LINDBERGH PLANE SPEAKER

JUNE 25 1927 15 CENTS

RADIO WORLD

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Is a Loop Efficient?

A Tube and Set Tester

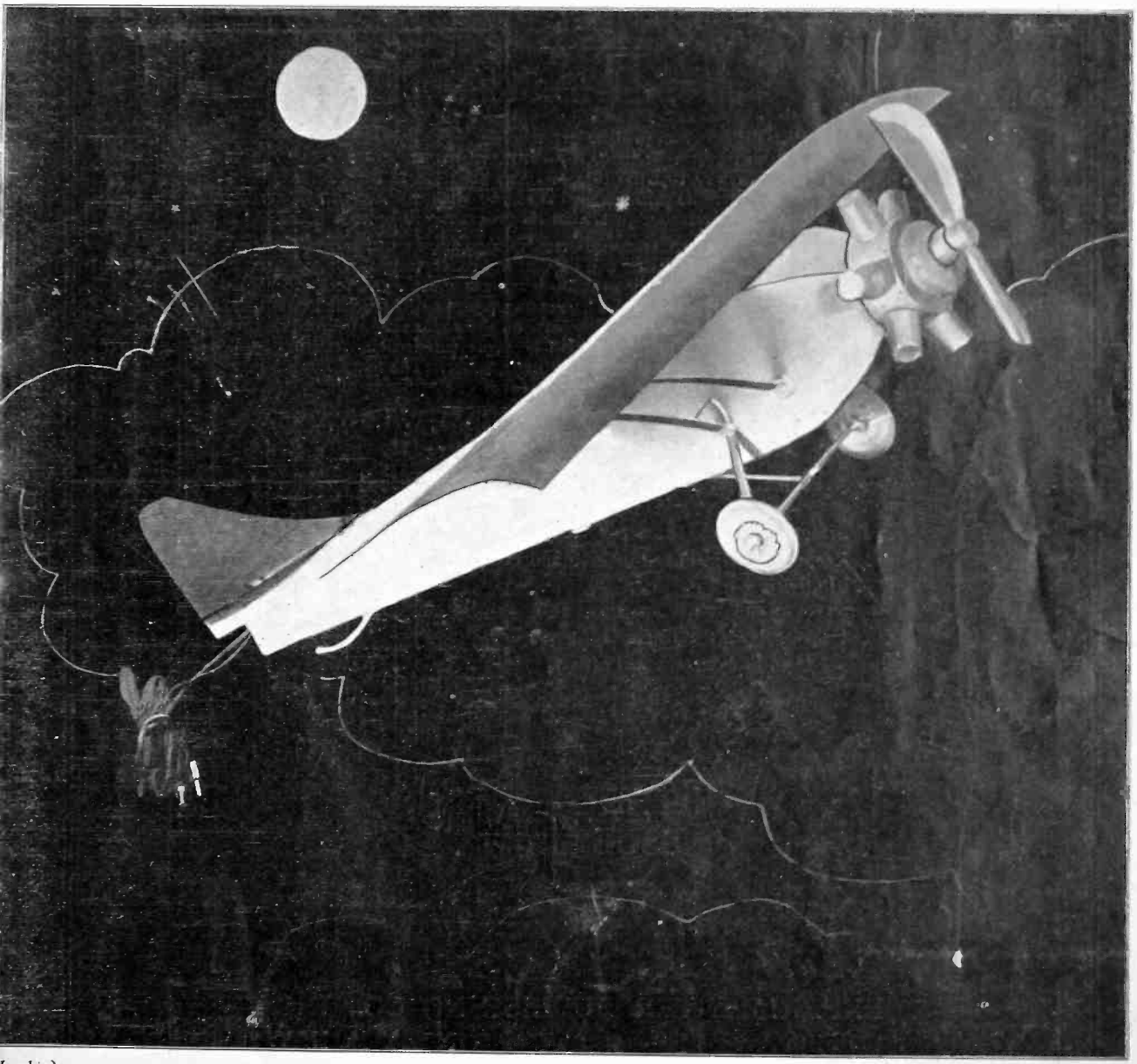
Second Harmonic Distortion

Storage B Batteries

Audio Cutoff Limits

Studio Road to Fame

The Spirit of St. Louis Speaker For Your Parlor



(Hayden)
The Lindbergh Plane Speaker consists of the fuselage, housing the unit, and the wing spread, comprising the sounding board. The cord tips are brought out at the tail. The rest of the apparatus is ornamental. See page 3.

