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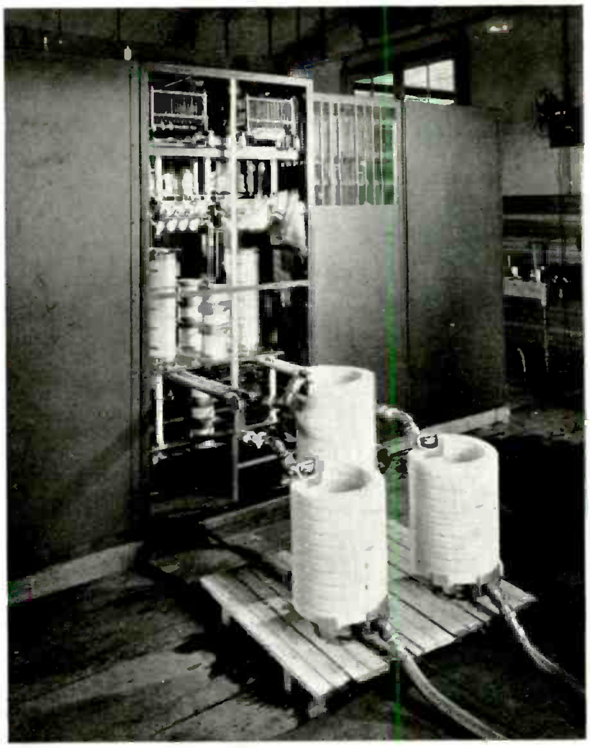

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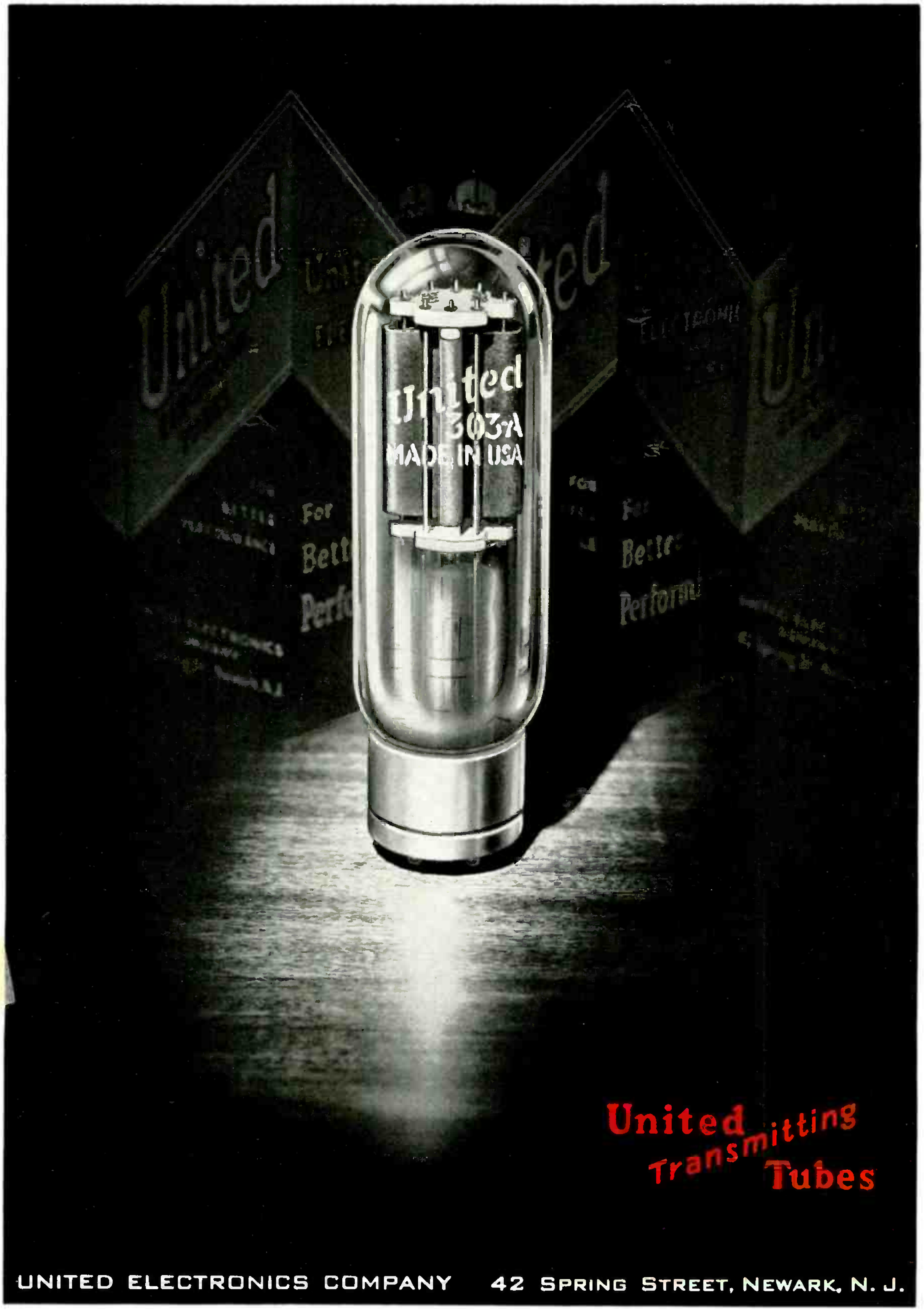
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EDITORIAL

NAB CONVENTION

THE THIRTEENTH ANNUAL Convention of the National Association of Broadcasters, held at Colorado Springs, was the largest and most productive convention in the history of the Association. Total registration far exceeded that for last year, and a lot of good business got under way.

Officers appointed for the current year are: President, Leo J. Fitzpatrick, of WJR, Detroit; First Vice-President, Charles W. Myers, of KOIN, Portland, Ore.; Second Vice-President, Edward A. Allen, of WLVA, Lynchburg, Va.; Treasurer, Isaac D. Levy, of WCAU, Philadelphia; Managing Director, James W. Baldwin, of Washington, D. C.

Directors elected for the three-year term are: Ed Craig, WSM; J. O. Maland, WHO; Ralph Brunton, KJBS; T. W. Symons, KFPY; and W. W. Gedge, WMBC.

Directors serving for the two-year term are: Alfred J. McCosker, WOR; Harry C. Butcher, WJSV; John J. Gillin, Jr., WOW; Gordon Persons, WSFA; and Gardner Cowles, Jr., of KSO-KRNT, who was named by the Board of Directors to serve until the next convention.

Directors for the one-year term are: William S. Hedges, WEAF; H. K. Carpenter, WHK; I. R. Lounsberry, WGR-WKBW; Frank M. Russell, WRC-WMAL; and Arthur B. Church, KMBC.

During the convention an extensive discussion of present copyright factors took place. A resolution was passed petitioning the Senate to enact the Duffy Copyright Bill which, if passed, will eliminate the $250 minimum damages for copyright infringements.

Resolutions were also passed favoring the issuance of radio station licenses for a term of at least three years, and the opposing of any legislation tending to restrict the freedom of speech.

Work is to be continued in connection with the institution of a bureau of cooperative nature for the broadcasting industry, which will have as its principal purpose the recognition of advertising agencies and the provision of a service to advertisers, and in conjunction with which the possible establishment of a companion cooperative bureau of listener data, coverage, etc., to be maintained by the broadcasters, advertisers, and advertising agencies alike. The institution of such a bureau would serve to consolidate the divergent efforts now carried on by various research agencies in the broadcasting and advertising fields and, through the centralization of collected data, provide information of much broader scope.

The NAB is to cooperate with the RMA in providing annual awards in broadcasting similar to the Pulitzer prizes awarded each year in the literary field. The setting up of such awards will do much to improve the cultural status of broadcasting and bring to light many unknown authors and artists having a particular flare for the technique of broadcast presentations. Undoubtedly these awards will stimulate progress in radio dramatics, music, news reporting, and so on, and likewise serve to enhance the status of broadcasting in general.

Consideration was also given to the establishment of one or more annual awards for conspicuous examples of public service rendered by American broadcast stations. Such awards, if offered, should instil into the minds of the public and the men serving the broadcasting industry, the irrefutable fact that the ideals motivating American broadcasting are no less in spirit than the ideals supporting the many other public services.

A resolution was also passed to continue cooperation with the Federal Communications Commission and educational groups to carry on a study of the possible applications of education to radio. Numerous local groups throughout the country have taken a keen interest in this subject. Cooperative efforts, and the collection of sectional opinions, would do much to improve the educational phase of broadcasting.

The newly elected President of the NAB was empowered to appoint a committee to determine the best procedure for the presentation of the United States' position and proposals at the next administrative conference to be held in Cairo, Egypt, in 1938.

The Managing Director has been authorized to continue the participation of the NAB in the Secondary Coverage Survey being carried on by broadcast stations and the Federal Communications Commission.

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EQUALIZERS

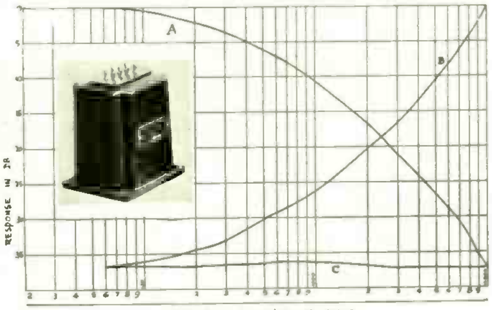

FIG. 1

The development of high fidelity receivers has necessitated high fidelity standards of broadcast transmitting.

With this objective in mind, Kenyon offers the BTEL equalizer!

"A" in Figure 1 indicates the attenuation of a ten-mile line. "B" indicates the attenuation of the equalizer, and "C" the resultant output.

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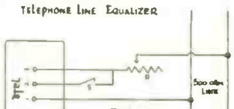

FIG. 2

Complete technical data, or information on special equalizers to meet your requirements, will be furnished on request.

Figure 2 illustrates the simplicity of hook-up and, by varying the value of resistor "R", the easy flexibility of obtaining equalization from 0 to 37 db.

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FOR AUGUST, 1935

The Chireix System of Modulation

● AUTHORITATIVE DATA ON MODULATION BY PHASE DIFFERENCE - A SYSTEM HAVING HIGH EFFICIENCY, AND PARTICULARLY SUITED TO HIGH-POWER BROADCAST STATIONS.

ONE OF THE FIRST authoritative articles on the much discussed Chireix system of modulation appears in the recently released Twenty-Fifth Anniversary Number of the house organ of the *Société Française Radio-Électrique*. In this publication, the inventor sets forth in direct understandable terms the principles of what he terms "Modulation by Phase Difference."

Probably the most noteworthy feature of the Chireix Modulation System is the high efficiency it is possible to attain in high-power radio transmitters with this arrangement. Mr. Chireix states that the 150-kw Luxembourg broadcast station, which employs his system of modulation, has a measured overall efficiency of 35%. This compares with an overall efficiency of some 30% for an equivalent Class B system modulating the power stage. Efficiency is defined as the ratio of delivered antenna power with an unmodulated carrier to the power taken from the power supply network, including all power taken by auxiliary apparatus. If the present tendency toward higher power broadcasters is continued—and at the present time all indications appear to confirm its continuance—it would appear that the Chireix system is destined to become of considerable importance.

POWER WITH ECONOMY

Both in this country and in Russia 500-kw stations have been constructed, and unless some obstacle, such as cross modulation in the transmission medium, prevents, there is reason to believe that even higher powers may soon be commonly used. While cross modulation in the ether has been observed in Europe in connection with the high power Luxembourg transmitter, so far as we are aware, this phenomenon has never been observed in this country. However, if some of the theories recently advanced to account for this type of modulation are correct, the possibilities of trouble from this source are relatively great. On the other hand, the fact that it has not been more generally observed indicates that conditions must be right before it can be observed. If this is the case, it would appear that this is a second order effect which may be of more academic than practical interest. It does not seem, therefore, that anything in the way of power limitations other than economy has yet appeared. It is a well-known fact in modern high-power installations that the cost of power supply and tube replacements represents a major portion of the total operating expenses. It then becomes imperative to design transmitters in which the power consumed by the output tubes is reduced to a minimum as compared with

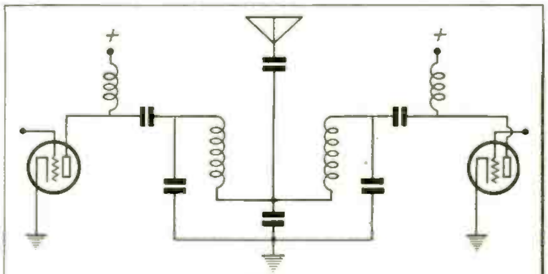


Fig. 1

ONE ARRANGEMENT OF THE POWER AMPLIFIER SYSTEM PROPOSED BY CHIREIX.

the desired radiated power, and in which the overall efficiency of the system is as great as possible.

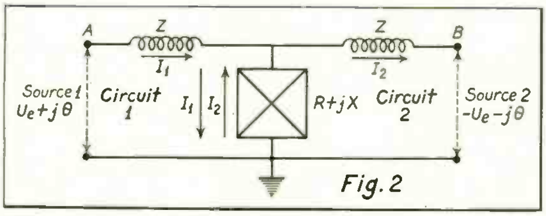
USES CLASS C AMPLIFIERS

In the Chireix system of modulation, Class C power amplifiers are employed, which are known to be highly efficient. Moreover the grid and plate voltages remain constant and the impedance of the output circuit is controlled over wide limits during each modulation cycle without any additional expenditure of energy. If the power factor of the output circuit is held close to unity while the circuit impedance is varied, a high total efficiency can be maintained in the entire system during each cycle of modulation, while the power radiated from the antenna is varied from zero to the maximum the tubes will deliver.

Fig. 1 illustrates one embodiment of the power amplifier system proposed by Chireix. It will be noticed that the power amplifier is divided into two units, each comprising one or more tubes. The output tuned circuit of each of these units is terminated by a common coupling element, which forms a part of the antenna circuit. Variation of output load with modulation is then obtained by control of the phase difference between the grid excitation applied to the input of the twin elements of the last amplifier stage.

THE PHASING

In the diagram of Fig. 2, $Ue^{j\theta}$ and $Ue^{-j\theta}$, represent the two high-frequency voltages of equal amplitude developed in the output circuit of the tubes in the final amplifier stage, but with relative phase varying with angle θ. Let Z be the reactance of each of the two equal inductances in the output circuits, the values of



CIRCUIT ILLUSTRATING MODULATION BY PHASE DIFFERENCE.

capacities of the circuits being disregarded in the present discussion. Let R + jX be the impedance of the antenna circuit. From Kirchhoff's laws we have:

$$jZI_1 + (R + jX)(I_1 - I_2) = Ue^{+j\theta} \quad (1)$$

$$-jZI_2 + (R + jX)(I_1 - I_2) = -Ue^{-j\theta}. \quad (2)$$

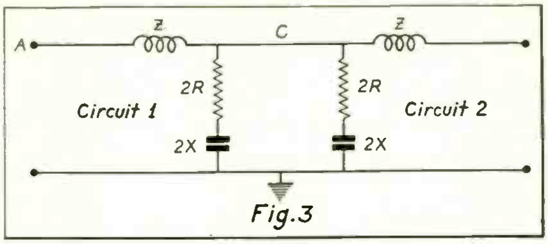
Adding and subtracting (1) and (2) yields:

$$I_1 - I_2 = 2jU \frac{\sin\theta}{2R + j(Z + 2X)} \quad (3)$$

$$I_1 + I_2 = 2U \frac{\cos\theta}{jZ}. \quad (4)$$

It is obvious from equation (3) that the current in the load circuit starts from zero at θ = 0 and increases with sin θ. As long as θ is small, the variation of current with θ is linear. For larger values of θ, the relation between load current and θ can be made linear if U is of the form $U\frac{\theta}{\sin\theta}$.

The real and reactive components of power generated



CIRCUIT ILLUSTRATING THE PHASE-ANGLE REQUIREMENTS.

in each circuit may be obtained by multiplying the values of I_1 and I_2 by their corresponding voltages. Solving separately for I_1 and I_2 yields:

$$I_1 = \frac{U}{jZ}\left[\cos\theta + j\sin\theta\frac{jZ}{2R + j(Z + 2X)}\right]$$

$$I_2 = \frac{U}{jZ}\left[\cos\theta - j\sin\theta\frac{jZ}{2R + j(Z + 2X)}\right]$$

Substituting α for $\frac{2R}{Z}$ and β for $\frac{2X}{Z}$ yields:

$$I_1 = \frac{U}{jZ}\left[\left(\cos\theta - \frac{\alpha\sin\theta}{(1+\beta)^2 + \alpha^2}\right) + j\sin\theta\frac{1+\beta}{(1+\beta)^2 + \alpha^2}\right] \quad (5)$$

$$I_2 = \frac{U}{jZ}\left[\left(\cos\theta + \frac{\alpha\sin\theta}{(1+\beta)^2 + \alpha^2}\right) - j\sin\theta\frac{1+\beta}{(1+\beta)^2 + \alpha^2}\right] \quad (6)$$

The powers in the two tank circuits are:

$$W_1 = \frac{U^2}{jZ}\cdot e^{-j\theta}\left[\left(\cos\theta - \frac{\alpha\sin\theta}{(1+\beta)^2 + \alpha^2}\right) + j\sin\theta\frac{1+\beta}{(1+\beta)^2 + \alpha^2}\right] \quad (7)$$

$$W_2 = \frac{U^2}{jZ}\cdot e^{+j\theta}\left[\left(\cos\theta + \frac{\alpha\sin\theta}{(1+\beta)^2 + \alpha^2}\right) - j\sin\theta\frac{1+\beta}{(1+\beta)^2 + \alpha^2}\right]. \quad (8)$$

The real powers are of course the real components of equations (7) and (8).

Substituting $e^{\pm j\theta} = \cos\theta \pm j\sin\theta$, we have for the real powers:

$$W_1' = \frac{U^2}{Z}\left(-\sin\theta\cos\theta + \frac{\alpha\sin^2\theta}{(1+\beta)^2 + \alpha^2} + \sin\theta\cos\theta\frac{1+\beta}{(1+\beta)^2 + \alpha^2}\right) \quad (9)$$

$$W_2' = \frac{U^2}{Z}\left(\sin\theta\cos\theta + \frac{\alpha\sin\theta}{(1+\beta)^2 + \alpha^2} - \sin\theta\cos\theta\frac{1+\beta}{(1+\beta)^2 + \alpha^2}\right) \quad (9)$$

$W_1 = W_2$ if:

$$(1+\beta)^2 + \alpha^2 = 1 + \beta$$

or:

$$\beta = -\alpha^2 \quad (10)$$

if α^4 is neglected. From equation (10) it is obvious that X is capacitative.

