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SEPTEMBER, 1935
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(See Article on Page 19)

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The American Brass Company

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RECEIVER DESIGN

RECEIVER DESIGN does not end with the chassis. For that matter, the design factors that meet the eye of the potential purchaser are quite often more important than circuit features.

A test of fifteen all-wave receivers of the table type—all in the same price range—brought out the interesting, but not surprising, observation that one set is about as good as the next in so far as practical results are concerned. In most instances the little superiorities that showed up in the more precise laboratory tests, were not particularly apparent on listening tests.

That receivers in the medium-price range are about as much alike as peas in a pod is not surprising, in view of the fact that present-day circuits are pretty well standardized. This condition does not hold for the higher-price receivers—in this instance considerable originality is expressed in circuit design, and the "results" obtained from a group of these receivers are not on a common level, as they appear to be with the table-type set.

We cannot vouch for the authenticity of the tests referred to—we can only state that, from our own meagre examinations of medium-price table-type receivers, and from what we have heard from other sources, there is an element of truth to the assertion. Be that as it may, the fact remains that few receivers in this class are so much better than others that the results are sufficiently obvious as to influence the potential purchaser.

Perhaps a purchaser is influenced principally by advertising claims, but it is safe to say that he is also influenced by the features of the set he can readily understand and which are apparent even to the casual observer... features such as, appearance, ease of handling, clearness of dial markings, comprehensible waveband indicators and readings, etc. If this be so—and we have the conviction that it is—more study should be given to exterior design and to the practicability of adding auxiliaries. Because improved appearance, and the inclusion of gadgets that add to the convenience of operation, should increase the salability of a table-type receiver, they should also do the same for receivers in all price classes.

Consider appearance: Table-type cabinets are as stereotyped as the circuits of the chassis they house. The opinion seems to be that it is preferable to have cabinets similar to, rather than different from, the cabinets of other manufacturers, whereas public psychology suggests that the average man would prefer to see a bit of variety. His house or his apartment may be similar to others architecturally, but the furnishings he selects are not copies of the furnishings in his neighbor's home. He exercises a power of choice, and he is apt to resent any restraint of this power.

We still believe that a radio cabinet should be functional in design. No serious effort has been made to develop a design expressing the actual character of a radio receiver. Yet a departure from standard cabinet construction might well capture the appeal of the public.

Dial design appears to be another problem. The dial should be either emphasized or subdued. To attempt to strike a happy medium between the two is to lose all effectiveness in exterior appearance. At least one manufacturer has realized that the two principal functions of a dial are, efficient operation and readability. As a result the dial has been designed to meet these requirements and, as it is necessarily large, it has been permitted to dominate the cabinet design. This comes nearer to expressing the function of a radio receiver than anything we have yet seen. It is a step in the right direction.

The loudspeaker or the auxiliary controls of a receiver, also hold interesting design possibilities. Were they to dominate the cabinet, rather than be subdued by it, a new note in exterior appearance could be created.

No manufacturer is helping his sales by sacrificing operating convenience. Let's see more emphasis placed on functional properties. If this is done, enhanced exterior appearance will develop as a natural thing.

Page 4
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SEPTEMBER, 1935
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Cathode-Circuit Degeneration

By W. D. SHEPARD

• Relating to the realization of a rising high-frequency response in audio circuits by the control of the cathode resistor bypass capacity. Formulas are provided.

AMONG THE REQUIREMENTS of a good audio amplifier, as generally set forth, is the condition that the response over a certain range of frequency shall be uniform, or as commonly stated, that the frequency characteristic shall be flat. For many applications this is ideal, but conditions exist where it is desirable to modify the characteristic in various ways. As an example of this intentional departure from uniform response, we have the tone control, by means of which reproduction may be made as unnatural as the tastes of the listener may dictate. In many cases, however, a departure from linearity is introduced for the purpose of compensating for deficiencies in speakers, lines, or other apparatus, or to minimize the effects of poor acoustics in an auditorium. For such purposes, a variety of filters and networks have been used. Most of these have been given a fair amount of attention by various publications, but the control of bypass capacity across the cathode-biasing resistor, frequently used to obtain a rising high-frequency response, is usually overlooked.

THE BYPASS CONDENSER

It is generally assumed that all resistances in the cathode circuit should be well bypassed in order to avoid losses due to degenerative feedback. Because of the usual low resistance employed for biasing purposes, it is necessary to use either a very large condenser or a resistance-capacity filter. We commonly meet with the statement that the use of too small a bypass condenser results in an undesirable loss of low-frequency response. As a matter of fact, the form of rising characteristic obtainable by this method finds considerable practical application, and lends itself quite readily to predetermination.

DERIVATION OF FORMULAS

In order to make clear the nature and possibilities of such circuits, it is desirable to outline the derivation of formulas suitable for purposes of design. Considering the quantities designated in Fig. 1, we may write the following three equations, all quantities in which are vectorial.

\[ E = E_x + E_k \]  
\[ E_x = \mu E_k Z_a / (R_x + Z_a + Z_k) \]  
\[ E_k = \mu E_x Z_a / (R_x + Z_a + Z_k) \]

Fig. 1. Functional circuit.

Fig. 2. Circuit with resistor added in series with bypass condenser.
Combining these, we obtain

\[ E_a = \mu Z_e E \left( 1 - \mu Z_e \right) / (R_e + Z_e) \]

The amplification, \( a \), is then

\[ a = E_a / E = \mu Z_e / (R_e + Z_e) \]  (4)

If, now, \( Z_e \) consists of a parallel resistance and capacity, at the higher frequencies \( Z_e \to 0 \), and the amplification becomes

\[ a = \mu Z_e / R_e \]

At low frequencies the bypass is ineffective, and \( Z_e = R_e \). The ratio of high- to low-frequency amplification is therefore

\[ a_0 / a = (R_e + R_L + R_c(1 + \mu) + jX_c) / (R_e + R_c + jX_c) \]  (5)

In the case of a resistance-coupled amplifier, this reduces to

\[ a_0 / a = 1 + R_e(1 + \mu) / (R_e + R_c) \]  (6)

which approximates any case in which the load is principally resistive. It will be noted that certain factors, such as inter-electrode capacities, have been neglected, as the slight increase in accuracy hardly justifies the resulting complication in formulae.

**EQUALIZATION**

The correction or equalization obtainable may be written in db as follows:

\[ db = 20 \log_{10}(a) \]  (7)

For the sake of ease in design, a set of curves may be plotted showing the variation of this quantity with frequency and circuit constants. For this purpose we write equation (4) in slightly different form, using the case of resistance coupling for simplicity.

\[ a = \mu R_e / \left[ (R_e + R_L + R_c(1 + \mu) + jX_c) / (R_e + R_c + jX_c) \right] \]

where the equivalent series resistance and reactance of the parallel cathode resistor and condenser are

\[ R'_e = R_e X_c / (R_e^2 + X_c^2) \]

\[ X'_e = X_c / (R_e^2 + X_c^2) \]

Writing

\[ X_c = 1/2 \pi f C_c \]

\[ k = R_e(1 + \mu) / (R_e + R_c) \]

and

\[ m = X_c / R_e = 1/2 \pi f C_c R_e \]

we obtain an expression for loss

\[ db = 10 \log_{10} \left[ 1 + m^2(1 + k) \right] \]  (8)

Graphs plotted by the substitution of various values for \( m \) and \( k \) in the formula indicate that certain definite values hold for frequency and amplification, dependent on circuit constants that are not easily changed. In order to afford additional control in design, a resistor is occasionally added in series with the bypass condenser, as shown in Fig. 2. The derivation for this case is entirely similar to that given above. Using \( n = r_p / R_e \), for the ratio of this series resistor to the biasing resistor, the following expression may be derived.

\[ db = 10 \log_{10} \left[ \frac{1}{1 + (n + 1)^2} + \frac{1}{1 + (n + 1)^2} + \frac{1}{1 + (n + 1)^2} \right] \]  (9)

The accompanying curves result from the application of this formula. This method of calculation may be applied to a number of similar circuits. In general, the results obtained will hold quite closely for resistive circuits, and as a first approximation for some circuits involving transformers.

**TWO NEW SPEEDCRAFT STRIPPER MODELS**

The wire stripper Co., E. Cleveland, Ohio, specialists in insulated wire stripping machines, have just placed on the market two new models of their entirely redesigned Speedcraft Strippers. Both are of the rotary knife type action, but one is a semi-automatic machine with electric operation instead of the usual foot-pedal operation.

Several years of intensive study and investigation of all kinds of operating problems under actual production conditions resulted in the new design of these machines, the many new features of which have increased their efficiency and have reduced the time required for servicing the knives, etc. These machines are said to represent the greatest improvements in insulated wire strippers since the motor-driven wire stripper was introduced.

Some of the features of these new machines are as follows: A new operating head with non-breaking coil springs and properly-designed long-wear bearings for knife levers. Knives can be hand-honed without removing from the head.

A new knife setting has been perfected. Quick change guide bushings that guide the wire on center can be locked in place with a simple twist.

A hinged cover that has just one thumb-screw makes the operating head instantly accessible. Also, no chips fall into the mechanism; they all fall clear of it.

On the semi-automatic model (the one illustrated) there is still easier operation, less fatigue, greater speed and larger production.

A new bulletin has been issued describing these and the other types of wire strippers which the company manufactures. It will be sent free on request.

**RADIO BOOSTER CLUB**

At a regular meeting of the Radio Booster Club, Southern California Branch No. 1, on August 5th, the following officers were elected: President, J. T. Hill; Vice-President, J. J. Perlman; Secretary-Treasurer, Harry A. Lasure; Directors, Carl Stone and Don Wallace.

The Radio Booster Club is composed of Radio Manufacturers Agents and other executives engaged in the distribution of parts, sets, and accessories, with the object of close co-operation among its members, and between manufacturers, wholesalers and dealers for the general betterment of the radio industry.

The address of the Secretary, Mr. H. A. Lasure, is 1406 South Grand Ave., Los Angeles, Calif.
Operation of the 6L7 as a Mixer Tube

The 6L7 is a 6.3-volt metal-shell tube intended for use as a mixer (first detector) in superheterodyne receivers, although its characteristics enable it to perform other functions. It is the purpose of this article to discuss operation of the 6L7 as a mixer, the discussion being based on data collected in the RCA Radiootron Laboratories.

The pentagrid-converter tube now in general use is a good frequency-converting device at medium radio frequencies. When a tube of this type is operated at frequencies higher than 15 or 20 megacycles, however, its conversion conductance is substantially less than that in the standard broadcast band, even though the oscillator voltage is maintained at a satisfactory value throughout the frequency range of the receiver. The cause of this decreasing conversion conductance with increasing frequency has been traced to an undesirable effect produced by space-charge coupling between oscillator and signal grids. This phenomenon is inherent in the operation of this type of tube and is serious when the ratio of signal frequency to intermediate frequency is very large.

PENTAGRID-CONVERTER SHORTCOMINGS

Variations in potential of the oscillator grid of a pentagrid converter modulate the electron stream from the cathode. These cause corresponding variations in the space charge surrounding the signal grid. If the intermediate frequency is low compared to the signal frequency, so that the impedance of the signal circuit is appreciable at oscillator frequency, this varying space charge will cause a voltage of oscillator frequency to be developed across the signal circuit. This generated voltage will be 180° out of phase with the oscillator-grid voltage when the oscillator frequency setting in order to obtain a reasonably high tuning ratio, the combined effect of the oscillator-frequency voltages on the two grids is to reduce the conversion conductance of the tube. This effect increases with frequency because of: (1) the increasing ratio of signal to intermediate frequency, and (2) the increasing value of L/C as the receiver is tuned toward the high-frequency end of a band. The use of a separate oscillator tube coupled to the normal oscillator grid does not reduce this space-charge variation phenomenon, because, as previously pointed out, this effect is inherent in the operation of pentagrid converter tubes.

SECOND DISADVANTAGE

A second disadvantage of operating a pentagrid converter tube at high radio frequencies is the shift in oscillator frequency which occurs when the signal-grid bias is varied. This frequency shift is due to a trans-conductance be-
A further refinement may be made by inserting a grounded suppressor between plate and oscillator screen. This hypothetical tube, which is substantially the new 6L7, thus requires five grids for good mixing at high radio frequencies.

**DETAILS OF 6L7**

Fig. 1 shows the relative positions of the elements of the 6L7. The tube consists, as may be seen, of a heater, a cathode, five concentric grids, and a plate. Grid No. 1, which is nearest the cathode, is one of two control grids. It is of the remote cut-off type and, because the r-f signal to be converted is applied between grid and cathode as shown in Fig. 2, may be referred to as the signal grid. The remote cut-off characteristic of this grid minimizes r-f distortion and cross-modulation effects when its bias is under the control of the avc system. Grid No. 2 serves the same purpose as the screen in a conventional tet rode; it accelerates the electrons toward the plate and reduces the G2G4 capacitance to a small value. (The numerical subscript denotes the grid number.) Grid No. 3, interposed between screens G2 and G4, is the second control grid of the tube and has a sharp cut-off characteristic. This grid may be referred to as the oscillator grid, because the output of the external oscillator is connected to it. Grid No. 4 is another screen; it increases the plate resistance of the tube, reduces the G3P capacitance, and functions similarly to the screen in a conventional tet rode. G2 and G4 are connected together internally. Grid No. 5 is a suppressor; it is connected to the cathode internally and serves to limit the effects of a secondary emission from the plate; because of the suppressor, it is possible to operate the tube at low plate voltages.

