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1926

RADIO WORLD

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America's First and Only National Radio Weekly

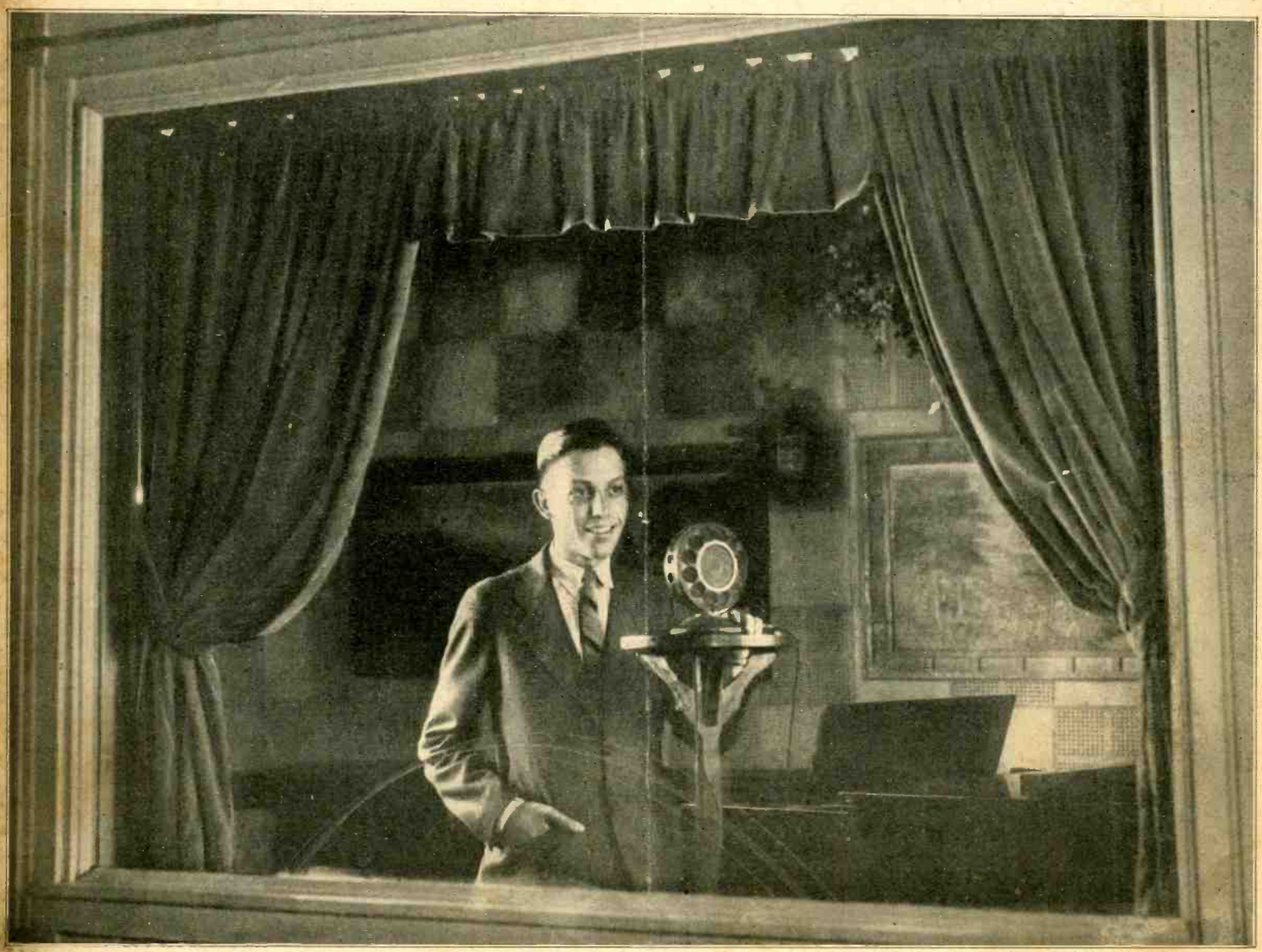
Vol. 9 No. 22 *Illustrated*

ENGINEERS ACHIEVE FEAT IN NEW CIRCUIT FOR BALANCED SET

SCIENTISTS GROPING AMONG WAVES TO GET PROPAGATION SECRET

HOW TO WIRE UP THE IMPROVED B-D TOLD STEP-BY-STEP

THE YOUNGEST ANNOUNCER IN THE UNITED STATES



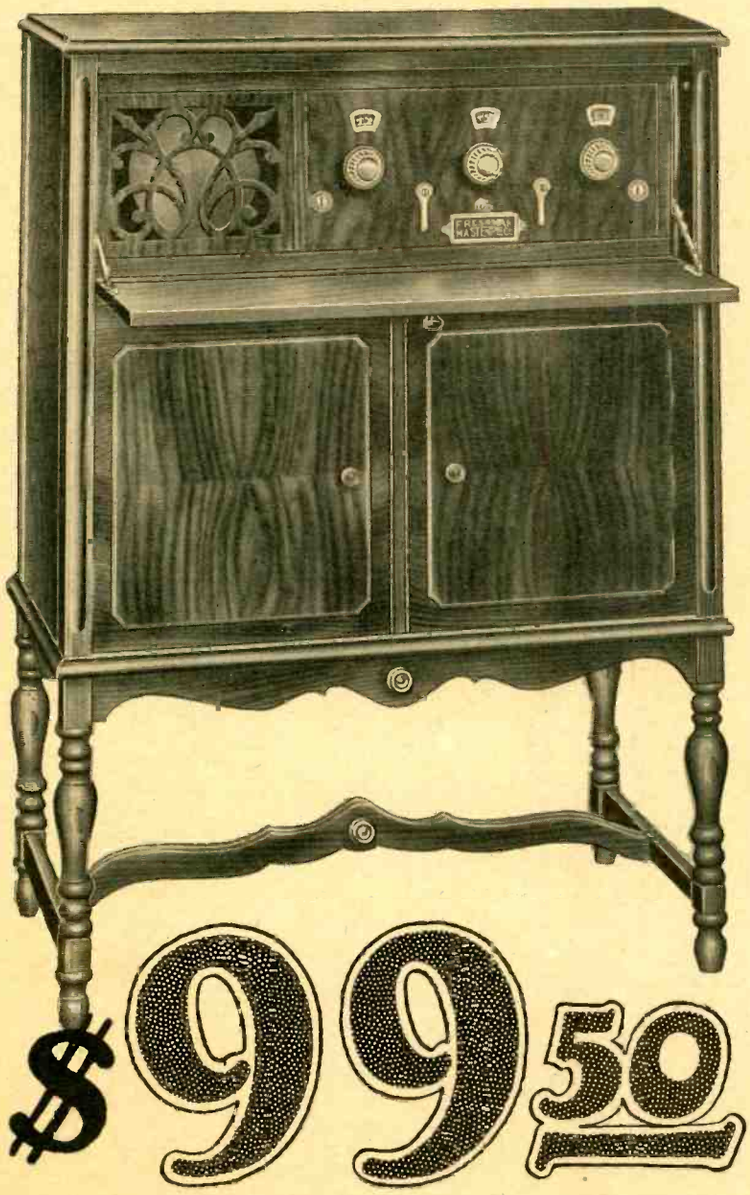
(*Underwood & Underwood*)

RALPH PRATT, nineteen, is a regular announcer at WDAF, Kansas City, Mo. This makes him the youngest professional announcer in the country. He has a good voice, good looks, good personality but bad luck as a fisherman.

How Steinmetz Solved Transformer Riddle

WRC to Send Out Programs of WEAF

QUALITY with 100% Reserve Power



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Tubes As Trouble Lamps

VALUABLE AID GIVEN BY TESTER

Simple Device Enables Reading of Plate Current Flow in Any Part of Receiver — Shorts and Opens Located Without Breaking Connections.

OUTPUT RATED

Slightly More Extensive Circuit Enables Readings of Comparative Strength At Any Point

By Ted Tobin

ONE of the toughest problems for some experimenters is to know what to do to make a set work that refuses to peep. Usually there is an open circuit that should be closed, or a short circuit, which means that current is effectively detoured. To find the seat of the trouble and to remedy it is the problem.

Tube testing devices help wonderfully in giving an insight into the trouble. Once trouble is located and identified it is comparatively easy to effect the remedy.

Take a tube tester circuit as shown in Fig. 1. This is easily constructed. It consists of a tube base, used as a plug; a socket, a switch and a milliammeter, say with a 0-to-50 full-scale deflector, and a fixed condenser, C. A panel and baseboard are used for mounting, as in Fig. 2. A pair of bent brackets should be used if a sloping panel is to be employed. To the four leads that come from the tube base terminals flexible leads are soldered. The two filament leads may be intertwined. Keep the plate and grid leads separate and as far apart from each other as is convenient.

Plate Current Flow

You can determine how much plate current is flowing by inserting the plug in a socket of a receiver, the tube taken from that socket being placed in the tester socket, to which the free ends of the four flexible leads have been properly connected.

A tube chart will tell you what plate current should be flowing at a given voltage with a given negative bias on the grid. See the July 10 issue of RADIO WORLD for such a chart. If the reading is considerably higher than what it should be there is some trouble connected with the circuit in which that socket in your set is wired. It may be a shorted grid leak, an incorrect grid bias or grid return (e. g., positive instead of negative) or a broken winding of a coil, either AF or RF. If there is no reading, reverse the connections to MA. If still no reading, the plate circuit is open or the grid bias is very excessively negative. The less negative or more positive the grid, the greater the plate current consumption.

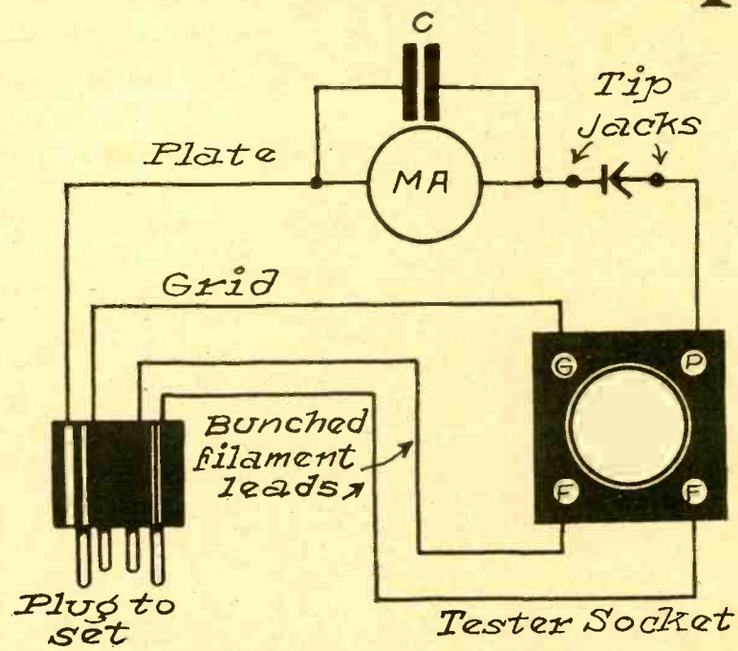


FIG. 1
A TUBE TESTER and trouble-shooting aid. The plug is made from an old tube base, the leads being carried by flexible wire to a socket in the tester. C is an optional fixed condenser, MA a milliammeter.

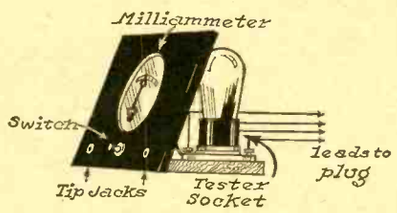


FIG. 2
The set-up for the tester shown in Fig. 1.

Fig. 1 shows how posts for a pair of earphones are provided. Combining the use of phones and milliameter MA you have a handy trouble-shooting outfit.

Variety of Uses

Some detection is possible even on a tube hooked up for radio frequency amplification. Therefore by starting with a test of the first tube (receiver input) and progressing toward the final audio tube you can use the phones to locate at what point no reception is possible, and know that your trouble does not lie beyond that.

In the audio channel you get regulation response in the phones by the Fig. 1 method.

Be sure to open the switch when the phones are plugged into the tip jacks.

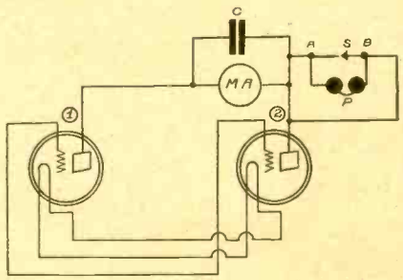


FIG. 3
Circuit diagram of the tester in use. The tube symbol at left (1) is really the plug in the receiver socket, as (1) and (2) represent the same tube.

The schematic diagram is shown in Fig. 3. The tube symbol (1) is not a tube, but the plug. The tube is in the tester socket (2). The phone tip jackets are A and B, the switch is S, the phones are P and the fixed condenser is C. A good value for C is .5 mfd., but other values may be used.

Better Yet

A tester with wider scope is diagrammed in Fig. 4. The choke coil CH has

(*Concluded on page* 4)

CONDENSERS LET DC PASS FOR SECOND

Charge Is Registered on Sensitive Meter When Key Is Pressed, But Subsides Almost Immediately

By Smedley Spear

If DC is impressed between two points of an insulator, a current flows, which stops shortly. It may be said then that the flow of DC exists but for a short while in an insulator. This may be proved by inserting a condenser or other insulating material in series with a battery and very sensitive meter, such as a galvanometer and a key. As soon as the key is closed a sudden deflection takes place. This soon drops to zero. This short-lived flow of current is due to the production of an electric strain. This, however, is held back by an elastic reaction of the plates or insulating material of the condenser.

This action may be referred to as an electric stress. Due to the reaction of the stress, the electric strain caused by a consistent emf., reaches a steady value, whereupon the current equals zero.

If the electric strain is allowed to diminish, a new current exists in the opposite direction. This current, which is called "displacement current," exists only when the electric strain is constantly changing. If we consider the existing of an electric strain or displacement in an insulating material, this material is called a dielectric, while the displacement current is called a dielectric current.

Question of Molecules

The electric displacement is not exactly defined as to the passage of matter on which the charge is carried from one plate to another, nor even from one molecule to another, within that substance. It may be better thought of as if in each molecule, when a positive charge is moved to one end and a negative charge to the other. With all the positive charges being directed in one direction, the effect is equal to a certain change which has been sent across the dielectric.

To illustrate, suppose a great many balls to be lying in a mass. Let one ball be pushed slowly. This ball will then push the others, a certain distant. Energy has been transmitted and still no single ball has gone the entire distance.

In a condenser, the displacement is produced in the dielectric, by placing the dielectric between metal plates and connecting th plates to a source of emf. The plate from which the displacement takes place is known as the positive plate of the condenser. The other plate is known as the negative plate. When a D C source of emf. is connected to the plates, a displacement current flows.

This continues until the electric displacement reaches its final value. The displacement, which is produced, is dependent upon the voltage applied to the condenser and the kind of dielectric material. Only in a conductor can a direct current flow.

Action of AC

An alterating current can, however, also flow through condensers, in the form of dielectric current. The electric strain or displacement reverses its direction. Here, the electric strain, at every reversal of current, reverses its direction. In the DC method, when the plates of the condenser have no potential difference, the discharging ceases. In the AC method, AC is constantly flowing into and out of the condenser, so that the voltage between the plates may be kept equal to the value of the emf. at the moment it is applied. A condenser offers less obstruction to the AC flow at high frequency, than at low frequency. Therefore, the more rapid the alterations, the more current will flow through the condenser.

The use of different dielectric materials changes the capacity of the condenser. The greater the area of the plate, the greater the capacity in direct ratio. This applies to the increasing of the distance between the plates.

Output Measured After Rectification

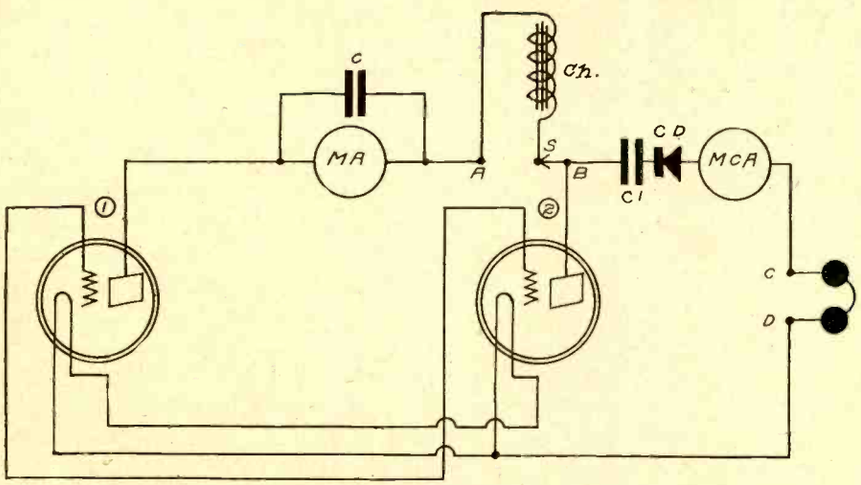


FIG. 4

Relative output values may be obtained with this hookup, which is more versatile than the Fig. 1 method.

(*Concluded from page 3*)

been added, likewise the crystal delector CD, the microammeter MCA, the tube jacks C and D, and the fixed condenser C1, also .5 mfd. If a microammeter is not available, use a 0-to-1 or 0-to-1 1-2 milliammeter.

Notice that this hook-up gives you a pulsating direct current output and means of evaluating this comparatively. Thus if you want to test a tube in comparison with some other tube, anywhere in the set, watch MCA and get the readings in each case. The output will increase if there is improvement. Note that the Fig. 1 plan is embodied in full, the switch being open if the phones are plugged in at A and B. Close the switch to utilize the phones at C and D, this use letting you judge by ear when volume is greatest. An odd point is that your ears may deceive you occasionally, a signal that seems louder actually giving a reading that shows the volume to be less.

Only First-Class Sets Useful In South America

Radio is proving to be the most vital of factors in the strengthening of relationships between the peoples of the North and South American continents. This is the opinion of Albert G. Linsig, foreign representative of the Freed-Eisemann Radio Corporation. He said:

"The demand for radio receivers in South America is enormous but only the best quality of sets can be used on account of the damp atmosphere. The first American sets shipped to South America were not satisfactory, but since that time the manufacturers have learned to provide apparatus which is suitable for the conditions that prevail there and which are sensitive enough to bring in stations at long distances because in South America the broadcasters are very far apart.

"My best estimate is that there are 250,000 sets in Argentine, in Chile, 40,000 to 50,000, in Brazil, 60,000; in Peru, 12,000 sets which have been licensed at an annual fee of a Peruvian pound, and probably, as many more which have not been licensed; in Uruguay, 10,000 to 15,000; in Ecuador, 5,000; in Paraguay, Bolivia, and Venezuela, very few receivers, due to restrictions."

Triumphant Return of WRC Players Planned For Fall

The WRC players, who made their debut last Winter, under the direction of Madge Tucker, it is said, will be back at the microphone in the Autumn after a Summer vacation, and other regulars of the air, including Mrs. Nina Reed with her discussions of books and world affairs, and Dorothy Townsend, with her discussions of women's affairs, will remain associated with the Washington Station.

Continuing in charge of the Radio Corporation activities in Washington will be the same organization that has carried on in the past. These officials are F. P. Guthrie, district manager; Ralph Edmund, program manager of WRC; Kenneth Berkeley, assistant program manager; William M. Sweets, studio manager and publicity director; George F. Ross, musical director and announcer, and George Ellis, engineer-in-charge.

A New Stabilized Circuit

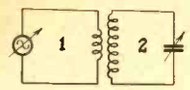


FIG. 1.

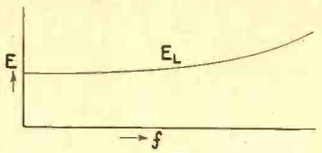


FIG. 2.

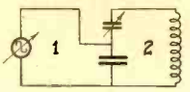


FIG. 3.

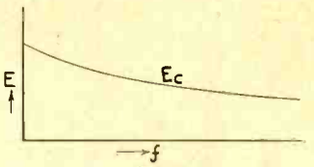


FIG. 4.

By Edward H. Loftin and S. Young White

PART I

THE electromagnetic form of coupling, which is the form in most common use in radio receivers, transfers more energy at the higher frequencies of a given range than at the lower of that range, which accounts for present-day broadcast receivers being more efficient on short waves than long, and also accounts for such receivers being more selective on the long waves than on the short.

This effect is more specifically illustrated in Figs. 1 and 2 where, in Fig. 1, there are shown two circuits 1 and 2 inductively coupled, circuit 1 having a source of alternating current which can be varied over a wide range of frequencies, and circuit 2 having a variable condenser that will permit its being tuned to follow in period, or resonant response, the variations of current frequency in circuit 1. Fig. 2 graphically shows the result in energy transfer as current frequency in circuit 1 is varied and circuit 2 is tuned to follow the variations. If ordinates represent energy transfer and abscissae represent frequency, then the upward sloping curve EL fairly well represents the increasing energy transfer with frequency increase.

It is apparent that in a cascade radio frequency receiver having a number of such couplings, as for example between the antenna and first amplifier, between the first amplifier and second, and between the second amplifier and detector, three in all, this effect multiplies and becomes decidedly marked; so that if the energy transfer can be straightened out, as by lifting the end at the lower frequency side, great improvement results.