Referring to Fig. 3, it appears from (10) that the common branch of the load circuit must be detuned by an amount such that the current flowing through this branch leads the developed voltage by an angle α, which is the complement of the phase angle which would exist between current and voltage if the two circuits were cut at point C. It also appears that if R is small compared to Z, that the amount of detuning of the common branch approaches zero. If the common branch of the circuit is adjusted so that this condition obtains, equation (9) becomes:

$$W_1' = W_2' = \frac{U^2}{Z}\,\frac{\alpha}{1-\alpha^2}\sin^2\theta = \frac{U^2}{Z}\gamma\sin^2\theta$$

where:

$$\gamma = \frac{\alpha}{1-\alpha^2}.$$

The imaginary components of power are then:

$$W_1'' = j\frac{U^2}{Z}(1-\gamma\sin\theta\cos\theta) \qquad (11)$$

$$W_2'' = j\frac{U^2}{Z}(1+\gamma\sin\theta\cos\theta) \qquad (11)$$

If the median branch of the load circuit were short circuited, the reactive power for each circuit would be:

$$j\frac{U^2}{Z}$$

From this it may be shown that the reaction from one circuit to another may be expressed by:

$$W_1'' = -j\frac{U^2}{Z}\,\frac{\gamma}{2}\sin 2\theta \qquad (12)$$

$$W_2'' = +j\frac{U^2}{Z}\,\frac{\gamma}{2}\sin 2\theta \qquad (12)$$

That is to say, the load circuit restores capacitative energy to the mesh in which θ is positive. This occurs for angles varying from zero to $\pi/4$. Equation (12) shows that the reactive energies created by the load circuit are equal.

When the median branch of the circuit is adjusted to satisfy equation (10) I_1 and I_2 become:

$$I_1 = \frac{U}{jZ}(\cos\theta - \gamma\sin\theta + j\sin\theta) \qquad (13)$$

$$I_2 = \frac{U}{jZ}(\cos\theta + \gamma\sin\theta - j\sin\theta) \qquad (13)$$

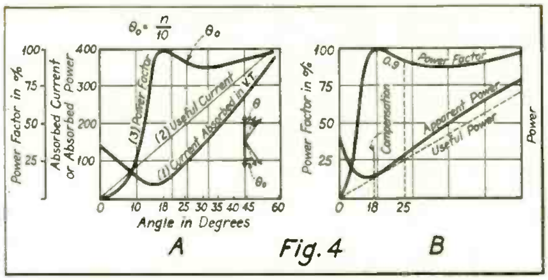
Whence:

$$\frac{I_1}{I_2} \sim= \sqrt{\frac{1-\gamma\sin 2\theta}{1+\gamma\sin 2\theta}} \qquad (14)$$

or:

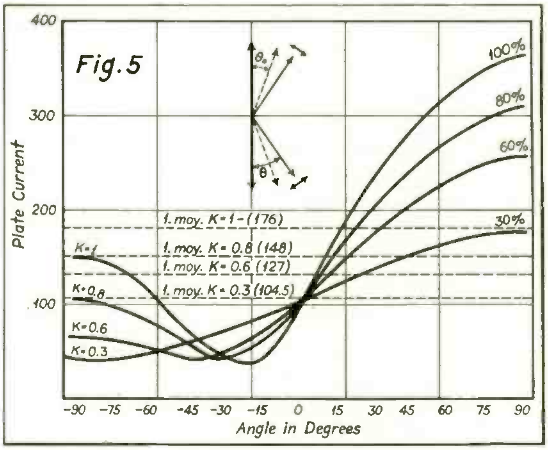
$$\frac{I_2 - I_1}{\frac{I_1+I_2}{2}} \sim= \gamma\sin 2\theta = \frac{\Delta I}{\text{average } I} \qquad (15)$$

Equations (13) to (15) indicate that when θ increases, current I_1 decreases and current I_2 increases. It is significant that while the currents are unequal the powers as expressed by equations (11) and (12) remain equal in the two circuits. When equal capacities C, chosen to resonate with inductances Z, are inserted between points A and B of Fig. 2 and ground, the reactive power will be exactly compensated and the power sources will only deliver the values of power expressed by equations (11) and (12).



POWER-FACTOR CURVES OF THE SYSTEM OF MODULATION BY PHASE DIFFERENCE.

Suppose, however, that a small capacity c be subtracted from C in circuit 1 of Fig. 3, and added to capacity C in circuit 2. The capacities of circuits 1 and 2 then become C — c and C + c, respectively. Provided c is small, the reactive energy absorbed by capacity C may be expressed as:



VECTOR DIAGRAM, INDICATING THAT THE PHASE ANGLE IS A FUNCTION OF THE MODULATION OR SIGNAL VOLTAGE.

$$-\tfrac{1}{2}\frac{U^2}{jZ}\gamma\sin 2\theta_0$$

where θ_0 is an angle defined by

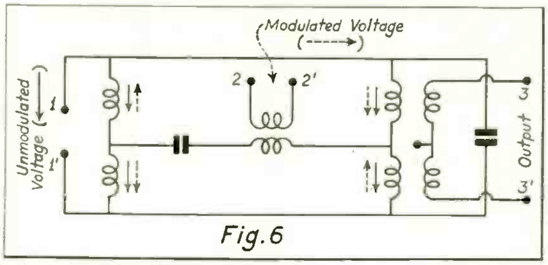
$$\frac{c}{C} = \tfrac{1}{2}\gamma\cdot\sin 2\theta_0. \qquad (16)$$

The total reactive energy to be furnished by power source 1 will be decreased by this amount and that to be delivered by power source 2 increased by the amount. Thus:

$$W_1'' = -\frac{U^2}{jZ}\gamma\sin(\theta-\theta_0)\cos(\theta+\theta_0) \qquad (17)$$

$$W_2'' = \frac{U^2}{jZ}\gamma\sin(\theta-\theta_0)\cos(\theta+\theta_0) \qquad (17)$$

In other words, for a given difference of phase corresponding to angle $\theta = \theta_0$, the reactive energy is entirely compensated and the condition for unity power factor



ILLUSTRATING ONE TYPE OF CIRCUIT WHICH MAY BE USED TO OBTAIN THE TWO INITIAL CARRIERS. DIRECTION OF MODULATED VOLTAGE IS INDICATED BY DOTTED ARROWS AND DIRECTION OF UNMODULATED VOLTAGE IS INDICATED BY SOLID ARROWS.

operation obtained. For any other angle the power factor is:

$$\eta = \frac{W'}{\sqrt{W'^2 + W''^2}}$$

From (11) and (16) this becomes:

$$\eta = \frac{\sin^2\theta}{\sqrt{(\sin^2\theta)^2 + \sin^2(\theta - \theta_0)\cos^2(\theta + \theta_0)}} \qquad (18)$$

The general trend of the family of curves which may be deduced from equation (18) is as follows: The power factor starts from zero for $\theta = 0$ and increases very rapidly toward unity, which is reached when $\theta = \theta_0$. For larger values of θ, the power factor decreases, passes through a minimum and again becomes unity at

$$\theta = \frac{\pi}{2} - \theta_0.$$

PHASE ANGLE FUNCTION OF MODULATION

From the foregoing it is evident that modulation occurs in the antenna circuit by virtue of the addition of two unmodulated, constant-amplitude carriers, the phase of each varying in opposite directions. The phase angle θ is a function of the modulation or signal voltage. This is indicated by the vector diagram of Fig. 5. The instantaneous antenna current or voltage is then the vector sum of $Ue^{-j\theta}$ and $Ue^{+j\theta}$. When the two vectors are in phase opposition the instantaneous current is zero and when they are at the other extreme of the swing, the instantaneous current is a maximum. From the curves of Fig. 4, it is evident a power factor of nearly unity obtains over nearly all of the operating range. This, coupled with the constant bias conditions of the Class C power amplifiers, makes for high efficiency.

The curve of Fig. 4 entitled "Apparent Power" may represent also, when multiplied by a proportionality factor, the power absorbed by the vacuum tube, or the plate current, since the plate voltage is maintained constant during operation. It will be noted that the plate current is not zero at the origin, which is the condition for zero output power. The amplitude of the current passes through a minimum for an angle which is slightly less than the angle normally chosen for compensation. For higher values of θ it varies in proportion to the useful load and as the square of the output current. Starting from this curve it is possible to trace the curve of variation of plate current or of the power input for one sinusoidal modulation cycle of the antenna current and for various degrees of modulation. Such a diagram is shown in Fig. 5, for various degrees of modulation. These curves represent the value of plate current during a half cycle of modulation. From these curves it is possible to calculate the average current, which is proportional to the average power absorbed from the power-supply circuit for various degrees of modulation. This power increases during modulation inasmuch as the effective power in the antenna increases as a function of the percentage modulation K in accordance with the relation $1 + \frac{K^2}{2}$. It would, of course, follow this relation exactly if the efficiency were constant over the whole modulation cycle.

CARRIER CIRCUITS

The two phase modulated waves, whose phases vary in opposite directions, are generated in the low-power amplifier st ges by comparing an unmodulated carrier with one which is completely modulated, the latter being $\frac{\pi}{2}$ radians out of phase with the former. (The vector excursion Δθ is ordinarily of the order of 50 degrees for complete modulation.) Each carrier wave is then amplified in separate amplifier stages up to the power stage. By introducing a phase-shifting device in the circuit, or by changing the tuning of the various amplifier stages, it is possible to excite the grids in the last stage of amplification with voltages differing in phase by the angle required for satisfactory unmodulated carrier operation.

Fig. 6 illustrates one type of circuit which may be used to obtain the two initial carriers. In this circuit the unmodulated carrier voltage is applied to points 1 and 1' and the modulated voltage to 2 and 2'. The bridge circuit is made up of four equal inductances and is tuned by two condensers. Full-line arrows indicate current due to the unmodulated excitation voltage applied to points 1 — 1', and the dotted arrows indicate currents due to the modulated voltage applied to points 2 — 2'. The effect of the excitation from 2 — 2' is opposite to that from 1 — 1' in output circuit 3 — 3'. Excitation voltage applied at 2 — 2' is itself the result of the action of an amplitude-modulated wave, obtained by one of the conventional methods, from which is subtracted a non-modulated wave.

ADDITIONAL ADVANTAGES

In addition to the advantage of high overall power efficiency, the inventor makes the following claims for this system of modulation.

1. Inasmuch as the power tubes work at high efficiency and at an average power practically equal to a quarter of their maximum, their power dissipation is very small. This condition is very favorable, as the formation of hot points on the anodes of the tubes is thereby avoided. The life of the tubes is thus increased and the problem of cooling simplified.

2. Inasmuch as the grid excitation is always large, negative resistance or dynatron effects are avoided. It is well known that these dynatron effects occur in transmitters utilizing the principle of amplification or modulated high frequencies at high power levels, these effects being caused by secondary grid emission.

3. It may be easily seen that the degree of modulation in the antenna is practically independent of the degree of modulation obtained in the modulator stage. For example, it is possible to obtain 100% modulation in the antenna with only 70% modulation in the modulator stage. Correct modulation characteristics can thereby be obtained.

A Broadcast Equalizer

By PAUL KENYON

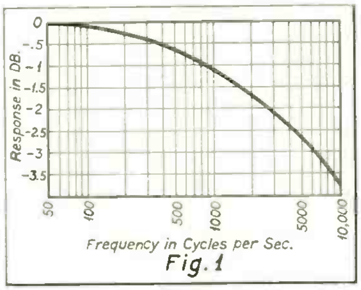
Audio Engineer

KENYON TRANSFORMER CORP.

WITH THE DEVELOPMENT of high-fidelity receivers, broadcast stations are becoming more and more interested in maintaining high standards for their programs. This article will give a description of a recently developed equalizer designed for use on any length of line up to ten miles, for the purpose of maintaining high-fidelity standards.

LINE ATTENUATION

The attenuation of a line is dependent on three factors: Distributed capacity, inductance and resistance. The capacity component is much greater than the inductance, giving the circuit a negative reactive component. Line constants are of the following approximate values: Inductance per mile, 1 mh; capacity per mile .052 mfd. Since

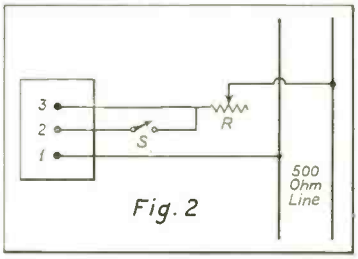


ATTENUATION OF ONE-MILE LINE.

this negative reactive component gives the circuit increased attenuation as frequency increases (Fig. 1), the duty of an equalizer is to supply a positive reactive component of exactly the same magnitude to cancel it.

INPUT LEVEL

The telephone company allow only a certain maximum input level on their lines, usually 0 level, because of cross-talk and inductive noises. Due to the unavoidable drop in level caused by equalization it is impractical in lines longer than ten miles with a single unit. The amount of amplification necessary



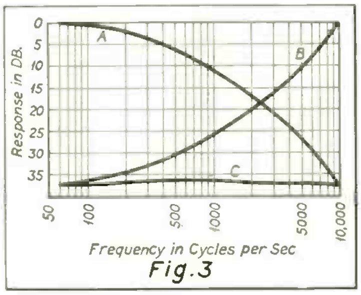
BROADCAST EQUALIZER CONNECTED TO LINE.

at the receiving end for lines longer than this would make stray line noises objectionable.

From the attenuation curve shown in Fig. 1, for one mile, the attenuation of line of any length may be obtained by multiplying the values given by the length of line for which the attenuation values are desired. As may be seen from the curve, the attenuation of a ten-mile line at 10 kc is 37 db. A high-fidelity program should be 2 db from 50 to 10,000 cycles.

EQUALIZER CIRCUIT

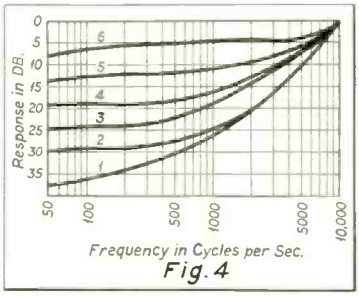
Fig. 2 shows the equalizer as it is connected to the line. Switch S is closed for values of equalization over 28 db and open for values from 0 to 28 db. Exact amounts of equalization desired



ATTENUATION OF A TEN-MILE LINE.

are controlled by a 500-ohm variable resistor; thus the frequency characteristics at incoming lines having been determined, a chart of settings for the equalizer for each line may be posted near it on the rack, making it possible to adjust for any incoming program with a minimum of trouble.

Fig. 3 shows the attenuation of a ten-mile line (Curve A), the attenuation of the equalizer (Curve B), and the output characteristic from 50 to 10,000 cycles (Curve C). The insertion loss due to this unit is less than 3 db.



FREQUENCY CURVES OF TELEPHONE-LINE EQUALIZER.

FURTHER CURVES

Further curves obtainable from this unit are shown in Fig. 4, showing that any value of equalization from 0 to 37 db may be adjusted for in a constantly variable manner:

For example, curve

No. 1 shows switch S closed. . R = 0
No. 2 shows switch S open. . . . R = 0
No. 3 shows switch S open. . . . R = 30
No. 4 shows switch S open. . . . R = 70
No. 5 shows switch S open. . . . R = 150
No. 6 shows switch S open. . . . R = 350

A unit such as this will be of great value to broadcast engineers, due to its great flexibility and its simplicity of operation and installation. It is designed for rack mounting.

IMPROVING THE

By D. E. REPLOGLE

• THE FIRST OF TWO ARTICLES ON THIS SUBJECT. THE PRESENT ARTICLE DEALS WITH THE TUBE TYPE SELECTED.

WITH ALL THE pentodes and other new tubes that are coming out on the market, one very good bet the engineer has not had thrust in front of him is the 930B tube.* The possibilities of these tubes have never been properly presented to the engineer and experimenter. They will form the basis of the Class B amplifier design to be dealt with in the forthcoming article.

A good Class B tube should have the following characteristics:

1—High amplification factor.

2—Ample filament emission.

3—Moderate plate resistance to facilitate transformer construction.

4—Good mechanical construction to withstand peak voltages.

5—Good dissipation characteristics.

TUBE CHARACTERISTICS

The high amplification factor makes necessary only a reasonable amount of driving power. The construction—bringing the plate lead out the top—will permit the use of high peak voltages such as are encountered in Class B, without the tendency of electrolysis across the bottom of the stem. Here are the characteristics of the 930B tube.

Filament....................20 watts;
2 amperes at 10 volts
Plate resistance............8,130 ohms
Mutual conductance...3,080 micromhos
Amplification factor...............25
Plate voltage........... 1,000 normal
Max. plate dissipation........60 watts
Max. plate current............150 ma
Plate material................graphite
Plate terminal................top cap
Base. ceramic.......standard four pins
Audio watts per pair... 200 watts max.

With these characteristics it seems that the 930B tubes possess to a great extent the characteristics needed for Class B operation. With its 200 watts of aud.o power per pair, it is possible to modulate a 2,000-volt Class C tube of the 204A type. Under these conditions the harmonic content will not exceed 12%, which is amply satisfactory for good speech and fair musical quality. Where high fidelity is required, these tubes are capable of delivering 150 watts of audio output with harmonic content of 5%. This would give excellent speech characteristics and good musical quality.

PLATE MATERIAL

The traditional limit of vacuum tubes has been the heating of the plate, and conservative users always loaded the tube just below the red point. With the coming of graphitized carbon plates it is no longer safe to use the plate color as a guide. As an example, a graphite plate will dissipate approximately twice as much power as a metal plate when loaded to just show a barely visible red glow on the plate. The heating of the surrounding glass, however, is greater in a graphite plate tube and consequently must allow ample paths for leakage and ample bulb area. This has been done in the 930B. This means that if a graphite plate tube is run at the same load as a metal plate which would just start to glow, the graphite plate tube will run far below the red level and consequently there will be a lower heat radiant to the bulb and lower temperatures will be maintained on the stem supporting the wires to the elements, hence less danger from electrolysis.

In the 930B tube the external plate and grid leads have been made very heavy. This is particularly desirable if used at high frequencies, as a self-excited oscillator, or as a driven amplifier.

DRIVING POWER REQUIRED

For the grid power necessary to drive a Class B stage using 930B tubes, a Class A driving stage is recommended. It had best be the push-pull type to minimize feedback, and also it happens to work out very nicely with commercial sizes of driving tubes.

Power per tube required for full output is approximately 4½ watts. The types 59 or 2A5 are good choices for the push-pull driver stage. 2A3 tubes or type 10 tubes may also be used. Types 47 and 45 are not recommended because of their lower output. It is assumed, of course, that the Class B input and output transformers are correctly designed.

*Similar in average characteristics to the 830B.

