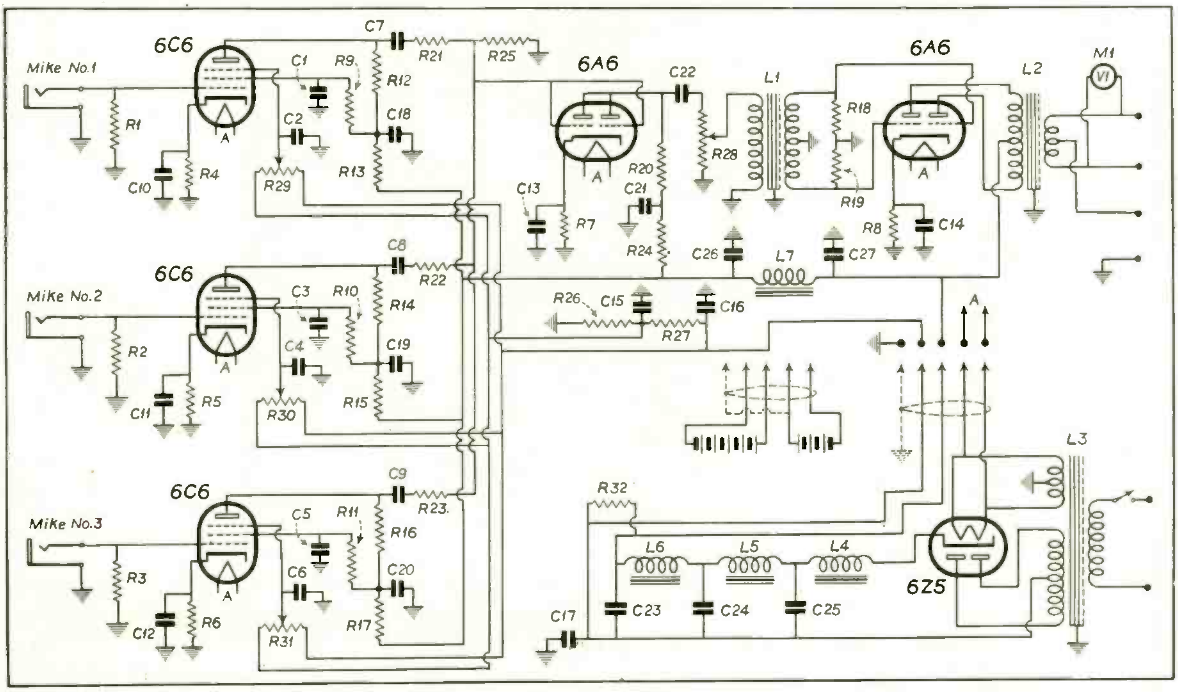
This amplifier uses three 6C6 tubes (see Fig. 3) as preamplifiers and electronic mixer tubes (one for each microphone channel). The output of these preamplifier tubes is fed into a 6A6 connected as a single Class A triode. This in turn is fed into another 6A6 connected as a push-pull Class A amplifier. A 6Z5 rectifier is used. A conventional rectifier-type volume indicator is connected across the output leads.

The amplifier was first built using the 6C6 screen grid as the mixer control grid. Later it was rebuilt using the space grid as the mixer control grid. In either case the operation was entirely satisfactory. The negative bias for the space mixer grid is obtained from a resistor in the negative leg of the plate supply. This is fed to three potentiometers which act as the mixer controls. The middle leg of each potentiometer is fed to the space grid. This grid is connected through a 0.25-mfd condenser to ground which eliminates any noise created by the wiping contact of the potentiometer.

It is necessary, in construction, to carefully shield each of the stages. The power supply has to be thoroughly filtered. The transformer connecting the

(*Continued on page 25*)

FIG. 3. SCHEMATIC OF REMOTE-CONTROL AMPLIFIER.



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BALANCED AMPLIFIERS

(*Continued from page 17*)

DP represents the peak actual current; DQ represents the peak of the fundamental component of this actual current. Load line OP undershoots the linear load line OA by a distance AP. Three-quarters of this distance or AQ represents reduction in the fundamental component due to the undershoot characteristic. One-quarter of AP or QP represents peak amplitude of third-harmonic current, and QP is evidently n percent of I_{LF} as required, and I_{LF} or DQ is the fundamental component which will give required fundamental output P_o.

On the other hand, if we take the actual conditions, OC is the actual relation between load current and grid signal voltage. If at the peak swing, a peak current of FE (= to DP) is required, the terminal grid voltage need only be OF instead of OD. Since OD is the peak generated voltage then FD is the allowable internal voltage drop of the driver and since for a grid voltage of OF the grid current is FG the internal driver resistance is evidently FD divided by FG or GD is the load line for R_D. The latter can therefore be calculated from the scales of current and voltage on the graph.

(*To be continued*)

TERMINATING R-F LINES

(*Continued from page 7*)

$$Z_{12} = +j X_L + \cfrac{1}{\cfrac{1}{R_a} + \cfrac{1}{-jX_c}}$$

Rationalizing,

$$Z_{12} = +j X_L + \frac{X_c^2 R_a}{R_a^2 + X_c^2} - j \frac{R_a X_c}{R_a^2 + X_c^2} \quad \text{.................. (19)}$$

For resonance

$$X_L = \frac{R_a^2 X_c}{R_a^2 + X_c^2} \quad \text{.................. (20)}$$

Characteristic impedance should be equal to the real part or

$$Z_o = \frac{X_c^2 R_a}{R_a^2 + X_c^2} \quad \text{.................. (21)}$$

Solving for X_c in equation (21)

$$X_c = \pm R_a \left(\frac{Z_o}{R_a - Z_o} \right)^{1/2} \quad \text{.................. (22)}$$

Substituting this value of X_c in equation (20), then

$$X_L = (Z_o (R_a - Z_o))^{1/2} \quad \text{.................. (23)}$$

$$C = \frac{10^9}{2\pi f X_c} \text{ micromicrofarads} \quad \text{.................. (24)}$$

where f is in kc.

$$L = \frac{X_L 10^3}{2\pi f} \text{ microhenries (f in kc)} \quad \text{.................. (25)}$$

The antenna in this case is first tuned to resonance before inserting L and C. Next L and C are inserted using values obtained above. A meter is used at each end of the line to check for correct termination.

LOOKING AHEAD

(*Continued from page 21*)

SOUND BUSINESS

THE GENERAL PUBLIC has now been educated to the use of sound to such a degree that they almost demand it. Sound installations will therefore find increased applications in stadiums, auditoriums, hotels, schools, factories, and the like, as well as for call and announcing systems, and for intercommunication purposes. All installations will increase in popularity with the better design for that particular purpose.

