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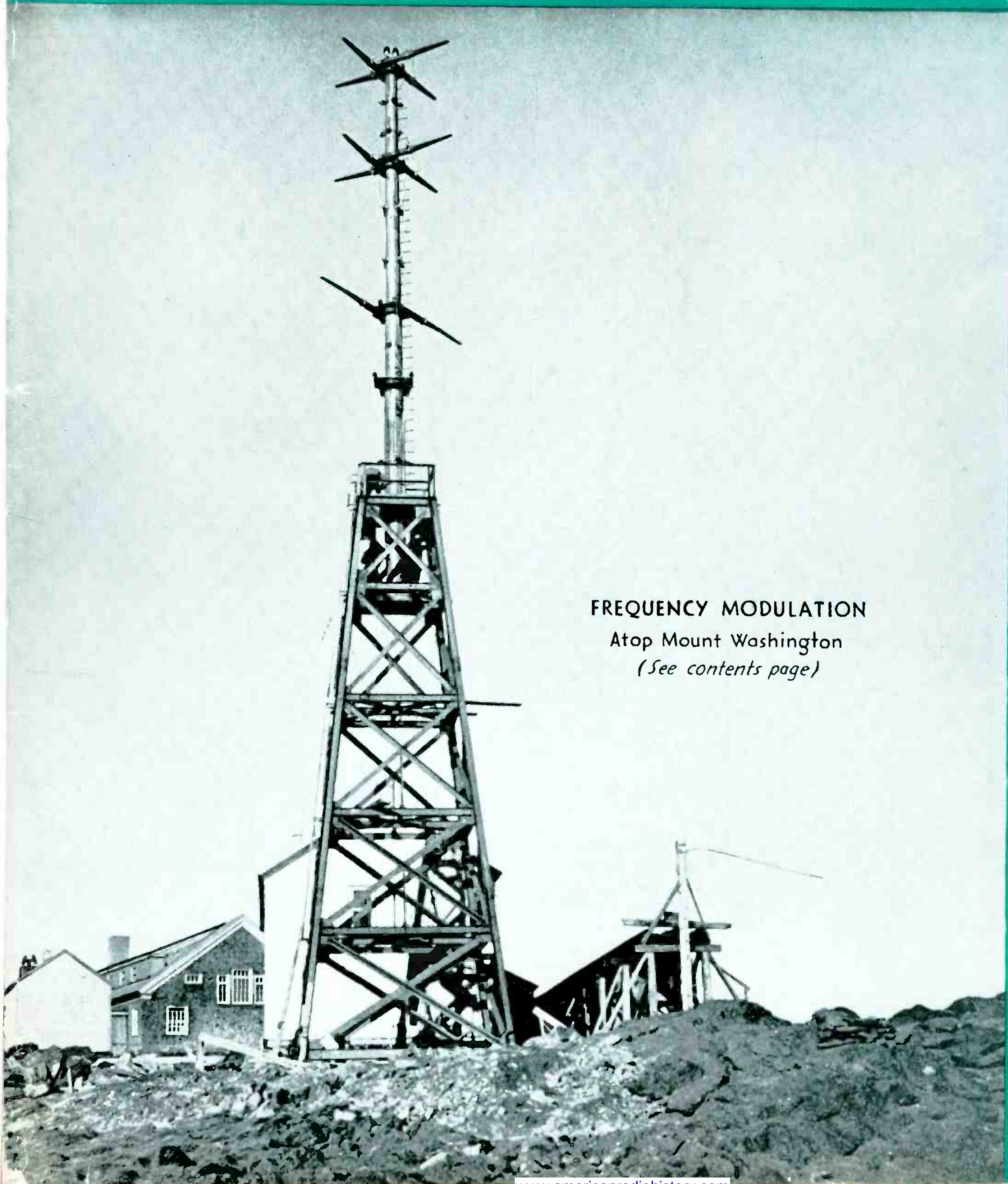

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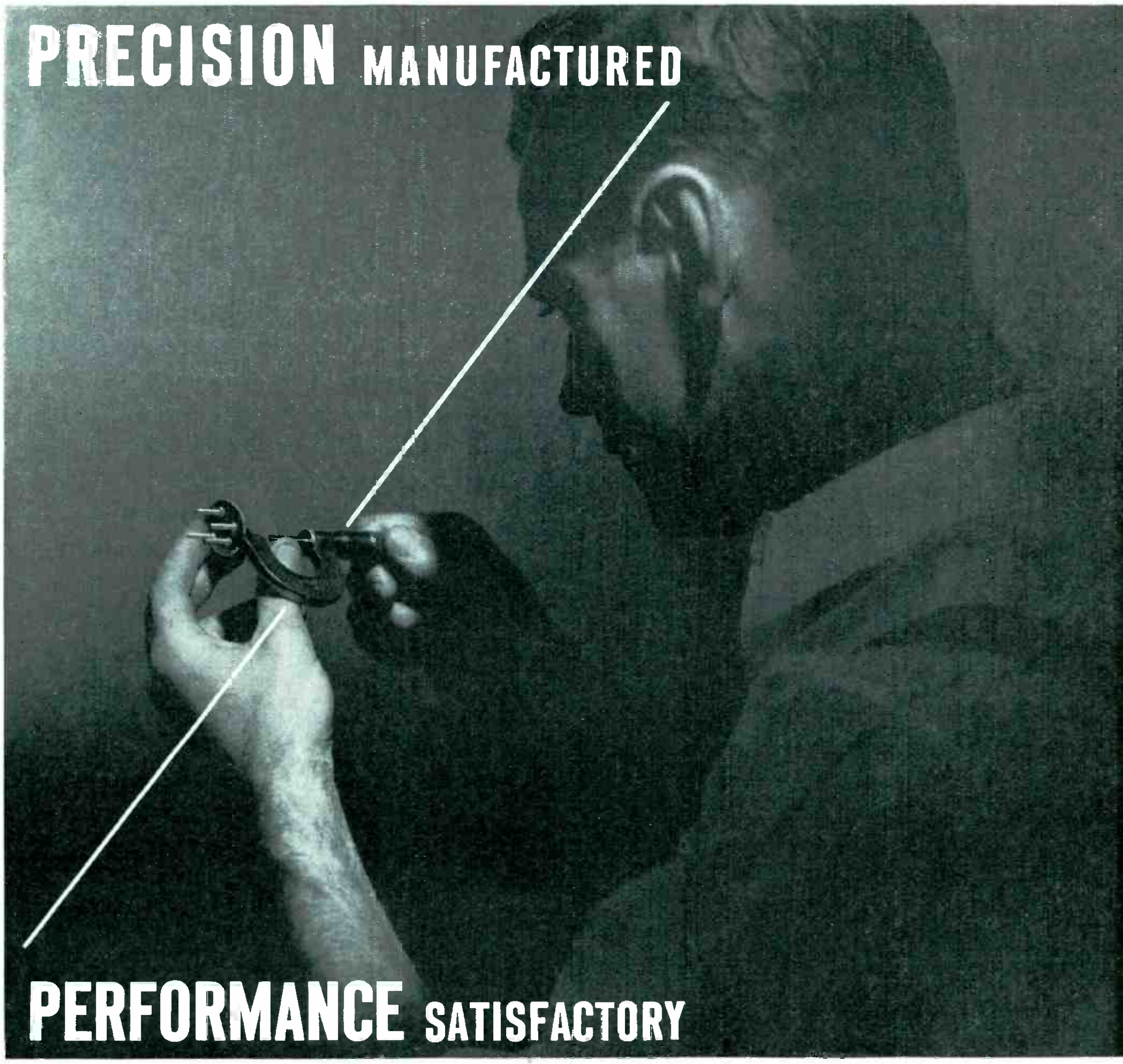

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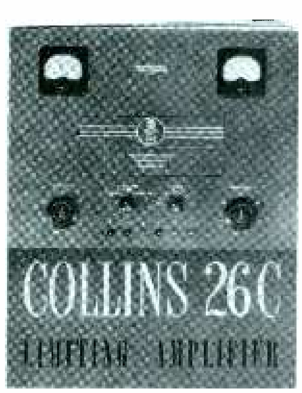

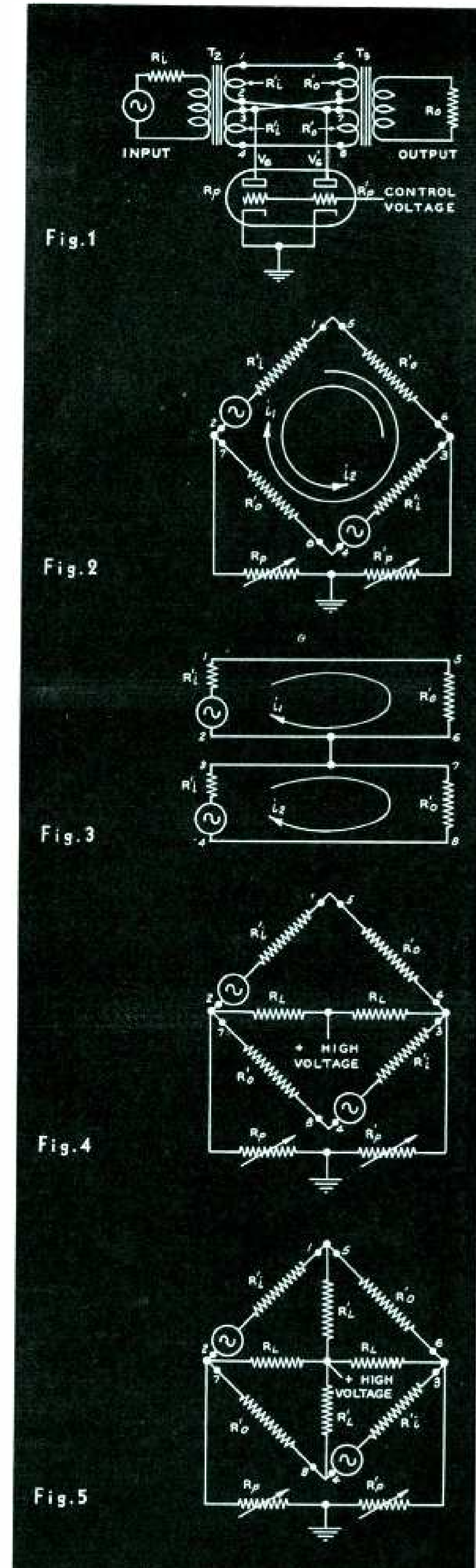

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ELECTRONICS

OCTOBER 1938

KEITH HENNEY
Editor

Crosstalk

▶ **VOLTS** . . . The sad accidental death of Ross Hull, editor of *QST*, as a result of coming into contact with 6000 volts from an experimental television receiver focusses attention upon the extreme necessity for adequate protection when working with high voltage equipment. In the experimental receiver built by *Electronics* considerable effort has been made to see that accidents cannot happen, and those who may build such equipment, perhaps designed after the articles written by Mr. Fink, must not slight the safety measures advocated.

▶ **NEW THINGS** . . . On September 14 New Yorkers got their first opportunity to comment on television and to be televised at the same time. On that day NBC took portable equipment to the street and interviewed passersby, their words and "looks" being sent to the television transmitter on the Empire State and broadcast from there. In a preview theater in New York, a new system of color movies was demonstrated on September 4. Using ordinary black and white film, processed in any laboratory, quickly, with what appeared to be excellent color fidelity, this new system is optical and not photographic or chemical in any way. It looks too simple to be true—but it works.

Using ordinary mercury vapor rectifiers, with few additional trappings, Professor Dorsey of the University of Manitoba demonstrates the rectification of a half-ampere at 70,000 volts in the high tension laboratories of the Consolidated Edison Company, New York City. In a 6-phase setup, this would amount to about 200 kw which is beginning to look like power. The utilities interest is in d-c transmission to avoid putting in new lines etc.

Eastman Kodak company undertakes research to extract vitamin E from wheat; not only develops a method of performing the task at hand, but develops a new type of vacuum pump as a by-product. It is probable that the pump will assume more importance than the vitamin product.

All of these recent events have significance to readers of *Electronics*. There is no end of new things in sight; may it ever be so!

▶ **INSERT** . . . As part of a McGraw-Hill program to promote more cordial relations between industry and the public, and industry's employees, stockholders and consumers, this issue contains a plea for better relations, a plan for achieving such good will, and facts about one of the many questions which bother us today.

The question debated is, should research be stopped?

None of our readers believe it should. We know that the fruits of research are new products, new materials, new economies, new industries, new living standards, new jobs. But the uninformed are often led astray by those who have little to say but talk much, and glibly. The final 8 pages of this insert contains the story of how an industry grew from research by men such as Richardson, Maxwell, Langmuir; by discoveries and inventions by Marconi, DeForest, Armstrong and others; a few words about the different kinds of people that are required to make an industry; and finally something on the benefits of research. Whole volumes could be written on any one of these subjects. But if these pages, written in words of one syllable, will aid anyone in explaining why we must not have less, but more research, to someone who doubts it, the purpose of the message will have been served.

▶ **CONSULTANTS** . . . For some time the editors have been collecting names of experts in various lines of electronic activity the world over. These experts are independent, and are available to be considered when special problems arise in which an outside engineer, physicist or mathematician is required. Inquiries are welcomed.

Electronics is always delighted to uncover a problem, which some one has, and which can be thrown open to the entire readership. There are no strings attached to any suggested solution secured; it is hoped, however, if a problem of general interest appears and is solved that its solution may be presented through these pages.

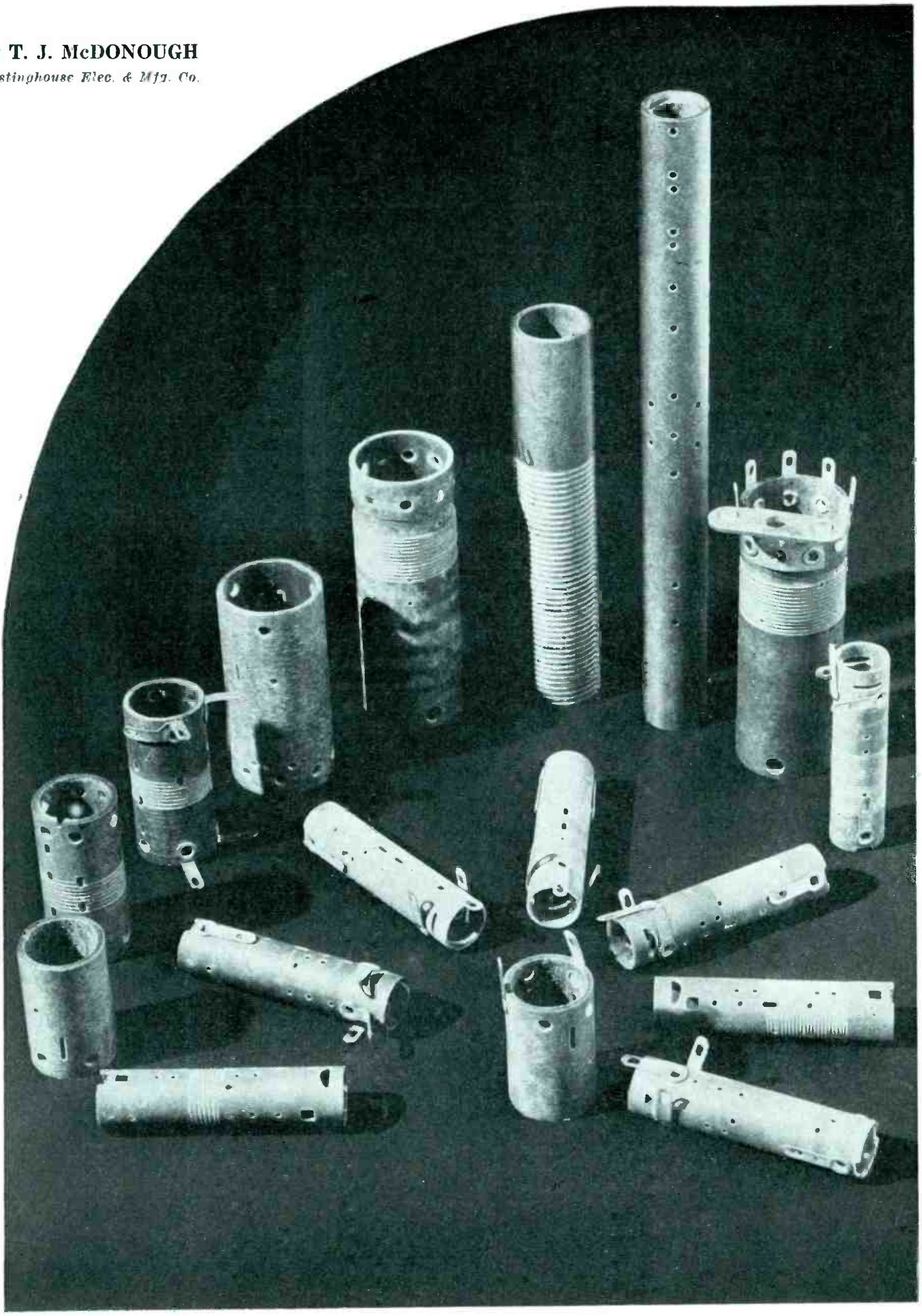
▶ **SORRY** . . . In Mr. R. W. Carlson's article in August, two errors occurred in the circuit diagram. To make the circuit work, connect the 50,000 ohm screen resistors to the bottom of the plate resistors, and reverse the 180-volt battery.

In April 1937, Professor Russell of Columbia wrote an article on feedback amplifiers. In the diagram on page 17 of that issue appears the circuit of an inverter stage. Anybody building this circuit, as several have, and finding that the 6L6 tubes blow up, had better ground the point between the 150M and 500M resistors feeding the two type 76 tubes.

Errors like these are regrettable; and without actually building the editors have nothing but their knowledge of circuits to call upon to check diagrams submitted by authors. Sometimes the editors add a few errors of their own, by neglecting to catch things the draftsman omitted or inserted. It's a help, however, to get from the authors diagrams which are free from errors and which a non-technical draftsman can follow easily.

LAMINATED

By T. J. McDONOUGH
Westinghouse Elec. & Mfg. Co.



PLASTICS FOR RADIO

Laminated plastics have had considerable growth in the radio industry because of light weight, easy machining, high resistivity, and freedom from moisture absorption. Some of the more important properties of laminated plastics, and their use in electronic circuit applications are given in this article by Mr. McDonough

IN THE past few years laminated plastics have played an important part in the radio field in reducing the size and weight of parts. In addition, low water absorption of the material enables it to retain its good electrical properties even after exposure to high humidities. Because of its lightness and strength it often serves as a combined structural and insulating member. Its density is about one-half that of aluminum. For example, Micarta weighs approximately 1.35 grams per cubic centimeter.

The physical properties are such that intricate punchings can be made which still possess the strength and durability necessary for radio service. The tools for punching are the same as those used in the punching of metal materials except the clearances should be smaller between punch and die. Laminated plate can be readily machined, drilled, tapped, threaded and milled with the same tools as soft metals such as brass and bronze. No special tools are necessary for any of these operations.

The electrical properties of the laminated material are such that there is an ample factor of safety for the general run of low frequencies. In the development of the radio field with its higher frequencies and in the electrical field with its step-up in voltage, insulation requirements became much more

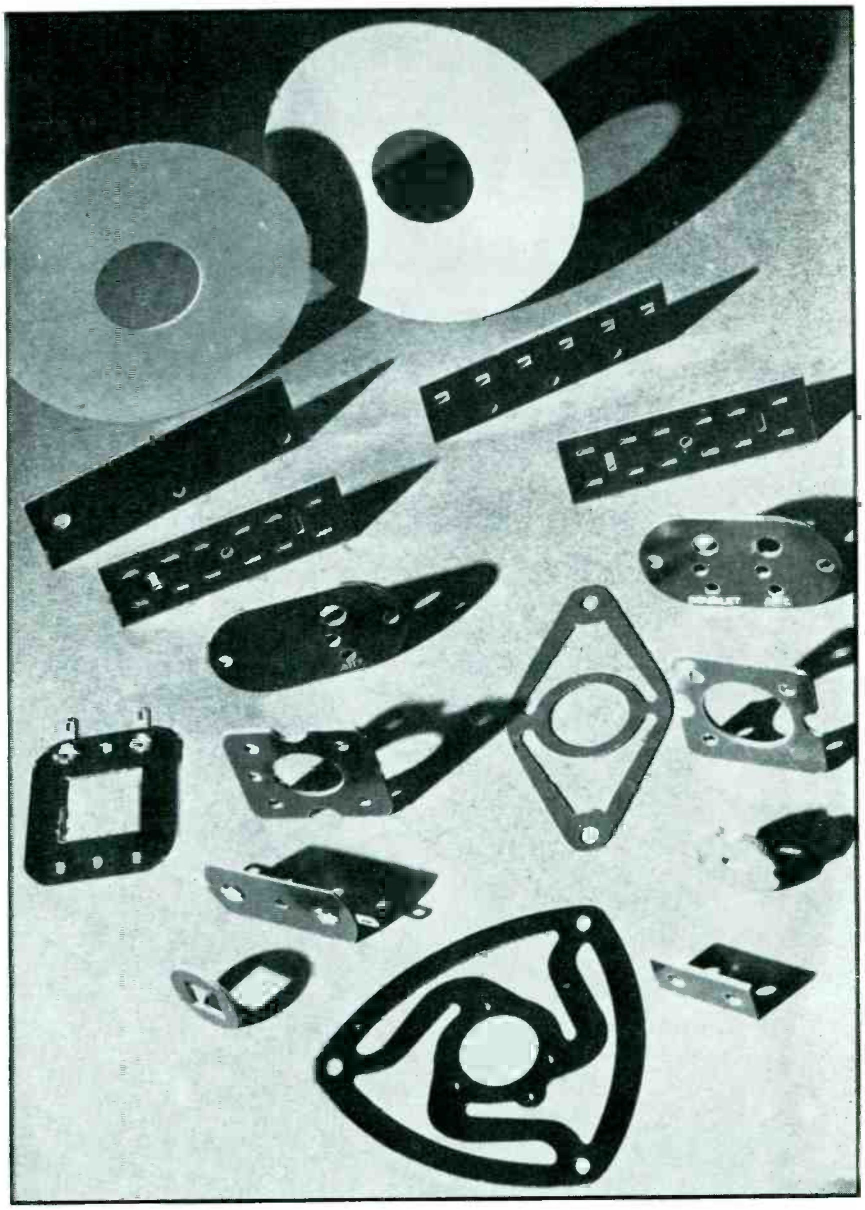
Punchability. Laminated plastics offer good mechanical and electrical properties and may be accurately and easily punched. Opposite page—Some of the many coil forms which laminated plastics have made possible rigid and laminated materials are finding increasing use.

Tubes made of the material possess all the properties of the plate with the added feature that they can be easily threaded with a very fine thread. On a $\frac{1}{32}''$ wall tube it is possible to cut 32 threads per inch. Also, tubes will withstand the heat of the soldering process without blistering or other harmful results.

Other materials such as hard rubber, glass, porcelain, etc. have been tried but none seem to have all the desirable properties of: good electrical characteristics under high humidities; strength, durability with lightness; machinability; resistance to heat; and punchability.

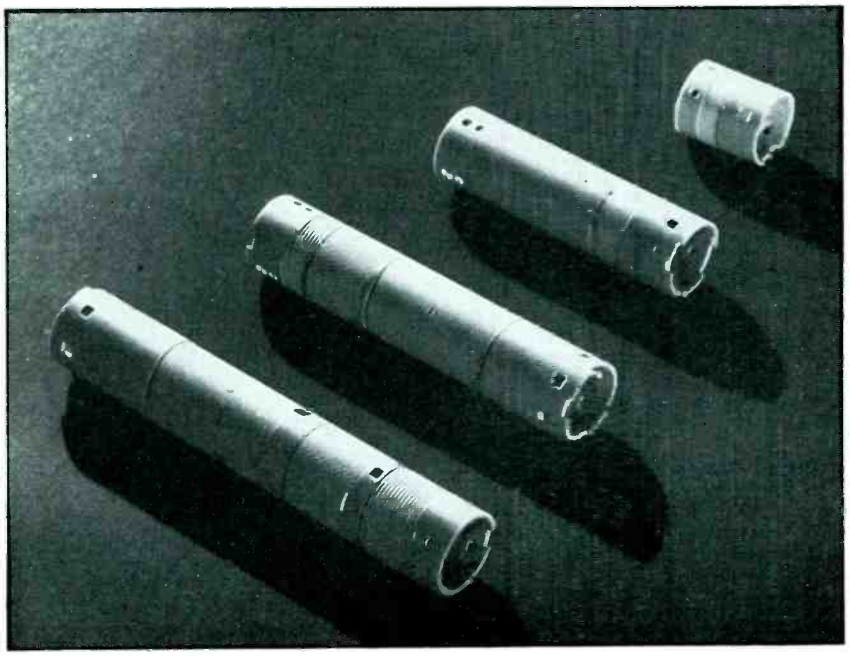
Particularly in radio transmitting apparatus, laminated plastic materials have simplified design problems by their ability to withstand the dielectric field stresses of the radio frequency voltages. Such applications require a material which has high insulation resistance, and which must be mechanically stable; that is, it must not cold flow under pressure.

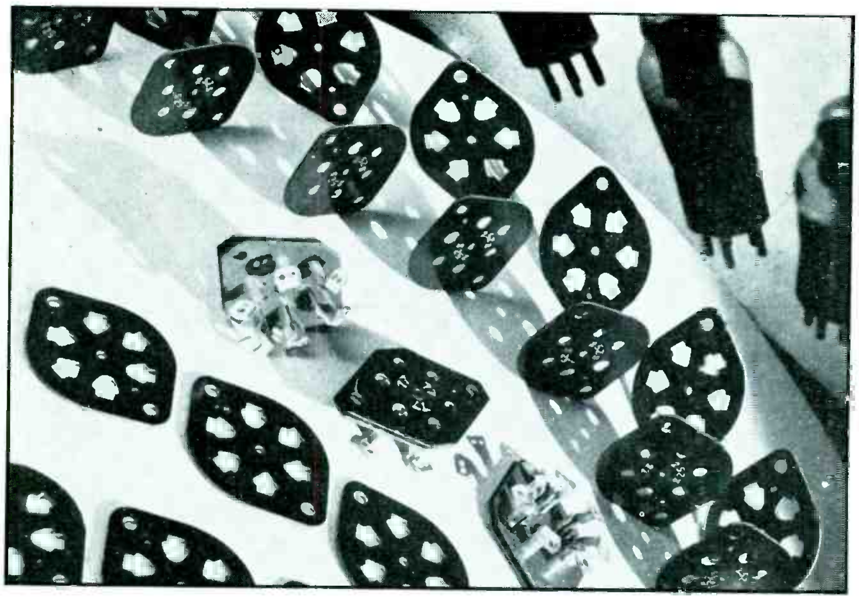
Coil forms of various sizes for short and long wave sets are shown. In the manufacture of coils it is necessary that a material be easily threaded with a fine thread and that punched holes and slots do not affect the electrical properties of the tube. Other examples of radio parts are shown. These parts include terminals, strips, insulators, speaker terminal blocks. All these parts have been punched cold, and do not show any cracking or bursting of the holes. They are also tapped and riveted. Another part used with great success is the speaker spider. It is very thin ma-



Typical, small radio parts punched from laminated plastics are shown at the right

Below—Radio coil supports made of laminated plastics are durable and low in cost

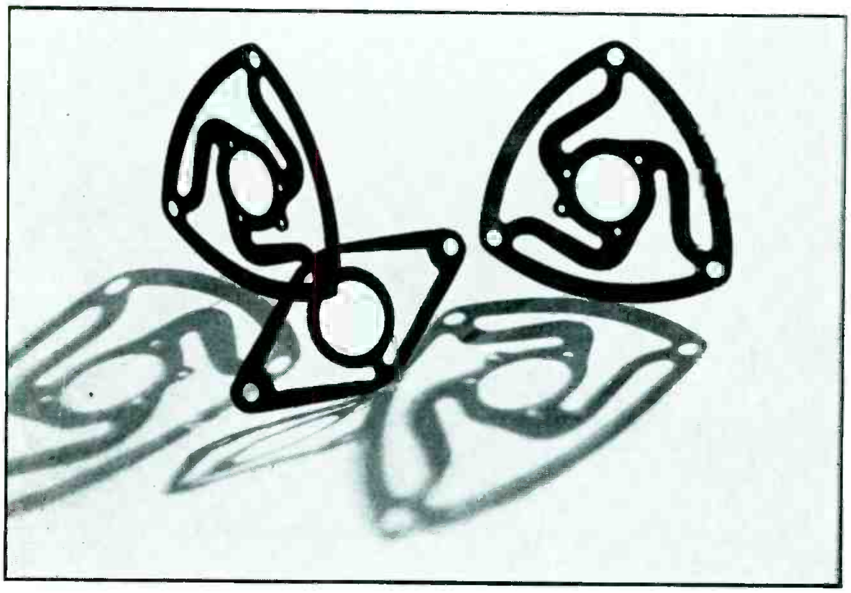




Modern wafer-type tube sockets can be easily punched out of Micarta

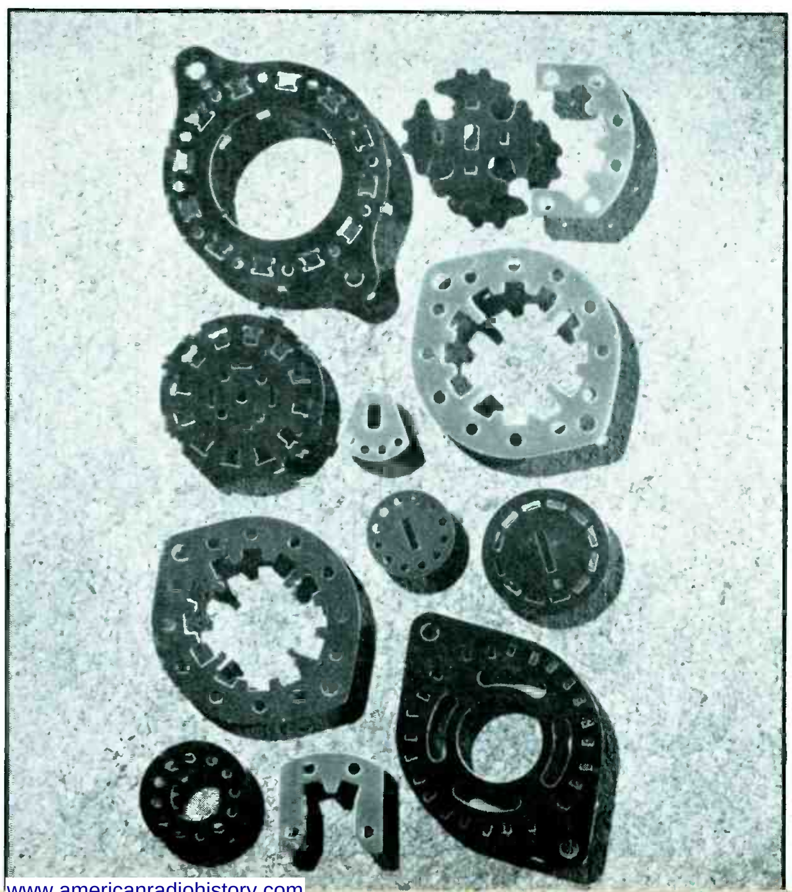
sheets are molded in sizes up to 48″ x 96″ and in thickness of .010″ to 10″. In production of plate the treated material is cut into sheets of the desired dimensions of the finished plate. These layers of impregnated sheets are then placed in a hydraulic press where they are subjected to a temperature of 347°F. and a pressure of more than 1000 lbs. per square inch.