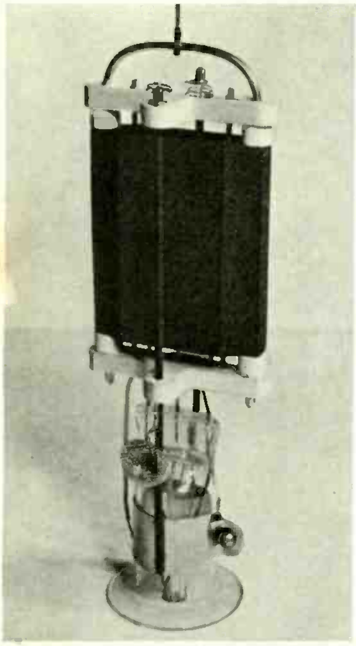


FIG. 1. SHOWING THE INTERNAL CONSTRUCTION OF THE 930B TUBE.

CLASS B AMPLIFIER

MECHANICAL FACTORS

In overall dimensions the 930B is little larger than the well known 10 type tube—fits the same socket and is not excessive in cost.

The construction of this tube is very sturdy and it will maintain its characteristics throughout its life.

It is particularly simple to fit up in a workable Class B circuit—no screen voltages to worry about with shift loads, nor suppressor voltage to adjust correctly, and the extra driving power for this tube over the requirements of a pentode of similar output is more than justified by the simplicity of the circuit and the fact that it is "sure fire" when connected up.

Incidentally, the 930B tube with the plate out the top makes an excellent r-f oscillator or driven amplifier up to 30 megacycles, and with somewhat lowered efficiency up to 60 megacycles. It will be found that in an oscillating circuit, the frequency drift will be minimized due to the graphite plate which will not change its form as metal plates do under heavy loads. This makes it particularly desirable for a modulated oscillator circuit where the load on the tube is intermittent.

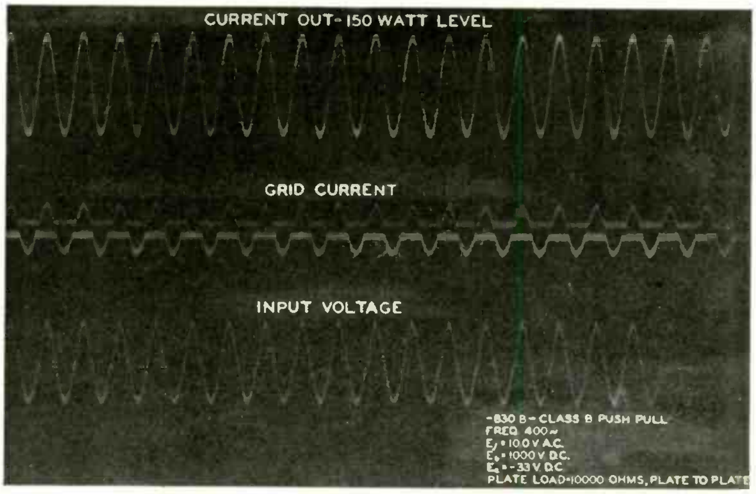


FIG. 3. OSCILLOGRAPHIC RECORD OF THE CARRIER OUTPUT AT 150-WATT LEVEL.

Fig. 1 shows the internal construction of the tube and the rigidity of the filament, grid and plate mountings will be noted. One other feature which is notable in this tube is the heavy plate and grid leads making for tube efficiency at the higher frequencies. The grid lead enters the stem through the side wall and not through the press, making leakage negligible as compared to the usual construction.

Fig. 2 shows the usual static characteristic curves.

Fig. 3 is an oscillographic record of the carrier output at a 150-watt level and also shows the simultaneous grid current in each tube and the input voltage on the grid at a frequency of 400 cycles.

Note in examining the oscillographic record that this is continuous modulation. Actually 100% frequency modulation of the carrier will work the tubes only a little more than half the extent needed for 200 watts sustained tone audio output. Recently the author had occasion to drive a 150-watt motor with 60 cycles, and a Class B stage using two of the 930B tubes was utilized very satisfactorily for driving this motor full load for a sustained period of time. This is an excellent test of the durability of these tubes in this service.

(*To be continued next issue*)

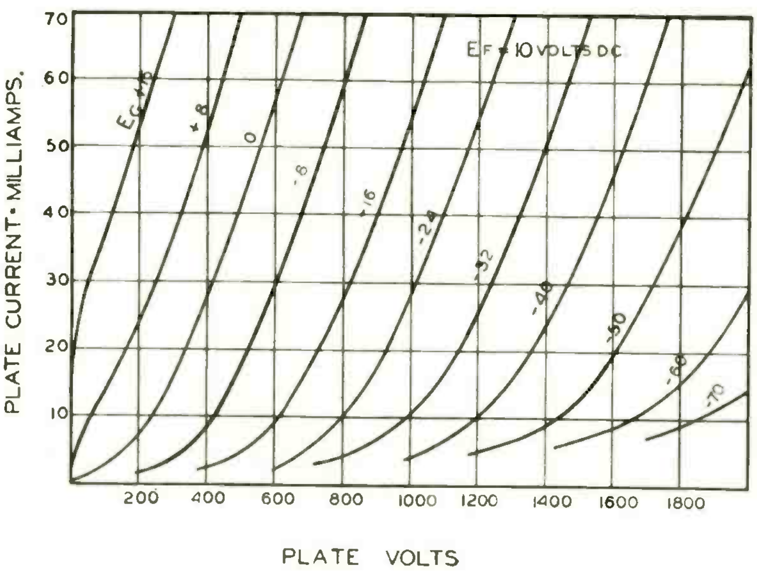


FIG. 2. STATIC CHARACTERISTIC CURVES OF THE TUBE.

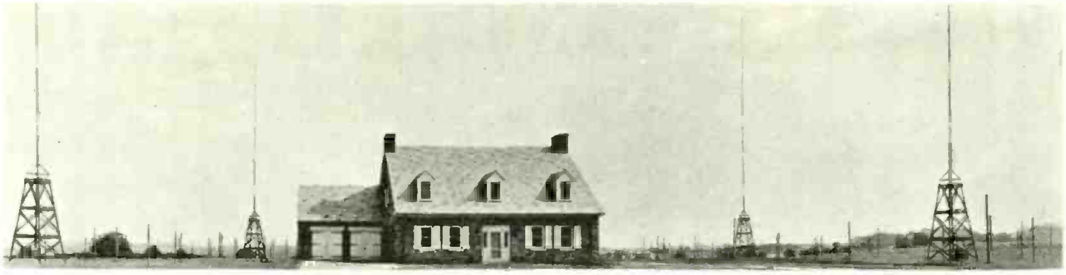


FIG. 2. WESTINGHOUSE STATION KYW, PHILADELPHIA, PA., TRANSMITTER BUILDING AND DIRECTIONAL ANTENNA SYSTEM.

Directional ANTENNA OF KYW

By R. N. HARMON
Radio Engineering Division
WESTINGHOUSE, CHICOPEE FALLS

IN A PAPER read before the I. R. E. convention at Philadelphia last June, the radiation restrictions imposed on the KYW antenna were mentioned, and it was shown that the figure-eight pattern proposed would meet the requirement. KYW's antenna has been in commercial operation since early December of last year. Accordingly it is thought that further information regarding this antenna might be of interest.

ANTENNA DETAILS

The directional antenna is composed of four quarter-wave vertical radiators spaced to form a rectangle whose sides are one-half and one-third wave length. The radiators on the two long sides are excited in phase and on the two short sides 180° out of phase.

The individual radiators are composite towers. The first forty-five feet is a four-leg, long leaf yellow pine wood tower, on top of which is mounted an insulated, free-standing steel tube, 200 feet high. This tube is 18″ in diameter at the base and tapers to 3″ at the top. The bottom of this tube is connected to a six-wire cage which runs downward through the center of the wood tower to the top of the termination house located at the base of the wood tower.

Each antenna works into a star-fish cage counterpoise whose radius is 100 feet and is approximately ten feet above ground. Counterpoise operation was favored as a means to obtain higher radiation efficiency and greater stability.

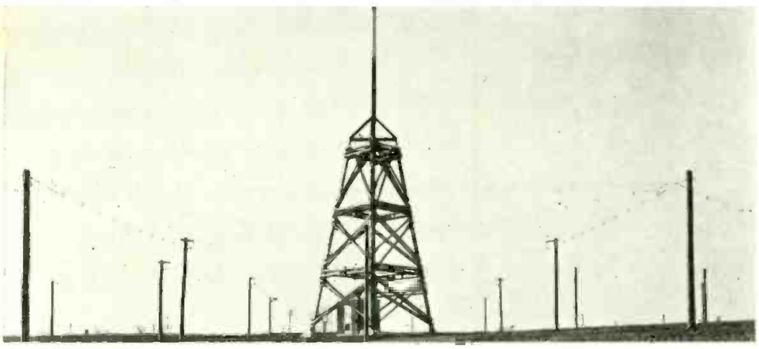


FIG. 1. WESTINGHOUSE STATION KYW—VIEW OF ONE OF THE FOUR DIRECTIONAL ANTENNA TOWERS, SHOWING THE CONSTRUCTION OF THE WOOD BASE AND THE SURROUNDING COUNTERPOISE SYSTEM.

CHARACTERISTICS

Measurements of the individual radiator characteristics show that the total resistance as measured at the base is 38 ohms accurate to ± 1 ohm, natural frequency approximately 1000 kc. Individual radiators vary about 10 kc as the earth level is somewhat irregular under two of the four units. Capacity to ground of vertical element is 995 mmfd. Counterpoise capacity to ground is 5520 mmfd.

TERMINATION HOUSE

The termination house located at the center of the base of the wood tower is made of brick and is approximately 8 feet on a side. It contains two glass windows through which the transmission line feed and the antenna and counterpoise leads are brought in. The equipment located in the termination house is made up of a fixed antenna series condenser, a motor-driven, remotely-controlled variable antenna series condenser, a two-winding radio-frequency transformer, four fixed condensers to resonate it, an antenna lead coil which at present is not in use, a thermocouple, a phase coupling unit, and an antenna drain resistor.

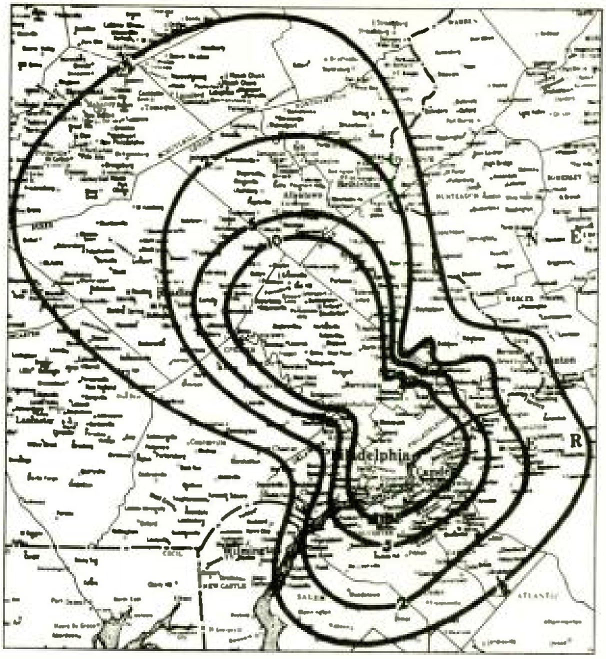


FIG. 3. CENTRAL PATTERN OF WESTINGHOUSE'S KYW, PHILADELPHIA, PA.

R-F TRANSMISSION LINES

The radio-frequency transmission lines which feed the individual radiators are four wires one-quarter wave long and have a surge impedance of 300 ohms. The two four-wire transmission lines on each short side are connected in parallel and terminate in a 150-ohm. eight-wire line which runs back to the transmitter. With such an arrangement it is possible to hold the same type of directional pattern with only two of the radiators active. It is also possible to make other directional patterns with minimum changes in transmission lines.

Multiwire lines are used as a means of reducing unwanted radiation and decreasing transmission line losses. The spacing of the individual wires in the four- and eight-wire lines has been made such that appreciable ice load or sag due to wind can be tolerated without a noticeable change in characteristic impedance.

RADIATION CONTROL

Control of the radiation properties of the antenna is obtained from the antenna control panel at the transmitter building. There are located on this panel an antenna ammeter, a motor control for the reversible, motor-driven series antenna condenser, and phase-control switch for each of the four antennas. There is also a cathode-ray. phase-angle meter to determine the phase of the individual radiator currents with respect to one another.

The phase-angle meter operates as follows: A pickup voltage in phase with the antenna current of each radiator is brought back to the antenna control panel over an underground two-wire transmission line where it is connected to the deflector plates of the cathode-ray tube. Switches are provided so that any one radiator may be compared with any other. By cross comparison the phasing of all four with respect to each other is known. Since the normal phasing for the present directional pattern is either in phase or 180° out of phase, the figure produced on the phase-angle meter will be an inclined line. If the phasing is slightly out, the line opens up to form a narrow loop. In the region of the 0°-180° position it is possible to notice a phase change of about one degree.

PHASE-ANGLE METER

In actual operation the directivity of the antenna has been reduced considerably and little actual use of the phase-angle meter is made. However, it indicates that a very accurate phasing can be held if necessary. The chief use of such a checking meter appears to be for periods when the transmission lines and antenna system are either covered with snow and sleet or during a snow or rain storm. The synchronizing effects of the transmission lines and termination equipment appear to hold the phasing of the antenna currents very close for other day-to-day operating conditions.

A multiconductor cable connects each termination house with the antenna control panel at the transmitter. This is buried under about thirty inches of earth. Each cable is exactly the same length as two of the wires in each cable are the phase-control wires for checking antenna current phase angle. Other wires which are contained in this cable are, variable condenser motor control. thermocouple output, 110 a-c for light and power, and telephone.

Airway protection is afforded by a 24-inch rotating beacon located on the top of a 50-foot tower in the center of the antenna array. This method of warning lights was chosen because the free standing tube radiators did not easily afford installation of the usual lighting system employed on towers.

DIRECTIONAL PATTERN

The directional pattern at one mile shows the directivity both as to amplitude and form, to be very close to the calculated pattern. Slight deviations, except in the null zone, are due to the irregular character of the location of the individual reading.

This pattern shows the signal on the beam to be slightly in excess of 1.000 millivolts/meter and about 14 mv/m at the null. This corresponds to a power ratio of beam signal to null signal of about 540. Since the equivalent power in the beam signal is 30,700 watts the null signal is 58 watts.

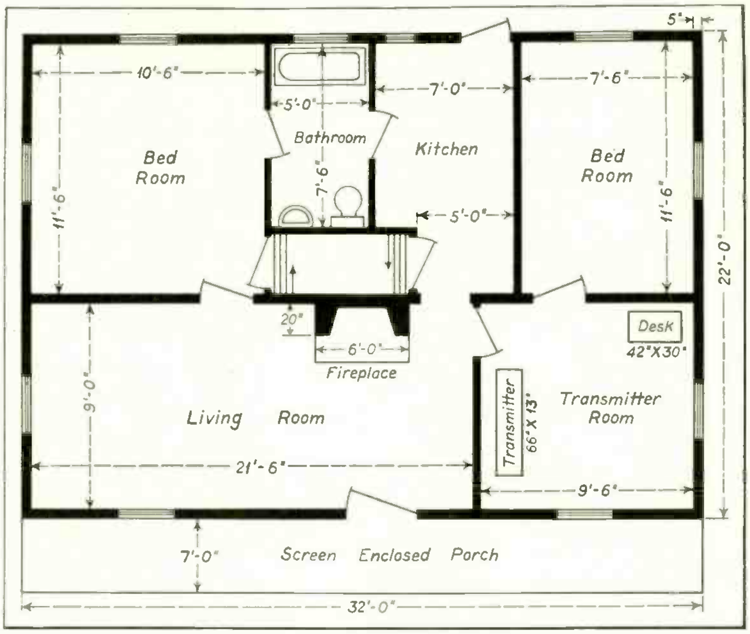
During the test periods it was found that the directivity of the antenna could be reduced considerably without causing interference with the adjacent channels. Accordingly the pattern was filled in at the null zone so that the minimum signal is now approximately 38 mv/m.

WSVA

By R. C. POWELL

PART III

THE FIRST STEP in locating a broadcast transmitter is the selection of a point from which the greatest number of listeners can be reached. When the general locality has been determined, selection of the actual site is based on technical considerations. Desirable features of a transmitter site from an engineering standpoint are: That the ground be swampy or moist at all times in the vicinity of the antenna, that there be no abrupt changes of contour near the radiator, and that telephone and power lines and a good road be near at hand. Where land is to be leased, preference should be given to pasture land in which a ground system may be buried without affecting its value for normal use.



FLOOR PLAN OF THE TRANSMITTER HOUSE.

SATISFACTORY EARTH

The location of WSVA with respect to its service area has been discussed in a previous article of this series. The site selected conforms generally with the specifications outlined above.

Through the center of the Shenandoah Valley runs the Lee Highway. All other roads branch off from this one and along the highway run the main power and telephone lines. Some point on this highway was therefore the logical location for the WSVA transmitter. The Massenutten mountain divides the Valley running north from Harrisonburg to a point opposite Strasburg. To avoid a shadow from this range lying in the eastern section of the valley a location south of Harrisonburg was desirable. This narrowed the choice down to the area along the highway between Harrisonburg and Staunton.

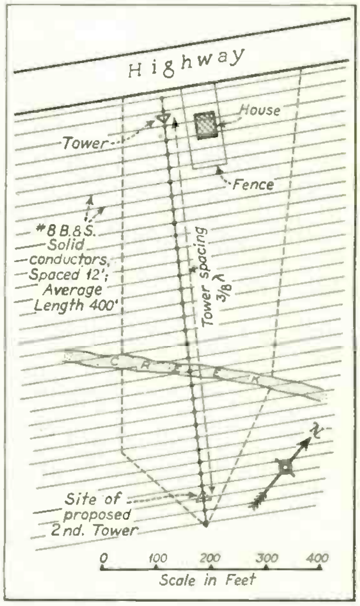
Finding a flat swampy section in the Shenandoah Valley is a difficult matter. The terrain varies from gently rolling to hilly. The soil is a clay loam thinly scattered over limestone. Such a combination does not retain moisture on the surface for more than a few hours after a rainfall. The site selected has a creek which runs throughout the year and several wet weather springs which serve to retain moisture in the ground considerably longer than the surrounding area.