S. RUTTENBURG
Amperite Corporation

MANUFACTURERS

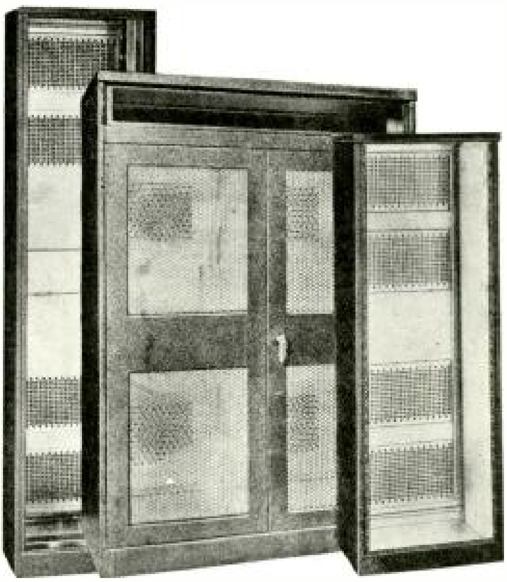
THE YEAR 1936 has been very successful for those manufacturers engaged in supplying the broadcast and communications industry and still greater achievements may be expected in 1937.

Naturally, we are all depending upon the general economic conditions and with all signs pointing toward the solution of our general problems in this country, the year 1937 should bring a full measure of return for all sincere effort expended by manufacturers.

C. P. CUSHWAY
General Sales Manager
Thordarson Electric Mfg. Co.

(*Continued on page 27*)

Gates Transmitter Cabinets



If you plan on dressing up the transmitter or speech equipment finish the job with Gates transmitter cabinets. Available in a wide variety of sizes or custom built styles finished in gray, or black baked crackle enamel.

Speech input cabinets drilled and tapped for standard rack mountings while larger units heavily reinforced for holding heavy transformers, etc.: Prices extremely moderate ranging from $27.50 to $145.00.

Fully described in Gates Catalog B-21.

GATES RADIO & SUPPLY CO.
Quincy, Ill., U. S. A.

OVER THE TAPE...

NEWS OF THE RADIO, TELEGRAPH AND TELEPHONE INDUSTRIES

FCC APPROVED TUBES

On Page 10 of the August, 1936, issue of COMMUNICATION AND BROADCAST ENGINEERING, appeared a table of transmitting tubes that had been approved by the FCC under Rule 127. The following additions should be made to this table in order to bring it up to date:

TABLE A

Power Rating (Watts)	Amperex	Federal Telegraph	Western Electric
75	HF-100 838	....	......
125	HF-200 203-H 211-C 211-D 211-H 805	....	......
250	212-E	....	......
10,000	......	F-332-B	......
40,000	......	....	298-A

TABLE B

Power Rating (Watts)	Amperex	Federal Telegraph	Western Electric
50	203-H 211-H	....	......
75	212-E	....	......
8,500	......	F-332-B	......
25,000	......	....	298-A

TABLE C

Power Rating (Watts)	Federal Telegraph
2,500	F-307-A

In Table A, also, the Amperex HF-200 should be removed from the 100-watt listing as this tube is now approved for operation at 125 watts.

OPERADIO CATALOG

A 12-page catalog describing the Operadio line of uni-matched public-address systems may now be secured from the Operadio Manufacturing Company, St. Charles, Illinois. Write for Catalog No. 10-A.

Of special interest in this catalog is the Model 111 amplifier paging system which is made up of a crystal microphone, a special amplifier that may be mounted at any convenient location, and a complement of permanent magnet speakers.

WGN NOTE

Donald Pontius, a member of the WGN sound-effects department for a number of years, transferred his allegiance to the traffic department of the Mutual Broadcasting System on Monday, November 16, and will be located in the Chicago office of the network.

OXFORD-TARTAK CATALOG

Oxford-Tartak Radio Corporation, 915 W. Van Buren Street, Chicago, now have available a new catalog describing their line of replacement and public-address speakers. Of special interest are the sections devoted to public-address reproducers and exponential horns.

WHOLESALE FLYER

The Wholesale "Bargain Flyer" is now ready for distribution by the Wholesale Radio Service Co., Inc., 100 Sixth Avenue, New York City, 901 West Jackson Boulevard, Chicago, and 430 West Peachtree Street N.W., Atlanta. This flyer is issued each year by Wholesale Radio Service Co., and consists of eight pages of "specials" in parts, tubes, test equipment and receivers.

SHURE CHART

In response to requests Shure Brothers, 215 West Huron Street, Chicago, have issued a microphone application and specification chart. This chart gives convenient technical data on 50 Shure microphones. The chart folds to 8½ by 11 inch size and is punched for standard three-ring binders.

DR. VICTOR J. ANDREW

NEW MANUFACTURER

Dr. Victor J. Andrew, 7221 South Francisco Ave., Chicago, formerly chief engineer of Doolittle and Falknor, Inc., has announced his entrance into the field of manufacturing and consulting for broadcast stations. At present Dr. Andrew is specializing in antenna coupling equipment, coaxial cable, and custom-built apparatus.

THORDARSON CATALOG

"Tru-Fidelity" is the title of a new 8-page catalog recently released by the Thordarson Electric Manufacturing Company, 500 West Huron Street, Chicago. Besides describing the Thordarson "Tru-Fidelity" line of transformers, this catalog contains considerable information on the construction of these units and their operating characteristics. Write for Catalog No. 500.

QUAKER STATE NETWORK

Donald Withycomb, general manager of WFIL, Philadelphia, has announced the formation of a regional chain of sixteen radio stations under the banner of the Quaker State Network, for the purpose of supplying commercial advertisers with concentrated coverage in the rural and urban markets of Pennsylvania.

The network will be available to advertisers in three separate groups broken up as follows:

Eastern: WFIL, Philadelphia; WCBA, Allentown; WRAW, Reading; WEST, Easton; WGBI, Scranton; WBRE, Wilkes Barre; WAZL, Hazleton; WGAL, Lancaster.

Western: WFBG, Altoona; WJAC, Johnstown; WWSW, Pittsburgh; WLEU, Erie; and WTBO, Cumberland, Maryland.

Central: WKBO, Harrisburg; WKOK, Sunbury; WRAK, Williamsport; WORK, York.

MIRROR RECORD CORP. REDUCE PRICES

Paul K. Trautwein, president of the Mirror Record Corporation, 58 West 25th Street, New York City, manufacturers of aluminum and coated discs, have announced reductions in the price schedule of their products. A bulletin will be mailed upon request.

AYDAR HOUSE REMODELED

Aydar House, home of broadcasting station 2GB, Sydney, Australia, has been entirely remodeled and redesigned as a modern broadcast center and is now known as Savoy House.