Tubes are made by rolling the paper or cloth on a mandrel which is so assembled that the paper or cloth passes over a heated roll which softens the resin and allows it to adhere to the adjacent layer of paper. When the desired thickness of tube is rolled the mandrel and tube are placed in an oven and allowed to cure. After the pressing and curing operations, the plate and tubes are permanently infusible and insoluble.



Left—Spiders for loud speakers are often made of laminated plastic materials

Below—Intricate designs with sharp corners, such as these switch parts, are usually made of laminated plastics



terial and has the strength to withstand the continual vibration.

Laminated resinous material is formed by the action of heat and tremendous pressure on a number of layers of either paper or cloth which have been impregnated with a synthetic resin. By dissolving this synthetic resin in a suitable solvent a varnish is produced with which the paper or fabric is impregnated. This base material passes continuously through a treating machine where the varnish is applied and the solvent evaporated.

Laminated plastic is available in sheets, rods, tubes, angles, channels and molded shapes. For example,

Half-Wave Gas Rectifier Circuits

Current and voltage wave forms for half-wave rectifier circuits having various types of plate loading and employing gaseous conduction tubes. Method of operation calculus provides rigorous analysis

By C. M. WALLIS

Assistant Professor
Department of Electrical Engineering
University of Missouri

FREQUENTLY it is desirable to predetermine the current and voltage wave forms which may occur in a circuit using the low pressure gas filled rectifier tube. The following analytical discussion presents a method, employing operational calculus in its simpler form, for determining in an exact manner these functions in circuits utilizing such an ionic device. The analysis is rigorous in so far as the circuit problem is concerned, though certain basic assumptions have been made.

One distinguishing feature of the low pressure gas filled tube is that tube voltage drop during its conducting period is small and practically independent of current magnitude. This constancy of tube drop is assumed in the following analysis. It is considered also that the circuit is fed from an a-c power source having sinusoidally varying voltage of constant effective value.

First consider the circuit shown in Fig. 1. The voltage impressed is $e = E_m \sin X$. E_a denotes the constant tube drop and v the instantaneous voltage across the load. During the period of current flow, the following equation expresses the voltage relationships in the circuit

$$0 = E_m (\sin X) - v - E_a \qquad (1)$$

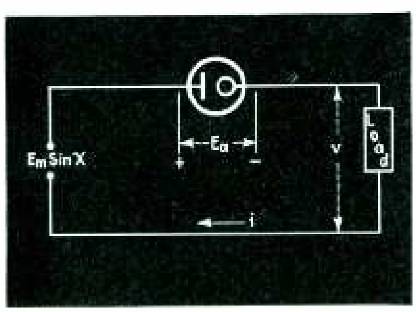


Fig. 1, above—Fundamental half-wave rectifier circuit using gaseous rectifier for which analysis is carried out

Fig. 2—Half-wave rectifier circuit with resistance plate load

Fig. 3, extreme right—Voltage and current wave forms for half-wave circuit using gaseous conduction rectifier

Case I. *Pure Resistive Loads*

As the simplest case let it be assumed that the load consists of a resistance in series with a battery on charge. See figure 2. The load voltage is $v = Ri + E_B$. Hence the equation (1) becomes

$$i = \frac{E_m}{R} [(\sin X) - k] \qquad (2$$

where

$$k = (E_a + E_B)/E_m.$$

The above equation gives the instantaneous value of the circuit current during the period of current flow. i.e., when the bracketed term is positive. The time angle of firing α is $\sin^{-1} k$. The angle of "cut off", β, is $(\pi - \sin^{-1} k)$. Figure 3 illustrates the nature of the current function. It may be seen that the current flows in impulses which are portions of sine waves. The average, or d-c value of the anode current is

$$I_{DC} = E_m [2 \cos \alpha - k (\pi - 2\alpha)]/2\pi R \qquad (3)$$

Case II. *Inductive Load*

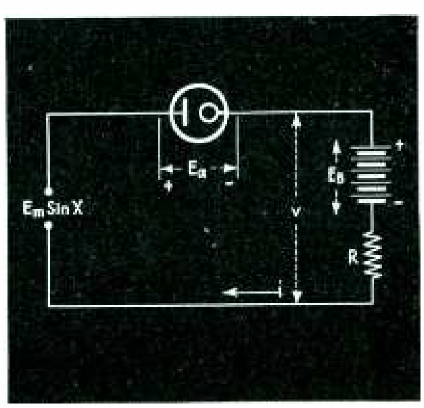
Assume now that an inductance of L henrys is placed in the circuit of Fig. 2 as shown in Fig. 4. The load voltage v must now be expressed as

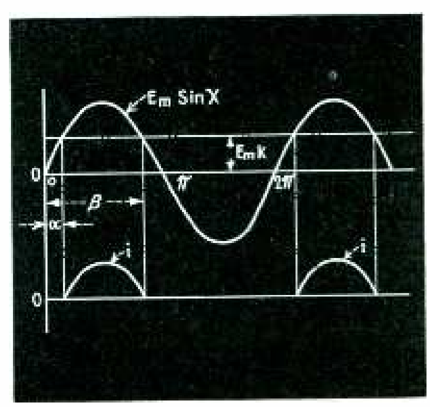
$$v = Ri - L\omega \frac{di}{dx} + E_B$$

which may be written in the form

$$v = L\omega (p + \eta)\, i + E_B$$

where $\eta = R/L\omega$ and p is the differential operator d/dx. Substituting





the above expression for the load voltage into equation (1) and transposing terms yields the result

$$i\,(p+\eta) = \frac{E_m}{L\omega}\,[(\sin X) - k] \qquad (4)$$

which is the differential equation of the circuit current expressed in operational form.

Since equation (4) indicates that the current i is the result of the two voltage functions $\frac{E_m}{L\omega}\sin X$ and $-\frac{E_m}{L\omega}k$ acting in the circuit, its complete solution includes the complementary function plus the particular integral for each voltage function. Hence the general solution may be carried out in the following manner.

Let $i = i_1 + i_2 + i_3$

where $i_1\,(p+\eta) = 0$ (5a)

$$i_2\,(p+\eta) = \frac{E_m}{L\omega}\sin X \qquad (5b)$$

$$i_3\,(p+\eta) = -\frac{E_m}{L\omega}k \qquad (5c)$$

the complementary function is obtained from (5a) which is the homogeneous equation. Since it is a differential equation of the first order, its solution is of the form

$$i_1 = A\,\epsilon^{-\eta x}$$

The particular integral for each voltage function is obtained from (5b) and (5c). They are the steady state solutions of these equations. Thus the steady state solution of (5b) is obtained by letting $p = j = \sqrt{-1}$, and the steady state of (5c) is found by letting $p = 0$. Carrying through these operations and simplifying, the complete solution of (4) may be written

$$i = \frac{E_m}{L\omega}\left[\frac{\sin(X-\delta)}{\sqrt{1+\eta^2}} - \frac{k}{\eta} + A\,\epsilon^{-\eta x}\right] \qquad (6)$$

where $\delta = \cot^{-1}\eta$.

The constant A is evaluated from the condition at the point of firing, i.e. when $X = \alpha = \sin^{-1}k$, and $i = 0$. Hence

$$A = \epsilon^{\eta\alpha}\left\{\frac{k + \eta\sqrt{1-k^2}}{\eta\,(1-\eta^2)}\right\} \qquad (7)$$

The voltage across the inductance is $e_L = L\omega\frac{di}{dx}$ or

$$e_L = E_m\left\{\frac{\cos(X-\delta)}{\sqrt{1+\eta^2}} - A\eta\epsilon^{-\eta x}\right\} \qquad (8)$$

It is now possible to determine the exact nature of the current and voltage wave forms by assuming values of X starting at $X = \alpha$. The angle of cut-off β is that value of X which makes the bracketed term of equation (6) equal to zero.

Figure 5 illustrates the voltage and current wave forms obtained in such a circuit. We note that the current rise is delayed due to the inductive property of the circuit. In addition the period of current flow is extended, cut off occurring at a point further along in the cycle than if the circuit were non-inductive.

The following example illustrates the ease with which the above equations may be handled: A 60 cycle voltage of 320 sin ωt is impressed across a circuit containing a gas filled rectifier tube, a 90 volt battery on charge, a resistance of 37 ohms and an inductance of 0.218 henry. The tube drop is 7 volts.

$$k = (E_a + E_B)/E_m = 0.303$$

$$A = \epsilon^{-\eta\alpha}\left[\frac{k+\eta\sqrt{1-k^2}}{\eta\,(1-\eta^2)}\right] = 1.55$$

$$\eta = R/L\omega = 0.45 \qquad \delta = \cot^{-1}\eta = 65.77°$$

$$\alpha = \sin^{-1}k = 17.64° \qquad \frac{E_m}{L\omega} = 3.89$$

Current equation between values of $X = \alpha$ and $X = \beta$ is

$$i = [3.54\sin(X-65.77°) + 6.03\,\epsilon^{-0.45x} - 2.62] \text{ amperes}$$

The quation for the voltage across L is

$$e_L = [291.5\cos(X-65.77°) - 223.5\,\epsilon^{-04.5x}] \text{ volts}$$

Curves computed from the above equation are shown in Fig. 5.

Case III. *Capacitive Load*

The third type of circuit to be considered is the one shown in Fig. 6 where the load is capacitive in character. When in operation the condenser C is charged during the period of tube current flow. During the period that the tube is not conducting, the condenser discharges through the resistance R. The nature of the load voltage v is illustrated in Figure 7.

During the the period of discharge

$$v = V'\,\epsilon^{-\frac{X-\beta}{RC\omega}} \qquad (9)$$

where V' is the value of the load voltage at the instant of rectifier cut off. During the charging period $v = Z(p)i$ where $Z(p)$ is the impedance of the load in operational form. Hence dur-

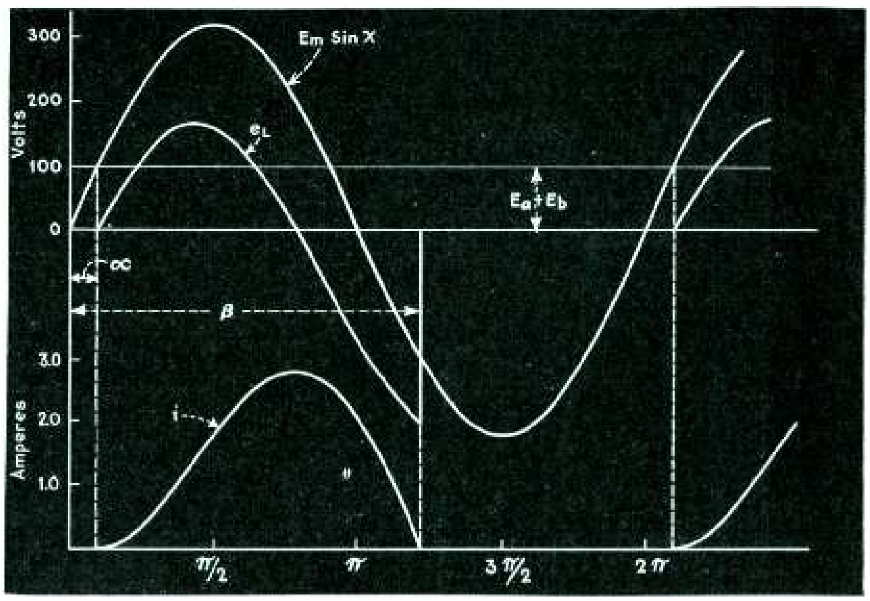


Fig. 5, above—Voltage and current wave forms for rectifier with inductive and resistive load

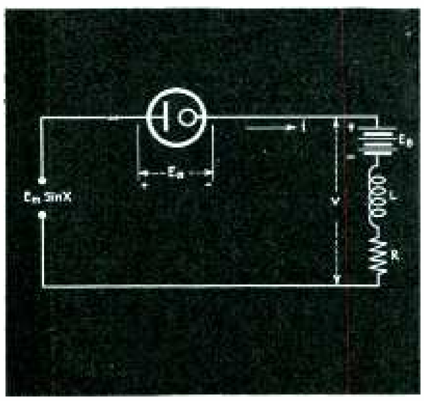


Fig. 4, left—Schematic diagram of half-wave rectifier having inductive and resistive plate loading

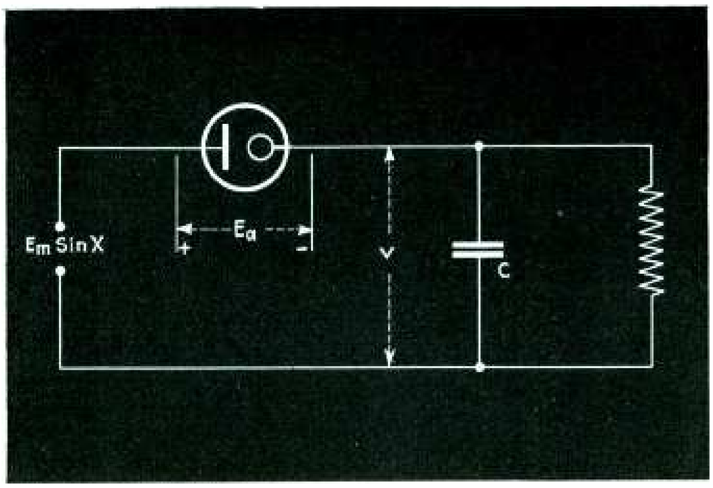


Fig. 6—Gas tube rectifier circuit having resistive and capacitive plate loading

ing this period the rectifier current i may be expressed as

$$i\Big]_{\alpha\ to\ \beta} = \frac{E_m (\sin X) - E_a}{Z(p)} \qquad (10)$$

The load impedance is

$$Z(p) = \frac{R/C\omega p}{R + 1/C\omega p} = \frac{R}{RC\omega p + 1}$$

which when substituted into equation (10) results in the following:

$$i\Big]_{\alpha\ to\ \beta} = E_m\left[\frac{\sqrt{1 + R^2C^2\omega^2}}{R}\right] \sin(X + \delta) - \frac{E_a}{R} \qquad (11)$$

where $\delta = \tan^{-1} RC\omega$.

The angle of tube current cut off, β, may be determined from the above equation, since when $X = \beta$, $i = 0$. Consequently

$$\beta = 180° - \delta - \sin^{-1}\left\{\frac{E_a}{E_m\sqrt{1 + R^2C^2\omega^2}}\right\} \qquad (12)$$

The value of V' is then

$$V' = E_m (\sin \beta) - E_a \qquad (13)$$

It should be noted that α cannot be determined from equation (11) since there is a discontinuous rise of current at the point of firing. See Figure 7. However, it may be found from the load voltage condition at the point R where $X = (2\pi + \alpha)$. At this point

$$E_m \sin(2\pi + \alpha) - E_a = V' \epsilon^{-\frac{2\pi + \alpha - \beta}{RC\omega}} \qquad (14)$$

Equation (14) contains the unknown α which cannot be solved directly. The easiest method, is to plot values of the right and left hand members against assumed values of α and determine the correct value from the intersection of the two curves. The angle of firing, α, having been found the current function may be determined by equation (10) between the limits of $X = \alpha$ and $X = \beta$.

Generally it is of major interest to know the d-c value of the load voltage v. This may be found from the following equation

$$V_{DC} = \frac{1}{2\pi}\left\{\int_{\alpha}^{\beta} [E_m (\sin X) - E_a]\, dx + \int_{\beta}^{2\pi + \alpha} V' \epsilon^{-\frac{X - \beta}{kC\omega}}\, dx\right\}$$

or

$$V_{DC} = \frac{1}{2\pi}\left\{E_m [\cos \alpha - \cos \beta] - E_a [\beta - \alpha] + RC\omega V'\left[1 - \epsilon^{-\frac{2\pi + \alpha - \beta}{RC\omega}}\right]\right\} \qquad (14)$$

One characteristic of such circuits is the high peaked current impulse that results and the low average or zero frequency current. Knowledge of the maximum instantaneous current is important, of course, in the selection of the rectifier tube to supply such a circuit.

The following example illustrates how the above equations may be handled: A voltage of 320 sin ωt at 60 cycles is impressed across a half wave rectifier circuit. The load consists of an 8430 ohm resistance in parallel with a 8.2 μf condenser. The tube drop is 7 volts.

$$RC\omega = 26.08 \qquad \delta = \tan^{-1} RC\omega = 87.8$$

$$\beta = 180 - \delta - \sin^{-1}\left\{\frac{E_a}{E_m\sqrt{1 + R^2C^2\omega^2}}\right\} = 92.2°$$

$$V' = [E_m (\sin \beta) - E_a] = 313 \text{ volts}$$

The angle α is determined from the equation

$$320 \sin(2\pi + \alpha) - 7 = 313\, \epsilon^{-\frac{2\pi + \alpha - 92.2°}{26.08}}$$

By solution $(2\pi + \alpha) = 414°$; $\alpha = 54°$.

$$V_{DC} = \frac{1}{2\pi}\left\{320 [\cos 54° - \cos 92.2°] - E_a [1.61 - .945] + (26.08)(313)\, 1 - \epsilon^{-0.2115}\right\}$$

$$V_{DC} = 279 \text{ volts;}$$

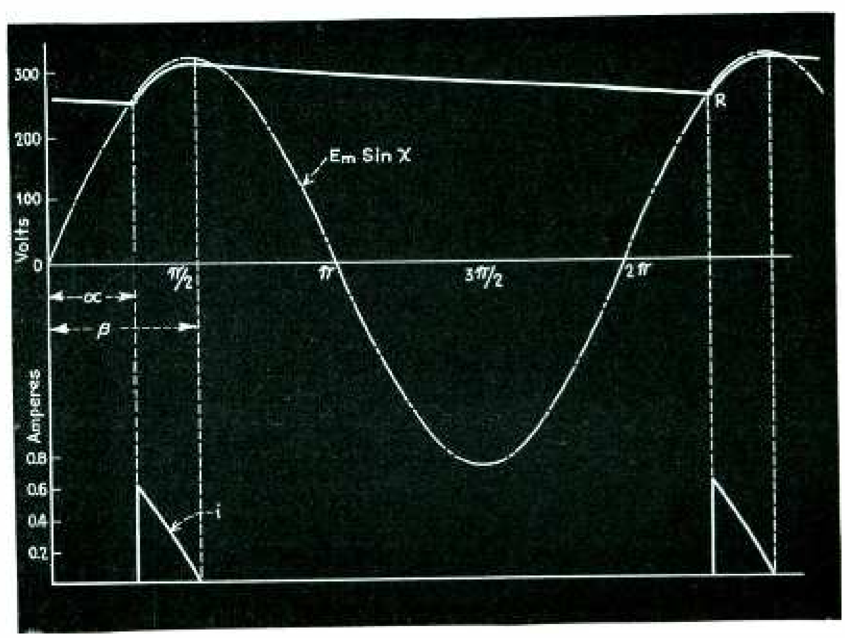
$$I_{DC} = \frac{279}{8430} = .033 \text{ amperes}$$

The equation for the rectifier current during the charging period is

$$i = .001 \sin(X + 87.8°) - .0083 \text{ amperes}$$

Figure 7 shows the voltage v and the current i as determined for the above equations.

Fig. 7—Current and voltage wave forms for resistance and capacitance loaded rectifier circuit of Fig. 6



Reduction In Broadcast Reception

Another way in which local noise may get into the antenna circuit is by radiation from a local noise generator, such as N' in Fig. 2, if this radiation is picked up anywhere in the antenna circuit. Such a noise generator might be an electric razor, a sparking commutator, corona in a nearby power line, or one of countless other types of electrical apparatus. The same noise generator may cause transient currents in the house wiring creating noise of the type N, and may at the same time act as a miniature antenna system and radiate noise of the type N' to the receiver antenna circuit.

The Shielded Loop

To reduce the reception of noise of both the N and N' types, a shielded loop may be employed. To find out why the loop must be shielded, let us first consider an unshielded loop. The latter acts as a loop with an amount of pickup as indicated by Eq. (1), but, in addition, due to its capacity to ground, C_x, it also acts as a vertical antenna of effective height equal about to the physical height of the loop. Since the pickup of a pure loop is inherently small, the pickup of an unshielded loop as a vertical antenna may be equal to or greater than its pickup as a loop. As a vertical antenna, the loop picks up noise from N, so that its noise-to-signal ratio is as bad as that of a vertical antenna, if not worse. This condition can be improved considerably by using a loop which is balanced to ground, thus reducing the vertical pickup, as has sometimes been done in the past. However, a loop which is balanced to ground in one location will probably not be well-balanced in another. Furthermore, when screen-grid tubes are used, balanced circuits which allow the loop to be tuned and tracked with the oscillator over the broadcast band are very complicated.

The whole situation, however, becomes simplified and immensely improved if the loop is electrostatically shielded. Such a shield, if connected to the chassis, greatly reduces the capacity C_x. Thus the loop no longer acts as a vertical antenna and noise pickup from N is eliminated.

Let us next consider the action of the shield on locally radiated noise, such as N'. It is a well-known fact that near a transmitting antenna, where the distance, r, from the antenna is small in comparison with the wave-length, λ, of the radiated energy, the ratio of the electrical energy to the magnetic energy is about

$$3\left(\frac{\lambda}{2\pi r}\right)^2$$

However, at a great distance from the antenna, where r is many times as great as λ, the electrical and magnetic energies are equal. Therefore, an electrostatic shield around the loop, which does not shield the loop magnetically, removes a much greater percentage of local noise radiation than it does signal. For example, if λ is 300 meters, and the local noise source is 10 meters (33 ft.) from the loop, $3\left(\frac{\lambda}{2\pi r}\right)^2$ is 68. In this case a perfect shield would discriminate in favor of the signal as against the noise by a factor of about 68 (or 18 db). While perfect shielding is not obtained in practice the shielded loop is nevertheless very effective against local noise radiation of the type N'.

The directivity of the loop is also very valuable in reducing the N' type

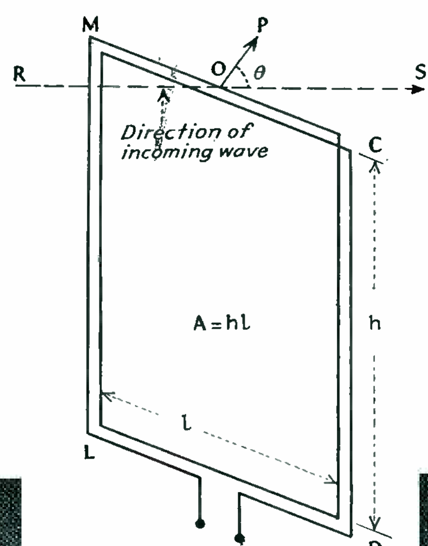


Fig. 1 (above)—Loop diagram for which equation (1) is derived.

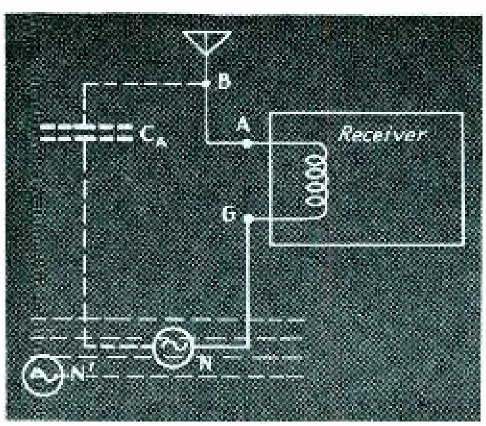


Fig. 2 (left)—Receiver and vertical antenna circuit showing two sources of noise voltage, N and N'.

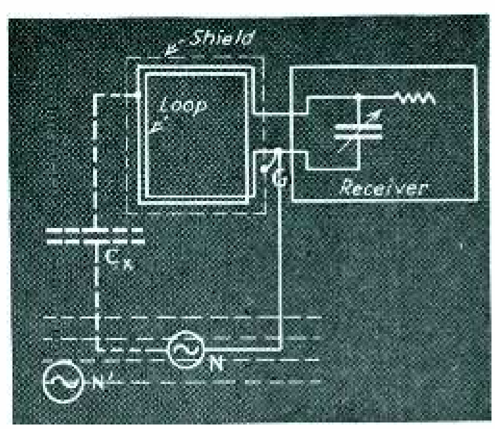
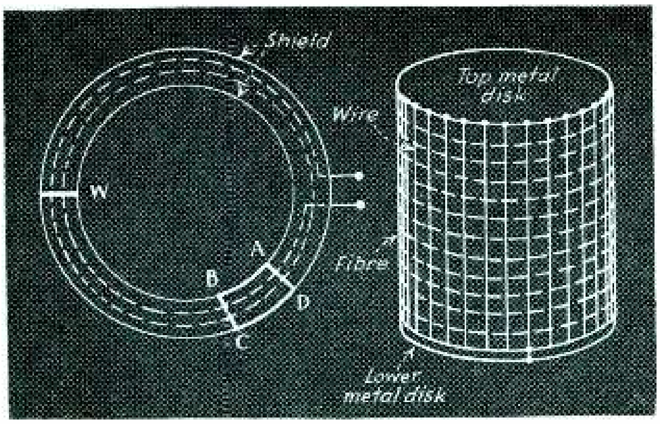


Fig. 3 (right)—Receiver with loop antenna. Unshielded loop antenna responds to noise voltages from N and N'.



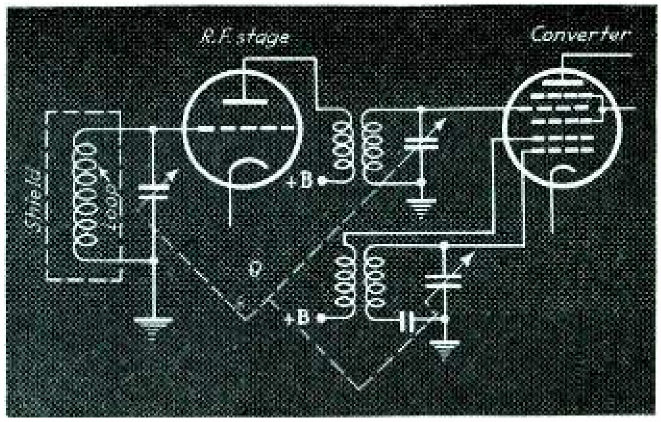


Fig. 4A (left)—Electrostatic shield in which loop winding is enclosed in metallic tube.
Fig. 4 (right)—Electrostatic shield of woven gauze as used in broadcast receiver.

Fig. 5—Schematic wiring diagram of the input circuit for receiver having shielded loop for reducing electrical noise. Condenser tuning the loop is ganged with other tuning condensers.

of noise. By rotating the loop so that the principal noise source is in its direction of zero response, a large part of the residual noise can be eliminated. This is especially important since it aids materially in reducing the screen requirements to obtain the desired reduction in electrostatic pick-up.

Electrostatic Shield Designs

An electrostatic shield is one which will remove the electric component of the electromagnetic radiation which enters its enclosure, leaving only the magnetic component.

The general idea of making a good electrostatic shield for a loop is to make the electric shielding as good as possible, and at the same time not to affect the component of the magnetic intensity which is perpendicular to the loop, since the latter component generates the signal which is used. To accomplish the first objective the usual procedure is to try to make the shield an equipotential surface by spreading as much metal over it as possible, either in the form of wires or sheets. In order not to affect the useful magnetic component at the same time, it is necessary that there should be no closed conducting circuits in the shield unless they are perpendicular to the plane of the loop. This can really never be accomplished completely, since every sheet of metal and even every wire has closed conducting paths within it. Therefore the object is really to keep the area and conductivities of all closed circuits which are not perpendicular to the loop as small as possible. A good way to measure the extent to which this has been accomplished is to measure the Q of the loop with and without the shield, because all closed circuits of the undesired type will cause the Q of the loop to decrease. A more detailed theory of shielding would take into account the potential differences between the various parts of the shield, since these do exist at radio frequencies. We shall not, however, go into this matter here.

In Fig. 4 are shown two types of electrostatic shields. In the first (4A) the loop winding is enclosed in a metallic tube, the conductive path through the tubing in the direction of the loop being broken by the insulating washer, W. This has been widely used in aeronautical work. Closed circuits in this shield such as *ABCD* which are parallel to the loop do reduce the Q, but since the area of any such circuit is small, the Q may still be good.