THE ANTENNA SYSTEM

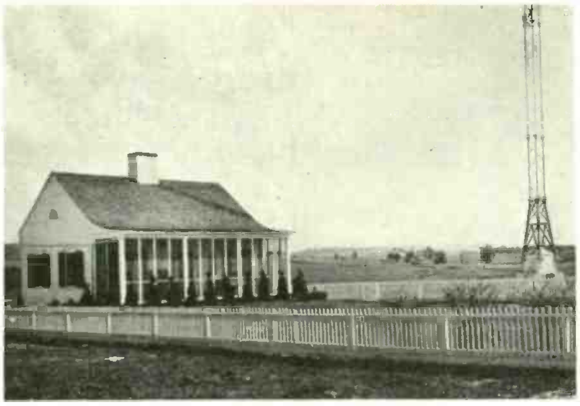
It was originally planned to erect a directional antenna, using two 150-foot radiators, which would give an hourglass field pattern and confine the signal to the valley proper. Advertising salesmen who started work concurrently with the construction of the station, however, reported that residents in the area to the west of the valley traded extensively with merchants in Harrisonburg and Staunton and that advertisers wanted coverage in this section. For this reason it was decided that operation would be started with a non-directional antenna until the more important service area of the station was definitely outlined.

Accordingly, an additional section was added to the Truscon radiator, bringing the height to 176 feet above the insulators. The Truscon tower, incidentally, is the only one which would permit a last-minute change of this kind without excessive expense. Except for the bases, the Truscon tower is formed of welded sections 22 feet in length. The addition of an extra 22-foot section reduced the wind velocity which the tower could be expected to withstand safely from 90 mph to 83 mph. Located between mountain ranges the wind velocity has never approached the lower figure in the vicinity of the antenna site.

PLAN OF ANTENNA AND GROUND SYSTEM.



● AN ACCOUNT OF THE ERECTION OF A REGIONAL BROADCAST STATION IN THE SHENANDOAH VALLEY, VA.



A VIEW OF THE TRANSMITTER HOUSE AND BASE OF TOWER.

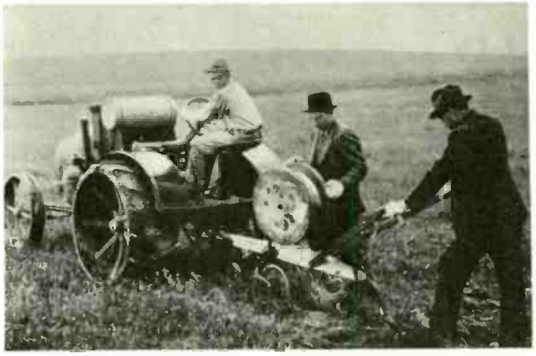
keeping horses and cows at a reasonable distance.

The tower was located close to the highway in order to obtain a 3/8 wave separation from the second tower which will be located at the eastern end of the property if a directional antenna system is installed.

Power and telephone cables were brought in underground conduits from the lines paralleling the highway. Power for the tower lights is also run underground from the control room to the tower. When completed, a concentric feeder will also be run underground to the radiator.

THE GROUND SYSTEM

Five miles of wire were buried for the ground system in the arrangement shown in the accompanying sketch. A special plow, developed by Glenn D. Gillett, made it possible to complete the ground system in two days' time. The plow, shown in an accompanying illustration, has added to it a pipe welded to the blade through which the wire feeds out behind the plow blade. A reel holder mounted on the plow beam accommodates a 50-lb reel of wire. A cutting disk slices a path through the sod which is lifted to one side by the blade and falls back into place over the wire after the plow has passed. The first rainstorm thereafter usually removes all evidence of the turf having been disturbed. The installation of the ground system without damage to the sod was particularly important in this case as the meadow is used throughout the summer for grazing. Of equal importance is the saving in time and expense in laying the ground system by this method.



THE SPECIAL PLOW USED FOR LAYING THE GROUND WIRES.

VIEW OF THE TRANSMITTER MOUNTED IN ENCLOSED-TYPE RELAY RACKS. NOTE METAL FLUES WHICH CARRY HEAT FROM THE TUBES TO THE ATTIC.

TRANSMITTER BUILDING

The building erected to house the WSVA transmitter is somewhat more elaborate than the original specifications called for. It had been contemplated that a building would be erected of sufficient size to accommodate the equipment and living quarters for the operator. The owner of the property leased for the transmitter had made plans for erecting a small residence on the site and plans were accordingly drawn for a house which would serve both for the transmitter and a dwelling.

The floor plan of the house is shown. The transmitter and power supply are mounted in frames occupying a floor space 66" x 13" in a front corner room which would be converted into a dining room if the station were moved.

The basement contains a built-in garage. The attic is lined with Insulite to form a closet and storage space. Stairs to the attic and cellar run one above the other behind the chimney.

A lot 60' x 150' surrounding the house is enclosed by a picket fence to improve the appearance of the house and also for the practical purpose of keeping horses and cows at a reasonable distance.

TELEPHONE CIRCUITS

Because telephone circuits were heavily overloaded with toll traffic, it was necessary to construct two telephone circuits, each four miles in length, from the studios to the transmitter. This involved some expense, but there was at the same time the advantage that the lines could be constructed with their use in view. The noise level on the circuits is exceptionally low and there has been no difficulty in transmitting frequencies up to 10,000 cycles although nothing above 8,000 is being transmitted at the present time.

TRANSMITTER MOUNTING

The transmitter, which will be described in detail in the next installment, is mounted in three enclosed-type relay racks. Considerable heat is generated by the 212-D tubes used in the final radio and audio stages. To carry off this heat, fans are mounted in the top of the radio and audio frames, which discharge the heat through metal flues to the attic. This heat is in turn discharged from the attic through the chimney. The air blast from the transmitter keeps the air between the roof and the attic lining in circulation and thus helps to discharge the heat from the sun through the chimney ventilator. During the winter months the air preheated by the transmitter will be circulated through unit heaters in the attic to warm the house.

(To be continued)

DIRECTIVE BEAM ARRAY ANTENNA

By SAMUEL M. WERTHEIMER

Engineer

BIRNBACH RADIO CO., INC.

• PRACTICAL DATA ON THE DESIGN, APPLICATION, CONSTRUCTION OF BEAM ANTENNAS FOR THE ULTRA-HIGH FREQUENCIES

THE GREATEST RELIABLE transmission range of ultra-high frequencies is limited by the quasi-optical nature of these short waves. They include all frequencies from about 40 mc and higher and all wavelengths of about 7½ meters or less. Due to the characteristics of these frequencies, as proven by the evidence on hand at the present time, little or no reflection takes place in the Heaviside layer. This indicates that reliable reception can be maintained only by the ground wave or when one station can be viewed from the other. However, records do show that signals have been received over several times the reliable quasi-optical range.

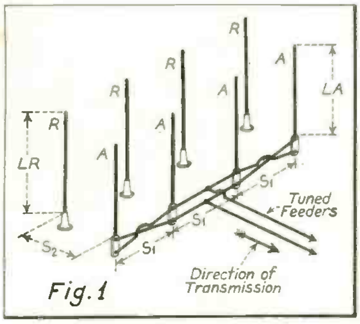
EFFECTIVE RANGE

Increased operating range is noticeable at night. The normal dependable communication range is about 10% greater than the optical range which is due to the bending of the wave around the curvature of the earth, or $1.34\sqrt{h_t + h_r}$, where h_t is the effective height of the transmitting antenna and h_r the effective height of the receiving antenna. To get the maximum range, the antenna should be placed as high as possible. This presupposes that sufficient power is used to effect communication; and with a directive beam array antenna, reliable communication is sometimes maintained for distances up to 200 miles when conditions are favorable.

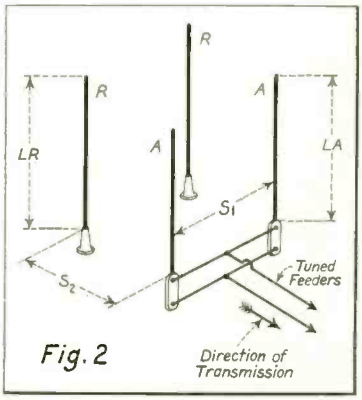
Antennas having well defined directivity have been widely used for transmission and reception since 1888. Hertz revealed their effectiveness even before that date. These principles have been used for years, as shown by the great variety of antennas in use at the present time in every field of communication. They are relatively inexpensive, and increased range and reliability are the advantages gained by transmitting with the properly constructed directive beam antenna.

DIRECTIVE BEAM ANTENNA

Two ways are open to increase the field intensity: Increased power or the use of a directive beam antenna. The latter will concentrate the radiation of the transmitter in the direction desired with a great increase in the effective power in that direction. Records show that when a non-directive, vertical antenna was used for radiation, no signals were received, but when the same power was applied to a directive beam antenna, an extremely strong signal was received, indicating increased field strength without increase in power.



A DIRECTIVE BEAM ANTENNA USING EIGHT ELEMENTS, FOUR AS AN ANTENNA AND FOUR AS REFLECTORS, OCCUPYING AN AREA OF 5 BY 24 FEET. "A" ARE THE ANTENNA RODS AND "R" THE REFLECTORS. SEE TABLE FOR DIMENSIONS.



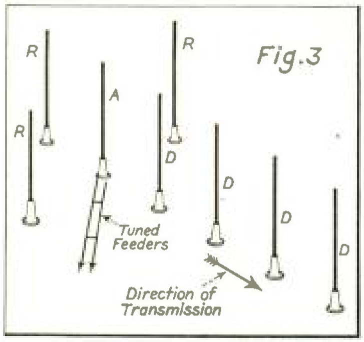
A DIRECTIVE SYSTEM FOR RESTRICTED SPACE . . . USING ONLY FOUR ELEMENTS AND OCCUPYING A SPACE APPROXIMATELY 8 BY 8 BY 4 FEET. "A" ARE THE ANTENNA RODS AND "R" THE REFLECTORS. SEE TABLE FOR DIMENSIONS.

RECEIVING ANTENNA

For reception, the vertical and horizontal angles of the antenna, and its direction, should be determined for best results. It will vary from the vertical to the horizontal and adjustments should be made accordingly. Experiments show that vertically polarized waves radiated from the antenna are received as substantially vertically polarized waves, although some change in polarity upon reception has been noted. This is evidently due to the reflection and absorption of the wave, and also indicates that the polarization of the radiated wave is continually changing as it passes through different media and encounters obstacles.

PHYSICAL DIMENSIONS

At the lower frequencies, the use of directive beam antennas, because of their size, amount of space, and expense involved, is prohibitive. With the ultra-high frequencies, the physical dimensions are more workable, permitting even very complicated directive antennas to be used for all frequencies from



THE YAGIS DIRECTIVE ANTENNA, FOR ULTRA-HIGH FREQUENCIES, OCCUPYING AN AREA OF 4 BY 8 FEET. "A" IS THE ANTENNA ROD, "R" THE REFLECTORS, AND "D" THE DIRECTORS.

40 mc and higher. The directivity of the beam array antennas will vary directly as the amount of elements used. Although no attempt has been made to describe all types of directive antennas,[1] several simple and effective directive beam antennas are herewith described, together with their physical dimensions and spacings. Approximate specifications given in the accompanying table are for the 56- to 60-mc band. However, they can be used for the 2½- and 1¼-meter bands as well, by dividing by 2 for 2½ meters and by 4 for 1¼ meters.

REFLECTORS AND DIRECTORS

These directive antennas use parasitic reflectors to cancel radiation in the back of the antenna, and in the case of the Yagis Antenna,[2] directors are used to further concentrate the direction of radiation in front of the antenna. In general, the length of the reflectors will be 103% of the length of the antenna and should be spaced 1/6-wavelength in back of the antenna and ½-wavelength from the other reflectors. The length of the directors will be 91.5% of the length of the antenna and are spaced ⅜-wavelength in front of the antenna and from each director. A practical way for closely determining the actual wavelength is to multiply by 1.56, which will give the length in feet of a ½-wave Hertz antenna. This figure has been found very reliable and will come close to the actual measured wavelength.

MEASUREMENT AND SPACING

Accuracy of measurement and spacing of the different elements of the array are very important so that the proper phase relationship and radiation pattern is had. Tuned feeders should be approximately a ½ wavelength of the operating frequency. The exact tuning of the feeders is obtained by parallel tuning across the antenna coil, or with a condenser in series with each feeder lead. The best method of tuning the feed line will usually be determined after the feed line is connected to the array.

After the antenna is erected and spaced properly, each element of the array is adjusted to the exact length, and the feed line is tuned to the desired frequency.

DETERMINING CORRECT ADJUSTMENTS

There are several ways to determine when the correct adjustments have been made. Have an assistant with a transceiver locate himself in front of the array and adjust until maximum signal strength is obtained. Then have him use this same receiver, tuned to the same frequency, directly in back of the reflectors, and have him advise you when signals are at a minimum while the reflectors are being adjusted.

ANTENNA MEASUREMENTS

Frequency Mc	*Wavelength Meters*	*Ant. Length LA*	*Ref. Length LR*	*Ant. Spacing S_1*	*Ant. to Ref. S_2*
56	5.357	8' 4"	8' 7"	8' 9"	4' 4½"
57	5.263	8' 2⅜"	8' 5½"	8' 7½"	4' 3¾"
58	5.172	8' ½"	8' 3¼"	8' 5¼"	4' 2⅞"
59	5.085	7' 10¾"	8' 2"	8' 4"	4' 2"
60	5.0	7' 9"	8' ½"	8' 2½"	4' 1¼"

[1] Ross Hull, QST, October, 1934.

[2] Yagis, Proc., I.R.E., 1928.

BOOK REVIEW

THEORY OF ALTERNATING CURRENT WAVE FORMS, by Philip Kemp, published by Instruments Publishing Co., Pittsburgh, Pa., 218 pages, cloth cover.

While this book is intended primarily for the student of power engineering, there is much of value in it for the communication engineer. The study of the properties of transients and nonsinusoidal waves generally is not new to the communication engineer, indeed a large part of communication technique is built around it. Nevertheless there is much to be gained from a fresh point of view, and from waveform analysis that can be applied directly to oscillographic patterns.

Chapters I and II are entitled, "Properties of Complex Waves" and deal with wave shapes of complex waves of few or many harmonics which are plotted with phase as a parameter. Harmonic vector diagrams are introduced and several ways in which they may be used effectively pointed out. An original graphical method of determining the root-mean-square value of a complex wave is explained and the subject of harmonic impedance treated in some detail. The apparent increase in reactance due to harmonics is given at considerable length. Circuits excited by rectangular and triangular waves are given considerable space and the resulting induced voltages derived. Wave filters of the simpler types are analyzed from a point of view that should be decidedly new to most radio engineers. Of particular interest is the author's method of plotting both sinusoidal and complex waves in polar coordinates instead of rectangular coordinates to facilitate vector analysis. A unique graphical method of arriving at the rms value of a complex wave from its polar coordinates is given. All in all, there is a great deal of interest in these two chapters for engineers dealing with oscillograms.

Chapter III deals with the effect of iron on complex waves. Saturation, apparent inductance, hysteresis, harmonic generation, iron losses, etc., are treated in some detail and in a very readable manner.

Chapter IV has to do with the effect of varying circuit conditions. One interesting point discussed in this chapter deals with the change in power factor in a purely resistive circuit brought about by a cyclically-variable resistance. The effect of pulsating inductance and capacity in complex waves is also treated in some detail.

Chapter V deals with harmonics in polyphase systems and is of somewhat less interest to the communication engineer. However, there is some nourishment even in this chapter for the engineer concerned with wired radio on power systems.

The last chapter is probably the most interesting of all. It deals entirely with harmonic analysis. It naturally starts with Fourier's Series, which is discussed at some length. Other methods of analysis, which will be new to many of the engineering fraternity who have been accustomed to the Fischer-Hinnen method, are Perry's method, Thompson-Runge method, Kemp's method, Clayton's method, Wedmore's graphical method, and Russell's method. The value, accuracy, and general prac-

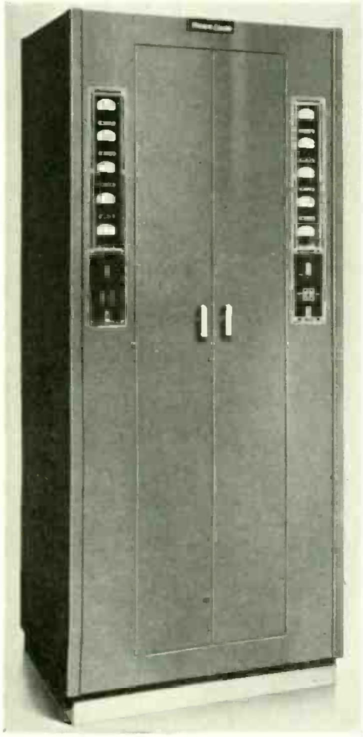
(*Continued on page 22*)

NEW BROADCAST-

A NEW 100-250 WATT, high-fidelity radio broadcast transmitter, of new design, developed by Bell Telephone Laboratories, has been announced by the Western Electric Company. This transmitter, the 20A, was shown for the first time at the National Association of Broadcasters' Convention at Colorado Springs. The transmitter embodies innovations, both electrical and mechanical, throughout its entire design and introduces three which are altogether new.

SPECIAL FEATURES

These three are the stabilized feedback principle for controlling the production of audio-frequency harmonics and noise within the transmitter, generally recognized as the outstanding problem in achieving high-fidelity transmission; an automatic delay circuit for use with mercury-vapor rectifiers; and the first application in a broadcast transmitter of the low-temperature coefficient (so-called AT cut) crystals.



FRONT VIEW, WITH DOORS CLOSED, OF THE NEW 100-250 WATT TRANSMITTER.

A fourth feature of the transmitter is its "surface cell" type of construction by means of which the elements are segregated into compartments or cells. These cells are grouped about a central axis placing all elements in a front-row position to the technician's reach.

The circuit employed in the transmitter consists briefly of two crystal-controlled oscillators, one serving as a spare; a buffer stage; a balanced modulating amplifier followed by two linear radio-frequency amplifiers; two stages of audio-frequency amplification; and grid bias and plate voltage rectifiers with their associated filter and control circuits.

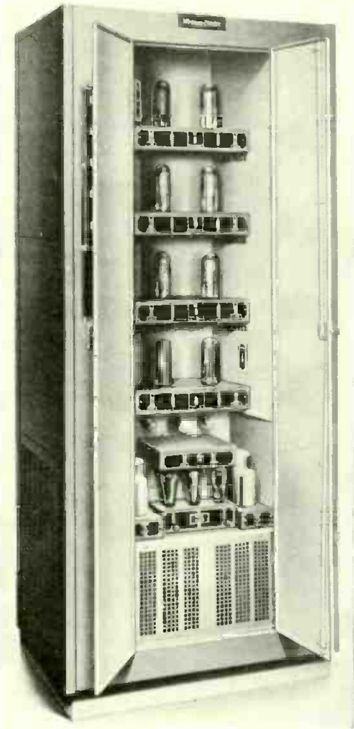
"STABILIZED FEEDBACK"

The stabilized feedback arrangement involves a linear rectifier coupled to the output circuit of the final radio frequency stage. The audio-frequency output of this rectifier is filtered and fed back into the audio input of the transmitter in such a way as to maintain the conditions required for stability. This feedback effects a proportional reduction in audio harmonics, modulation products, noise and any other unwanted components of the transmission which originate in the equipment. No critical adjustments are involved and only one setting is required for all components. This set-up is highly stable and there is no need for frequent readjustment to compensate for variation in operating conditions.