**THEORY OF OPERATION OF 6L7 AS A MIXER**

The manner in which the 6L7 produces an intermediate-frequency component of plate current when it is connected to operate as a mixer may be described as follows:

An r-f signal applied to G1 modulates the electron stream by virtue of the G1P transconductance (s91). The r-f component of the plate current is, therefore, Er sinωt, where Er is the signal voltage. The oscillator voltage applied to G1 varies s91 between zero and a maximum, s91 being maximum at the peak positive potential of G1 and minimum at the peak negative potential of G1. Thus, regardless of the manner in which s91 varies, there is an alternating component of s91 having the same frequency as that of the oscillator. If the signal is represented by Er cosωt and the component of s91 at oscillator frequency is represented by s91 cos ωt, the instantaneous plate current will be:

\[ I_p = Er \sin \omega t + \frac{Er s91 \cos \omega t \cos (\varphi - \omega t)}{2} \]

where \( \omega \) is the angular velocity of the signal and \( \varphi \) that of the oscillator; \( s91 \) is the peak value of the alternating component of s91 having the same frequency as that of the oscillator. The difference-frequency, or i-f, component of this plate current is

\[ I_{i-f} = \frac{Er s91 \cos (\varphi - \omega t)}{2} \]

Thus, it is seen that the i-f component of the plate current increases directly with signal strength and with s91. If I (i-f) is to be a maximum for a...
given signal strength, then $s_{ma}$ must be varied by the oscillator in such a manner that $s_{ma}$ is a maximum. The ideal relation between $s_{ma}$ and $E_o$, for maximum $s_{ma}$ is shown by curve (a) of Fig. 3; for this case,

$$s_{ma} = \frac{2}{r}$$

If the relation between $s_{ma}$ and $E_o$ is linear, as shown by curve (b), then,

$$s_{ma} = \frac{3}{r}$$

The conversion conductance ($s_r$) of a mixer tube is defined as

$$s_r = \frac{r}{E_c}$$

so that Eq. (1) becomes

$$s_{ma} = \frac{2}{r}$$

For curves (a) and (b) of Fig. 3, then, $s_r$ is as follows:

Curve (a)

$$s_r = \frac{s_{ma}}{r} = \frac{2}{r}$$

Curve (b)

$$s_r = \frac{s_{ma}}{r} = \frac{4}{r}$$

**CHARACTERISTICS OF 6L7**

The table of characteristics (Table I) recommends for a given plate voltage of 250 volts two screen voltages, 100 and 150 volts. Although the space-charge phenomenon discussed previously is very small in the 6L7, it has been found that electrons repelled by the oscillator grid during its negative voltage excursions enter the vicinity of the signal grid and cause a current to flow in that circuit. At high radio frequencies, where this effect is appreciable, the signal-grid bias must be increased to $-6$ volts to prevent the flow of this current. The screen voltage may be raised to 150 volts in order to compensate for the consequent decrease in conversion conductance. For all-wave receivers, it is preferable to maintain the screen voltage at 150 volts and the minimum signal-grid bias at $-6$ volts in all bands.

Fig. 4 shows the relation between plate current $I_p$ and $E_c$, for the two recommended values of screen voltage. Grid No. 1 is seen to have a remote-cut-off characteristic so that it may readily be controlled by the avc system. Fig. 5 shows the relation between conversion conductance ($s_r$) and $E_c$, for the same two values of screen voltage. These curves show how the gain of the converter stage varies with ave voltage. The variation of $s_{ma}$ with $E_c$ is depicted in Fig. 6. The actual variation of $s_r$ with $E_c$ for different oscillator voltages is shown in Figs. 7 and 8; these families of curves are probably the most interesting from an application standpoint.

Considering only the solid-line curves for the moment, it is seen that the optimum value of $s_r$ increases rapidly with small oscillator voltages and slowly for larger voltages. It is also well to note that the highest values of $s_r$ are obtained when the oscillator voltage is much higher than the bias; of course, current then flows in the $G_1$ circuit of the 6L7. Because of the shape of the high oscillator-voltage curvles in the region of $E_c = 0$ comparatively constant gain may be expected within this region from the converter stage for varying oscillator voltages. Practically, this means that, for nearly constant bias on the oscillator grid, the conversion gain will remain substantially constant as the oscillator frequency is varied over a given tuning band. The minimum oscillator voltage in any tuning band, therefore, should be large enough to give nearly maximum $s_r$.

**COUPLING CIRCUITS**

The foregoing analysis is based on the assumption that the oscillator voltage is obtained independent of $E_c$. Although this condition may be realized with some circuits, it is more practical to use either of the coupling circuits shown in Figs. 9 and 10. In the circuit of Fig. 9, $G_1$ of the 6L7 connects to ground through a 5000-ohm resistor; it also connects to the grid of the oscillator tube through the blocking condenser $C$. The voltage developed across the grid leak of the oscillator tube, therefore, appears across $R$ and modulates the electron stream to produce the i-f component of plate current. If the oscillator voltage applied to $G_1$ is high, rectification takes place in the $G_1$ circuit, just as in a diode, and a rectified

(Continued on page 16)
The Cathode-Ray Oscillograph

PART II (Continued from June issue)

By WILLIAM F. DIEHL
Engineering Department RCA MANUFACTURING CO., Inc.

MODULATION ANALYSIS

The cathode-ray oscillograph is invaluable for analyzing the waveform of a modulated radio-frequency transmitter. Fig. 27 illustrates one method of measuring percent modulation. In this case the modulated r-f output of the transmitter is applied to the vertical plates of the cathode-ray oscillograph either directly or through the amplifier, depending on the frequency range. In using this method neither the timing axis oscillator nor the horizontal amplifier are required, the instrument functioning as illustrated in Fig. 12-B (Part 1).

A second method of measuring percent modulation is illustrated in Fig. 28. In this method the modulated r-f is applied to the vertical plates of the oscillograph either directly or through the amplifier (depending on the frequency range) and the timing axis oscillator is set to a frequency corresponding to the modulation frequency, or a sub-multiple thereof. The number of complete cycles appearing on the screen will then be equal to the modulation frequency divided by the frequency of the timing axis oscillator. Figs. 29, 24 (Part 1), 30 and 31 illustrate 25-, 50-, 75- and 100-percent modulation, respectively. Fig. 32 illustrates over-modulation.

A third method of measuring percent modulation is illustrated in Fig. 33. In
this case the modulated r-f is applied to the vertical input, while the modulation frequency is applied to the horizontal input either directly or through an amplifier, depending on the sensitivity required. Since the modulation frequency may be obtained from the output of any stage of the modulator, the gain control on the horizontal amplifier may be used effectively to adjust the horizontal width of the image. Figs. 34, 35, 23 (Part I) and 36 illustrate 25-, 50-, 75- and 100-percent modulation, respectively. Fig. 37 illustrates over-modulation.

A fourth method of measuring percent modulation is illustrated in Fig. 38. In this case the modulated r-f is applied to both the vertical and the horizontal deflecting plates, but by means of a phase-splitting circuit, the horizontal input is arranged to be 90 degrees out of phase with the vertical input. Fig. 39 illustrates the carrier only (zero modulation), while Figs. 40, 41, 42 and 43 illustrate 25-, 50-, 75- and 100-percent modulation, respectively. Fig. 44 illustrates over-modulation.

The cathode-ray oscillograph may also be used in conjunction with a radio receiver to determine the modulation characteristics and to check the percent modulation of a distant transmitter. For this application, a high-fidelity receiver is employed and a separate shielded stage of i-f incorporated which feeds the vertical plates of the oscillo-

Fig. 38. When very near to 100% modulation, the inner circle, while extremely minute, will be open in the center. At exactly 100% modulation, the inner circle will simply be a spot which will increase in intensity with over-modulation.

dotted curves of Figs. 7 and 8 show the variation of $s_n$ with total grid bias for two typical circuits of the type shown in Figs. 9 and 10. The flat portion of each curve is of greatest importance to the set designer, since it determines the minimum oscillator voltage required for nearly maximum conversion conductance. The minimum oscillator voltage is that of each waveband in the receiver should be great enough to secure nearly maximum conversion conductance; any further increase in oscillator voltage, such as may be obtained when tuning from the low-to the high-frequency end of any band, will not materially change the gain of the converter stage.

Consideration should be given to the $G_s$ input capacitance which shunts the tuned circuit of the oscillator through the oscillator-grid condenser. The oscillator coils and padding circuit should be so designed that the desired tuning range can be covered with this capacitance in the circuit. The use of part of the voltage developed across the oscillator coil, the connection of $G_s$ to the plate instead of to the grid of the oscillator, or the use of the circuit of Fig. 9 with a smaller value of $C$, will lower the effects of this capacitance.

THE 6L7 AS A MIXER TUBE

(Continued from page 13)

current will flow through $R_s$; the d-c component of this current produces a d-c voltage across $R_s$ which contributes to the fixed bias developed by $R_b$. Thus, the total bias on $G_s$ is a function of the oscillator voltage.

In the circuit of Fig. 10, the d-c and a-c components of the voltage developed across $R_s$ by the oscillator tube are applied to $G_s$; the d-c component of this voltage plus the fixed voltage across $R_s$ equals the total bias on $G_s$. If the peak value of the a-c component of the oscillator voltage is greater than this total bias, rectification will occur in the $G_s$ circuit of the 6L7; the total bias $E_{c_s}$ will thus be augmented. For these considerations, it is clear that, once the voltage drop across $R_s$ is fixed, the variation of $s_n$ with $E_{c_s}$ depends on the type of coupling circuit and the characteristics of the oscillator used. The

A 6L7 coupling circuit in which the total bias on $G_s$ is augmented by the a-c component of the oscillator voltage.
FOREIGN RADIO MARKETS

BY ANDREW W. CRUSE

Chief, Electrical Division, U. S. DEPARTMENT OF COMMERCE

AUSTRIA

Negotiations among Austrian radio manufacturers are reported to have made considerable progress recently toward the establishment of a radio cartel in Austria. It is believed that the cartel may become effective by August 15.

It is proposed to continue production to certain types of apparatus and equipment, thus reducing production costs. No price increases are expected as a result of the new cartel, which will endeavor to stop price cutting and to fix production contingents for individual plants. A special endeavor of the new cartel will be the promotion of radio exports, which, although increasing in quantity, have declined relatively from 30% of total sales three years ago to 10% of total sales this year. (Gardner Richardson, Commercial Attaché, Vienna.)

BRAZIL (BAHIA)

The development of the radio market in Bahia has been progressing during the past two and one-half years.

The people of Bahia are naturally fond of music. Up to a few years ago one was certain to find phonographs in the most surprising places, such as small, dark rooms where the negroes or poorer natives lived; today radios are as frequently found in the same places. There is very little information available regarding the development of the radio market in Bahia, but it is understood that the first radio imported was an American battery set in 1924. From 1924 to 1926 there were practically no radios imported into Bahia, and it was not until 1930 that any measurable interest was shown in radio. The first broadcasting station was founded in 1925, the second in 1930, and the third in 1934. All of these stations use medium waves.

According to the local laws, all radio sets should be registered. On June 30, 1935, the Telegraph and Post Office department had registered only 1,866. It is estimated, however, that there are between 3,500 and 4,500 sets in Bahia.

The market for radios has been very good during the past two years in Bahia, especially when it is considered that over 80% of the people are of the black race and can buy only the bare necessities of life. It is true that the high rate of exchange has hindered the importations during the past few months, but the retailers state that the market is still good and they are looking forward to increased sales. There seems to be an increased demand for all-wave table models of 7 to 9 tubes.

Most of the radios are sold on time, with down payments ranging from 10 to 30 percent with the rest payable in monthly installments of from 10 to 18 months. Most dealers do not charge interest for the first 10 months, but for longer periods a charge of 6 percent is made. (Vice Consul Lee Worley, Bahia.)

CANADA

Radio manufacturers' sales to dealers in June registered an increase of nearly 500 units over the previous month and list value of sales increased 81/2 percent. This is entirely accounted for by improved movement of battery sets, particularly dual-wave units, sales of which increased by more than 500 units. The sale of alternating-current models was smaller than in the previous month. Demand for automobile sets also fell slightly.

Projected production in the industry for the third quarter is placed at 70,203 units, a considerably higher manufacturing rate than set for June. Output of a-c chassis will be chiefly dual-wave and all-wave models, each in excess of 22,000 units. Only 4,544 standard band sets are forecast.

Demand for all-wave battery sets has been relatively light recently, but it is significant that in the third quarter production schedule manufacturers of nearly 5,000 of these units is projected. It is also significant that jobbers' inventory and projected production of automobile sets is only 500 greater than sales reported in June. (Asst. Trade Commissioner Avery F. Peterson, Ottawa.)