The shield in Fig. 4B is now being used in broadcast receivers. This shield is a simple right cylinder which completely enclosures the entire loop winding. Metal sheets cover the top and bottom faces of this cylinder, and the side is made of a coarse woven material in which the vertical threads are wire and the horizontal threads are a non-conducting fibre. Each vertical wire makes contact with the metal disc on the top, but only one wire makes electrical contact with the disc on the bottom. In this way, closed circuits parallel to the loop are reduced to a minimum.

Design of a Practical Loop

For reasons of styling, it is found desirable that the loop be placed in the lower compartment of a console receiver where it is not visible from the front. The space available for the loop is further restricted by the fact that a rotatable mounting and a shield must be provided. A loop of 21 turns, 10.5 inches high and 7.5 inches in width, was finally used. Although this loop is small, its sensitivity is about that of a good indoor antenna, the increased sensitivity being accomplished by tuning. In Fig. 5 is a schematic diagram of the tuned input circuit used. It is worth mentioning that since a loop is inductive it can be tuned over the whole broadcast band by a condenser which tracks with the oscillator so that no extra tuning control is needed. Tuning would not be practical in the case of an ordinary vertical antenna.

It is worth while to calculate the sensitivity of the loop just described. When the loop is rotated to its most sensitive position for a given signal, $\sin\theta$ (in Fig. 1) is equal to one, and the magnitude of the voltage impressed on the grid is

$$e = 2\,E\,Q\,n\,h\,l\,\pi/\lambda \qquad (2)$$

where Q is the quality factor ($\omega L/R$) of the loop circuit and E is the field strength of the signal. The loops described above had a Q of about 215, so that

$$e = 6.0\,E \qquad (3)$$

at a frequency of 1000 kc. The loop thus impresses a potential on the grid of the first tube equal to six times the field strength (volts per meter) of the incoming signal.

A photograph of a shielded loop is shown on page 20. A receiver using this antenna completely dispenses with the need for an antenna or ground wire. Furthermore, as we have shown, it has striking noise-reducing qualities.

Squeeze or Matted Track

By JOHN K. HILLIARD
Transmission Engineer, Metro-Goldwyn-Mayer Pictures

DURING the past few years several methods have been in use to reduce the ground noise which is inherent in film records. Some of these methods use a noise reduction system which varies with the percentage modulation, the reduction being zero at high modulation and increasing to a fixed amount at a low modulation (approximately 30%). This method is accomplished by a varying bias on the light valve and either a bias on the galvanometer or by an auxiliary pair of shutters. It has been restricted in release prints to a total of 10 db noise reduction by certain inherent range of electrical and photographic dimensions. For scenes which require less than 30% modulation over relatively long periods of time such as 10 feet or more, another method of providing noise reduction in variable density recording has been in use and is known as squeeze or matted track operation. This noise reduction is obtained by reducing the width of the track and simultaneously increasing the percent modulation such that the overall output remains linear. Since this method does not change during modulation, the increased noise reduction is very effective in further decreasing the background noise which is the equivalent of added volume range. The technique can be applied to advantage on whisper, intimate, extremely low level or completely silent scenes.

The matted track is obtained by introducing a "W" or "V" type mask in the light beam at a point in the optical system such that the edge of the mat is in focus at the film.

At present an interlock or selsyn motor system is used to drive the necessary equipment. Four motors are required to drive synchronously the mat, a compensating attenuator in the audio circuit, an indicator on the mixer table, and the master distributor operated by either a foot pedal or hand control of the mixer.

As much as 10 db squeeze is being used commercially. It is desirable to have the mat continuously variable so that it is not difficult to be able to insert and remove it easily. The original setups used matting in fixed amount and it was soon found that it could be used only in scenes of considerable length whereas with the continuous movement it can be withdrawn or inserted in the middle of a scene, and the amount of rehearsal time required to determine the

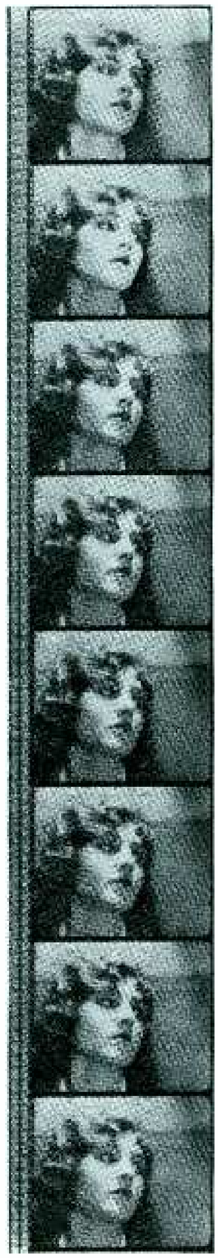


Fig. 1—Left. Single variable density double squeeze, showing transition from full width track to double squeeze track. Fig. 2—Right. Single variable density squeeze, showing change from full to squeeze track

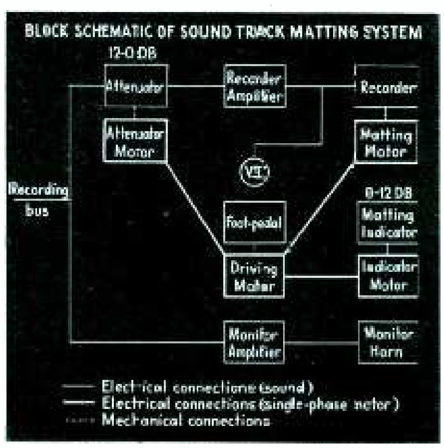


Fig. 3—Block diagram showing the functional arrangement of equipment for sound track matting system

amount of matting possible is reduced.

The use of matted track requires that the slit of the reproducer have an even illumination across the entire 76 millimeter track width in order that there be no change in level with matting operation. An improvement in adjusting the slit illumination has resulted because of the demands of other systems of recording and field use indicates that the illumination is sufficiently uniform so as to obtain results that justify the method. In order to reduce the effect of a level change due to the lamp usually having greater illumination at the center than at the outside a "W" (Fig. 1) shaped mat has replaced the original "V" mat (Fig. 2). As a result the matted track then varies in such a manner that the extreme matted condition is not at the center of the lamp.

The "W" mat also requires no change for push-pull since each track is matted at about its center. The mat is also used to limit the track width to .076 inches, which is the new working standard for both variable area and variable density sound track.

Higher quality standards require less over-modulation and this added improvement in noise reduction can be used to maintain a good signal to noise ratio and hold the modulation on the film such that it is not excessive.

Principal uses for matted track are in musical pictures where it is necessary to fully modulate the musical passages and keep the dialog at a relatively low volume without surface noise becoming objectionable.

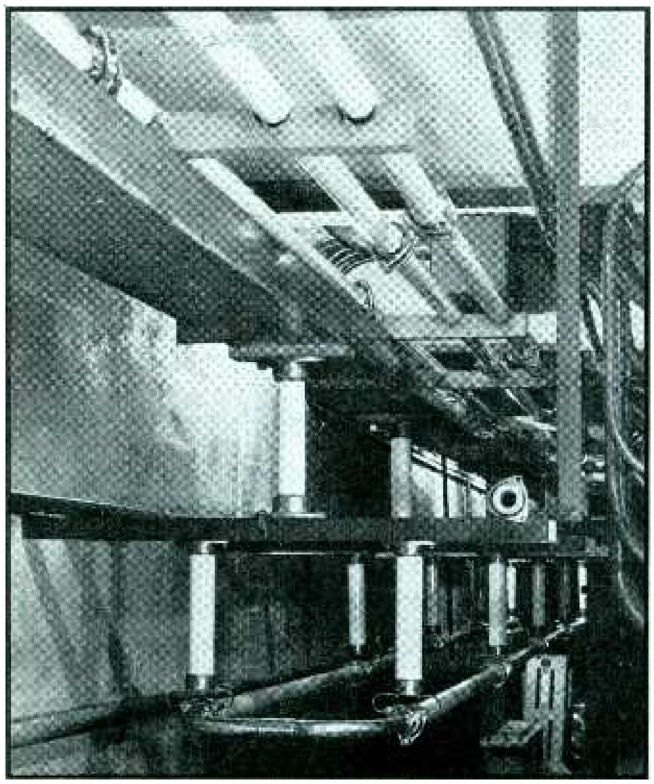


Fig. 1—Water system at broadcast station WHAM, in basement under the transmitter

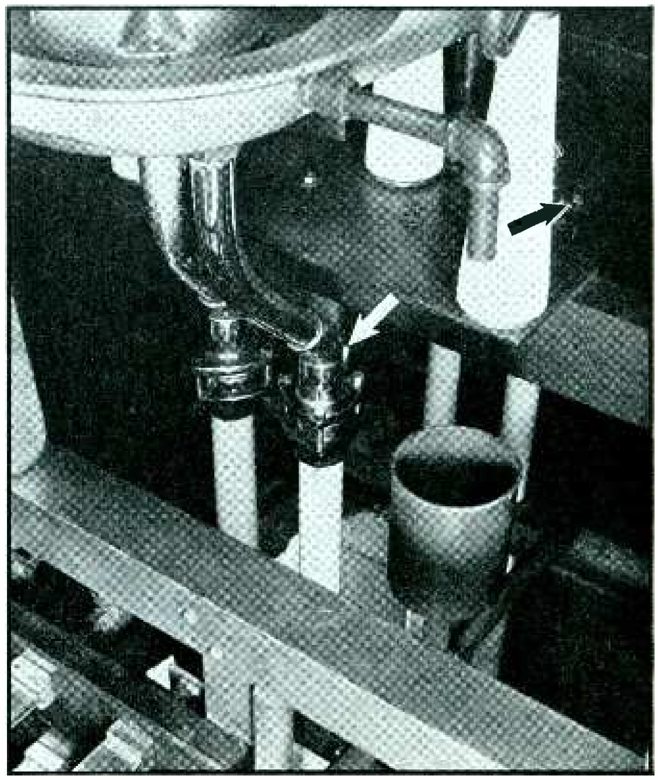


Fig. 2—Method of attaching the pipe to the water jackets. Note electrolysis target

Porcelain Pipe at WHAM

ALL broadcast station operators who have water cooled tubes to deal with, have experienced trouble with the water system used to cool the tubes. This trouble can be very serious in some cases. At WHAM, we are located about sixteen miles from the nearest source of distilled water, and in the winter we are often snowed in for several weeks. It is impractical to use a still with the well water we have at the station, so we must buy it in large quantities, and store it in the transmitter building.

We operate a Western Electric 306A, 50,000 watt transmitter and use about 130 gallons of distilled water in the cooling system. For the first year we had no trouble with the conductivity in the system. Shortly after a year, we began to get high leakage current in the water, and in two years, the thing began to be a real problem. The rubber hose deposited sludge and conducting minerals in the water and we had to change the water sometimes as often as once a week. In the original setup we had galvanized tanks. The galvanizing soon disappeared, and iron rust began to get into the water also.

The tanks were replaced with welded copper tanks, which were made locally by a sheet metal company. We specified welded tanks, because we were afraid of any soldered joints. Distilled water is very active when in contact with metals, and the use of one type of metal is recommended. We have red brass pipes in our system, but if we were doing it again we would use copper tubing with flared tube fittings.

The hose troughs are about 25 feet long, and are supported on insulators. We took the hoses out, and made up wooden supports to hold the porcelain pipe as shown in Fig. 1. This view shows the pipes running along the cellar under the transmitter. The pipe at the bottom, hung on insulators, is the loop across the 2nd power amplifier tubes. The total r-f voltage across the push-pull amplifier is across this loop. The resistance is so high that we have had absolutely no trouble with it. When we had a hose across at this point, we had to clean it very often as it put an added load on the amplifier as well as giving us loss from d-c leakage. At one time our old hose system put a total extra load of 9 kw on the high voltage rectifier! The loop circuit is left floating above ground, as this doubles the leakage path.

An end view of a spare piece of pipe with the fitting is shown in Fig. 1. The pipe used at WHAM is one inch diam. inside. The walls are made thick to prevent any breakage in case anything is dropped on them. Figure 4 shows the ends of the pipe with lead expansion loops connecting them to the pump connections. The leakage connection is made on one of these pipes, and connected to a milliammeter to give a check on the condition of the water. It runs normally about 2 ma. Figure 3 is a

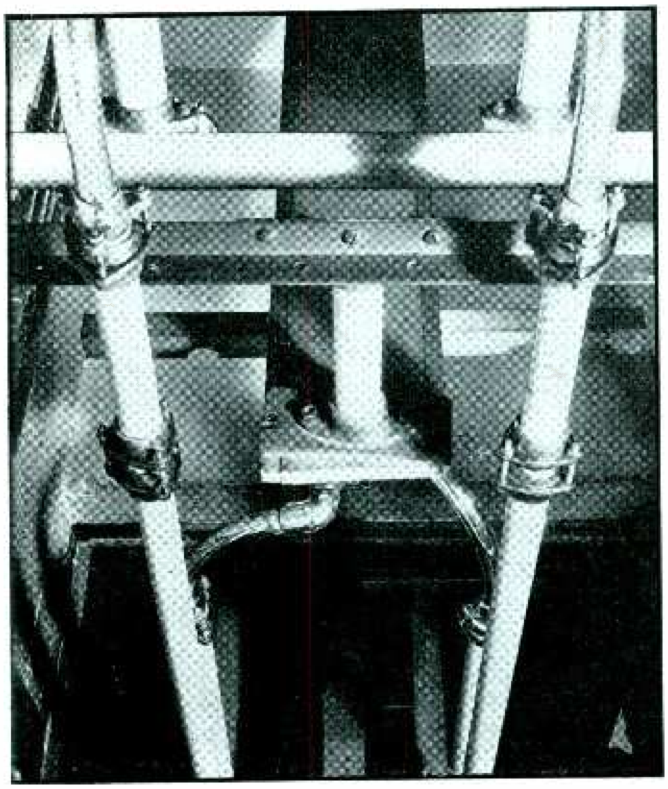


Fig. 3—Method of making bends with copper tubing and bronze fittings

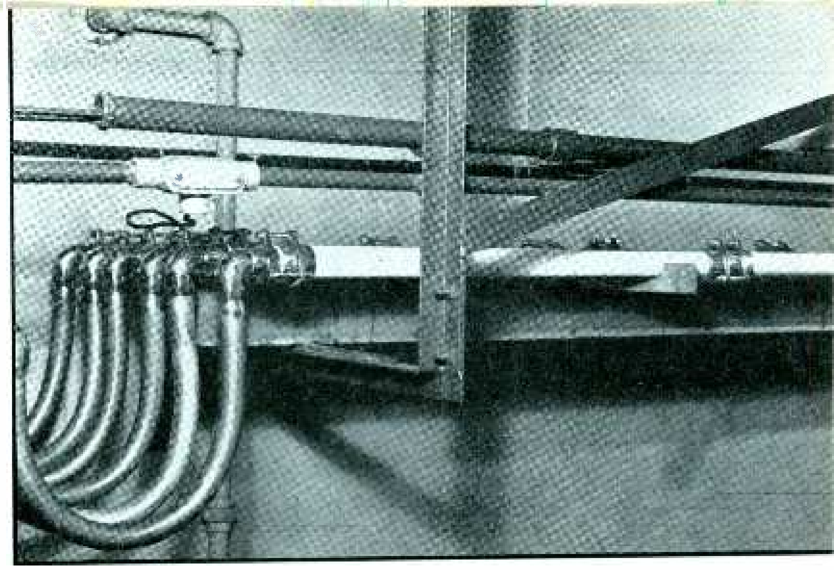


Fig. 4—Pipe ends with lead expansion loops connecting them to the pumps

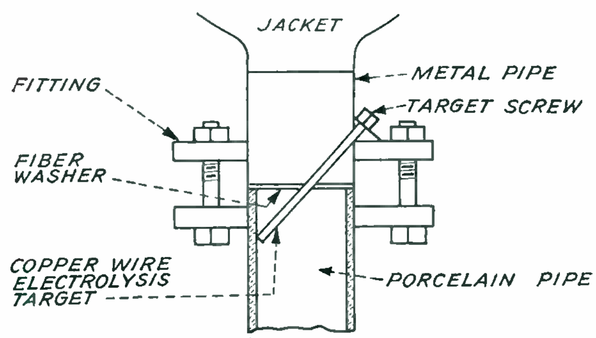


Fig. 5—Drawing showing how targets work

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Technical Supervisor, Station WHAM

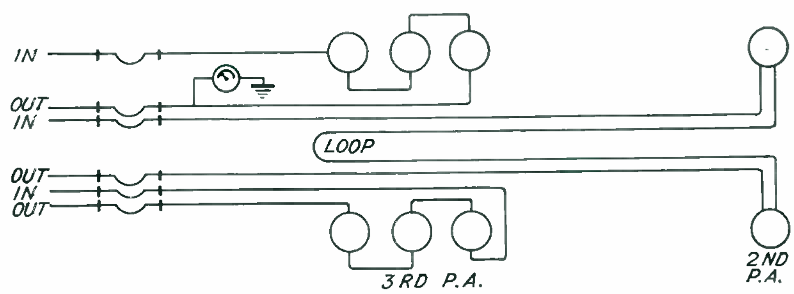

Fig. 6—Diagram of water lines to the different water jackets

view looking up under the 2nd power amplifier unit. This shows the method used to make bends with copper tubing and bronze fittings. The fittings are drawn together with three bolts, and a special type of fiber washer is placed between the ends of the porcelain. The fittings do not come in contact with the water at any place except on the metal bends. Washers with metal inserts were used at first, but it was found that the insert deteriorated.

In our installation, we have a small cellar under the transmitter which contains the hose troughs and duct boxes for the wiring.

Figure 2 shows the method of attaching the pipe to the water jacket. The arrows point to the electrolysis targets which are cap screws which have a piece of No. 4 copper wire soldered in the ends. This copper wire is about five inches long and projects down into the water below the point where the metal is attached. If these targets were not used, the fittings on the positive, or water jacketed, end of the line would be eaten away in time. These wires on the targets have to be renewed about once every two months. This will depend on the condition of the water however. High conductivity water will cause faster deterioration. We have only changed our water three times in a year, and the last changes were six months apart. Our system was pretty dirty when we changed to the porcelain pipe. With a new system, the water should not need changing for a year.

Our pipe and fittings were supplied by the Lapp Insulator Co. of LeRoy, N. Y. We are not very far from their plant, and were fortunate in having considerable advice and help from them in making the original installation. We estimate that the present system will pay for itself in three years, to say nothing of the reliability and trouble free operation it affords.

All new transmitters using water cooled tubes are using porcelain coils or pipes. We favor the pipes on any old transmitter that is to be changed over to porcelain, as they are easier to clean out with a fish wire and some cloth.

PARASITIC CIRCUITS

Parasitic oscillations are a source of erratic operation and reduced output in transmitters. Most troublesome cases occur when parasitic oscillation are at fundamental frequency. This article discusses remedies which have been found effective in practice

THERE has appeared a full discussion on parasitic oscillations which are caused by parasitic circuits in transmitters.[1] However, no mention has been made of parasitic circuits which absorb power from a transmitter stage on the fundamental frequency. Such circuits are especially troublesome in a transmitter covering a wide continuous band of frequencies, as parasitic oscillations must be avoided over the entire band. At the frequency for which a parasitic circuit is resonant, the power absorbed is often considerable. This power absorption may take place in a low powered stage, thus lowering the excitation to the next stage. Because of the diminished excitation, the power output and efficiency of the succeeding stage will be reduced. Parasitic circuits in the final stage of a transmitter will reduce the useful power output which may be obtained. In high power transmitters the components may be injured due to the high voltage which may be developed in a parasitic circuit.

Parasitic circuits are usually more evident when the transmitter covers a large continuous band of frequencies. An oscillator may actually stop oscillating over a small frequency range due to a parasitic circuit.

Typical Parasitic Circuits

A few typical parasitic circuits will be discussed in the following paragraphs. These circuits have all been encountered while testing transmitters.

The unshorted coil of a lower frequency band will become resonant at a higher frequency, due to its stray capacity. As there is nearly always some stray electrostatic or electromagnetic coupling to the circuit in use, the unused coil may take considerable power at its resonant frequency. The usual remedy is to short circuit the lower frequency unused coils. However, it has been found that this will not always cure the trouble for all frequencies. In one case it was found that a 500 kc. coil in the oscillator stage of a marine transmitter would absorb considerable power at approximately 13,000 kc. even though the coil was short circuited. This was indicated by a loss in excitation to the next stage. The 500 kc. coil was a two layer bank wound coil. The resonance apparently resulted from the inductance of each turn and the capacity between turns. The remedy used in this case was to shift the location of the coil so that the coupling to the other high frequency coil was very low. If a similar effect had occured in a high power stage the coil would probably have been injured due to the high voltages which would have been developed.

Another type of parasitic circuit is shown in Fig. 1. This was a frequency doubler stage in which the plate circuit was tuned to the second harmonic of the frequency applied to the grid of the first tube. The condenser C_B is a large by-pass condenser, C_T is a balanced ungrounded tuning condenser, and C_S is the stray capacity, which in this case was quite large. At approximately 12,000 kc. it was found that the circuit was not tuning correctly with the condenser C_T, and that the excitation to the two amplifier tubes was greatly unbalanced. At higher and lower frequencies the circuit operated as expected. It was found that the circuit shown by the heavy lines was resonant at the frequency at which it was desired to tune with C_T. The remedy used in this case was to change the inductance of the coil, so that this undesired resonance fell at a frequency at which this transmitter was normally not used. Another solution would have been to lower the stray capacity C_S to as low a value as possible. Connecting a balancing condenser whose capacitance is equal to that of C_S from the lower side of the tuning condenser C_T to ground, would also have eliminated the difficulty.

In another transmitter two separate tuned oscillator circuits were used with a single tube, the appropriate oscillator coil being selected by a band change switch. The unused coil was shorted. The circuit is shown in Fig. 2. It was necessary to ground one side of the tuning condenser, and as the tuning coil could not be grounded, the tuned circuit was completed through the 0.01 μf. fixed condenser for each oscillator circuit. When tuning the oscillator through the higher frequency band it was found that the oscillator would stop oscillating at about 11,000 kc., but would work correctly on either side of this narrow frequency band. An inspection of the circuit and some testing showed that there was a resonant circuit through the two 0.01 μf. condensers and the connecting lead between the two oscillators, as shown by the heavy lines in Fig. 2. A radio frequency choke was inserted at *X* between the two condensers, and this cured the trouble.

Another type of circuit which is similar to that above is shown in Fig. 3. As shown, the B+ lead and the by-pass condensers form a resonant circuit which may resonate

[1] Parasites and Instability in Radio Transmitters by G. W. Fyler. *Proc. I. R. E* vol. 23 p. 985. September, 1935.

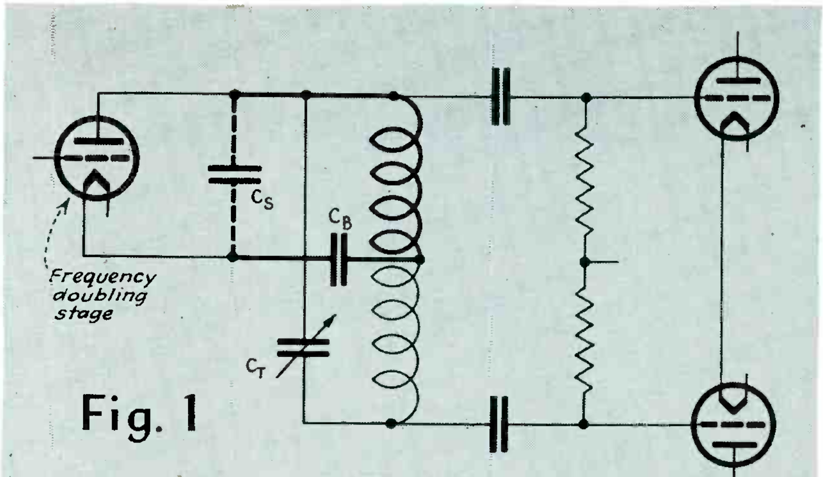

Fig. 1

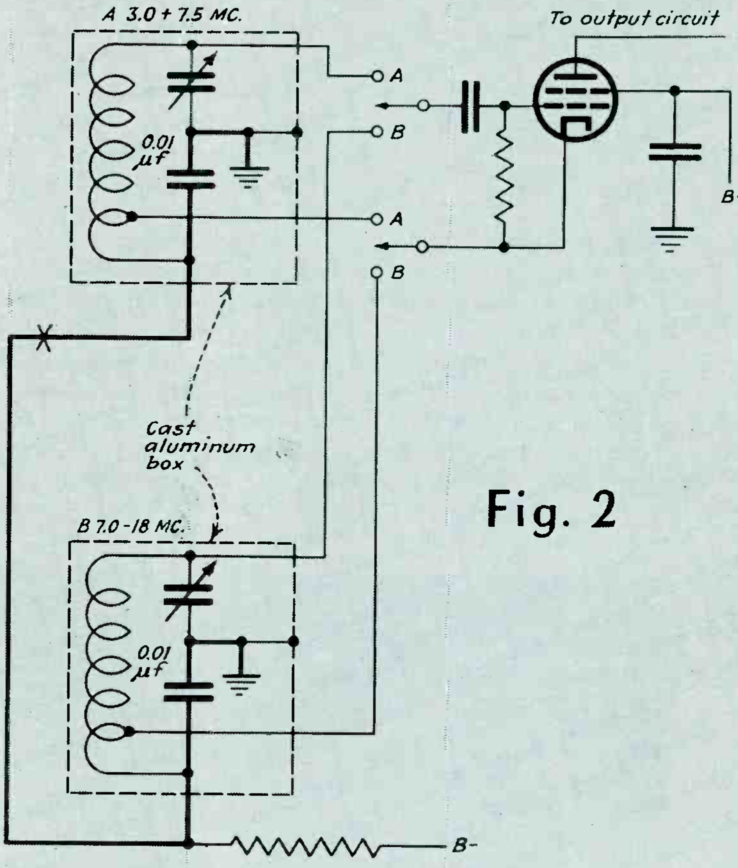

Fig. 2

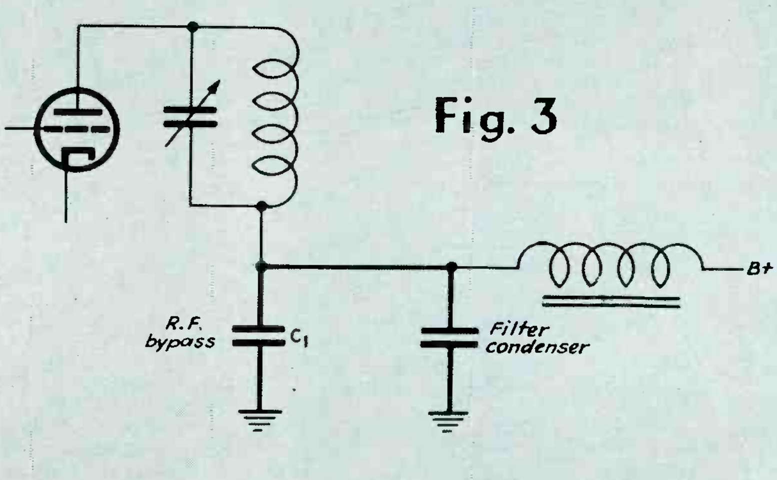

Fig. 3

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at some frequency which is in the frequency band of the transmitter. This circuit is shown by the heavy lines. The effect is a partial loss of excitation to the next stage at this frequency, or a reduction in power output. Also, the radio frequency current flowing is very detrimental to the filter condenser. The remedy was to insert a radio frequency choke in the B+ between the by-pass and filter condensers.

Another type of parasitic circuit which sometimes occurs is due to a design where a closed loop circuit is formed. This often makes a transmitter stage hard to neutralize and to excite, and in general makes for poor performance. Of course the difficulty can be cured by opening up the loop circuit.

Discussion

Some parasitic circuits may be avoided by careful design. Other parasitic circuits may not be as obvious, and these must be located while the transmitter is being tested. In general, in a transmitter which tunes through a band of frequencies, there should not be a limited frequency range where the excitation to a stage is low, or where there is a marked drop in power output. If this does occur, it is usually an indication of a parasitic circuit which is absorbing power.

One type of parasitic circuit which is particularly objectionable is that in which two by-pass condensers placed some distance apart are connected in parallel. The connecting wire and the two condensers form a resonant circuit which may absorb considerable power. Therefore, care must be used to ascertain that the resonant frequency of a circuit consisting of two by-pass condensers connected in parallel, does not fall within the operating frequency range.

The same types of parasitic circuits can also occur in radio receivers. In this case, the sensitivity will be reduced at the resonant frequency of a parasitic circuit. Therefore receivers should always be designed to avoid parasitic circuits.