Long the home of 2GB, which occupies the sixth and seventh floors, as well as executives' quarters throughout the entire building, station 2UE has also moved to Savoy House where it occupies the fifth floor.

American Radio Transcriptions Agencies also occupies space in Savoy House with audition rooms for agencies, as well as a specially constructed library housing some 30,000 radio transcriptions.

KEN-RAD BULLETIN

The Ken-Rad Tube and Lamp Corporation, Inc., Owensboro, Kentucky, have recently issued an engineering bulletin on "The 6V6G Beam-Power Amplifier." Write for Bulletin CEB 36-12.

APCO OFFICERS

The Associated Police Communication Officers have announced the results of their election of officers for the year of 1936-37. The following officers were elected: President, Lieut. E. C. Denstaedt, Detroit, Michigan; First Vice-President, George M. Kinsey, Columbus, Ohio; Second Vice-President, William Nelson, Niagara Falls, New York; Secretary-Treasurer, Sgt. Everett Fisher, St. Louis, Missouri; and Sgt.-At-Arms, E. F. Brown, Des Moines, Iowa.

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SUPER-POWER PUBLIC ADDRESS

(Continued from page 11)

hand, no such source is available, and to provide one would increase the original cost out of proportion to the decrease in operating cost which could be expected. An even more important factor, however, is the difference in operating procedure. In a broadcast station, a smaller number of tubes means less-frequent interruptions due to tube failure, and hence less time lost. In a sound installation, such as that described, the reverse is true.

The input and control arrangement of this installation requires only a brief note—for, whereas the output of this particular system was required to be unusually high, the flexibility and input provisions were considerably less than average. The chief importance of this particular system was in providing a means of carrying instructions and announcements over a wide area. Entertainment was of very secondary importance, and was required over only relatively short periods of time. Thus, instead of numerous pickup points and studios, there was but a single combined control room and announce booth—all the functions of which were satisfactorily provided for by a 14-A cabinet. This unit, which is shown in Fig. 10, includes a radio receiver, a two speed turntable and provision for a microphone input. Actually two such cabinets, each followed by a volume compressor panel and a switching panel are provided. The latter contain all necessary controls and allow either of the input circuits to feed either or both of the two groups of output amplifiers. This system combines a large degree of reliability with all of the flexibility that was required in this instance. For other applications a greater number of pickup points, and possibly a different system of distribution, would be required. Comparison of this typical system with the standard arrangement shown in Fig. 1 will suggest the possibilities along this line.

REMOTE-CONTROL AMPLIFIER

(Continued from page 22)

two 6A6 tubes must be of a very low ratio.

Crystal microphones naturally have rising characteristics and by varying the value of the grid resistor in the first 6A6 stage (R-25) it was found that the frequency response of the amplifier could be varied up or down.

When the amplifier was first constructed it was found that varying any of the "fade controls" tended to momentarily block all three 6C6 tubes, cutting off any open microphones for an instant. This was eliminated by the use of resistors (R-21, R-22, R-23) and by changing the value of R-25. If R-25 is made sufficiently low, R-21, R-22 and R-23 may be eliminated.

Although crystal microphones are used on this amplifier there is no reason why other low-level type of microphones could not be used if an input transformer is placed in the grid circuit of each 6C6. The frequency response represents "high fidelity," although in this particular amplifier, a falling characteristic was used to offset the rising characteristics of crystal microphones. This was accomplished by eliminating R-21, R-22, R-23 and lowering the value of R-25. The operation after construction was better than expected.

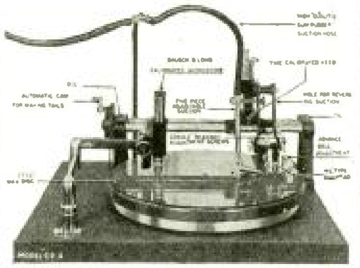
R-1	5,000,000 ohms, .5 watt	R-23	30,000 ohms, .5 watt	C-13	.25 mfd, 25 volts
R-2	5,000,000 ohms, .5 watt	R-24	50,000 ohms, 1 watt	C-14	.25 mfd, 25 volts
R-3	5,000,000 ohms, .5 watt	R-25	100,000 ohms, .5 watt	C-15	25 mfd, 25 volts
R-4	2,000 ohms, .5 watt	R-26	1,000 ohms, .5 watt	C-16	25 mfd, 100 volts
R-5	2,000 ohms, .5 watt	R-27	6,000 ohms, .5 watt	C-17	25 mfd, 100 volts
R-6	2,000 ohms, .5 watt	R-28	100,000-ohm pot.	C-18	1 mfd, 400 volts
R-7	2,000 ohms, .5 watt	R-29	100,000-ohm pot.	C-19	1 mfd, 400 volts
R-8	2,000 ohms, .5 watt	R-30	100,000-ohm pot.	C-20	1 mfd, 400 volts
R-9	1,000,000 ohms, .5 watt	R-31	100,000-ohm pot.	C-21	1 mfd, 400 volts
R-10	1,000,000 ohms, .5 watt	R-32	20,000 ohms, 10 watts	C-22	1 mfd, 400 volts
R-11	1,000,000 ohms, .5 watt	C-1	.25 mfd, 400 volts	C-23	8 mfd, 400 volts
R-12	100,000 ohms, 1 watt	C-2	.25 mfd, 400 volts	C-24	8 mfd, 400 volts
R-13	100,000 ohms, 1 watt	C-3	.25 mfd, 400 volts	C-25	8 mfd, 400 volts
R-14	100,000 ohms, 1 watt	C-4	.25 mfd, 400 volts	C-26	8 mfd, 400 volts
R-15	100,000 ohms, 1 watt	C-5	.25 mfd, 400 volts	C-27	8 mfd, 400 volts
R-16	100,000 ohms, 1 watt	C-6	.25 mfd, 400 volts	L-1	1:1 transformer
R-17	100,000 ohms, 1 watt	C-7	.01 mfd, 400 volts	L-2	output-500-ohm line
R-18	100,000 ohms, .5 watt	C-8	.01 mfd, 400 volts	L-3	power transformer
R-19	100,000 ohms, .5 watt	C-9	.01 mfd, 400 volts	L-4	30 h choke
R-20	100,000 ohms, 1 watt	C-10	.25 mfd, 25 volts	L-5	30 h choke
R-21	30,000 ohms, .5 watt	C-11	.25 mfd, 25 volts	L-6	30 h choke
R-22	30,000 ohms, .5 watt	C-12	.25 mfd, 25 volts	L-7	100 h choke

Custom Built RECORDING EQUIPMENT

with a Proven Performance Record

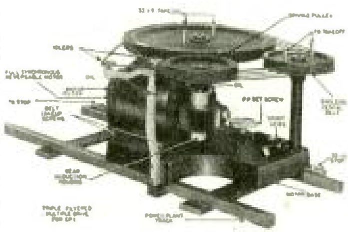
Recorded a 30-minute programme of the El Paso Symphony Orchestra on your Portable Recording Machine . . . I found the results amazing in reproduction and fidelity of tone and have no hesitancy in recommending this machine for recording other orchestras.
(Signed) H. ARTHUR BROWN,
Director, El Paso Symphony Orchestra.