IRISH FREE STATE

According to official figures there were 69,500 licensed receiving sets in the Irish Free State on June 30, 1935, as compared with 54,000 in October, 1934, 45,000 in December, 1933, and 30,000 in December, 1932.

POLAND

The annual congress of the "Union Internationale de Radio Diffusion" was held in Warsaw from June 18 to 29. Representatives from 22 European countries and from European offices of two American broadcasting companies participated in the conference.

It was announced at the conference that the number of radio listeners had increased during the last year to about 200 millions at the beginning of June, as against 180 millions a year previously.

Among the more important resolutions passed at the conference was one inviting national and international radio organizations of all countries and continents to participate in the inter-continental conference of 1936, to discuss the organization of a World Radio Federation.

On the initiative of the "Polskie Radio," the Union decided to create a new series of lectures, which would establish contact between leading representatives of science, literature and art, and the listeners of all broadcast stations belonging to the Union. The selection of speakers as well as of subject would be made with the cooperation of national and international academic institutions.

It was further agreed that a concert of students' choirs from all countries belonging to the Union would be organized on October 27. The Union resolved to take part in the work of the newly organized International Union for Promotion of the Workers' Recreation, the Institute for Intellectual Cooperation in Paris, and the International Film Educational Institute in Rome.

The delegates discussed the technical development of the Union's laboratory and of the Central Bureau for Wave Measurement, in Brussels. It was reported that the wave stability of the European broadcast stations had considerably improved during the last 10 years, and that the former fluctuations, which in some cases were as high as 1000 to 3000 cycles, had been reduced to one cycle.

The Congress approved the text of a resolution on the Bern-Rome Convention concerning copyright, to be presented at the Conference in Brussels in 1936. (Commercial Attaché Clayton Lane, Warsaw.)

SWITZERLAND

Switzerland has six broadcast stations: Beromünster, Basel Bern, for the German part of Switzerland, Sitten and Geneva for French Switzerland, and Monte Ceneri for Ticino, the Italian canton, all under the control of the Federal Post and Telegraph Department. For German Switzerland the three stations alternate in giving programs and
the same is true of Sottens and Geneva for French Switzerland. With three principal languages, French, German, and Italian, one national broadcasting station would not meet the needs of this country, as continuous broadcasting in all three languages is required. No commercial broadcasting is permitted in Switzerland and no use is made of this medium for advertising or political propaganda.

As a result of the severe import restrictions established in 1932, Swiss producers have been able to fill about one-half of the demand. Some domestic firms have put on the market a fairly satisfactory product. It cannot be said, however, that Switzerland really has a radio industry of its own, since the manufacturers are still largely dependent on foreign parts, notably Philips. Most of the cabinets are now made in Switzerland.

Imports of Radios and Parts
Prior to 1933 radios and parts were not classified in customs statistics separately from telephones and telegraph parts, and therefore the statistics as to imports of radios in previous years can only be estimated. The figures for imports from the United States, however, are considered substantially correct in the earlier years, because it is understood that this country did not import American telephones and telegraph apparatus.

Imports have steadily declined since 1932 under the severe Government restrictions and American trade has especially suffered in this curtailment. In the boom year of 1931, when trade was unfettered, American radios represented one-third of the total value of imports, and probably over one-half in the actual number of sets, as many small radios were imported at that time from the United States. In 1932 American trade shrank one million francs. The following year it dropped again by more than two-thirds. In 1934 it had declined to about one-tenth of the total trade, and during the first six months of the current year the value of American radios was only 9 percent of the total imports.

Import Restrictions
On April 1, 1933, the first restrictive measures on radio imports were taken by increasing the duty on radios and parts from 60 to 200 francs for 100 kilograms gross weight. Although this was an increase of over 300 percent, it was not a serious handicap for the sale of American radio sets, as a duty of 2 francs per kilo is only a minor factor in the final sale price of American radios, which are always been sold for several times the American retail price. The principle of large sales and small profit has not been practised in the radio business. There have always been too many dealers in the field and they have had to figure on a large margin of profit on each transaction to pay expenses, and this system flourishes under monopolistic conditions.

Further Restrictions
Notwithstanding the high duty and the quota restrictions, it was found that at the end of 1933 large numbers of small radios were still being imported, with resulting severe competition to native production, and on January 1, 1934, a new restrictive measure was imposed the effect of which was practically to bar further importation of small and miniature sets from the United States. This new measure provided that, while the quotas are still dependent upon weight, it was arbitrarily arranged that each radio or chassis would be considered to weigh 12.5 kilograms in other words, eight chassis imported by a dealer would reduce his contingent by 100 kilograms. It did not matter whether the chassis weighed more or less than 12.5 kilograms, only eight units could be imported for 100 kilograms of quota contingent. In the case of a radio with a cabinet, the weight was arbitrarily fixed at 16 kilograms, which meant that the Swiss dealer could bring in six of these units for a contingent of 100 kilograms.

In 1934 Switzerland imported 49,236 kilograms of radio products from the United States. About 25 percent of this total was probably tubes and other radio parts imported by dealers and Swiss manufacturers. After this deduction the figures indicate a total of about 37,000 kilograms for sets, and averaging seven sets to each 100 kilograms, the total number of American sets imported in 1934 approximately 2,600. Actual sales of American sets in 1934 were estimated between 4,000 and 5,000 sets, the difference representing radio sets imported by dealers in previous years. Judging by the imports of the first six months of 1935, imports for the current year will probably not much exceed 2,000 sets.

Radio Tubes and Prices
Radio tubes are also subject to quota restrictions, being treated in the same way as radio sets and parts. The Federal Department of Economics, in apportioning the import allocations at the beginning of the year, deducts 10 percent from the quota granted to each dealer as a reserve to apply to tubes and other parts. If the importer does not utilize this reserve for the importation of tubes and accessories he is allowed to use it up at the end of the year for the importation of sets and chassis. Importers apparently have had no difficulty in filling their need for tubes, as the 10 percent reserve is adequate to cover the requirements of sets imported. However, it is not possible for a dealer to specialize in the sale of tubes because of the 10 percent limitation. Consequently, the dealers in radio sets provide the replacement tubes for their customers. The customs duty on tubes and accessories is the same as for radio sets.

The retail prices of tubes vary little between the different makes, but as American tubes cost less the dealers can make a greater margin of profit on the American tubes. Whereas the profit on the Philips and Telefunken tubes ranges from 35/ to 40 percent, the American product yields a gain of from 50 to 60 percent. It is apparent, therefore, that dealers prefer to sell American goods and are only restrained by quota restrictions and threats of litigation. (Consul General A. C. Frost, Zurich.)

UNITED KINGDOM
British Television Notes
The following report, which has just been received from Mr. Henry E. Stebbins, Assistant Trade Commissioner, in the office of the Commercial Attaché in London, is to me most interesting. Here we have a picture of the entire situation for the inauguration of high-definition television in England. The atmosphere is becoming tense, "The air is still filled with rumors," efforts are being made to calm the nerves of the radio manufacturers and the motion picture interests, both of which have been jittery over the possible effect on their business ever since the publication of the report of the Television Committee in January of this year. Only the actual presentation of the proposed television programs from the Alexandra Palace transmitters of E.M.I. and Baird will clarify the situation and answer the questions now being asked regarding the future of television for entertainment. I can only repeat what I have said before, and that is, that, in my opinion, after having seen both the Baird and E.M.I. systems in operation, I feel that the entire future of British television depends entirely upon the ability of the British Broadcasting Corporation to present programs which will be enthusiastically received by the public. Technically, both the transmitting and receiving equipment is adequately satisfactory to introduce this service at this time, but the unknown factors are—program material and program presentation. Will the novelty of this new art be sustained after the novelty has worn off? We, in the United States, can learn many valuable lessons which may later save us many dollars by patiently watching this development of the British television picture.

Mr. Stebbins is very well qualified to

Continued on page 21)
THE OFFICIAL public-address system of the California-Pacific International Exposition now open in Balboa Park, San Diego, California, is a complete Western Electric System possessing many features not heretofore attempted on an installation of this scope and size. In effect it is the exact counterpart of a radio broadcast chain with the exception that the releasing stations are audio frequency instead of radio frequency.

BROADCASTING STUDIOS

The system was engineered and installed by the C. C. Langevin Company, of California, and it is operated under their supervision. It in-

Block diagrams of the amplifier and wide-range loudspeaker equipment in the Arch of the Future, Hollywood Hall of Fame and the Foods and Beverage Building tower.

Block-diagram of the central distribution system, the heart of the audio-frequency broadcast chain.
includes two broadcasting studios, Studio A and Studio B, especially constructed, of the live and dead end type, and each having its own speech-input equipment, together with a bridged monitor amplifier. The output of these studios is fed into the main control room for distribution either to any of the broadcast stations or to either the National Broadcasting or Columbia Broadcasting chains.  

Also installed in the main control room is reproducing equipment which makes it possible to play records over any or all of the various loudspeaker audio stations. In addition to this, program loops are brought in from many points throughout the grounds. At these points remote programs are picked up, amplified and sent over the loops to the main control room, from which place they are routed either to the ether or over audio channels within the grounds.

SEVEN "AUDIO" STATIONS

There are seven audio broadcast stations which supply both announcements and music to practically every square yard of the Exposition grounds. Five of these stations are wide-range set-ups, the speaker banks consisting of horn projectors equipped with moving-coil units for the higher frequencies and dynamic loudspeakers equipped with baffles to cover the low-frequency end of the audio spectrum. The division of frequency between the middle and high range, and the low range, occurs at 800 cycles. The other two audio stations are largely intended for use as individual public-address stations and originating points. These two stations are located at the Organ Amphitheatre and at the Ford Bowl. Permanent remote-control equipment is installed for picking up programs from the Cafe of the World, the Ford Music Bowl and the Patio of the Ford Building, as well as the Spreckles Amphitheatre. From these locations programs are regularly picked up and broadcast both over the air and over the audio chain within the grounds.

PROGRAM LOOPS

In addition to these permanent pickup points, there are some twelve or fourteen others from which programs are occasionally picked up. Program loops and private telephone loops are permanently installed at these spots, but portable pickup equipment is installed only when programs are to originate there. All incoming program loops as well as outgoing loops are grouped in a number of patching strips whereby any incoming program, either from a remote position or from Studio A or B, or from the transcription equipment, can be transmitted to any one or all of the loudspeaker audio stations.

In addition to the above sources of programs, a radio receiver is installed so that radio programs may likewise be transmitted over any of the channels. It will be noted from the accompanying block diagrams that wide-range equipment is used throughout. The program amplifiers and monitoring amplifiers in every instance are of the latest type.

FREQUENCY DIVIDING SYSTEM

In the case of the audio stations, the program is fed over loops into an inter-
mediate amplifier, which in turn feeds the power amplifier. In the case of two of the stations, one in the Arch of the Future in the Plaza del Pacifico and the other on top of the Hollywood Hall of Fame Building, a slightly different frequency-dividing arrangement is utilized. More audio power is required at these stations. The incoming loop feeds an amplifier, and an 800-cycle dividing network is led by this amplifier through an auto transformer. The high-frequency end of this dividing network then leads into a power amplifier, the output of which supplies the high-frequency speakers. The low-frequency end of this network is likewise led into an amplifier which supplies the low-frequency speakers through a loud-speak filter. The object of the filter is, of course, to limit high-frequency harmonics generated in the low-frequency amplifier should the overload point be approached at any time.

**LAYOUT OF SYSTEM**

The accompanying block diagrams give the entire layout. In Fig. 1, in the upper left-hand corner is shown the equipment installed in Studio A. Directly below it, that in Studio B. Directly below 6 Studio B are the various remote-program loops coming into the main control room. In the top right-hand corner of Fig. 1 are shown the outgoing loops to both Columbia and the National Broadcasting Company, as well as to the Telephone Company Toll. Directly below that are shown the loops to the various audio-loud-speaker stations within the grounds. All jacks shown, together with patch cords, are located altogether in four patch bays.

Fig. 2 shows the block diagrams of the audio stations at three locations.

Fig. 3 shows the equipment at three remote radio pickup stations.

Programs at the Exposition start at 10 A. M. and conclude at 11 P. M. There are no quiet periods. The procedure of operation is exactly the same as in chain broadcasting. Change-overs are made to the second with the usual cues and announcements.

The management of the Exposition, as well as the Associated Oil Company which has sponsored this system, have actually received thousands of complimentary comments, both written and oral, about the system.

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**FOREIGN RADIO MARKETS**

(Continued from page 18)

observed results of developments for us in England. He accompanied me on all my visits to the various laboratories during my stay in connection with this subject. He knows the engineers who are doing the work—he knows the manufacturers who are making the receiving equipment—he knows the people at B.B.C., which will present the programs.

While the General Post Office is still considering the renders of Baird Television Co., Ltd., and the Electrical and Musical Industries, Ltd., for the construction of the two stations to be erected at the Alexandra Palace, the air is still thick with rumors as to how far and how soon the public broadcast of television will progress. Each company directly interested in television is handling its affairs in its own particular way with little or no reference to each other.