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The Lindbergh Plane Speaker

The Spirit of St. Louis Makes a Fine Model

By Herbert E. Hayden

(Photographs by the Author)

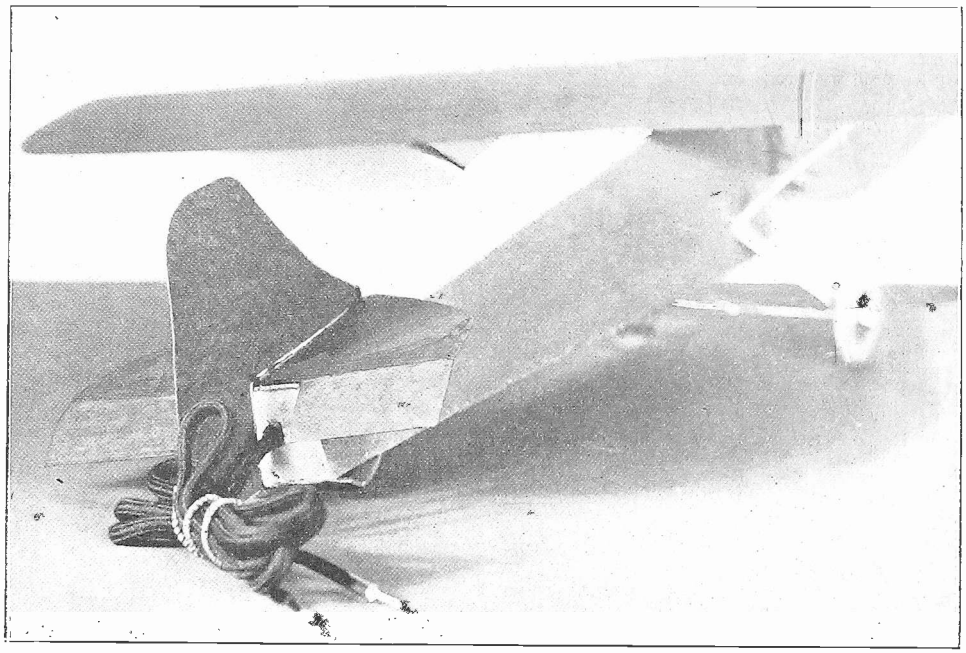


FIG. 2

Rear view of the assembled plane, showing wing, landing gear and steering gear. The fuselage is the long body, the wing is at right angles to it. The speaker cord is brought out through the tailpiece.

A LOUDSPEAKER that reflects the Spirit of St. Louis and the spirit of aviation, to remind you of the epochal flight from New York to Paris made by that ace of air and hearts, Col. Charles A. Lindbergh, is a decided attraction in the home. You will want one the instant you see that a satisfactory speaker in the form of Lindbergh's plane can be made simply and with only a few ordinary tools.

In the construction of a speaker model of an airplane it is not necessary to include all the details of the plane. But the general lines of the Spirit of St. Louis may be followed to remind anyone of the magnificent flight by America's Ambassador without portfolio.

Mount Unit Securely

Since the model is not to be a flying model it is not necessary to consider weight in selecting parts. It can be made of Alhambra Fonotex paper, actuated by an Ensco unit. It is much easier to make it out of such speaker material than out of metal. But there is one advantage in making the body of the model rather heavy, and that is its efficiency as a loudspeaker.

If the unit is not mounted securely on something which is much heavier than the mass which it is supposed to shake, it will not shake it well but will itself be shaken. A movement of the speaker unit back and forth does not contribute much to the sound. The unit should remain in one position and the sound board must vibrate if there is to be a maximum sound.

Although a loudspeaker driving unit has nothing to do with Col. Lindbergh's flight, it is the first thing that should be selected in building the model, because the driver is one of the most important things about a loudspeaker, and its size determines the size of model to make.