We just finished installing the equipment and we are very much pleased with it . . . We cut a test record before we got the adjustments right and it was good enough to use for broadcast purposes.
(Signed) PHILLIP A. JACOBSEN,
Technical Adviser to the Cornish School and University of Washington, Seattle.



1937 Model Combination Wax and Acetate Recorder

The *Finest* Equipment that *Can* be Produced • Precision built • Constant speed • No vibration • Records 33⅓ or 78 r.p.m. • 96, 110 or 125 lines per inch • Reversible cutting head • Universal type cradle with adapter for any type of cutting head • Simple to operate • Compact.



RECORDING EQUIPMENT MANUFACTURING CO.
6611 SUNSET BOULEVARD
HOLLYWOOD, CALIFORNIA
• *Write for Bulletin C. 12.*

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THE MARKET PLACE

NEW PRODUCTS FOR THE COMMUNICATION AND BROADCAST FIELDS

THEATRE AMPLIFIER

The Gates Radio and Supply Company, Quincy, Illinois, have announced a new high-fidelity theatre amplifier for commercial theatre installations. This amplifier is completely a-c operated, having a uniform frequency response from 35 to 13,000 cycles, equipped with visual volume indicator having attachment for hard-of-hearing headphones, and is completely equipped for dual projector, microphone, and phonograph pickup operation.

Descriptive material is available upon request.

TRANSMITTING CONDENSERS

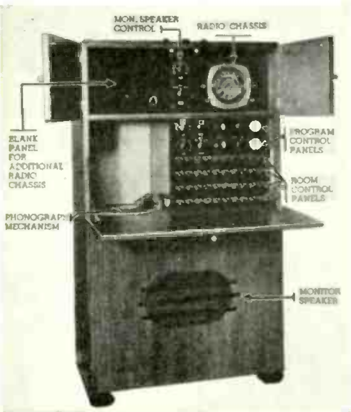
Dumont Electric Company, Inc., 514-516 Broadway, New York City, have announced a complete line of low-loss mica transmitting condensers. These units are said to be constructed of high-grade mica, and to possess a high power factor. They are housed in a ceramic which has a low r-f resistance. For further information communicate with the manufacturer.

SECTIONALIZED SOUND SYSTEMS

The Webster Company, 3825 West Lake Street, Chicago, have introduced their sectionalized sound systems for schools, hotels, hospitals, department stores, and the like. The systems are designed on a section basis, one section taking care of approximately 10 rooms. Provision is made in the cabinet to accommodate additional sections.

These systems incorporate the following features: distribution choice of radio program, phonograph recordings, or speech; two-way communication from central control to each point; and emergency cut-in switch to all points.

Complete literature is available from the above organization.



MULTI-RANGE METER

The Model 300 multi-range meter, a product of the Triumph Manufacturing Company, 4017 West Lake Street, Chicago, is shown in the accompanying illustration. This unit does not use pinjacks and operates with only one selector switch. This meter has 11 ranges and is said to be of laboratory accuracy, d'Arsonval meter movement being used. The following are the ranges covered: d-c voltages in ranges 0-10, 0-100, 0-500 volts, with d-c sensitivity of 1000 ohms per volt; a-c voltages in ranges 0-10, 0-500, 0-1000 volts, with a sensitivity of approximately 850 ohms per volt; d-c current ranges 0-50, 0-500 ma; resistance ranges 0-1000, 0-1,000,000, 0-10,000,000 ohms.

The maximum battery drain of this instrument is said to be 1 ma. Only occasional compensator adjustment is necessary. It is capable of withstanding 500 percent overload.

DIRECT-READING FREQUENCY METER

The Type 620-A heterodyne frequency meter and calibrator is designed primarily for frequency measurements in the high-frequency ranges above 10 megacycles. By using harmonic methods, however, the entire range of frequencies between 300 kilocycles and 300 megacycles can be covered.

The instrument consists of a heterodyne frequency meter covering a fundamental range of 10 to 20 megacycles, a piezoelectric oscillator for checking its calibration, and a detector-amplifier for obtaining beats.

The range of the heterodyne is divided into 10 steps, each covering one megacycle. The condenser dial is calibrated directly in megacycles, and the fundamental frequency is read directly from the range switch and the dial.

The calibrator uses a low-temperature-coefficient one-megacycle quartz plate. A large number of calibrating points are produced and they fall at the same dial reading for each range of the heterodyne fundamental.

The accuracy of measurement is 0.01 percent or better.

An a-c power supply is included, but provision is also made for operation from external batteries.

Complete information may be obtained from the General Radio Company, 30 State Street, Cambridge, Mass.

CONSOLETTE RECORDER

Radiotone Recording Company, 6103 Melrose Avenue, Hollywood, California, have just placed on the market their A-50 consolette recorder. This consolette recorder is constructed with all Radiotone Recorder features. It is equipped with a 12-watt recording amplifier, cutting head, and crystal pickup for record reproduction. A crystal microphone is standard equipment with the unit, and a 12-inch dynamic speaker gives excellent results with any type of record. On request full details will be furnished by the manufacturer.

(*Continued on page* 28)

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Neobeam OSCILLOSCOPE

$40.00 NET

Makes Sound Visible

- Sensitivity—1 Microvolt to 200 Volts
- Completely Self-Contained
- 4" Calibrated Screen

NEOBEAM utilizes new Neon Beam principle in portraying audio wave form of amplifiers, radios and transmitters. Also used for vibration, sound level and acoustic study.

It's more than an OSCILLOSCOPE; it's a vacuum tube voltmeter and supersensitive A.C. galvanometer. The calibrated sweep permits direct frequency determination. The 125 db gain 6L6 beam power amplifier permits direct crystal microphone inputs and has speaker output as in a P. A. system, giving both visible and audible perception. Operates direct on all potentials from 1 microvolt to 200 volts. Comes complete, with tubes, ready to operate on 110 V. 60 cycle lines. 8¼" x 11" x 13" high. Weight 25 lbs.

Finest instrument of its type made—fully guaranteed. Order on approval or write for literature.

SUNDT ENGINEERING CO.

4242 Lincoln Avenue CHICAGO, ILL.

VERSATILE!

Self-starting Synchronous motor, absolute constant speed, quick change from 78 to 33-1/3 speed.