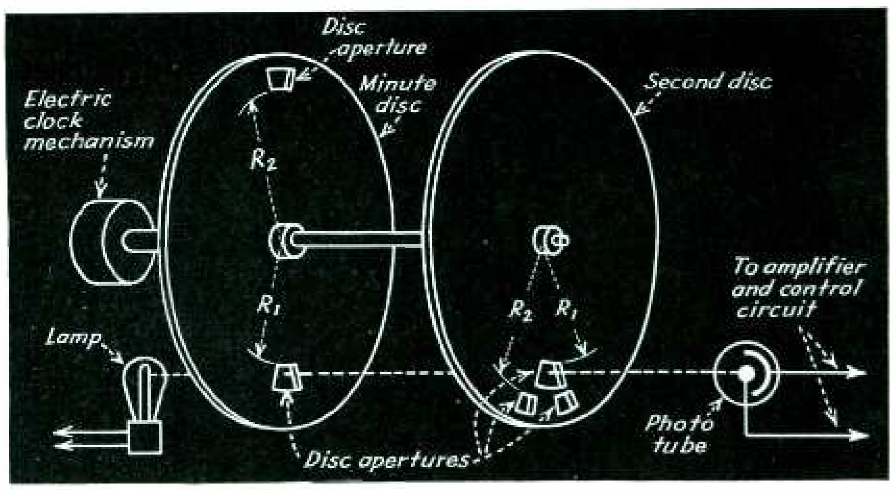
An Electric Timing Device

Simple timing device, using synchronous clock mechanism, phototube, and amplifier is described. May be used to transmit timing impulses or control time sequence operations. Low in cost; simple in construction

By ROBERT W. CARLSON
WBNY, Buffalo

An accurate, inexpensive electric timing device operated by means of a synchronous electric clock mechanism in conjunction with a phototube and its accessory amplifier may be made to perform a wide variety of timing operations. At WBNY a simple timing device built along these lines has proven useful in transmitting time impulses or chimes every half hour, although the system to be described lends itself readily to the production of timing impulses at other time intervals if this is desired. The device is simple both in operation and construction, and the precision of operation is dependent, for all practical purposes, only upon the accuracy of the mean frequency of the a-c power supply line and the time operating characteristics of the relays in the control circuit. The frequency of regulated power supply lines from which clocks may be operated is usually maintained much more accurately than is ordinarily required. With proper care and attention, the time characteristics of the relay may be made quite uniform over a long period of time. Consequently the overall precision of the device is satisfactory for all ordinary purposes. In practice the timing device has been found to be accurate to within one sixtieth of a second.

The fundamental method of operation is indicated in Fig. 1. The essential elements of the system include a synchronous clock mechanism having the usual clock hands replaced with opaque discs having suitable apertures, a light source, and a phototube together with its associated amplifier and control circuit. The hour, minute, and second hands ro-



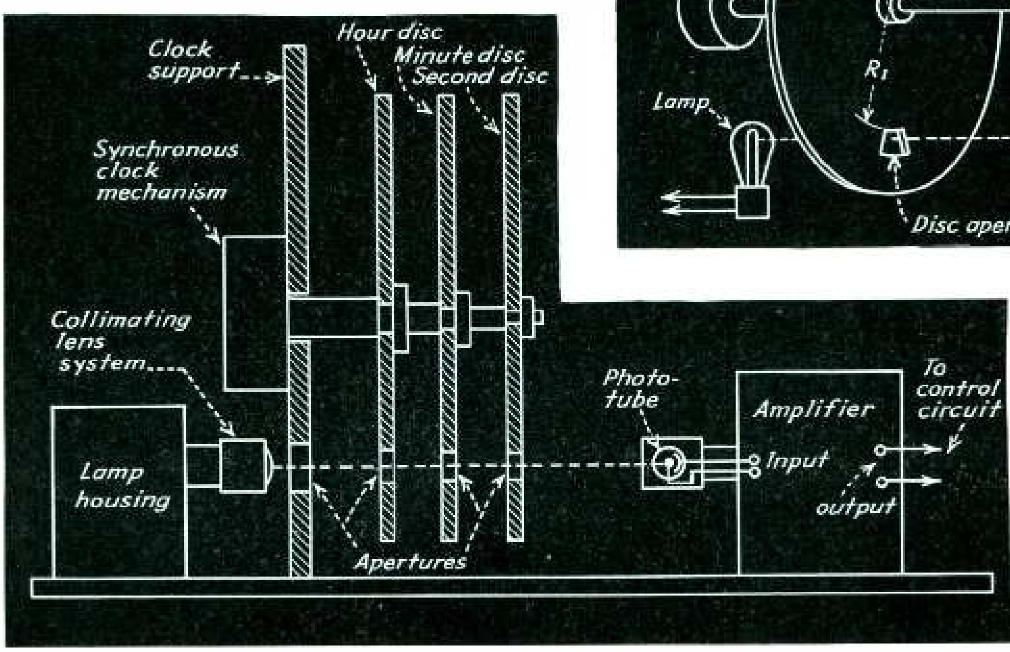


Fig. 1, left — Diagram showing the fundamental mode of operation of clock driven, phototube operated electric timing device

Fig. 2, above—Simplified and improved form of electric timer producing one pulse on the hour and two pulses every half hour tate, respectively, once every twelve hours, once every hour, and once every minute, in accordance with the motion of the hands they replace. The discs are provided with one aperture each near their periphery, and by means of adjustable collars by which the discs are attached to their proper shafts, the apertures may be made to become aligned at any desired time, with the light source and phototube. The apertures, which are slightly wedge shaped are cut so as to subtend an arc of 6°.

When the apertures are aligned with the light source and the phototube, the light impulse acting on the phototube may be convered into an electric current impulse which may be made to operate any circuit in the output of the amplifier. The duration of the impulse is one second after which the light is cut off by the opaque disc of the second hand. When the aperture of the second hand returns to the position of original alignment with the lamp and phototube, the minute hand has moved 6° and cuts off the light so that no signal impulse is possible. With this method of operation, an impulse may be transmitted once every twelve hours.

Although only one lamp and phototube are shown in Fig. 1, it is possible to extend the fundamental method so that, through the use of a plurality of lamps and phototubes, impulses may be transmitted at several equally spaced time intervals throughout the day. Because such a system does not permit impulses to occur at convenient time intervals, another system was developed which operates every half hour.

An improved version of the fundamental system of operation, designed to transmit a single impulse every hour and two short pulses on the half hour is shown in Fig. 2. The apertures on the minute disc are 180° apart and are cut for two different radii, R_1 and R_2. One aperture on the second disc has a radius of R_1 and two adjacent apertures on this same disc have radii R_2. All of the apertures on the second disc are symmetrically placed along one radius vector rather than being displaced 180° as is the case with the minute disc.

Every hour on the hour the apertures on the two discs which have radius R_1 become aligned and a light impulse is permitted to flow to the phototube, actuating the control once. Hourly on the half hour, the apertures having radius R_2 become aligned with the lamp and phototube, and two short impulses actuate the control circuit through he intermediary of the amplifier and the phototube circuits.

With this arrangement, which was designed primarily to provide a time signal for use in broadcasting, a service highly appreciated by the listener, it can be seen how a tone or chime can be controlled by the relay circuit in the phototube amplifier.

It is important to select a type of phototube, amplifier, and relay whose operation is dependable, and whose time lag is small or at least very constant. It has been the author's experience that the emission type of photoelectric device performs most satisfactorily. The selenium or resistance type of photosensitive device was found unsatisfactory because of its lack of stability. The generating or barrier layer type of cell proved unstable with the heat developed by the voltage dropping resistors which were used in the amplifier.

A wide variety of amplifier circuits is available for amplifying the phototube current. Two circuits which have been found useful at WBNY are illustrated in Fig. 3 and Fig. 4, both of which operate directly from the 110 volt a-c line. The circuit shown in Fig. 3 operates in the absence of light, whereas that of Fig. 4 operates by virtue of the presence of a light beam.

Since the resistance of the phototube is likely to be much larger than the resistance in series with it, the major portion of the applied voltage will appear across the phototube. The peak instantaneous voltage across the phototube may be as much as 150 volts when the line voltage is 110 volts r.m.s. This voltage is in excess of the ionization potential of most gas phototubes. A vacuum type of phototube is recommended for use rather than a gas phototube which would ionize over a considerable portion of the positive half of the cycle.

As in all phototube circuits, careful attention must be given to the matter of insulation resistance if the circuit is to operate most satisfactorily.

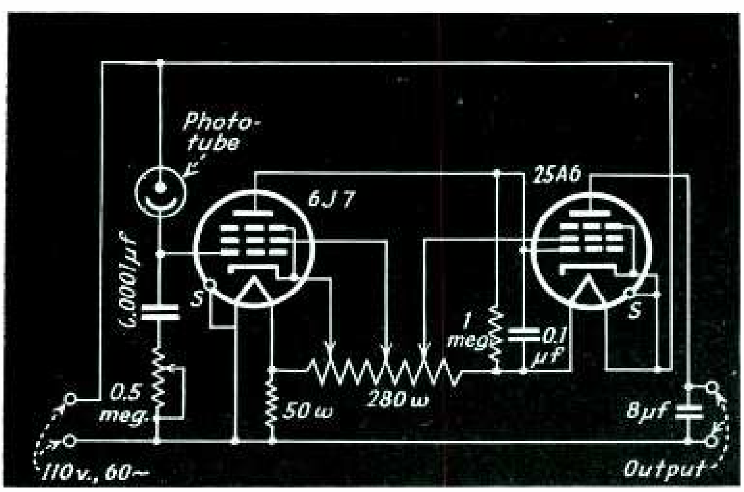


Fig. 3—A simple two stage a-c operated phototube circuit and amplifier functioning in a negative direction on the received light

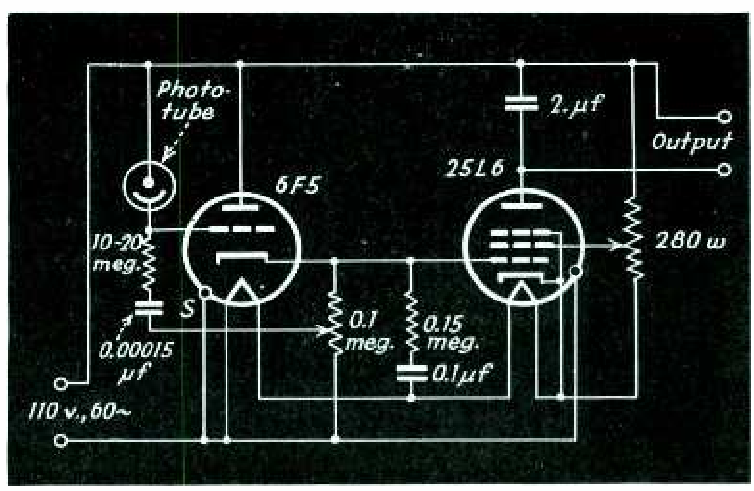


Fig. 4—Another simple a-c operated phototube control circuit operating in a positive direction on the light received by the phototube

NEW BOOKS

Television Engineering

By J. C. Wilson. *Isaac Pitman and Sons, Ltd., London, 1937. 492 pages, 276 illustrations. Price $10.00.*

THIS IS THE first book to appear within the "modern era" of cathode-ray television which can lay definite claim to the engineer's interest. (The second book, in point of time of appearance, Maloff and Epstein's "Electron Optics in Television" was reviewed in June *Electronics*). It is a solid book, carefully written, well illustrated, and except for the high price at which it must unfortunately be sold, has all the qualifications requisite to a place on the radio engineer's shelf of important books.

The volume opens with an historical survey, well backed up with references to technical literature and patent numbers, which in itself must have consumed many hours of the author's time and speaks well for his knowledge of the background of the art. Three important fundamentals of the subject, optics, scanning theory and methods, and photoelectricity, are treated at length in separate chapters, as are the design problems associated with wide-band amplifiers and related circuits. Cathode rays as applied to the reception of television images, and light modulation as it applies to transmission, are discussed at length. Synchronizing methods, with illustrations from British practice, and descriptions of typical, as well as specialized, television equipment are included. The book concludes with the important subject of the physical limitations imposed on a television system. Throughout the book are given extensive references to the literature.

The mathematical level assumed by the author varies with the subject under discussion, but in general it includes elementary calculus, series expansions, especially of the Fourier variety, and the geometrical symbolism of ordinary optics. In many parts the book must be studied, rather than read, and no attempt has been made to gloss over the difficult parts. The treatment of electric circuits is conventional and should be followed easily by engineers familiar with circuits in general.

The most obvious omission in the book is the almost total absence of any mention of the electronic methods of scanning at the transmitter. A paragraph or two mentions the existence of the Farnsworth dissector and the Zworykin iconoscope, but no explanation of their action and peculiarities are given. In fact the treatment of scanning is almost wholly confined to the rotating mechanical type of scanner which at present takes second place to the electronic methods throughout the world. From this point of view the book is not thoroughly representative of modern electronic practice. Cathode ray reception of images, on the other hand, is adequately treated. Another topic which might well have been included in the chapter on amplifiers and circuits is that of modulation and demodulation in wide-band channels. With these reservations, the book is recommended to those who have sufficient technical background to "wade in," and who desire an authoritative treatment of most, if not all, of the important fundamentals in television engineering—D.G.F.

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Wireless Direction Finding

By R. Keen. *Third Edition. Iliffe and Sons, Ltd., London, 1938. 803 pages, 549 illustrations, 25 shillings.*

THE SECOND EDITION of this book was published in 1927 under the title "Wireless Direction Finding and Directional Reception." In the eleven years which have since elapsed, the whole art of radio direction finding has undergone the most intensive development and its applications have been extended from the marine to the aeronautical fields. The third edition consequently has been greatly enlarged and contains a well-rounded discussion of the latest developments.

The book is primarily descriptive, but the theory of the subject is nevertheless well developed by means of diagrams and simple mathematics. Although written from the British point of view, with its differences in terminology, American apparatus is described fully.

It may be wondered how over 800 pages may be filled with a subject as specialized as radio d-f, but the answer is simply that the author writes with traditional British thoroughness, and that no topic having any connection with the subject has been neglected. Starting with the theory of wave propagation, and the directional properties of "frame" (loop) aerials, the author proceeds to descriptions of the well-known Bellini-Tossi system, the Adcock system, beacon systems for long range work, aircraft d-f equipment, etc., etc. Attention is given to the vagaries of direction-finding including polarization errors, night-effect, quadrantal errors due to installation, etc. Approach and landing systems (called instrument landing in this country) as applied to aircraft are fully covered. A chapter is especially devoted to maps and the proper ways of using them, a topic not often well understood by the radio engineer. A bibliography of 570 references concludes the volume, and gives a fair indication of the immense amount of work that has been done in this field. The book is recommended as "essential" to all those whose work has to do with direction finding systems, and as worth while to others who may have simply an academic interest in the subject.—D.G.F.

• • •

Science and Music

By Sir James Jeans. *The MacMillan Company, New York, 1938. 258 pages, 64 illustrations, price $2.75.*

MOST RADIO ENGINEERS who have high fidelity receivers and/or phonograph reproducers pride themselves on being connoisseurs of music. They know a high frequency when they hear one (which is not so often at that), and they can tell the difference between a 40-cycle resonance peak and simple exhuberance on the part of a tuba player. But Sir James Jeans knows a great deal more about it than that, and he puts most of what he knows down on these 258 pages in such a way that any reader, technical or otherwise, cannot but profit from the reading of it. Sir James has long been known for his ability to make technicalities easy to take without reducing them to pulp, and his hand has not lost its customary cunning in the present instance. You can fool your friends with this one: "Which makes the better tone, a piano virtuoso striking but one note, or a lump of leading falling on the same note?" Sir James has oscillograms to show the difference, which is undetectable, but at the same time he gives the virtuoso his due when more than one note is to be struck.

Any engineer who is charged with designing an audio system on which music is reproduced ought to be required to read this book. Short of such compulsion we can only urge all such to read the book just for the fun of it. A considerable improvement in our feeling for, and handling of, reproduced music should result.—D.G.F.

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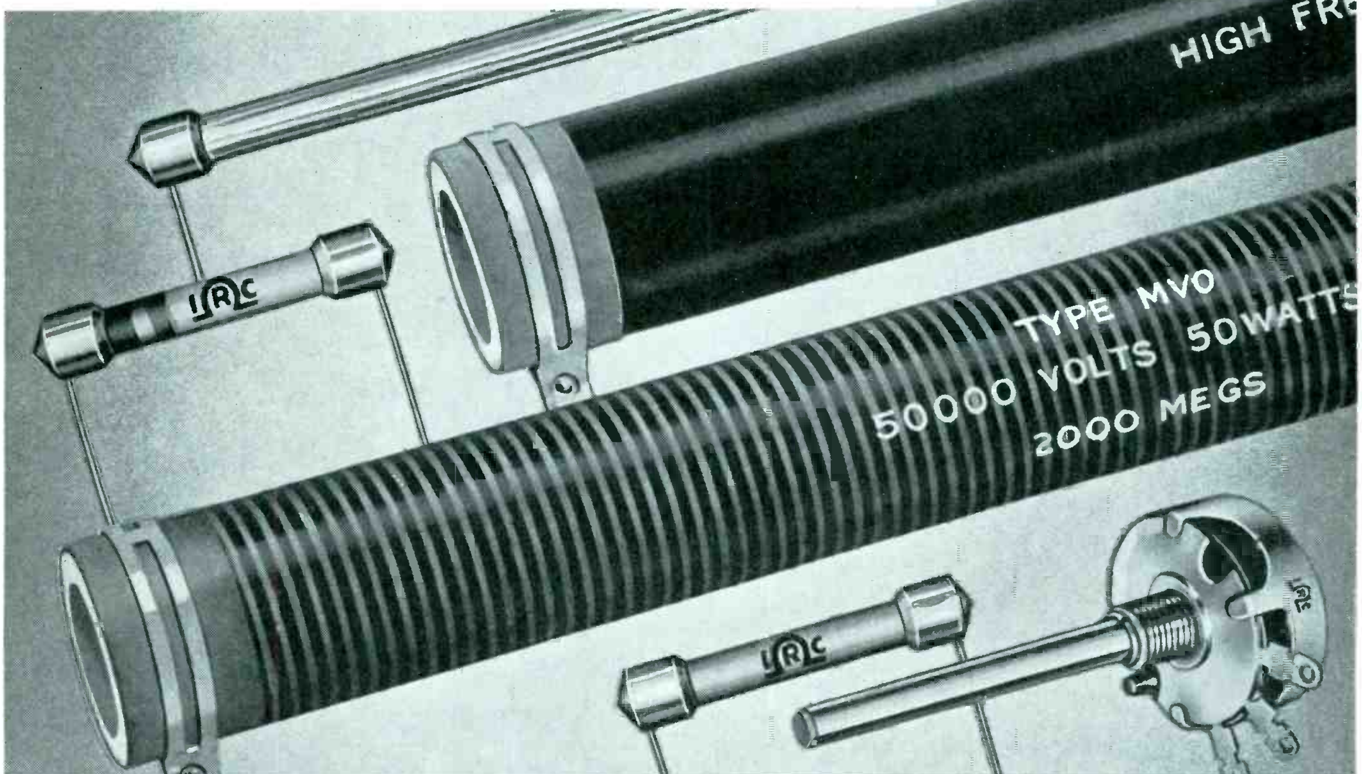

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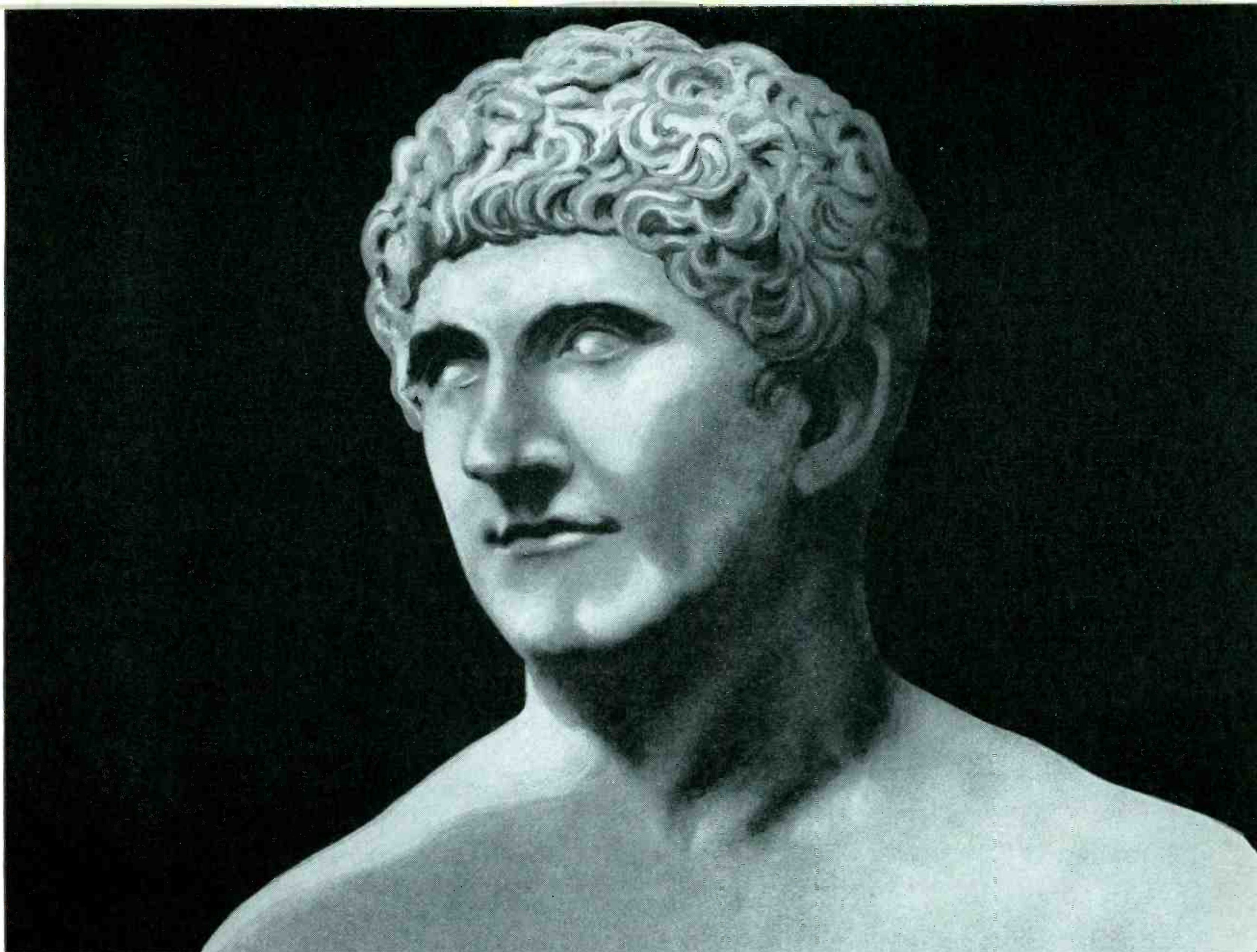
Abbreviations

AIEE	American Institute of Electrical Engineers
ATM	Archiv fuer Technisches Messen
CIGRE	Congrès international des grands réseaux électriques à haute tension
EEI	Edison Electric Institute
ERA	British Electrical and Allied Industries Research Association, 15 Savoy St., London W. C. 2
ETZ	Elektrotechnische Zeitschrift
E u M	Elektrotechnik und Maschinenbau (Vienna)
IEE	Institute of Electrical Engineers (London)
NELA	National Electric Light Association
POEE	Post Office Electrical Engineers (London)
RMA	Radio Manufacturers Association
VN	Veroeff. auf dem Gebiet des Nachrichten-Wesens (Siemens, Germany)



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AMONG the tube applications this month are measuring the "latheriness" of soap, regulating temperature directly from the thermometer dial, lighting neon signs without electrodes, and reproducing phonograph records via a negative conductance oscillator.

Phototube Indicates Softness of Water

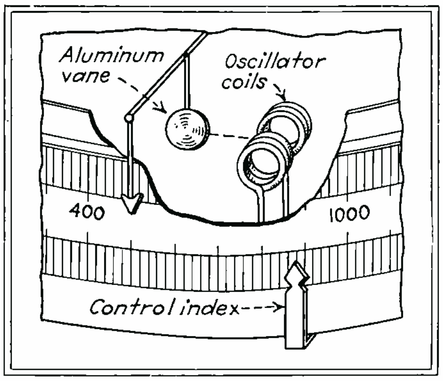
A MEANS OF CONTROLLING a water softening machine automatically, using photoelectric tubes, has been disclosed in patent No. 2,122,824, recently issued to Eric Pick and assigned to the Permutit Co. of New York. The tester consists of the usual combination of a phototube and a light source between which is mounted a trough through which the water to be tested passes. A definite quantity of soap of known chemical properties is added to the water and stirred to create a lather which appears above the surface of the water in the trough and interrupts the light beam. Depending upon the amount of lather produced, the phototube relay can be used to actuate a water softening machine as the need for it arises.

• • •

Induction Pick-Up Regulates Temperature Directly from Indicator Pointer

AN INGENIOUS ARRANGEMENT for transferring the indications of an electrical thermometer directly to a heat-control circuit has been developed by the Wheelco Instrument Co. of Chicago. The indicating instrument is of the millivoltmeter type, used in conjunction with the standard thermocouple unit. As shown in the diagram, the indicator pointer carries with it a small circular vane made of aluminum foil, which adds but negligible weight to the pointer assembly. Attached to the case of the instrument is another pointer which is adjustable manually to the position on the scale at which temperature control is required. Attached to this pointer are two small coils of silk-covered wire so arranged that at any position on the scale they allow the aluminum vane previously mentioned to pass directly between them. These coils are energized with radio frequency energy from a vacuum tube oscillator mounted within the case of the instrument. When the pointer moves within the near vicinity of the coil position, the aluminum vane enters the space between the two coils, and eddy currents are induced in it. These losses result in a change in frequency of oscillation, and this change in frequency is detected in a tuned circuit so that the current drawn by the radio tube oscillator changes in proportion to the change in frequency. The current change operates a relay which in turn controls the contactor in series with the heat supply of the furnace.

Since the control depends only upon the production of eddy currents, and



Arrangement of pick-up coils and aluminum vane

since there are no ferromagnetic elements involved, there is no force exhibited between the coils and the aluminum vane. Consequently, the control system does not advance or retard the indication of the pointer itself.

In one variation of the instrument, the heating current is periodically turned on and off whenever the pointer is within a few degrees of the control position. Usually the control range is 30 deg. F. wide. At the lower edge of this range heat is applied continuously. At 6 degrees higher (20 per cent of the total range) heat is off only 20 per cent of the time; at 12 degrees above the lowest position, (40 per cent higher), the heat is off 40 per cent of the time and so on until at the top of the 30-deg. band the heat is off 100 per cent of the time. This proportioning control system has the effect of completely eliminating time lag, overshooting, and hunting.

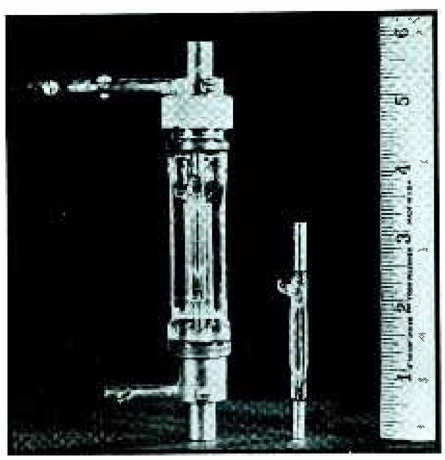
• • •

Electrode-less Neon Tubes Excited by Radio Frequency Energy

THE EXCITATION of light from rarefied gases by radio frequency bombardment has been applied recently in a new type of neon sign. The conventional neon sign consists of an evacuated tube fitted with two electrodes and containing rare gas at low pressure. The expense of the electrodes and of inserting them in the tubes has resulted in the practice of combining many letters in one tube, the regions between letters being painted out by covering the tube with on opaque paint. The high voltages employed necessitate placing the tubes several inches from the main body of the sign itself to obtain the necessary insulation.

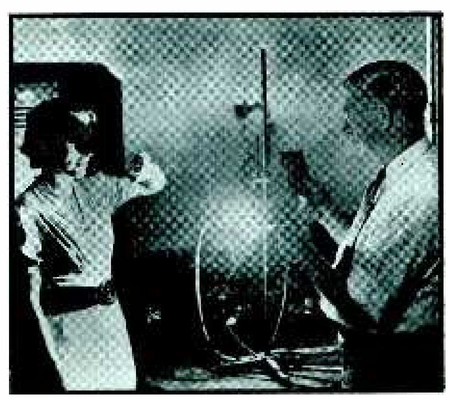
In the new system of tube lighting, each individual letter in the sign is formed separately and consists of a tube

(Continued on page 52)



Announced coincidentally by General Electric and Westinghouse, a new 1,000-watt high pressure mercury lamp, shown at right above, is cooled by running water through a jacket surrounding the lamp. The water filters out much of the infrared but allows the ultraviolet and visible radiation to escape. The brilliance attained is about one-fifth that of the sun's surface

WATERCOOLED QUARTZ LAMP



The Westinghouse version of the new lamp is demonstrated by Dr. J. W. Marden. The compactness of the source is one of its important advantages. It is expected to revolutionize methods in the photoengraving industry, as well as in searchlight practice

PUBLIC RELATIONS in Industry

With special reference to industries based upon the electron tube

electronics

A McGRAW-HILL PUBLICATION

OCTOBER 1938

An Editorial Service to Meet

INDUSTRY'S MAJOR PROBLEM

TO THE READERS
OF ELECTRONICS

There is no doubt that today the American people are taking a keener, more critical interest in the conduct of business than ever before. And when I say critical, I mean exactly that. During recent years most of them have suffered loss, either of jobs or of savings, and under such circumstances men are prone to accept without serious question any scapegoat that appears plausible. In the confusion of fears and resentments, they seem to have concluded that shortsighted and selfish business management is chiefly responsible for their misfortune.

However mistaken and unfair such conclusions may be, management cannot ignore them. It must recognize that in the long run, the opinions of men are the result of experience, of what happens to them each day, much more than of what they are told.

Progressive management has already faced that fact; has already begun to think and work beyond the technicalities of production and distribution that once absorbed most of its energies. It sees more clearly and deals more proficiently with its human responsibilities. It is learning to reconcile the economic success of the industrial unit with the social welfare of worker and community.

Presently, every business—the small retailer as well as the large manufacturer — must learn how to interpret more convincingly to its own public the social as well as the economic benefits of its policies and accomplishments. Only as each business satisfies the newly aroused and critical interest of people in its affairs will it be able to disarm those who trade on the human tendency to blame our troubles on someone else. Yes, if business as a whole is to win a favorable public opinion, each and every business must act to improve its own public relations.

The readers of this journal, and of other business publications, compose, we believe, a group that can achieve for American business a sound and lasting solution of this vital problem. They alone are in position to shape the working conditions of 21 million employees. They alone can mould the attitude of those other millions who compose the various "publics" to which all business must be responsible.