One thing to remember in selecting the unit is that it must be concealed in the fuselage of the plane model, and therefore it cannot be too large. If too large a unit is used the dimensions of the plane will have to be increased generally.

Brace for the Unit

The unit should be so arranged that it can be fastened simply but securely to the bottom of the fuselage. A heavy foundation for the speaker, or backing, will improve its operation quite a good deal. This backing can consist of a block of hardwood or metal. As much of this should be used as is consistent with the space available and the strength of the fuselage. Wood or machine screws can be used to fasten the unit to the bottom of the fuselage, depending on the type of backing is used for the unit.

The operation of the Lindbergh plane speaker is the same as that of any other speaker of the cone type. The wings, fuselage and all form a part of the sound-radiating surface, but the wings constitute the main sound board. The wings really consist of a single piece of Alhambra paper. In the model constructed the piece is 5½ inches wide and 19½ inches long. A diagram shows cut and dimensions of the wing or sounding board.

The fuselage can be constructed of stiff cardboard, which makes the construction simpler, and for that reason it was used in the laboratory model.

Fuselage Dimensions

Fig. 4 illustrates the cut and the dimensions of the cardboard. The dotted lines represent where the cardboard should be folded at right angles. A half-inch flap is provided on one side for gluing the

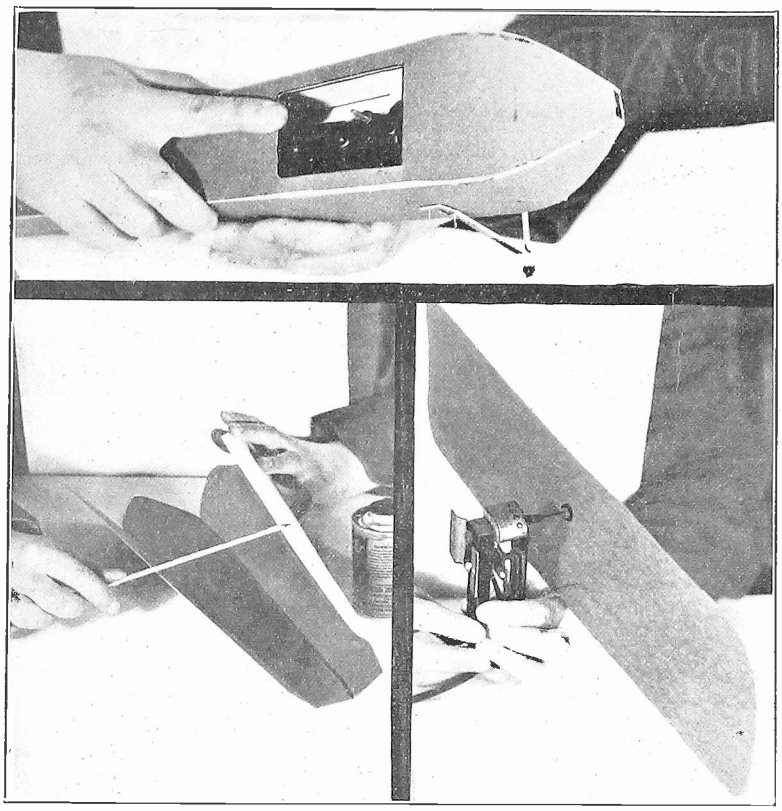


FIG. 3

Left—How the fuselage is put together with glue. Right—How the unit is attached by means of the driving rod to the wing or sound board. Upper—The assembled fuselage, showing the driving unit in the cockpit. It also shows how the wheels of the landing gear are mounted and braced.

fuselage together after it has been folded. At the folds it may be advisable to stitch with thread, as well as at the flap.

The rectangular hole in one of the sections is the cockpit into which the driver unit must fit. It is fitting to remark that the driver occupies the cockpit!