Coupling Varied

Turning to the electrostatic form of coupling we remark on its characteristics. Referring to Fig. 3, if we take two circuits 1 and 2 as before and couple them through a condenser which is large in capacity with respect to the tuning condenser in circuit 2 then we have loose coupling, but if we vary the frequency of the current in circuit 1 and tune circuit 2 in consonance by varying the tuning condenser, then the degree of coupling will change with such variation in accordance with the ratio between the values of the larger capacity coupling condenser and the smaller, but varying, capacity tuning condenser. The coupling is tighter on the longer waves or lower frequencies, and therefore transfers more energy, and looser on the shorter waves or higher frequencies, and therefore transfers less energy. The resulting energy transfer with frequency variations is somewhat as represented by the downward sloping curve E_c in Fig. 4.

This electrostatic effect suggests the result that can be obtained if the two couplings can be made to work together, for where one is deficient the other is efficient, and vice versa. So we proceed to combine them as shown in Fig. 5. Just combining, however, is not all that is necessary, for in broadcast receivers we want the result shown in Fig. 6 where the electrostatic transfer curve E_c combines with the electromagnetic curve E_1 to produce a substantially constant, or horizontal line, transfer E_{lc}.

Can Shift Coupling

The electromagnetic coupling can be shifted 180 degrees in phase merely by reversing the connections to either coil, so that the electromagnetic transfer can be made to either aid or oppose the electrostatic transfer. If connected to oppose, then it would be represented by putting the curve E_1 below the line in Fig. 6, so that at the frequency where the two curves are shown to cross, that is, energy transfer for each is equal, they would cancel out and give zero coupling or no energy transfer instead of adding up to give the substantially horizontal line E_{lc}. While this ability to get zero or very small coupling may have an important place in some forms of radio work, yet it is not what is desired in a broadcast receiver, so that care must be taken to so pole the electromagnetic coupling as to have it aid or be in phase with the electrostatic coupling.

In Fig. 7 assume a vacuum tube having its grid circuit excited with high frequency current, and its plate energized through a choke coil having sufficiently high inductance and low distributed capacity that the reactions of elements selected in a shunt circuit will predominate, or be in effect the plate circuit reactions for the high frequencies, as by having a switch as shown that will select at will anyone of the resistance, inductance and capacity elements shown. We represent the inherent tube capacity in dotted lines.

If we take the potential at the grid due to the exciting current as a zero or reference vector for the vector diagram of Fig. 8, shown as the zero vector E_g, then placing the switch on the resistance R leg of the plate shunt circuit the resulting high frequency amplified plate current will be (neglecting the reaction of the choke coil which if properly designed will have little effect) in phase with the grid potential, and can be represented by the vector I_{pr}, also on the zero vector line.

Grid Current Phasing

The reaction of the resistance to this in-phase current will tend to drive some current to the grid through the inherent tube capacity, but due to this inherent path being substantially capacitive only in reaction the current to the grid will lead the grid potential E_g by 90°, and can be represented on the vector diagram by the vector I_{gr} on the +90° vector line, and being 90° out of phase with the grid potential E_g, neither aids nor opposes its operation, and therefore is neutral in the matter of regenerative amplification or oscillation production.

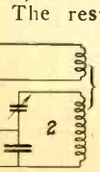


FIG. 5.

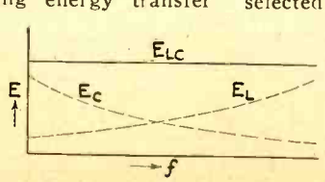


FIG. 6.

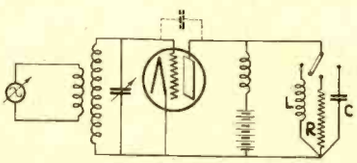


FIG. 7.

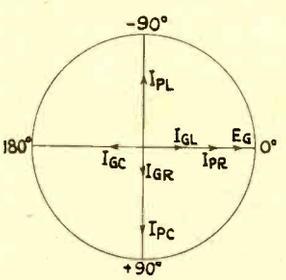


FIG. 8.

Opposing Effect Used

Switching to the capacitive C leg the resulting high frequency amplified plate current, by reason of the capacitive reaction, leads the grid potential by substantially 90°, and can be represented by the vector I_{pc} on the +90° vector line.

But mere combining and correct polarity are not in themselves sufficient if a good horizontal line is to be obtained. It must first be decided how much total or combined coupling is desired, and then each of the two kinds proportioned with the regard for the other to arrive at the desired amount and desired constancy.

The electrostatic coupling must take due cognizance of the tuning condenser, and particularly its maximum and minimum values at the extremes of the broadcast wavelength band. Therefore the electromagnetic coupling must take into consideration the limitations imposed on the electrostatic by the tuning condenser, and so on, each design being a study in itself, but the results compared to those obtained with an ordinary non-constant coupling are well worth the trouble.

The results are rather easily arrived at as between two simple circuits after a little experiment, but when it comes to applying the combination to vacuum tube amplifiers then the problem requires further consideration, so that a few thoughts

Feat in Constant Coupling

A Non-Reactive Plate Circuit Is Used by Loftin and White, With Combination of Capacity and Inductive Interstage Coupling, Which Is Constant for All Broadcast Frequencies and Above.

Inventors Call Tuned Radio Frequency a Misnomer — Declare Only First Stage Is at Signal Frequency, the Others Being at Different Frequency and Cutting Down Energy Transfer.

leading up to the use there may not be amiss.

Plate Reaction Important

The principal effect that requires the additional consideration is the reaction of the plate circuit of the tube on the amplified currents causing them to take effect on the grid through the inherent capacity of the tube which is principally the grid-plate (and their leads) capacity. Examining the different possible reactions and their effects through the aid of a

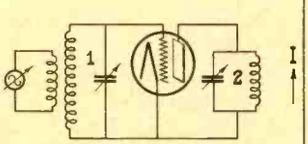


FIG. 9.

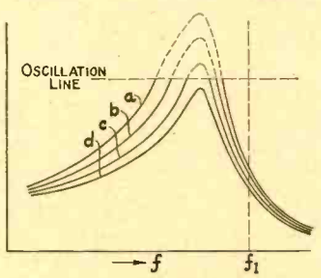


FIG. 10.

circuit diagram and a vector diagram is helpful.

Likewise the reaction of the capacity of this 90° leading current will tend to drive some current to the grid through the inherent tube capacity, but due to this inherent path being substantially capacitive only in reaction, a further leading of 90° will be brought about, making the current arriving at the grid 180° out of phase with the grid potential E_g, and can be represented on the vector diagram by the vector I_{gc} on the 180° vector line. This substantially complete opposing effect of a capacitively reacting plate circuit is therefore most effective in destroying the amplifying ability of the tube.

Switching to the inductive L leg the resulting high frequency amplified plate current, by reason of the inductive reaction, lags with respect to the grid potential by 90°, and can be represented by the vector I_{pL} on the —90° vector line. As before, there is a reaction through the tube capacity due to this lagging current, but the capacitive nature of the tube path produces a lead that just about overcomes the lag, so that the current arriving at the grid is just about in phase with the grid potential E_g, and can be represented on the vector diagram by the vector I_{g1} on the zero vector line.

Foundation of Regeneration

This substantially in-phase effect of an inductively reacting plate circuit is the foundation of regenerative amplification through tube capacity and production of oscillations when the returned current is sufficient; in fact when the returned current is enough to raise the potential by an amount at least equal to the original impressed potential.

Thus we may set up the axiom that a resistive or non-reactive plate circuit is neutral in the matter of regeneration, a capacitive plate circuit is opposed to regeneration, and an inductive plate circuit supports regeneration.

With the analysis behind us we can examine these effects as encountered in practice. Considering a simple vacuum tube amplifier having an adjustable circuit 2 of proper proportions to pass through resonance in the plate circuit, as shown in Fig. 9, with a current of high frequency f_1 input to the grid. Now by varying the adjustable circuit 2 in the plate circuit we know that we can get wide variations in current intensity or signal strength. Representing in Fig. 10 signal intensity by ordinates and wave length or frequency of circuit 2 by abcissae, we find by plotting a curve a for instance, strongest signals are obtained in the region of wavelengths below the resonant frequency f_1.

Phase Angle Widens

Using the preceding analysis the reason is obvious. As the circuit is tuned from low wavelength upward its reactance is predominatingly inductive, and with the series impedance rapidly increasing, though remaining inductive, in going towards resonance, more and more current is sent to the grid in proper phase to produce regenerative amplification or oscillations. Approaching near resonance, though the series impedance is still increasing, the capacitive reactance begins to neutralize the inductive reactance, so that the fed-back currents draw more and more out of phase with the grid potential, and the regeneration falls off rapidly before resonance is reached as shown by curve a.

At resonance, though the series impedance is enormous and maximum, tending to send large current through the tube, the current is 90° out of phase and therefore neutral, as the circuit is now entirely resistive, due to the capacitive and inductive reactances neutralizing each other. Beyond the frequency f_1, or resonance, the circuit 2 creates a predominating capacitive reactance, so that de-amplification takes place and the signal intensity continues to fall off by reason of the fed-back currents being in opposing phase to the grid potential.

Oscillation Too Easy

Considering the Armstrong patent (U. S. Patent 1,113,149), for instance, nothing could be more fallacious than to say that its reference to a tuned plate circuit includes regeneration, for obviously when the plate circuit is in the tuned condition it is non-reactive, wholly neutral in its effect on grid potential, and totally innocent of any regenerative defects. And we say defects, for in looking towards producing a tuned radio frequency receiver nothing is more unwanted than regenerative effects, as will be more specifically pointed out.

In Fig. 10 we have included a horizontal broken line marked "oscillation line," and have shown the portions of curves above this line in broken lines, this being for the purpose of indicating that above the line is the oscillation region. We do not mean to convey the impression, however, that every system like Fig. 9 will produce oscillations merely by reason of having a tunable circuit in the plate circuit. To the contrary, whether or not the curves reach the oscillation line depends upon the selection of the relative values of inductance and capacity in both circuits as well as adjustments of the tube potentials, but of course with modern high amplification constant, or high mu, tube oscillations occur more readily than usually desired.

Proceeding a step further, and to the circuit ordinarily selected as a basis for multiple stage radio frequency amplifiers shown in Fig. 11 where the plate circuit is merely coupled, and more or less loose-

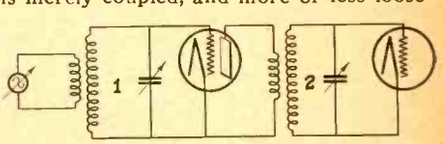


FIG. 11.

ly, to the tunable circuit 2 in the grid circuit of a succeeding tube, it is obvious that varying the coupled circuit 2 will cause it to produce in the plate circuit all the varieties of reactions produced by the directly inserted circuit 2 in Fig. 9, but less in magnitude in proportion to the looseness or percentage coupling. Thus, if the constants of circuits 1 and 2 are so chosen, and amplification is sufficient, that there is a substantial region of oscillations above the "oscillation line" in Fig. 10 for the arrangement of Fig. 9 (and in broadcast receivers the circuits are usually of suitable design and modern tubes of such amplification for this), then going to the arrangement of Fig. 11 will result in producing decreasing tendency to oscillate as the coupling is loosened, as pictured by curves b, c, and d in Fig. 10, curve d being shown to represent such looseness that regenerative amplification only, and no oscillation, is secured.

At first blush this might make it appear that it is easy to build a receiver that will not oscillate by merely using sufficiently loose coupling, but if the receiver is to cover a wide range of frequencies, as must a broadcast receiver, then the defect it would have is immediately obvious by turning back to Fig. 2 and observing the curve E_L.

An Inefficient Way

To be entirely free from oscillations the

Amplification Equalized

Decline of Comparative Energy on Higher Wavelengths Avoided By Combining Opposite Characteristics of Capacity and Inductance—System Neutralizes Independent of Tube Capacity.

receiver would have to have such loose coupling at the lowest wavelength (highest frequency) that it would not oscillate there, and then accept the substantial decrease in efficiency for the longer wavelengths illustrated by curve EL.

Some commercial broadcast receivers meet this situation by associating a part of the coupling element with the tuning condenser shaft so that coupling is mechanically simultaneously varied with tuning to keep up the efficiency throughout the broadcast band.

It might be well to consider this expedient from a practical point of view. The manufacturer might adjust his coupling in the factory with a given set of tubes and adjustments, such as 90 volts on the plate, so that it remains just below oscillations substantially uniformly throughout the broadcast range. Since the receiver is depending on regenerative amplification for its amplification, and a change in the amplifying ability of the tube does not change the regenerative amplification in direct proportion but in geometric ratio, the receiver will fall off enormously in efficiency as a 90 volt B-battery loses its voltage with use, or tube filaments lose their emissive power as they do only too rapidly, or there is other cause for loss of amplification.

Likewise, the fellow who is ambitious and wants to use 135 volts or more on his plates is out of luck, for all he will get will be oscillations.

Loss Between Stages

We stop here to answer a pertinent query, as follows: Being told that with a single regenerative tube amplification in the order of hundreds (sometimes stretched to a thousand) of times is had, why is it that in a radio frequency receiver having two stages just below oscillations, as just described, we do not get as an overall amplification the product of the hundreds of times obtained in each tube, namely, ten thousand or more times? The answer is simple and is found in Fig. 10, where it is clearly shown that maximum regeneration is had when circuit 2 is considerably out of tune, and though large energy is built up in the plate circuit there is no resonant transfer of it to the succeeding tube, which of course means extreme inefficiency and therefore waste of the regenerative effect. Also, to prevent oscillations the coupling in such a receiver must be quite loose, so taking together non-resonant transfer and loose coupling transfer, though there may be amplification to the extent of several hundred times in the plate circuit, an extremely small percentage of this is effective on the grid of the succeeding tube.

The Rice Method

This leads up to pointing out that in such a receiver the term "tuned radio frequency" when applied is a misnomer, for in fact the only circuit in the system tuned to the incoming radio frequency is the grid circuit of the first tube. The other radio frequency circuits are merely adjustable reactance producers, and when adjusted for maximum effect are out of tune with the signal frequency and grid circuit of the first tube.

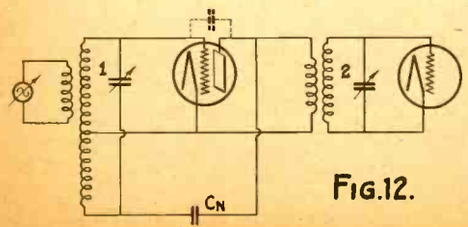


FIG. 12.

Pausing for a moment with the so-called Alexanderson tuned radio frequency patent (U. S. Patent 1,173,079), a search of it does not disclose any means provided for overcoming the defects outlined, so that it too works on the principle of one tuned circuit and succeeding circuits as reactance producers, and therefore out of tune. The claims specify all circuits as tuned but the provided system does not permit carrying out the specifications.

When Rice proposed (U. S. Patent 1,334,118), to destroy the effectiveness of the inherent tube path the first step towards actual tuned radio frequency amplification was taken. Even though belittled from some corners on the grounds that he only had "close coupling" and 100% coupling is necessary, his critics have simultaneously taught the construction of receivers having the range of 35% to 45% neutralizing coupling.

As to the operation of Rice, we show in Fig. 12 his system for neutralizing the troublesome inherent tube capacity used in a tuned radio frequency system. Obviously, when circuit 2 is varied the same cycle of reactions as heretofore described will obtain in the plate circuit with the same tendency to send amplified current to the grid in all phases as before through the tube capacity (in dotted lines), but these self-same reactions act in the same manner through the Rice neutralizing condenser C_n, but the upper and lower portions of the coil in circuit 1 being oppositely poled, the effects at the grid of the current going through C_n will be opposed to that going through the tube.

It only remains to make that going through C_n of such value with relation to that through the tube to wipe out the effect of this inherent tube capacity entirely, and this may be done by either adjusting the coupling between the upper and lower portions of the coil, or adjusting the value of C_n, or both. Having just merely the "close coupling" of Rice is no disadvantage, for variation of C_n to arrive at the complete result is a simple matter.

The critics contend that Rice cannot neutralize for more than one frequency because he hasn't 100% coupling. It is true that Rice is so limited, but not for the 100% coupling reason, but for a reason to which the system of the critics is also a victim, and that is lack of constant coupling between the coils with variation of frequency, so that both of them get a neutralizing result quite the same as the energy transfer effect illustrated in Fig. 2. Of course, if it were possible to get 100% coupling then it would be just that and constant coupling. But it

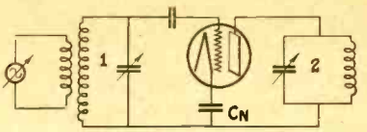


FIG. 13.

cannot be had so that any practical plain inductive coupling below the theoretical 100% will suffer from lack of constancy as shown in Fig. 2 whether in the 10% neighborhood or 90% neighborhood.

Rice vs. Armstrong

The contention seems to carry with itself the admission that all of the 35% to 45% neutralizing coupling receivers are free from regeneration at but a single frequency in the entire broadcast band, thus coupling them with substantially 100% to any patent that can be made to cover regeneration.

In his claims Rice defined his neutralizing system to include a capacity coupling between the grid and plate circuits "to prevent the generation of oscillatory currents," which brings up the technical consideration as to whether or not his definition distinguishes from the Armstrong patent, Fig. 1 for instance, which consideration is so instructive as to the reactions we have discussed that its analysis is helpful to a better understanding of these effects. We reproduce Armstrong Fig. 1 in its essential features in our Fig. 13 in which there is a variable condenser, which we mark C_n, in common to, and therefore coupling, the grid and plate circuits.

Before commenting on whether or not Armstrong stands between Rice and these claims let us see what are the affects of the condenser C_n on feedback. As before, varying the circuit 2 will produce of itself the cycle of plate circuit reactions we have previously pointed out, so that it will tend to produce oscillations in some of its adjustments, be neutral in one, and prevent oscillations in others, all as pointed out, but not by reason of being a coupling between two circuits, but rather by reason of producing a reaction to act through a coupling, namely, the inherent tube capacity.

Likewise the condenser C_n is in the plate circuit, in series with circuit 2, and this condenser of itself always produces a capacitive reaction in the plate circuit, no matter what its value, the capacitive reaction being simply large or small as C_n is small or large respectively.

Therefore C_n of itself always tends, by reason of being a mere series reactance element in the plate circuit, to feed current through the inherent capacity of the tube in such phase as to prevent regeneration and therefore oscillations; but, and let us make this clear, not by reason of being a capacity coupling between the circuits, as specified in the Rice claims, but by reason of being a mere series capacitive reactance element in the plate circuit; and it would continue to so act and to the same extent if it were taken out of its position common to the two circuits and put anywhere else in the plate circuit.

Whether or not it succeeds in actually preventing oscillations by this series reactance effect depends entirely upon how much reactance is produced with respect to the maximum inductive reactance that the circuit 2 is capable of producing when in that critical adjustment where the inductive reactance is a predominating

(*Continued on page 26*)

Scientific Groping Unmasking Waves

Mystery of Propagation, Outstanding Problem in Radio, Being Studied By Leading Experts—Brief History of Findings

By Leon L. Adelman

The Chas. Freshman Co., Inc.

The question, "What is electricity?" has been puzzling the world's greatest minds. Time and again explanations have been offered which even after heated argument and debate proved to be unsatisfactory.

Of as great importance are the questions "What are radio waves?" and "How are they propagated?" The first of these two questions has been answered. Maxwell, whose theory concerning the nature of light won for him undying fame, has defined radio waves as electromagnetic vibrations in the ether.

The question regarding the propagation of radio waves has been a puzzle to great minds.

Hertz Called Discoverer

To Heinrich Hertz belongs the credit for discovering and experimenting with radio waves. His experiments were made in the latter part of the nineteenth century. Although he was greatly handicapped by the lack of necessary apparatus, it is remarkable to note to what great extent he progressed.

Following Hertz were many other scientists who became eagerly interested in the subject. Among these was Sir Oliver Lodge. Elaborating on Hertz's experiments, Lodge invented the counterpoise, a system of wires underneath the antenna which replaced the ground connection. With this arrangement he found that he could get sharper tuning and more radiated energy.

At about the same time Marconi was experimenting with various antennas and grounds. A few years later, in the last month of 1901, using a wave length of approximately 1,800 meters, he was able to send the letter S over across the Atlantic.

High Waves at First

Before 1912 both experiments and calculations showed the advisability of using the higher wave lengths for distant communication. In fact, no one ventured below 600 meters, while the general tendency was to use 20,000 to 30,000 meters. Today, the short waves, as from 40 to 80 meters are the thing for distance.

One of the first of the striking phenomena that were noted was the difference between the so-called Hertzian wave and the electromagnetic radiations of the Marconi system. Hertz had noticed that when his radiated waves encounted an obstruction, a region of electrical shadow was left behind, analogous to the shadow of an opaque object interposed in a beam of light.

Marconi, on the other hand, found that lines of force were set up between the antenna and earth which, detaching themselves, became free waves grounded at their lower extremities, thus following the curvature of the earth. It was found, also that the surface of the earth offered no appreciable hindrance to the waves and that when an obstruction such as a hill or low mountain was reached, they passed up one side and readily glided down the other.

Why Water Excels

The conductivity of the earth has a direct bearing on the propagation of the waves. If the resistance of the ground is high, little absorption of the ground currents takes place, the earth loses its guiding influence and as a consequence, the waves become ungrounded, act like Hertzian waves, travel in straight lines and no longer follow the curvature of the earth. Thus, it is readily seen that distant transmission is best over water, the water being a much better conductor than the earth.