This type of circuit has found extensive use over a period of several years in the wire communication field. It is considered a noteworthy contribution to the problem of controlling non-linear distortion, which has always been a matter of great concern to radio engineers.

AUTOMATIC DELAY CIRCUIT

In the automatic delay circuit for use with mercury-vapor rectifiers, a novel arrangement has been developed which will not only delay the application of plate voltage for the proper time, but also in event of circuit interruption will automatically re-apply the power to the transmitter after a lapse of time sufficient to permit the vacuum tubes to reheat to a safe operating temperature.



FRONT VIEW, WITH DOORS OPEN, OF TRANSMITTER SHOWING THE "SURFACE CELL" TYPE OF CONSTRUCTION.

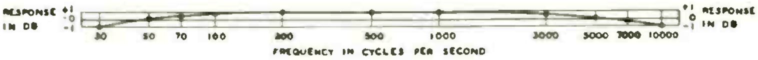
This circuit assures a minimum of service interruptions with a thorough protection of the tubes involved. As the majority of power circuits are provided with circuit breakers which reclose automatically, most interruptions are of extremely short duration. Before the introduction of the new delay circuit it has been necessary to wait ten to twenty seconds for the power to be re-applied after a power interruption of any duration. With the new system, however, power is restored immediately after momentary interruptions. If the power is off for more than a moment, it is re-applied after an appropriate interval which is automatically determined.

AT-CUT CRYSTALS

In the twin crystal control units, the temperature coefficient of the AT-cut plate is less than 2 cycles in a million per degree of centigrade as compared with 60-80 cycles for the older (Y cut) plates. The carrier frequency with these new quartz plates should be maintained well within 10 cycles under all operating conditions.

A new level in operating economy is achieved by the use of a number of small inexpensive tubes rather than a lesser number of larger, more expensive ones. The vacuum tubes are mounted on shelves. The tubes are completely accessible from the front of the cabinet at any time, even while the transmitter is in operation, inasmuch as no high voltages are exposed in the tube compartment.

• A 100-250 WATT TRANSMITTER WITH "STABILIZED FEEDBACK" FOR CONTROLLING A-F HARMONICS, NEW AUTOMATIC DELAY CIRCUIT, AND "SURFACE-CELL" CONSTRUCTION



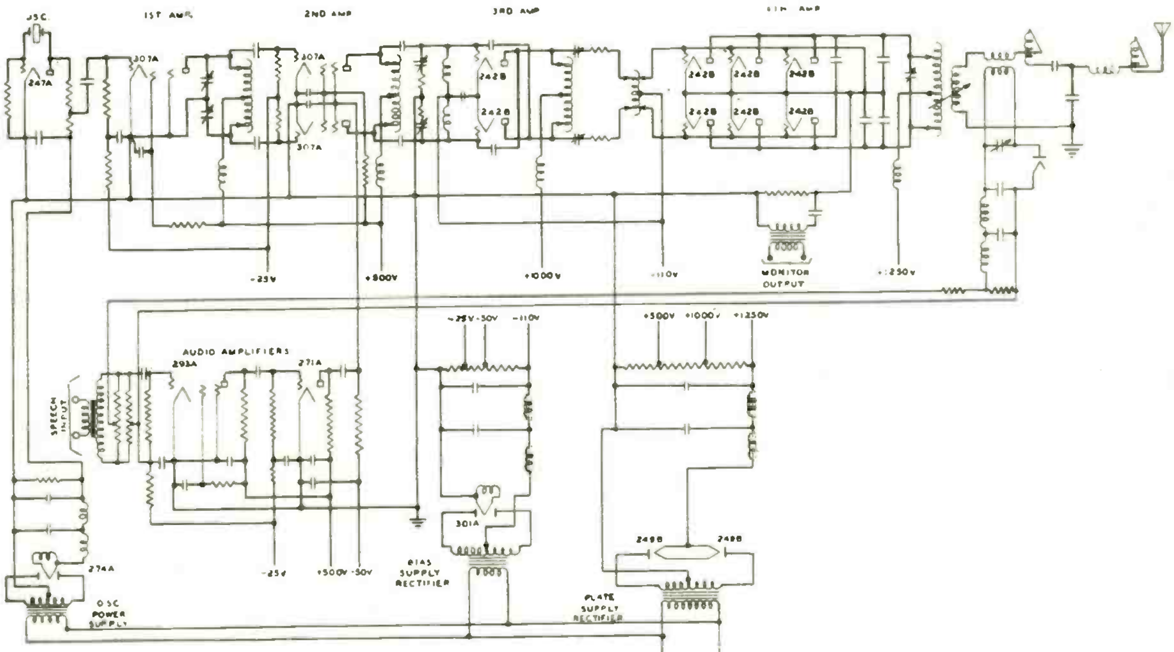
AUDIO-FREQUENCY RESPONSE OF 20A TRANSMITTER: CARRIER FREQUENCY, 600 KC; OUTPUT POWER, 250 WATTS.

LOW-HIGH POWER

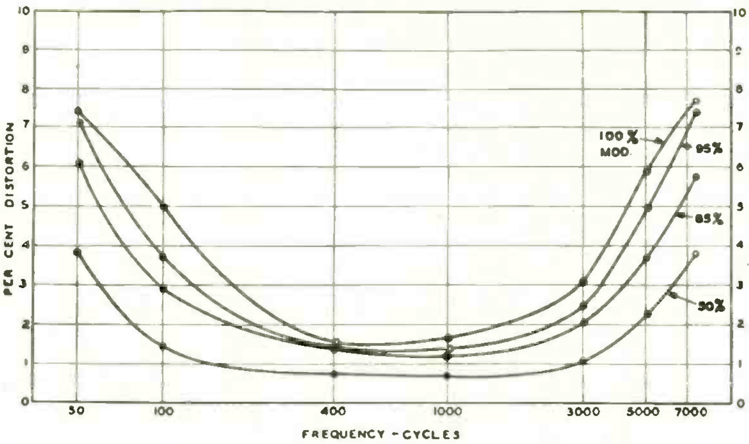
The arrangement of tubes enables the transmitter to be operated at either 100 watts or 250 watts by merely switching one pair of tubes in the final stage. With either 4 or 6 tubes the failure of a tube in the final stage does not necessarily interrupt the continuity of service, but merely reduces the power of the transmitter. The pair of tubes which includes the defective one may be quickly disconnected and replaced without taking the transmitter off the air. The entire transmitter is contained in a single cabinet.

GRID-BIAS MODULATION

The transmitter presents all the advantages of the grid bias method of modulation, plus an even greater simplification of tuning and adjusting circuits. The latter is achieved through the use of multi-electrode tubes, which makes it possible to separate the radio frequency and audio-frequency inputs to the tubes in which modulation takes place. Moreover, the amount of audio power delivered to the modulating grid circuit is less than one watt, which fa-



SIMPLIFIED SCHEMATIC OF THE WESTERN ELECTRIC 20A TRANSMITTER.



AUDIO FREQUENCY DISTORTION CHARACTERISTIC OF THE TRANSMITTER: CARRIER FREQUENCY, 600 KC: OUTPUT POWER, 250 WATTS.

cilitates the attainment of minimum distortion.

OPERATING ADJUSTMENTS

In designing the new transmitter, a serious effort has been made to simplify the adjustments required in tuning the transmitter initially to an assigned frequency and in keeping it in regular operation. The necessary controls are mounted in a novel manner where they can be accurately adjusted while observing the corresponding meters, yet, being placed behind the doors on the front of the cabinet, they are not likely to be disturbed through accident. Neutralization is employed in connection with the radio-frequency amplifier stages, but by careful circuit design, a fixed neutralizing adjustment has been evolved that requires no attention in the field.

AUDIO-FREQUENCY MONITORING

An audio-frequency monitor circuit, provided from the final stage of the transmitter, delivers a satisfactory audio level for station monitoring.

Small coupling coils, in each linear amplifier, can be used to energize a cathode-ray oscillograph or other visual monitoring device which the station may wish to use for the purpose of checking the adjustment and operation of the transmitter.

ANTENNA

The transmitter is designed to work into any antenna having more than 10 ohms resistance or into the new concentric type of transmission line.

A switch on the transmitter enables the operator to transfer the output from the artificial load to the real antenna. Where, because of the location of the transmitter, it is desirable to use a radio-frequency transmission line leading to an antenna structure at some distance from the operating room, the antenna coupling circuit elements may be removed from the transmitter and installed at the base of the antenna. This enables one to take advantage of the benefits of radio-frequency transmission lines with little additional expense.

CHARACTERISTICS OF TRANSMITTER

Among the characteristics of the transmitter are the following: Unique high fidelity; uniform flat frequency response within plus or minus 1 decibel from 30 to 10,000 cycles; less than one watt of audio power required to modulate the transmitter 100 percent; carrier noise reduced to extremely low level, better than 70 decibels (weighted) below 100 percent modulation; the total (rms) of the audio-frequency harmonics in the important middle frequency range is less than 2½ percent at 85 percent modulation, and less than 5 percent at 100 percent modulation; no radio-frequency harmonic greater than .03 percent of fundamental.

BROADCASTING OF RADIO PROGRAMS IN NETHERLAND WEST INDIES

THE CURACAOSCHE Radio Centrale, a subsidiary of the N. T. M. Radio Holland, N. V., Amsterdam, has installed a central wired-wireless station at Willemstad for reception of programs from certain countries. It is said that approximately 50,000 florins have been expended in placing wires and cables throughout Willemstad.

The Curacaosche Radio Centrale proposes to give subscribers a choice of programs from the following countries: The Netherlands, England, France, Germany, Venezuela and Colombia. Programs from the United States are not included.

The principle upon which the scheme is worked is to place in each subscriber's home an apparatus which allows the subscriber to plug into the station he prefers. This is reported to have been successful in the Netherlands.

Reports indicate that the response to the offer of the Curacaosche Radio Centrale has been extremely small. In the first place, costs are high—12.50 florins per installation, the purchase of a loudspeaker, and 5 florins per month subscription; secondly, the radio amateur does not desire selected programs; and in the third instance, elimination of the United States from the list of broadcasting countries has greatly injured demand. American programs, on the whole, are much more popular than programs from European countries.

Radio dealers expressed little fear that broadcasting by the Curacaosche Radio Centrale will affect their sales, and state that the enterprise appears to be certain of failure, or at least of heavy financial loss.

It is understood that the Netherlands firm of N. V. Phillips Gloeilampen Fabrieken, Eindhoven, Holland, controls the Curacaosche Radio Centrale. (Consul Russell M. Brooks, Curacao. *Electrical Foreign Trade Notes.*)

"THE HIGH-QUALITY PROBLEM"

IN THE ARTICLE *The High-Quality Problem*, by J. A. Hutcheson, which appeared in the July, 1935, issue of COMMUNICATION AND BROADCAST ENGINEERING, there are certain discrepancies that should be called to the attention of the reader.

On page 21, near the bottom of the second column, the formula reading

$$A = \frac{B}{f.5}$$

should read

$$A = \frac{B}{\sqrt{f}}$$

Also on the same page, the formula near the top of the third column, which reads

$$Dx \left(\frac{f_n}{f_o} \right) .5 = C$$

should read

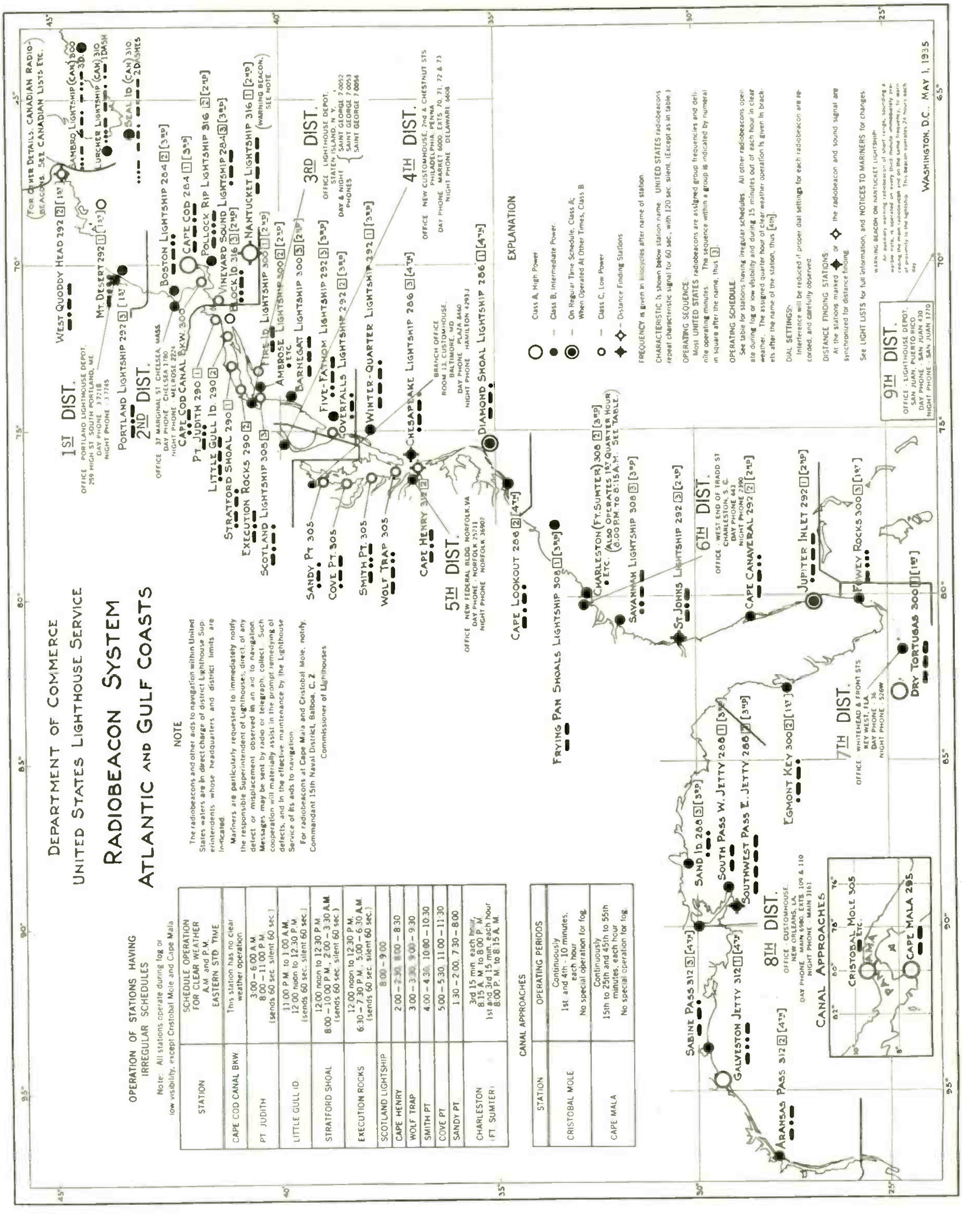
$$Dx \sqrt{\frac{f_n}{f_o}} = C$$

BOOK REVIEW

(*Continued from page* 19)

ticability of the various methods are analyzed and compared.

A very complete bibliography adds considerably to the value of this work and permits the reader to glean more detail on most of the subjects discussed. All in all, *Theory of Alternating Current Wave Forms* is to be recommended for those engineers interested in analysis of complex waves.



MAP No. 8 - - Radiobeacon System, Atlantic and Gulf Coasts

SHOWING THE RADIO BEACON STATIONS, WITH CODE SIGNALS AND OPERATING PERIODS, AS PREPARED BY THE UNITED STATES LIGHTHOUSE SERVICE, U. S. DEPARTMENT OF COMMERCE. CORRECTED TO MAY 1, 1935 (REVISION OF MAP NO. 6).

TELECOMMUNICATION

PANORAMA OF PROGRESS IN THE FIELDS OF COMMUNICATION AND BROADCASTING

SIMULTANEOUS TRANSMISSION OF BEACON SIGNALS AND VOICE

A BUREAU of Air Commerce radio station now undergoing practical service trials at Pittsburgh, Pa., represents four important advances in radio transmissions for airmen. This broadcast and radio-range beacon station:

(1) Transmits voice and directional signals simultaneously, so that there is never any interruption of the radio beacon for radio-telephone broadcasting.

(2) Transmits its directional signals so that they can be received aurally in the pilot's headphones, or in an instrument which gives visual readings with a needle.

(3) Is better for use with an airplane's radio direction finder than present standard radio-range beacons.

(4) As a result of 1 and 3 gives more efficient assistance than present standard types for an approach to an airport under conditions of poor visibility.

In a demonstration for representatives of scheduled air lines and manufacturers of radio equipment recently, the Pittsburgh station gave evidence that its new features are efficient and practicable. In flights of an hour to an hour and a half each, Bureau pilots simulated conditions under which an airman might be lost and searching for the radio-range course, or for the airport, and in each case the equi-signal zone was found promptly and followed to the landing area.

For visual interpretation the aural radio-range beacon, as usual, transmits two different code signals in different quadrants. In the airplane, one signal is received on one side of the course, the second on the other side of the course. The pilot can receive the signals as usual in his headphones, in which case he will fly in such a way as to receive both signals with equal intensity, and thus will know that he is on course.

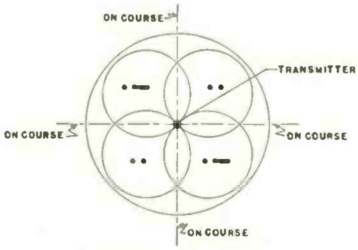
VISUAL INTERPRETATION

If the signals are to be visually interpreted, special receiving equipment in the airplane will distinguish between the two code transmissions. In response to one signal it will tend to move a needle pointer on the instrument panel to the left; in response to the other it will tend to move the pointer to the right. When the airplane is on course, and the two signals are equal in intensity, the needle will be centered.

Signals ordinarily used in radio-range beacon transmission are A (.—) and N (—.) interlocking to form a continuous monotone for on course. For visual interpretation an asymmetrical pair of code signals is required to operate the receiving apparatus. The two signals used are A (.—) and I (..). These are satisfactory for visual interpretation and understandable for the pilot, since he will know that one off-course signal will consist of a dot and a dash, unequal in duration, while the other signal will be two dots of equal duration.

Simultaneous transmission is achieved by broadcasting on two slightly separated frequencies . . . so close together that for most practical purposes they would be considered the same. Radio-range signals are put on the air from a set of four tower radiator antennas. The voice signals go on the air from a fifth tower antenna located in the center of the square formed by the radio-range antennas.

Transmissions of the radio-range signals form a pattern consisting of two intersecting figure eights. The signals are sent alternately, first A in one figure eight and then I in the other figure eight. Voice transmissions go out over the usual circular pattern as shown in the accompanying illustration. Both types of signals may be received up to 100 miles from the transmitter. The character of the signals is such that both have to be on the air for any range reception to take place.