Every well-appointed airplane has a rudder and elevators to serve as tail feathers on the mechanical bird. Hence this model is equipped with them, too. They should be made of cardboard (as was the fuselage) or of Alhambra Fonotex (as were the wings). The shape and size of the rudder are shown in Fig. 6. The elevators are of equal size and cut so that when the two are placed side by side they form an approximate square. One is placed on each side of the rudder. The rudder is mounted vertically behind the fuselage so that normally the plane of the rudder is parallel with the center line of the fuselage. The elevators are mounted horizontally. Ambroid cement can be used to attach these parts to the fuselage.

While glue or cement is drying the other parts of the model should be made.

Three essentials of any airplane are the motor, the propeller and the landing gear. All of these must be added to give the model the appearance of the real thing.

The body of the motor is made of a 2-inch cork. This has been shaped so that it fits the front of the fuselage. A sharp pocket knife is the only tool required to give the cork the proper shape. The cylinders are represented by six smaller corks glued to the side of the main one at suitable intervals. While the real motor has more than six cylinders, this number is sufficient to give the illusion of reality. Anyone with a little ingenuity can fashion a neat-looking motor out of this material. If, however, corks do not meet with the requirements in any case, the complete motor can be moulded out of plastic wood, which can be shaped like putty and which hardens into regular wood on drying.

The propeller can be whittled out of a block of wood about ½ inch square and 2 or 3 inches long. Finishing touches can be given with sandpaper. Or the propeller can also be cut out of cardboard. In this case the propeller should be made in two halves and separately glued in position in front of the motor, each half being set at the proper angle to give the correct effect.

The landing gear is made of two parts, the landing skid and the wheels.

The wheels consist of two round rubber ink erasers such as are used in offices. These are mounted to the fuselage by wooden sticks about the thickness of matches and 4½ inches long. Stays and struts are made of similar material. Ambroid cement and thread will suffice to bind these parts together.

The landing skid requires separate treatment. It is made of a thin piece of wood and bent into proper shape. The bending can be made by first heating the strip over a candle flame, not enough to char it but to soften it throughout. While hot, the strip can be bent and shaped as desired, and if constrained until it is cold it will retain its curved form. It is glued to the under side of the fuselage under the steering gear.

The next step is mounting the driver unit in the fuselage in such a manner that the driving rod projects out of the center of the cockpit.

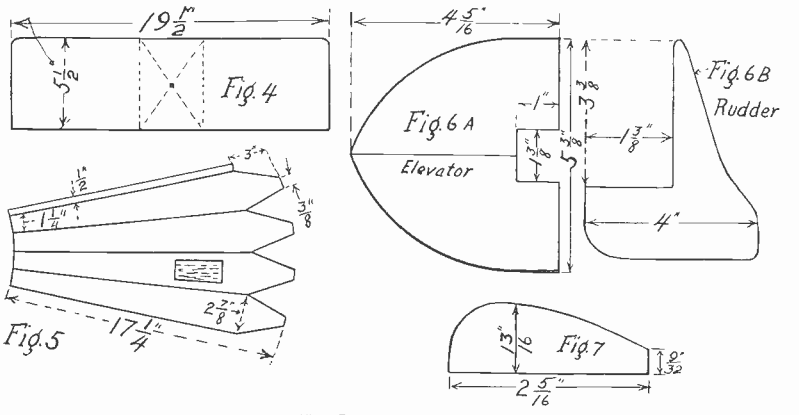
When this has been done the wing can be put in place. It is secured by means of struts in such manner that the plane as a whole clears the upper side of the fuselage. Only the struts and the driving rod should touch the sounding board. Four struts are required to hold the plane in position.

A smaller hole is drilled in the center of the plane. The end of the driving rod is inserted in this hole. The two can be secured together by means of a screw and nut. If the Ensco unit is employed this part of the work can easily be done because the rod is threaded. Two nuts, one on each side of the plane, will be enough to make the coupling firm.

A standard 6-foot phone cord is run from the driving unit to the output tube of the receiver. This cord can be brought out at the tail of the machine. Or a small Carter single open circuit jack can be mounted at the rear of the fuselage and the terminals of the driver unit connected to this. The output of a receiver can then be plugged in this jack whenever it is desired to operate the plane model speaker. This construction will do away with a dangling cord from the tail of the machine when it is not used.