Although it is now known that the Alexandra Palace, London, has been definitely chosen as the site of the high-definition television station for the London area, and that two different systems are to be given an opportunity of demonstrating their capabilities, it is important that the facts in regard to television should be clearly presented. Otherwise there is likely to be a good deal of disappointment; there is also danger that an imperfect realization of the true position may have an adverse effect on the manufacture and sale of sound-broadcasting receivers in the immediate future.

The two systems to be tried at the Alexandra Palace will be the Baird, using 240 lines, 25 picture traversals and 25 complete frames per second, and the Marconi-E. M. I., with 405 lines, 25 pictures, interlaced to give 50 frames each 202½ lines per second. Schemes for ultra short-wave, high-definition television services have been based on the belief that wavelengths below eight meters have optical characteristics. There is, however, reason to doubt whether this assumption is fully justified. Experiments made by the Marchese Marconi in the Mediterranean first suggested that the range of ultrashort waves was a good deal greater than the limit of optical visibility. Now, it seems that British Post Office engineers are picking up and resolving the Berlin television transmissions and that these have even been received in Buenos Aires. The theory of propagation of radio waves would appear to be still in need of revision—whether another ionized layer above the Appleton is at work, or whether there is some other cause for the distant reception of ultrashort waves has yet to be ascertained. Whatever the reason may be, it is evidently necessary to discover its nature and the manner in which it may be expected to affect reception on ultra short wavelengths before it will be safe to proceed with the erection of a number of transmitters using the same wavelengths—a scheme which seemed quite practicable heretofore.

SEPTEMBER, 1935
The following pages contain information which it is believed will be of value to executives, engineers and purchasing agents. The companies listed are recognized sources of supply whose products thru past and present acceptance and use by the radio and allied industries, have achieved a reputation for merit and satisfactory performance.

In presenting this information, Radio Engineering assumes no responsibility for omissions. We have tried to give comprehensive and accurate information. We have tried to make the information usable and as complete as possible. If we have unintentionally overlooked or omitted information, we'll be only too glad to have it brought to our attention and will make any needed additions in a following issue of the publication.

For the purpose of brevity and convenience, the listings are grouped in rather broad classifications which include groups of related materials or components. See Index below.

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**Our readers are cordially invited to communicate with us at any time concerning products which they are interested in purchasing. We will be glad to give prompt, unbiased information regarding sources of supply.**
ALLOY TRANSFORMER CO. [See page 32]
28 Liberty St., New York City. Equilizers, Chokes.

AMERICAN BRIDGE CO.

AMERICAN MICROPHONE COMPANY
Los Angeles, Calif. Microphones of All Kinds. New York Office: 27 Park Place, N. Y. C.

AMERICAN TRANSFORMER COMPANY
175 Emmet Street, Newark, N. J. Date of Organization: 1900.

PRODUCTS
Standard and Special Transformers for Audio, Plate, Filament, Power and Modulation Circuits; Audio and Filter Ractors, Transformers and Reactors for use in Laboratories and with Special Electronic Devices; Power Distribution and Special Industrial Transformers; Testing Sets for Oil, Paper, Cable and Insulation; Spot Welding Machines.

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E. H. Bard .................... Purchasing Agent

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Vice-President .... Wm. Rottenburg, Purchasing Agent; Murray Simon
Advertising Mgr. .............. Forman Gold

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46 Hubbard Road, Youngstown, Ohio.

PRODUCTS
Crystal Microphones, Contact Microphones, Phone Pickups, and Cardiophones.

EXECUTIVE
President .......... F. H. Woodworth, General Mgr.; C. E. Semple, Jr., Vice President; Engineering; C. M. Choping

BRANCH OFFICES OR REPRESENTATIVES
C. C. Baines Sales Co., 4017 River Park Drive, Louisville, Ky.
R. L. Cooper, 1971 Morrill Ave., Kansas City, Mo.
Merton A. Dobbin, 427 Postal Bldg., Portland, Oregon.
B. J. Fitter Company, 151 E. Elizabeth St., Detroit, Mich.
M. E. Foster Company, 601 Cedar Lake Road, Minneapolis, Minn.
General Engineers, 2205 Law Street, Dallas, Texas.
Walter V. Geisert, Volunteer Bldg., Atlanta, Ga.
L. H. Jackman, 3643 E. 7th St., Cleveland, Ohio.
D. R. King, King Sales Co., 2031 W. Cyborn St., Milwaukee, Wis.
Conrad R. Strasser, 1076 N. Fairfax, Los Angeles, Calif.
James H. Southard, 420 Market Street, San Francisco, Calif.
Wesley S. Scharp, 67 W. 46th St., New York, N. Y.

EXPORT
C. O. Brandes, 3716 East Euclid Ave., Cleveland, Ohio.

AUDAK COMPANY
305 Fifth Ave., New York City. Pickups.

BEACON MICROPHONE CO.
590 Summer Street, Akron, Ohio. Microphones.

BELL SOUND SYSTEMS, INC.
61 E. Goodale St., Columbus, Ohio. Portable P-A Equipment.

BLAW-KNOX CO.

BLEILY ELECTRIC COMPANY
257 Union Station Bldg., Erie, Pa.

PRODUCTS
Piezo-Electric quartz crystals, holders and covers for transmitters, receivers, monitors and standards.
Broadcasting and Public Address Equipment
(Continued)

GATES RADIO & SUPPLY COMPANY
Main Office and Factory—Quincy, Illinois.

PRODUCTS
Broadcast Station Apparatus, Public-Address Equipment, Centralized Sound Apparatus, Talking-Picture Equipment and other Apparatus in the Sound Communication Field.

EXECUTIVES

GENERAL ELECTRIC CO.
Schenectady, New York.

GENERAL RADIO COMPANY
30 State Street, Cambridge, Mass.

PRODUCTS
Radio and Electrical Laboratory Apparatus and Accessories.

EXECUTIVES

BRANCH OFFICES OR REPRESENTATIVES

HAMMARLUND MANUFACTURING COMPANY, INC.
414 West 33rd Street, New York City.

Established for over a quarter of a century.

PRODUCTS
Midget condensers, Miniature and Straight Line capacity types; dual Midget condensers, all types; transmitting condensers; standard miniature condensers; flexible couplings; short-wave and ultra short-wave coil forms and kits; Insulation sockets: tube shields: "ultra-plan" I.F. transformers and oscillators: heavy duty transmitting chokes: high impedance and shielded R.F. chokes; adjustable padding condensers. Midget triplers and equalizers: X. C. 100 Superheterodyne receivers for high frequency and all frequency coverage. Other special units are Western Union Call-boxes and other precision devices.

EXECUTIVES

BRANCH OFFICES OR REPRESENTATIVES
1438 North 12th Street, Philadelphia, Pennsylvania.
55 Kilby Street, Boston, Massachusetts.
9 South Clinton Street, Chicago, Illinois.
125 East Elizabeth Street, Detroit, Michigan.
1400 West 23rd Street, Cleveland, Ohio.
943 East Pico Street, Los Angeles, California.
1204 Polson Street, San Francisco, California.
977 South West Oak Street, Portland, Oregon.
Box 401, Station "A," Dallas, Texas.

EXPORT
Rocke International Co., 15 Light Street, New York City.
White Radio Co., Canadian Representative, 41 West Avenue, North Hamilton, Ontario, Canada.

HARVEY RADIO LABS.
12 Boylston St., Brookline, Mass. High Frequency Equipment

HEINTZ AND KAUFMAN, LTD.
311 California Street, San Francisco, California. Transmitting tubes.

INT'L BROADCASTING EQUIPMENT CO.
312 W. 51st Street, Chicago, Ill. Frequency Monitors—Amplifiers.

THE INT'L DERICK & EQUIPMENT CO.
650 Michigan Ave., Columbus, Ohio. Radio Towers.

JENKINS & ADAIR, INC.
333 Belmont Avenue, Chicago, Ill. Monitors-Microphones, etc.

KELLOGG SWITCHBOARD & SUPPLY CO.
106 W. Adams Street, Chicago, Ill. Microphones.

KENYON TRANSFORMER CO., INC. (See page 32)
440 Barry St., New York City. Trolleys, Choppers, etc.

LEAR DEVELOPMENTS, INC.
125 W. 17th St., New York City. Aircraft Equipment.

MACY ENGINEERING CO.
1452 39th St., Brooklyn, N. Y. Directional Baffles.

MEYER KOULICH CO., INC.
64 Fulton St., New York City. Recording Needles. Styli.

MOREL ELECTRIC CO.
100 Fifth Avenue, New York City.

PRODUCTS
Amplifiers and P.A. Equipment.

MIRROR RECORDING CORP.
58 W. 25th Street, New York City. Aluminum Discs.

D. W. ONAN & SONS
503 Royalton Ave., Minneapolis, Minn. Power Plants.

OPEROadio MFG. CO.
St. Charles, Ill. Amplifiers—Sound Equipment.

PHILCO RADIO & TELEVISION CORP.

B. A. PROCTOR CO., INC.
17 W. 60th Street, New York, N. Y. Recording Equipment.

PRESTO RECORDING CORP.
159 W. 19th Street, New York, N. Y.

PRODUCTS
Recording Equipment—Instantaneous. Amplifiers, Tuners, Playback Machines. Chemically Coated Discs for Instantaneous Recording.

EXECUTIVES
President Sol Sholes Electrical Engineer George Saliba Vice-President M. M. Graber Advertising Mgr. N. N. Sholes

EXPORT
W. J. Witte, 1880 Mendez, Buenos Aires, Argentina.

Export inquiries direct to main office in New York City.

RACON ELECTRIC CO., INC. (See page 30)
52 E. 19th Street, New York City. P.A. Equipment.

RADIO INSTRUMENT CO.
22 Wooster Street, New York City.

PRODUCTS
Oscillographs, Oscillators.

RADIO RECEPTOR CO., INC.
106 Seventh Avenue, New York City.

PRODUCTS
Microphones, P.A. Equipment.

THE RADIANT CORP.
State Avenue, Cleve land, Ohio. Amplifiers.

RADIOTONE RECORDING COMPANY
6063 Melrose Avenue, Hollywood, Calif.

PRODUCTS

EXECUTIVES
President W. H. Snow Chief Engineer W. H. Snow General Manager F. H. Brown Production Mgr. C. E. Butterworth

EXPORT
Ad Aumentum, Inc., 116 Broad Street, New York, N. Y.

RADIO TRANSCEIVER LABS.
86-21 115th Street, Richmond Hill, N. Y. Transceivers.

RAYTHEON PRODUCTION CORP.
DELTA DIVISION
Newton, Mass. Receivers.

RAWSON ELECTRICAL INSTRUMENT CO.

RCA MANUFACTURING CO., INC. (See page 34)
RCA RADIOTRON DIVISION
Camden, N. J.

PRODUCTS

EXECUTIVES
Chairman David Sarnoff President E. T. Cunningham Executive Vice-President, G. K. Throckmorton

RCA VICTOR DIVISION
Camden, N. J.

PRODUCTS

EXECUTIVES
Chairman David Sarnoff Vice-President in Charge of Engineering and Research G. K. Throckmorton

REMLER COMPANY, LTD.

SCIENTIFIC RADIO SERVICE
124 Jackson Avenue, University Park, Hyattsville, Md. Crystals.

SHALLCROSS MFG. CO.
Collinsville, Pa.
Testing Equipment—Attenuators, Decades, etc.

RADIO ENGINEERING
ISOLANTITE PLAYS AN IMPORTANT ROLE IN THE MODERN BROADCAST TRANSMITTER

The 50KW Transmitter recently built by Western Electric for Station WOR employs ISOLANTITE liberally.

In this up-to-date station are strain insulators, concentric transmission line spacers and end seals, stand-offs, switches, shafts, inductance supports, power and rectifier tube supports, condenser cases, pedestals and many other parts of ISOLANTITE.

To improve your equipment, specify ISOLANTITE insulation. Isolantite Inc., 233 Broadway, New York, N. Y. Factory at Belleville, N. J.

Represented by GRAYBAR ELECTRIC CO.
Broadcasting and Public Address Equipment (Continued)

SHURE BROTHERS COMPANY
215 West Huron Street, Chicago, Illinois.

PRODUCTS
General Purpose Diaphragm and High-Fidelity (Wave-Equalized) Sound-Cell Type Crystal Microphones; General Purpose and High-Fidelity (Wave-Equalized) Condenser Microphones; Single- and Double-Button Carbon Microphones (Voice to High Quality types); Power Supplies; Pre-Amplifiers; Microphone Stands and Accessories; Mixing and Input Transformers; Microphone Cords.