Another large factor which was very noticeable was the difference between daytime and night-time transmission. As we all know, much greater distances can be covered at night than during the daytime. Just why is this so? A plausible explanation is that the ultraviolet-rays from the sun ionize the upper atmosphere and thus cause considerable absorption of the radiated energy.

Precedent Upset

Recently, upsetting all precedents, it has been established as a positive fact that daylight communication on 20 meters is much better than night-time communication on other wave lengths.

Sommerfeld, in his theoretical investigation, found that there must be two kinds of waves set up simultaneously by a transmitter,—space waves, which travel freely in space, and surface waves, which move only along the surface of the earth. As a consequence, Heaviside, in 1901, propounded this theory. Somewhere in the upper regions, perhaps at an elevation of 100 miles, there exists a well defined stratum, or ionized layer, acting as an excellent conducting surface. As soon as a wave leaves a radiating system, it travels upward toward the conducting layer as well as along the surface of the earth. The space wave on striking the ionized layer is reflected back to earth, but having a greater distance to travel arrives at the receiving station out of phase with the gliding ground waves and hence interference or fading occurs. Heaviside asserts that the ionized conducting layer serves as a shield and reflector, returning the waves to the earth. If this is the case interplanetary communication is virtually out of the question.

In the main the argument among scientists seem to center about the manner in which the waves are guided around the earth, whether by the conductivity of the earth's surface or by the reflection from the Heaviside layer.

Short Space Waves

Meissner, working along the hypothesis suggested by Sommerfeld and bearing in mind that both the space waves and earth waves must be in some way connected, found that the space waves are predominant in the short wave lengths and that the ground waves are stronger in the long wave lengths.

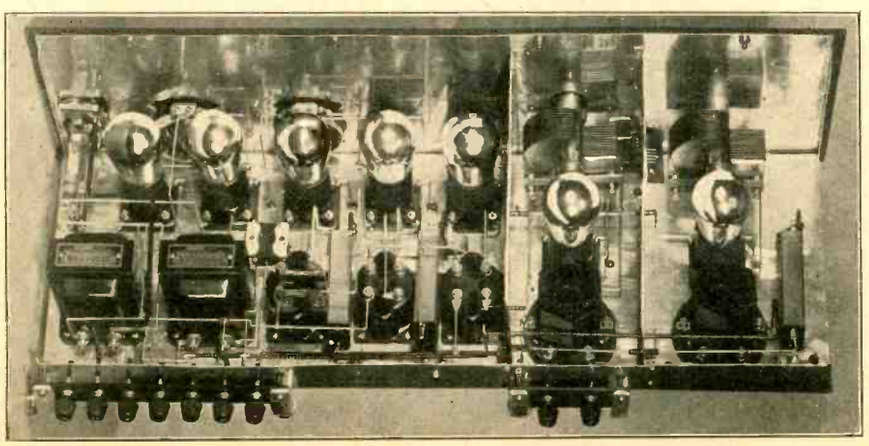
In transmission over short distances and particularly over water, the surface waves are to be counted upon as of greater importance, chiefly because the surface is a good conductor. Over long distances, however, the earth waves may be absorbed, leaving only the space wave component. Thus, for extremely long distances the signal strength may remain constant, little or no interference taking place at the receiving station. Is it, then, permissible to concede that the degree of fading depends upon the wave length and the distance?

It would be well to compare the electromagnetic vibrations in the ether known as light with those known as radio. Their only difference, as far as is known, is in their wave length, a frequency. Whereas, in the space of one second there can be from 10,000 to as many as 60,000,000,000 vibrations (corresponding to a wave lengths of from 30,000 meters to half centimeter, the extremes of range which it has been possible to obtain to date) it is conceded that the average value of light vibrations lies in the neighborhood of 600,000,000,000,000 per second. This is 10.000 times the frequency of the shortest radio wave produced!

Was Einstein Right?

However, as both are vibrations in the ether, it stands to reason that they should follow the same laws. Unless one

A SHIELDED SUPER-HETERODYNE



A GOOD MODEL for a 7-tube Super-Heterodyne is shown in the photograph. Only two intermediate stages are used, instead of the more conventional three. Note that shielding is employed. The panel rear has a metal lining, also the modulator circuit (at right) is shielded from the oscillator which adjoins it, and the oscillator is shielded from the intermediate channel. The shielding is completed by soldering a copper lid on the two compartments at right and on the rear, where the "walls of copper" rise. The set was built by W. C. Breeden, c-o P. O. Box 493, New York City.

cares to follow Einstein, light travels in straight lines and is subject to reflection, refraction, absorption, diffusion, etc. Scientists know the causes of these various phenomena, but when such actions affect radio waves we are at a loss to give a satisfactory explanation. Sir Joseph Larmor, whose work on the electromagnetic theory and other physical manifestations is recognized by all scientists, has shown by an elaborate analysis that the simple explanation of the Heaviside layer is not the best.

He actually proves that the Heaviside layer would not act like a mirror but that a radio wave on encountering a sufficient quantity of electrons to render the atmosphere conducting would suffer so great a diminution that it would be damped out or absorbed in the space of a few miles. Larmor's theory is that refraction bends the waves around the earth.

As is well known, light is composed of different frequencies ranging from the infra-red to ultra-violet. The shorter waves, those near the ultra-violet rays, are bent or refracted more than the longer ones, as experiments with a prism will readily show.

Analogous to this, Larmor contends that the shorter radio waves are bent more than the long, consequently they lie nearer to the earth's surface. This perhaps may explain why short-wave transmission on low power is so successful over long distances.

Dr. Rogers, who invented the underground antenna, proves conclusively that radio waves depend upon earth conduction for their propagation. In numerous experiments he has found that signals were in no way interfered with by static or atmospheric conditions, that no fading occurred, that signal intensity was greater than with the ordinary antenna, and that there was no rise or fall in signal strength regardless of whether it was day or night, Summer or Winter. Because of these facts Dr. Rogers believes that the space waves encounter much resistance in the atmosphere and thus die out after a relatively short distance, while the earth currents persist and are responsible for the long range.

Announcers Study to Gain Smoothness; Need Know Music

The daily routine of the announcer varies with different stations, just as the announcer policy of stations differ. WGY has always been known for its dignified, reserved announcements. Words are not wasted and the form of the announcement is usually well thought out in advance and correctly spoken. The announcers at WGY assist in the preparation of programs, write their announcements, give hearings to prospective performers and also in many cases build up the actual program. Each announcer of the WGY staff is a musician and if called upon can give a creditable performance. Occasionally special programs are offered by the announcer staff and these are among the most popular offered by the Schenectady station. For example the Georgia Minstrels, the farm night programs, the Radio Four offerings are all presented by members of the studio staff.

NO MUSIC FEE LEGISLATION

WASHINGTON.

Congress adjourned without passing any copyright amendment. Thus the quarrell between the broadcasting stations and the American Society of Composers, Authors and Publishers will be renewed when Congress meets again in December.

No Place on the Air for Creed of Hate

"If a Man Has Not a Good Word to Say, Let Him Be Silent," Carroll Advises—Guile Is Shadow on Radio

By James H. Carroll

Radio has grown so close to the hearts of us Americans and has come to mean so much in our national home life that it has at last reached a new and commanding status. Almost overnight we have come to realize that it is a necessity, and, what is more, something to be cherished, and, also from present conditions, something to be protected. There is a serious condition confronting us and one that should be faced firmly and settled once and for all.

This is the sinister shadow of vicious propaganda—and vicious propaganda to set race and creed and nationality one against the other. There is only one kind of propaganda that should be allowed and that is the teaching of brotherlove, unselfishness and the upbuilding of American ideals, patriotism and love for the flag. With the unsettled condition of the minds of the people and their striving for the light, this kind of propaganda is sadly needed at the present time.

Instead of that, what have we? One religious denomination belittling another, and picking it out for bitter attack, sowing the seeds of unrest and hate. And then on the other hand, we have several brands of bigotry, race hatred and demagogism served to us, disguised, thickly or thinly as the case may be, in the guise of entertainment. Of course, we have the remedy of tuning them out, but to the untrained ear much harm may be done—as much, or more, than can be done by disguised pernicious literature. But that is not the question. Why have it at all, when so much real good can be done?

If a religious denomination or group wishes to broadcast its services or lectures, let it be done openly. There is nothing more beautiful than a religious service and a man of any faith can learn something good from listening to the service. Any religion is useless unless one observes its tenets to the utmost, and there is nothing in the tenets of any religion that preaches malice, bigotry or race hatred.

Politics must also be kept out of broadcasting and out of radio as a field for trickery and advancement. If, at election, a candidate wants to broadcast a speech as paid advertising that should be allowable if so announced. But if a politician wants to debate or make an attack on an opponent, the opponent should be granted the privilege of answering him over the same station on the same night.

Radio as a whole must also be kept out of the hands of politicians or parties, classes or cliques. The national government must be brought to realize the importance of radio as a factor in national life, as a means of entertainment and education, and the power of the united radio fans and listeners of the nation.

Bitterness and strife must be kept off the air—only wholesomeness and cheer should be the background for the splendid programs that we are enjoying daily. If a man has not a good word to say, let him be silent. If he have spleen in his system let him follow the example of Socrates and with a mouthful of pebbles go down to the beach and mumble it there. The "mike" is not for such.

The "gate" should also be opened for those who have something to "put over." If we have a message to deliver, let us give it straight, without "applesauce," without guile. The American public likes fair dealing; it likes to get its punch straight from the shoulder. At least, the better element does, and this element is represented en masse by the radio listeners.

At present this is the only real shadow on radio.

RIGHT BATTERIES

(*Hayden*)

THE NEW 171 power tubes require high B voltage. Although the application of a high grid bias tends to keep down the B drain, it is still too high for batteries, unless parallel connection is used or layer-built B batteries.

WLW Prepares For Super-Power

WLW, Cincinnati, has ordered equipment to enable it to use 50,000 watts for broadcasting, putting it on a par with WJZ as a super-power station. WGY, Schenectady, is considering trying 500,000 watts next Winter.

WITH THE AMATEURS

HONOLULU, T. H.

When officials in the local office of one of the commercial radio companies wanted to send greetings to the staff of the company's Johannesburg office, at South Africa, they found themselves unable to do so, due to their inability to establish direct communication with the Johannesburg station. At this point, however, a local amateur, Masayuki Hismato, operator of station 6CLJ, volunteered his assistance, and in a few hours the message had been delivered in South Africa through a Johannesburg amateur with whom Hismato maintained regular schedules.

How to Wire Up the Improved BROWNING-DRAKE

[Part I of this article, with wiring diagrams, was published last week, issue of August 14. The wiring directions are given in full this week. Operating data will be published next week.]

By Herman Bernard

Associate, Institute of Radio Engineers

ASSUMING an 8x22" panel, preferably Bakelite, as is the decorated type, the shaft line is 4½" up from bottom, hence 3½" from top. This location improves tuning convenience. On the line for the shafts, C1 is mounted 3" from left and C2 is 3" from right. The switch is 5⅞" from left. while the tickler knob (¼" hole) locates itself 5⅞" from right of panel. The Tate bracket holes are ½" and are 2" from top and bottom, respectively, making four holes, two on each side, ½" from side edge and 2" from top and bottom. As the baseboard is fastened to the brackets, the panel is completed when drilled for the aforementioned holes. The official panels are already drilled.

Now mount the six panel parts—two condensers, C1 and C2; tickler knob, switch, S; and two brackets. Next affix the baseboard to the other arms of the brackets with wood screws. A space of 1¼" is left between baseboard front and panel rear.

It will be found that the baseboard just slides underneath the 3-circuit coil L3L4L5 so that the baseboard slightly helps support the coil.

Baseboard Assembly

Turning the outfit around, so that the panel is farthest from you—a position assumed throughout, from this point on—proceed to locate the instruments in position.

STEP 1.—Put the five sockets in a row, with arrow to the left rear. Thus the minus hole in the socket is nearest you, the plate hole at the opposite side, grid to left and plus to right. The outside socket mounting holes are ½" back from rear edge of baseboard and are, right to left, distant from baseboard right as follows: 6½", 8⅜", 10¼", 12⅛" and 14". Drive wood screws through the socket mounting holes at these points. The other socket mounting holes locate themselves.

STEP 2.—Locate the single mounting for the filament resistor R7 with its mounting hole 3½" from right and 1⅛" in. A double mounting is located 4½" from left and 1⅛" in. This is for R1 and R2. The fixed bypass condensers C4 and C5 are located just to the left of this double mounting. Now remove the baseboard from the brackets.

STEP 3.—Locate the audio transformer PBFG ½" from long panel edge of baseboard, with P and B posts at left, nuts on these posts 6¼" from baseboard left.

STEP 4.—Fasten the 4.0 mfd. condenser C8 with four flush lugs at bottom and the two connection lugs at top left. The right side of C8 is 5¾" from baseboard right.

STEP 5.—Put the 0.1 mfd. condensers C6 and C7 in alignment 3-8" back from sockets, so that C6 is centered in respect to the P post of socket 3 and the G post of socket 4. Likewise locate C7 in respect to these posts on sockets 4 and 5.

STEP 6.—Place two double mountings at right angles to C6 and C7, with lugs ¼" from these condensers. The mounting holes are 4⅜" back and respectively 10¼" and 12¼" from left.

STEP 7.—Locate the filter choke FC with binding posts facing you and put it between PBGF and C8, equidistant from both.

(Foto Topics)

FIG. 4

The power tube is the large bulb and is second from left as one looks toward the front panel. The photo shows this point being made at the Haynes-Griffin radio store in West Forty-third Street, New York City, where many admired the exhibition set, shown on opposite page in detail

Wiring Directions

A little of the assembly will be taken care of as part of the wiring.

Restore panel to baseboard.

STEP 8.—First wire the filaments. Connect the + post of socket 2, extreme left-hand socket, to the minus post of its neighbor, socket 3, second from left. Connect the plus post of socket 4, third from left, to the minus post of socket 1, extreme right-hand socket. Join the right-hand side of R7 to the GN post on L2 (designated GN on the coil) and to the left-hand binding post of C1 and to one side of the switch S. Continue this lead to the minus post of socket 2 (extreme left) and to the minus post of socket 4 (third from left). Connect together the plus posts of sockets 1 (extreme right) and 3, (second from left). Continue this lead to the plus post of socket 5 (second from right). Join the open side of R7 to F minus on socket 5 (second from right).

STEP 9.—Place in position the bracketed antenna-ground strip and the bracketed battery strip. The antenna-ground one is at right, edge 1" in from right, the other with edge 1" from left. The strips extend 1¼" from baseboard.

STEP 10.—Connect the Ant. post on the strip at right to the A2 post of L2 (designated A2 on the coil). Connect ground post to the rear side of the right-hand lug on the R7 mounting. This lead previously was carried to GN, etc. Connect the A1 post on coil to the central binding post on C1. Remove nut from G post of right-hand socket (1) and place lug of NC thereon; also the lead continued from the central condenser post (C1). Let CN be at right angles to the baseboard length. Wire the other end of CN by a long high lead to the left-hand upper post of L4.

STEP 11.—Join the plate post of socket 1, extreme right, to the middle left-hand lug of the detector coil arrangement (L3). This lead may be partly parallel to the CN lead, but at least 1½" lower. The lower left-hand lug of the detector coil outfit (L3) goes to one side of the adjacent condenser C4 and one side of the double mounting (the lug at right rear). Remember that "rear" means nearer the panel. The other side of C4 and of this section of the mounting goes to the adjoining lug on the other section of this mounting and to one side of C5 and on to B Amp. +, a binding post on the strip. The other side of C5 and of the incompletely wired mounting section goes to the B post of the audio transformer PBGF.

STEP 11.—Solder a short right angle bus lead to one side of the grid condenser C3 and loop the wire to enable the free end to be fastened to the G post of socket 2 (extreme left) by tightening the nut. Connect the other side of C3 to the right rear lug for L4 and join to the right-hand binding post of C2. Connect the left-hand binding post of C2 to the coil lug at left rear (L4). Bring the rotor plate connection of C2 to positive by carrying a wire from the screw at upper right rear of C2 to the common joint of F+ and F— of sockets 2 and 3 (extreme left and second from left.)

STEP 12.—The plate post of socket 2, extreme left, goes to the right-hand under lug of the detector coil system (L5, tickler) and the upper post at right goes to the P post of PBGF.

STEP 13.—G of PBGF goes to the grid post G of socket 3, second from left, while F of PBGF goes to minus A.

STEP 14.—Connect P of socket 3, second from left, to one lug of C6, right above binding post of socket, and other C6 lug to grid of next socket, 4. Also, P of socket 4 goes to one lug of C7 and the other C7 lug to G of socket 5 (second from right.) These condenser lugs are connected also to the mounting lugs directly underneath.

STEP 15.—Join the right-hand lugs of the mountings and carry on to B of FC (choke coil) and to the B Amp. + lead at left of the previously wired mounting (near detector coil.)

STEP 16.—Connect P of socket 5 (second from right) to P post of CH and to one lug of C8 (4.0 mfd.).

STEP 17.—Join the right hand rear lug of mounting at left (near PBGF) to the F post of PBGF and right hand rear lug of mounting at right (only remaining free lug) to C Bat.—on strip.

STEP 18.—Join free lug of C8 to spring of SCJ. Connect from SCJ to A Bat—on strip and to open side of switch S. Connect + post of socket 3 (second from left) to A Bat + on strip.

Insertion of Resistors

Put R7 (Brach-stat) in mounting at right, near antenna strip. Put R2 (Lynch resistor, .09 meg.) in mounting clips nearer battery strip and R1 (.025 meg.) in clips nearer detector coil. Put grid leak R8 (6.0 meg.) in grid condenser clips. R3 (0.1 meg.) goes in left-hand clip behind left-hand upright fixed condenser C6, while R4 (0.5 meg.) goes in adjoining clips. The two remaining 0.1 meg. resistors are placed in the unoccupied clips.

Battery Leads

A Bat—binding post goes to the 6-volt A battery minus post, A Bat. + binding post goes to the positive (+) post of the A battery, usually red, and also to B battery minus and to C plus. (See Fig. 2, page 5, August 14 issue.) Note the common connection, battery to battery, of A+, B— and C+. C minus goes to bat-

(Concluded on page 25)

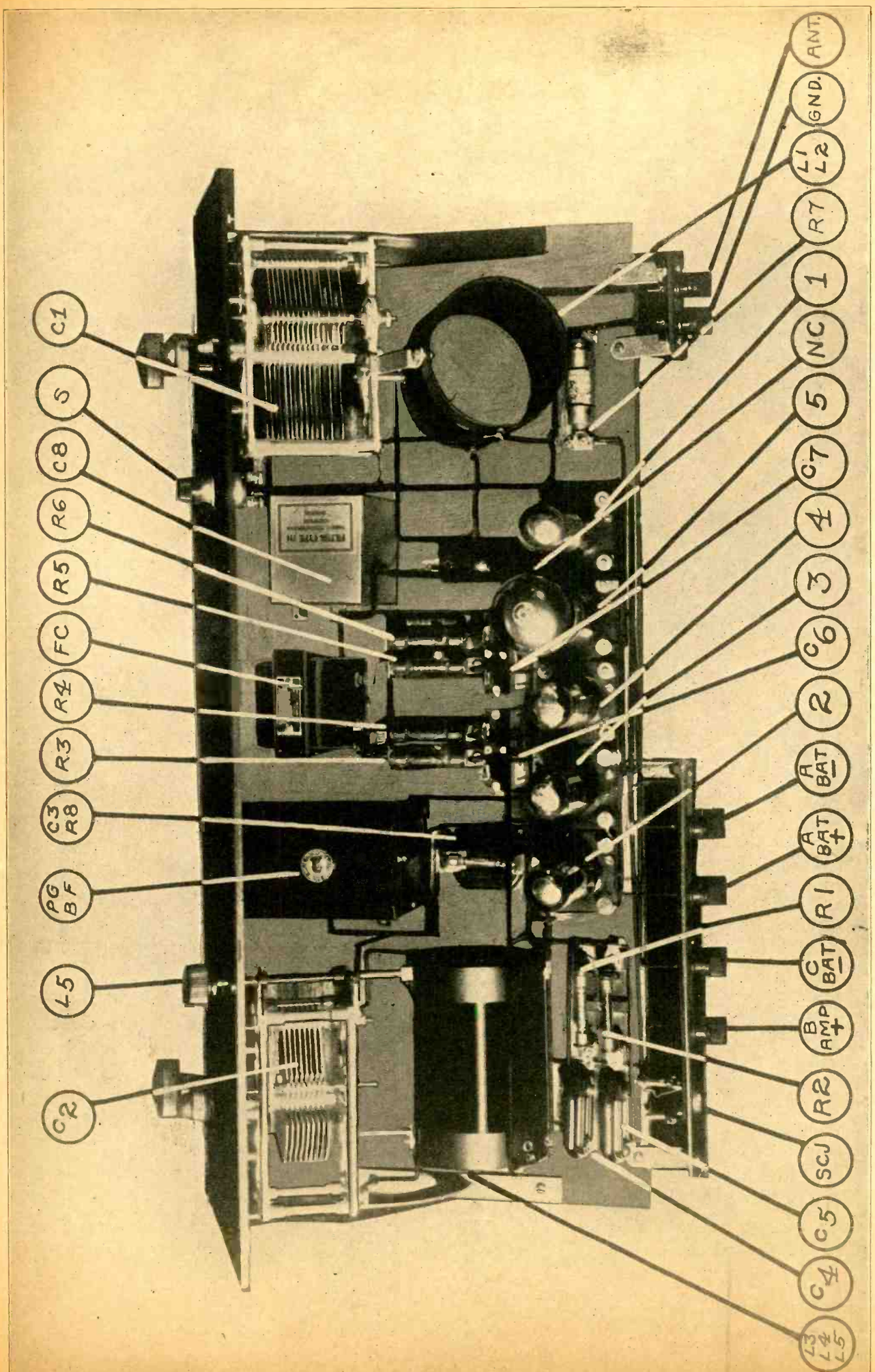


FIG. 5 The Location and Identification of the Assembled Parts of the Improved Browning-Drake

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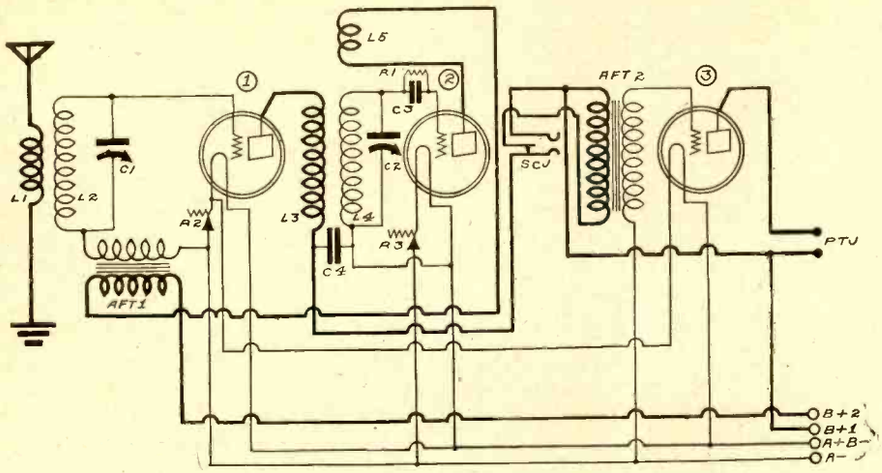

FIG. 412a
The electrical diagram of the Crosley Trirdyn, 3-tubes, 3-controls.