LIST OF PARTS

One sheet of Alhambra Phonotex.
Two circular ink erasers.
One single open circuit Carter jack.
One sheet heavy white cardboard.
One can of plastic wood.
[or one large cork and six small ones].
One Ensco loudspeaker unit.
One can of Ambroid cement.
A few small sticks of wood.



FIGS. 4, 5, 6 AND 7

Drawing showing the size and shape of the wing of the model plane speaker (Fig. 4). Pattern of the fuselage as it should be cut from a sheet of cardboard (Fig. 5). The shape and dimensions of the elevator (Fig. 6A). The outline and dimensions of the rudder (Fig. 6B). Half of the propeller if this is cut out of cardboard (Fig. 7).

Why Loops Are Efficient

Some Popular Fallacies Get Severe Jolt

By Capt. Peter V. O'Rourke

Contributing Editor

THERE are many cases in which it is not practical to use an open circuit antenna, so a loop is employed.

It is usually considered that the pick-up efficiency of a loop is very low and that it is not practical to use a loop. It is true that a loop is not exposed to the same strength of electric field as an antenna, but not that it is inefficient. The reason for the comparatively high efficiency of the loop as an energy gatherer is that it has a very low resistance.

The voltage in it is small because the electric field in which it is placed is small, but owing to the low resistance in the circuit the current induced in it at resonant frequency is very high. Hence the voltage across the tuned circuit in the case of a loop circuit, which is the input voltage to the tube, is of the same order of magnitude as the voltage that gets to the grid when an open antenna coupled loosely to a secondary is used to pick up the signals.

Large Turns Area Helps

The factor beside low resistance which makes for an efficient loop is large turns-area. That is, the greater the number of turns in the loop the greater will be the voltage induced in the loop by a given field strength. Also, the greater the area of the loop the greater will be the voltage induced in it by a given field strength. The voltage induced is directly proportional to the number of turns but not quite to the area, except for small loops. It is, however, proportional to the height of the loop.

A loop 2 meters in height will pick up just twice as much as a loop one meter high, all other conditions remaining constant. It is not quite proportional to the distance across the loop but may be taken so for loops which are small in comparison with the wavelength of the carrier being received. For all practical loops at broadcast frequencies the pick-up capabilities of the loop can be taken as proportional to the number of turns and the area of each turn.

When the turns have different dimensions, as in the case of spirally wound loops, the mean turn should be taken and all the turns considered to be of that size.

Condenser Limits Turns

There is a limit to the number of turns that can be used. The loop must be tuned with an ordinary condenser, and the ratio of maximum to minimum capacity must be such that the entire broadcast band can be covered To make the minimum capacity as small as possible, thus allowing a large number of turns and a small tuning condenser, the turns should be spaced. The usual practice is to space the turns about a quarter of an inch. It is better to use bare wire than insulated because with solid insulation the capacity between turns is much greater with a given separation than with no insulation other than air.

The design of a loop which will cover a given frequency band with an available condenser begins with a determination of the total capacity in the circuit when the tuning condenser is set at maximum. Suppose that this capacity is 300 mmfd., and the range 50 to 300 mmfd., the 50 mmfd. representing the "zero" setting capacity of the condenser, the capacity of the leads to the grid of the tube and the capacity of the loop. This last part will have to be assumed, since it cannot be measured before the loop has been made. The loop capacity, if the loop is well constructed, will not be great in comparison with the other stray capacities and the 50 mmfd. assumption is not far from correct.

Runs from 550 to 1,350 kc Usually

Now the desired tuning range will probably be from 550 to 1,500 kilocycles. If the inductance of the loop be made 278 microhenrys the lower frequency limit of the tuner will be just 550 kilocycles, the broadcast limit.

If the tuner also reaches the upper frequency limit of 1,500 cycles, well and good. If it does not, the tuning condenser will have to be larger and the inductance of the loop smaller, or the zero setting capacity of 50 mmfd. will have to be reduced. Actually the tuner will not reach higher than about 1,350 kilocycles. To reach 1,500 the zero setting capacity must not be larger than 40 mmfd.