EXECUTIVES
President................. S. N. Shure
BRANCH OFFICES OR REPRESENTATIVES
R. R. Bauman, 2168 Ann Arbor St., St. Paul, Minn.
W. T. Croydell, 956 Lafayette Ave., Buffalo, N. Y.
R. C. James, c/o Northwestern Agencies, 3rd Ave. & Vine St., Seattle, Wash.
Leonard C. Kahn, 422 Wilkinson Bldg., Omaha, Nebraska.
F. Edwin Schmidt, 156 Liberty St., New York, N. Y.
O. H. Smith, 215 W. Huron St., Chicago, Ill.
J. A. Wherry, 434 Camp Street, New Orleans, La.
J. F. Ray, Ray Sales Co., 34 S. Cincinnati, Tulsa, Oklahoma.
Clayson, c/o Harry R. Gehrbart, 55 Kelly St., Boston, Mass.
Henry W. Burwell, 593 Peachtree St., N. E., Atlanta, Ga.
W. Bert Knight, 115 W. Venice Blvd., Los Angeles, Calif.
J. Earl Smith, P. O. Box 1805, Dallas, Texas.
A. C. Simmonds, 218-220 Front St. E., Toronto 2, Ontario, Canada.

EXPORT
Through own or local agents.

SOUND ENGINEERING CORP.
412 N. Lawns Street, Chicago, Ill. Amplifiers.

SOUND SYSTEMS, INC.
1311 Terminal Tower, Cleveland, Ohio.

PRODUCTS
Amplifiers; Pre-Amplifiers; P. M. Speakers: Crystal Microphones; Automatic Turntables; Complete Sound Systems for schools, hospitals, and hotels; Portable Systems for all types of work; Aluminum Trumpets; Electro-Dynamic Units: Exciters.

EXECUTIVES
President................ Edward L. Gove
Vice-President........... C. A. Hyde
General Mgr............. K. J. Banier
Sales Mgr................ P. R. Buss
Purchasing Agent........... T. J. Banier
Advertising Mgr........... A. Korh

BRANCH OFFICES OR REPRESENTATIVES
Wasley W. S. Scharp, 67 West 44th Street, New York City.
C. O. Brandes, Export Manager, 516 Enclid Ave., Cleveland, Ohio.

STROMBO-CARLSON TEL. MFG. CO.

THOMASTON LABS, INC.
220 42nd Street, New York City. Microphones.

TRUSCON STEEL BLDG.
Youngstown, Ohio. Radio Transmitting Towers.

TURNER COMPANY
700 3rd Avenue, Cedar Rapids, Iowa. Microphones.

UNITED ELECTRONICS CO.
43 Spring Street, Newark, N. J. Transmitting Tubes.

UNITED TRANSFORMER CORP. (See Page 32)
72-78 Spring Street, New York City.

UNIVERSAL MICROPHONE COMPANY, LTD.
423 Warren Lane, Englewood, Calif.

Microphones—all types for broadcasting, amateur and sound uses.

EXECUTIVES
President................ James R. Flood
Advertising Mgr........... Ralph L. Power

THE WEBSTER COMPANY
3837 W. Lake Street, Chicago, Ill. Amplifiers.

WEBSTER ELECTRIC COMPANY

WESTERN ELECTRIC COMPANY, INC.
195 Broadway, New York City.

Founded in 1896. Since 1882 it has been the manufacturer of communication apparatus for the Bell Telephone System. Its research and engineering work is conducted by the renowned Bell Telephone Laboratories. The Company has three principal manufacturing plants located at Chicago, Ill., Baltimore, Md., and Kenney, N. J.

PRODUCTS

WESTINGHOUSE ELEC. & MFG. CO.

WESTON ELEC. INST. CORP. (See page 34)
Newark, N. J. Meters.

WHOLESALE RADIO SERVICE CO.
100 Sixth Avenue, New York City. Amplifiers.

Coils and Coil Forms

Radio Frequency
(For Choices, Speaker Coils, etc., see listings under Transformers)

ALADDIN RADIO INDUSTRIES, INC.
4045 Diversey Avenue, Chicago.

PRODUCTS
Radio Coils.

COILS, INC.
1229 Chapman Street, Providence, R. I.

ELECTRICAL WINSING CORP.
23-26 Wooster Street, New York City.

PRODUCTS
Radio Coils.

EXECUTIVE
President................ Benjamin Vilkenerson

FERROCART CORP.
1229 RCA Building, New York City.

GENERAL MANUFACTURING CO.
8066 S. Chicago Avenue, Chicago, Ill.

EDWIN I. GUTHMAN & CO., INC.
1036 W. Van Buren Street, Chicago, Ill.

PRODUCTS
Radio Coils, Chokes, Oscillators, I-F Transformers, R-F Amplifier and Antenna Coils.

EXECUTIVES
President................ Edwin I. Guthman
Vice-President.............. Seymour Rothschild
General Mgr.............. Edwin I. Guthman
Sales Mgr................ H. J. Funk
Advertising Mgr............ Seymour Rothschild

BRANCH OFFICES OR REPRESENTATIVES
P. Saffler, 27 Warren St., New York City, N. Y.
M. Friedman, 600 Christian St., Philadelphia, Pa.
Edward H. Himmann, 2142 Berkeley St., St. Paul, Minn.
L. H. Jackson, 3943 E. 77th St., Chicago, Ill.
R. Smith, 912 Commerce St., Dallas, Texas.
G. O. Tanner, 600 Grant St., Pittsburgh, Pa.
R. A. Adams, 940 Dexter St., Detroit, Mich.
Geo. D. Norris, 303 E. Pike St., Seattle, Wash.

EXPORT
M. Simons & Son Co., 25 Warren St., New York City, N. Y.

HAMMARLUND MFG. CO. (See page 24)
424 W. 32nd Street, New York City.

MEISSNER MFG. CO.
522 S. Clinton Street, Chicago, Ill.

SICKLES COMPANY
109 Main Street, Springfield, Mass.

PRODUCTS
Radio Coils.

BRANCH OFFICES OR REPRESENTATIVES
Edward Speigel, 384 West 32nd Street, New York, N. Y.
Harry Gerber, 54 Portland Street, Boston, Mass.

UNIVERSAL WIRELESS CO.
300 Main Street, Springfield, Mass.

PRODUCTS
Coll. Wiring & Picture shows.

EXECUTIVES
President............... R. A. Leeson
Vice-President............... R. L. Chisholm
Sales Mgr................ R. Leeson, Jr.

BRANCH OFFICES OR REPRESENTATIVES

UNIVERSAL WIRELESS CO.
200 Main Street, Springfield, Mass.

PRODUCTS
Coll. Wiring & Picture shows.

EXECUTIVES
President............... R. A. Leeson
Vice-President............... R. L. Chisholm
Sales Mgr................ R. Leeson, Jr.
SEVISON MAGNETO ENG. CO.
379-401 Phillips Avenue, Toledo, Ohio.

PRODUCTS
Small paper condensers.

SOLAR MFG. CORP.
599-601 Broadway, New York City.

PRODUCTS
Wet and Dry Electrolytic Condensers; Mica Condensers; Trimmer and Padding Condensers; Eim-O-States; Condenser Testers.

EXECUTIVES
President.................. Otto Paschke
Chief Engineer.......... Paul Hetenyi
Vice-President........ Paul Hetenyi
Production Mgr........ J. A. Poitras
Sales Mgr .............. W. C. Harter
Purchasing Agent...... George Sexton
Advertising Mgr......... Sylvan Wulin

SPRAGUE SPECIALTIES CO.
No. Adams, Massachusetts. All types.

SANGAMO ELEC. CO.

TOBE DEUTSCHMANN CORP.
Canton, Massachusetts. Paper Condensers, Filters, etc.

Condensers, Variable

ALLEN D. CARDELL MFG. CO. (See page 23)
81 Prospect Street, Brooklyn, N. Y.

DEJUR-AMSCO CORP.
95 Morton Street, New York City.

GENERAL INSTRUMENT CO.
253 Varick Street, New York City.

Hammarrlund MFG. CO. (See page 24)
424 W. 3rd Street, New York City.

OAK MFG. CO.
711 W. Lake Street, Chicago, Ill.

PRECISE MFG. CO.
254 Mill Street, Rochester, N. Y.

Radio Condenser Co.
Davis Street & Copeland Avenue, Camden, N. J.

RELIANCE DIE AND STAMPING CO.
1260 Cygnet Avenue, Chicago, Ill.

SCOVILL MFG. CO.
Waterbury, Conn.

UNITED SCIENTIFIC LABS.
510 Sixth Avenue, New York City.

Insulation, Molded and Laminated
(Molding Powders)

BAKELITE CORPORATION
247 Park Avenue, New York, N. Y.

PRODUCTS

BRANCH OFFICES OR REPRESENTATIVES
Main Office—247 Park Avenue, New York.
Research and Office—230 Grove Street, Brookline, N. J.
Plant and Office—River Road, Bound Brook, N. J.
Office—206 East Avenue, Cleveland, Ohio.
Office—105 West Street, Chicago, Illinois.
Office—410 Asylum Street, Hartford, Connecticut.

CONTINENTAL DIAMOND CO.
Newark, Delaware.

FORMICA INSULATION CO.
404 Spring Grove Avenue, Cincinnati, Ohio.

GENERAL ELECTRIC CO.
Schenectady, New York (Textile)

GENERAL PLASTICS, INC.
North Tonawanda, N. Y. Durez.

MICA INSULATOR CO.
200 Varick Street, New York, N. Y.

PRODUCTS
Built-Up Mica Plate (Micanite) for transformers and the like; Raw Mica Fabricated Parts, such as Condenser Fins, Tube Supports, etc.; Varnished Fabric and Paper; Varnished Canvas Tubing; Laminated Bakelite Sheets, Tubes, Rods and Fabricated Parts.

EXECUTIVES
President........ M. A. Chapman
Vice President........ C. H. Bell

BRANCH OFFICES OR REPRESENTATIVES
Mica Insulator Co., Sales and Executive offices, 200 Varick Street, New York, N. Y.

Mica Insulator Co., Branch Office in Chicago and Cleveland.

Eberh & Kirkman, Birmingham, Alabama.


NAT'L VULCANIZED FIBRE CO.
Wilmington, Delaware.

SEPTEMBER, 1935
Insulation, Molded and Laminated (Continued)

RESINOX CORPORATION
Sales Offices—Terre Haute, Indiana.

SYNTHANE CORPORATION
Oaks, Pa. (near Philadelphia)
New plant constructed and production started during March 1929

PRODUCTS
Synthane Laminated Bakelite; Sheets; Rods; Tubes; Fabricated Parts; Stabilized Reel Material; Synthane Radiogerm Tubing; Synthesisographic Process for making parts. The Synthane Corporation will furnish, or on demand fabricate, Laminated Bakelite for the following: Coil Forms for Broadcast and Short-Wave Coils; Coil Forms for Transformer Coils (power or audio); Terminal Strips for connecting blocks; Plug Base, or Speaker Connections; Antenna Switch or Plug Plugs with markings stamped or printed; Trimmer Condenser Bases; Fixed Condenser Bases; Strips for winding Resistance Coils; Panels and Subpanels; Insulating Washers and Bushings; Gears; Pipe Bases; Dual Light Mountings; Turning Dials; Light Diffusing Discs; Plug and Pin Plugs; Forms for Mounting R-F Choke Coils; Short-Wave Switch Stator and Motor Mountings: 4, 5, 7, and 8-Pin Tube Sockets; Loudspeaker Plug Sockets; Volume Control Strips for Resistance Coils; Insulated Arms; Bases for Volume or Tone Controls; Heat Resisting Bakelite Strips; Loudspeaker Coil Forms; Voice Coil Bobbins; Speaker Spacers; Terminal Strips; Field Coil Separation; Condenser Shelf Brackets; Washers, Bases. Bakelite Tops, Insulating Washers for Metal-Tube Control Grid.

EXECUTIVES
President.................................R. R. Terry
Vice-President and Secretary...................J. E. Ritchenhouse
Chief Engineer.........................S. W. Place

BRANCH OFFICES OR REPRESENTATIVES
Synthane Corporation is represented in all the principal cities in the country. Immediate and personal service on a national scale is a feature of this organization.

EXPORT
Export shipments to Europe and Asia are handled through the New York and San Francisco offices.

WESTINGHOUSE ELEC. & MFG. CO.
E. Pittsburgh, Pa. (Micanita)

WILMINGTON FIBRE CO.
Wilmington, Del.

Resistors, Controls and Rheostats
Fixed and Variable Resistances, Carbon and Wire-Wound—Volume and Tone Controls, Voltage Regulators, Suppressors, Etc.

AEROVOX CORP. [See page 27]
80 Washington St., Brooklyn, N. Y.

ALLEN-BRADLEY COMPANY
126 West Greenfield Avenue, Milwaukee, Wisconsin

PRODUCTS
Fixed Radio Resistors, Spark Plug Suppressors, Bradleys, and other Variable Resistors. Filament Rheostats, Adjustable Grid Lamps, and a complete line of Industrial Electrical Controlling Apparatus, such as Motor Starters, Controllers, Contactors, Relays, etc.

EXECUTIVES
President..................Lynde Bradley
Vice President............Harry L. Bradley
General & Sales Mgr. F. F. Loock
Chief Engineer............G. W. Wilkins

BRANCH OFFICES
In all leading cities.

EXPORT
Rocke International Electric Corp., 12 Light St., New York, N. Y.

AMPERITE CORP. [See page 23]
561 Bemis St., New York City.