PLEASE PRINT the circuit diagram of the Crosley Model 3R3 Trirdyn, stating the approximate constants. A wiring description, in so far as the RF and the Det. tubes are concerned, is desired, also. —Manual Connely, Mississippi, Mo.

Fig. 412a shows the circuit diagram of this receiver. The first tube acts both as an RF and AF amplifier. The detector is regenerative, the 3-circuit tuner idea being employed. A separate rheostat controls the filament temperature of the detector tube, while the filaments of the RF-AF and the AF tubes are controlled by a single rheostat. L1 may consist of 15 turns, while L2 may consist of 45 turns. The secondary is first wound, a few pieces of Empire cloth separating them, and the primary wound. A tubing 3" in diameter and No. 22 double cotton covered wire is used. This same kind of wire is used in winding the primary and secondary of the tuner. L3, the primary of the tuner, consists of 8 turns. The secondary consists of 45 turns. These are wound in the same fashion as the primary and secondary of the RFT. The tickler consists of about 26 turns of No. 26 SCC wire. C1 and C2 are both .0005 mfd. variable condensers. C3 is a .00025 mfd. grid condenser. R1 is a 2 megohm grid leak. The first AFT should be the 6-to-1 ratio, while AFT2 is of the 3-to-1 ratio, etc. C4 is a .002 mfd. fixed condenser. A single circuit, closed jack is used at the output of the detector stage, while phone tip jacks or tips are placed at the output of the AF amplifier. It will be noted that there are three controls in this set, each of which is critical, requiring care of adjustment. No external neutralization is used. The beginning of the primary winding L1 is connected to the antenna post. The end of this winding is brought to the ground. The beginning of the secondary winding is brought to the G post on AFT1 and to the rotary plate post of C1. The stationary plate post of this condenser is brought to the G post of the first socket, which will carry the RF-AF tube. The F post on this AFT is brought to the A minus post. The beginning of the primary winding L3 is connected to the P post on the first socket. The end of this winding is brought to the bottom terminal of SCJ and to one terminal of C4. The other terminal of this condenser is connected to the beginning of the secondary winding L4, to the rotary plate connection of C2 and to the F plus post on the socket. The end of this secondary winding is connected to the stationary plate post of C2 and to one terminal of the leak-condenser combination. The other terminal of this combination is brought to the G post on the second socket. The beginning of the plate winding L5 is connected to the P post on the socket. The end of this winding is connected to the P post on AFT1. The B post on this AFT is connected to the B plus 67½ volt post (B plus 1). The second terminal from the bottom of SCJ is brought to the P post on AFT2. The B post on this AFT is brought to the top terminal of SCJ and to the B plus 2 post (90 volts). When the plug is inserted in this SCJ, the connection between the bottom and the center prong is broken. This disconnects the AFT. However, when the plug is taken out the contact is again made. The AFT is then placed in the detector output circuit. A double circuit jack may be used for convenience of connections, if the other proves confusing. Using this latter jack, the two inner prongs are brought to the P and B post of the AFT, while the outer posts are brought to the end of the tickler and B plus post. The -01A tubes are used throughout.

* * *

IN THE Radio University columns of the August 14 issue of RADIO WORLD there appeared a wiring description of a 4-tube receiver, employing two steps of tuned radio frequency amplification, a non-regenerative detector and one stage of transformer coupled radio frequency amplification. The first stage of RF amplification was reflexed. However, being a novice, I do not quite understand these directions. With the aid of diagram I believe I will have no difficulty. Will you please, therefore, print a diagram, stating the constants of the coils, condenser, etc.—Burris Watkins, Alba, Tex.

Fig. 412 shows the wiring diagram of this receiver. L1 is the continuous antenna winding. L2, L3 and L4, L5 are the primary and the secondary windings of the radio frequency transformers. C1, C2, C3 and C4 are the .0005 mfd. variable condensers. AFT1 is the 6-to-1 ratio audio frequency transformer. AFT2 is the 3-to-1 ratio audio frequency transformer. R1 is the 10 ohm rheostat. R2 is the ¼ ampere ballast resistor. R3 is another 10 ohm rheostat, while R5 is a ¼ ampere ballast resistor. A .00025 mfd. grid condenser is used. R4 is a 2 megohm grid leak. SCJ is the single circuit jack. S is the filament switch. B plus 1 equals 45 volts, while B plus 2 equals 90 volts. The -01A tubes are used throughout, with a 6 volt A battery for filament supply.

* * *

I AM told that by inserting a C battery in the grid circuit of the second detector in a Super Heterodyne, the selectivity of the set may be increased. Is this correct? Exactly where should it be placed? — Henry Silver, Tacoma, Wash.

Yes, to a certain extent. The C battery should be variable from 4½ to 16. This should take the place of the grid leak and condenser. It may be applied to either the first or second detector circuits.

* * *

WHAT IS a 500 micromicrofarad variable condenser equal to in mfd? (2) What is a 350 mfd. variable condenser equal to in microfarads?—Kendall Hirsh, Washington, D. C.

(1) A 500 micromicrofarad condenser is equal to .0005 mfd. (2) A 350 mmfd., which is the abbreviation for micromicrofarad, is equal to .00035 mfd.

* * *

I HAVE a 3-circuit tuner 3-tube receiver, with which I am troubled with body capacity. The condensers, coils are all of the low-loss type. What can I do to remedy this trouble?—Borden Pringle, Jersey City, N. J.

Check over the secondary connections. See that the beginning of the secondary winding, or that nearest the ground is connected to the filament or grid return, while the end of this winding is connected through the grid condenser and leak to the grid.

See that the rotary plates are connected to the filament circuit. Keep the grid and plate leads away from the panel. Keep the lead going to the plate of the detector tube from the tickler away

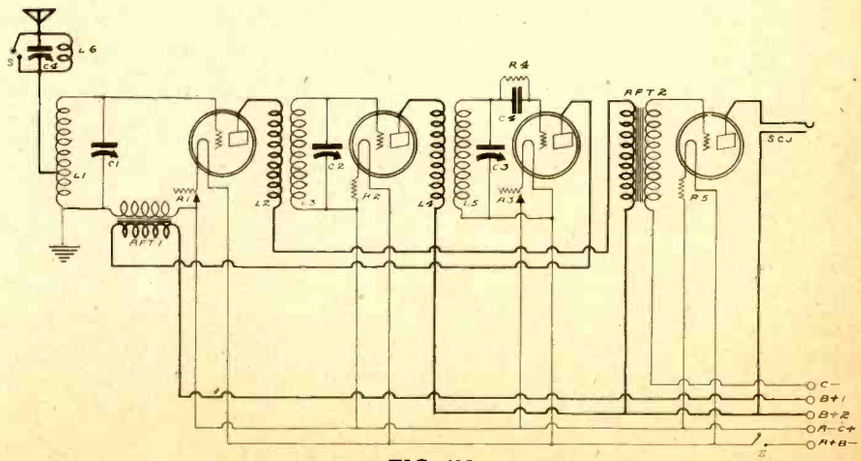

FIG. 412
The electrical diagram of the set described in the August 14 issue of RADIO WORLD in the Radio University columns.

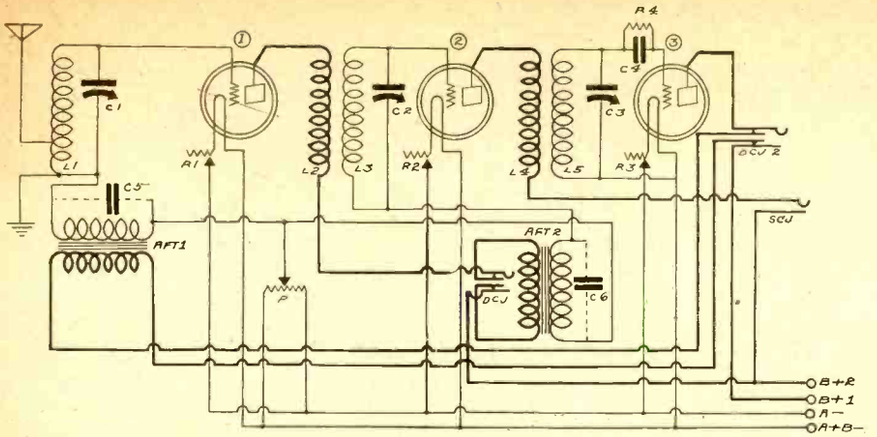

FIG. 413
The circuit diagram of the 3-tub reflex, wherein three tubes do the work of five.

from the shaft. Do not run the antenna and ground near the front of the panel or parallel to each other.

* * *

PLEASE DESCRIBE the construction of a single grid leak, using Indian Ink as the resistance.—Charles Burches, Pasadena, Cal.

Obtain two pieces of cardboard, 2" in length and 2" wide. Make a ½" heavy line with the Indian Ink on one of the cardboards. Lay this aside. Punch a hole in the center of the other piece of cardboard. Cut out some thin copper stripping about 2" in length and 1" wide. At one end punch a hole. Place this in the hole punched in the cardboard. Run a small flat head screw, about ¼" long, with a nut through this bolt, tightening the hold on the copper. Lay the cardboard so that the flat head is on the inside. Now punch two holes on both the cardboards. Run small eyelets through. Flatten down. so that the copper strip makes contact with the heavy line and also so that the copper strip can be moved about. A small knob can be attached to the screw. This allows easier adjustment of the resistance. One terminal contact is made through the knob, while the other contact is made through one eyelet attached to a lug. The other eyelet should not touch the resistance.

* * *

I WOULD appreciate having the circuit diagram of a 3-tube receiver wherein the first second tubes act both as RF and AF amplifiers. That is, the three tubes should do the work of five. Rheostats should control the filaments of the three tubes. Double circuit jacks should be placed at the output of the first and third tubes and a single circuit jack should be placed at the second tube output, so that I may listen to the output of each of these stages. Please state the constants of the parts. I know this set will be difficult to wire, so may I have a wiring description to ease up maters?—Joshua Meyers, Long Beach, N. Y.

Fig. 413 shows the electrical circuit diagram of this receiver. L1 is a continuous winding antenna coupler, consisting of 50 turns of No. 22 double cotton covered wire, wound on a tubing 3" in diameter. A tap is made at the 8th turn from the beginning of the winding. L2 and L4, the primaries of the radio frequency transformers, consist of 10 turns would on a tubing 3" in diameter. The secondaries L3 and L5 are also wound on the same tubings as the respective primaries. The secondaries consist of 45 turns. A ¼" separation is left between the two windings. No. 22 dcc wire is again used. The filaments of the tubes, which are of the -01A type, are each controlled by 20 ohm rheostats. Both the transformers, AFT1 and AFT2 may be of a high ratio type (6-to-1). The potentiometer is of the 400 ohm type. The secondaries of the RFT are shunted by .0005 mfd. variable condensers, C1, C2 and C3. C4 is a .00025 mfd. grid condenser. R4 is a 2 megohm grid leak. DCJ1 and DCJ2 are double circuit jacks. SCJ is the single circuit type. As to the wiring: The antenna post is connected to the 8th turn tap of L1. The beginning of this coil is connected to the ground, to the rotary plate connection of C1 and to the G post of AFT 1. The end of this coil is brought to the grid post of the first socket (first RE-AF tube) and to the stationary plate post of C1. The F post on AFT1 is connected to the arm of the potentiometer and to the F post of AFT2. One resistance terminal of the potentiometer is connected to the plus post of the A battery, while the other resistance terminal is connected to the minus post of the A battery. In this way it is possible to vary the grid bias of these tubes. It also controls the oscillatory action of these tubes. The P post of AFT1 is connected to 2nd inner terminal from the top of DCJ1. The third terminal from the top of this jack is connected to the B post on this AFT1. The posts of the three rheostats, R1, R2 and R3, which are connected to the arms, are connected to the A minus post. The resistance wire posts of the three rheostats are connected to the F minus posts on the three respective sockets. This means that the rheostats are connected in the negative legs of three tubes. The F plus posts on these sockets are connected together and thence to the A plus B minus post. The P post on the first socket is connected to the beginning of L2. The end of this winding is connected to the top terminal of DCJ2. The first inner terminal of this jack is connected to the P post on AFT2. The second inner post (third from top) is connected to the B post on AFT2. The bottom terminal of the jack is connected to the B plus 90 volt post (B plus 2). This same connection is extended to the bottom terminal of SCJ. The top terminal of this jack is connected to the end of L4, the beginning of which is connected to the P post on the second socket (2nd RF-AF tube). The beginning of the secondary L3 is connected to the G post of AFT2 and to the rotary plate post of C2. The end of this winding is connected to the stationary plate post of C2 and to the G post on the second socket. The beginning of L5 is connected to the rotary plate post of C3 and to the F plus post on the socket. The end of this winding is connected to the stationary plate post of C3 and to one terminal of C4R4. The other terminal of this combination is brought to the grid post on the third and last socket. The plate post on this socket is connected to the top terminal of DCJ1. The bottom terminal of this jack is connected to the B plus volt post (B plus 1). C5 and C6 optional condensers of the .001 mfd. fixed type, may be shunted across the secondaries of both AFT. The filament control in this set is not critical. The three dials should read alike, if the proper secondary turns are used.

* * *

PLEASE PUBLISH the circuit diagram of the new Harkness reflex, wherein the first tube is neutralized, stating the constants and giving a wiring description.—Charles Peterson, Buffalo, N. Y.

Fig. 414 shows the electrical diagram of this receiver. L2 and L4, the secondaries, consist of 50 turns of No. 24 double cotton covered wire, wound a tubing 3" in diameter. L3, the primary, consists of 15 turns. This is wound on the same tubing as the secondary L4, with a ¼" separation between the two. In the old type receiver, the primary winding L1 was included. This is shown by the dotted lines. However, in the new receiver, a .00005 mfd. variable condenser, C1, is used to induce the energy from the antenna to the secondary and grid. C5 is a .0001 mfd. fixed condenser. C6 is a neutralizing condenser, having a maximum capacity of .00004 mfd. C2 and C3 are .0005 mfd. variable condensers. R1 is a 10 ohm rheostat, which controls the filament temperature of the RF-AF and the AF tube. The filament temperature of the detector tube is controlled by a 20 ohm rheostat, R2. C4 is a .00025 mfd. grid condenser. R4 is a 2 megohm grid leak. R3 and R5 are variable grid leaks used to control volume. The audio frequency transformer used in the reflex stage should be of the high ratio type. The AFT used in the regular stage is of the low ratio type. It is preferable to use the -01A type of tube, so as to obtain maximum volume output. SCJ indicates the single circuit jack. The antenna is brought to stationary plate post connection of C1. The rotary plate post of this condenser is connected to the grid post of the first tube, to the end of the secondary winding L2 and to the stationary plate post of C2. The beginning of this winding is brought to the rotary plate post of this variable condenser, to the stationary plate post of C6, to one term-

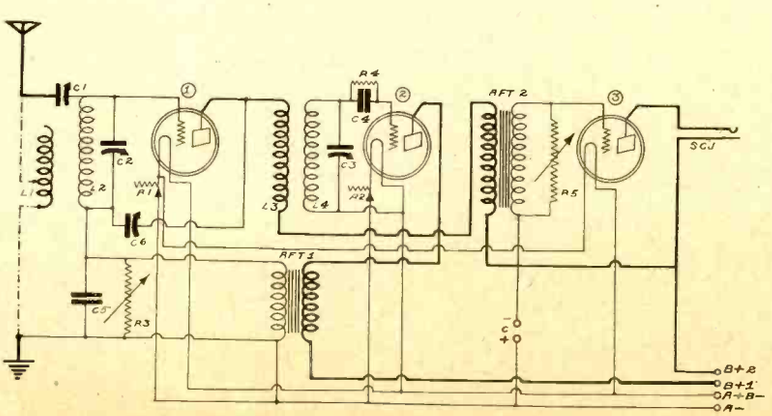

FIG. 414
The electrical diagram of the new neutralized Harkness reflex.

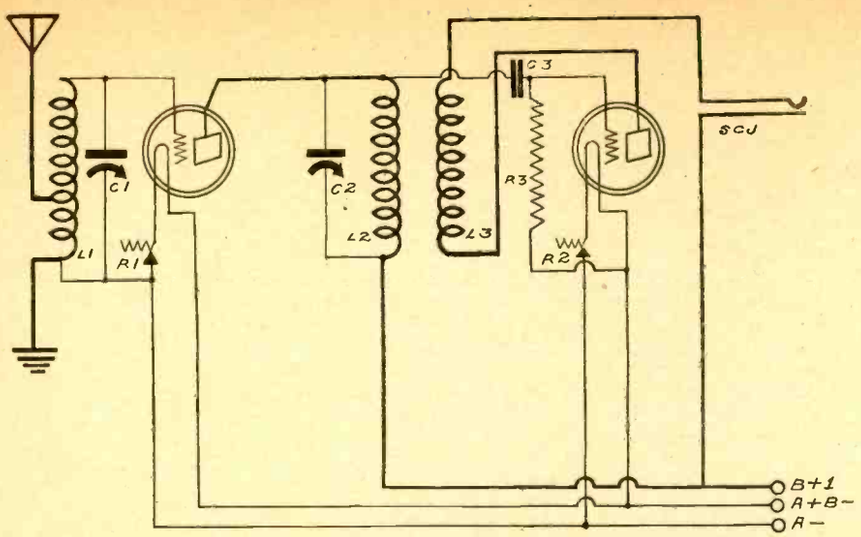

FIG. 415
THE CIRCUIT diagram of the 2-tube impedance regenerator.

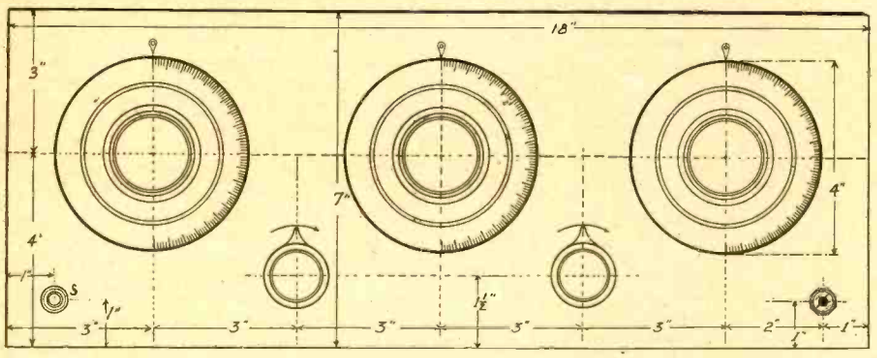

FIG. 416
THE PANEL layout for the impedance regenerator.

inal of C5, to the grid terminal on AFT1 and to one terminal of R3. The rotary plate post of C6 is connected to the P post on the first socket. This same connection is also brought to the beginning of the primary winding, L3. The end of this winding is brought to the P post on AFT2. The other terminals of R3 and C5 are connected to the F post on AFT1 and to the A minus post. The F minus post on AFT2 is connected to a C minus post. The B post on AFT2 is connected to the bottom terminal of SCJ and to the B plus 90 volt post. The beginning of the secondary winding L4 is connected to the rotary plate post of C3 and to the F plus post on the socket. It is also connected to the F plus post on the last socket, which holds the AF tube. The end of L4 is connected to the stationary plate post of C3 and to one terminal of C4 and R4. The other terminal of this combination is brought to the grid post of the second socket (detector tube). The plate post on this socket is brought to the P post on AFT1. The B post on this AFT is brought to the B plus 45 volt post (B plus 1). The G post on AFT2 is connected to the grid post of the last socket. The plate post on this socket is connected to the top terminal of SCJ. The grid post on this socket is also connected to one terminal of R5. The other terminal of R5 is connected to the C minus post, which has already been connected to the F post on AFT2. When connecting these resistances, be sure that the arm is brought to the low potential points, while the resistance points are connected to the high potential points (to grid). The F minus posts of sockets 1 and 3 are connected together and thence to the resistance wire post of R1. The arm of this rheostat is connected to the A minus post. The resistance post of R2 is connected to the F minus post on the second socket. The arm of this rheostat is connected to the A minus post. If you should wish to use the primary winding, L1, it will consist of 15 turns wound on the same tubing as the secondary L2 using No. 22 dcc wire. This is tapped at every fifth turn. Both variable condensers should tune in step. Before adjusting the neutralizing condenser, a loud howl will be heard, when the station is tuned in, which can be killed by the condenser.