The Radiotone A-16 Studio Recorder will cut 100 or 120 lines per inch, will handle 78 RPM phonograph recording and 33-1/3 RPM electrical transcription use, will record from the inside out or the outside in, has full adjustment for stylus angle and tension. These features mean: EFFICIENCY, ECONOMY, RESULTS! Write Radiotone Recording Co., 6103 Melrose Ave., Hollywood, Calif., for full information.

RADIOTONE PROFESSIONAL RECORDER

LOOKING AHEAD

(*Continued from page* 23)

POLICE RADIO

LOOK for a rather active year in the police radio field in 1937. Radio divisions in our municipal and state governments have been struggling along on relatively low budgets and even though private business has forged ahead during the last year, the police-radio field, dependent upon collection of taxes for its finances, has lagged behind. The 1937 budgets will be the first to reflect the generally improved conditions.

It is probable that there will be expansion in the police field along three lines:

(1) Much relatively old equipment is in use on the medium-high-frequency police channels. This is due for replacement. A number of departments also desire to increase the power of their transmitters so as to cover counties instead of cities. In the same frequency spectrum we also note increasing activity among states who are intending to put in systems covering the entire state.

(2) Two-way communication at ultra-high frequencies is now looked upon as practical and as an ideal police-communication system. With a few exceptions the larger cities have not as yet attempted to put in city-wide communication systems. Numbers of them have, however, experimented with two-way systems in parts of the city. Many of these cities are waiting only for the necessary finances to make the installation city-wide.

The installation of two-way communication equipment has already been going on in the smaller cities at a rapid rate. This rate will probably grow even more rapidly in 1937.

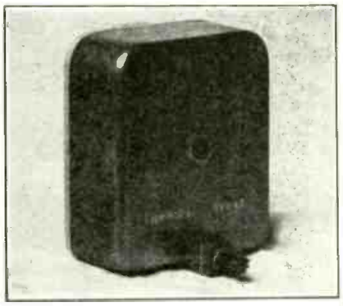
(3) The Federal Communications Commission's General Order No. 14, making nine frequencies available for nation-wide intercity police communication by radio telegraph, has caused intense interest. Though only nine cities have so far put transmitters on the air, numbers of them have made the necessary budget requests and are anxiously waiting for the money to become available. We anticipate at least five states and nearly fifty cities will put transmitters in operation in the next year. A number of them have already filed applications for construction permits with the FCC.

Yes, all indications point to an active year in the police-radio field in 1937.

E. C. DENSTAEDT
President
Associated Police Communication Officers

(*Continued on page* 28)

Recording Head Producing Excellent Results . . . WHY?



THEY are properly designed to have a constant velocity down to 300 cycles, and an essentially constant amplitude below this frequency. Due to their correct dampening (spring oil-damped method) they show no resonance points over the whole range. This feature simplifies the proper use of equalization which is especially necessary for slow speed direct recording to raise the higher frequencies, and to compensate the loss in record materials. Their durability is warranted, as no deteriorating materials are used.

These recording heads are individually tested, numbered, and sealed, bearing the name of George Neumann & Co. which is a guarantee of high quality workmanship and performance.

SEND FOR LITERATURE

Net prices:

Direct recording head
$65.00

Wax recording head
$175.00

SOUND APPARATUS CO.

150 W. 46th St., New York, N.Y.

Sole Distributor of

Neumann sound recording apparatus • Duralatone records • Saja Synchronous Motors • Herold cutting and reproducing needles • Neumann Automatic High Speed Level Recorder.

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LOOKING AHEAD

(*Continued from page 27*)

AERONAUTICAL RADIO

RADIO DEVELOPMENT, as applied to aeronautics, will probably advance along the following lines during the year 1937:

(1) Higher-power transmitters, a-c operated.
(2) Development of instrument-landing radio aids.
(3) Installation of direction finders to supplement the radio-range beacon system.
(4) Continued development of the visual, right-left type of radio compass.
(5) Adoption of anti-noise circuits.
(6) Development of facsimile apparatus for ground-to-aircraft use.
(7) Development of ultra-high-frequency equipment for airport control and for marker-beacon use.
(8) Development of automatic recording equipment to record all aircraft two-way communication for record purposes.

It cannot be said that any of the above equipment will actually be put into service during the coming year, since in all aeronautical-radio work a large amount of development and preliminary trial is necessary before routine operation can be attempted.

J. C. FRANKLIN
Communications Engineer
Transcontinental & Western Air, Inc.

INTENSIVE DEVELOPMENT has promoted aeronautical radio in the space of a few brief years from a relatively minor air transport aid to the status of an indispensable necessity. Two-way aircraft radio-phone gave the pilot weather information; the radio range made him largely independent of beacon lights and other ground aids required for contact flying.

The radio compass or direction finder was the next logical development to serve off-airway operations. Numerous difficult problems have arisen in connection with the successful development of the radio compass. However, daily progress is being made on these various problems so that within the coming year it is believed that greatly improved compass reliability will be attained.

The rapidly increasing number and speed of aircraft has complicated the problems of traffic control and in turn created an urgent demand for radio traffic markers or block signals as well as markers to positively identify radio-range-station locations. The development work now under way will meet this requirement through the use of ultra-high frequencies. Ultra-high frequencies will undoubtedly play an important part in the ultimate system for making blind landings. They will probably be used to give both vertical and lateral guidance together with the required inner and outer markers.

During the next year the possibilities of communicating from ground to plane on radio telephone and simultaneously operating point-to-point radio-teletype circuits together with the possibility of operating teletype equipment directly on the airplanes using ultra-high frequencies will be demonstrated. During the

W. E. JACKSON
Chief, Radio Development Section
Bureau of Air Commerce

BUSINESS

IT IS QUITE APPARENT, from the decided increase of business in general during the last nine months, that the outlook for 1937 in the radio industry is the brightest it has been since the general widespread use of electronic devices. Business in 1937 should show a decided increase over the much-quoted boom year of 1929. The public is becoming generally conscious of the need of sound in a large number of business enterprises, the theatre has definitely decided to hold its business and high-fidelity equipment is their answer, and radio-broadcast stations in months to come will give the receiver manufacturers something to shoot at in reproducing all that the broadcasters can put out.

P. S. GATES
Gates Radio & Supply Company

CORNELL-DUBILIER POWER FACTOR CONDENSERS

The Power Factor Division of the Cornell-Dubiller Corporation, South Plainfield, New Jersey, recently announced a change in the design of their box type Power Factor Correction Capacitors. These new units exceedingly compact, and flexible, are easy to install, lending themselves very readily to various applications. The greatly improved mechanical and electrical features of these units plus their simplicity of installation, make them particularly feasible for modern economical power factor correction and adjustment. It is possible to mount these capacitors on the ceiling, wall or floor in single units or compact groups up to 100 kva.