If it is desired to use a large number of turns on the loop and a small tuning condenser and still reach the high frequency limit of the broadcast range it can be done by tapping the loop.

The whole loop could be used as long as the condenser tunes properly, and then two-thirds of the turns, for example, could be used for the higher frequencies. The loop is more efficient on the higher frequencies, and the reduction in the number of turns will not greatly affect the sensitivity as compared with the sensitivity at the lower frequency end when using the entire loop.

Weak Field Strength

One reason why the loop antenna has gained the reputation of being inefficient is that it is usually employed in locations where the field strength is very weak. An open circuit antenna is not used in these locations because of obstructions. If it were used it, too, would prove inefficient.

One place where loops are employed frequently is inside large steel structures, which themselves are often located in the center of a large area of similar steel structures. No antenna will pick up much energy in such places. There are so many radio shadows thrown on the receiver that it is practically located in the "dark." Only tiny undulations of the ether waves reach the receiver.

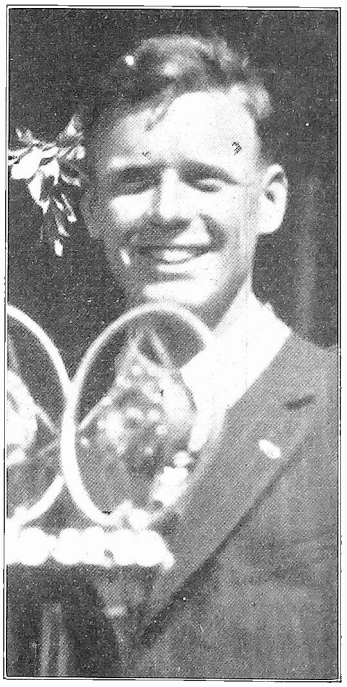
Just how much of the radio waves that get through to receivers thus shielded by steel structures can be estimated from an analogy. Suppose there is breakwater situated on an exposed part of the coast. Let this breakwater be made of several parallel concrete walls have small openings at regular intervals. Let the openings of one wall be opposite the solid portion of the next wall. Under these condtions how much water disturbance will there be on the lee side of the breakwater?

30,000,000 Tune In On Lindbergh

More than 30,000,000 persons scattered throughout the United States, listening to broadcasts from fifty stations of the National Broadcasting Company's Red and Blue networks, heard the reception given at Washington to Colonel Charles A. Lindbergh, the intrepid New York-to-Paris flier. WJZ and WEAF were the key stations. The chain was the most gigantic ever, involving more than 12,000 miles of wire, and more than 400 radio and telephone engineers. The events were also sent out on short waves by WGY and KDKA.

It was a most dramatic broadcast when Colonel Lindbergh stepped on the bridge of the cruiser Memphis, in the Navy dock in Washington, and greeted his mother. Again, when President Coolidge pinned the Distinguished Flying Cross on Lindbergh's lapel, at Washington Monument, came another thrill. Colonel Lindbergh spoke before a microphone, his voice carrying to the people of the United States for the first time. He brought from France a message of friendship on behalf of France and the other nations of Europe, to the people of the United States.

Phillips Carlin, of WEAF, who was perched on top of the monument, painted a vivid word picture of the medal presentation. Graham McNamee, also of WEAF, described the meeting at the dock. John B. Daniels, of WJZ, told of the proceedings from the Treasury steps.



(Underwood & Underwood)

COLONEL CHARLES A. LINDBERGH, at the Mall, in Central Park, New York City, broadcasting his thanks after receiving the New York State medal from Governor Smith.

The Universal Tester

The Device That Changes Trouble to Joy

By Herman Bernard

Associate, Institute of Radio Engineers

THE handiest trouble-shooting and information-yielding device that a radio experimenter, service man or engineer can possess is a universal tester. This would require five meters. But the tester may be made to include fewer meters, depending on how far you want to go, or what apparatus you have on hand or desire to buy. There is one outstanding fact about the universal tester. It pays for itself in the long run. It saves considerable time when one is hunting the cause of trouble and insures first-class reception.