* * *

I HAVE a variocoupler having a 3 in. stationary form and a 1¾ in. rotary form, which I would like to place into a 2-tube receiver, employing a regenerative RF and detector tube. A diagram, wiring description with constants of parts, and panel layout of such a receiver are requested. I also have a .00035 mfd. variable condenser and a .0005 mfd. variable condenser which I would like to use.—Norton Mellert, Far Rockaway, N. Y.

The circuit diagram appears in Fig. 415, while the panel layout is shown in Fig. 416. The tuned impedance method coupling is used. The stationary winding L2 is used to couple the input of the detector circuit to the output of the RF tube, while the rotor L3 is used to obtain a regenerative action from the detector tube. L1 is the antenna coupler and consists of 65 turns, tapped at the 10th turn from the beginning of the coil. It is wound on a tubing 3 in. in diameter, using No. 22 double cotton covered wire. C1 is the .00035 mfd. variable condenser. C2 is the .0005 mfd. variable condenser. L2 consists of 50 turns, using No. 22 double cotton covered wire. L3 consists of 36 turns, using No. 26 single silk covered wire. C3 is a .00025 mfd. fixed grid condenser, while R3 is a 2 megohm grid leak. R1 and R2 are both 20 ohm rheostats, controlling the filament temperature of the -01A type tubes. SCJ indicates a single circuit jack. When laying out the parts, place the two condensers at the end of the panel and the variocoupler in the center. The rheostats are placed in between the rotor and condenser dials on both sides of the rotor. The jack is placed at the extreme right hand corner, while the switch is at the opposite corner. A 7x18 in. panel and cabinet are used. The sockets are mounted on a subbase, with a pair of brackets. Follow these wiring directions carefully, comparing them with the diagram when wiring. The antenna post is connected to the tap on the coupler L1. The beginning of this winding is connected to the ground post, to the rotary plate post of C1 and to the arm of R1. The end of this winding is connected to the grid post of the first tube socket and to the stationary plate post of C1. The plate post of this socket is connected to the stationary plate post of C2 and to the beginning of the stationary winding, L2. The end of this winding is connected to the B plus 45 volt post. The plate post connection of the first socket is also connected to one terminal of C3. The other terminal of this condenser is connected to one terminal of R3 and to the grid post of the second or detector tube socket. The other terminal of the leak is connected to the F plus post on the socket. The beginning of the rotor winding is connected to the plate post of the second socket. The end of this coil is connected to the top terminal of the single circuit jack. The bottom terminal of this jack is connected to the B plus 45 volt post. The arms of both rheostats

(*Continued on page* 28)

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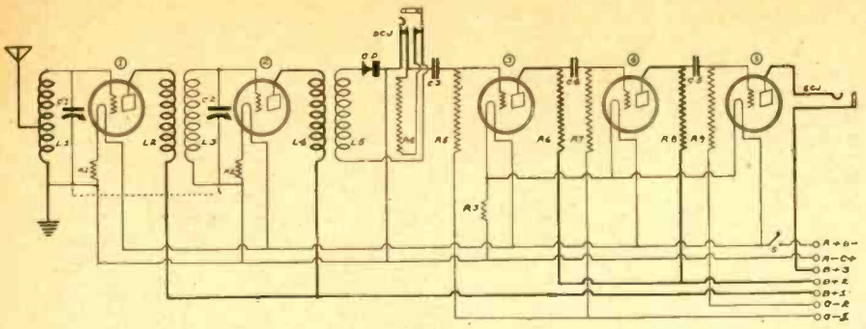
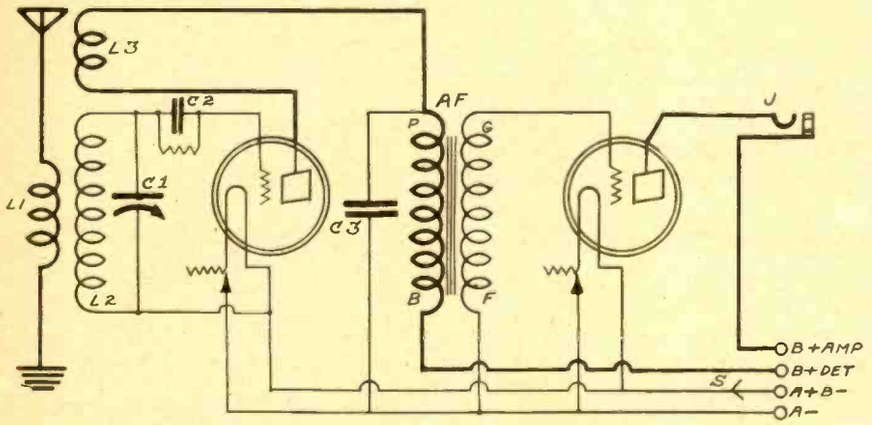
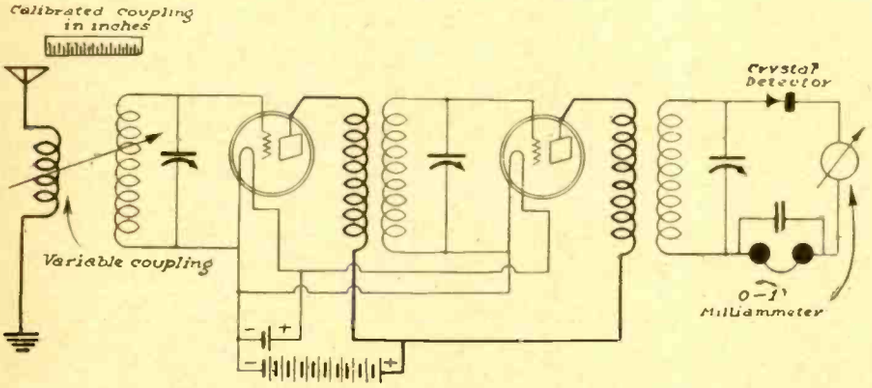
Morsels for Circuit Appetites



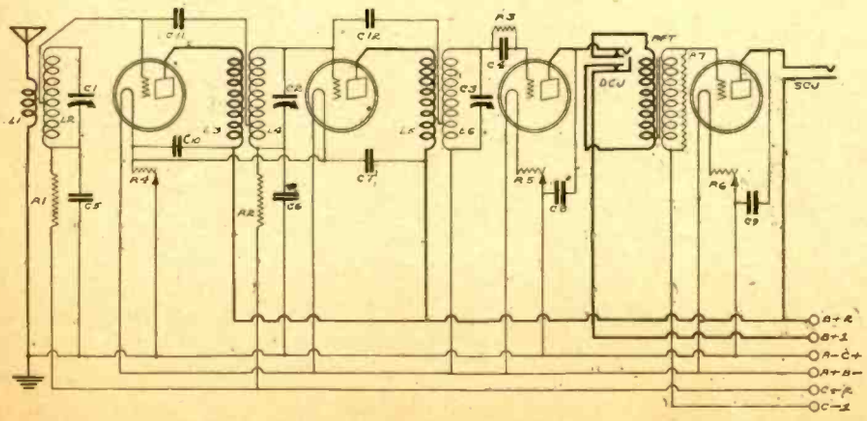
A 5-TUBE receiver, employing two stages of tuned radio frequency amplification, a crystal detector, with an untuned RFT, and three stages of resistance coupled audio frequency amplification. A double circuit jack is used at the detector output.



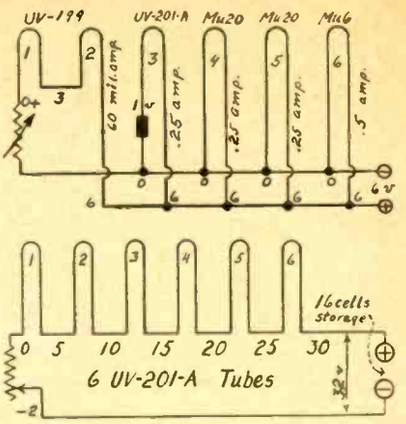
A 2-TUBE regenerative receiver, wherein the popular 3-circuit tuner is used in the detector circuit, while a transformer is used in the AF stage.



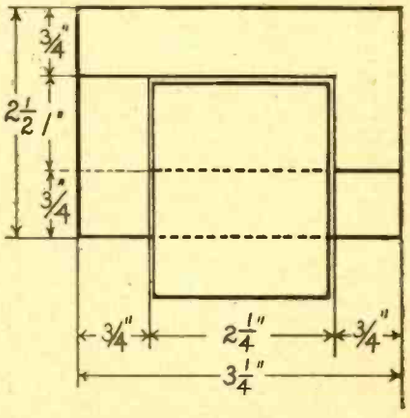
BY USING individually wound primary and secondary with a ruler, it is possible, to measure the coupling required to obtain maximum signal strength.



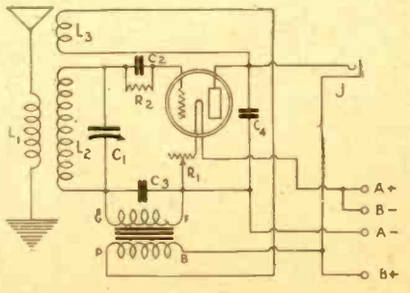
THE Garod Neutrodyne. Constructonal data on this set were given in the Radio University columns of the July 24 issue of RADIO WORLD.



A 32-VOLT storage battery used on farms for lighting may be employed to a great advantage in conjunction with a 6-tube receiver, using 5-volt tubes, as illustrated in the bottom diagram. The filaments are connected in series. On top is a circuit diagram illustrating how six tubes may be hooked up to obtain economy of filament consumption. The -99 type tubes are used as RF amplifiers, the —01A type tube as a detector, two high-mu and one low-mu tube as AF amplifiers, in this hookup. The total drain when the filaments are hooked up in this fashion is 1.31 amperes. A 1-ohm resistance should be placed in series with the —01A filament, since that tube operates best at 5 volts.



HOW A lamination, used in the step-up transformer of the Raytheon B Eliminator, Jan. 16 issue, appears diagrammatically.



THE CIRCUIT diagram of a 1-tube regenerative reflex receiver. The 3-circuit tuner method is used. A high ratio audio frequency transformer should be used. Both the by-pass condensers, C3 and C4, are of the .001 mfd. fixed type.

WRC to Retransmit Programs of WEAF

Ipana Troubadours, Atwater-Kent Hours, Capitol Theatre Concerts, A. & P. Gypsies, Davis Saxophone Octette and Grand and Light Opera Included

With the passing of Station WCAP from the broadcasting field and the transmission of its final program WRC inherited full-time on the 469 meter wavelength in the East and is carrying on the work of entertaining the radio fans of the Capital, Maryland and Virginia that was formerly conducted alternately by the two stations.

WRC will continue to broadcast all of the programs that formerly were transmitted from WCAP and at the same time include in their broadcasts the entertainment heard on the evenings when the Radio Corporation station had the air.

Since the first program presented by WRC on August 1, 1923, radio broadcasting has undergone many radical changes and the Washington station of the Radio Corporation has kept pace with the many developments in the art.

When it first came on the air, WRC could transmit only programs that originated in its own studios that had been built in the Riggs Bank-Tompkins Building especially for this purpose. Development of a wire line system followed in the Station's first year of existence and by August 1, 1924, programs could be picked up from a number of points in the Capital and transmitted by relay through the Park Road antenna. In another few months WRC had been connected further with its sister station WJZ, in New York, which in turn was connected with WGY, in Schenectady. This brought added interest to the Washington programs and enabled the station to present a much more varied and entertaining radio bill.

In another year the wire system was still further developd to where WRC could take its entertainment from practically any place in the Capital it desired, from Baltimore, Philadelphia and a number of other cities in the East.

Although the form of radio programs and their presentation has progressed as rapidly as has the scientific development of broadcasting, the opening program transmitted from WRC still stands as one of its most notable ether offerings.

On that first program that inaugurated the studios and the station of WRC were addresses by David Sarnoff, vice-president and general manager of the Radio Corporation of America; Colonel Theodore Roosevelt, then Assistant Secretary of the Navy; Major General John L. Hines, then Deputy Chief of Staff, U. S. A.; Judge Stephen B. Davis, Solicitor of the Department of Commerce, and Dr. Alfred N. Goldsmith, Director of Research of the Corporation. A special radiogram from General James G. Harbord, president of the Corporation, was received from Paris and was read to the station's listeners. Musical features on that first program included a concert by the United States Marine Band, and a number of nationally prominent artists—Elias Breeskin, violinist; Charles Trowbridge Tittman, soloist with the Philadelphia, Detroit and New York Symphonies; Ruth Peter, soprano with the Washington Opera Company; Victor Golibart, tenor and Clelia Fioravanti, mezzo-soprano.

In the three years that followed its debut, WRC has offered its listeners hundreds of programs of entertainment and instruction that have included such events as the Democratic National Convention of 1924; addresses by President Coolidge and practically every member of his Cabinet; funeral services conducted for William Jennings Bryan; memorial services for President Woodrow Wilson; concerts by many of the leading singers and instrumental soloists of the world, which were arranged and presented as Victor and Brunswick Concerts; dance programs originating in London, England; ringside descriptions of the outstanding prize-fights of the world; important baseball games; concerts by the New York Philharmonic Society, the United States Marine, Army and Navy Bands and their orchestras; descriptions of boat races, automobile races and football games and scores of other events.

Through the cooperation of the Smithsonian Institution and several of the Governmental departments in Washington, WRC has offered educational programs of interest to the scientist, farmer, business man and the student in almost every field.

Further educational and instructive programs have been offered in the past year that have taken the form of a radio school of international relations, conducted under the auspices of the Foreign Service School of Georgetown University; and the "Radio Congressional Forum," at which members of the Senate and the House of Representatives discussed the weekly work of Congress when in session.

Discussion of the political situation in Washington has been conducted weekly for more than two years by Frederic William Wile, prominent writer and lecturer, and the drama has been followed studiously on the air by Leonard Hall, drama critic of "The Washington Daily News."

In the future, it has been announced, WRC will continue to follow in the path it has set in the past and practically all of the features that have stood the test of time will be continued, along with the addition of the outstanding attractions that have come to listeners from WCAP.

Among the latter programs will be the Atwater Kent Hours of Music, the Capitol Theatre Concerts, the entertainment of the Ipana Troubadors, the A. and P. Gypsies, the Davis Saxophone Octette, the WEAF Grand Opera and Light Opera presentations and many others.

The Metropolitan Tower setting-up exercises will be on the air every morning for the early risers; noon-hour organ concerts and programs of luncheon programs, formerly daily features of WRC, will be continued as in the past, and play-by-play sports descriptions will be featured.

BIG BROADCAST

(Photo Topics)

Arranging a treat for the radio fans, G the Radio World's Fair, is shown in conf ing stations that will provide entertain week of Sept. 13. Some of the programs Middle West. Left to right are W. H. S W. Newton, WJZ; Mr. Irwin, G. W. WNAC; Dr. Charles D. Isaacson,

Major J. Andrew White, pioneer broadcaster and announcer of exceptional events, will again be heard on the air the evening of September 15, when he will act as master of ceremonies for the Third Annual Radio Industries Banquet to be held at the Hotel Astor in New York City.

More than twenty broadcasting stations will participate in the broadcasting of the program from the banqet hall with lead-

Public Control of Radio Called Only Safe Way

By Sir Frederick Whyte

Former President, India Legislative Assembly and Prominent Journalist

In a country where there is a public opinion the appeal to the platform is at least as powerful as the press. If you will give me the platform I will give you the press.

The platform itself is changing owing to the arrival of the radio. And there is danger, of course, in radio, that owing to the magnitude of the financial outlay, those in control of the radio may control the channel of news.

You read the other day of the stupid action of the British Broadcasting Company in its attempt to silence Mr. Bernard Shaw. If they had known their business they would have broadcast Shaw and nothing else that night.

The radio and the press are being subjected at this moment to influences which tend to concentrate whatever power disseminators of opinion may have in the hands of a few, and therefore the contact which the public opinion of one country can make with another country may become increasingly difficult.

If the discussion in the Assembly of the League of Nations were adequately broadcast through Europe, I should be prepared to regard radio as on the whole an entirely beneficient influence. There will be accidents no doubt. There will be tyrannical suppression of opinion here and there, but the interest in international discussions as broadcast by radio cannot do anything but good.

PLANS FOR SHOW

Clayton Irwin, Jr., general manager of ference with representatives of broadcast- ment from Madison Square Garden the will be transmitted also by stations in the chubel, WHN; George Podeyn, WEAF; Johnstone, WEAF; John Shepard, 3rd, WRNY; and Ted Nelson, WMCA.

ing organizations in the radio industry furnishing talent that will undoubtedly make this program one of the outstanding affairs of the radio season.

More than twenty radio associations will join in the sponsorship of the Third Annual Banquet with an attendance of possibly over 2,000. More than 10,000,000 listeners are expected to hear the program broadcast as show adjunct, too.

One Link Joins The Broadcaster And Manufacturer

By Frank Reichmann

President, Reichmann Co.

Many not thoroughly conversant with radio conditions have the idea that the broadcasters and radio manufacturers are identical, and that broadcasting is controlled by radio set and accessory builders, while set builders are controlled by broadcasters.

This is far from the case, however, as less than 12 per cent. of the broadcasting stations are owned or controlled by concerns interested in the manufacture of radio sets or accessories.

There is one link between the broadcaster and the manufacturer, however, and this link is very important and strong. The public controls the radio set manufacturer, for if the receivers do not please the public they will stay on the dealers' shelves, and on the other hand the public controls the broadcasting stations—unless the programs are interesting they'll never be brought into the receiving sets of the listeners.

OLD SONGS REPEATED

As an experiment the Radio Four of WGY recently gave a program of songs popular about twenty years ago and the fan response was so enthusiastic that a second program of the same type was held August 12. The quarter sang "Billy," "Just a Baby's Prayer at Twilight," "Did He Run?", "From Me to Mandy Lee," "I Lost My Heart When I Saw Your Eyes," "I Love the Ladies" and others.

First Set Ordered For N. Y. School Use

Radio Center to Be Inaugurated, With Attending Audience Listening to Lectures Embellished With Music As Step That May Lead to Installations in Most of the Institutions

The first step toward introducing radio instruction in the public schools of New York City was taken by the budget committe of the Board of Education when it recommended an appropriation of $2,000 for the purchase and installation of radio receiving apparatus in the auditorium of Washington Irving High School, which has girl pupils only.

This "radio center" will be used experimentally in connection with the system of evening lectures for adults, which the Board of Education has maintained as "a university of the people" for some thirty years. Its success there will determine the use of radio equipment throughout the school system.

If it is found that a sufficient number of persons are attracted by the "radio" lecture plan at Washington Irving, where the programs of lectures will be enriched with music and other entertainment "on the air," schools in the other boroughs will be similarly equipped.

It is the hope of Arthur S. Somers, chairman of the budget committee, to see a score or two of centrally located schools equipped with receiving apparatus, where teachers and pupils may be assembled on notable occasions to hear addresses by distinguished educators or by public officers. In the evening such centers will be used for adults.

In setting aside $2,000 for the Washington Irving radio equipment the committee really effected a saving. It made a drastic cut in the allowance given the bureau of lectures last year, for it has been found that since the advent of the movies and the radio men and women do not care to attend the lectures given evenings in the school buildings.

Preference for Men Announcers 100 to 1

WJZ Reveals Result of Canvass—Male Voice Said to "Take" Better in Transmission and Possessor's Versatility Is Called Greater.

By Charles B. Popenoe

Manager of WJZ

Station WJZ canvassed more than 5,000 radio listeners as to their choice between men and women as announcers.

The answers to our questionnaires were about 100 to 1 in favor of men as announcers. Our previous experience had indicated that listeners preferred men announcers, but we were surprised to find that the preference was so overwhelming.

It is difficult to say why the public should be so unanimous about it. One reason may be that most receiving sets do not reproduce perfectly the higher notes. A man's voice "takes" better. It has more volume.

Then, announcers cover sporting events, shows, concerts, operas and big public meetings. Men are naturally better fitted for the average assignment of the broadcasting announcer.

Another reason may be that women prefer to hear the voice of a man. If that is true you would expect the converse to be the case. But the vote does not indicate that men prefer to hear women announcers.

Many soprano voices reproduce perfectly. There is no preference for the man over the woman in singing. There is no doubt of the radio popularity of women artists, but they are certainly not in demand as announcers.

Herbert Declared Leading Composer

BALTIMORE.