CENTRALAB
300 East Kemper Avenue, Milwaukee, Wisconsin.

PRODUCTS
Variable Resistors and Fixed Resistors manufactured primarily for radio service. Power Rheostats.

EXECUTIVES
President................E. E. Stocker
Vice President............H. E. Osmun
General Mgr. F. F. Loock
Sales Mgr. H. E. Osmun

EXECUTIVES
President................E. E. Stocker
Vice President............H. E. Osmun
General Mgr. F. F. Loock
Sales Mgr. H. E. Osmun

CLEAROMAT MANUFACTURING COMPANY
203 N. Sixth Street, Brooklyn, N. Y.

Established in 1928, succeeding the American Mechanical Labs.

PRODUCTS
Wire Wound Volume Controls, Potentiometers, Fixed Resistors, Ballast Resistors, Tone Controls, Rectifiers, Transformer Mounts, Flexible Resistors, Noise Suppressors—Composition Element Volume Controls, Potentiometers, Tone Controls—Composition Type Rheostats—Fractional Horse Power Motor Speed Controls.

EXECUTIVES
President...................John J. Mucha Chief Engineer................George Mucha
Controller................N. W. Mucha
Production Mgr...........S. H. Mucha

BRANCH OFFICES OR REPRESENTATIVES
L. G. Cushing Co., 9 S. Clinton Street, Chicago, Ill.
A. M. Baer, 1400 W. 25th Street, Cleveland, Ohio.
B. L. Moore, Jr, 219 Starm Ocean Avenue, Buffalo, N. Y.
R. S. Jurin, 225 E. Pike Street, Los Angeles, Calif.
W. J. Oso, 503 Mission Street, San Francisco, Calif.
J. M. Carpenter, 1394 Vincon Avenue, Memphis, Tenn.

EXPORT
M. Simons & Son. 25 Warren Street, New York City.

CONTINENTAL CARBON, INC.
3250 Avenue of the Americas, New York City.

CHICAGO TELEPHONE SUPPLY COMPANY
1142-1228 W. Beardsley Avenue, Elkhart, Ind. Volume Controls.

ELECTRAD, INC.
175 Varick Street, New York City. Resistors, Suppressors and Controls.

ERIE RESISTOR CORPORATION
644 W. 12 Street, Erie, Pa.

PRODUCTS
Fixed and Variable Carbon Resistors, Molded Carbon Resistors and Molded Carbon Suppressor Resistors.

EXECUTIVES
President..................G. P. Fitting
Vice-President............G. R. Fitting
Sales Mgr..........W. H. Fitting
Purchasing Agent..........C. M. Evers
General Manager........H. C. Sheri

BRANCH OFFICES OR REPRESENTATIVES
S. W. Black Jr. 117 26th Street, New York City.
E. F. Miller, 265 W. Wacker Drive, Chicago, Ill.

EXPORT
Erie Resistor of Canada, Ltd. 49 Bathurst Street, Toronto, Canada.

GLOBAR CORP.
Nicholas Falls, New York.

HARDWICK, HINDE, INC.
46 Heron Street, Newark, N. J. Wound.

INTERNATIONAL RESISTANCE CO.
2100 Arch Street, Philadelphia, Pa.

PRODUCTS

EXECUTIVES
President....................Ernest Searing
Vice-President............Fred D. Williams
Production Mgr...........M. W. Wassick
Sales Manager...........Daniel J. Fairbanks
Purchasing Agent........H. J. Bethany
Advertising Mgr...........D. J. Fairbanks

BRANCH OFFICES OR REPRESENTATIVES
Dallas, Texas
Cleveland, Ohio
Buffalo, New York
Chicago, Illinois
Detroit, Michigan
Cedar Rapids, Iowa
Boston, Mass.
San Francisco, Calif.

EXPORT
International Resistance Co. Ltd., Toronto, Canada.
International Resistance Co., Copenhagen.
International Resistance Co., France.
International Resistance Co., Italy.
Other Offices in Australia, New Zealand, South America, Mexico and most countries.

LYNCH MANUFACTURING CO., INC.
405 Lexington Avenue, New York City.
P. R. MALLORY & CO. (Yale Div.)
1028 E. Washington Street, Indiana, Ind.

MICOMALD RADIO CORP.
1097 Flushing Avenue, Brooklyn, N. Y.

THE MUTER CORP. [See page 27]
1250 S. Michigan Avenue, Chicago, Ill.

OHIO CARBON COMPANY
1250 Berea Road, Cleveland, Ohio.

OHMITE MFG. CO.
675 N. Albany Avenue, Chicago, Ill.

PRECISION RESISTOR CO.
384 Bedger Avenue, Newark, N. J.

Page 28
An invitation

- We invite you to benefit by our experience gained in the design and manufacture of 6, 12, 32 and 110 volt power units for all makes of radios. Our experienced engineering staff along with a well equipped laboratory and a modern, up-to-date plant enables us to offer you the same efficient service and quality workmanship we have been able to render others.

- As the world’s largest exclusive manufacturer of vibrators and vibrator power supplies, we are in a position to be of valuable assistance to radio engineers, designers, and manufacturers and solicit the opportunity to offer helpful suggestions in radio power supply problems. Please write for complete details.

ELECTRONIC LABORATORIES, INC.
122 WEST NEW YORK STREET, INDIANAPOLIS, INDIANA

HAMMARLUND
Trimming, Padding and I. F. Tuning
CONDENSERS

A MOST complete line of small adjustable condensers—the result of ten years of specialization on the exacting requirements of the radio industry.

Isolacite or Bakelite bases; air or mica dielectric; phosphor bronze spring plates; brass, self-aligning adjusting screws; in a large variety of sizes, shapes and ratings. Actual minimums are lower and actual maximums are higher than stated ratings. Individually tested for capacity range, power factor and for breakdown at 500 volts D.C.

Special models made to specifications.
If you want condenser quality at interesting prices, put your problems up to HAMMARLUND.

See the Difference Good Design Makes

Write Dept. RG-35 for Complete Catalog. Send specifications for quotation on special designs.

HAMMARLUND MFG. CO.
424-438 W. 33rd St., New York
Resistors, Controls, Rheostats, Etc. (Continued)

(Continued from page 28)

PRODUCTS Wire-wound Resistors exclusively.

EXECUTIVES

Production Manager........A. H. Mellick

SHALLCROSS MFG. CO.
700 Parker Avenue, Collingdale, Pa. (Wire-wound).

SPEER RESISTOR CORP.
St. Marys, Pennsylvania

STACKPOLE CARBON CO.
Tannery Street, St. Marys, Pennsylvania.

PRODUCTS


EXECUTIVES

President........H. C. Stackpole Chief Engineer.........J. V. Dobson Vice President & Gen. Mgr. ....H. S. Conrad Sales Manager........H. S. Conrad Purchasing Agent........L. F. Joyce

BRANCH OFFICES OR REPRESENTATIVES

Arthur C. Beckert, 1112 Durand Street, Saginaw, Michigan.

SOLAR MFG. CORP. [See page 27]
599 Broadway, New York City.

TECH LABORATORIES
703 Newark Avenue, Jersey City, N. J. Resistors, Volume Controls.

S. S. WHITE DENTAL MFG. CO.
10 East 44th Street, New York City.

PRODUCTS

Molded Resistors; Flexible Shunting for Remote Controls.

WARD LEONARD ELECTRIC CO.
Mt. Vernon, New York.

WIRT COMPANY
5221 Greene Street, Philadelphia, Pa.

Sockets, Dials, Switches, Jacks, Plugs, Executheons, Nameplates, Binding Posts, Knobs, etc.

THE D. L. AULD COMPANY
5th Avenue and 5th Street, Columbus, Ohio

ALDEN MANUFACTURING CO.
Campello Station, Brockton, Mass.

BASTIAN BROS. CO.
1600 N. Clinton Avenue, Rochester, N. Y.

BEST MANUFACTURING CO.
1200 Grove Street, Irvington, N. J.

CINCH MANUFACTURING CORPORATION
2333 W. Van Buren Street, Chicago, Ill.

CROWE NAME PLATE & MFG. CO.
1749 Grace Street, Chicago, Illinois.

PRODUCTS

Tuning Units, Executheons (Embroided and Etched), Remote Controls (Auto Radio), Grills and Metal Trim for Cabinets, Dials and Scales. Nameplates (metal), Radio Cabinets (metal).

EXECUTIVES

President........F. C. Coolidge Purchasing Agent........G. C. Mass Radio Sales Manager........Lawlow C. Goodwin

THE H. H. EBY MFG. CO.
2066 Hunting Park Avenue, Philadelphia, Pa.

EDDIE MFG. CO.
9 W. Illinois Street, Chicago, Ill.

GENERAL RADIO CO. [See page 24]
30 State Street, Cambridge, A. Mass.

INSULINE CORP. OF AMERICA
21 Park Place, New York City.

RADIO ENGINEERING

PRODUCTS

Radio Parts—Sockets, Jacks, Phone Plugs, Short-Wave Coils, etc.

EXECUTIVES

President........Samuel J. Spector Chief Engineer........Alex G. Heller

PHILCO RADIO & TEL. CORP.

RCA MFG. CO. [See page 24]
Camden, N. J.

RACon ELECTRIC CO., INC.
52 East 19th Street, New York City.

(Continued on page 25)
Not a rough and tumble player, either . . . but a smooth article, this hero of a million touchdowns.

If it's tough going in the “service game”, change to CENTRALAB and watch your score go up.

For CENTRALAB Controls (a mere handful) do the trick with practically every set ever built.

Centralab smoothness results from the patented Centralab non-rubbing contact whereby a strip of polished metal rocks on the resistor so that the only rubbing action is between an oilless wood bearing and the polished metal.

Centralab
SAVES THE DAY

A UNIQUE MATERIAL WITH WHICH TO WORK

In the fields of radio and electronics, "dag"* Brand colloidal graphite when dispersed in water is proving of great value. This is true particularly in cases where coatings are desired which are electrically conductive, homogeneous, chemically inert and photo-electricly poor. 

These characteristics have been utilized to produce coatings (1) for resistance strips in volume and tone controls; (2) on the grids of radio tubes to retard secondary emission; (3) on the interior of the glass envelopes of various cathode ray tubes as a ray focusing anode material. Technical Bulletins No. A11, C31 and D191 give in detail information concerning the above applications. We will be glad to forward you copies of these Bulletins gratis on request. Our Research Department is ready and eager to cooperate in any problems which you feel might be aided by the use of colloidal graphite.

Centralab
MILWAUKEE, WIS.

RADIOHMS  SUPPRESSORS  FIXED RESISTORS


COLLOIDS CORPORATION
FOUNDED 1908 AS ACHESON OIL-DAG COMPANY
PORT HURON MICHIGAN
AMERICAN TRANSFORMER CO. (See page 23)
175 Emmet Street, Newark, N. J.

CHICAGO TRANSFORMER CORP.
2523 W. Washington Boulevard, Chicago, Ill.

DONGAN ELECTRIC MFG. COMPANY
2067-301 Franklin Street, Detroit, Michigan.

GENERAL TRANSFORMER CORPORATION
920 S. Tiwam Street, Chicago, Ill.

THE HALLDORSON COMPANY
4500 Ravennaswood Avenue, Chicago, Ill.

JEFFERSON ELECTRIC CO.
Bellwood, Illinois.

KENYON TRANSFORMER CO., INC.
840 Barry Street, New York, N. Y.

PRODUCTS
Chokes, Equalizers, Transformers and Reactors.

RCA MFG. CO., INC. (See page 24)
Camden, New Jersey.

THE RADIANT CORPORATION
Saw Avenue at 53rd Street, Cleveland, Ohio.

STANDARD TRANSFORMER CORP.
866 Blackburn Avenue, Chicago, Ill.

THORDARSON ELECT. MFG. CO.
500 W. Huron Street, Chicago, Ill.

UNITED TRANSFORMER CORP.
72-78 Spring Street, New York City.

PRODUCTS
Speciality Transformers for rectifiers, battery chargers medical equipment, lighting circuits, instruments, dry and oil filled equipment, all types Power Transformers; all grades and types Audio Transformers; reactors; Voltage Regulators; Filters; Rectifiers; Amplifiers; Power Amplifier Kits.

EXECUTIVES
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BRANCH OFFICES OR REPRESENTATIVES
Seattle, Wash.--Third Ave at Vine St.
Boston, Mass.--94 Portland St.

VOICE OF THE AIR CO.
210 Phillips Avenue, Toledo, Ohio.

PRODUCTS
Pressed and Molded Forms and Foundations in Paper-Cloth—Composition—Speaker Diaphragms.

EXECUTIVES
President.............Harry Raffles Chief Engineer.........Frank Raffles
Vice President........Frank Raffles Production Mgr........Frank Raffles
Sales Manager........Frank Raffles

EXPRESS &enco.

755 Boylston St., Boston, Mass.

Western Electric Co. (See page 26)
195 Broadway, New York City.

WRIGHT-DE COSTER, INC.
2251 University, St. Paul, Minnesota.

Transformers and Chokes
(Speaker Coils)

THE ACME ELEC. & MFG. CO.
1400 Avenue of the Americas, New York.