Anybody who builds a tester should have one that enables him to obtain the plate current reading of any tube circuit in the set. This function is performed by the milliameter, MA, which might as well be of 0-to-100 full-scale deflection, since you can always read the lower drains sufficiently well, and are not prevented from obtaining the full current drain of an entire set, with only one exception. That is the case of series connected type A tubes, which draw a quarter ampere (250 milliamperes).

What's Quickly Determined

As the tester will be used in most instances to determine the state of affairs in respect to any one tube at a time, if we have the 0-to-100 milliameter MA, the 0-to-10 voltmeter V, the 0-to-5 ammeter A, and the 0-to-1 or 0-to-1.5 milliammeter MCA, we can find out the following in a jiffy:

The plate current.
The filament current.
The filament voltage.
The grid current.

If we know the characteristics of the tube that we are testing, then by using grid bias we can determine the effective plate voltage as well. For instance, if a tube draws 2 milliamperes at 5 volts positive grid with 45 volts effective on the plate, then when we know any two of the three conditions we perforce know the other. Hence we use the tube as a voltmeter. By actually applying various plate voltages and grid biases, positive, zero and negative, for a particular tube, we can mark that tube for identification, so we will choose the right one as our tests are made, and can determine effective plate voltage without future use of a voltmeter. If we draw a curve, plate current against plate voltage, with a given bias, we can always apply the same bias to the same tube, and read the voltage by the current indications in MA.

Measuring High B Voltage

Note the 0-to-100 milliammeter MA, the 0-to-1 milliammeter MCA, and the ammeter A interrupt the four leads that go from the socket in the receiver (lower part of Fig. 1) to the socket of the tester (top). The 0-to-10 voltmeter is connected in parallel. The B voltage meter BV also would be connected in parallel, if one were used, and this connection is shown by the dash line in Fig. 1 (with B-to-F-).

With B eliminators in such popular use, it would be necessary to have a high resistance voltmeter for BV, and even one of 0-to-250 volts full-scale deflection, because of the high voltages used on the plates of output tubes. But if you can borrow enough batteries to add to your own to bring up the plate voltage to suitable heights, then you can chart a tube by metering the plate voltage, reading the plate current, with fixed bias, return the borrowed batteries and B voltmeter, and proceed with the vacuum tube voltmeter.

Of course the system works the other way as well. Knowing the plate voltage and plate current, you can determine the grid bias. This is important where one uses the resistor method of obtaining negative grid bias.

Resistor Bias Connection

The connection is as follows: the B minus lead of the B eliminator is used as C minus for the last audio tube, and for that only. A resistor is placed between this point and the common voltage source, e.g., A battery or A eliminator or midtap of a filament secondary where the tube filament is AC heated. The B minus lead is the most negative point, hence as the current flows through the resistor, any other point on the resistor is positive in respect to B minus. The resistance of the resistor for this purpose will differ, depending on the total plate current drain, since all the plate current for the entire set flows through this resistor. A good plan is to use a variable resistor, somthing around 400 ohms being enough for most output tubes, except the 71 and the 210, where 2,000 ohms would be nearer the desired resistance, provided the B supply delivers the high voltage current required by these tubes.

A word of warning: If you desire to determine the negative grid bias resulting from the introduction of the biasing resistor, do not suppose that the plate current and voltage throughout the set undergo no reduction when the biasing resistor is introduced. The negative grid bias is obtained at the expense of the total voltage output, and as this is a fixed maximum for any given plate current drain, the plate voltage is less all around and naturally so is the plate current. But as the biasing resistor should be used only in connection with B eliminators designed to supply the necessary voltages at high loads, there is nothing to worry about, only something to remember.