Victor Herbert is the most popular of American composers if repetition of broadcast is any criterion. Checking back through his records WBAL's staff annotator finds that he has been called upon to prepare annotations on forty different Herbert numbers since December last. These include light opera selections for WBAL's Sunday Orchestra programs as well as individual instrumental and vocal Herbert numbers used by various week-night artists appearing over WBAL.

The light opera selections cover a greater part of Herbert's career. "The fortune Teller" and "The Serenader" from the period of the famous Bostonians have been heard over WBAL as well as "Mlle. Modiste," "Babes In Toyland" and other works of Herbert's golden middle years. "The Dream Girl," Herbert's last opera, has been on a WBAL program and also several posthumous orchestral works of the great Irish-American composer.

Licenses Granted to 3 New Stations

WCRW, Chicago; WJBW, New Orleans, and KGBW, Joplin, Mo., Are Added to Existing List

WASHINGTON.

Three new stations have been licensed by the Department of Commerce while eight stations have changed their wave lengths.

NEW STATIONS

WCRW, Clinton R. White, Chicago, Ill., 239.9 meters, 1,260 kcy.

WJBW, C. Carlson, Jr., New Orleans, La., 340.7 meters, 880 kcy.

KGBW, Martin Brotherson, Joplin, Mo. 282.8 meters, 1,060 kcy.

WAVELENGTH CHANGES

WBBR, Peoples Pulpit Assn., Rossville, N. Y., from 272.6 meters, to 416.4 meters.

KTNT, N. Baker, Muscatine, Iowa, from 256 meters, to 333.1 meters.

KGY, St. Martins College, Lacey, Wash. from 245.8 meters, to 277.6 meters.

KFDD, St. Michael's Episcopal Church, Boise, Idaho, from 277.6, to 275.1

WHAP, Wm. H. Taylor Finance Corp., New York, from 240 meters to 431 meters.

WCMA, Culver Military Academy, Culver, Ind., from 222.1 meters, to 258.5 meters.

WMSG, Madison Square Garden, New York, from 212.6 meters to 302.8 meters.

KFNF, Henry Field Seed Co., Shenandoah, Iowa, from 263 meters to 461.3 meters.

NAME CHANGES

WBAW, First Baptist Church, Nashville, Waldrum Drug Co., the former call letter being WCBQ.

KFEL, W. L. Winner Radio Shop, Denver, to Eugene P. O'Fannon, Inc.

KMTR, Oliver S. Garretson to Echophone Mfg. Co., Hollywood, Cal.

WQAO, New York, has been authorized to use the call WPAP when broadcasting from the Palisades Amusement Park. The station has changed its location to Cliffside, N. J.

DON'T ALTER WAVE, CLUB VOTE WARNS

Resolutions Adopted Setting Forth "New Occasion for Exercise of Self-Government and Respect for Public"

At a special meeting of its Board of Directors, the Radio Club of America—the oldest radio organization extant—drew up a set of resolutions backing the regulations heretofore rigidly observed in broadcast practice. The resolutions:

"RESOLVED that until the present limitations on the powers of the Department of Commerce shall have been removed or other provisions made by legislation, no broadcaster should change his wavelength or hours on the air or increase his power without first receiving the approval of a committee representative of the art, organized for the purpose, and be it further

"RESOLVED that the Radio Club of America, organized for the object, among others, of developing the radio art, hereby declares that the present condition in the radio field, caused by the temporary removal of legal restraints, is a new occasion for the exercise of that capacity of self-government and respect for the interest of the public, in which the radio art has led, and it further declares that it will hold its members responsible in the opinion of the club for their conduct in the observance of the principles underlying these resolutions."

AN ODD NOTION

Many folk seem to think that by placing the filament switch in the positive lead better results will be obtained than by placing it in the negative lead. This is not so. It may be placed in either lead with the same results.

Severe Wave Tangle Afflicts Australia

Demand Is Made for 50-Meter Separation and for High Waves During Day, Short Ones at Night

When it comes to controversies over wavelengths, the broadcast listeners of the United States are conducting an agitation mild in comparison with the campaign now being staged in Australia.

There fans want their stations not only to alter their present wavelengths, so as to permit of 50 meters separation, but want them to send on high waves in the sunlight hours and shorter waves at night, in the belief that this will improve reception.

The Four Stations

The stations involved in the discussion are 2BL, in Sydney, 353 meters; 3LO, Melbourne, 371 meters; 4QG, Brisbane, 385 meters, and 5CL, Adelaide.

While there has been an increased use of more-selective receivers in Australia, particularly those made in America, representatives of the Freed-Eisemann Radio Corporation report, still the majority of listeners are troubled in tuning out one station and bringing in another.

Advocacy of the use of longer wavelengths during daylight hours is made in the following statement by L. C. Jones, of the Adelaide Radio Co.:

"It is absolutely essential that there should be at least one powerful station operating on a long wavelength in order to give the people out back a good daylight service.

Two for Each

"If one were looking for the ideal wavelengths for use in Australia without considering any other point it would undoubtedly be for each of the large stations to have two different wavelengths, a long one for use during the day, and a shorter one for the night, and there does not seem to be any technical difficulty in the way of this arrangement.

"If it were possible for this to be done there is little doubt that the advantages would be compelling."

Co-operation Solves Problem in Europe

Exclusive Waves Granted to Large Stations and They Guarantee Accurate Frequency in Transmission New Era September 15

Interference between stations in several countries will be eliminated, according to officials of the Technical Commission which has been studying the problem for more than a year.

This was the information brought by Alexander Eisemann, after a month's study of the foreign broadcasting situation. He quoted the statement of the Union Internationale de Radiophonie, the headquarters of which are in Geneva, indicating that on Sept. 15 European stations will enter a new era in broadcasting history through the effectuation of a plan of co-operation that gives every station a wavelength that insures it clear, transmission at short and long distances.

Not only have exclusive wavelengths been granted, but each station has guaranteed the stabilization of its broadcasting wave and the suppression of harmonics. Stations are divided into two classes: Class A, to which an exclusive wave is given; Class B, smaller stations, to which a common wave is assigned. The geographical situation of the stations is a primary consideration in the allotment of wavelengths.

"Co-operation in the public interest is responsible for the efficient and practical solution of the European wavelength problem," stated Mr. Eisemann. "The same principle will eliminate interference here due to temporary wavelength changes."

Air Waves to Test Racial Mysteries

Theory of Distribution of Plant and Animal Life to Be Weighed By New Longitude Determinations

By William Bowie

Chief of Division of Geodesy, U. S. Coast & Geodetic Survey

Scientific men have puzzled for generations over the problem involved in the distribution of animal and plant life over the land areas of the earth. Some claim that there were land bridges connecting the continents which have been washed away by the waves or currents of the ocean or have subsided like the mythical Atlantis.

We know that plant and animal life, on widely separated continents, is in many cases closely related. How it became so may remain forever one of the many mysteries of the natural world. But it is no mystery to Prof. Wegener and his followers. He has a very fascinating theory to explain it all but the trouble with it is that it does not stand up under the acid test of mathematics, mechanics, physics and geology.

He claims that sometime in the past all land areas of the earth were joined together, later separating into continents and islands, with water rushing in between. The land animals and plants floated along undisturbed on their cakes of earth.

Depended on Moon

Wegener used some longitude determinations made in Greenland during the last century to substantiate his theory that continents are drifting. The trouble here is that the earlier longitude determinations in Greenland depended upon observations on the moon and they were subject to errors of several miles. His use of the Greenland longitudes is not justified.

A new proposed world net of longitude stations will prove or disprove Wegener's theory for the error in the location of a longitude station will not be more than 30 feet. At intervals of five, ten or some other number of years the observations will be repeated and any movements during the intervals, amounting to 100 feet or more, will surely be detected.

That the Hertzian waves used in radio communication travel fast we all agree. But how fast? Even should we know, it would not affect us in the enjoyment of a radio concert, but it might affect the map and chart makers who are engaged in locating shore lines, mountains, rivers and cities, and also the navigator of a vessel. The determination of the velocity of radio waves will result from the longitude work planned.

Will Know Distance

After the net has been adjusted to eliminate all discrepancies we will know the distance between each two longitude stations. Take, for instance, the U. S. Naval Observatory at Washington and the Observatory at Greenwich, England. Their distance apart will be known with extreme accuracy. Then let the signals sent from Annapolis radio station be received and compared with the clocks at the two observatories. In one case, the radio signals traveled about thirty miles and in the other about 3,000 miles. The difference in the clock times of receiving the signals at the two observatories, subtracted from the difference in longitude between them, will be the time required for the radio impulses to travel 2,700 miles.

All methods for the determination of longitudes were crude prior to the discovery or development of telegraphy by Morse. While the cable and land wires made it possible to determine longitudes with great accuracy, yet the longitude stations must be at the cable landings or along the land wires.

Radio More Useful

It is readily seen that radio imposes no such restrictions. Islands which have no cable stations can now be located with the same accuracy as points on continents. The radio will be used to determine many places which now are inaccurately shown on maps and charts.

The radio time signals sent from stations of various countries can be improved by the world logitude net. At present a navigator, explorer or surveyor may be receiving time signals from more than one station. He may receive from one station today and from another one tomorrow. If there is an error in the difference in longitude between two observatories from which the signals emanate this error will appear in the time of receipt of the signals. If the explorer or navigator should rate his chronomter or watch by these signals he might get into serious difficulties.

Geodesists and astronomers have considered making a radio longitude net since the first radio signals were received across the Atlantic. Many obstacles arose to postpone actual operations but now they seem to have been overcome."

COST OF STATIONS

Few realize how costly a station is. About $25,000 investment and equal annual upkeep is a fair average.

REALISM

Underwood & Underwood

ROBERT D. BONIEL, of WEBH, Chicago, letting the fans hear the "swish of the waves" on Lake Michigan. These are the waves that the fans hear while listening to the Edgewater Beach Hotel Orchestra.

Louder Signals

By cleaning off that portion of the insulated wire on the leadin which is to be placed underneath the window and placing strips of tape over this portion, which may be hammered to the wood of the sill, an excellent leadin wire substitute may be made. As a matter of fact, with this leadin method, the signals will be a bit louder, since the wire is continuous, while with the other method, the lead is broken introducing resistance. Be sure that the entire wire is covered with the tape, otherwise a small ground will prevail, causing a decrease in signal strength.

Friendly Dialogue Wins the Listeners

Poor Speaker and Deliverer of Stilted Orations Loses Not Wanted, Pickard Reports—Farmers Like Radio

WASHINGTON.

Educational programs are liked best of all by the farmers, while classical and jazz music have their place. This is the conclusion of Sam Pickard, Chief of Radio of the Department of Agriculture, who has just completed a farm radio survey tour through twenty agricultural states.

"I know of no field into which educational agencies have entered that offers keener competition than that of radio," says Mr. Pickard. "The day has passed when the mediocre speaker can hold a radio audience. The lecture of long difficult words and sentences must give way to the more friendly, natural dialogue presented by effective radio voices.

"Until educational institutions vale the effectiveness of radio instructions highly enough to adequately finance a competent staff, trained in the technique of broadcasting, they can not expect successfully to utilize this new invention, probably the greatest boon to education since the printing press was invented.

"The farm fan has two chief criticisms of radio. The one most often voiced is the curse of not getting enough sleep. Most farmers admit they sit up with their sets late into the night. Many others say that while they like their neighbors they tire of the entire community dropping in every winter evening and then forgetting to go home."

Many so wrote to Pickard.

A THOUGHT FOR THE WEEK

JUST before the leaves begin to fall, the radio trade's hopes begin to rise.

RADIO WORLD

REG. U.S. PAT. OFF.

Radio World's Slogan: "A radio set for every home."

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AUGUST 21, 1926

R. C. A. Patent Troubles

THE De Forest Company's newest victory over the Westinghouse Company and its licensees, covering the regeneration patent, hangs another patent crape on the door of the Radio Corporation of America, principal licensee. The world always had been told that Major Edwin H. Armstrong was the inventor of regeneration, but it is time now that the revised proofs be turned in, with Armstrong's name deleted and Dr. Lee De Forest's written in its place. Two Federal Court decisions have done just this, and as the question is a legal one, the text book authors and others should take their law from the courts.

The latest decision, hailed by the De Forest Company as representing "the final stage" of nine years of litigation, swept aside the Patent Office's award to Armstrong and upheld De Forest's claim to being the inventor. The findings are clear enough.

Radio's sore spot is the patent situation. It is hardly possible to manufacture anything in radio without reference to some patent. The R. C. A. more often has been the one to assert patent infringement, for it has been more careful than many others not to be a patent pirate, and no doubt has spent millions on patents. It has long enjoyed the effect of legal rigor that awards no medals for finishing second in a patent suit. One of the patents it prized most is that concerning regeneration. Its relationship to that patent, perhaps the second most important one in radio, is that of a co-owner.

Virtually all the receivers sold by the R. C. A. involve the feedback patent, either in exclusively regenerative sets or in the Super-Heterodyne, in which regeneration is a prerequisite to the circuit. Hence to find it does not own any part of the patent or hold any legal license under it is indeed a hard blow to the corporation.

Those who are detached from any of the animus that the two principals necessarily feel toward each other after years of legal fights on this subject and others, naturally see in the crowning of De Forest and the unseating of Armstrong a lesson in the uncertainty of human business, particularly radio. To the inventor should go the invention, but that a decision strong enough to convince the loser should not be reached until nine years have elapsed must strike all as being painful delay. No suspicion of laches need attach to either side. But the necessity of expedition in the determination of far-reaching rights is obvious. The patent has only five years more to run. How absurd would it be if a conclusive determination were reached only after the patent's expiration. A definite conclusion at this time is only one-third less absurd.

The law's delays have rankled both the parties and the juridical reformers since the earliest laws, but now we have a new object lesson in our own ranks. A selective system of trial of issues, where precedence is given to paramount questions, which obtains in some branches of the law, should be more generously extended to patents. In other words, the R. C. A., if it must lose, should know that its case is hopeless, instead of being half led by legal conditions to continue business on a misapprehended basis.

The penalty may run high or low, or there may be none, nevertheless the De Forest Company is talking about suing for millions of dollars, alleging patent infringement, particularly by the R. C. A. since 1924, when De Forest won his first regenerative victory.

The R. C. A. has spent a fortune, not only for the patent, but in protecting it against infringers. The De Forest Company will not sue for the privilege of refunding the expenses of these suits. With the R. C. A. finally wrenched away from the patent, will it be held a gratuitous defender, entitled to no recompense? This is not a far-fetched possibility.

The R. C. A. record has not been a clean one in all respects, but judged as a whole the corporation must be regarded as one of the wholesome influences in radio, as to research and developmental work, and respect for patents. In its merchandising it has made some costly and inexcusable blunders.

Some of its patent zeal may have been expensively misdirected, but it is not always possible to outguess the courts, and in big business almost every time you guess wrong you suffer big consequences.

Lately the R. C. A. has been running in ill patent luck. Besides the Pennsylvania decision in favor of Armstrong, where the R. C. A. was defendant, there was the Garod case, where the plaintiff R. C. A. lost in its contention that the Hazeltine Neutrodyne patent infringed the Rice and Hartley patents. The victory of the Western Electric Co. over the Lektophone Corporation, in which the W. E. was held to be non-infringing, must have been of passing interest to the R. C. A. which had paid $200,000 in certified check only a few months before to the Lectophone Corporation for the right to manufacture cone speakers in perpetuity.

It is painful to be hit left and right, and to feel the blows even when one is only a spectator.

Remote Cones

THE phonograph grafted into radio the habit of having the horn at the receiver. The phonograph was mechanical, hence had to have its tone chamber where the instrument was, and unless there was that combination there was no phonograph. When radio made its entrance the horn stayed right beside the receiver, although the radio is electrical and makes possible, indeed quietly invites, the placing of the horn elsewhere than where the leadin compels the set to be.

Many persons get greater delight from their radio sets by placing the cone speaker at that point which they find gives best acoustical results. Experiments along this line often prove profitable because the best sounding-board effect is not always obtainable where the set is.

Hence extension cords are becoming popular. These connect to the set and have provision for hooking up the speaker cords at the other end of the extension. There will be some decline in volume when this system is resorted to, in conjunction with conventional speaker output connections, where one speaker cord goes to the plate of the final audio tube and the other cord to the B battery positive. A better output for utilization of the extension plan is that obtained through a choke coil and fixed condenser, the speaker cords being joined respectively to one side of the fixed condenser and to minus A. Such a system is used in the Improved Browning-Drake and other home-constructed sets, as well as in some factory-made receivers.

Better Receivers Now

THE improvement in receiver design in the past few years is emphasized by recent experiences at Summer resorts. In the mountains or at the shore reception conditions are not usually so good as they are in the cities, due to distance and to intervening barriers or absorbers of radio energy. Sometimes the earth is highly metallic. Other times trees spread a hindering canopy over an aerial. Whatever the impediments, they almost melt away before the present efficiency of sets, both home-constructed and factory-made.

Persons who frequent the same Summer resort year after year find that the sets today penetrate the barriers. They remember the futility of reception efforts three or four years ago, and even discuss them while half listening to the speaker reproducing music originating at a studio a couple of hundred miles away, and plainly audible across a good-sized lake.

Radio Paradise Located in England

The radio paradise of the world is Bude in Cornwall, England, where American stations are continuously received and where continental broadcasters are heard with the loudest and clearest of volume even in summer, reports Kenneth Arnott, British civil and radio engineer who is now visiting in New York.

"Through some unexplained cause, signals in Bude are far better than anywhere else that I have been or that others have reported," said Mr. Arnott. "And yet, in Bodmin, ten miles inland from the coast, there is an actual dead spot. On five tubes, it is possible to get nearby Cardiff only weakly."

How Steinmetz Ended Transformer Riddle

Developed Formula for Calculating Alternating Current —Had to Stop Speech After 80-Minute Introduction

[*The story of Charles P. Steinmetz's early life and first great electrical discovery, the hysteresis law, was told in the August 7 and 14 issues.*]

By John W. Hammond

(Broadcast by WGY.)

About the time that Steinmetz left Yonkers for Lynn. After the General Electric Company had bought the Eickemeyer & Osterheld Company he began to study alternating current, which, it will be remembered, is one of the two kinds of electric currents. The other is direct current.

The mathematics relating to these two currents must be thoroughly understood by electrical engineers in order to develop the immense number of useful things that electricity can be made to do. In other words, electrical engineers must find out, by mathematics, how to make use of this mysterious power.

Up to the last ten years of the nineteenth century they had found that it was much easier to make mathematical calculations with direct current, which flows continuously in one direction, than with alternating current, which flows first in one direction, then in the opposite direction.

Enter the Transformer

Just before the time when Steinmetz began to work for the General Electric Company at Lynn certain new electrical apparatus had been invented which used alternating current much better than it had previously been used. The most important of these was the transformer, which was developed into a remarkable device by William Stanley, of Great Barrington, Mass.

It was so remarkable that electrical engineers decided at once that electricity would be of very great value to people everywhere if it were produced as alternating current, rather than as direct current.

Perhaps the most surprising circumstance about the transformer is that it has no moving parts. No mechanical action of any sort takes place; only swift, silent and, when all is said, mysterious, movement of electrical forces.

A transformer always consists of an iron core in the form of a ring, usually laminated; and primary and secondary windings, placed on opposite sides of the core. There is no metallic connection between the primary winding and the secondary winding. They are, however, connected magnetically.

Transformer Action

Alternating current, flowing through the primary winding from a supply circuit to which it is connected, produces alternating magnetic flux in the iron core. This flux, as it passes around the magnetic circuit, induces an alternating electric current in the secondary winding, which is always made a part of an electrical circuit. This induced current flows through that circuit and can be used for lighting, for power or for heat.

The electric currents in the primary and secondary coils are not of the same voltage—and that constitutes the most useful characteristic of the transformer. By arranging the proper ratio between the number of turns and the thickness of wire in the primary and secondary windings, the voltage of the current in the secondary winding can be made either higher or lower than that in the primary winding. If it is higher, then the transformer is known as a step-up transformer; if lower, then it is called a step-down transformer.

In the simplest kind of electrical transmission systems, designed to send current for any great distance, transformers always work in pairs. The sequence of operation is:

First, the electric generator, producing alternating current at perhaps 2,000 volts; second, a step-up transformer, which raises the voltage from 2,000 to perhaps 30,000 volts; third, the transmission line, which carries the current at 30,000 volts from the secondary winding of the step-up transformer to the primary winding of the step-down transformer, located perhaps twenty-five miles away; fourth, the step-down transformer, which lowers the voltage from 30,000 volts to 220, or 110 volts; fifth, the secondary circuit, or "local circuit," which carries the current at 220 or 110 volts from the secondary winding of the step-down transformer to incandescent lamps or to alternating current motors.

Sent Hundreds of Miles

Usually, in actual practice, a sub-station, supplying a local distribution circuit, receives the high-voltage current and reduces the voltage, through a step-down transformer, to a distribution voltage of, perhaps 2,000 volts. Small transformers, located on electric light poles, lower it to the final voltage, 110 volts, for use in dwellings, offices, stores and elsewhere.

The great advantage of the kind of electrical system just described is, as previously stated, that it allows electrical energy to be sent from one place to another, even for hundreds of miles. But this can be done only with alternating current; direct current is not adapted for such usage. And the transformer is absolutely necessary to enable it to be done even with alternating current.

This indicates the situation when the transformer first came into use, through the work of Stanley, and it makes clear the tremendous importance which the alternating current thus suddenly assumed, around 1890, just about the time that Steinmetz was completing his investigation of the magnetic circuit.