THE DIAGRAM SHOWS PATTERNS OF RADIO-RANGE BEACON SIGNALS AND VOICE IN SIMULTANEOUS TRANSMISSION ON A SINGLE FREQUENCY. RADIO-BEACON SIGNALS ARE REPRESENTED BY THE INTERSECTING FIGURE EIGHTS, VOICE BY THE LARGE CIRCLE.

RECEIVING EQUIPMENT

In the airplane, the pilot who is equipped to take advantage of all the features offered by this radio station has one radio receiver, with extra equipment for visual interpretation, and for directing either voice output, or radio directional signals, into his headphones.

He tunes his set to 210 kc, the frequency of the Pittsburgh experimental station. Directional guidance and voice broadcasts both come into his receiver on this frequency, although, as previously mentioned, there is a margin between the two. The set directs the output representing directional guidance into the visual equipment to operate the needle pointer. The other output goes to the headphones. The latter is on the air at all times, although the pilot will be hearing voice broadcasts only when a weather broadcast is scheduled, or when special messages are being sent.

If the pilot wishes to listen to the radio-range beacon signals instead of watching the needle pointer, he simply moves a switch which directs that output into his headphones. In that event, he will have to switch back to the voice output if he wishes to listen to a weather broadcast.

The simultaneous transmissions also can be received in an ordinary receiver not equipped with the special equipment for separating voice from directional signals. In this event, they are heard together, in much the same way that the announcer at an entertainment station sometimes talks over a musical background. However, itinerant pilots could equip their sets to distinguish between the two types of signals at small cost, dispensing with the more expensive visual indicating equipment, and then could listen either to voice or directional signals at their own choice.

Depending for guidance and weather information upon a station of the type in operation experimentally at Pittsburgh, the pilot would have assurance that the radio-range beacon signals would be available at all times.

INTERRUPTION OF RADIO-RANGE BEACON

Such is not the case at present, because the radio-range signals have to be halted when a weather broadcast or emergency message goes onto the air. This may mean that the directional signals will stop at a time when a pilot is most in need of them. A Bureau radio station will keep the directional signals on the air without interruption for limited periods, when this is requested (putting scheduled broadcasts on an alternate frequency if the station is equipped to do so, or, if it is not, postponing them temporarily. This procedure has been of material assistance to pilots flying blind on many occasions, but does not provide for all emergencies, and does interfere with the broadcasting of weather information. It would be unnecessary with simultaneous transmission.

One of the features of the Pittsburgh installation, previously mentioned, is better transmission for use with an airplane's radio direction finder than present standard radio-range beacons. This advantage arises from the fact that the standard radio beacon transmits first in one figure eight and then in the other figure eight. This causes a fluctuation in the needle pointer of the radio direction finder. The pilot can use his radio direction finder to point the airplane in the direction of an ordinary radio-range beacon and fly to it, but has to make allowances for the fluttering of the needle caused by the alternate transmissions.

The Pittsburgh installation has the alternate figure eight patterns for radio-range signals, but it also has a constant circular pattern. Therefore, the radio direction-finder needle does not fluctuate. The pilot tunes to the Pittsburgh station frequency with his radio direction finder, heads his airplane in its direction, and flies to its location with a steady needle as he would do in flying to a radio marker beacon (as in the Department's instrument landing system) or to any other radio broadcasting station.

APPROACH TO AIRPORT

Outstanding in the demonstration at Pittsburgh were the approaches to the airport made with the assistance of the radio transmissions.

One of the station's four radio courses leads over the landing area. To find the airport, therefore, the pilot need only know which course he is using for his approach to Pittsburgh, follow this course until passing through the cone of silence at the transmitter and then flying to the landing area on the course which is directed there. This requires, of course, expert knowledge of radio range beacon flying and familiarity with the orientation of the particular radio-range beacon's courses, also a familiarity with obstructions to flight in the vicinity of the airport.

With a station of the Pittsburgh type, the pilot would have other assistance not now available at radio-range beacon stations. In addition to features already mentioned, this station is equipped with a high-frequency radio marker beacon which tells the pilot when he is passing through the cone of silence by flashing on a light on the instrument panel. (*Air Commerce Bulletin.*)

HAMILTON, OHIO, TO INSTALL TWO-WAY POLICE RADIO

THE FIRST TWO-WAY police radio system in the state of Ohio will be installed this summer by the city of Hamilton. The equipment, of the ultra-high-frequency type, is being supplied by the General Electric Company and will consist of transmitting and receiving apparatus for one headquarters installation and six mobile units.

The headquarters transmitter will have a maximum power of 150 watts and will be located in a new municipal building now under construction in Hamilton. For the mobile units, six new prowl cars to be purchased by the city will each be equipped with 15-watt transmitters and suitable receiving equipment. The mobile transmitters and related motor-generator power-supply units will be compactly mounted, out of the way, in the rear trunks of the automobiles, while the receivers will be located, much like conventional auto sets, under the cowls.

Although the satisfactory use of conventional medium-high frequencies for police work has been clearly demonstrated in the past few years and although there are at present nearly 200 of these systems in operation, very few cities have two-way communication, which Hamilton officials wish to employ as a more efficient means of protecting their city.

With ultra-high frequencies the bands are less crowded, there is less interference, particularly at night, and the antenna installations are more compact and less expensive. For these reasons, Hamilton's new system will operate on an ultra-high frequency corresponding to a wavelength of about eight meters.

ENGINEERING EXPERIMENT STATION BULLETIN

BULLETIN NO. 273, "Mechanical-Electrical Stress Studies of Porcelain Insulator Bodies," by Cullen W. Parmelee and John O. Kraehenbuehl, has been issued by the Engineering Experiment Station of the University of Illinois. The investigation described in this bulletin was part of a research conducted by the Experiment Station in coöperation with the Utilities Research Commission of Chicago.

The object of the investigation was to determine the relation and correlation between the electrical and the mechanical properties of porcelain insulator bodies furnished by manufacturers of high-voltage insulators, and of similar bodies produced under laboratory conditions.

Among the results of the investigation were the following:

(a) A form of sealed-in electrode was developed for the dielectric tests which compared favorably with the mercury electrode recommended by the A. S. T. M., gave consistent results, and could be prepared and assembled in large quantities.

(b) There was found to be a marked relationship between the mechanical and the electrical strengths of the bodies. The correlation between the compressive and the dielectric strength was 0.71, while that between the tensile and the dielectric strength was 0.88.

(c) A punctured porcelain body was found to retain approximately eighty-five percent of its original strength when subjected to compression loading, and approximately seventy-five percent of its original strength when subjected to tension loading.

(d) The study of the dielectric strength of the available porcelain bodies was really a study of the chance of the presence of flaws in the material. The breakdown, in the major portion of the instances, was through some defect in the material which was apparent when the body was opened at the puncture track.

In an appendix to Bulletin No. 273 is given a brief discussion of statistical methods used in analyzing and interpreting the results of such tests.

Until January 1, 1936, or until the supply available for free distribution is exhausted, copies of Bulletin No. 273 may be obtained without charge upon application to Engineering Experiment Station, Urbana, Illinois.

BROADCASTING IN INDIA

"DEVELOPMENT OF NATIONWIDE Radio Broadcasting in India," by K. Sreenivasan, Indian Institute of Science, Bangalore, is a very interesting 22-page booklet reprinted from *Electrotechnics*, No. 8, April, 1935. This booklet is a summary, with modifications, of lectures delivered at Bangalore on the 10th and 11th of January, 1934, under the Mysore University Extension Lectures Scheme. This paper discusses the radio broadcasting problem as it exists in India, and sets forth definite proposals based on past experiences of other nations and present Indian conditions.

RULE 258 RENUMBERED

ON JULY 2 Rule 258 was renumbered as 258 (a) and the following rule was approved:

"258 (b) *Airport marker-beacon transmitting equipment will not be separately licensed, but shall be described in the application for construction permit and license for the airport station with which it is associated. When such an application is approved the marker-beacon transmitting equipment will be considered as an integral part of the airport station and its authority for operation will be included in the instrument of authorization for the airport station. Airport marker beacons may be operated during periods when no interference will be caused to airport radio-telephone communication. The frequency to be used by marker beacons shall be* 1000 *cycles plus or minus the frequency assigned the airport station, and the transmitting equipment shall be installed so that the direction of radiation will be substantially vertical.*"

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ORDER NO. 16

PURSUANT TO Section 308 (b) of the Communications Act of 1934, it was ordered, on July 2, that every radio-telegraph common carrier (except those operating exclusively in Alaska) which holds a point-to-point telegraph station license in the fixed public service, or in the fixed public press service, shall file a supplementary statement with each application for renewal of license for the next license period only, showing:

(a) The name of the organization operating the other end of each circuit designated in the license sought to be renewed and (to the best of applicant's information and belief) its relation to other communications operating or holding companies in the same country and any affiliation which it may have with any communications operating or holding companies or administrations in other countries.

(b) The number of paid words of public correspondence transmitted during the month of July, 1935, to each point specifically designated in the license sought to be renewed.

(c) The name of each point of communication specifically designated in the license sought to be renewed to which no paid words of public correspondence have been transmitted during the license period, prior to the date of this order.

(d) The name of each point of communication specifically designated in the license sought to be renewed, to which paid correspondence was transmitted at some time during the license period, but to which no such paid correspondence was transmitted during the month of July, 1935.

(e) The reason for not handling paid words of public correspondence with each point that may be listed under (c) or (d) above.

(f) The reason for desiring to continue inactive points of communication in the license.

It was further ordered that the aforementioned common carriers shall at the same time file an additional statement showing the number of paid words of public radio-telegraph correspondence received by them in the United States during the month of July, 1935, from each fixed point outside the United States from which messages are received.

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COMMISSION ORDER NO. 12

THE COMMISSION, on July 3, adopted Commission Order No. 12, approving Tariff Circular No. 1, containing rules governing the construction, filing and posting of tariffs relating to interstate and foreign wire or radio communications by carriers subject to the Communications Act of 1934.

A conference between carrier representatives and representatives of State commissions and of the Commission was held at the office of the Commission in Washington, D. C., on June 6, 1935, at which conference rules previously served on State commissions and on carriers were considered. The rules adopted are to become effective September 1, 1935, a date sufficiently in advance to allow interested parties time within which to suggest amendments of the rules and to give the Commission an opportunity to revise the rules, if necessary, before they become effective.

These rules, when effective, will automatically supersede Commission Order No. 11 relating to the notice required in filing tariffs.

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ORDER NO. 17

IN A REGULAR MEETING of the Telegraph Division of the Federal Communications Commission, July 9, 1935, by virtue of the discretion granted to the Commission in Section 416 (b) of the Communications Act of 1934, it was ordered that common carriers authorized to engage in interstate or foreign communication by wire or radio in Alaska, in so far as such service is rendered in Alaskan territory or by ship stations communicating with coastal stations in Alaska be excused from answering Telegraph Division Orders numbered 2, 5, 6, 7, 9, 10, 11, 12, 13, 14, 15, 16, and the annex to Order No. 3.

It was further ordered that the carriers above mentioned be excused from answering future Telegraph Division orders unless such orders specifically call for answers from said carriers.

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PRESS WIRELESS ADDS ADDIS ABABA, ETHIOPIA

THE TELEGRAPH DIVISION on July 19 granted Press Wireless, Inc., temporary authority for a period beginning July 19, 1935, to add Addis Ababa, Ethiopia, as a point of communication.

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RESOLUTION

ON JULY 24 the Commission resolved that upon compliance with Commission Order No. 2 the Interstate Commerce Commission shall be released from further requests pursuant to Section 213(g) of the Communications Act of 1934.

The Federal Communications Commission expressed its appreciation of the courtesy and co-operation of the Interstate Commerce Commission.

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APPLICATIONS GRANTED FOR NEW STATIONS

Telegraph Division

June 18, 1935.

CITY OF SALEM, granted construction permit, portable-mobile, general experimental, municipal police, 30,100, 33,100, 37,100, 40,100 kc, 15 watts, emission A3, unlimited.

CITY OF ELMHURST, Illinois, granted construction permit, portable-mobile, general experimental, 37,100 kc, 15 watts, emission A3, unlimited.

OPERADIO MANUFACTURING CO., granted construction permits, two applications, mobile, general experimental, 30,100 kc, 10 watts, emission A3, unlimited.

WESTERN RADIO TELEGRAPH CO., granted construction permits, two applications, portable-mobile, general experimental, 31,600, 41,000 kc, 10 watts; emission A2, A3; day only.

TRANSBAY CONSTRUCTION CO., California, granted construction permit, portable-mobile, special emergency; (a) 2726 kc, emission A3; (b) 3190 kc, emission A1; 50 watts.

STATE OF MINNESOTA, Forest Service, granted construction permits, two applications, portable-mobile, general experimental, 31,600, 35,600, 38,600, 41,000 kc, 3 watts, emission A3, unlimited. Also granted three similar permits for portable equipment.

BOROUGH OF LONGPORT, granted construction permit, portable-mobile, general experimental, 30,100, 33,100, 37,100, 40,100, 86,000—400,000, 401,000 kc and above, 4.5 watts, emission A3.

E. A. DILLON, NC-425-M, granted license, aviation-aircraft, 3105 kc, 12 watts, emission A3.

AMERICAN TIN FIELDS, Inc., Tin City, Alaska, granted construction permit, fixed public point-to-point telephone, 2616 kc, 2 watts, emission A3.

June 25, 1935.

AERONAUTICAL RADIO, Inc., Monroe, Louisiana, Dallas, Texas, Atlanta, Georgia, Jackson, Mississippi, granted construction permits, four applications, aeronautical point-to-point, 2854 kc unlimited, 5707.5 kc day only, 2608 kc, 100 watts.

WBNS, Inc., Columbus, Georgia, granted construction permit, obstruction marker beacon station, 392.2 kc, 30 watts.

CARONDELET TOWNSHIP POLICE DEPT., granted construction permit, two applications, portable-mobile, municipal police in emergency service, 30,100 kc, 10 watts.

OHIO VALLEY RADIO RESEARCH LABS., Steubenville, Ohio, granted construction permit, general experimental, 1614, 2398, 3492.5, 6425, 12,862.5, 23,100 kc, 100 watts; 41,000, 86,000 kc, 50 watts.

CITY OF LONG BEACH, California, granted construction permit, portable-mobile, general experimental, municipal police station, 30,100, 33,100, 37,100, 40,100 kc, 4.5 watts.

CITY OF PETERSBURG, Virginia, granted construction permit, police, 2450 kc, 50 watts.

STATE OF WASHINGTON, Department of Fisheries, *Governor Eliza P. Ferry*, granted license, 2490 kc, 50 watts.

TRANSBAY CONSTRUCTION CO., California, granted construction permit, portable-mobile, special emergency, 2726, 3190 kc, 50 watts.

JULIUS ROSE, Schooner *Effie M. Morrisey*, granted construction permit and license for period ending October 1, 1936; 6425, 8665, 12,882.5, 17,310, 23,100, 27,100 kc, 100 watts.

July 2, 1935.

AERONAUTICAL RADIO, INC., Casper, Wyoming, Cheyenne, Wyoming, Billings, Montana, Sheridan, Wyoming, and Denver, Colorado, granted construction permits for five stations, aviation aeronautical, 3172.5, 5582.5 kc, 125 watts.

TOWN OF HULL, Massachusetts, Police Department, granted construction permit, general experimental, 40,100 kc, 10 watts.

JOHN A. ROEBLING'S SONS CO., Trenton, New Jersey, granted construction permit, portable, general experimental, 35,600 kc, 5 watts; to communicate on an experimental basis only under the exceptions of Rule 320 for the purpose of determining the usefulness of high frequencies in connection with cable spinning of the San Francisco-Golden Gate Bridge project. Also granted six similar applications.

SUN PIPE LINE CO., Philadelphia, Pennsylvania, granted construction permit, two applications, portable-mobile, geophysical, 1602, 1628, 1652, 1676, 1700 kc, 5 watts.

CITY OF CLEARWATER, Florida, Police Department, granted construction permit, emergency municipal police service, 2466 kc, 50 watts.

CITY OF ONEONTA, New York, granted construction permit, emergency municipal police service, 2414 kc, 50 watts.

July 16, 1935.

PAN AMERICAN AIRWAYS, Inc., Alameda, California, granted construction permit for portable-mobile aeronautical station in the aviation service, 1638, 2986, 5165, 8220, 12330, 16440 kc, 12 watts.

AERONAUTICAL RADIO, Inc., West Yellowstone, Montana, granted construction permit for aeronautical station, 2906, 5692.5 kc, 50 watts.

S. C. JOHNSON AND SON, Inc., NC-6V, granted aviation aircraft license to be used in an expedition of exploration in South America; also authority to communicate with amateur stations in accordance with provisions of paragraph 2 of Rule 282; frequencies: 333, 500, 3082.5, 5692.5, 8220, 5520, 6210, 11,040, 12,420 kc, 15 watts.

DELTA AIR CORPORATION, granted licenses for six aircraft stations in aviation service, 3105 kc unlimited, 2854 kc unlimited, 5707.5 kc day only, 15 watts.

CITY OF ALPENA, Michigan, granted construction permit, general experimental, authority to communicate as police station, 30,100 kc, 25 watts.

EAST PROVIDENCE POLICE DEPARTMENT, Rhode Island, granted construction permit, portable-mobile, general experimental, municipal police, 30,100, 33,-100, 37,100, 40,100 kc, 5 watts.

RCA COMMUNICATIONS, Inc., Destrehan, Louisiana, granted license to cover construction permit authorizing operation of station by remote control from Norco, Louisiana, and to use frequency 13,705 kc at Destrehan, Louisiana.

ALASKA EMPIRE GOLD MINING CO., Hawk Inlet Camp, Alaska, granted construction permit for point-to-point telegraph station in fixed private service in Alaska, portable, 1622 kc, 100 watts.

ALASKA EMPIRE GOLD MINING CO., Funter Bay Camp, Alaska, granted construction permit for point-to-point telegraph station in fixed private service in Alaska, portable 1606, 2632 kc, 100 watts.

CITY OF WILKES-BARRE, Pennsylvania, granted construction permit for police station, 2442 kc, 50 watts; also authority to operate by remote control with operator located at control point in lieu of transmitter location.

CITY OF WINTER HAVEN, Florida, granted construction permit, municipal police, 2442 kc, 50 watts.

STATE OF ILLINOIS, Department of Public Works and Buildings, Springfield, granted construction permit, police station, 1610 kc, 1 kw.

WESTCHESTER AIRPLANE SALES CO., NC-14566, granted license, itinerant aircraft station, 3105, 4967.5, 5572.5 kc, 20 watts.