Full descriptive bulletin furnished free of charge upon application at the South Plainfield office of the Cornell-Dubillier Corporation.

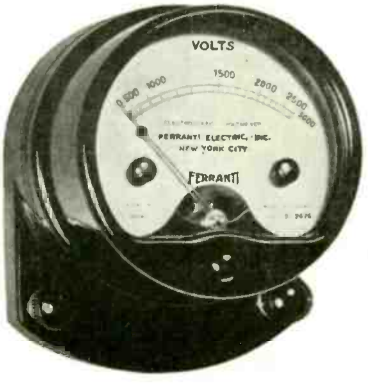
PACK TRANSMITTER

The Radiotransceiver Laboratories, 8627 115th St., Richmond Hill, N. Y., have announced a 2-watt pack transmitter and cueing monitor. This instrument, Type PTR-19-M, employs six 2-volt tubes, two of which being twin-triodes give the effect of eight tubes in all. In spite of the number of tubes employed the total filament current is only 0.93 ampere and the total plate drain 0.70 ma. Medium-sized batteries mounted internally provide all potentials for a minimum of ten hours.

The master oscillator employs a push-pull unity-coupled oscillator with a frequency range of 30-41 mc. The r-f amplifier is also push-pull. An antenna-resonance indicator and inductively-coupled circuit are provided. All r-f circuits are insulated with Micalex or Isolantite and the frequency may be locked whenever desirable.

R-F VOLTMETER

Ferranti Electric, Inc., 30 Rockefeller Plaza, New York City, have announced an r-f voltmeter which may be used on power, audio and radio frequencies up to 1500 kc. This instrument, employing electrostatic construction, is said to be independent of temperature, frequency and waveform. It may be used for making measurements on high-impedance circuits or measuring the voltage in the tank circuit of a radio transmitter.



Up to 3500 volts these meters can be directly connected either to a-c or d-c circuits. They are supplied in three standard dials: 2½ inches, 3¼ inches and 4 inches.

RECORDING MACHINES

Introducing their new line of instantaneous recording machines under the "Remco" trade name, Recording Equipment Manufacturing Co., 6611 Sunset Boulevard, Hollywood, Calif., announces four types of machines ranging from the "Babytone" model for home recording to the "Mastertone De-Luxe" for professional and studio use.

Both the "Babytone" and the "Babytone De-Luxe" models consist of an amplifier, loudspeaker, crystal microphone, combination cutting and reproducing head with a tracking device, turntable and motor. The "De-Luxe" model, in addition, is equipped with a self-contained radio receiver.

The "Mastertone" and "Mastertone De-Luxe" units are designed for professional use, being miniature portable reproductions of a professional studio installation. They are equipped with full synchronous motors, 78 rpm; overhead lathe type feed; builtin preamplifier for microphones; crystal microphone mounted on an adjustable floor-type stand; 12-inch turntables; recording amplifiers; self-contained loudspeakers; crystal reproducing arms, and rubber-damped type cutting heads.

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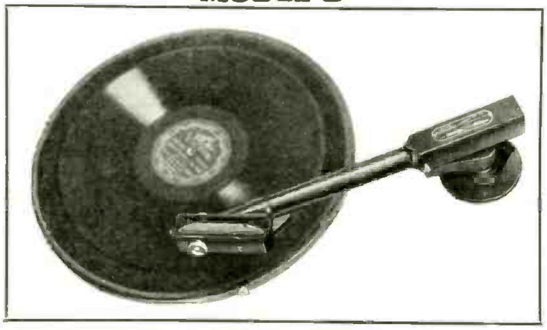
ASTATIC ANNOUNCES
A NEW QUALITY CRYSTAL PICKUP
TRU-TAN
MODEL B



SCIENTIFICALLY DESIGNED OFFSET HEAD GIVES BETTER REPRODUCTION AND LONGER RECORD LIFE

Every engineer will immediately recognize the value of the Astatic offset design, which reduces the needle tracking error from 15° to 1½°, resulting in longer record life and better reproduction. A new reversible head design makes needle loading very easy as compared to present day methods.

Licensed under Brush Development Co.
Patents—Astatic patents pending.

AVAILABLE JAN. 1....WRITE FOR PRICE AND DETAILS

ASTATIC MICROPHONE LABORATORY, Inc. YOUNGSTOWN, O.
Pioneer Manufacturers of Quality Crystal Products

NEW!

Type "TH" TRANSTAT* Voltage Regulator

TRANSTAT Regulators provide the ideal method for controlling voltage in alternating-current circuits. The Transtat is a continuously variable auto-transformer which permits smooth, uninterrupted control of voltage. It also offers high efficiency, good regulation, and great flexibility. As it is moderate in cost, economical in use, and dependable in operation, it is well suited for a large number of radio and industrial applications.

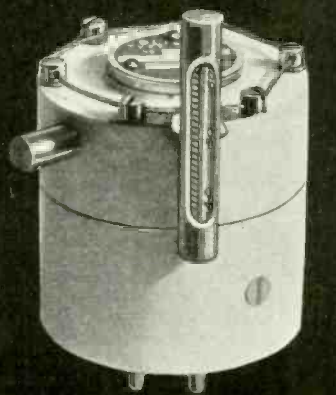
*Patents 1,993,007 and 2,014,570. Other patents pending.

AMERICAN TRANSFORMER CO., NEWARK, N. J.

AMERTRAN
QUALITY TRANSFORMERS SINCE 1901

Approved by F. C. C.

BLILEY OVENS

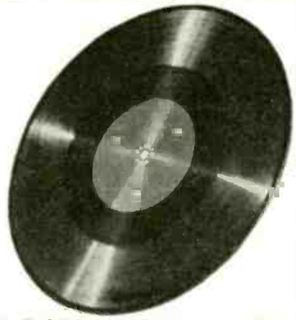


BROADCAST CRYSTALS

Write for Bulletin G-9

BLILEY ELECTRIC COMPANY
UNION STATION BUILDING ERIE, PA.

SAVE 20%



Use the
NEW PRESTO BLACK SEAL DISC

For test cuts and your less important instantaneous recordings.

Made in 6″—8″—10″ and 12″ sizes selling at 20% less than you now pay for Green Seal discs.

WHILE THEY LAST

PRESTO ALSO has in stock a limited number of "Green Seal seconds."
These discs *do not* meet the rigid standards for Green Seal discs. Most are good on one side. Sold strictly "as is" at 40% off prices you now pay for Green Seal discs.
Orders for "seconds" will be filled only when these rejected discs are available.

PRESTO RECORDING CORPORATION
145 W. 19th St., New York

Export Division
(Except Australia and Canada)
M. SIMONS & SONS, Inc.
25 Warren St., N. Y.
Cable: Simontrice, N. Y.