Men realized that the whole future growth of electrical systems, and their successful service to the people of the world, depended upon an understanding of the alternating current.

Yet the alternating current was much harder to work with, mathematically. In fact, it was so very difficult to figure it out that even the wisest men had to proceed slowly. And even then they did not make much progress.

Enigma of Direction Change

The chief reason for this, as Steinmetz noticed when he began to study the matter, was the change in direction of the alternating current.

This change of direction is swifter than the human mind can imagine. A second is not very long, yet an alternating current of electricity, on a circuit used for lighting a dwelling, may make a complete change in the direction of its flow sixty times every second.

That means that it is called a current of low frequency, or a current of sixty cycles. A cycle represents the period of time that it takes for an alternating current to flow in one direction, reverse and flow in the opposite direction, then reverse a second time and begin flowing again in the original direction.

Strives for Better Method

In working out their mathematical calculations with the alternating current, before Steinmetz began to study the subject, electrical engineers used a most elaborate method, which was far from satisfactory. Steinmetz tried this same method, but it seemed so clumsy to him that he at once decided there must be a better way. He began to search for it, doing an amount of mathematical work that was simply tremendous, and that kept him busy for many months. But he found the method! And the Steinmetz method of calculating alternating current is in use to this day.

He made his first announcement of the new method in 1893, at a meeting in Chicago of the International Electrical Congress. This was a large gathering of distinguished engineers and scientists from many countries.

Each speaker was allowed an hour to present his paper and could obtain a time extension of ten minutes in case he could not finish within the hour. Dr. Steinmetz used up the whole hour and twice was given ten minutes more. By this time, as he himself says, "I had just finished the introduction to my paper."

Shortly after this he began to write a series of books about electric currents. In these books he gave a complete account of his method for making mathematical calculations with the alternating current. The books were intended for the electrical engineers of America. But he also wrote books for college men who were studying electrical engineering, and even one for high school pupils who planned to take electrical engineering when they went to college.

In this way he made it easy not only for the men who were then engineers, but also for young men who became electrical engineers later to make themselves familiar with his valuable work. Every high school or college graduate can study the alternating-current formula worked out by Steinmetz, and they always do so in preparing for a career as electrical engineers.

Thus, before he was hardly more than thirty years old, Steinmetz had solved two of the most serious mathematical problems that electrical engineers had to handle.

Picturesque Figure

Steinmetz was still quite young—not much more than thirty—when he became an employe of the General Electric Company. He was an odd figure, very short in stature, with long, black hair and a quick, nervous way of moving about. Men always stopped and looked when he walked past.

People forgot about the strange appearance of this young man, however, when they had occasion to speak to him in the course of the day's work. At such moments it was an impressive sight to see the keen, eager, yet quiet enthusiasm of his friendly eyes. It was interesting to hear him talk—a thin, rather high voice, with a slight accent that made it a little hard to understand just what he was saying.

Soon the engineering work of the General Electric Company began to make great progress. This, to a large extent, was because of the knowledge that Stein-

(*Concluded on page* 22)

Steinmetz Made Toy of Own Lightning

His Famous Creation of the Artificial Product Grew Out of His Study of "Transients", i.e., Strong Stray Currents

(*Concluded from page* 21)

metz was passing along to the other General Electric engineers.

His Brilliance Capitalized

Especially in building alternating current machinery, and in laying out alternating current systems of electricity, the General Electric Company was able to do unusually fine work. It could sell to its customers apparatus which almost always would do just what they said it would do. Much of this was due to Steinmetz and his brilliant mind; it was also due to the patience and friendly willingness which Steinmetz showed in helping others.

During the time that he was located at Lynn, Steinmetz was a member of the calculating department, of which H. F. Parshall was the manager. In this department was done all the necessary mathematical work in the designing of electrical generators, motors, and other equipment. Thus it can be seen that it was exactly the place where Steinmetz belonged.

In December, 1893, the General Electric Company transferred a number of its engineers from Lynn, Mass., to Schenectady, N. Y., where the company's headquarters had been moved from New York.

Steinmetz was one of those transferred; and from 1894, until his death in 1923, he lived in that city.

In Schenectady he made most of his friends; became a public official; built a house and adopted a son, to whose children he became an adopted grandfather. It was during his many years in Schenectady that he had a cheery little camp on a small stream flowing into the Mohawk river.

He enjoyed his home and his adopted family so much, and he had such good times at his camp, that these years in Schenectady made up, without doubt, the happiest part of his life.

When he went there to live, however, he was not known to the public. He was very well known among electrical engineers, and was more admired by these men of his own profession every year. But what he had done for electrical engineering had not yet been understood sufficiently well by persons who were not electrical engineers. The world in general did not perceive what it all meant.

About that time, Mr. Parshall went to England to perform some special work for the company, leaving the department without a head. When the transfer to Schenectady had been completed, however, the whole department was reorganized. Steinmetz himself was appointed supervisor, or director, of the department.

Steinmetz soon began a new line of electrical study, the third great investigation of his career. It really grew out of his two previous studies—which, it will be remembered, were the law of hysteresis and the new mathematical formula for alternating-current calculations.

The new study was an examination into what electrical men call "transients." Transient electrical currents are those which suddenly and unexpectedly enter an electrical system, because of a short circuit, or because of lightning, and by letting loose great volumes of current do much damage, unless they can be held in check.

More will be told later regarding this line of work by Steinmetz, for it led to the building of his famous lightning generator and the creation by him of "artificial lightning."

Five years had now passed since Steinmetz came to America. He was able to go back to Yonkers and receive from the court his certificate as a naturalized citizen. Of this he was always very proud, for he admired America and felt happy to be an American.

New Complete Kit For the Diamond Fully Licensed

The B-C-L Radio Service Co., large mail order house, of which Louis Lager is the head, announces that it will market a complete kit of parts for an Improved Diamond of the Air. The list price of the parts is $60.

This kit, says the announcement, will be fully licensed under the Armstrong regenerative patent No. 1,113,149, and the license will cover all the parts, not merely the coils.

"The popularity of The Diamond is proof that the licensed kit will attract the radio public as few kits ever did before," said Mr. Lager.

The B-C-L Radio Service Co. has a large stockroom and shipping department at 223 Fulton Street, New York City.

Makes Phonograph Run Radio Speaker

The Bristophon is a device manufactured by The Bristol Company, Waterbury, Conn., which makes it possible to operate the old type of phonograph electrically. It is said that it gives richer and smoother tone and greater volume. It is available with any phonograph which has an even-running motor and a correctly balanced turn table.

It will greatly improve the performance of the old style record, the manufacturer says, but, when used to play the new-process, electrically produced records, it will bring out all the tonal depth, clarity and range which is possible with the new model phonographs.

When the Bristophon is to be used, it displaces the regular tone arm and horn, and utilizes a radio speaker, either horn or cone type. It can be operated through the medium of a radio power speaker, with any good audio amplifier and speaker, or with speaker only. In the first two instances a 1½-volt battery is required, but with speaker only, an ordinary 6-volt storage battery is used. It has a volume adjustment.

TABLE FOR CONVERSION OF FREQUENCIES AND METERS appeared in RADIO WORLD dated May 1, 1925. Sent on receipt of 15c, or start your sub. with that number. RADIO WORLD, 145 W. 45th St., N. Y. C.

THE GREAT AID OF BY-PASS CONDENSERS, by John F. Rider, appeared in RADIO WORLD dated May 8. Sent on receipt of 15c, or start sub. with that number. RADIO WORLD, 145 W. 45th St., N. Y. C.

THE RADIO TRADE

Good Parts Stable And Move Off Shelf

Dealers Should Be Encouraged to Handle Well-Made Products and to Avoid Cheap Novelty Items, Says Osmun, Commenting on Milwaukee Survey

By H. E. Osmun

Sales Manager, Central Radio Laboratories

Some very interesting comments bearing on the radio parts market have just been made in a letter circulated by the Wisconsin Radio Trade Association among its members. Here is the letter, in part:

"According to figures compiled by 'The Milwaukee Journal' in their 1926 survey of the Greater Milwaukee market, out of every seven radio receivers owned, two were assembled by the owner.

"At first thought, this figure does not seem very startling or exceptional, yet if a little analysis is made of selling and advertising effort during the past radio season, there is strong proof that the set builder is still an important factor.

"Virtually no advertising was done in the Milwaukee newspapers to stimulate the home building of sets. Fully 95 per cent. of the money spent for advertising lineage both the dealer, distributor and manufacturer was on complete receivers and the accessories to be used with them.

"This same condition applies to the advertising which was done in the so-called national publications, such as 'The Saturday Evening Post,' 'Literary Digest,' 'Liberty,' etc.

"For every five receivers that were purchased as a complete unit, two were built by the owner himself, yet, the radio dealer and distributor have given little thought or consideration to the sale of parts.

"In the face of these facts, it would seem that a considerable amount of money left Milwaukee and Wisconsin last year for the purchase of parts from mail order houses.

"The home set builder is a definite influence."

During the past year radio jobbers discontinued parts lines because they believed the prospect of large obsolete stocks, unsold at the end of the season, outweighed any possible profit. This may be true of cheaply made novelty lines, but certainly is not true of the better known products. In fact, the history of the past two seasons indicate that a stock of manufactured radio receivers is menaced by obsolescence much more than an equivalent stock of parts.

In the case of Centralab, for example, our jobber sales increased steadily from January 1, with scarcely any letdown during the Spring months. Now our new catalog is out, and while we have announced some new items, every type of unit we sold last season is still in demand and salable at full price. What set manufacturer can show that kind of a record?

Pass this information on to the jobbers and dealers in your territory, pointing out that well-known part and accessory lines, like Centralab, will stabilize their radio sales and are the safest radio lines they can carry. Without question, radio parts sales will be much greater in 1926 than ever before.

NEW CORPORATIONS

Slagle Radio Co., Wilmington, Del., radio receiving and transmitting sets, $100,000. (Corporation Service Co., Wilmington, Del.)

Literature Wanted

THE names of readers of RADIO WORLD who desire literature from radio jobbers and dealers are published in RADIO WORLD on request of the reader. The blank below may be used, or a post card or letter will do instead.

Trade Service Editor,
RADIO WORLD,
145 West 45th St., N. Y. City.

I desire to receive radio literature

Name .....

Address .....

City or town.....

State .....

Alfred Eberhart, 3732 62nd St., Woodside, N. Y. (Dealer.)

Atlas Radio Co., 7765 75th St., Glendale, N. Y. (Dealer.)

Jenkins Radio Sales and Service, Milton, Ia. (Dealer.)

M. E. Kuhn, 2709 Seminary Ave., Richmond, Va.

Russell Ryan, 716 Cypress St., Kansas City, Mo.

J. A. L. MacKinnon, 1016 Noe St., San Francisco, Cal.

Albert J. Lydehn, 124 Fourth Ave., Moline, Ill. (Dealer.)

E. W. Moore, 5 Five Station, Jacksonville, Fla.

W. J. Robinson, Box 624, The Pas, Manitoba, Canada.

De Luxe B-D Panel

The new radio season witnesses the annual expansion of the Cortlandt Panel Engraving Co. Every year they have to enlarge to take care of increasing business. They now occupy practically the entire building at 79 Cortlandt street, New York City. The newest and finest equipment has been installed and any quantity of panel work can be handled, with rush work a specialty. Only the best quality of proven insulating material is used for panels. Under the personal supervision of Mr. Pullman, a de luxe panel for the Improved Browning-Drake is being turned out. This panel may be had in quantity or singly by set builders.

Good Back Numbers of RADIO WORLD

The following illustrated articles have appeared in recent issues of RADIO WORLD:

1925:

Sept. 19—The 1-Dial, 2-Tube Speaker Set, by Percy Warren. Anderson's Theory of Fading. The Way of the Frequency Dial, by Capt. P. V. O'Rourke.

Oct. 24—The 3-in-1 RF Receiver, by Sidney E. Finkelstein. A Phonograph Cabinet Set, by Lewis Winner.

Nov. 7—A 3-Tube Dry-Cell Circuit, by Capt. P. V. O'Rourke. One of the Best Crystal Sets, by Herbert E. Hayden. 1-Tube DX Set, by Herman Bernard.

Nov. 28—The Zero Potential Loop, by Frank Freer. The 1-Tube Headset Receiver, by J. E. Anderson.

Dec. 12—A Self-Contained Receiver, by H. E. Hayden (Part 1). B Battery Eliminator, by Lewis Winner (Holiday Gifts No.).

Dec. 26—The Regenerative Wave Trap, by John F. Elder. The 5-Tube Tuned RF Set, by Capt. P. V. O'Rourke.

1926:

Jan. 2—The 2-C Set for Simplicity, by Capt. P. V. O'Rourke.

Jan. 9—The 4-Tube DX Symphony Set, by A. Irving Witz. A Skillfully Made 1-Dial Set, by Herman Bernard.

Jan. 16—Anderson's 5-Tube Quality Receiver. The Raytheon B Eliminator, by Lewis Winner.

Jan. 30—An Individual AF Amplifier, by H. E. Hayden. Trapping Out Super-Power in New Jersey, by Capt. P. V. O'Rourke.

Feb. 20—The 8-Tube Victoreen, by Herbert E. Hayden. Quality Stressed in 3-Tube Set, by Brainard Foote.

Feb. 27—The 4-Tube DX Dandy, by Herbert E. Hayden. Umbrella Aerial for DX, by Hugo Gernsback. Part 2 of The Victoreen.

Mar. 6—The 1-Tube Set, by Capt. O'Rourke. The Chemistry of Batteries, by A. R. Reid. The Victoreen Set (Part 3), by Herbert E. Hayden.

Mar. 13—The Non-Regenerative Browning-Drake Set, by M. B. Sleeper. The Tectron Eliminator (Part 1), by Lewis Winner. Curing Victoreen Trouble, by Herbert E. Hayden.

Mar. 20—The Super-Heterodyne, by J. E. Anderson. A 2-Tube Speaker Set, by Percy Warren. The Browning-Drake Set (Part 2), by M. B. Sleeper.

Mar. 27—An Economical 4-Tube Set, by Edgar T. Collins. A Practical B Battery, by Capt. P. V. O'Rourke. Tectron Trouble Shooting, by Lewis Winner.

April 3—The Bernard Portable, by Herman Bernard (Part 1). How to Get DX, by Capt. P. V. O'Rourke. A Compact B Supply, by Lewis Winner.

April 10—The Bernard Portable, by Herman Bernard (Part 2). Two Eliminators for DC, by Lewis Winner.

April 17—The New 1-Dial Powertone, by Capt. P. V. O'Rourke. The Bernard Portable (Part 3), by Herman Bernard. The Action of Transformers, by Lewis Winner.

April 24—All Waves on One Set, by Capt. P. V. O'Rourke. Bernard's Portable (Conclusion).

May 1—New Multiple Tube, by Herman Bernard. The Aero All-Wave Set, by Capt. O'Rourke. Kilocycle-Meter Chart. An Analysis of Detection, by J. E. Anderson (Part 1).

May 8—A Study of Detection, by J. E. Anderson (Part 2). To Wind a Loop on a Cardboard Frame. How to Reflex Resistance AF, by Theo. Kerr.

May 15—Super-Heterodyne Results Brought Up to Maximum, by Herman Bernard. The Truth About Coil Fields, by J. E. Anderson.

May 22—A Built-in Speaker Set, by Herbert E. Hayden. The Powertone in Operation, by Capt. P. V. O'Rourke.

May 29—Aerials in Ground and Water, by Lewis Winner. Economized Filaments, by J. E. Anderson. How to Get DX, by John F. Rider.

June 5—Five-Tube Compact Receiver, by J. E. Anderson. A Tester for Tube Circuits, by Spencer Hood. Problems of Portables, by Hugo Gernsback.

June 12—The Light 5-Tube Portable, by Herman Bernard (Part 1). The Rogers-Schudt Receiver, by Wm. A. Schudt, Jr. (Part 1). The Freshman Masterpiece, by A. W. Franklin.

June 19—Selectivity's Amazing Toll, by J. E. Anderson. The Light 5-Tube Portable Set, by Herman Bernard (Part 2). The 4-Tube Rogers-Schudt, by Wm. A. Schudt, Jr. (Part 2).

June 26—The Victoreen Portable, by Herman Bernard (Part 1). The Manufacture of a Tube, by F. C. Kelley. The Light 5-Tube Portable, by Herman Bernard (Part 3). The Rogers-Schudt Circuit (Part 3 concluded), by Wm. A. Schudt.

July 3—Set with a 1-Turn Primary, by Herman Bernard. Part 2 of the Victoreen Portable, by H. Bernard. Trouble Shooting Article for The Light 5-Tube Portable.

July 10—A Rub in Single Control, by Herman Bernard. A DX Double Regenerator, by Capt. P. V. O'Rourke. A 2-Tube Dry Cell Receiver, by Samuel Schmalz.

July 17—A Double Duty Loop Aerial, by J. E. Anderson. How to Measure Coupling, by John Rider. A 1-Control Crystal Set, by Smedly Lyons.

July 24—Why the Super-Heterodyne Is the Best Set, by Herman Bernard. A 1-Tube Reflex Receiver, by H. A. Reed.

July 31—What's Best in an AF Amplifier, by Herman Bernard. A 6-Tube Reversed Feedback Set, by K. B. Humphrey.

Any copy, 15c. Any 7 copies, $1.00. All these 23 copies for $3.25, or start subscription with any issue. RADIO WORLD, 145 West 45th Street, New York City.

Irwin Purchases New York Cabaret

The Club Circus, at 160 West Fourth Street, New York City, will have among its entertainers many whose voices are identified with broadcasting, says G. Clayton Irwin, Jr., general manager of the Radio World's Fair, who purchased the place. He adds that the Club Circus will become the entertainment headquarters of the radio industry when alterations are complete, which will be early in September.

Thomas Reorganizes

The W. I. Thomas Company of Chicago has enlarged its facilities for greater operations under the name of the Iten Fibre Company of Illinois. The company will represent in this territory the Iten Fibre Company of Cleveland and Ashtabula, Ohio, manufacturers of hard and flexible fibre sheets, rods, tubes, washers, bushings and specialties. They will carry in Chicago a complete stock of fibre sheets, rods and tubes in order to be able to ship orders the same day as received. The company is under the management of W. I. Thomas, inventor and manufacturer of the famous Thomas Loop.

Attention, Radio World Subscribers!

Subscribers will note that the end of their subscriptions is indicated on the labels on wrappers. If your wrapper shows a date earlier than the current issue, please send payment for renewal. Changes in expiration dates on wrappers appear two weeks after receipt of renewal.

RADIO WORLD, 145 West 45th St., New York City. (Phones: Bryant 0558-0559.)

How to Test the B-D Without Any Risks

Care Must Be Taken Not to Let a 99 Tube Be Lighted Alone, Due to the Series-Connected Filament, Although If Set Is Properly Wired the Tube Won't Light

LIST OF PARTS

One National antenna unit, type BD-1B (one single tapped coil, one Equicycle variable condenser and one dial); L1L2, C1.

One National detector tuning unit, type BD-2B (one triple coil, one Equicycle variable condenser and one dial); L3L4, L5, C2.

One Jefferson Concertone sealed audio frequency transformer; PBGF.

One Thordarson 30-henry filter choke, R 196; FC.

One Tobe paper filter condenser, 4.0 mfd.; C8.

One Sangamo, Aerovox or Dublier mica fixed condenser, .002 mfd.; C4.

One Sangamo, Aerovox or Dubilier mica fixed condenser, .006 mfd.; C5.

One X-L Vario Denser, model N; NC.

Three Lynch double mountings for the resistors R1, R2, R3, R4, R5, R6.

Two Tobe paper filter condensers, 0.1 mfd. each; C6, C7.

Three Lynch metallized resistors, 0.1 meg. each; R3, R5, R6.

One Lynch metallized resistor; 6.0 meg.; R4.

Five Benjamin push type Cle-Ra-Tone sockets; 1, 2, 3, 4, 5.

One Lynch metallized resistor; 6,0 meg.; R8.

One Lynch metallized resistor, .025 meg. (25,000 ohms); R1.

One Lynch metallized resistor, .09 meg. (90,000 ohms); R2.

One Brach-stat, code 2B, with mounting; R7.

One Carter battery switch; S.

One Sangamo, Aerovox or Dubilier mica fixed grid condenser, .0005 mfd., with clips; C3.

One Bakelite decorated panel, 8x22" (Cortlandt Panel Co., Insulating Co. of America or Pausin).

One pair of Tait brackets.

One Corbett sloping panel cabinet for 8x22" panel.

One bracketed antenna connection block (Ant. Gnd. Eby binding posts thereon).

One bracketed battery connection block (A—, A+, B—, B+, C— Eby binding posts and one Frost Gem-Jac No. 954 thereon).

One 9¼x21¾" hardwood baseboard (furnished with Corbett cabinet).

Four Ce-Co type C tubes.

One 171 power tube.

[Note: The National Velvet Vernier type A dials are furnished with the BD-1B and BD-2B units, unless the variable ratio type is specially requested.]

(Concluded from page 10)

tery post from battery to C Bat— post on strip.

Remember to use 180 volts of B battery and that there is only one B plus lead to set.

Starting Operation

Do not put any tubes in the set yet.

Connect aerial to Ant. post, ground to Gnd. post.