Heretofore, the function of business papers has been to exchange successful experience; to dig up and disseminate practical facts for the use of their readers, serving primarily the technical and merchandising needs of business. But this matter of human relations has now become of equal importance, for good industrial and public relations, it has been found, reduce corporate losses, remove fear and suspicion, promote operating efficiencies in both production and sales. A better knowledge of public relations technique is, therefore, quite properly essential for men in, or moving into, positions of greater executive responsibility.

So, beginning with this insert, each McGraw-Hill publication sets out to strengthen its editorial service in the important domain of Public Relations. I hope that the million readers of McGraw-Hill's business papers will get much real and practical help toward building better relationships between their own businesses and their employees, their customers, and the communities in which they must carry on.

James H. McGraw, Jr.

President, McGraw-Hill Publishing Co., Inc.

WHY

A Public Relations Program

IN LESS than two generations the United States has changed from an agricultural to an industrial nation. Living standards and efficiencies at once the despair and envy of other countries have been created. Foreign delegations still flock to our shores to study our methods so that they may use them as patterns for their own organizations. Yet here at home today these methods and the systems responsible for them are under increasing attack.

Since every person employed in productive enterprise is a part of American industry, these attacks imperil the livelihood of nearly forty million workers and their dependents. The newest addition to the payroll has as much—if not more—at stake as the veteran business executive. That also is true of particular industries which at present may not be under direct fire. All industry is so interrelated and interdependent that even the seemingly immune enterprise must suffer when the legitimate activities and the buying power of their customers, or the customers of their customers, are curtailed.

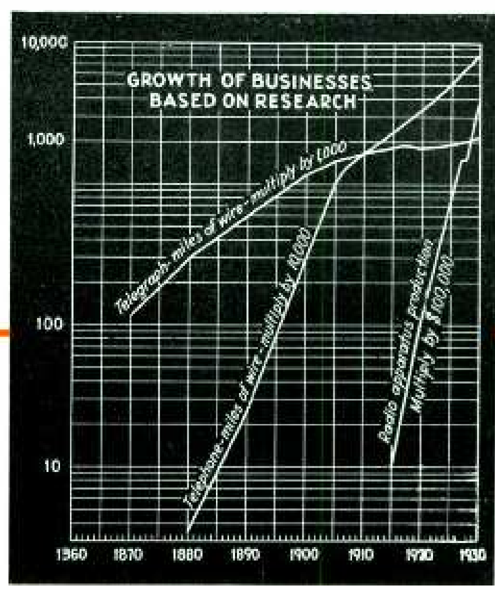
Ironically enough, public acquiescence in many of the current attacks is an indirect recognition of the satisfactory manner in which our industrial system normally functions. Reasonable opportunities for the employment of those ambitious to put their mental or physical talents to work, and continually rising standards of living have come to be widely accepted as a matter of course. Any unfavorable change in these conditions leaves the general public surprised, confused and resentful. Such reactions as these make it easy for pressure groups to unloose destructive propaganda which further heightens resentments and breeds new misconceptions.

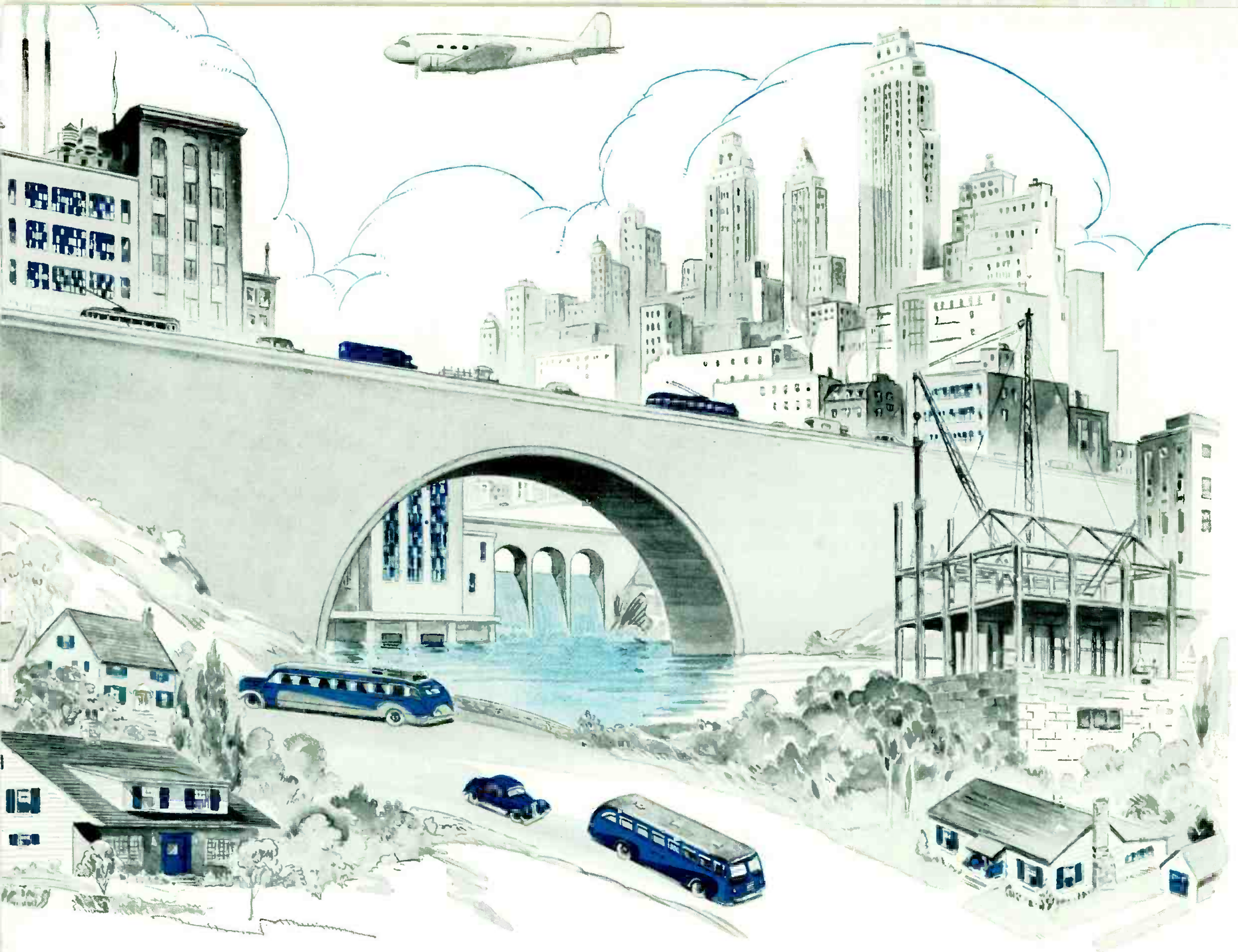
These misconceptions take many forms shaped by the experience, the inexperience, or the special interests of the critics. To one it appears that business can't manage itself and must be owned and managed by the Government. Another believes that employees are underpaid or that stockholders and executives are overpaid. To others corporate surpluses are too high. Many have convinced themselves that power and machines have reduced employment opportunities; and that industry can raise wages and reduce prices while costs go up.

Several misconceptions are based on faulty generalizations. Because a few companies have been remarkably successful, it is argued that all could make money. Because some corporations have been ruthless, all corporations, it is contended, will stoop to unethical conduct to gain their ends. This is like saying: John Smith killed Bill Brown; John Smith is auburn-thatched; all redheads, therefore, are murderers. Unfortunately, those who would indict all business for the crimes of a few are more subtle in their approach and so create an impression not in accord with the facts.

To put it bluntly, American industry, once so highly praised for its contributions to the national well-being, is now on the spot. Prevailing misconceptions of how business operates and what it does have made a field day for those who propose to hamstring or destroy private initiative and individual opportunity. These proposals run a broad gamut; they include public ownership, increasing and rigid federal control at

Industrial contributions of research and invention in United States. Curves showing motor car and airplane production parallel closely data on telephone growth and increases in annual radio apparatus production. (Source, National Industrial Conference Board.)





the expense of local autonomy, ill-conceived legislation on hours and wages, labor dictatorships, and confiscatory taxes on thrift and employment security.

While the man in the street may be criticized for his willingness to swallow these nostrums, he is not wholly to blame. Industry, too, has been at fault, in assuming either that he was fully informed on those phases of its operations which are properly a matter of public interest, or that a healthy curiosity should be discouraged. Misconceptions multiply where the facts are hidden.

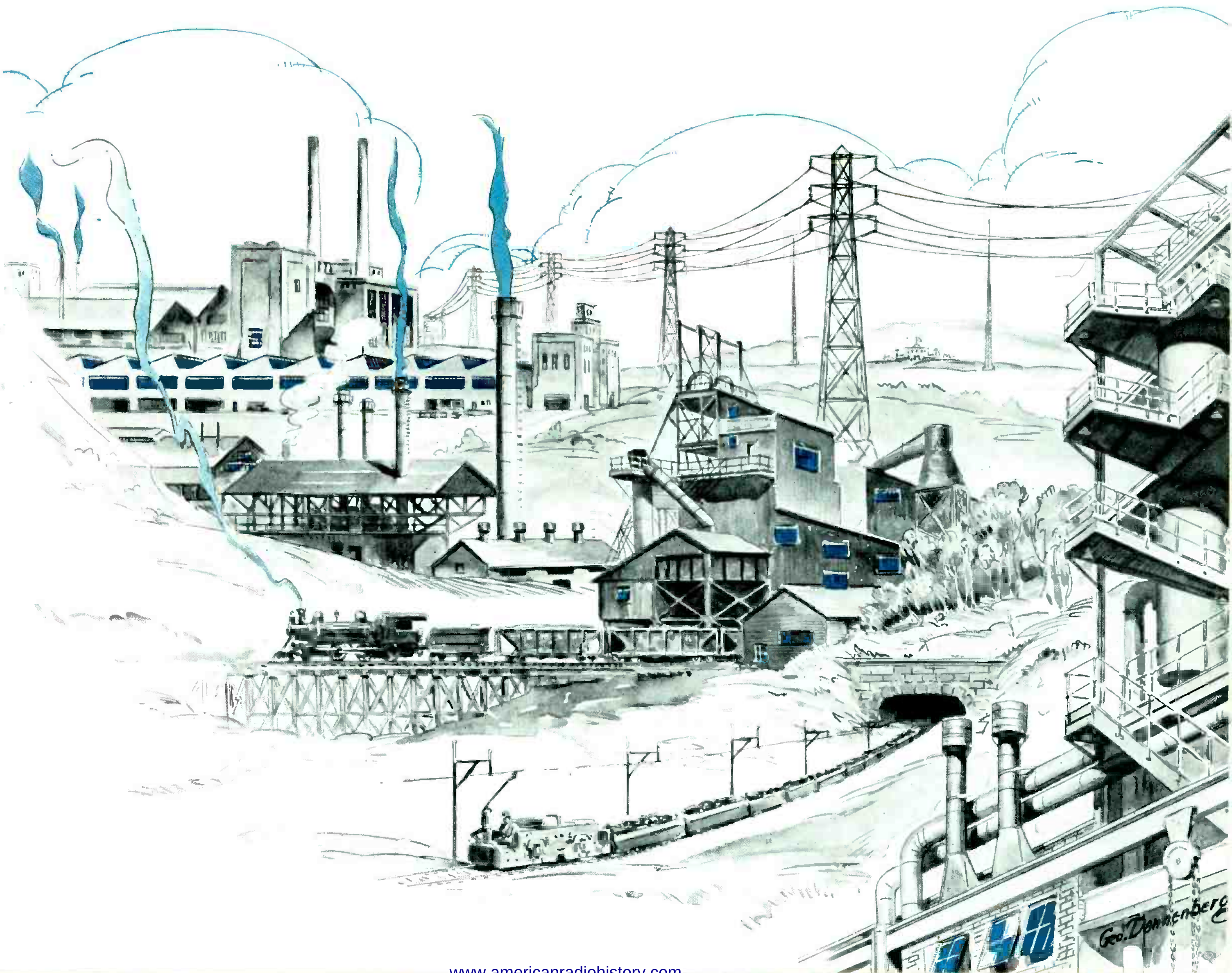
The tragedy of the situation lies in the fact that it might easily have been avoided. In the simple days of local and localized industry, everybody connected with a particular enterprise knew everybody else connected with it, and the details of its operations were an open book. The boss and the employees were neighbors; the customers, for the most part, fellow townsmen. Outside purchases were limited largely to those products which the local community neither manufactured nor raised. Competition in the modern sense was practically non-existent.

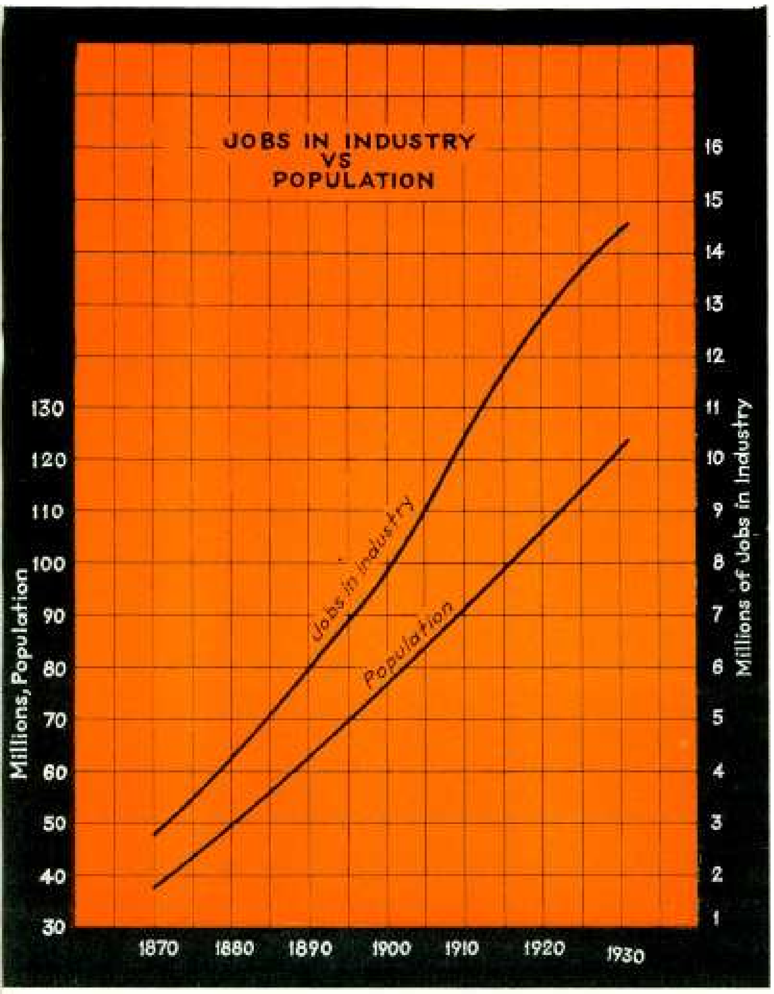
As industry developed and enlarged its field of operations, much of this early intimate personal touch was lost. The small enterprise grew bigger. In some cases combinations took in the local business and financial control passed out of the community. The local industry which still retained its identity was busy meeting increased competition and seeking to expand its distribution. Little attention was paid to changing conditions that were fostering misconceptions about the personal relations of the business. Bit by bit the close acquaintance and familiarity of the early days disappeared.

Common understanding of these things also was impeded by the greater variety of occupations as industry expanded. Each man's job became so highly specialized that the old feeling of common partnership in a joint undertaking frequently was buried in an exaggerated feeling of the relative importance of his own work. This made it easy for each occupational group to get the idea that its contribution to the undertaking alone was essential and that many of the other groups were parasitic or, at best, unimportant.

Such mistaken beliefs are the exclusive property of no particular group. "Goods are valueless until sold," chants the sales staff; "without us the wheels of industry would cease to turn." "The wheels would turn much faster," growls the production department, "if we didn't have so many lame-brains drawing fat salaries as salesmen." Under the cold glance of both groups, the clerical force heatedly inquires: "How long do you think this business would last if we didn't keep the cost records, send out bills and collect the money for pay checks?" Some executives and engineers, too, have been known to forget that their plans cannot be carried out without the cooperation of other groups.

Possibly the greatest single cause of misunderstanding and friction has been fuzzy thinking on social responsibilities. Many of the responsibilities which rested on the individual or the state in our fathers' and grandfathers' days have been shifted to the shoulders of industry. New ones constantly are added or proposed—often before industry has had time to adjust itself to those which have gone before. Some of these responsibilities affect employee relations; others involve customer relations. The worker, for example, no longer is completely defenseless against the occupational hazards of his employment. "Let the buyer beware" no longer is considered smart merchandising. Many of the changes now embodied in the laws were anticipated by industry itself. Opposition—valid or





Industrial jobs have grown faster than the population has increased. New industries depend upon research and invention.

otherwise—to social legislation, however, has been used to damn business in the public eye.

Fortunately, the barriers to good will and common understanding can be broken down. The process is a simple one. It consists chiefly in maintaining good policies in human relationships and in keeping all interested people—employees, stockholders and their neighbors, customers and the general public—informed. It means telling them in plain terms what revenue is received and where it comes from, what revenue is paid out and who gets it, how an industry serves the individual, the community and other industries. Finally, it includes the acceptance of the social responsibilities which the advance of civilization imposes upon business.

Add all these things together and you have public relations.

Most employers are willing to accept their social responsibilities, but they are inexpert in making that acceptance articulate. Too many employers have failed to make clear their policies, their practices and their purposes as they relate to fair dealing with employees, investors and the general public. Their intentions have been good, but they have cloaked them with a veil of secrecy and made a mystery out of simplicity. As a result the uninformed have been given a royal opportunity to exercise their imagination. And they have done it!

Public relations is a comparatively new activity for most business enterprises and involves a technique which too many have not yet learned. Obviously, the first place for each company to start is within its own organization. This is the "inside job" that builds a company's good name among its own family and lays the firm foundation for building public confidence and favor. As one exponent of the art phrases it: "Industry's public relations cannot be one thing and its private actions and policies something else. The two must be in complete accord."

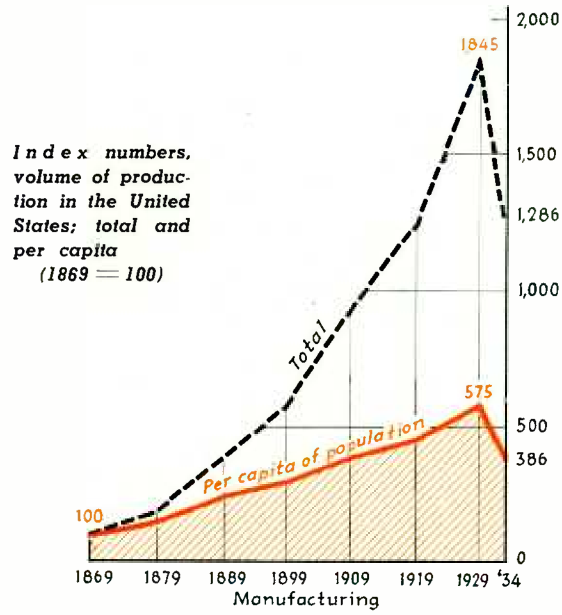
The inside job should present no real difficulties to fair-minded employers. Most workers have a normal predisposition to view in a favorable light the organization in which they earn their livelihood. Most companies endeavor to conduct their operations so as to justify that favorable attitude. But too few of them are adept at dramatizing the facts that furnish a substantial basis for maintaining employee good will. So, where misunderstanding and suspicion born of ignorance exist, time may be required to break down the barriers that have grown up.

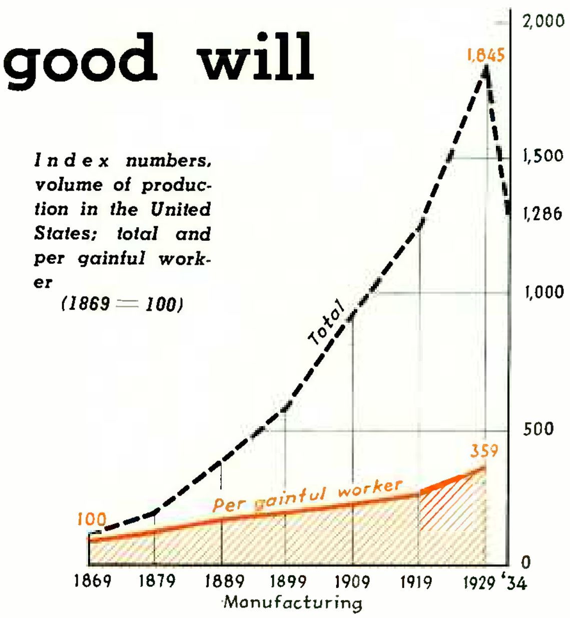
The task of telling this inside job to the outside world, however, will not be easy, for two reasons. First, it has been so long neglected that the backlog of misunderstanding is large. Second, public relations involves attitudes as well as actions, a viewpoint as well as an organization. Public relations is not a commodity that can be purchased like a car of coal or a bolt of silk; neither can it be sold by "canned" material. Each program to establish sound public relations must be individualized and indisputably stamped with the personality of the company promoting it. *And the deed must always back the word!*

But the task is worth the effort. For, with the inside job right, a properly conceived and intelligently executed public relations program offers business the means of successfully counteracting unjust public suspicion, unfair political attack and unwarranted outside dictation. The need is urgent.

A WAY

to achieve good will





THE basic elements of public relations technique is a matter of maintaining a contented and effective organization and a good name. The problem resolves itself into an inside job and an outside job.

In the development of good industrial relations within the organization, certain steps are necessary. They may be set down as follows:

1. *Determine personnel policies.* A statement of the personnel policies of the company should be formulated. It should be submitted for endorsement and acceptance by representatives of the personnel, from top to bottom. It should be made known to all employees.

Policy statements should be definite on such matters as wages, working hours, overtime, promotions, layoffs, vacations, sickness, relief, safety, training and education, profit-sharing, collective bargaining.

2. *Improve personnel efficiency.* Strengthen the influences within the organization which insure the efficiency of the working force, the purpose being to advance the opportunity for the individual and the company, through lower production costs, better service to customers, and improvements in the quality of the product.

3. *Assure the well-being of the employees.* Provide safe and sanitary working conditions and plant services necessary for comfort. This means adequate ventilation, heating, illumination, the elimination of noise, and suitable provisions for rest, meal time, recreation.

The stabilizing of employment and the establishment of organized protection against unemployment, sickness, old age and death have far reaching influence upon both the physical and mental welfare of employees. So has assistance to deserving individuals in their problems of savings and housing.

4. *Train and educate.* A suitable program should be developed for advancing men and women in the organization. Educate them as to the aims of the company, its place in the national economy, the place into which each worker and executive fit; of the benefits of cooperative effort. Train them to assume the responsibilities of higher jobs, to earn more pay.

If good will prevails inside the organization, the most important step has been taken toward good public will toward the organization. The outside world, however, has an active interest in any company whether it deals with the public only locally, or on a national scale. The public will be interested to know the place in the national or local economy which the company occupies.

For customers and prospects there are many interesting facts.

1. Manufacturers of materials and products which touch the lives of people only indirectly can show how their products raise the general standard of living.

2. Companies that sell their products directly to the people can interpret the resulting social and economic benefits in terms of human well being.

3. All types of companies can publicize interesting facts about themselves, their products, their policies.

4. Through local and national trade associations all types of business can join in promotional programs for the information and education of the public.

In the community where the company is located the company is judged by what people hear about the company. In promoting local good will, informed employees are an invaluable asset to the company that has done the "inside job."

1. Good will in the community is built by the publication of facts about a company, by making these facts available promptly, accurately, clearly and frankly through the media which exist in every community.

2. Community affairs can be shared by the company. By taking an active part in local activities, by becoming itself a good citizen and neighbor, a company makes itself known and liked.

Industry Cooperation. An industry as a whole is represented by its trade association. This representative should be able to act as clearing house for the exchange of the plans and experiences of individual companies in the work of industrial and public relations.

A part of the clearing-house job can be collection of industry-wide statistics and their distribution to member companies for immediate use. Through standardization programs, through promotion of good business practices, through self-regulation an industry can benefit much from active participation of all companies in the trade association. And as an industry benefits, its constituent companies benefit.

3. Local good will may be promoted by all local companies cooperating in a public relations campaign. Advertising in the local press is a most effective weapon with which to combat untruths told by those who have selfish and hidden aims or who merely lack proper information. The welfare of the community as a whole is bound up with the welfare of the industries of the community—but this fact is not self-evident. It must be brought home clearly, and truthfully, to the local people.

All of these steps are part of one program, starting from the inside and working outward. Such a program calls for a lot of work and thought. It is no job for an amateur. In most cases, some outside aid will be needed. If the executives of a company are solidly behind such a plan and if the services of a competent consultant in public relations are secured, both the inside and the outside job of improving public relations can be accomplished.

RESEARCH MAKES JOBS

One of the aims of management should be to educate employees on subjects about which there is doubt or actual misinformation.

One of these subjects is that of the effect of research and technical advance upon employment. Many people seem to think that all research should be stopped, that invention be outlawed. There is no doubt that technical advancement causes shifts and actual displacements of some jobs, but so far history shows that the total number of jobs in industry has increased faster than the population of the country has increased.

In the following pages *Electronics* presents data of the kind which, we believe, are useful in showing employees the true facts in the question of research versus employment. Although the data apply only to the industries closely associated with the electron tube, similar data can be obtained for other industries based upon research, discovery, invention.

Future articles will deal in similar fashion with other questions that crop up in the minds of all of us, questions which are most easily answered by facts. Such questions concern the source of money entering a plant, where it goes, the relation between the employees share of this money and that earned for the owners: the respective roles played by employer, employee, stockholders, and the consumer.

HOW
An Industry Grows

MANY times these days one hears that research and technical advances of all kinds should be prohibited: that we are far enough advanced technically; that further inventions will rob men of jobs. But is this the truth?

All of our present industrial age is based upon research, upon invention, upon discoveries, upon technical advance. If there had been no research and if invention had been prohibited, there would be no telephone, no radio, no movies, no telegraph, no wireless aids to safety at sea and in the air. There would be none of the newer uses of radio tubes in the factory to prevent accident, to increase productivity, to lower cost. These items represent only a few of the results of research and invention. One need but look about his own home to discover a much greater list of materials and things which would not exist were it not for somebody's research into chemistry, into electricity, into mechanics.

The great achievement of commercial research is to improve the productiveness of each worker, and, therefore, to improve his value to himself and to all other workers. In the long run, the purpose of industry and of factories is to produce wealth in terms of wages to employees and employers, in terms of real goods for all the people—radios, automobiles, clothing, medicine, food, books, houses, etc.—in terms of a money return on the capital invested in industry.

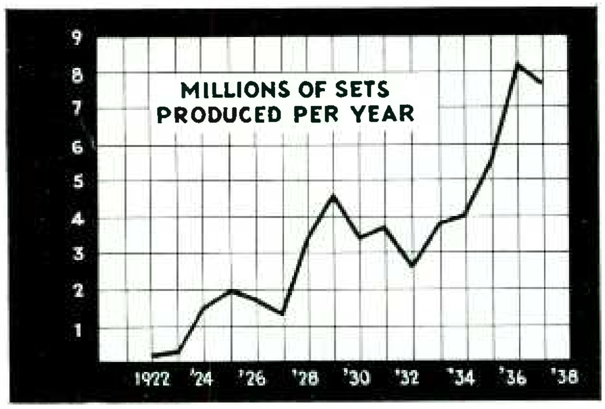
But before there are any jobs or any research there must capital be invested; the money for a factory or a laboratory must be spent, wages must be paid before there is any chance of a single dollar coming back to the owners in return for their investment.

The radio industry is an excellent example of how entire industries arise from research, from a discovery, from an invention, that may seem at first to have no practical value.

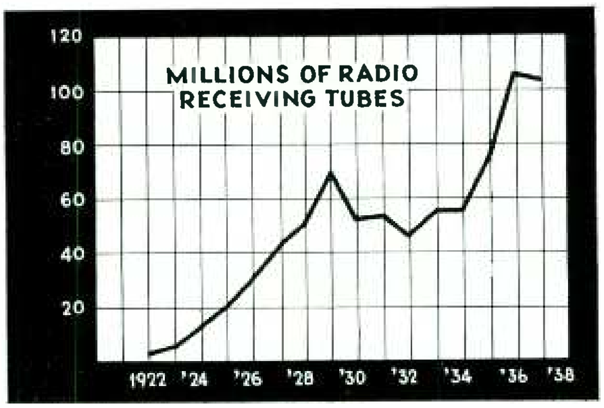
Many early men of science had a share in making possible communication without wires or other visible tangible link between sender and receiver. An American, Joseph Henry, played an important part in the beginnings of wireless systems. An Englishman, Maxwell, developed by pure reason and without any apparatus at all the electrical laws by which all radio is carried on today. This was pure research. The only sign of accomplishment was a series of mathematical equations which only a very few people can understand.