PRODUCTS
Radio Transformers, X-ray Transformers, Television Transformers, Voltage Regulators; Industrial Transformers.

EXECUTIVES
President.............G. R. Hillstrom Sales Manager...........C. H. Bunce
Vice President........J. A. Comstock Chief Engineer........J. A. Comstock
Purchasing Agent......J. A. Comstock

BRANCH OFFICES OR REPRESENTATIVES
Adolph Friedman, 220 E. 3rd St., New York, N. Y.

ALLOY TRANSFORMER COMPANY
135 Liberty Street, New York City, New York.

PRODUCTS
Audio Transformers, Power Transformers, Audio and Power Chokes.

EXECUTIVES
President............Leon J. Littman Sales Mgr..............James R. Lone

Speakers and Headphones (Continued)

(Continued from page 30)

PRODUCTS
Loudspeaker, Horns, Electro-dynamic Horn Units, Dynamic Cone Speakers, Public Address Equipment.

EXECUTIVES
President...............A. I. Abraham Sales Mgr..............C. J. Brown
Chief Engineer.........A. I. Abraham Production Mgr.........S. Davis
Advertising Mgr........C. J. Brown

BRANCH OFFICES OR REPRESENTATIVES
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Boston, Mass.------------Denver, Colo.
Tampa, Florida------------Seattle, Wash.
Louisville, Ky.----------Chicago, Ill.
St. Paul, Minn.---------St. Louis, Mo.
Los Angeles, Calif.----------------Buffalo, N. Y.

THE ROLA COMPANY
2360 Superior Avenue, Cleveland, Ohio.

PRODUCTS
Loudspeakers and all kinds of remote sound and public address equipment.

EXECUTIVES
President...............B. A. Engstrom Sales Mgr..............I. Gold
Vice-President...........H. S. Tanny Chief Engineer........B. A. Engstrom
Purchasing Agent........K. Phillips

BRANCH OFFICES OR REPRESENTATIVES
205 East 42nd Street, New York, N. Y.

EXPRESS &enco.

135 Liberty Street, New York City, New York.

PRODUCTS
Audio Transformers, Power Transformers, Audio and Power Chokes.

EXECUTIVES
President............Leon J. Littman Sales Mgr..............James R. Lone

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RADIO ENGINEERING
UTC Linear Standard Audio Units are the finest quality transformers available regardless of price. Each transformer is housed in a high permeability cast iron shield. The transformer illustrated is a high power output transformer. These transformers are individually calibrated and the response is in accordance with the most rigid requirements of outstanding High Fidelity Broadcast Stations.

Write for the M180 R bulletin describing the use of Linear Standard Units. In amplifier circuits having an output of from ½ watt to 1,000 watts. Also includes (1) Input Transformer and Resistance data charts.

UTC Transmitter Components are used by discriminating commercial organizations and experimenters to obtain superior, long lasting results. The unit illustrated is an output transformer designed to match Class B 203’s or A Prime 845’s to a 6,500, 5,000 or 3,500 ohm load.

A typical value in the new CHROMIUM FILAMENT Transformers. Outer shield, chromium plated - bakelite terminal strips with new type solder or screw terminals. Will handle 230’s in bridge rectifier circuit, insulated for 5,000 volts.

A typical CHROMIUM FILAMENT Plate Transformer 900 volts each side of center at 150 M.A. Many other types are described in the new CS-1 Bulletin.

CHROMIUM FILAMENT Stepdown Transformers 220-240 to 110-120 volts, 50, 60 cycles. Available in 8, 12, 15, 25, 50, 900 and 1000 volt capacities.

Some other mechanical arrangements also used in new type induction transformers to filter out any trace of noise coming from the incoming line. Consists of a complete transformer with a double electrostatic shield and a multiple resistance, capacitance filter structure. Available in 75, 125 and 175 volt sizes.

Write for Details.

UNIVERSAL STANDARD UNITS
72-74 SPRING STREET
NEW YORK, N. Y.

Export Division, 18 Laight St., New York City.

"Controlled pointer action" . . . is the way sound engineers compliment the unvarying response of Weston DB indicators. Skillful engineering, and years of experience in the manufacture of DB meters, accounts for this uniformity. Also, it explains the widespread use of Weston DB indicators by communication engineers, companies manufacturing monitoring control, and amateur broadcasters . . . everywhere. The line consists of three types . . . High Speed — Low Speed — and General Purpose . . . to meet all requirements. Full details available in bulletin form . . . Weston Electrical Instrument Corporation, 612 Frelinghuysen Ave., Newark, New Jersey.

WESTON Instruments
Testing Instruments (Continued)

(Continued from page 32)

J. E. Smith, P. O. Box 1605, Dallas, Texas.

EXPORT

J. Koedig, Jr., P. O. Box 2113, Havana, Cuba.
Frazier & Co., Ltd., 17 F St, N.W., Washington, D.C.
S. Ginsbury, 97A Blvd. Bontempi, Brussels, Belgium.
F. M. Necker, 10 Wellington Ave, Hamilton, Ontario, Canada.
Pat-American Trading Co., 38 W. St. S.W., New York, N. Y.
Taylor & Pearson, Ltd., Edmonton, Alberta, Canada.

Lincoln Export Co., 41 Water St, New York, N. Y.

FERRIS INSTRUMENT CORP. Fairview Avenue, Broomfield, N. J. Micro-Voltmeters.


GENERAL RADIO CO. [See page 24]
30 State Street, Cambridge, A. Mass.

MICKOK ELEC. INST. CO. 10112 Dupont Avenue Cleveland, Ohio. Tube Testers.

INTERNATIONAL RESISTANCE CO. [See page 28]

JACKSON ELECTRICAL INSTR. CO. 430 Kiester Street, Dayton, Ohio. Tube Tester, etc.

KALTMAN & ROMANDER 62 Court Street, Newark, N. J. Cathode-Ray Oscilloscopes.

LAMPKIN LABORATORIES Bradenton, Florida. Monitors.

L & L ELECTRIC CO. 136 Madison Avenue, Memphis, Tenn. Tube Testers, etc.


RCA MFG. CO. [See page 24]
Camden, New Jersey.


RADIO CONSTRUCTORS LABS 136 Liberty Street, New York City. Signal Generators.

RADIO DEVICE MFG. CO. 142 Washington Street, New York City. Continuously Tuned Receivers.

RADIO INSTRUMENT CO. 22-36 Wooster Street, New York City.

PRODUCTS
Cathode-Ray Oscilloscopes. Scleral Testers.

RADIO PRODUCTS CO. 1405 Sunrise Place, Dayton, Ohio. Tube Testers.

RADIO RESEARCH CO., INC. 9th & Kearny Streets, N. E., Washington, D. C. Special Instruments to Order.

RAWSON ELEC. INST. CO. 90 Windsor Street, Cambridge, Mass.

Voltmeters. Electrical Measuring Instruments, Thermocouples, etc.

READRITE METER WORKS 117 College Avenue, Bluffton, Ohio. Meters.

SHALLCROSS MFG. CO. 1217 Collingdale, Pa. Wheatstone Bridge—Decade—etc.

SUPREME INSTRUMENTS CORP. Greenwood, Mississippi. Tube Testers.

THE TEST-RAIL CO. 2035 E. 90th Street, Cleveland, Ohio. Test Racks.

THE TRIPLETT ELECTRICAL INST. CO. 49 Main Street, Bluffton, Ohio. Tube Testers, etc.

TRIUMPH MFG. CO. 4017 W. Lake Street, Chicago. Tube Testers.

WESTERN ELECTRIC CO. [See page 26]
195 Broadway, New York City.


WESTON ELECTRICAL INSTRUMENT CORP. 614 Prefighingroot Avenue, Newark, N. J.

(Established in 1888)

PRODUCTS
Electrical Measuring Instruments of all types and for all classes of service and "Photronic" Photodetector Cells.

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Vice-President.......Coxton Brown W. N. Goodwin, Jr.
Sales Manager..........R. E. Lambe
Advertising Manager.....A. R. Briggs

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In all principal cities.

EXPORT
In all principal cities in all foreign countries.

Tubes—Receiving and Transmitting Photo Cells—Cathode Ray Tubes

ARCTURUS RADIO TUBE COMPANY Newark, New Jersey.

CHAMPION RADIO WORKS, INC. 90 Helen Street, Danvers, Mass.

HERMAN A. DEVRY, INC. 37 E. Wacker Drive, Chicago, Ill.

ALLEN B. DU MONT LABORATORIES [See page 32]
9 Bradford Way, Upper Montclair, N. J.

FEDERAL TELEGRAPH COMPANY, INC. 200 Mt. Pleasant Avenue, Newark, N. J.

G-M LABORATORIES, INC. 1711 Belmont Avenue, Chicago, Ill. Photo-cells

GENERAL ELECTRIC CO. Schenectady, New York.

GENERAL SCIENTIFIC CO. 4628 S. Kedzie Avenue, Chicago, Ill. Photo-cells

GOLD SEAL MANUFACTURING CO., INC. 127 S. 15th Street, Newark, N. J.

HEINZT AND KAUFMAN LTD. 311 California Street, San Francisco.

HYGRADE SYLVANIA CORPORATION 500 Fifth Avenue, New York City.

PRODUCTS
Receiving Tubes of all Types, Incandescent Lamps.

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Chairman of the Board, E. J. Poor
Vice-President in Charge of Manufacturing........W. E. Poor
Vice-Pres. & Gen. Manager, Schenectady........W. J. Poor

BRANCH OFFICES OR REPRESENTATIVES
See page 32.

THE KEN-RA CORPORATION Owenton, Kentucky.

PRODUCTS
Radio Receiver Tubes; Incandescent Electric Lamps.

EXECUTIVES
President...........T. E. Sandridge
Vice-President, Roy Barlow

SHALLCROSS MFG. CO. 116 Broadway, New York, N. Y.

THE KEN-RA CORPORATION, Owenton, Kentucky.

NATIONAL UNION RADIO CORP. 570 Lexington Avenue, N. Y. C.

RCA MANUFACTURING COMPANY, INC. RCA RADIOTRON DIVISION Harrison, N. J.

PRODUCTS
RCA Radio Tubes of Glass and Sealed-in-Steel All-Metal Types, Transmitting Tubes, Cathode-Ray Tubes, and Amatuer Radio Tubes.

EXECUTIVES
Chairman of the Board, David Sarnoff
President...........E. T. Cunningham
Executive Vice President, G. R. Strockmorten

RCA MFG. CO., INC. [See page 24]
Camden, N. J.

RAYTHEON PRODUCTION CORP. 30 E. 34th Street, N. Y. C.

TELEDYNE TV CORPORATION, 133 W. 19th Street, N. Y. C.

TRIAD MANUFACTURING CO., Inc. Pawtucket, Rhode Island.

TUNG-SOL RADIO TUBE CO. 670 8th Avenue, New York, N. Y.

UNITED ELECTRONICS CO. 47 Spring Street, New York, N. Y.

WESTINGHOUSE ELEC. AND MFG. CO. E. Pittsburgh, Pa.

WESTERN ELECTRIC CO. [See page 26]
195 Broadway, N. Y. C.

RADIO ENGINEERING
High voltage discharges from the insulation system are no longer a hazard to auto radio reception on the most sensitive sets if you equip your sets with these STACKPOLE CARBON AUTO SPARK SUPPORTERS.

The new STACKPOLE improved paper type RADIO VOLUME and TONE CONTROL

1. The Bakelite hub which carries the contact, fully licenses the moving contact and resistance element from bouncing and shifting... very necessary in a great number of applications.
2. The Self-Actuating cam is fastened directly to the bakelite hub and therefore, fully insulated from the resistance element.
3. Uniform contact pressure is maintained by a specially designed coil spring carried within the bakelite hub—always maintains the correct contact pressure.
4. The newly designed contact maintains a true line contact with the resistance element, thus eliminating any possibility of noise due to contact resistance.
5. New Type "F" resistance element made by depositing carbon on high grade paper. Element is fixed at high temperatures making it permanent and unaffected by changes of humidity and temperature.

Stackpole Fixed Molded Carbon Resistors
Non-inductive... unaffected by humidity... the standard of comparison in the radio and electrical fields... designed for voltage reducers, cathode bias resistors, grid leaks and suppressors, tube plate loads and all radio and audio circuits.

Write for descriptive catalogue

STACKPOLE CARBON COMPANY

* * * ST. MARYS, PA. * * *

ANNOUNCING Two New Models SPEEDCRAFT WIRE STRIPPERS

The Biggest Advance in Wire Stripping Machines in Recent Years

Scientifically designed to meet every requirement on production jobs, these machines have improved operating heads, easily accessible mechanism, a new knife action, quick change guides bushings, aluminum castings, etc. They are precision built throughout.

THE SEMI-AUTOMATIC MODEL is entirely different from any stripper on the market. It has easier operation, causes less fatigue, has greater speed and increased production. It must be seen in operation to be appreciated.

Both models are guaranteed by FREE TRIAL IN YOUR PLANT

Write for literature and prices on these and our other types of Insulated Wire Strippers.