Disconnect B minus from A plus at batteries and disconnect A plus, too. Put a 99 tube in each of sockets 1 (extreme right) and 4 (third from left.) Connect A plus lead to battery again, but not B minus. Turn on switch. If tubes light you are safe to proceed. Turn off switch. Put 199 tubes in sockets 2 and 3 (extreme left and second from left). Remove the other tubes. Turn on switch. The tubes should light.

Never turn on the switch to try 99 tubes unless there are tubes in sockets 1 and 4 or sockets 2 and 3, or both. But the power tube may be tested alone for lighting. Do this now.

(Note L1 is that part of the input coil between antenna and ground. The designation was omitted from Fig. 1 last week.)

THE NEW CIRCUIT

(*Continued from page 7*)

maximum, and all of which is a matter of selection of values throughout.

Prevents or Aids?

Now we can look at the condenser C_n in its aspect as a capacity coupling between the circuits. In this aspect it feeds back energy to the grid via the grid circuit for any operative adjustment of the circuit 1 in a phase tending to produce oscillations, and therefore, as a capacity coupling between the circuits, is not a means "to prevent the generation of oscillatory currents," as specified for the coupling capacity in the Rice claims, but a means functioning diametrically the reverse.

Considering further, it is well within the realm of the possible adjustments of the electrical values of the system of Fig. 13 as a whole to find one where the out-of-phase current fed back by reason of the plate circuit capacitive reaction of C_n would just overcome the in-phase inter-circuit transfer by reason of the inter-circuit coupling of C_n, so that varying C_n would not produce any overall effect one way or the other, thus being neutral as far as the system as a whole is concerned, leaving the reactions produced by circuit 2, which are the reactions that Rice teaches preventing, unaffected one way or the other by variation of C_n; or other weird results could be had, such as in one set of adjustments increasing the capacity of C_n would lessen the tendency to oscillate, and in others the same increasing of capacity would increase the tendency to oscillate. At best, the matter is complicated and indefinite, but there is one feature that is certain, and it is that C_n, in its aspect of capacity coupling between circuits, tends in the worst way to create oscillations.

Not Entire Elimination

As to the advantages of Rice, going back to Fig. 10, by reason of neutralizing the effect of reactions through the tube, and provided it is properly done, the "oscillation line" shown is eliminated. This of course assumes that due care is taken to eliminate so-called stray or distant stage feedbacks between input and output parts of the receiver, such as coil and like couplings.

Of course, on account of the lack of constant coupling in the neutralizing system it is not possible to eliminate regeneration entirely except at one frequency, but it can be kept within such limits that for the range of a broadcast receiver oscillations will not appear. Further, at the one frequency at which neutralization is complete there will be no regenerative rise of current in the plate circuit before actual resonance of the succeeding coupled tuned circuit is reached, as is shown in Fig. 10 for the non-neutralized type of receiver, and though, as a consequence, much less energy exists in the plate circuit we obtain all the benefits of an actual resonant transfer of energy, and we do not have to go far from resonance in circuits designed for high order of selectivity, as is the case in broadcast receivers, to get a most inefficient transfer.

While these benefits cannot be fully realized for those frequencies removed from the one neutralized frequency, yet they are approached to a fair degree in practice. There is also the ability to use a much tighter coupling between stages in the neutralized type than in the necessarily loosely coupled regenerative type, giving a further increase in energy transfer efficiency, along with the fact that there may be used the full amplifying

ability of the tubes, as by full plate and filament voltages permitted by the design of the tubes.

Comparison of Types

These considerations taken together reveal why it is possible to design a multiple tube neutralized receiver that has a higher overall efficiency in spite of much less amplification per stage than a multiple tube regenerative type with extremely high amplification per stage.

It appears unnecessary to mention the benefits to quality of reception accompanied by eliminated excessive regeneration. The destructive effects of regeneration on quality very early started broadcast receiver development towards avoiding it.

We may comment in passing that while Rice was in fact the first to take a real step towards tuned radio frequency amplification, claims for it repose in the cascaded radio frequency regenerative reaction system of Alexanderson.

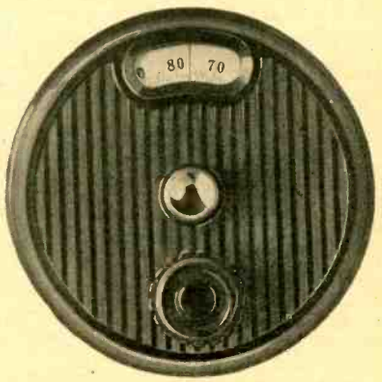
The Rice System has some defects, however, aside from the inability to completely neutralize throughout the broadcast band, one of which is of considerable operating importance, and the other of enormous commercial importance. Rice contemplates no more than mere inductive interstage coupling, and therefore produces the non-uniform energy transfer illustrated in Fig. 2, being much more efficient at the short wavelengths when built into a multiple tube receiver than at the long wavelengths, which fact also results in much less selectivity at the short wavelengths where broadcast stations are now crowding in making selectivity there of increasing importance. The other defect is of the sort that puts the set manufacturer at the mercy of the tube manufacturer, and limits the possibilities of the set in the hands of the ultimate purchaser.

Critical Points

Going back to Fig. 12, it is obvious that the value of the condenser C_n is determined largely by the value of the troublesome inherent tube capacity (in dotted lines), so that to arrive at the proper adjustment a tube must be in place with proper operating adjustment, as this disturbing tube capacity depends to some extent on the filament and plate voltage adjustments.

Now it has never been found commercially logical for the set manufacturer to furnish the ultimate purchaser with tubes, so that once the adjustment is made the adjustment tubes are removed and thereafter what happens is entirely beyond the control of the set manufacturer. He does the best he can by adjusting with tubes he finds to be average for certain types, and recommends in his literature the same type, but has no assurance that his recommendations will be carried out or that the manufacturer of the tube he recommends will continue to produce a tube of the average characteristics with which the adjustment was made. It is not unlikely that the ultimate purchaser finds that his set squeals, and since he doesn't know why, he feels that he has been wronged in some way.

(Concluded next week)



How to Use Crystal in Broadcast Set

Potentiometer Is Used for Bias Alteration, to Provide Greater Sensitivity and Volume—Coil Data Given

(*Continued from page* 14)

are connected together and to the A minus post. The resistance terminals of these rheostats are connected to their respective F minus posts on the sockets. The F plus posts of both sockets are connected together and thence to the A plus, B minus post, through the filament switch, S. It will be noticed that the A minus is grounded. The controlling of the filaments and the regenerative action of the tubes will be found to be rather difficult. It is suggested that the detector regenerative control be kept at a minimum point, when tuning in a station, it should be used for loudening the strength of the signals of the station being tuned in. If it is found that the tubes over oscillate, break the common B plus lead and place 22½ volts on the detector, or on the RF tube, etc. Also try increasing the value of the leak, either via the fixed or variable grid leak methods. Do not keep L2 near L1. Place these coils at right angles to each other.

* * *

PLEASE DESCRIBE how to insert a 120 tube in the last stage of audio frequency amplification in the 4-tube Diamond of the Air, which I have built from the circuit diagram, which appeared in the January 23, 1926 issue of RADIO WORLD. Will this tube increase the volume?—Maxwell Frars, Boston, Mass.

Break the lead from the F minus post of the last socket now going to the resistance terminal of the rheostat controlling the filament temperature of the amplifier tubes. This means that this rheostat will control the filament temperature of the first AF tube only. Connect the F minus post of last AF tube to one terminal of a 120 type Amperite. Connect the other terminal of this ballast resistor to the A minus post. Now break the F minus lead of the second AFT going to F minus of the first AFT, leaving the C battery, connected in the grid circuit of the first AF tube only. Run the minus post of a 22½ volt C battery to the F post of the last AFT. The positive of this battery is connected to the minus of the A battery. About 135 volts should be applied to the plate of this power tube for best results. This tube will not only increase the volume but also the quality.

* * *

I HAVE a piece of carborundum, which I would like to place into a receiver. Would you please describe a circuit, using this crystal, with a battery.—Jack Miller, Brooklyn, N. Y.

A simple RFT, .0005 mfd. variable condenser, 400 ohm potentiometer, .002 fixed condenser, 1½ volt A battery and phones are required. The primary of the coil consists of 20 turns of No. 22 dcc wire wound on a form 3" in diameter. The secondary consists of 45 turns of the same wire, wound on the same tubing as the primary, with a ¼" separation between the two. The beginning of the primary winding is brought to a switch arm. Switch points are brought to taps made on the 20 turn primary, at every 2nd turn. The end of the coil is brought to the ground. The beginning of the secondary winding is brought to the stationary plate post of the variable condenser and to the arm of the potentiometer. The rotary plate post of this condenser is brought to the end of the secondary winding. One terminal of the phones is also connected to the end of the winding. The other terminal of the phones is connected to the high potential point of the crystal and to one terminal of a .002 mfd. fixed condenser. The other terminal of this condenser is brought to the rotary plate post of the variable condenser. The low potential point of the crystal is connected to the resistance terminal of the potentiometer and to the plus post of the battery. The minus post of the battery is connected to the resistance terminal of the potentiometer. This set should give good volume.

* * *

I HAVE a condenser having three stator sections and one common rotor. Each section has a capacity of .0005 mfd. I also have a single .0005 mfd. variable condenser. I would like to build a set using these condensers, with a three-stage resistance coupled AF unit. Please describe the wiring of the RF- Det. unit with the constants of all the parts.—Clem Dorman, Dearborn, Mich.

Use three stages of tuned radio frequency amplification, a non-regenerative detector and the three stages of resistance coupled AF amplification. The first RF stage in the antenna circuit, is tuned by the individual condenser, while the two RF and detector stages are tuned by the triple condenser. The primaries of the second, third and fourth RFT all contain the same number of turns, e. g., 10. The secondaries of all the RFT contain 45 turns. The primary of the antenna or first RFT consists of 8 turns. Each primary and secondary is wound on a tubing 3" in diameter, using No. 22

double cotton covered wire and separated ¼". The antenna post is connected to the beginning of the 8 turn primary winding. The end of this winding is brought to the ground. The beginning of the secondary winding of this RFT is brought to the rotary plate connection of the single .0005 mfd. variable condenser and to the arm of a 20 ohm rheostat. The end of this winding is connected to the stationary plate connection of this condenser and then to the grid post of the first socket. The resistance post of the rheostat is connected to the F minus post on the socket. The arm is also brought to the A minus post. The beginning of the primary winding of the second RFT, is brought to the plate post on the first socket. The end of this winding is brought to the B plus 67½ volt post. The beginning of the secondary winding of this RFT is brought to the common rotary plate connection of the triple condenser. It is also connected to the beginning of the secondaries of the third and fourth RFT. This common terminal is brought to the A minus post. The beginning of the secondary winding of the second RFT is brought to one stationary plate terminal of the triple condenser and to the grid post of the second socket. The beginning of the secondary of the third RFT is brought to another stationary plate post terminal of the triple condenser and to the grid post on the third socket. The last stationary plate connection on this triple condenser is brought to the beginning of the secondary winding of the last or fourth RFT and to one terminal of a .00025 mfd. grid condenser. The other terminal of this grid condenser is brought to the grid post on the detector socket and to one terminal of a variable grid leak. The other terminal of this leak is connected to the F plus post on this same socket. This means that the grid return of this tube is to F plus. The beginning of the primary winding of the third RFT is connected to the plate post on the second socket. The end is connected to the end of the primary winding of the second RFT. This same connection is extended to the end of the primary winding of the fourth RFT. The filaments of the two RF tubes are controlled by a 10 ohm rheostat, which is connected in series with the negative leg of the filament. The filament of the detector tube is controlled by a 20 ohm rheostat, also connected in series with the negative leg of the filament. A bypass condenser, having a capacity of .001 mfd., is connected from the plate of the detector tube to the A plus post. The F plus posts are all connected together and to a terminal of a filament switch. The other terminal of this switch is connected to the A plus. B minus post. The —01A tubes are used in this RF-detector unit, or also in the AF circuit.

High-Class Songs Require Best Voices

Listeners Content With Untrained Who Sing Plain Ballads But Demand Real Quality of Those Who Offer Arias

Although a majority of the radio audience is lenient to a degree with most programs, there is a certain minority which becomes super-critical at the first indication that the program to which it is listening is at all out of the ordinary. Accepting willingly and without question such untrained voices as may sing ballads pleasingly, this portion of the audience will not acept an aria by a trained voice unless it is flawlessly sung, as stations have long ago discovered.

This anomaly is familiar to Arthur Kales KFI manager, who characterizes broadcasting as a microscope, through which imperfections assume most unpleasant proportions. In his opinion the average receptionist is a much wiser man than he is given credit for being. The announcement of a "quality" program serves to put him on his mettle as a critic and has subsequent concentration of attention subjects the radio singer to a searching scrutiny that would disclose flaws in the work of the finest concert artists.

The requirements of radio serve to intensify the effort of both artist and receptionist. If the audience is becoming more critical and harder to please, on the other hand the quality of programs is increasing, for the knowledge of keenly appreciative audience spurs the artist to greater efforts.

Although each fine program sets a precedent and a standard by which all succeeding programs are judged, each program makes it easier to procure and arrange similar presentations. At times it might seem that broadcasting were marking time, but a careful consideration of the average radio fare of today and that of a year ago will indicate that it has progressed remarkably and is getting better all the time.

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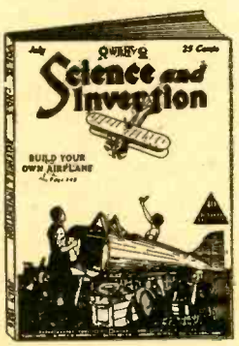

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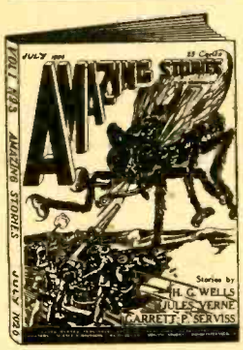

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THEY ALL PRAISE THE BRETWOOD Variable Grid Leak

The Bretwood Grid Leak came with today's mail. It is now exactly 9:00 P.M. and the leak was installed about a half-hour ago.
This note is not only an expression of appreciation but also an attestation of the truth of your advertising. During the past half hour I have tuned in stations "ALL OVER THE DIALS" at leisure, and can adjust reception with the leak almost equal to a variable condenser.
I feel constrained to add that while waiting for reply and then receipt of leak from you, there has been on the set a fixed leak and condenser of well known and thoroughly reliable make, and fairly good reception has been enjoyed, but during this half-hour only test thus far the results are inexpressibly beyond expectation.
Have been a radio fan only about four years, but feel I have sufficient knowledge and experience to recognize a good thing upon fair trial. Your promptness and desire to satisfy your trade, in this case has won for you another "BRETWOOD BOOSTER." Thank you.
The Rev. WALTER G. BARLOW,
Bishopville, Md.

Very many thanks for your kind letter of the 21st ult. and for the grid leak, which works perfectly. I have tried four different makes of grid leaks. The Bretwood "has 'em beat."
M. SAWYER,
Box 238, Los Gatos, Calif.

Received your grid leak and wish to say that none can compare with it when it comes to clearing up reception.
JOHN A. BLACKBURN,
5328 Warren Ave., Norwood, Ohio.

Enclosed find P. O. money-order for $3.00. Please send me two of your Variable Grid Leaks. I am using one and it works fine. Please mail them as soon as possible.
W. H. PERRY,
119 Congress St., Buffalo, N. Y.

Received your grid leak and many thanks. It is the best $1.50 that I have spent for radio equipment.
ED. JENKINS,
703 E. Main St., Louisville, Ky.

Enclosed herewith find check for $1.50 for one Bretwood Grid Leak. I am using your leak and find it far superior to any others. This is my third Bretwood.
J. C. WHITE,
422 W. Wooster St., Bowling Green, Ohio.

Will you please send me by return mail two Bretwood Variable Grid Leaks. I enclose herewith check for $3.25, the 25c. being for a special handling stamp, as these leaks are needed at once.
The leaks are the only satisfactory instrument on the market. I find them absolutely essential in the construction and operation of sensitive experimental receivers.
ED. J. WHITTIER,
The American Appraisal Co.,
Milwaukee, Wis.

I want to thank you for your leak, it makes the set 100% better. I was going to have a Diamond of the Air built, but since I have added your leak to my set I am now down in the dining room of the first floor and the set is on the second floor. I can hear the set just as plainly as if I were up there. I can hear every player in any band or music which is on air. The first night I gave the leak a very good test, and I got four stations in Chicago, one in Detroit, one in Canada, one in Atlanta, Ga., and several others without any noise. All were good and clear. It is going to make me spend more money, as I will have to get a good loud speaker. The horn I have now is a Manhattan Jr., and is good and clear, but as soon as your leak is installed the howling present when using three tubes is immediately stopped.
LEON E. COLE,
5816 Tilbert St., Philadelphia, Pa.

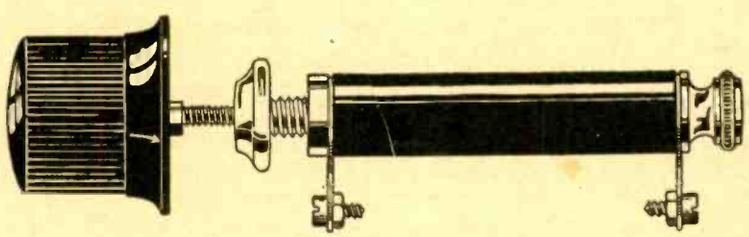
Grid Leak received and tested out, and find it is the only variable leak I ever used that is really variable. Enclosed find $1.50, for which please send me another one.
F. E. STAYTON,
Box 240, Ardmore, Okla.

Thank you for introducing me to the Bretwood Variable Grid Leak! I have installed one in my Three-Circuit Tuner, according to your instructions, and find that it does all you said it would—and more. I am now recommending the Bretwood to all my friends, and those who have used this wonder grid leak have nothing but high praise for it. The fact that it can be adapted for any hookup makes it invaluable to the experimenter.
Although I have only used the Bretwood leak for three weeks I have pulled in several of the weaker stations which were inaudible before, and the microphonic noises which were decidedly pronounced before have entirely disappeared.
Please accept my best wishes for your continued success and also for the Bretwood Grid Leak.
S. R. HUBBS,
180 Quincy St., Brooklyn, N. Y.

Let me say that the Bretwood Grid Leak improves the set 100%.
J. E. McGINNISS,
27 Lenox Rd., Brooklyn, N. Y.

I wish to take this occasion to thank you for your courtesy in furnishing me with your very excellent Grid Leaks. I have installed one with your Condenser on my own personal radio set, and am delighted with the results.
R. W. DeMOTT,
Experimenter Pub. Co.,
53 Park Place, N. Y. C.

I have received the Grid Leak you sent me and it is perfect. It is surely wonderful the way it works. Please send me another by return mail for a friend.
J. F. COOPER,
1029 Courtlandt St.,
Cincinnati, Ohio.



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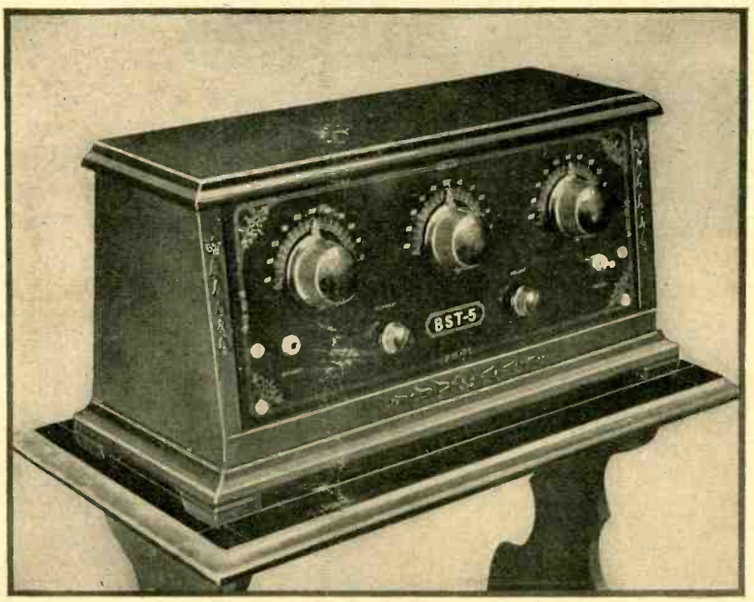

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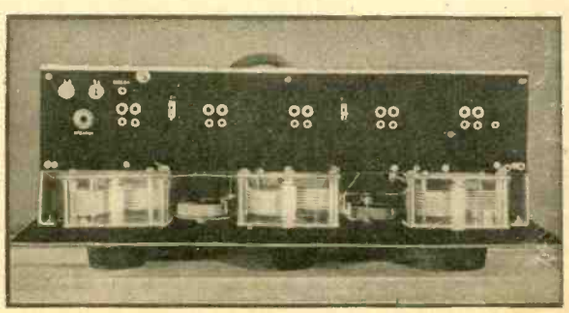

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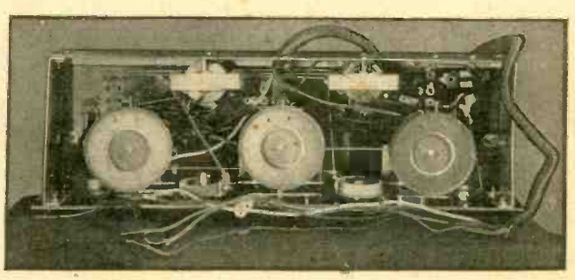

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