Australia and New Zealand
Agents and Stockists
A. M. CLUBB & CO., LTD.
45 King Street
Sidney, N.S.W. Australia

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VETERAN WIRELESS OPERATORS ASSOCIATION NEWS

W. J. McGonigle, Secretary, 112 Willoughby Avenue, Brooklyn, N. Y.

SEASON'S GREETINGS

ON BEHALF of the officers and board of directors of the Veteran Wireless Operators Association we extend to our members and friends every wish for a very merry Christmas and the happiest of New Years.

JANUARY MEETING

THE JANUARY MEETING of the Veteran Wireless Operators Association will be held at 6 p. m. on Monday, January 4, 1937, at Bonat's Restaurant, 330 West 31st Street in New York City. This is the annual meeting at which the sealed ballots sent in by the membership in the election for 1937 Officers and Directors will be counted by tellers appointed from among the members present. Final plans for the Annual Dinner-Cruise will be formulated on this evening.

TWELFTH ANNUAL

THE TWELFTH ANNUAL DINNER-CRUISE of the Association will be held simultaneously in various cities throughout the United States as well as Honolulu. The affair in New York will be held at 8 p. m. on Thursday, February 11, 1937, at the Hotel Great Northern, 118 West 57th Street, New York City. The lavish Crystal Room, one of the most beautifully decorated dining rooms in any New York hotel, will be available for our exclusive use on that evening. The room has an incomparable dance floor and is equipped with a superb public-address system which will, we promise, find little use in speech making but will be used almost exclusively in amplifying entertainment features. In addition to a well-known orchestra to furnish dance music, the wired-music system, which is a part of the facilities engaged in the Crystal Room, will be used to provide continuous music of a varied nature. A delicious steak dinner, including a Manhattan cocktail for each guest, will be served and the subscription for the entire evening of jollification is the modest fee of $3.00 per person.

CHICAGO

WE SALUTE Geo. I. Martin, Chicago Chapter chairman, for his splendid work in securing advertisements for our 1937 Year Book. Among his sales are a half page to Bill Halligan, a Veteran Wireless operator, who is at present president of The Hallicrafters Company, manufacturers of the Hallicrafter line of communication receivers; a quarter page to R. E. Smiley, general sales manager of the Continental Electric Company of St. Charles, Ill., manufacturers of Cetron photoelectric cells and electronic specialties. In his letter to Mr. Martin, Mr. Smiley relates: "In looking over the book (1936 Year Book) I got quite a thrill when I noticed 'IN MEMORIUM' the names of Clifton J. Fleming and Harry Fred Otto, who went down on the *SS Leggett* in September, 1914. Lady Luck must have been with A. J. Lindholm and myself because we left her just before her final sailing and our jumping the *Leggett* came as a result of a battle royal that he and I had with the steward over the poor chow they were serving. I have been mighty thankful to this day that he had such terrible grub"; and a quarter page from the Allied Radio Company, distributors of general radio parts. Fine business, GIM, and thanks a lot.

NOMINATIONS

THE FOLLOWING MEMBERS were unanimously nominated by the board of directors at a meeting held in New York City on November 18, 1936: President, William J. McGonigle, A. J. Costigan; vice-president, Fred Muller, R. H. Frey; secretary, Harvey Butt W. S. Fitzpatrick; treasurer, W. C. Simon, C. A. Carney; directors, J. A. Bossen, Harvey Butt, C. A. Carney, G. H. Clark, A J. Costigan H. F. Coulter, W. S. Fitzpatrick, R. H. Frey, C. D. Guthrie, A. A. Isbell, F. Klingenschmitt, William J. McGonigle, Fred Meinholtz, Fred Muller, C. O. Peterson. J. R. Poppele, W. C. Simon, J. W. Swanson, P. K. Trautwein, A. F. Wallis. Ballots containing the names of the above nominees have been sent the membership and should be returned before the January meeting for tabulation.

PERSONALS

ARTHUR A. ISBELL, manager, Commercial Department, RCA Communications, appeared hale and hearty at the December meeting in New York on his return from several weeks' tour of Eastern and Gulf sections of the United States, inspecting RCA Communications centers in various cities. He was accompanied on the trip by Mrs. Isbell, who enjoyed the trip immensely. . . . W. S. Fitzpatrick, secretary of the board of editors of the *RCA Review*, sees to it that subscribers in over 70 countries receive their copies of the *RCA Review* regularly. . . . Arthur Enderlin assures us that the picture of him with George Street in a recent issue is as he used to be. He states that he has since regained much of the weight that he had lost just before the picture was taken. Good luck and good health and thanks for your cooperation in securing new members, G. Warren Clark, who started in radio in 1916, and is at present associated with the Mackay Radio Company in Honolulu, and M. D. Williams, First Class Radioman in the U. S. Navy since 1928 and at present on the U. S. S. S-29, which we believe is a submarine, in Pearl Harbor, T. H. And also 'twas good news to hear that your most recent beer party was a financial success resulting in a considerable profit. Nice idea, too, that of sending a lei on Decoration Day to the services at the Monument at Battery Park. . . . Karl Baarslag has signed a contract with Farrar and Rinehart for his next three books. Best of luck, Karl, and may you write many more equally as successful as your "S O S to the Rescue." . . . Congratulations to our life member, Charles W. Horn, on his recent elevation to the vice-presidency of the National Broadcasting Company. . . . All good wishes to Charles J. Weaver, superintendent of the RCA Communications' Central Office at Broad Street in New York City, where he has been stationed continuously since 1922, upon his retirement from active service after 33 years with the Marconi Wireless Telegraph Company, Radio Corporation of America and RCA Communications. May your years of retirement, CJW, be as joyful as your fruitful years in the radio industry. . . . Glad to see E. A. Nicholas, of the Radio Corporation of America, a life member of our Association, at the December meeting. Hope you make it to some of our future meetings, particularly the 11th of February, next, EAN.

Gilson V. Willets, Charter Member, now engaged in writing in the Pacific Coast area, writes a very interesting letter regarding VWOA activity in the region of San Francisco. We feel certain that with the whole hearted support of members like GVW and Col. Stanford the San Francisco Chapter will up and go places. We suggest you get in touch with either of them, GVW, at 1430a 26th Avenue, and Col. Stanford, at the Presidio of San Francisco (U. S. Army Signal Corps), and also with Mr. T. M. Stevens, Chairman of the San Francisco Chapter, at Radiomarine, 16 First Street, S. F.

R. H. Pheysey with his American Mrs. recently sailed on the *Manhattan* for a visit to his folks in England. He plans to visit the various people interested in VWOA activity while in London. Bon Voyage and a pleasant trip RHP.