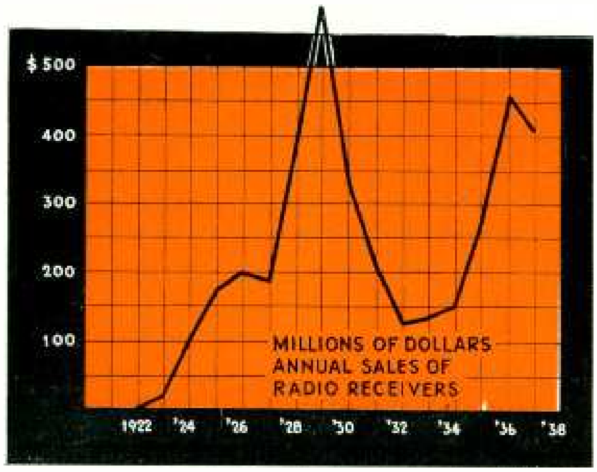
For many years these mathematical expressions had interest only for the theorist. Then a German, Hertz, decided to put them to the test. He made an experi-

Each year, several million radios from American factories go into American homes

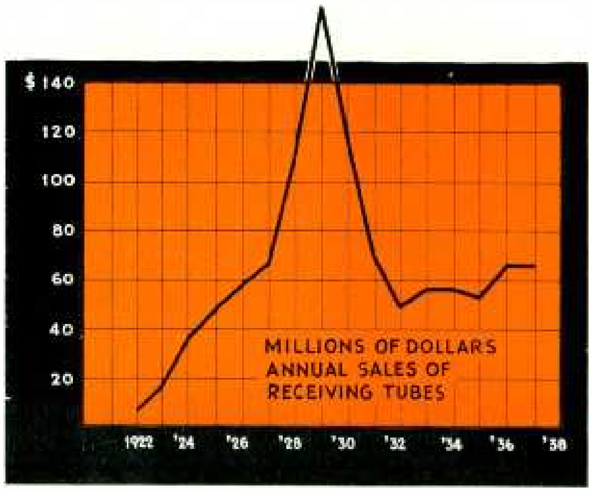


Who in 1922 would have thought 100 million radio tubes would be built each year?





From nothing in 1922 to 400 million dollars in 1937—such is radio's 15-year growth



Even in dollars the annual production of radio tubes makes an appreciable figure

ment with actual apparatus and proved that Maxwell's brain child had physical meaning. Hertz proved that a sender and a receiver could be connected together by invisible links for the transmission of intelligence.

And still no one saw the practical application.

Several years later, Marconi, an Italian, said to himself "why can't we put to work Maxwell's equations, Hertz's experiments?"

And so ships at sea were enabled to communicate with land, and with each other at first only over very short distances, but now, through the effects of more research and more invention, vessels going around the world can keep in continuous touch with their home ports. The humanitarian value of wireless was brought home forcefully in its early days by the tragic loss of the "Titanic." The passengers who finally got ashore were saved solely through the ability of the captain of the "Titanic" to summon other ships to the rescue.

Marconi provided the practical touch; he saw that a use could be made of the scientific work of his predecessors. He made it possible for ships at sea, and later for airplanes and motor cars to communicate with each other or with stations in fixed positions on land. There were no jobs until Marconi came along; but research came first.

Even before Marconi's practical touch provided jobs, other lines of research were going on; research which at the moment seemed to have no practical value, but which later fitted into the picture started by Marconi very well. An American made a discovery that has provided many jobs and created much physical wealth.

Edison discovered that incandescent lamps got black inside the bulb. In an effort to determine why this was so, he made a most important discovery—that a current would flow from the hot filament to a metal plate sealed inside the bulb, even though there was no internal metallic connection between the two elements. Furthermore the current would only flow in one direction, from the filament to the plate, and not in the reverse direction.

This discovery has come to be known as the Edison effect. But its discoverer was not interested. It was not an important link in the research he was carrying on.

Not for twenty years did anyone see the practical value of Edison's discovery. Then an Englishman, Fleming, saw that it would increase the ability of ships at sea to receive messages over longer distances. He made a wireless detector out of the Edison effect. He supplied the practical touch.

A few years later another American, DeForest, made another important discovery, one which turned the Edison effect and Fleming's valve into the modern radio tube. DeForest found that the addition of one more metallic plate inside the bulb made the Fleming detector vastly more sensitive.

DeForest's tube and more research made radio telephony possible; provided, finally, the practical touch that made possible modern radio broadcasting.

A piece of pure research by O. W. Richardson, an Englishman, carried out before DeForest's discovery has made it possible to understand the laws by which the radio tube works, work by eminent scientists such as Langmuir, and others has showed how to make the tube have long life, how to make it cheaply, how to operate it efficiently, how to expand its uses. Remember that the first radio tubes sold for $6 and higher, that they had short lives, that they would only operate from batteries, that they were vastly inferior to tubes now purchased for less than a dollar.

Another experimenter, Frank Conrad of the Westinghouse company, provided the final link leading to broadcasting. He discovered that people would listen to wireless telephone programs he put on the air experimentally; he found they would even pay money for apparatus by which to listen to these "broadcasts." He showed that wireless, now called radio, had a meaning for every man, woman, and child, for every home, for every factory worker, for every office worker. Broadcasting was born.

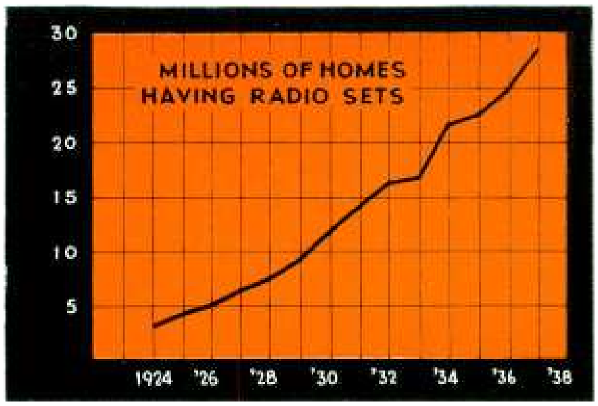
All of this took years and labor and dollars. From obscure research, from new discoveries, from inventions, has come an industry based entirely upon technical and scientific facts, an industry that annually employs a hundred thousand workers—not counting those thousands whose jobs are only indirectly associated with radio—that has placed radios in 27 million American homes, 85 million homes throughout the world, that has promoted safety at sea and on land.

But this is not all that has come from research in our own industry. While Marconi and Edison and DeForest and Conrad were laying the groundwork for the radio industry other research was taking place. A group of mathematical equations by a German scientist of world renown, Einstein, disclosed the facts about the photoelectric tube, the "electric eye" that now protects arms from injury in punch presses, and performs innumerable other factory services. And one must not forget that the photoelectric tube is the heart of sound motion pictures providing annual jobs to thousands of people and entertainment and relaxation and education for millions.

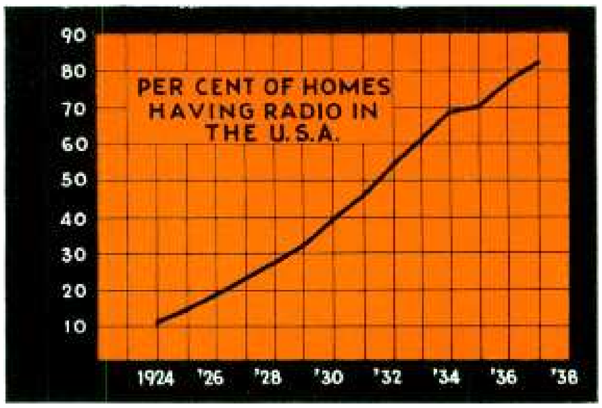
Broadcasting and sound movies and the application of the radio tube in the factory are all less than twenty-five years old. Who, twenty-five years ago would have dreamed of the present vastness of the radio industry, of the wealth existing in 27 million receivers, of the hundreds of thousands of man-hours of labor that went into those radio receivers, or of the millions of dollars of wages that paid for these man hours of work? Who can imagine now, what the next twenty years will bring?

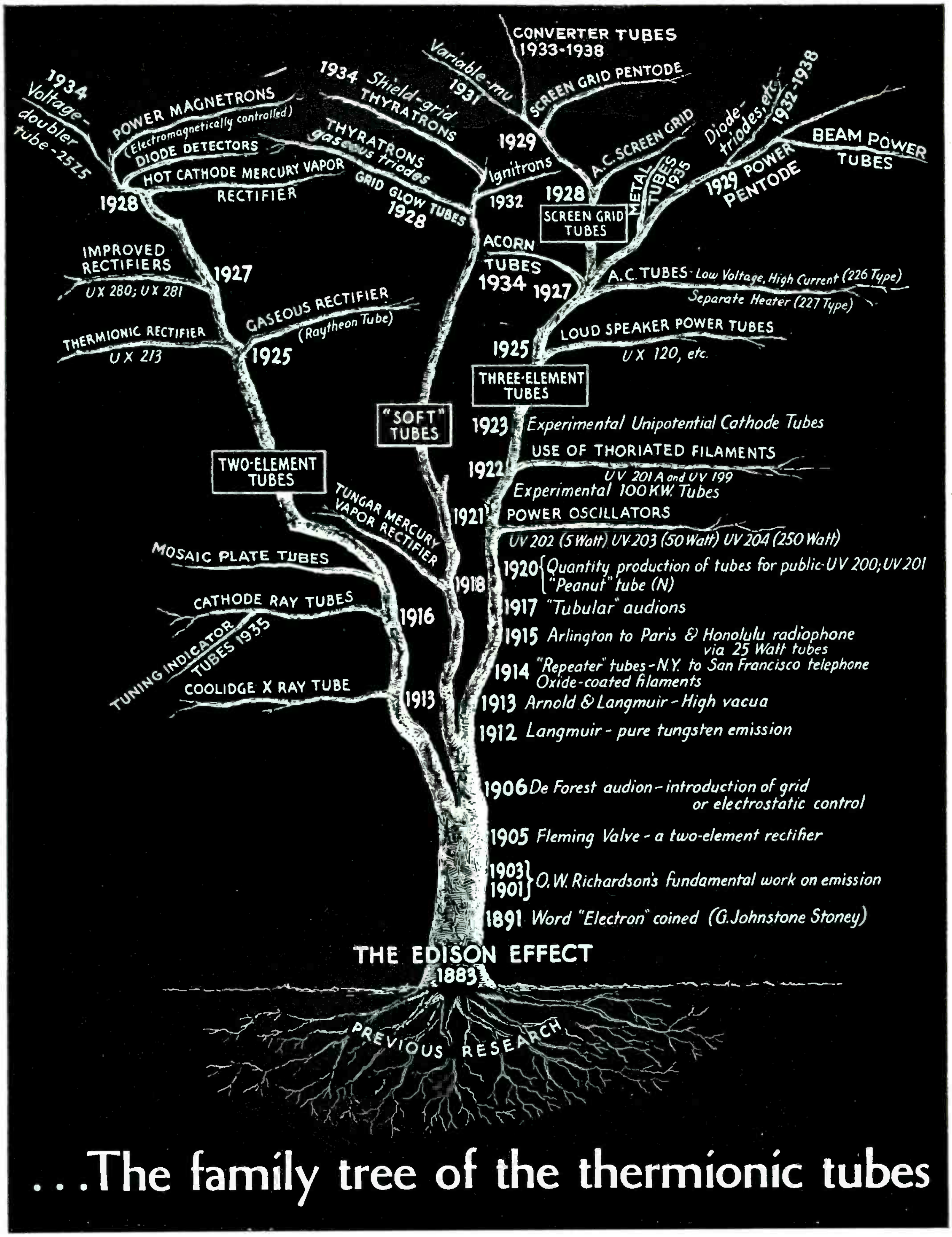
Is there any truth to the statement that research should be stopped, that invention be prohibited?

Nearly 30 million American homes enjoy radio entertainment and education



Of all the homes in United States more than 80% are radio equipped



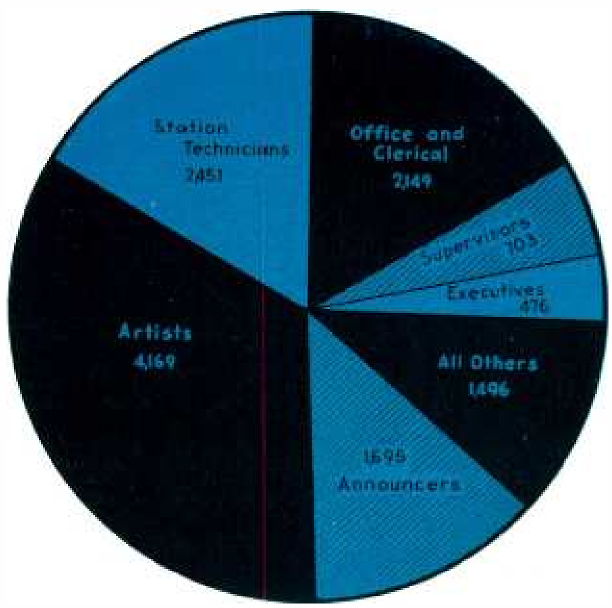


...The family tree of the thermionic tubes

★ *From the early work of Edison and previous research men, many types of vacuum or thermionic tubes have come. The words on this chart describing these new devices may sound like Greek to the uninitiated reader, but each new tube has proved to be of vast technical importance. Whole new systems of communication have been based upon them. There is no end in sight to the production of still further tools of this sort—provided the research laboratories keep going. Similarly, there is no end in sight to the new uses for the tubes already produced.*

WHO

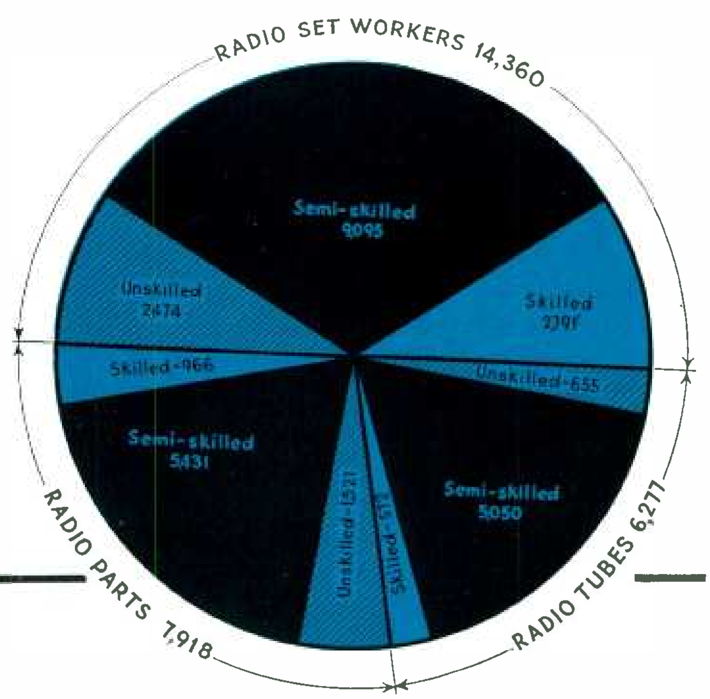
Makes an Industry



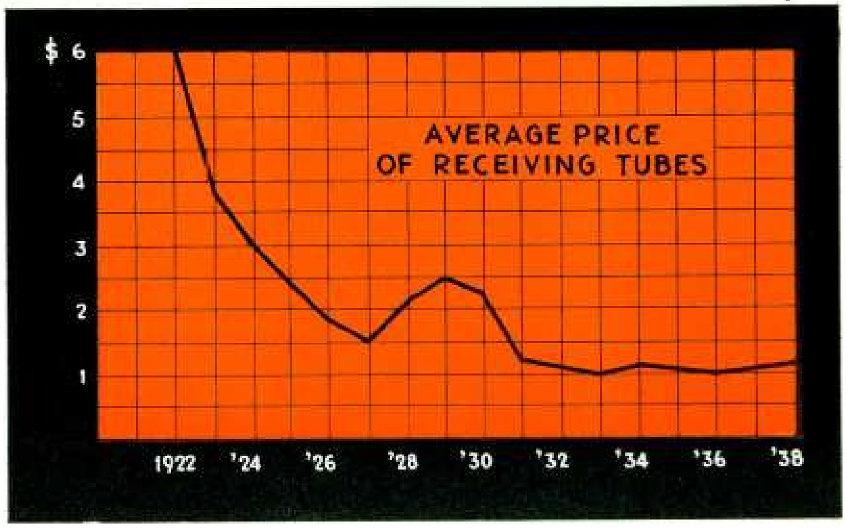
IT TAKES all kinds of people to make a world—or an industry. A business built upon technical knowledge needs all kinds of people. There are executives, clerks, engineers, salesmen, factory workers, watchmen, lawyers; men and women. Each plays an important part in the entire process of design, manufacturing, distribution. A factory cannot operate without engineers and the engineers don't hold their jobs long unless the factory produces goods which the salesmen can sell. The executives' job is to knit all this work together into a unit, and to fit this unit successfully into the nation's business.

The charts shown above are only two examples of recent data concerned with the radio industry. One chart shows the kinds of factory people, and the number, who were employed in 59 plants making radio parts, tubes and sets and employing 28,555 people in August 1937. The data are from the *Monthly Labor Review,* August 1938. About twice this many people were at work in the entire industry. In addition to these workers must be added the technical men and women, the engineers, the research people, the executives, the salesmen, the clerks, and the vast number of radio service men who derive their livelihood from putting back into operation the nation's receivers which get out of whack.

The other chart shows the type of employee working in the broadcast stations and the studios in this country as of the week of October 26, 1935. The data were taken from the "Census of Business," 1935, published by the United States Chamber of Commerce. At this time there were 557 stations in operation; the weekly payroll amounted to $429,401. The data do not include entertainers supplied by advertisers, nor those who maintained the network of wires that connected the stations together. The total number of employees accounted for by this chart add up to 13,139.



WHAT
RESEARCH DOES



WHAT is research?

"Research," according to Charles F. Kettering, director of General Motors research laboratories writing in the *Saturday Evening Post,* September 10, 1938, "is a state of mind—a friendly, welcoming attitude toward change. Going out to look for change instead of waiting for it to come. Research for practical men, is an effort to do things better and not to be caught asleep at the switch. It is the problem-solving mind as contrasted with the let-well-enough alone mind. It is the 'tomorrow' mind instead of the 'yesterday' mind."

What can be done with research? The answers to many problems can be found by research. The first step in turning research loose on a problem is to define the problem. Is it to find a new product to build in a factory, a product that people will buy? Is it to find ways of lowering the price of a product so that more people can afford to buy it than can afford to buy it at the higher price? Is it to find a better, although not necessarily cheaper, way to do something so that better performance gives the buyer more for his money? Is the problem to determine how to make a given amount of raw materials go further; or how to reclaim raw materials from discarded automobiles, clothes, newspapers, ashes, or other waste products?

RESEARCH LOWERS PRICES

Research can find out all kinds of things—but the fellow who starts a piece of research must not be afraid of the answer. Perhaps what he started out to find can not be secured in the way he tried. There are other methods of approach so that seldom, indeed, is "no" a final answer to any line of research today.

Let us follow through only one or two of the things research does.

One need only look at the radio receiving industry to see how engineering and research has brought down prices until, today, you can buy a better radio for twenty-five dollars than you could buy at any price only a few years ago.

Let us look at the prices of radio receivers and the number produced in the early years of the radio industry. In the very early years nearly all the receivers were built by hand at home, in the kitchen at night, in the basement. Factory production barely got started during the first three or four years after KDKA began broadcasting. Prices of receivers were high, life of tubes was short, use of headphones was necessary. Better receivers were required. More tubes per set, more complex circuits was the answer. The average price of the receiver rose—but the user got more for his money. He could now hear programs free from interference; he could fill a room with music; he could discard the outmoded headphone.

In 1926 new tubes arrived which made it possible to run a radio from house lighting current instead of storage batteries. Immediately the annual production of receivers jumped. In 1927 these a-c receivers really got under way; and the next year the total number of sets built and sold doubled over that of the previous year. The price, however, was about the same. Research, in this case, had not lowered the price; it had improved the product. The owner got more for his money.

Then came the depression. People had less to spend; they could not afford so much for a radio. What were the manufacturers to do? Here was a job for research—for the open mind, one looking for and knowing how to handle, change. If people had less money to spend, and if factories and capital invested were not to be idle, prices must be brought down.

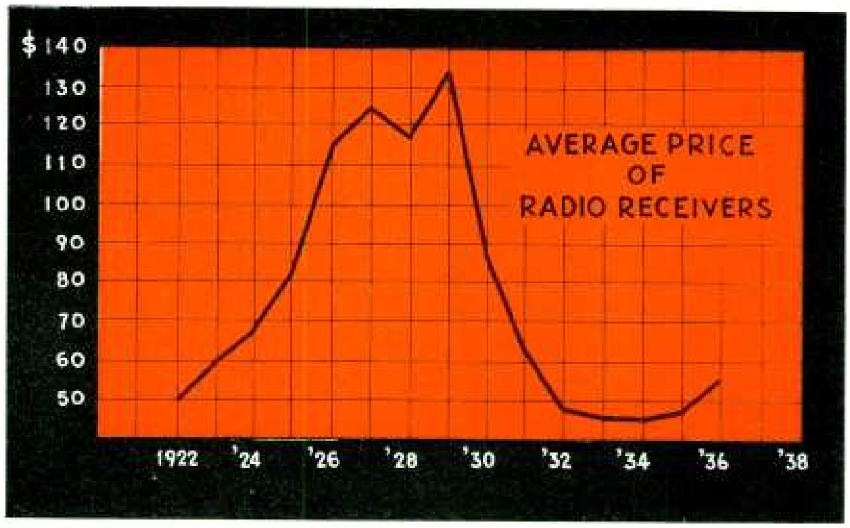
It is instructive to note that the annual production of receivers since 1929 has remained above the three million mark every year in spite of the fact that the purchasing power of the people has been consistently low. How was this done? By lowering the unit prices of receivers so that this decreased purchasing power continually got more for its money. No one would have thought, in 1922, or in 1929, or in 1935 that radio sets so cheap as $25 would be so full of value as the many thousands of this price being made today.

There was a time when a radio-phonograph cost a good $300 and weighed as much as two men could carry. Today radio-phonographs can be had for as little as $20; they are small enough to go on top of a very small table; and they are easily portable. What is more, present-day radio-phonograph combinations are superior to the $300 units of only a few years ago.

While more radio was being offered for less money, research was going on in the tube factories. Radios, in fact, are but tubes plus accessory apparatus. If the price of radio tubes could be brought down, the price of a radio with tubes could be brought down. Or, if fewer tubes could be made to do the work of more tubes, the receiver could be sold for less money.

When the first radios were made, each tube cost the user as much as $6.00. Imagine a 7-tube radio costing as much as $42 just for tubes! Average tube prices came down every year until 1928 and 1929 when they went up slightly. But in these years new types of tube came into existence, as the result of research. These tubes were more complex to build than those used up to that time. But they were more useful; they delivered more output, they improved the operation of radio receivers. They cost more to make; they cost more to buy. The purchaser, however, got more for his money than he had before. Here was another case where research did not lower price, immediately, but improved the product.

All through the depression, research went on in the plants of the tube makers. When, in 1932, purchasing power was such that people could not afford to pay a hundred dollars for a radio, the tube makers found ways of making one tube do the work of two and often three tubes. This lowered costs of radio sets greatly, so that in 1933 the average price paid for a set went as low as $34. Since that time the prices of radio receivers has not varied much from $50.



Research Improves Performance and Lowers Price

This table shows, in technical language, how tubes used in transmitting stations have improved since 1921. In the first place the power obtainable from such tubes has increased. Secondly the efficiency has improved, due to new methods found for operating the tubes. The price has decreased. And finally, the worth of the tube (final columns) has increased due to improved performance and lowered cost, taking effect at the same time.

1921					1938				
Tube Type	Power Output Watts	Plate Efficiency	Price	Watts Per Dollar	Tube Type	Power Output Watts	Plate Efficiency	Price	Watts Per Dollar
UV-202	5	50.0%	$8.00	0.625	809	55	73.5%	$2.50	22.0
UV-203	50	50.0%	$30.00	1.67	805	215	69.0%	$13.50	15.9
UV-204	250	50.0%	$110.00	0.44	833	1,000	80.0%	$85.00	11.8
UV-216	20	......	$7.50	3.75	866	550	......	$1.50	366
UV-217	150	......	$26.00	5.77	872	3,000	......	$14.00	214

If receivers still cost, on the average, more than $100, if headsets were still needed rather than loud speakers, if interference and "squeals" were as common as 15 years ago, if every tube you bought cost $6.00, and the best of these tubes was greatly inferior to the dollar product of to-day, do you think that 27 million homes would have radio sets; that 4 to 6 million new sets would be built and sold every year; that 6 million automobile receivers would be in operation. Research, more than anything else is responsible for these vast changes which have taken place. Do you believe research should be stopped?

Research Provides New Opportunities

In every field of endeavor, research has increased the opportunity for men to work, for capital to earn its pay. Better, cheaper, quicker communication; better, cheaper, safer, faster transportation are only two results of continued research.

In the many ideas, products, and jobs contributed by the radio tube, one has a beautiful example of the benefits of research. At first the tube was only an aid of communication. Then it made talking motion pictures possible. Then it improved, immeasurably, the art of recording the human voice or music so that the great artists can be heard in every home.

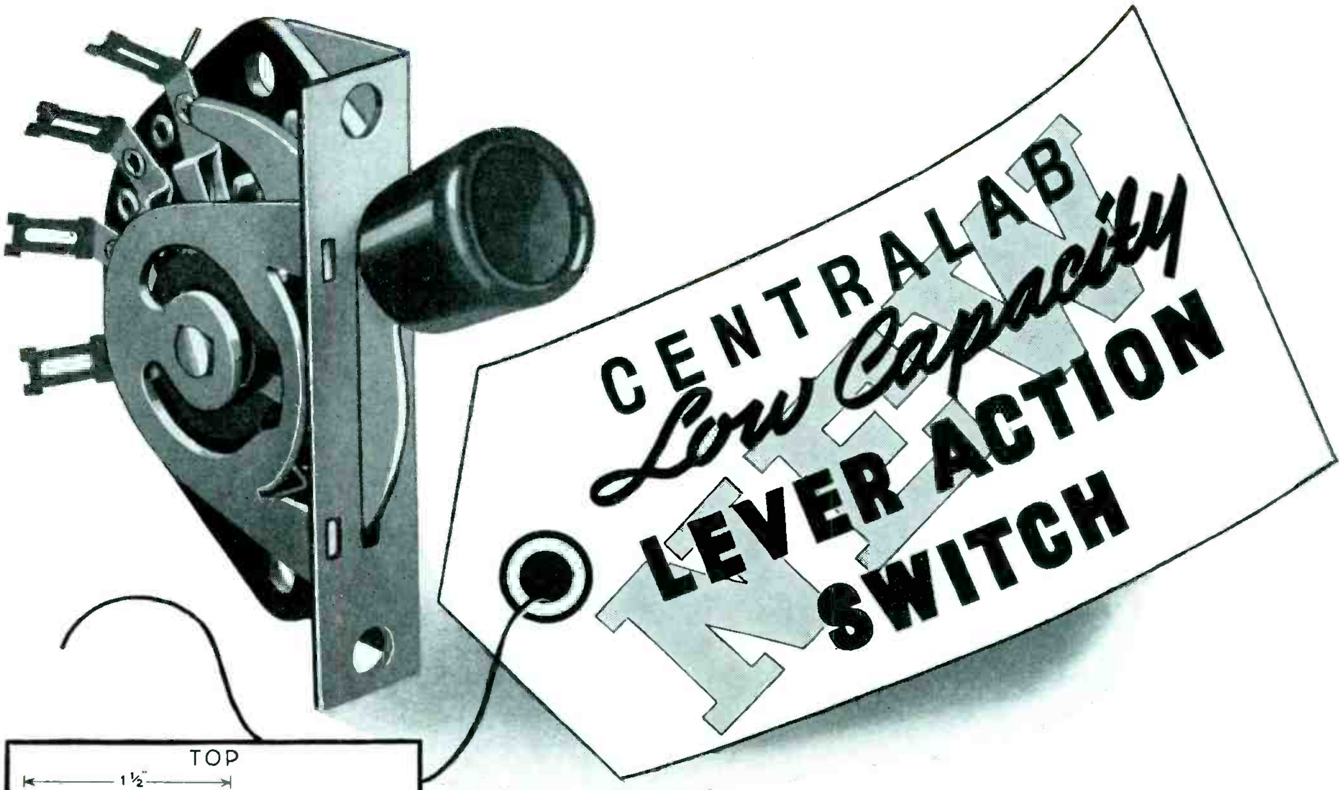
Books are recorded so the blind may hear, at home, entire volumes of the world's literature.

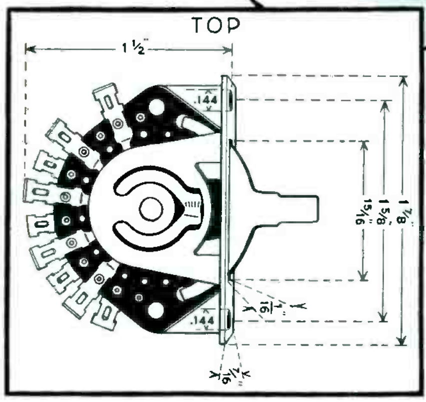
These are very natural applications of the use of the radio tube. But it is in the extension of the use of the radio tube to industry as a whole that a most remarkable proof of the benefits of research is displayed. Opening doors without human touch; safeguarding a punch press so that the operator's hands are completely protected against injury are but two of the spectacular uses of the electric eye in industrial use.

The radio tube, and its ally the electric eye, are controlling all sorts of processes in the factory now, increasing the output of the factory's workers, improving the product, counting, sorting, metering, calipering, doing, in addition, many dirty jobs that are but drudgery for humans.

In medicine the tube is an important tool. X-rays are generated in a tube, not too unlike the radio tube; certain illnesses are now corrected by local fevers created by the tubes such as are used in transmitters.

All of these are applications of but a single product of research, the radio tube and other members of its family. Shall we stop further research—or shall we look forward to other new products, other new industries, other new jobs?





A space-saving lever action switch that can be furnished singly or assembled to an attractive mounting plate with any required number of switches in a group. Each switch will take up to 12 contacts that can be used in countless shorting or non-shorting switching sequences. Contacts are of the long lived double wipe type.

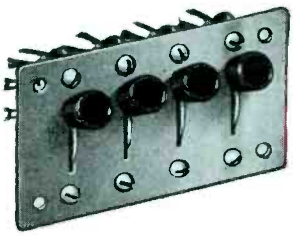
Centralab Lever Action Switches are furnished with either two or three positions. Index action can be positive in all positions, or spring return to center from either side.

for:

- **BROADCASTING** In control panels for commercial and amateur transmitters.
- **RADIO RECEIVING** Band changing, I.F. selectivity, sensitivity, tone, and similar controls.
- **PUBLIC ADDRESS** Centralized sound, inter-communicator, call systems.
- **TEST INSTRUMENTS** Signal generators, analyzers, tube testers, multi-meters.
- **INDUSTRIAL USE** Electronic apparatus, signalling devices, business machines.