TERRITORY OF ALASKA, Kasilof, granted authority to erect and operate a point-to-point telegraph and telephone station in Alaska, pending receipt and consideration of formal application, 2616 kc, 40 watts.

CITY OF GREEN BAY, Wisconsin, granted construction permit, police station, 2382 kc, 50 watts.

July 23, 1935.

BOROUGH OF BELMAR, Belmar, New Jersey, granted construction permit, general experimental, 37,100 kc, 25 watts. Same also granted for mobile equipment, .5 watt.

TERRITORY OF ALASKA, Deering, granted temporary authority to operate a small point-to-point telephone and telegraph station subject to filing and approval of formal application, 2616 kc, 40 watts.

THE TRAVELERS BROADCASTING SERVICE CORP., Avon, Connecticut, granted construction permit, special experimental service, 63,000 kc, 150 watts.

CITY OF ADA, Oklahoma, granted construction permit, police service, 2450 kc, 25 watts.

BUREAU OF CRIMINAL APPREHENSION, State of Minnesota, Redwood Falls, granted construction permit, police service, 1658 kc, 500 watts.

DR. DANA COMAN, on American owned Pacific Islands, granted construction permit (two applications), fixed private point-to-point telegraph service, for communication with the expedition vessel *Kinkajou* for communication with amateur stations and aviation stations of Pan American Airways and to communicate between islands in cases of emergency; 500, 5520, 8280, 12,420, 18,560 kc; 454, 8240, 12,360, 16,480 kc; 5165, 8220, 12,330, 16,440 kc, 10 watts.

July 30, 1935.

AERONAUTICAL RADIO, Inc., Summit, Illinois, granted construction permit, aeronautical point-to-point, to operate in aviation service, authority to operate by remote control; 2922, 2946, 2986, 4122.5, 5652.5 kc unlimited; 2748,* 4745* kc unlimited; 6590, 6600 kc day only; 400 watts (*1000 watts).

July 31, 1935.

MAX C. FLEISCHMANN, NC-14945, granted aviation aircraft station license aboard privately owned itinerant airplane, 3105, 3182.5, 5122.5, 5572.5, 5592.5, 5662.5, 4937.5, 4967.5, 5692.5, 5602.5, 2922, 4122.5 kc, 125 watts.

Broadcast Division

July 2, 1935.

THE MONOCACY BROADCASTING CO., Rockville, Maryland, granted construction permit, 1140 kc, 250 watts, daytime.

DONALD A. BURTON, Muncie, Indiana, granted construction permit, general experimental, portable-mobile, 31,100, 34,600, 37,600, 40,600 kc, 5 watts, unlimited time.

July 16, 1935.

G. L. BURNS, Brady, Texas, granted construction permit, 1500 kc, 100 watts, daytime.

ANDERSON BROADCASTING CORPORATION, Anderson, Indiana, granted construction permit, portable-mobile, 31,-100, 34,600, 37,600, 40,600 kc, 7 watts.

KANSAS STATE COLLEGE OF AGR. AND APPLIED SCIENCE, Manhattan, Kansas, granted construction permit, portable-mobile, general experimental, 31,-100, 34,600, 37,600, 40,600 kc, 4 watts.

AGRICULTURAL BROADCASTING CO., Chicago, Illinois, granted construction permit, portable-mobile, general experimental, 31,100, 34,600, 37,600, 40,600 kc, 25 watts. Same, two applications, 2 watts power.

AGRICULTURAL BROADCASTING CO., Chicago, Illinois, granted construction permit, portable, broadcast pickup, 1606, 2020, 2102, 2760 kc, 100 watts.

NATIONAL BROADCASTING CO., Inc., granted license to cover construction permit for broadcast pickup station (portable-mobile), experimental basis, 31,100, 34,600, 37,600, 40,600 kc, 25 watts, for period ending October 1, 1936.

July 23, 1935.

PUGET SOUND BROADCASTING CO., Inc., Tacoma, Washington, granted construction permit, portable-mobile, broadcast pickup, temporary service, for rebroadcasting events over station KVI; 1646, 2090, 2190, 2830 kc, 40 watts.

NATIONAL BROADCASTING CO., Inc., New York City, New York, granted construction permit, portable-mobile, general experimental, broadcast pickup on experimental basis, 31,100, 34,600, 37,600, 40,600 kc, 25 watts. Also granted license covering same for period ending October 1, 1936.

NATIONAL BROADCASTING CO., Inc., New York City, New York, granted construction permit, portable-mobile, general experimental broadcast pickup, 31,100, 34,600, 37,600, 40,600 kc, 25 watts.

CONNECTICUT STATE COLLEGE, Storrs, granted construction permit, general experimental, 86,000-400,000, 401,000 kc and above, 500 watts.

PUGET SOUND BROADCASTING CO., Tacoma, Washington, granted construction permit, portable, general experimental, broadcast pickup, experimental basis, 31,100, 34,600, 37,600, 40,600 kc, 2 watts.

July 30, 1935.

HONOLULU BROADCASTING CO., Ltd., Hilo, T.H., granted construction permit, 1420 kc, 100 watts, unlimited time.

CARTER PUBLICATIONS, Inc., Fort Worth, Texas, granted construction permit, portable-mobile, broadcast pickup station in temporary service for rebroadcasting over station WBAP; 1606, 2020, 2102, 2760 kc, 50 watts.

THE PULITZER PUBLISHER CO., St. Louis, Missouri, granted construction permit, portable-mobile, general experimental, broadcast pickup on experimental basis, 31,100, 34,600, 37,600, 40,600, 86,000-400,000 kc, 5 watts, unlimited time.

FRANK O. KNOLL AND JULIAN F. McCUTCHEN, St. Cloud, Minnesota, granted construction permit, special general experimental, 31,600, 35,600, 38,600, 41,000 kc, 100 watts, unlimited time.

RADIO SERVICE CORP. OF UTAH, Salt Lake City, Utah, granted construction permit, portable-mobile, broadcast pickup in temporary service, 1646, 2090, 2190, 2830 kc, 200 watts.

WESTINGHOUSE ELECTRIC AND MANUFACTURING CO., Chicopee Falls, Mass., granted construction permit and license, portable-mobile, general experimental broadcast pickup station on experimental basis, 31,100, 34,600, 37,600, 40,-600 kc, 150 watts.

VETERAN WIRELESS OPERATORS ASSOCIATION NEWS

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

NAVY DAYS (Continued)

C. D. GUTHRIE favors us with some further anecdotes of the pioneer days of wireless aboard ships of the U. S. Navy.

"The mercury turbine interrupter was at best a troublesome device, clogging and back-firing when the alcohol got low from evaporation; so a rather crude chopper was designed by "the staff," consisting of a hard rubber disc six inches in diameter and half an inch thick, with two slip rings on the bottom and six segments on top. It was driven by a spare motor and produced excellent results since it was possible to push forty amperes through it while the mercury turbine interrupter would invariably clog when subjected to this load. The effectiveness of the chopper arrangement was amply demonstrated when one day the *West Virginia*, equipped with a 2-kw De Forest transmitter, found it difficult to exchange traffic with the station at Guantanamo. We volunteered to relay for them; it is a continuous source of satisfaction to recall that a makeshift transmitter of our own making effectively assisted the then most powerfully equipped vessel of the Atlantic Fleet.

"Subsequently in 1906 we were provided with a 2-kw, 60-cycle motor-generator, and the chopper and interrupter were immediately discarded. Our troubles had just begun, though, for we discovered that our induction coil was wound for 65 volts and the a-c generator was wound for 125 volts. Some turret armature wire was secured and the primary of the induction coil rewound for the higher voltage.

"The only spark gap known at that time was the 'plain' or 'open' gap which, when operated, could be heard in every corner of the ship. In our efforts to improve on this device experiments were conducted using flag discs, a point and a disc and multiple gaps, but little of importance was evolved. It was found that with a water gauge, using pieces of zinc carefully spaced about an eighth of an inch apart and then sealed, worked well on low power but when medium power was used the glass cracked and then we had to revert to the old 'plain' gap. We were working on the quenched gap principle but were unaware of it.

"In our day in the Atlantic Fleet two-letter calls were the order of the day. Sometime in the summer of 1906 a second-class electrician from the U. S. S. *Wasp* (a converted yacht and carrying no radio equipment) came aboard our ship in the Norfolk Navy Yard and asked for any spare radio parts we cared to part with. Enough spare parts were secured on his round of the ships in the Yard to construct a transmitter and receiver and we later had the pleasure of hearing probably the first use of a four-letter call when this enterprising fellow in sending an OFM signed W A S P, the name of his ship, as he had not been assigned an official call.

"Probably the first 'radio chess' game was played between officers on two of the ships of the Atlantic Fleet in 1906.

"The antenna systems employed varied with each installation, some being cage types, others fans and later ones were four-wire 'Y' types, so called because they were not drawn up taut. A certain Equipment Officer built an antenna with barbed wire as he had heard that many persons believed the 'barbs' increased the effectiveness of propagation. It was later replaced by one of standard construction which apparently proved that the 'barbs' had little effect on the transmissions. The insulators used in the antenna systems were of hard rubber, 24 x 2 inches.

"The frequencies used were 425 meters for Naval Vessels, and the high-power Navy stations in the West Indies transmitted on 1,800 meters. The 425-meter wavelength, to us, was a myth as in our experiments we found a setting (wavelength unknown) that gave excellent results. At one time an Officer came aboard with a Pierce wavemeter and tuned our transmitter to the 425-meter wave. The same evening we found that results were not as satisfactory as our own setting so we immediately changed back to the more effective setting.

"The transmitters of the old Atlantic Fleet (8 battleships) were all conductively coupled and emitted at least two waves. The receivers were equally broad and not having the receiver tuned to a particular wave was no excuse for not hearing any ship that was transmitting. The later vessels to join the Fleet were equipped with inductively - coupled transmitters which proved most satisfactory. The Portsmouth, N. H., Boston, and Philadelphia Navy Yards were equipped with this type equipment, manufactured by the John Stone Company, of Boston."

More from CD later. Many thanks, "Jerry," and we hope your contributions will prompt others familiar with the early days of wireless, both in the Navy and commercially, to set the facts on paper and forward them to the Association for inclusion on this page.

PERSONALS

We haven't heard from Alonzo Carroll, formerly with the U. S. Coast Guard up Massachusetts way. Let's hear from you soon, AC. . . . What has happened to John W. Stannage, radio operator with Wing Commander Kingsford-Smith back in 1930? . . . Is Dick Cuthbert still sailing the seven seas aboard a palatial yacht? . . . Fred McDermott with the A. T. & T. Co. in New York, continues to reside in Jersey. What has Jersey that is so interesting, FMC? Wager it's good locality for "ham" transmitting. . . . O. A. Wyckoff, who radio operated in the Navy back in 1906 to 1910, is in the real estate business in Bellmore, L. I. . . . Ben Beckerman continues cruising the Atlantic coast on the Old Dominion Line. . . . Benjamin Wolf continues in charge of the Monitoring station at Grand Island, Nebraska. . . . R. H. Frey, Bull Line Radio Supervisor, was preparing for a week-end in the country when last seen by the Sec'y at the office of A. F. Wallis, Mackay Marine Superintendent.

FALL ACTIVITY

Meetings of the association will be resumed within the next month or so. Notices will be mailed stating the time and place, and it is hoped that the first meeting of the fall season will be a banner one. Plans will be made for future activities for the fall and winter seasons.

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WTMJ ENGINEERS PLAY "RING AROUND ROSY" IN GOLF BROADCAST

BY DINT OF MUCH ingenuity and the use of three short-wave transmitters, Station WTMJ at Milwaukee, Wisconsin, was able to broadcast for the fourth consecutive year the play-by-play description of the finals in the Wisconsin State Amateur Golf Tournament. It was the toughest assignment which WTMJ engineers have ever faced in picking up this annual event.

The tournament was played at the Pine Hills Country Club, 60 miles from Milwaukee and three and one-half miles west of the city of Sheboygan, Wisconsin. The course is in the shape of two long, narrow fingers, extending north and south about 1,500 yards from the clubhouse. The terrain is very rough and hilly, and gullies running through both sections of the course make it difficult to travel conveniently from hole to hole by car. The one telephone line between the clubhouse and the city of Sheboygan was not available for broadcast purposes, and it was not practicable to install special circuits over the three and one-half miles for this one-time event. Furthermore, after all plans had been made and all difficulties seemingly solved, intermittent rain during the day of the broadcast further complicated the pick-up problem.

Transmission between the clubhouse and the WTMJ control board in Milwaukee was effected by a combination of short-wave broadcasting and leased telephone lines. A semi-portable transmitter, using the call letters WJER, was set up on the porch of the clubhouse. This transmitter operated on 7½ watts power, on a frequency of 2,102 kilocycles. A short-wave receiver was set up in the ball park in the city of Sheboygan, where short lines from the Sheboygan central office had been terminated. The ball park site had been chosen as the one most free from local interference and the signal from the short-wave transmitter on the clubhouse porch was picked up by a directional antenna.

Transmission between the various points on the golf course and the clubhouse was effected by portable-mobile short-wave transmitter W9XAJ, broadcasting with a power of 5 watts on a frequency of 40.6 megacycles. This transmitter was installed in a small coupe. Billy Sixty, Golf Editor of *The Milwaukee Journal*, who handled the play-by-play description of the match, used a crystal microphone and amplifier, mounted on a breastplate. For the most part, he broadcast while riding in the car which was driven from hole to hole as the play progressed. The microphone, however, was equipped with a 50-foot extension cord so that he was able to leave

(*Continued on page 29*)

OVER THE TAPE . . .

NEWS OF THE RADIO, TELEGRAPH AND TELEPHONE INDUSTRIES

HART FORMS ENGINEERING CONCERN

George B. Hart, formerly a member of the technical staff of WLW-WSAI-W8XAL, now heads the newly-formed company, "George B. Hart and Associates," Recording and Sound Engineers, Suite 324, 622-626 Broadway, Cincinnati, Ohio.

The offices, workshop and laboratory are located at the above address. In addition, this company maintains a studio in the Hotel Sinton, under the supervision of Madame Alys Michot, as well as a thoroughly-equipped workshop and air-recording studio at Hyde Park.

George B. Hart and Associates operate an air-checking service for broadcast stations and commercial sponsors, making electrical transcriptions of any programs desired. A special all-wave receiver has been designed, using nine tuned stages, in order to give the best possible service. A number of foreign short-wave stations are already clients.

PANNILL ELECTED PRESIDENT OF RMCA

At the regular meeting of the Board of Directors of the Radiomarine Corporation of America on August 7, 1935, Mr. Charles J. Pannill was elected President of that corporation.

Mr. Pannill joined the company in 1928, and is the holder of American Radio Operators License number one, the first operator's license issued by the American Government.

ANTENNA BULLETIN

The Birnbach Radio Corporation of 145 Hudson Street, New York, N. Y., have recently released an interesting bulletin covering ultra-high-frequency antennas and allied equipment. Copies may be obtained by writing to the above organization.

W. E. TRANSMITTER PAMPHLET

A pamphlet entitled "400 Watt Radio Transmitting Equipment," issued by the Western Electric Company, describes a high-frequency transmitter for aviation ground stations and ship-to-shore service. The equipment transmits over any one of ten pre-selected frequencies in the range of 2 to 18.1 megacycles, the shift being made automatically and quickly by the single twirl of a dial.

FORREST NOW IN U. S. A.

Charles E. Forrest, Managing Director, International Radio Co., Ltd., 254 Castlereagh Street. Sydney. N.S.W., is making his yearly visit to the United States. Mr. Forrest. who has been paying this country a yearly visit since 1927, will be in the United States through September, returning to Australia via the Pacific Coast.

The International Radio Company, Ltd., has been in the radio business since 1920, and has branches in Queensland. Australia: Adelaide. South Australia; Melbourne, Victoria, and Auckland, New Zealand. This organization acts as exclusive factory representatives and distributors for the whole of Australia and New Zealand for such firms as the National Union Radio Corp., Sprague Specialties Co., Ohio Carbon Co., Jensen Radio Manufacturing Co., Sparks-Withington Co., Lenz Electric Manufacturing Co., Diamond Braiding Mills, Amperite Corp., Shure Brothers Co., Goat Radio Tube Parts, Inc., and American Phenolic Corp.

If there are any American manufacturers who have any associated radio or refrigerator lines and who are not represented in Australia, they can contact Mr. Forrest by addressing the International Forwarding Co., 431 South Dearborn Street, Chicago.

UTC MOVES PLANT AND OFFICES

United Transformer Corporation announces the removal of its offices and plant to a new location at 72 Spring Street, New York City. The new plant represents a consolidation of the three floors formerly occupied at 264 Canal Street into one large plant having more than twice the previous area and production facilities.

The additional manufacturing facilities have been necessitated by the great demand for the company's diversified lines of audio transformers, power transformers, filters, etc., it is stated. The scope of operations of the new plant includes audio transformers up to 50,000 watts and power transformers up to 100 kva, 100,000 volts.

The new plant will enable UTC to render broader, more cooperative service to its manufacturing and distributing outlets.

EASTERN MIKE-STAND CATALOGUE

The Eastern Mike-Stand Company (formerly the Eastern Coil Co.) of 56 Christopher Ave., Brooklyn, N. Y., have issued their new 1935-1936 catalogue, copies of which may be had on request from public-address and allied companies.

The new catalogue lists three methods of microphone stand adjustment: namely, thumb-screw, chuck, and air cushion. Descriptions are provided for numerous types of microphone stands and microphone mountings.

OTTO K. OLESEN IMPROVES STUDIOS

The Otto K. Olesen sound studios. Hollywood. under the direction of C. C. McDonald, have started to refinish equipment. The quarters have been largely occupied the past year by KNX but. with the removal of the station to new quarters, additional space has been made available to the sound work.

Twenty-four individual offices, formerly used as dressing rooms by stars when Paramount Studios occupied the building, will be used for a miniature "radio city" with rentals to equipment firms, producers, writers and other connected with the industry.

The new set-up will include three sound studios, a special auditorium for "in the flesh" productions, and a 25-foot cathedral ceiling studio for oversize productions.

The studios have been completely equipped with crystal microphones of directional type with high-fidelity equipment.

New developments in the Olesen studios include the "Congo Bartlett" unit which will produce 154 fifteen-minute transcriptions called the "Voice of Africa," and the developing of a 30-pound portable recording machine for use by M-G-M and British Gaumont in tropical lands. They will be used to record native sounds and will later be dubbed on film.

WTMJ ENGINEERS HANDLE GOLF TOURNAMENT

(Continued from page 28)

the car and walk to the greens whenever this was desirable. A vertical antenna, 6½ feet high, ran up from the rear bumper of the coupe. This antenna was of the telescope type, which made it possible to tune it to maximum efficiency. A coupe was chosen for the broadcast car as the turtle back of the body made it possible for the antenna to be more in the free than with other body styles.