THE WIRE STRIPPER CO.

1725 Eastham Ave., E. Cleveland, Ohio

4819 SO. CAMPBELL AVENUE CHICAGO, ILL.

Gardiner

ROSIN-CORE SOLDER

insures faster and cleaner work. Its uniformly high quality permits experienced mechanics to obtain better results and inexperience help to do expert work.

It is available in various alloys and core sizes and in gauges as small as 1/32 of an inch. Also in ribbon type.

The flux is made of Extra Water White Rosin with no added solvent — will not sputter. Positively non-corrosive and non-conductive.

While modern production methods permit a price for Gardiner Rosin-Core Solder that is less than ordinary solders, it conforms to the most rigid specifications. The use of Gardiner Solder will give better results at a lower production cost.

We also make a complete line of solid wire and bar solders, casting and dipping metals. We invite correspondence regarding soldering requirements and problems.

Gardiner

METAL CO.
Tube Machinery

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400 E. Ohio Street, Chicago, Ill.

EISLER ENGINEERING CO.
174-178 South 13th St., Newark, N. J.

PRODUCTS
Incandescent Lamp Machinery, Radio Tube Mach., Tube Parts.

KAHLE ENGINEERING CO.
330 Manhattan Avenue, Union City, N. J.

LEBEL HIGH FREQUENCY LABS.
29 W. 60th St., N. Y. C.

PRODUCTS
Bombarding Apparatus, High-Frequency Coils, High-Frequency Induction Furnaces.

THE ENGINEERING CO.
37-59 Branford Street, Newark, N. J.

PRODUCTS
All types Aluminum-Brass Bars and Clays. Combination Tungsten Welds. Equipment for Electronic Tubes.

INTL MACHINE WORKS, INC.
922 Van Wagenen Place, N. Bergen, N. J.

KING LABORATORIES, INC.
3175 Wilson Avenue, Philadelphia, Pa.

AMERICAN ELECTRO METAL CORP.
Lisbon St., Lewiston, Maine.

PRODUCTS
Molybdenum and Molybdenum Tungsten Alloys in forms of wire, sheet, foil, etc., for use in electronic and atomic energy work.

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THE AMERICAN BRASS COMPANY
26 Crane Street, Waterbury, Conn.

PRODUCTS
Eyelets, Radio Base Pins, Screen Grid Caps, Grommets, Soldering Terminals, Cans and Shells, Blanks and Stamping Washers, Recess, "Hotfill" Brazing Solder.

EXECUTIVES
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25 Broadway, New York, N. Y.
336 West Washington Blvd., Chicago, Ill.
131 Dorrance Street, Providence, R. I.
925 Euclid Ave., Cleveland, Ohio.

AMERICAN LAVA CORPORATION
1411 Williams Street, Chattanooga, Tennessee.

PRODUCTS
Insulating parts for receiving tubes and broadcasting tubes. For these parts, specially treated Lava, Magnesia and Alumina, form the raw materials. Also a new ceramic insulating body to which through derivation of its constituent materials, is given the name of "Alumag." "Alumag" combines high dielectric strength with a low loss factor and unusual mechanical strength, while porosity tests show 99.97 per cent absorption by weight. The coefficient of expansion at 900° C. has tested as low as 2.25 x 10^-9. In practice, "Alumag" is being used advantageous, not only in highly specialized applications, but in all ordinary appliance work where it shines against current leakage.

EXECUTIVES

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J. F. Moran, 80 Federal St., Room 223, Boston, Mass.
C. E. Wistar, Newman Sterno Building, Cleveland, Ohio.
J. H. Mills, Globe Industry Building, N. Y. J.
R. H. Geiser, 115-119 Washington Ave., St. Louis, Mo.
A. P. Hartley, 675 Second St., San Francisco, Calif.

ART WIRE & STAMPING CO.
16 Boarden Place, Newark, N. J.

PRODUCTS
Tungsten and Molybdenum Products in shape of rods, sheet and wire filament. Tungsten and Refractory Contacts. Radio Products, Refractory Carbide Tools and Dies; Lead-in wire. Rollgrid wire, etc.

EXECUTIVES

ARTICLES WIRE & STAMPING CO.
540 39th Street, Union City, N. J.

PRODUCTS
Tungsten and Molybdenum Products in shape of rods, sheet and wire filament. Tungsten and Refractory Contacts. Radio Products, Refractory Carbide Tools and Dies; Lead-in wire. Rollgrid wire, etc.

EXECUTIVES

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207 E. 78th Street, Cleveland, Ohio.

HENRY L. CROWLEY & COMPANY, INC.
1 Central Avenue, West Orange, N. J.

DRIVER-HARRIS COMPANY
Harrison, New Jersey. Alloy wires.

FANSTEEL PRODUCTS COMPANY, INC.
46 West 22nd Street, North Chicago, Illinois.

WILBUR B. DRIVER CO.
Newark, N. J.

GOAT RADIO TUBE PARTS, INC.
314 Dean Street, Brooklyn, N. Y.

PRODUCTS
Radio Tube Parts, Radio Tube Shields.

EXECUTIVES

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Feder Gren, 43 East Ohio Street, Chicago, Ill.
Frank Ennest Co., 700 N. Edgerton Ave., Los Angeles, Calif.

KING LABORATORIES, INC.
210 West Division Street, Syracuse, N. Y.

NEWARK WIRE CLOTH COMPANY
91 Varna Avenue, Pawtucket, R. I.

PEQUOT WIRE CLOTH CO., INC.
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GEORGE W. PRENTISS & COMPANY
429 Dwight Street, Holyoke, Massachusetts.

STUPAKOFF LABS, INC.
1617 Hamilton Avenue, Pittsburgh, Pa.

PRODUCTS
Filament Insulating Material; Insulated Filament Wires; Roped Filaments to Specifications; Rods, Single and Multiple Hole Cathode Insulators, Ceramic Spacers for Receiving and Power Tubes; Radio Set Insulators; Refractory Ores and Conductive Ceramics; Thermocouple and Electric Appliance Insulators.

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EXPORT
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SUMMERILL TUBING COMPANY
Bridgeport (near Philadelphia), Pa.

PRODUCTS
Summerill Tubing; Mechanical Tubing Specialties; Special Tubing for Radio Industry; Plastic Insulated Tubing; Needle Tubing; Get and Fishing Rods. Industrial Instruments; Heat Transfer.

(Continued on page 58)
A FRANK MESSAGE
from
FEDERATED PURCHASER

WHEN choosing your wholesale source of supply, you naturally want to know something about the firm which solicits your business. What is their price policy? Do they cooperate or compete with you? Are they a large organization able to carry comprehensive stocks of standard merchandise for immediate delivery?

Federated’s price policy guarantees world’s lowest prices. We meet all competition.

Trade where you never overpay!

Federated does a wholesale business. No business is solicited from the general public. A set and sound equipment List Price Catalog is issued for dealer’s profit protection and selling convenience.

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Federated is the world’s largest WHOLESALE organization with 8 branches for speedier service. Instant teletype puts stocks of all branches at your disposal. Federated’s pick-up Shopping Service avoids the bother of “Splitting” orders.

Trade where you get what you want . . . when you want it!

The Federated Creed

• ALWAYS to be the lowest priced wholesale house in the industry.
• ALWAYS to cooperate with the dealer, serviceman, amateur and experimenter.
• ALWAYS to guarantee the satisfaction of every customer by backing every product with our own name and reputation.
• ALWAYS to merit your confidence.

NEW CATALOG
Send for your free copy

Just off the press—our new 1935 catalog tells you how to solve your locking problems. Also illustrates and explains other patented Shakeproof products—a truly valuable book—send for your free copy today!

SHAKEPROOF
Lock Washer Company
Distributors of Shakeproof Products
Manufactured by Illinois Tool Works

2509 N. Keeler Ave.  Chicago, Ill.
Tube Parts and Materials (Continued)

(Continued from page 36)

EXECUTIVES
President................. E. L. Parker Sales Manager............. J. P. Dods Vice-President............... N. H. Wolf Chief Engineer........ R. R. Lawson General Manager........... N. H. Wolf Production Mgr........ Theodore Heske Purchasing Agent........ R. S. Bixler
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California Panel and Veneer Co., Los Angeles, Calif.

SUPERIOR TUBE CO.
Norristown, Pa. Seamless Tubing.

SWEDISH IRON & STEEL CORPORATION
17 Battery Place, New York City.

PRODUCTS
SVEA METAL Ribbon and SVEA METAL Wire for internal vacuum tube parts such as Plates, Getter Cups, Screens, Grids, Mica Strapping, Wells, Lead-In, etc. Also Electrode Shells for Neon Lights; Non-Magnetic Iron for Core Parts, Armatures, etc., in Relays, Loudspeakers, Switches, Signals.

EXECUTIVES
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Chief Engineer.............. Myers L. McMaster, Jr.

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66 Rutledge Street, Brooklyn, N. Y.

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EXECUTIVES
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H. W. Burwell, 431 Le Brun Ave., Montgomery, Ala.
R. M. Cameron, Box 101, Station A, Dallas, Texas.
I. M. Cartwright, 1206 Vinton Ave., Memphis, Tenn.
Frank A. Emmett, 741 S. Burnside Ave., Los Angeles, Calif.
S. K. MacDonald, 217 Riggs Bank Bldg., Washington, D. C.
E. H. Pratt, 4129 E. 69th Terrace, Kansas City, Mo.
W. F. Seaman, 763 Tacoma Ave., Buffalo, N. Y.
H. H. Smith, 220-235 Witth St., New York, N. Y.
G. O. Tanner, 484 Fourth Ave., Pittsburgh, Pa.
Trade Contact Corp., 22 Hunting Ave., Boston, Mass.
F. C. Valentine, 433 Drury Lane, Fort Wayne, Indiana.

PHELPS DODGE COPPER PRODUCTS CORP.
(Inca Manufacturing Division)
Fort Wayne, Indiana.

JOHN A. ROEBLING SONS CO.
Trenton, New Jersey.

SPARCO WIRE COMPANY
Rome, New York.

Wire—Resistance

DRIVER-HARRIS CO.
Harrison, New Jersey.

WILBUR B. DRIVER CO.
Newark, N. J.

HOSKINS MANUFACTURING CO.
Detroit, Michigan.

GEORGE W. PRENTISS AND CO.
Holyoke, Mass.

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THE WIRE STRIPPER COMPANY
1729 Eastman Avenue, E. Cleveland, Ohio.

Products
Spectracraft Semi-Automatic Knife-Type Wire Stripper; Spectracraft Foot-Pedal Knife-Type Wire Stripper; Brush-Type Wire Stripper; Bar Cleaning Stripper.

EXECUTIVES
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145 Hudson Street, New York City.

ARTHUR H. LYNCH, INC.
277 Fulton Street, New York City.

PORCELAIN PRODUCTS, INC.
Flinthill, Ohio.

RIVARD MANUFACTURING CO.
104 Madison Avenue, Toledo, Ohio.

TECHNICAL APPLIANCE CORP.
27-28 Jackson Avenue, Long Island City, N. Y.

Auto-Radio Vibrators

ELECTRONIC LABORATORIES, INC.
132 W. New York St., Indianapolis, Indiana.

PRODUCTS
Vibrators and Vibrator Power Supplies.

EXECUTIVES
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(Continued on page 40)

Page 38
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REDUCES MANUFACTURING COSTS in the production of I.F. and R.F. coils
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Page 44
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SEPTEMBER, 1935
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- Porosity: Nil

**MECHANICAL PROPERTIES**
- Tensile Strength: 8,000 lbs. per sq. in.
- Compressive Strength: 120,000 lbs. per sq. in.
- Modulus of Rupture: 18,000 lbs. per sq. in.
- Impact bending strength: 1.6 — 2.1 ft. lbs. per sq. in.
- Thermal expansion between 20°C and 650°C: 10^-6

Use this Alsimag (Steatite) body 196 for your short wave sets and get the experience which you will need for television.

_Can your engineers afford NOT to specify this Steatite body Alsimag 196 for your ceramic parts?_

Samples Furnished on Request

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Manufacturers Of Ceramics For Over 1/2 Of A Century

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HIGH CAPACITIES
FOR HIGH FIDELITY

Solar Type GEP Capacitors
Offer Remarkable Compactness

Solar Engineers have perfected methods whereby greater capacity in electrolytic condensers is now obtained through increase in effective surface area without increasing overall foil size. This improved construction exhibits thorough reliability, both in the field and in laboratory tests.

For High Fidelity Receivers using high capacity in the filter sections, the astonishing space-saving of these new condensers is of obvious value. Either the wet or dry types may be employed.

Size comparisons are indicated in the illustration above. Approximately three times the capacity will fit a given space, as compared with older construction. For many values, the electrical characteristics are superior to the ordinary foil types.

These new Solar capacitors are designated as Type GEP for drys, Type EA for wets. Take advantage of this latest advance in the electrolytic art!

ENGINEERING SAMPLES ARE FURNISHED PROMPTLY

Solar Wet and Dry Electrolytic, Paper, Mica and Trimmer Capacitors display unusual freedom from field trouble in all climates throughout the world.