. . . and any other application where multiple contact, low capacity switches are required to operate at low voltages and currents.

ENGINEERS: *Send for specification sheet number 628 for further electrical and mechanical details.*



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CENTRAL RADIO LABORATORIES

DIVISION OF GLOBE UNION INC., MILWAUKEE, WISCONSIN

Simple Phonograph Oscillator

By H. C. KIEHNE

MANY PEOPLE who own radio receivers would like to use a phonograph with them; but they hesitate to encourage a service engineer to take the receiver away for the necessary wiring, etc. It is also true that certain radio receivers equipped with phono outlets in the back

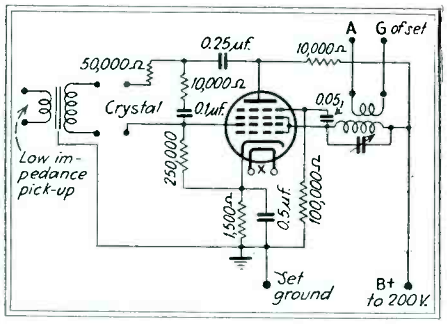


Fig. 1—Basic circuit of phonograph oscillator

of the chassis are not so equipped for naximum convenience and that the service man must be called in to make the proper connection.

The circuits shown here represent a simple negative conductance oscillator which may be modulated by the phonograph pick-up and which may then be demodulated, amplified and reproduced by the receiver. Compensation is provided for the fact that lower frequencies are not recorded to full amplitude.

Figure 1 gives the circuit diagram. Figure 2 shows the use of the circuit on an A.C.-D.C. basis. A 6J7 or a

CHECKING GRID STARS

A phototube speed timer has been used by the coaches of the Villanova College football team to check the reaction times and running ability of the players, as well as the speed of passes and kicks

6C6 work satisfactorily. It is not necessary to describe how the negative conductance oscillator works as this was done in *QST* in detail some time ago.

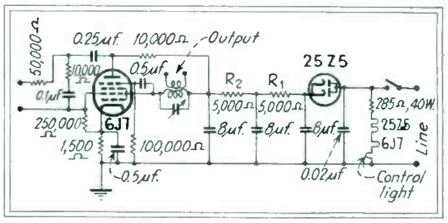


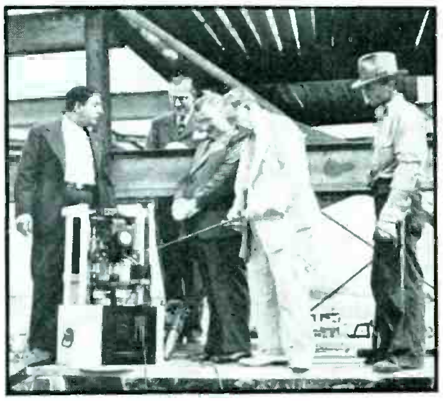
Fig. 2—A-c d-c version of circuit

It is important to filter the plus B lead well. An i-f transformer with good (if possible) critical coupling will alloy the signals to be received at about 540-560 kc by turning the trimmer to the proper value. The signal is tuned into the receiver in the usual manner. The oscillator may be used in a room adjacent to the receiver by employing a small antenna. A lot of fun may be had with the unit by attaching a microphone with a high gain transformer. By using proper coils, the oscillator will go down to about 12 Mc.

Midland Television Installs 441-Line Television Equipment

ACCORDING to a recent release received from Station KMBC in Kansas City, the engineering staff of Midland Television, associated with that station, have recently completed the construction of a 441-line television system. The equipment, claimed to be the only high definition television system in the Middle West, includes a camera, video channels and monitor facilities. All of the equipment was designed and manufactured under the direction of J. R. Duncan, chief television engineer.

R-F HEATS RIVET FOR RCA AT WORLD'S FAIR



A portable transmitter, with an induction heating coil attached in place of the antenna, was used to heat the last rivet in the steel work of the RCA Exhibit Building at the New York World's Fair Grounds. The rivet, suspended in the induction coil, became white hot in less than a minute

Lenz RF HOOK-UP WIRE *

MEETS *EVERY* CONDITION

Especially recommended for AVC circuits, All Wave Switching Systems and all parts of a radio circuit requiring hook up wire of exceptionally high dielectric characteristics, where it offers an unparalleled degree of stability and dependable service. We will gladly comply with your request for samples.

* *Now Protected Under U.S. Patent No. 2120306*

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"IN BUSINESS SINCE 1904"

THE ELECTRON ART

Each month the world's technical literature is scanned to see what physicists and engineers are doing with tubes, for presentation in tabloid form to Electronics' readers

New Standards on Electronics

A NEW standards reports has been issued by the Institute of Radio Engineers dealing with definitions of terms and symbols for electronic devices. A section in this report also deals with the methods of testing vacuum tubes.

The "Standards on Electronics—1938" are, essentially, a revision of a portion of the 1933 I. R. E. Standards Report. Copies of the new report have been mailed gratis to members of the I. R. E. Persons interested in this report may obtain additional information by communicating with the Institute of Radio Engineers, 330 W. 42nd St., New York, N. Y.

Current Articles on Electronics and Related Subjects

THE FOLLOWING bibliography on electronic and related subjects has been prepared from American and foreign publications by Mr. J. G. Sperling. Readers are invited to submit their comments on this compilation.

VACUUM TUBES AND ELECTRON THEORY

Single-Ended R. F. Pentode — R. L. Kelley, J. F. Miller, *Electronics*, Sept. 1938, pp. 26–27; Experimental pentode having g_1 cap on base. Increased gain. Decreases regeneration. Simplifies set wiring and construction.

A New Converter Tube For All-Wave Receivers—E. W. Herold, W. A. Harris, T. J. Henry, *RCA Rev.*, July, 1938, pp. 66–77: Non-conventional tube design in 6K8 pentagrid converter. Increased oscillator stability and h-f performance.

A New Converter Valve — J. L. H. Jonker, *Wireless Eng.*, Aug. 1938, pp. 423–431: New shapes of electrodes employed in Phillips FC4. Advantages of octode principle retained. Frequency drift eliminated.

On Electronic Space Charge With Homogeneous Initial Electron Velocity Between Plane Electrodes—M. J. O. Strutt, A. O. Van Der Ziel, *Physica*, Aug. 1938, pp. 705–717: Electronic space charge phenomena in the (gridanode) V-space, with consideration given to returning electrons. Secondary emission of composite surface.

The Permatron, A New Type of Rectifier With Magnetic Control, *QST*, Sept. 1938, pp. 42, 86: Use as a keying rectifier.

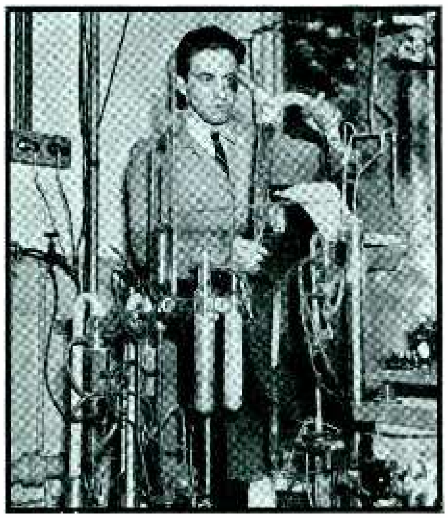
On Some Consequences Of Our Simple Relation About Glow Discharge — Y. Kasiwagi, *Proc. Nippon Physico-Math. Soc. Japan*, July, 1938, pp. 568–585: Relation between current intensity and the vertex distance. Explanation of sputtering, Crookes dark space and negative glow.

Phenomena In Amplifier Valves Caused By Secondary Emission — J. L. H. Jonker, *Phillips Tech. Rev.*, July, 1938; Secondary emission can occur from non-conductors at a positive potential. Treatment of this action in tetrodes and c-r tubes described.

High-Power Valves: Construction, Testing And Operation—J. Bell, J. W. Davis, B. S. Gossling, *Jour. I. E. E.*, Aug. 1938, pp. 176–207: Complete treatment of high power water cooled tubes.

Methods Of Measuring Luminescent Screen Potential—H. Nelson, *Jour. App. Phys.*, Sept. 1938, pp. 592–599: Results on determination of potentials of areas on inner surface of vacuum tube glass envelope. Upper limits of monex glass surfaces and willemite screens.

NEW MASS SPECTROMETER



Dr. A. O. Nier of Harvard with his new mass spectrometer, said to be the most accurate "atom sifter" ever devised. It is to be used in studying isotopic forms of matter

R-F CIRCUITS AND TRANSMITTERS

Iron Powder Cores—E. R. Friedlander, *Wireless Eng.*, Sept. 1938, pp. 473–479: Properties of iron cores for receiving coils. Set designers needs and data on present state of art.

Time Constants For A. V. C. Filter Circuits—K. R. Sturley, *Wireless Eng.*, Sept. 1938, pp. 480–494: Study of time constants for series and parallel types of filters up to three stages.

Broadcasting Station LS-1, Buenos Aires—R. E. Coram, A. W. Kishpaugh, W. H. Capen, *Elec. Comm.*, July, 1938: Installation of W. E. 50 KW. transmitter, type 407-A.

Stabilized Feed-Back Oscillators—T. G. H. Stevenson, *Bell Sys. Tech. Jour.*, July, 1938, pp. 458–474: Mathematical development for oscillator with stabilized feedback at constant frequency under changes of electrical potentials or cathode temperature.

The Rome Medium Wave Broadcasting Centre—*Alta Frequenza*, July, 1938, pp. 382–417: Complete information on two 250 kw. transmitters. Both can be operated together with 500 kw. output.

Transient Frequency Variation Of Crystal Oscillator—I. Koga, M. Shoyama, *E. T. J.*, Sept., 1938, pp. 199–201: Tests on Pierce circuit with special crystal show frequency drift due: (a) Temperature difference between two principal surfaces of a crystal plate (b) contact between crystal plate and electrode (c) electrical constants of tube elements.

Carrier And Side Frequency Relations With Multi Tone Frequency Or Phase Modulation—M. G. Crosby, *RCA Rev.*, July, 1938, pp. 103–106: Development of equations for carrier and side frequencies when more than one modulated tone is applied.

High Frequency Stability In Quartz Oscillators Obtained By Positive And Negative Feedback — *Alta Frequenza*, June, 1938, pp. 365–382: Crystal oscillator with conventional positive feedback in addition to negative feedback which is current controlled.

TELEVISION AND FASCIMILE

L. M. T. Laboratories 7-Frequency Radio-Printer, L. Devaux and F. Smets, *Elec. Comm.* July, 1938, pp. 22–34: The characters are scanned in 7 horizontal

(Continued on page 60)

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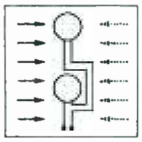
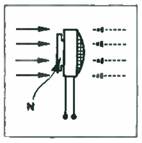
You Get the Advantages of Shure "Uniplex" Directivity at Lower Cost!

* Shure Patents Pending

New "Uniphase" Uni-Directional Principle

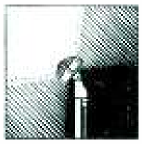


1. Previously all uni-directional microphones employed the "Two-Unit Bucking" system requiring two precision-matched elements for true uni-directivity over a wide frequency range. Precision matching is difficult and expensive to attain in practice—involves higher costs.

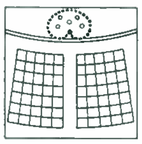


2. Discovery of the amazing new "Uni-Phase" principle by Shure Engineers made possible the simplified "Uniplex" uni-directional microphone. It employs only *one* microphone element—achieves *true uni-directivity* through action of acoustic network N. *No other microphone employs this system!**

"Uniplex" Solves Tough Pick-up Problems



3. The Shure "Uniplex" is the only true uni-directional microphone at such low cost. Provides excellent high quality response from 30 to 10,000 cycles at the *front,* yet is "dead" at the rear! (Rear response down 15 db, average, over a wide frequency range.)



4. Shure "Uniplex" uni-directivity solves tough pickup problems—gives you performance impossible with ordinary microphones. Eliminates feedback, audience and background noise, reduces reverberation energy pickup 66%. May be tilted for non-directional horizontal characteristics. The "Uniplex" does most every sound pickup job *better.*

Model 730A. Shure "Uniplex" Crystal Microphone, complete with 25 ft. cable with plug attached......... $29.50

Write today for technical information and data.

Shure TRI-POLAR

This versatile professional-type crystal microphone provides Uni-Directional, Bi-Directional, and Non-Directional pickup in one unit, each instantly available through built-in selector switch. Laboratory-tested performance. Smooth "ultra" wide-range response, 30 to 10,000 cycles.

Model 720B. "Tri-Polar." List Price, with 25 ft. cable and plug.................. $45

Shure ROCKET with BAFFLE

A semi-directional crystal microphone with performance matching its striking streamlined beauty. "Ultra" wide-range response. A91A Baffle increases high frequency discrimination against sound from sides and rear. Model 705A "Rocket." List Price, with 25 ft. cable and plug.. $25

(A91A Baffle, $2.50 List Extra).

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SHURE BROTHERS • *MICROPHONE HEADQUARTERS*

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Shure Patents Pending. Licensed under patents of the Brush Development Company.

lines, each line being represented by an audio frequency. All 7 frequencies simultaneously modulate the carrier. It is claimed considerable interference can be tolerated.

Wide Band Amplification And Modulation In The High Frequencies, Y. Kikuti, *E. T. J.*, Sept. 1938, p. 220: The sending end impedance characteristic of the plate circuit band-pass filter must be so designed that the plate wave form is not deformed. Discussion of effects of filter sending end impedance characteristic on signal frequency distortion.

A Laboratory Television Receiver—D. G. Fink—*Electronics*, Sept. 1938, pp. 22–25: Details of vertical scanning generator and synchronizing circuits. Testing scanning pattern characteristics.

Some Problems of Color Television—M. Von Ardenne, H. Prebler, *T. F. T.*, July, 1938, pp. 264–273: Fundamentals of transmission for clear, undistorted patterns.

Figure Of Merit For Television Performance—A. V. Bedford, *RCA Rev.*, July, 1938, pp. 36–44: Measurement of resolution of television picture as a whole. Use of tapered wedge chart for ease in reading, and sectionalized resolution chart for rigorous measurements.

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Graphs For Exponential Horn Design—A. J. Sanial, *RCA Rev.*, July, 1938, pp. 97–102: Four charts for determining all measurements for correct transmission of sound.

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Electronic Voltmeter Using Feedback—S. Ballantine, *Electronics*, Sept. 1938, pp. 33–35: Wide range A. C. voltmeter. Employs negative feedback in amplifier. Voltage range 0.001–100 v. Freq. range 10–100,000 cps.

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Vacuum Relay—C. W. Miller, *Jour. Sci. Instr.*, Aug. 1938, pp. 263–265: A Pirani gauge in one arm of a bridge circuit in conjunction with a thyratron may be used to open or close an external circuit when the pressure in a vacuum system exceeds a given value.

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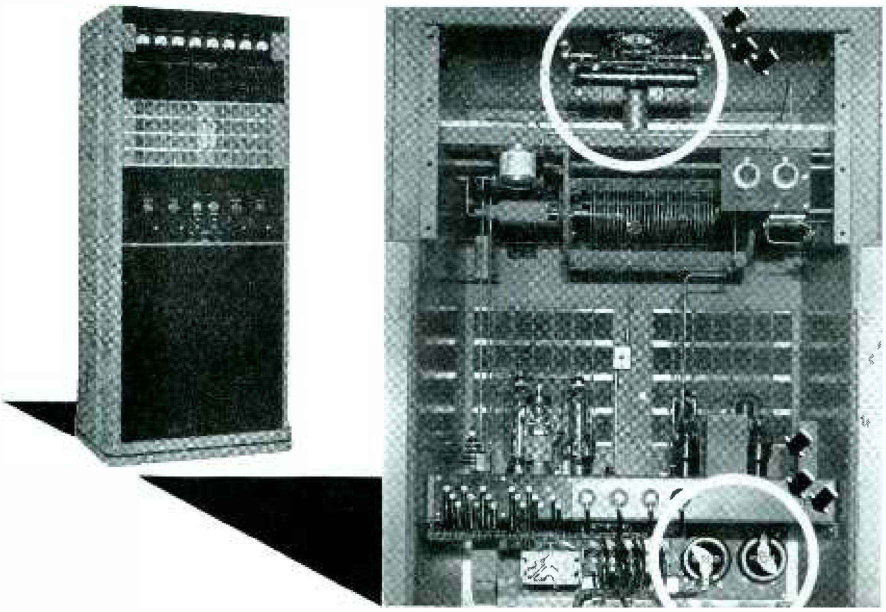
Color Matching In Paper Industry—E. L. Deeter, *Electronics*, Sept. 1938, pp. 18–19: Use of phototubes in bridge circuit to determine color of paper samples by reflected or transmitted light.

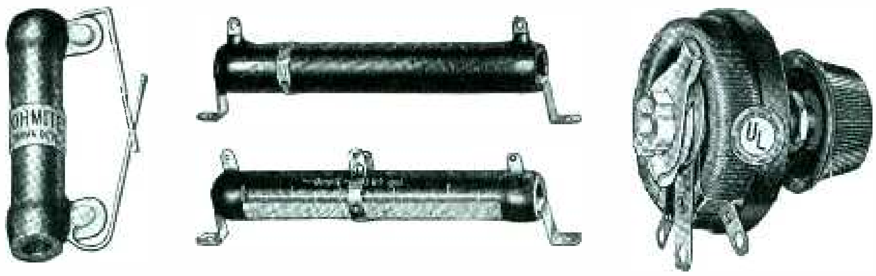
Photoelectric Weft-Straightener Control, C. W. LaPierre, A. P. Mansfield, *Elect. Eng.*, Sept. 1938, pp. 513–519: Use of two scanning units to determine skew (deviation from straightness) in weaving and to correct weft.

Electronics Helps Make Beer—*Electronics*, Sept., 1938, p. 13: P. e. counting apparatus for registering beer kegs.

New Adaptations For Speaking Machines—C. Ahlberg, *Ericsson Review*, No. 1, 1938: Use of Ericsson p. e. operated talking machine for distributing weather and road information over telephone system in Oslo.

Biological Effects Of Low Velocity Cathode Rays — C. P. Haskins, *Jour. App. Phys.*, Sept., 1938, pp. 553–561: Electron gun used to kill cancerous and non-cancerous cells. Survey made of relative susceptibility of cells over a wide range of cathode ray velocities.





Radio Manufacturing

THE SECOND SERIES of "Story of American Industry" contains a compilation of thirty-two radio speeches which have been given over the Columbia Network, by Harry R. Daniel, under the auspices of the Department of Commerce. Of the thirty-two talks, one is entitled "Radio Manufacturing."

A brief outline of the developments of the radio industry is given in this story of American industry from the popular point of view. Although the article goes back to communication of 3,000 years ago and brings in the development of the electric telegraph, radio is introduced with the experiments of Hertz and Marconi. Brief mention of the work of Fessenden, DeForest, Armstrong and Hazeltine is made and we learn that "credit should be given to all the American scientists such as Fleming."

Copies of the second series of "Story of American Industry" are available from the Government Printing Office, Washington, D. C., at 20 cents per copy.

Precision Frequency Control

A SUMMARY OF the modern methods of precision frequency control, with special emphasis on the frequency spectrum between 500 and 1,500 kc., is given by Geoffrey Tuilger and J. E. Benson in the *A.W.A. Technical Review* for April, 1938. In this article, "Precision Frequency-Control Equipment Using Quartz Crystals", the methods used and the principles involved in the design and making of commercial frequency control equipment for precision to within ±0.001% are set out briefly. Sections dealing with frequency measurements, quartz crystal plates, crystal mountings, temperature control and crystal oscillators are included. Applications of the principles and methods discussed are illustrated by a description of some practical design, and performance data are given.

The *A.W.A. Technical Review* is published by the Amalgamated Wireless (Australasia), Ltd., Sydney, Australia.

Electron Tubes in Industrial Applications

A NON-TECHNICAL article setting forth the characteristics, advantages and disadvantages of electron tube controlled equipment appears in the August issue of *Factory Management and Maintenance.* Under the title "Electron Tubes Never Complain," E. H. Vedder gives a number of useful hints and suggestions concerning a proper installation and operation of electron tube equipment.

The article is non-technical and practical, and should be especially useful to those whose technical knowledge of electronics is somewhat limited. In a succeeding article, the measurement and procedure in locating trouble in industrial electronic apparatus will be discussed.

Simple Sine-Wave Oscillators

A SIMPLE OSCILLATOR circuit using both positive and negative feedback is described by P. M. Honnell in the August issue of the *Review of Scientific Instruments*. The oscillator uses a minimum of parts, and has been found to be very free from harmonic content, particularly at low audio-frequency.

As shown in Fig. 1, the circuit is a

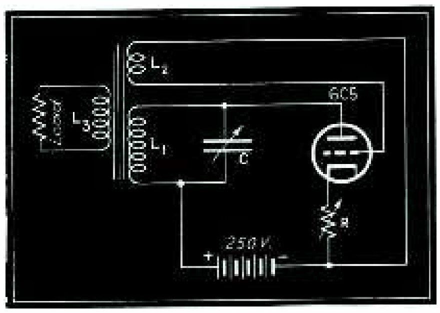


Fig. 1—Circuit of sine-wave oscillator using negative feedback

tuned-plate type of oscillator with energy being fed back from coil L_1 to coil L_2 in the grid circuit, which is untuned. Negative feedback is introduced by means of the variable resistor in the cathode circuit. It has been found that this resistance, R, requires slight readjustments for each oscillation frequency if threshold conditions are to be maintained. Values of the resistance R smaller than those for the threshold of oscillation result in increased power output and increased harmonic content. The circuit has been used with triodes having an amplification factor anywhere between 3 and 20, and satisfactory results have been obtained. For test tubes, the resistance R should be variable from 0 to 5,000 ohms.

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Printing Telegraph System

AN INGENIOUS printing telegraph system for wire communication in which the original text is scanned in much the same manner as facsimile transmission is described by L. DeVaux and F. Mets in the July issue of *Electrical Communication*. Their article "L.M.T. Laboratories Seven Frequency Radio-Printer" describes the theory of operation, practical applications, and the results obtained by the equipment manufactured by the L.M.T. Laboratories at Paris, France. The article is much too long and extended to reproduce here with any detail, and the original article should be consulted for complete details.

An outline of the method of operation, however, may be summarized briefly. In this radio printer system developed in the L.M.T. Laboratories, the characters are scanned and analyzed into seven horizontal lines, each line being represented in the electrical transmission by one definite audio frequency. The lines are transmitted simultaneously rather than in sequence, and the radio carrier is, therefore, modulated simultaneously by all of the seven audio frequencies corresponding to the seven horizontal lines. This arrangement enables a high speed of record printing to be obtained, combined with a modulation at an audio frequency and a resultant high degree of reliability in printing.

The equipment operates on the "start-stop" principle so that the receiver mechanism is automatically set in motion at the beginning of each character transmission and automatically stopped when transmission of that character has been completed. In this system there is no need to maintain synchronism between the transmitter and receiver mechanism, and the receiver may consequently be left unattended.

The "marking" or "printing" condition may correspond either to the existence or to the suppression of the carrier frequency. The latter condition has been adopted so that the general effect of static is not to print unwanted components of letters, but to suppress points in the characters, which in the majority of cases, remain perfectly legible.

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Self-Regulated Rectifiers

THE SEPTEMBER, 1938, issue of the *Bell Laboratories Record* contains an article by T. E. Trucksess, entitled "Regulated Tube Rectifiers Using Magnitude Control" which have been used for charging storage batteries automatically at some predetermined rate. A grid controlled rectifier or thyratron is employed for rectification, the voltage on the grid determining the charging current by establishing the fraction of the positive cycle for which the tube becomes conductive.

A simple half-wave rectifier circuit which uses the magnitude method of self-regulation, is shown in Fig. 1. In

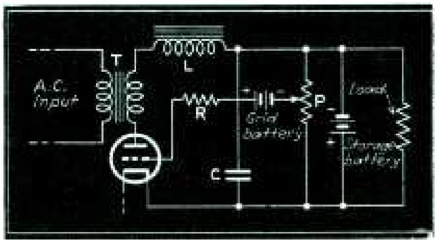

Fig. 1—Wiring circuit of half-wave regulated rectifier

this circuit, the alternating voltage to be rectified is fed to the tube from the transformer. The choke L and condenser C form a simple filter so that the current flowing into the storage battery and load is sensibly constant. The control circuit which determines the portion of the cycle for which the tube becomes conductive, consists of the voltage divider P, the grid battery, the grid resistance, and the grid of the thyratron. The function of the resistor R is to limit the magnitude of the grid current which flows.

When the load is applied to the rectifier the output voltage decreases and this change, reaching the grid through the regulating circuit, permits the tube to conduct earlier in the cycle. As a result, rectified current flows through the tube for a longer part of the positive cycle and the charging current is increased. This causes an increase in the output voltage sufficiently to return it to the regulated value.

A circuit with magnitude control arranged for full-wave operation is shown in Fig. 2. The operation of this full-

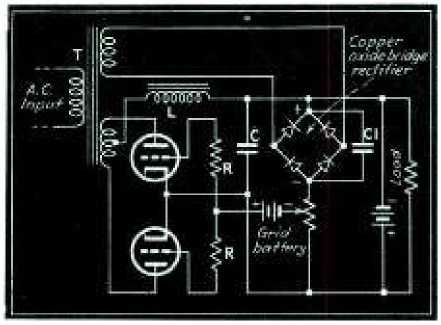

Fig. 2—Full-wave self regulated rectifier circuit

wave circuit is similar to that of the half-wave circuit, with each tube operating on alternate halves of the cycle. In this circuit, if the alternating input voltage changes, the regulating circuit can be compensated for the effect on the plate voltage of the tube. The grid voltage required to make the tube fire also changes at the same time and causes the output voltage to increase with the plate voltage. This effect may be nullified by connecting in the potentiometer circuit a small direct voltage obtained from a copper oxide rectifier and a winding on the plate transformer. The ripple in this voltage is smoothed by the condenser C_1. If the alternating input voltage increases, the direct voltage supplied by the copper oxide unit would also increase proportionately and the potential applied to the grids of the tubes, through the grid battery, will be more negative. This causes the tube to pass current later in the cycle and compensates for the added input voltage, if the copper oxide rectifier is properly selected.

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Electronics in Pharmacy

RESEARCH HAS a peculiar habit of bringing together strange bedfellows. One electrical engineer becomes a biologist, another becomes a recognized authority on photography, a photographic supply house is responsible for the introduction of a new series high vacuum pumps, and a mathematician evolves a new method of electrical analysis. All of these are the direct result of scientific research.

In "Physics in Pharmacy" appearing in the September issue of the *Journal of Applied Physics*, Ronald L. McFarlan enumerates some of the more recent advances in which physics has played an important part in pharmaceutical analyses. It is pointed out in this article that spectroscopy x-rays, fluorescence, colorimetry, polarization and photoelectricity as well as other miscellaneous applications of physical and electrical principles are used as an aid to determining or specifying the purity of drugs.

In spectroscopy, the use of emission spectra for the detection of small metallic impurities is rapidly gaining in popularity. In the routine examination of drugs for control purposes there is often a need for a quick method of detecting the presence of impurities. One excellent tool for this purpose is a properly constructed fluorescent lamp. A photoelectric fluorometer has recently been adapted to the measurement of aneurin-vitamin B_1. The colorimetric test, officially recognized at present by the *Pharmacopoeia* consists of the visual comparison of the colors of pharmacopoeial drugs with the colors of standard colorimetric solutions. The use of photoelectric color comparatives is an aid in colorimetric analysis.

With the increasing application of optical principles to the problems of pharmaceutical analysis, it is natural that the photoelectric devices should frequently be employed to measure the light intensities by means of which many pharmaceuticals are analyzed..It is but a matter of time before photoelectric instruments will be used to

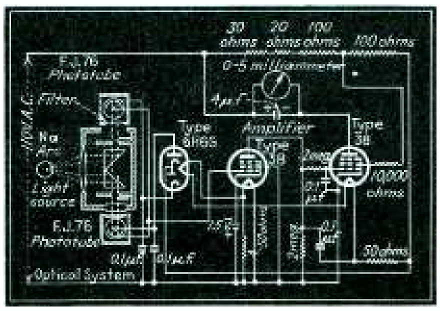

Fig. 1—Photoelectric circuit for determining potency of fish liver oil

assay other vitamins as well. These instruments are not only supplanting and replacing many of the older methods, but are also opening new fields of research.

Color comparators and analyzers which are based on photoelectric methods of light intensity measurements are finding many useful applications. The reason for the strong popularity of photoelectric color measuring equipment lies in the rapidity of making observations, the absence of eye fatigue, the elimination of the necessity of a trained observer, the full intensity at the end reached for the spectrum and the high accuracy of the observation. Among the useful pharmaceutical applications are the colorimetric determinations of hydrogen ion concentration, fluorescent measurements, micro-analysis and complex organic and biological assays. The ready adaptability of these photoelectric color comparatives to viscosity and turbidity measurements increases their usefulness to the pharmaceutical chemist.

A good illustration showing the use

to which photoelectric devices may be put for the determination of absorption spectra is found in the determination of the vitamin A potency of fish liver oil, and ultra-violet absorption spectrum. Various physical instruments have been developed for measuring vitamin A concentration. All these instruments measure quantitatively the absorption of light in the region of 3,200 A by oils containing vitamin A. A schematic wiring diagram of one such instrument is shown in Fig. 1. With this instrument it has been found possible to obtain a measurement of the vitamin A potency of a properly diluted oil to 1 per cent accuracy in less than two minutes, exclusive of the time required for diluting the oil.