A receiving point was established 100 yards south of the clubhouse on a high knoll, in order to get the best signal from the car transmitter and to get away from electrical interference generated in the clubhouse. A straight, vertical antenna was used and the equipment was housed under a tent, with provision for a standby announcer who could broadcast from the clubhouse location whenever this was desirable.

Communications between the tent at the clubhouse and the car on the course for control purposes were effected by short-wave transmitter W9XAI, located 150 feet from the tent, on a 15-foot pole. The car carried a high-frequency receiving set for picking up the signal from this control transmitter. The car was also equipped with a regular automobile receiving set which was used for checking the broadcast as it came over WTMJ on the regular frequency of 620 kilocycles.

Although it was not used on the day of the match, WTMJ engineers had a special pack transmitter ready as standby equipment, to be used in the event that Billy Sixty could not get near enough to the scene of play in the car. This transmitter broadcasts with a power of one watt on 86 megacycles and weighs 14 pounds. If it had been used its signal would have been picked up by the car, relayed to the clubhouse by short wave, relayed from there to the Sheboygan ball park again by short wave and then to Milwaukee by telephone line. Even though this first step in the series of relays was eliminated, the broadcast as it actually went on the air is unique from an engineering standpoint, as it is probably the first time that two short-wave transmitters and one regular transmitter have been used to pick up and broadcast a sports event. Considering the many possibilities for a poor pick-up due to the roundabout course which had to be taken, the quality of the broadcast was pronounced excellent, with very little distortion of any kind.

THE MARKET PLACE

NEW PRODUCTS FOR THE COMMUNICATION AND BROADCAST FIELDS

NEW W. E. MIDGET RADIO TRANSMITTER

An unusually compact radio transmitter, intended primarily for the small privately-owned airplane and suitable also for harbor craft, has been designed by Bell Telephone Laboratories for the Western Electric Company. Complete with shock-proof mounting, it weighs about 11 pounds and is only 8½ by 9½ by 6½ inches in size.

The transmitter operates over the frequency range between 2 and 7 megacycles and offers three types of transmission—voice, tone telegraphy with complete modulation and an output of 5 watts, and continuous-wave telegraphy with an output of 15 watts. Filament power is obtained from a 12-volt battery, high voltage for the tube plates being supplied by a 550-volt dynamotor operated from the same battery.

Any two frequencies within the band may be obtained by merely inserting the proper crystal and adjusting the single tuning control. A twin crystal unit is available for use with the transmitter which enables the pilot to transmit on either 3105 or 3120 kilocycles. No tuning adjustment is necessary in making this shift because of the small difference in frequency.

The pilot can thus request weather data or other information which may not be included in the regular weather broadcasts, but may be specially vital to him. He can communicate with airports to obtain landing information which is particularly important to those using radio for traffic control.

Only two vacuum tubes are employed in the transmitter. Both are of the same type, a recently developed power pentode tube (Western Electric No. 307A). The first tube acts as the crystal controlled oscillator. The second acts as either an amplifier, a modulating amplifier or a modulating amplifier and voice frequency oscillator, depending on the type of transmission being employed.

Used in conjunction with the new two-band, 11-pound double-duty receiver, this transmitter equips the small plane for two-way communication with apparatus of the same standard as that used on the nation's major airlines. The weight of the complete transmitter and receiver installed, with dynamotor power supply, is about 46 pounds.

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PROCTOR PIEZO REPRODUCER

The Proctor Piezo Reproducer has been designed for use in broadcasting stations, sound studios, theatres and other places where a high degree of fidelity and consistent performance must be maintained.

This unit employs a piezo-electric crystal as the reproducing element. This crystal element is coupled to a light stylus chuck. Due to the flexibility of the crystal and the small mass of the stylus chuck little mechanical damping is required. The frequency range is thereby materially increased, especially at the high end, and results in a reproducer having uniform response over practically the whole audio range and one so free-damped that it will handle maximum amplitudes at the lowest frequencies with as little as one and one-half ounces of weight on the stylus, it is stated.

The entire unit, including the tone arm, is built of cast aluminum, machined and finished in instrument black and chromium. By the use of double self-aligning ground cone ball-bearings, which take both the radial and thrust strain, freedom of movement of the pickup arm is obtained in both vertical and horizontal directions. The pickup arm is equipped with an adjustable counterweight and calibrated scale indicating in ounces the exact needle pressure on the record.

For further information write to the B. A. Proctor Company, Inc., 17 West 60th Street, New York, N. Y., for Bulletin 1.

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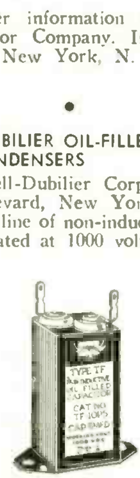
CORNELL-DUBILIER OIL-FILLED MIDGET CONDENSERS

The Cornell-Dubilier Corporation, 4375 Bronx Boulevard, New York, has introduced a new line of non-inductive, oil-filled condensers rated at 1000 volts d-c. These



condensers are but 2 inches high and 1 inch square, are hermetically sealed and may be obtained in capacity values of 0.05 mfd, 0.1 mfd, 0.25 mfd and 0.5 mfd.

These condensers are classified as Type TF. They can be used very effectively in high-fidelity amplifiers, low-power transmitters and in transceivers.

These condensers are described in the new Cornell-Dubilier Transmitting and Industrial Catalogue No. 127, which will be ready for distribution shortly.

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FTC MERCURY-VAPOR RECTIFIER

The Federal Telegraph Company, 200 Mt. Pleasant Avenue, Newark, N. J., recently announced their Type 104 mercury-vapor rectifier which has been designed for use where voltages of from 5,000 volts to 10,000 volts direct current are required.

The normal current rating of the Type 104 is 2.5 amperes with a maximum ripple voltage of 0.2 percent. The rectifier operates from a 230-volt three-phase source of supply.

The voltage at which the full-load current of 2.5 amperes may be drawn can be varied in five steps by means of a primary tap selector switch which is operated by a hand wheel from the front panel. These steps correspond to 5,000, 6,250, 7,500, 8,750 and 10,000 volts d-c.

The frame work of the rectifier is constructed of steel angles. All panels and shields are made of steel, and all brass and copper parts are cadmium plated. The entire exterior is protected with a gray duco finish.

A fenced enclosure completely surrounds three sides of the unit and access to the interior is accomplished by means of a hinged door in the right side of the fenced enclosure.

The high-tension transformer is mounted directly to the rear of the rectifier frame in such a manner that the tap change hand wheel drive shaft is in alignment with the shaft projecting from the transformer casing.

High-tension leads terminate on the insulator mounted on the frame for that purpose, and the primary leads terminate on three lower connections to the upper primary contact. Both sets of leads are provided with wood blocks to maintain them in place and to prevent contact with the transformer case.

The primary 230-volt three-phase power-supply lines may be brought in through knock-out holes in the manually-operated disconnect switch on the front panel. This switch is fused to avoid the possibility of accidental damage to the unit.

The high-tension direct-current leads from the load may be brought up within the frame of the rectifier and connected directly to the ungrounded terminal of the filter condenser.

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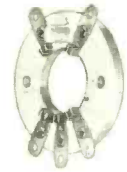
ISOLANTITE ACORN TUBE SOCKET

Another unit has just been developed in the laboratories of the Hammarlund Manufacturing Company. It is a special extruded Isolantite socket for the new ultra-high-frequency acorn type tubes, types 954 and 955. This socket, only 1⅞ inches in diameter, has five double grip prongs of tinned phosphor bronze. These are not only eyeletted to the base, but also lipped. This guarantees perfect contact, for the prongs cannot move nor shift.

Another important feature is the align-



ment plug, which assures proper insertion of the tube. The top, sides and the alignment plug are all glazed for highest surface resistivity. The opposite side of the socket is flush with all terminals recessed, permitting flat mounting to a metal shielding partition to prevent interstage coupling. Two mounting holes are provided.

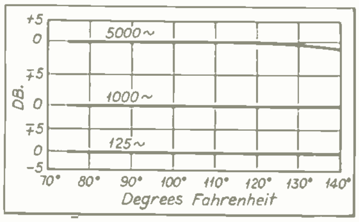
TEMPERATURE—DB

For many years the Audak Company has been manufacturing pickups of the magneto-induction type. It is said they have been, and are being, used throughout the world—in the Tropics, the Frigid Zones, etc., and have successfully stood the test of time, under any and all climatic conditions and temperature changes.

However, during the past year and a half there has been quite a bit of talk of "performance under large temperature changes." For example, in the past no one would have thought of asking for a "Temperature—DB" curve on an electric pickup. Yet, it is stated that when one of the well-known radio manufacturers was ready to again switch back to using Audak pickups, he insisted on a test being run to determine the performance under temperatures up to 140° F.

To the best of our knowledge, no such test has ever been carried out before or, at least, no curves of that kind have ever been published.

The curves shown were made with a thermocouple inserted directly inside the



Audak pickup head, so that the temperatures shown are those actually existing inside the head. It will be noted that the curves shown are flat. In other words, the performance of Audak pickups does not change with temperature variations, be they small or large.

During the test a reading was also taken at 168° F. and the performance was still unchanged, it is said.

POLICE MIKE

A police-type handi-mike has just been placed on the market by the Universal Microphone Co., Inglewood, Cal., for police cars that are equipped for two-way radio communication.

The press button switch is operated entirely independent from the instrument, and is designed to operate a change-over relay which changes the radio from a transmitting to a receiving position.

The microphone is fitted with a rubber mouthpiece, and a six-foot tube covered with a four-conductor shielded cable. It weighs less than two pounds and comes in single- and double-button models.

NEW BRUSH UNI-DIRECTIONAL MIKE

The Brush Development Company, East 40th Street and Perkins Avenue, Cleveland, Ohio, have recently announced their latest microphone development. This is a uni-directional microphone which they have designated as Model UD-3.

This microphone is said to possess many advantages not available in other instruments. It has a wide sound field and is sensitive to sounds originating in a field extending over an entire 180 degrees. It is dead at the back and is therefore adapted for use in broadcasting studios, theatres, auditoriums, sound-on-film recordings, and many other uses. The restricted field of sensitivity eliminates interference caused by reflection, feedback, audience noise, camera clicking, and the like. By a switching arrangement incorporated in the pre-amplifier the Brush UD-3 uni-directional microphone can be changed from uni-directional to entirely non-directional and back again, it is stated. This gives the user an all-purpose universal microphone.

As is the case with all Brush Sound Cell microphones, the UD-3 requires no button current or polarizing voltage. Typical Brush assembly offers the advantage of light weight and small size, while its rugged construction renders the UD-3 impervious to the effects of moisture and mechanical shocks.

Further information may be obtained by writing to the above organization.

VACUUM POWER SWITCH

The Continental Electric Co., 210 S. 1st St., St. Charles, Illinois, announce their new Continental Vacuum Power Switch, types VPS-1 and VPS-2. This new switch has eliminated the use of tilting or rotating devices in making or breaking contact, it is stated. It incorporates a solenoid in its construction which controls the position of the contacting mechanism in making or breaking the circuit.

The contacting mechanism is sealed in a high vacuum chamber, which chamber is hermetically sealed in a strong metal container. As a result there can be no oxidization or difficulties with dust, lints, or other particles of inflammable material that may be cast off during processing. It can be used in corrosive or inflammable atmospheres without any danger, because of the sealed construction. It can be used for remote control and high voltage installations for sign flashing, traffic signals, automatic equipment control, inasmuch as its construction eliminates pitting or burning of contacts. Speed of operation can be set either high or low. Satisfactory operation is assured through the fact that there are no parts which will wear out under continued action. Its estimated life under normal operating conditions is said to be practically unlimited.

The VPS-1 and VPS-2 are single-pole, single-contact switches, normally open and normally closed, respectively. Practically any contact arrangement can be had through the use of one or more of the units.

It is cylindrical in shape, 5½" overall height, 1½" in diameter. Its compact size makes it useful in installations and equipment where space is at a premium.

Maximum continuous load ratings on alternating current are 20 amperes at 110 volts or 10 amperes at 220 volts; on direct current, 20 amperes at 110 volts, 10 amperes at 220 volts. Maximum speed of operation at full load is 100 contacts per minute. Higher speeds may be used under certain load conditions.

A special bulletin giving complete information will be sent gratis upon request.

NEW W. E. SPEECH EQUIPMENT

In a pamphlet entitled "Studio Speech Input Equipment to Meet Modern Broadcasting Needs," the Western Electric Company describes an entirely new line of studio speech-input equipment developed by Bell Telephone Laboratories. Three assemblies are principally described— a complete studio amplifier channel, an operator's control panel, and a receiving and dispatching terminal.

The equipment, it is said, features the following:

1. Low installed cost. Factory assembled and wired bays reduce installation time; flexibility of design minimizes the specific engineering required on an installation.

2. High fidelity. The equipment has a frequency characteristic flat from 30 to over 10,000 cycles. Operating at normal line feed level of 6 milliwatts output, the harmonic frequencies are below .01 of one per cent and noise introduced by the equipment is more than 55 decibels below program level.

3. Provisions for future growth. Increasing demands on studio and other facilities can be met by adding new units rather than replacing existing ones.

4. Attractive appearance. On the basis that stations and studios are showrooms, the designers have stressed the attractiveness of all units, achieving a result in keeping with the high standards of the radio art.

The pamphlet summarizes the three principal assemblies as follows:

The 701A bay is a complete a-c operated amplifier assembly for one studio amplifier channel. Some of its features are—flexible switching facilities; loudspeaker communication between the monitoring operator and the studio occupants; interchangeable line and monitoring amplifiers, and volume indicator which closely follows the program envelope, rather than recording the instantaneous peaks and valleys of sound volume. The cabinet measures 83⅜ inches high, 22 inches wide and 13⅛ inches deep.

The 267 type control panel contains input and output circuit control keys, potentiometers and signals for the operation of the 701A Speech Input Bay as an independent program production unit.

The 702A Speech Input Bay possesses all necessary switching, terminating and communicating facilities for handling incoming and outgoing program circuits. It contains an output switching panel, and an incoming program line panel which provides for pre-selection of one incoming program circuit while another is in use.

The pamphlet is profusely illustrated with both photographs and diagrams and contains several typical studio layouts.

MU-X SERIES CRYSTAL MIKES

The Turner Company has developed the Mu-X microphone to meet modern standards of high-fidelity reproduction. The Mu-X, or Multi-Crystal, microphone uses a varying number of crystal units. The diaphragm area of each unit is relatively small, thereby forcing resonant peaks into the higher frequency ranges. This, in conjunction with the phasing of the units, produces a microphone which is said to possess excellent response characteristics.

The Mu-X microphones supply their own energizing current and are free from background noise. The high-impedance characteristic of crystal units permits the output to be fed direct to single or push-pull grids.

The Bimorph construction of the crystal units, plus a wax sealing, provides protection against moisture and varying temperature conditions. Standard and stock models are available in the following types: S4-MX, S6-MX, S8-MX, P4-MX, P6-MX and P8-MX. The S4-, S6- and S8-MX group indicate the number of crystal units employed and that the microphone is to be supplied with single-grid input; while the P series refer to the push-pull models.

Complete information may be obtained by writing to The Turner Company, Cedar Rapids, Iowa.

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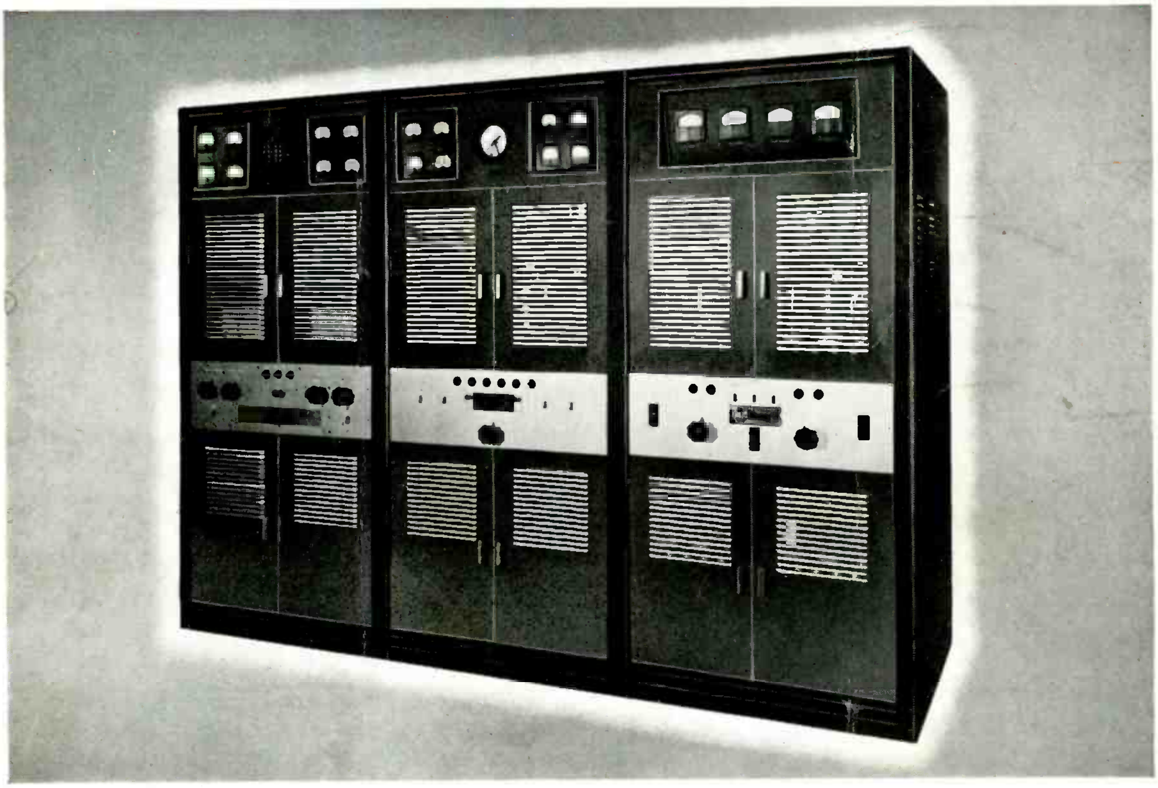
THE NEW RCA "HIGH FIDELITY"

BROADCAST TRANSMITTER

TYPE 5-C



A DE LUXE 5000 WATT EQUIPMENT FOR 1/2.5, 1/5 AND 5 K.W. BROADCASTING STATIONS

FEATURING:

1 High Fidelity Performance
2 Low Operating Cost
3 Complete A. C. Operation
4 Ingenious Hum Compensation
5 Safety and Convenience of Operation
6 Cathode Ray Indicator for Modulation
7 Complete Harmonic Suppression
8 Automatic Overload Protection
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10 Strikingly Attractive Modern Design

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