"Steve" Kovacs informs us that he has been elected corporate president of the School of Communication Engineering which has its headquarters in Newark, N. J. Good Luck Steve.

AIRCRAFT SHOW

The "Aircraft in Industry" exhibition which opened at the Metals and Plastics Bureau, December 1, and which will close January 15, presents a most interesting picture of the materials, devices, and developments fashioned by industry for aviation.

This exhibition, sponsored by *Aero-Digest*, features safety devices, such as deicer equipment, controllable propeller, safety glass, homing devices, etc. This exhibit is on the third floor, International Building, Rockefeller Center, New York City, and is open daily from 10 a.m. to 6 p.m.

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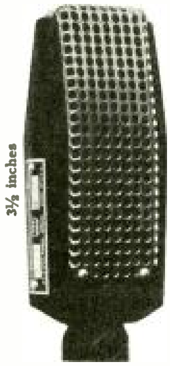

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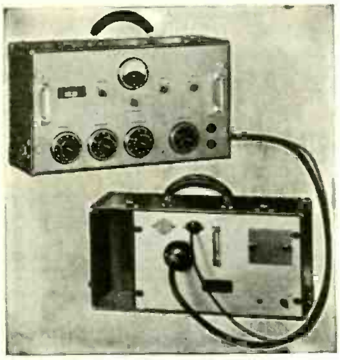

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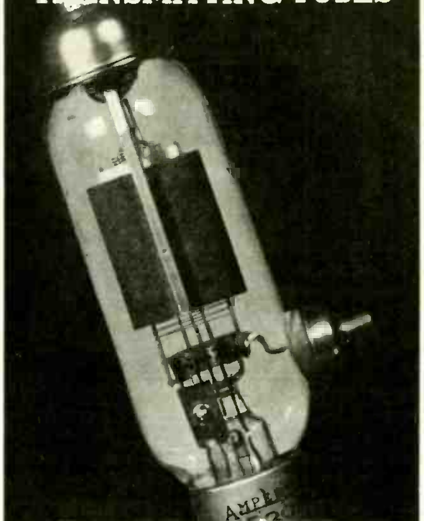

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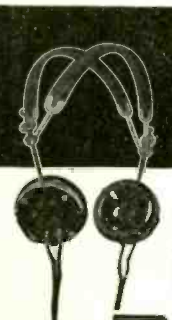

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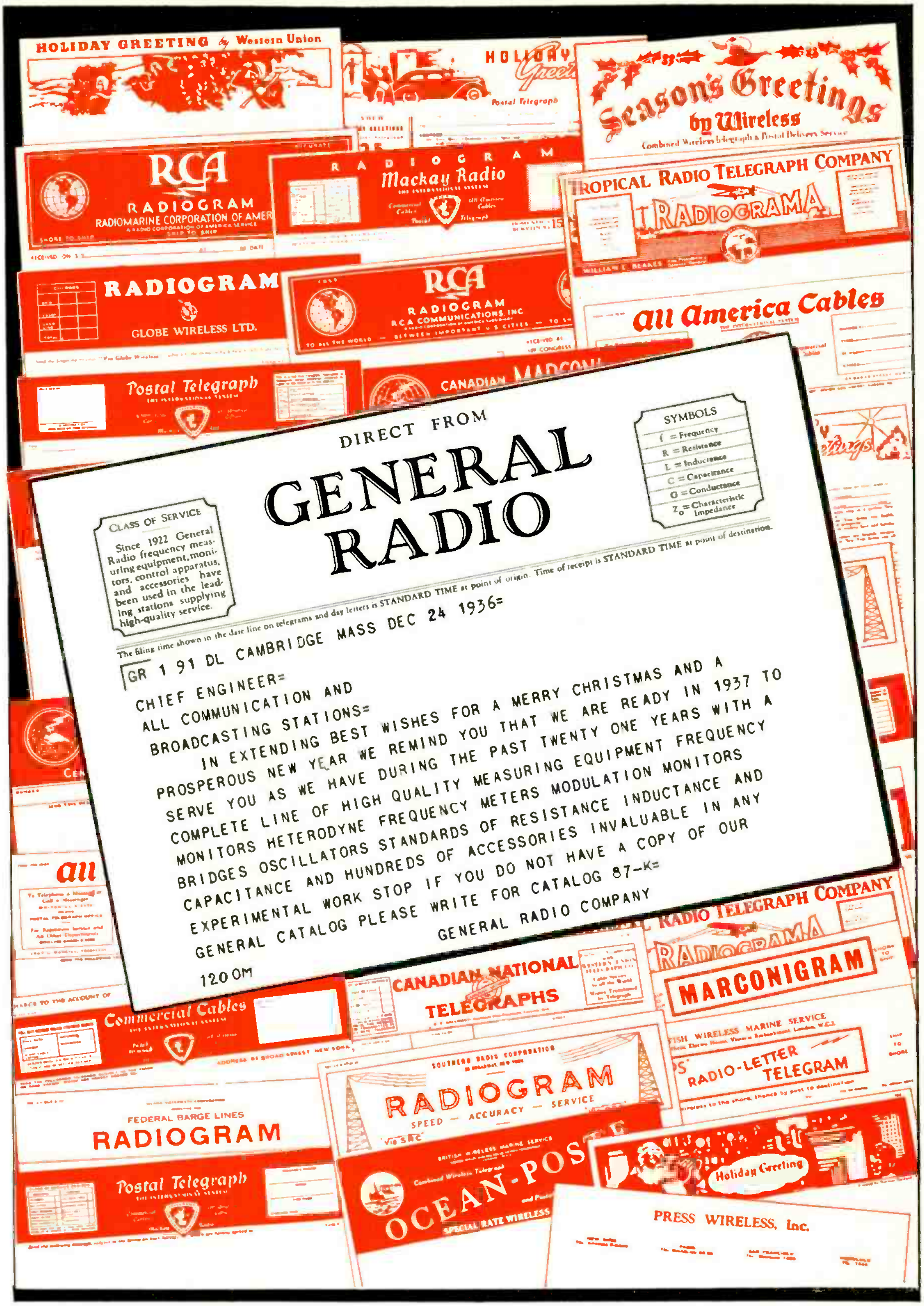

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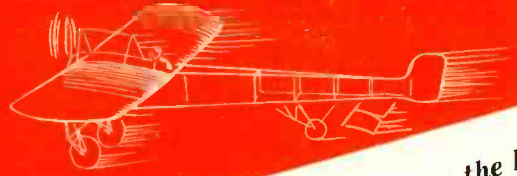

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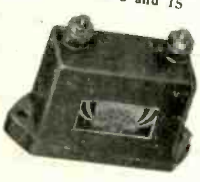

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