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Luminescent Screen Potential

A METHOD has been devised by Herbert Nelson for the determination of potentials of areas on the interior surface of the glass envelopes of vacuum tubes, and is described in the article "Method of Measuring Luminiscent Screen Potential" in the September issue of the *Journal of Applied Physics*. The method depends upon the determination of three voltages. One of these is the voltage between the second anode, and the outside face of the cathode ray tube. This voltage is designated as E_1 in Fig. 1. The

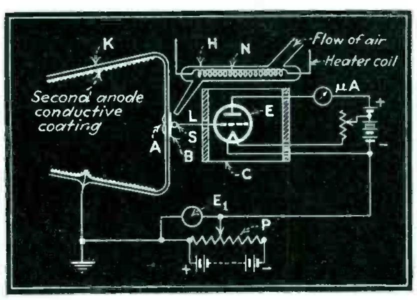


Fig. 1—Circuit showing method of measuring screen potentials of cathode ray tubes

second voltage, E_C, is a potential of the control element of the electrometer tube with respect to the negative terminal of the filament. The determination of this voltage E_c may be made on the basis of a previous calibration of the electrometer tube. The screen potential E_s is therefore the sum of the voltages E_1 and E_C. This method has the advantage in that measurements may be made on almost any type of finished tube.

As a result of measurements made for kinescopes under different conditions, it was found as a general feature that as the second anode is made increasingly positive, the screen follows and remains a few volts negative with respect to the second anode until despatched to the upper limits of the potential with respect to the cathode. When his occurs, he screen rapidly becomes more negative with respect to the second anode.

THE INDUSTRY IN REVIEW

Co-Axial Transmission Cable . . . . *By J. L. Bernard*

An inexpensive co-axial transmission line of small size, greater flexibility and one not requiring gas drying agents has long been in demand, and while cotton, treated cellulose, rubber, etc., have been at the disposal of the transmission line manufacturer, it is desirable that the dielectric used for this purpose be one of the inorganic group and preferably one having a low dielectric constant and power factor. The conventional procedure of insulating the elements of a transmission line with ceramic spacing insulators could be followed, but fabrication by this method is neither economical nor conducive to a product sufficiently free from installation difficulties to admit it to general use.

The hope had been that a "flexible ceramic"—steatite, porcelain, glass or the ultimate fused quartz with the workability of cotton—might put in its appearance among the engineering materials of radio to aid in the solution of line construction problems. If obtainable the co-axial transmission line might be raised to a new level of performance and vastly increased serviceability. The search for such a product resulted in the introduction of good electrical grades of spun glass. This dielectric simultaneously provides the desired electrical and physical qualities for the production of ¼" co-axial line. Application of spun glass to transmission lines was first limited to this small dimension although development work in connection with larger lines is now in progress.

By applying "a braid of glass" to the inner conductor of the line, a free space ratio is obtained in this new line which gives low loss without risk of short circuit between inner conductor and sheath at an arbitrarily chosen bending radius of 3". This is accomplished by winding the glass around the inner conductor in spiral fashion. The braid diameter and winding pitch best suited to produce the lowest loss consistent with rigid mechanical requirements were the principal factors in determining bending radius. The sheath of this line may be bent back upon itself without shorting.

The high degree of flexibility of solid wall copper tubing resulting from recently improved annealing methods has contributed much to place this transmission line in a class with ordinary electrical cable insofar as flexibility is concerned. The new ¼-in. line may be wound on small spools from which it may be drawn directly and snaked through conduit, partitions, shaft-ways, run in trenches, etc., with not much greater care than is necessary with ordinary rubber insulated wire and cable. Thus, the need for right angle junction boxes and painstaking forming of the sheath to avoid short circuits at bends, along with other special installation requirements are eliminated.

* Communication Products Inc.

After manufacture, the ¼ in. copper tubing, serving as the sheath of the line, is thoroughly dehydrated by heating in furnaces in which a reducing gas is admitted. It is then promptly sealed to prevent the admission of moist air. The spiral construction of the inner elements, heated to 300° F. before being inserted in the sheath, fit closely within it and tend to seal the line well enough to exclude appreciable quantities of moisture. Tightly fitting insulated terminals are also provided. The d-c resistance of the line remains well above 50 megohms in 500 foot lengths in spite of wide variations in temperature, atmospheric pressure and moisture.

The surge impedance of the new ¼ in. line is approximately 75 ohms. It has been successfully used for the past eighteen months on transmitters which deliver a power input of 300 watts to the line at about 60 megacycles. While the power loss in this cable is greater than that in larger diameter lines it is apparently well adapted to low power service at high frequencies in reasonable lengths and is very satisfactory for receiving installations in long lengths.

News

✦ G. H. Browning is back in the radio industry with a new Corporation which will specialize in kit receivers and tuners for the amateur and experimenter. It will be known as Browning Laboratories, Inc., 750 Main St., Winchester, Mass. . . . United American Bosch Corp., Springfield, Mass., announce that because they are retiring from the radio business they have sold their Police Radio Division to Fred M. Link, 15 East 26 St., New York City, who is taking over the current Bosch inventory. This acquisition will give Mr. Link, who is a licensee of the A. T. & T. a complete line of police radio equipment. Morris Metcalf, former Bosch vice president, will join the Link organization. . . . Victor J. Andrew, consulting engineer and manufacturer of broadcast and aviation transmitter equipment, announces that due to increasing business this past year his organization has purchased new and larger quarters at 6429 S. Lavergne Ave., Chicago. . . . Allegheny Ludlum Steel Co. and Ludlum Steel Co. announce the formation of the Allegheny Ludlum Steel Corp. Business will be handled through present channels. . . . T. Kennedy Stevenson was elected president and a director of Electrical Research Products, Inc., a subsidiary of Western Electric Co., with whom he has been associated for the past 24 years. He succeeds the late Whitford Drake. . . . Society of Motion Picture Engineers, Fall Convention will be held in Detroit from October 31 to November 2 when a presentation of the Progress Medal (awarded in recognition of any invention, research or development, of significant advance in the field's technology), and the Journal Award (made to authors or an author of the most outstanding paper originally published in the Society's Journal) will be made. SMPE has recently completed nominations of its officers for 1939. . . . American Lava Corp. of Chattanooga, Tenn., has acquired all equipment of the American Ceramics & Specialties Corp., Jackson, Mich. Carl R. Hower, Vice President and Manager, and O. D. Riseden, Production Engineer, will be retained in Sales and Engineering capacities with American Lava. . . . RCA recently started preliminary tests of facsimile transmission and reception between Philadelphia and its exhibit building on the World's Fair Ground in Flushing, N. Y. RCA plans to exhibit and demonstrate facsimile equipment designed for use in the home.

Literature

Photometer. Photrix Universal, Models A and B. 4-page bulletin thoroughly describes precision instruments for studio, darkroom, laboratory and test-room. Dr. F. Loewenberg, 10 E. 40 St., New York City.

Relays. Complete line described in booklet. Advance Electric Co., 1260 W. 2nd St., Los Angeles, Cal.

Industrial Temperature Guages. 12-page booklet contains specifications, illustrations, and sectional diagrams. Weston Electrical Instrument Corp., Newark, N. J.

1938–1939 Catalog. Cathode Ray Tubes, Oscillographs and Accessory Apparatus. Allen B. Du Mont Laboratories, Inc., Passaic, N. J.

Radio Power Equipment. As well as small air-insulated equipment for radio power circuits are listed in Bulletin 43-1, American Transformer Co., 178 Emmet St., Newark, N. J.

Industrial Controller. Checking list and catalog sheets available for holders of Industrial Controller Division catalogues of Square D Co., 710 S. 3rd St., Milwaukee, Wis.

Enclosed Safety Switches. Type RBA heavy duty industrial switch supersedes old RB line. Descriptive bulletin available. Trumbull Electric Mfg. Co., Plainville, Conn.

Thermal Time Delay Relays. Bulletin 351 describes three different types. Ward Leonard Electric Co., Mount Vernon, N. Y.

Panel Instruments. 37 line, covering industrial and radio applications in a variety of forms described in 12-page illustrated catalog. Catalog section 43-370. Westinghouse Electric & Mfg. Co., E. Pittsburgh, Pa.

Clays. Especially for use with porcelain enamels. Color chart and descriptive matter. Porcelain Enamel & Mfg. Co., Pemco & Eastern Aves., Baltimore, Md.

Welders. Electric spot and arc welders are listed in new catalog #38-T, "Transformers in the Making". Eisler Engineering Co., 740 S. 13th St., Newark, N. J.

Thermionic Amplifier. For pH and other potential measurements in high resistance circuits. Described in 8-page Catalog E-OOA. Leeds & Northrup Co., 4907 Stenton Ave., Philadelphia, Pa.

Quartz Crystals. For general communication frequencies. Catalog G-10. Bliley Electric Co., Union Station Bldg., Erie, Pa.

Armite. Is an improved thin insulation (fish paper) for electrical and mechanical uses. Described in bulletin "New Standards for Spaulding Armite". Spaulding Fibre Co., Inc., 310 Wheeler St., Tonawanda, N. Y.

Bi-Phonic Reproducer. Is a scientific tone chamber designed for use with loud-speaker cones. Thoroughly described in bulletin. Bi-Phonic Laboratories, 5 Carman Place, Baldwin, L. I.

Kit Receiver

THE 83 KIT RECEIVER of Browning Laboratories, Inc., Winchester, Mass., covers a band of frequencies from 540 to 2200 kc. in 4 bands to make a receiver of, and has extremely low noise level, high sensitivity and high quality

reproduction. A series of amateur tuners covering 10, 20, 40, 80 and 160 meter bands are also available. The tuners are all band switching assemblies with electrical band spread. Full sized wiring diagrams are furnished with the kit.

Volt Ohm Milliammeter

MODEL 4922, "JUMBO" voltmeter and milliammeter is a new product of Hickock Electrical Instrument Co., Cleveland, O. It has a large scale suitable for classroom demonstration purposes. Meter sensitivity is 350 micro-amps. A wide variety of a-c and d-c current and voltage ranges is available.

Welding Contactor

AN A-C IGNITRON, without timing, is the new Weld-O-Trol of Westinghouse Electric & Mfg. Co., East Pittsburgh. Suitable for use with existing timing devices, it will handle applications where difficulty of switching the welding machine current is involved. WL-652 and WL-657 tubes give a rating for spot welding approximately that of a 300 amp. contactor, and the WL-651 and WL-656 tubes roughly approximate the rating of a 600 amp. contactor. Descriptive Data 18-345 is available.

Filterette

TYPE R-1 OF Tobe Deutschmann Corp., Canton, Mass., is a unit designed to effectively overcome radio interference created by electric shaving devices. It is listed by Underwriters Laboratories.

Crystal Phonograph Pickup

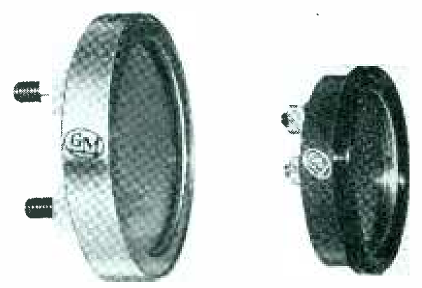
THE NEW "STANDARD" Mellotone Series X-78 is designed with a tone arm to minimize tracking errors down to 3 or 4%. A full lift hinge facilitates needle insertion. The low list price will appeal to service men and dealers in replacing old types of phonograph pickups on record players and radio phonograph combinations. Webster Electric Co., Racine, Wis.

Voltage-Dropping Power Cords

A LINE OF voltage-dropping power cords either for initial or for replacement use with a-c or d-c sets is announced by Clarostat Mfg. Co., Inc., 285 N. 6th St., Brooklyn, N. Y. Each cord is made up of three conductors enclosed in heavy braided covering.

Visitron Phototubes

NEW ADDITIONS to the Visitron series of G-M Laboratories, 1731 Belmont Ave., Chicago, are two new barrier type cells having twice the output of preceding units. When desired, both cells can



be supplied with visual filters to give them a color response equivalent to that of the human eye. Bulletin CS604 describes them in detail.

Measuring Electrical Impulses

RAYTIMER IS a new instrument of Raytheon Mfg. Co., Waltham, Mass. The time during which an a-c circuit is energized is shown directly on a meter scale. It may be calibrated in either cycles or seconds and has a range of 1/120 of a second to 30 seconds, the accuracy being plus or minus 5%. Some of its applications are: Checking welder and X-Ray exposure timing; measuring the closing and opening time of relays and contactors, measuring time periods and speeds of mechanisms having electrically actuated sequences, etc.

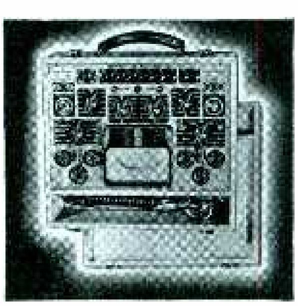
Exponential Speaker

PM REPRODUCER AND talk-back unit known as "Marine Midget" suitable for all types of indoor and outdoor intercommunication systems is a new item of Atlas Sound Corp., 1451 39th St., Brooklyn, N. Y. The specifications are: permanent magnet type, 7 oz.; power 5 watts; voice coil impedance 3.2 ohms

at 400 cycles; frequency response from 100 to 5000 cycles; overall size of complete speaker—bell opening 10 in. in diameter; overall depth, 8 in. The speaker is completely protected from mechanical damage as well as adverse weather conditions.

Tube Tester

PRECISION Apparatus Corp., 821 E. New York Ave., Brooklyn, N. Y., announces their new Series 900 dynamic mutual conductance tube tester. It is push button operated and has four re-



sistance ranges, four decibel ranges, four output ranges as well as paper condenser leakage test. Provision is made for measuring leakages of all types of electrolytic condensers.

Input Transformer

Model A216X, of Ferranti Electric Co., 30 Rockefeller Plaza, New York, is a new, light weight input transformer having electrostatic shields between primary and secondary windings. Technical data is: Primary 50/200, 125/500

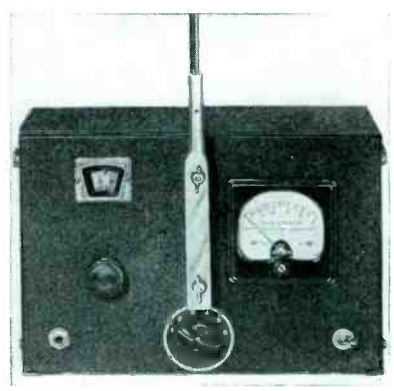
ohms; secondary 15,000/60,000 ohms; operating level —80 to +20 db; primary unbalanced 4 ma.; primary current per leg 50 ma.; operation is from a line to a single or push-pull grid and the weight of the unit is 2 lbs.

Trouble Shooter

"Trouble Shooter" is manufactured by Radio City Products Co., 88 Park Place, New York City. It has a multi-scale D'Arsonval 0-1 milliammeter, accurate within 2%, and measures d-c volts up to 1000, d-c milliamperes, and resistance up to 500,000 ohms.

Field Strength Meter

A handy low priced instrument for the measurement of the field intensity of antennas on frequencies from 1750 to 60,000 kc. has been introduced by Radio Transceiver Laboratories, Richmond Hill, New York City. It employs a diode tube rectifier powered



from a single dry cell mounted in the case. A wavechange switch for six bands and a phone jack for monitoring are provided. A damped meter indicates the relative radio frequency field strength.

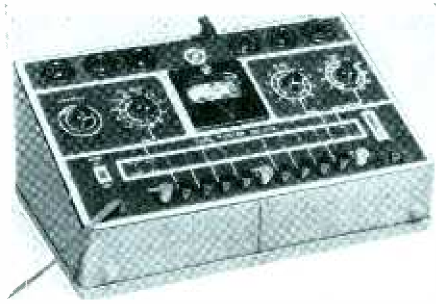
Heavy Duty Relays

CAN BE FURNISHED for either a-c or d-c operation by Ward Leonard Electric Co., Mount Vernon, N. Y. Average coil consumption for d-c is 4 watts and for a-c is 7.5 watts. Contacts and insulation for breaking 30 amps. at 2500 volts.

New RCA Products

RADIO TUBE TESTER. A unit designed for simplicity of operation is Model 156-A. It is push button operated and has a roller chart for setting the controls. Gas, electron ray, ballast, and battery tubes, including the new 1½ volt types, may be tested, as well a one and two-in. cathode ray tubes. All tests according to RMA standards can also be made.

ANTENNA COUPLING TRANSFORMER, designated as 9849 makes possible the conversion of existing antenna installations to provide features of noise reducing antenna when used in conjunction with the proper coupling transformer. Up to 16 radios may be operated at one time from a single antenna using the new coupling unit together with associated distribution and receiver coupling transformers.



PORTABLE VICTROLA, designated as O-12 has also been announced. It features improved appearance and a new low price.

MOBILE SOUND UNIT. It is completely self-contained and operating from either 6 volt storage battery or 110 volt a-c power supply. It contains an amplifier, all input and output controls, and a phonograph turntable. Two 12-in. permanent magnet loud-speakers, a microphone, and all necessary cables and connections to place the system in operation complete the unit. RCA Mfg. Co., Camden, N. J.

Electric Plants

D. W. ONAN & SONS, 43 Royalston Ave., Minneapolis, Minn., announce new 2000 and 3000 watt a-c electric plants styled with the radiator on the forward end. Welded steel generators increase their efficiency. These are made in manual, self-starting and full automatic types. Mechanical details and specifications are available from the manufacturers.

Patents

Patent Suits

1,544,081, F. K. Vreeland, Transmitting intelligence by radiant energy; 1,778,456, I. Langmuir, Means for producting alternating currents, D. C., S. D. Calif. (Los Angeles), Doc. E 745-(C) J, *R. C. A. et al.* v. *Globe Wireless, Ltd., et al.* Dismissed Apr. 1, 1938.

Re. 19,744, H. A. Wheeler, Volume control, D. C., N. D. Ill., E. Div., Doc. 14961, *Hazeltine Corp.* v. *Stewart-Warner Corp.* Consent order dismissing suit without prejudice Mar. 23, 1938. (To correct error formerly published as Re. 19,774).

1,623,996, P. S. Carter, Radio transmission system; 1,909,610, same, Electric circuit; 1,974,387, same, Antenna; 1,884,006, 1,927,522, N. E. Lindenblad, same, C. C. A., 2d Cir., Doc.—, *R. C. A.* v. *Mackay Radio & Telegraph Co., Inc.* Decree modified (notice May 2, 1938).

Re. 19,744, H. A. Wheeler, Volume control, D. C., E. D. Mich. (Detroit), Doc. 8322, *Hazeltine Corp.* v. *Sparks-Withington Co.* Consent decree dismissing bill without prejudice (notice Apr. 28, 1938).

1,811,099, L. W. Stonequist, Radio apparatus, D. C., N. D. Ill., E. Div., Doc. 11297, *L. W. Stonequist et al.* v. *Carter Radio Co.* Dismissed on plaintiff's motion with prejudice Apr. 29, 1938.

1,573,374, P. A. Chamberlain, 1,795,-214, 1,707,617, E. W. Kellogg; 1,894,-197, Rice & Kellogg; 2,052,316, R. E. Sagle, D. C., N. D. Ill., E. Div., Doc. 15955, *R. C. A. et al.* v. *B. Friedman et al.* (*Lake Sales Radio Co.*). Consent decree, finding patents valid and infringed, injunction Feb. 21, 1938.

1,710,073, 1,714,191, S. Ruben, Electrical condenser; 1,891,207, same, Electrolytic condenser, D. C., S. D. N. Y., Doc. E 76/400, *Ruben Condenser Co. et al.* v. *E. B. Latham & Co.* Dismissed without prejudice (notice May 5, 1938).

1,403,475, H. D. Arnold; 1,403,932, R. H. Wilson; 1,507,016, L. de Forest; 1,507,017, same; 1,811,095, H. J. Round; Re. 18579, Ballantine & Hull, D. C., N. D. Calif. (San Francisco), Doc. E 4079-S, *R. C. A. et al.* v. *L. D. Stark* (*Federal Radio & Television Co.*). Patents held valid and infringed, injunction May 16, 1938.

1,051,685, H. A. Wheeler, Peak detector; 2,041,273, same, Amplifier volume control, D. C. Md., Doc. E 2466, *Hazeltine Corp.* v. *General Electric Co. et al.* Dismissed without prejudice to the plaintiff May 20, 1938.

2,022,514, 1,913,604, W. A. MacDonald, Wave signaling system, D. C. Md., Docs. E 2466-E and 2467, *Hazeltine Corp.* v. *General Electric Co. et al.* Dismissed without prejudice as to plaintiff May 20, 1938.

1,707,545, 1,992,268, E. C. Wente, Acoustic device; 2,037,187, same, Sound translating device; 1,734,624, H. C. Harrison, Piston diaphragm having tangential corrugations; 1,730,425, same, Acoustic device, D. C., S. D. Calif. (Los Angeles), Doc. E 1308–Y, *Western Electric Co., Inc.*, v. *Lansing Mfg. Co.* Dismissed without prejudice June 4, 1938.

1,350,752, H. J. Van der Bijl; 1,403,475, H. D. Arnold; 1,448,550, same; 1,507,016, L. de Forest; 1,507,017, same; 1,531,805, R. C. Mathes; 1,592,934, R. V. Hartley; 1,596,198, S. Loewe; 1,823,322, R. A. Heising; 1,966,065, R. Gunn; Re. 17,245, Re. 17,247, W. G. Cady; Re. 17,355, same, D. C., N. D. Calif. (San Francisco), Doc. E 3946–L, *R. C. A. et al.* v. *Heintz & Kaufman, Ltd.* Dismissed Mar. 30, 1938.

1,356,763 (a), R. V. Hartley; 1,403,475, H. D. Arnold; 1,465,332, same; 1,520,994, same; 1,403,932, R. H. Wilson; 1,507,016, L. de Forest; 1,507,017, same; 1,936,162, H. A. Heising, D. C., S. D. Calif. (Los Angeles), Doc. E 742–J, *R. C. A. et al.* v. *Globe Wireless, Ltd., et al.* Dismissed Apr. 1, 1938.

1,356,763 (b), R. V. Hartley; 1,403,932, R. H. Wilson; 1,465,332, H. D. Arnold; 1,520,994, same; 1,447,773, Espenschied & Brown; 1,507,016; L. de Forest; 1,507,017, same; 1,544,081, F. K. Vreeland; 1,869,323, P. H. Evans; 1,890,302, W. Runge; 1,896,780, F. B. Llewellyn; 1,936,162, R. A. Heising; Re. 18,579, Ballantine & Hull; Re. 18916, J. G. Aceves, D. C., N. D. Calif. (San Francisco), Doc. E 3945–L, *R. C. A. et al.* v. *Heintz & Kaufman, Ltd.* Dismissed Mar. 30, 1938.

1,938,092, 2,002,844, Amy & Aceves, Radio receiving system; Re. 19,854, same, Duplex radio aerial system, filed May 27, 1938, D. C., S. D. N. Y., Doc. E 87/113, *Amy, Aceves & King, Inc.*, v. *Birnbach Radio Co., Inc.*

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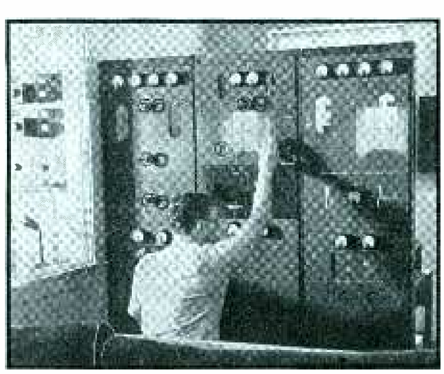
SERVICE FOR SAILORS



Twenty-four hour radio service on 2514 kc. is offered to all sailors, on Lake Michigan, amateur or professional, by station WAY, above, owned by a Chicago publisher. Subscribers to the service are provided with a transmitter which is installed on the boat and operates at a fixed frequency of 2118 kc.

1,573,374, P. A. Chamberlain; 1,795,214, 1,707,617, E. W. Kellogg; 1,894,197, Rice & Kellogg; 1,728,879, same, D. C., N. D. Calif. (San Francisco), Doc. E 4078–R, *R. C. A. et al.* v. *L. D. Stark (Federal Radio & Television Co.)*. Patents held valid and infringed, injunction May 16, 1938.

1,455,141, Lowell & Dunmore, Radio receiving apparatus; 1,606,212, same, Power amplifier; 1,635,117, same, Signal receiving system, C. C. A., 4th Cir., Doc. 4261, *P. D. Lowell et al.* v. *A. G. Triplett et al.* Decree affirmed insofar as it dismisses bill with respect to 1,455,141 and 1,635,117, and reversed insofar as it sustains validity of 1,606,212 June 11, 1938.

1,329,283, 1,398,665, H. D. Arnold, Thermionic amplifier; 1,349,252, same, Method of and means for utilizing thermionic currents; 1,403,475, same, Vacuum tube circuit; 1,448,550, same, Thermionic amplifier circuit; 1,465,332, same, Vacuum tube amplifier; 1,520,994, same, Electron discharge amplifier; 1,453,982, B. W. Kendall, Electrical receiving or repeating apparatus and method of operating same; 1,493,595, D. G. Blattner, Amplifying with vacuum tubes; 1,544,921, R. C. Mathes, Amplifier circuit, D. C. Minn., 4th Div., Doc. E 2804, *Western Electric Co., Inc., et al.* v. *Cinema Supplies, Inc., et al.* Consent decree for plaintiffs as to 1,329,283, 1,398,665, 1,403,475, 1,453,982, 1,465,332 and 1,520,994, injunction May 28, 1938. Bill dismissed as to 1,349,252, 1,448,550, 1,493,595 and 1,544,921, Dec. 3, 1936.

Adjudicated Patents

(C. C. A. N. Y.) Crossley patent, No. 1,694,341, for magnesium compound and process of producing the same, claims 1 and 3 *Held* invalid. *Plant Products Co.* v. *Charles Phillips Chemical Co.*, 96 F.(2d) 585.

(C. C. A. N. Y.) Lindenblad patent, No. 1,927,522, for antenna for radio communication, claims 9, 10, 19, and 23 *Held* not infringed. *Radio Corporation of America* v. *Mackay Radio & Telegraph Co.*, 96 F.(2d) 587.

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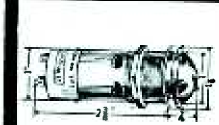

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INDEX TO ADVERTISERS

the Screw

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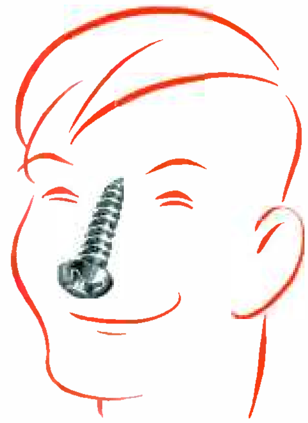

goes straight

Then something came over The Screw. Took that slot off his head and put in a patented recess. Changed his habits altogether. Guarantees now never to go crooked again, to use his head and really save some money.

The crew took to him like your wife to a pay envelope. He's on the ball from whistle to whistle, and no foolin'! Makes it easy for the guy that's doing the driving, because you can depend on him to keep the driver from slipping. No more burrs — really a smooth article now. And I don't know of a crooked job he's done since he made his comeback.

The boss says he's worth his weight in gold. The Screw has gone straight — and you can lay your cash on that!

Manufacturers Report Assembly Costs Cut Up To 50% . . .

Even when working in an awkward position or on pre-finished parts, it's safe to use faster driving methods. The screw clings to the driver, the driver can't slip from the screw, and the screw can't go in crooked. Freedom from burrs saves an extra filing operation. Result: 10 to 30 minutes saved each assembly hour.

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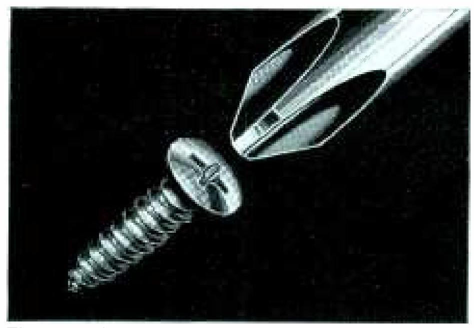

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Gain Time . . . Guide-Driver . . . Guard Work

MACHINE SCREWS | SHEET METAL SCREWS | WOOD SCREWS | STOVE BOLTS

U. S. Patents on Product and Methods Nos. 2,046,343; 2,046,837; 2,046,839; 2,046,840; 2,082,085; 2,084,078; 2,084,079; 2,090,338.
Other Domestic and Foreign Patents Allowed and Pending.

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- GREATER UNIFORMITY OF AMPLIFIER GAIN
- HIGHER GAIN PER STAGE
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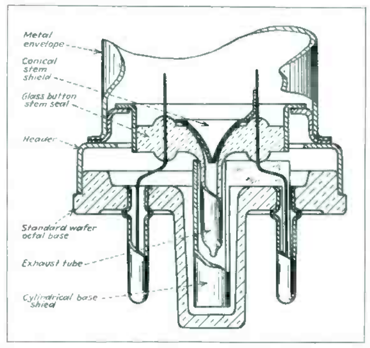
- SIMPLIFICATION OF TUBE RENEWAL



Base construction of the new RCA single-ended pentodes is shown in this cross-section diagram. It also shows shield cone and cylinders for reducing inter-electrode capacitance.

RCA's two new metal r-f amplifier pentodes, the RCA-6SJ7 and 6SK7 feature single-ended construction with interlead shielding. The result of modern methods of tube manufacture, they not only have the same grid-plate capacitance as tubes wearing grid caps but also have lower input and output capacitance values—plus higher transconductance. The 6SJ7 has a sharp cut-off characteristic. The 6SK7 has a remote cut-off characteristic. Both have a small wafer octal 8-pin base to fit standard octal socket.

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