A Mistake Many Make

For instance, if there were no biasing resistor, and a grid biasing battery were inserted at X in Fig. 1, many might assume that removal of the biasing battery and insertion of the biasing resistor at

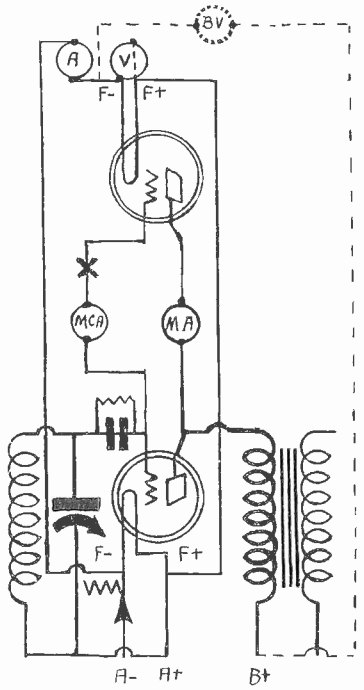
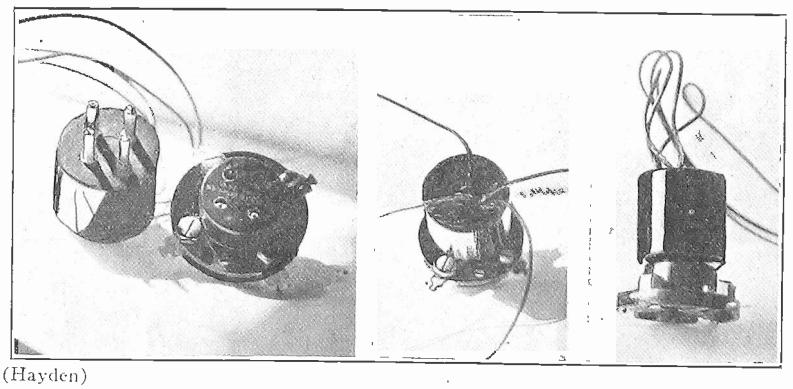


FIG. 1.

The tester connected. The detector stage is utilized as the example (lower part of the diagram). The tube is removed from the detector socket and in this socket a plug is put. The removed tube is put instead in the socket of the tester (top). The four leads from the plug to the tester socket are shown perpendicularly, three of them interrupted by suitable meters. MCA is a microammeter or 0-to-1 or 0-to-1.5 milliammeter, MA is a 0-to-100 milliammeter A is a 0-to-5 ammeter and V is a 0-to-10 voltmeter. If the applied plate voltage is to be measured directly, an additional meter, BV, 0-to180 may be used.



(Hayden)

FIG. 2, FIG. 3, FIG. 4.

The plug consists of the base of an old tube, in conjunction with which a socket is used as the foundation apparatus of the tester. Four flexible leads are soldered to the feet of the plug base. The inside of the base then is filled with plastic wood or sealing wax.

its proper place (not at X, but at the point previously described), would give plate current readings that would indicate the grid bias. This is not so, because the voltage has been reduced (and the plate current likewise) by the insertion of the biasing resistor.

Determining what the bias is when obtained by the voltage drop in a resistor in series with the common voltage sources is rather difficult. A good solution, although not the most scientific, would be to obtain the effective plate voltage and turn the resistor until the plate current flow equals that prescribed for that type of tube at the specified plate and grid voltages. An easier and still pretty good method is simply to turn the biasing resistor until the milliammeter needle MA stands still on loud signals, without reducing the volume much. One will find that too little negative grid bias almost always gives more volume than just the right bias, but this is a sort of siren. The bias is determined on the basis of the tube characteristics, and is equal, generally speaking, to a negative amount equal to the maximum positive swing of the grid at any cycle of the loudest signal.

Fixed Drop, Varied Bias

The determination of the correct negative grid bias is greatly facilitated by using a potentiometer instead of a high-resistance rheostat, as in R. Fig. 5. The voltage drop in the potentiometer R is constant for any given total plate current load, but the bias is varied by turning the knob, simply by cutting in so much or so little of the drop as is necessary. The only change in plate current is that developed by the bias alteration itself, and this applies only to the final audio tube, the sole one biased by this method. Thus as the negative grid bias is increased the plate current drain by this tube is lowered, and vice versa. Only a small change of plate current results in actual practice,

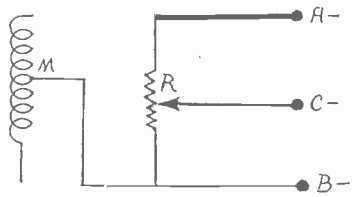


FIG. 5

The potentiometer method is preferable, since the voltage drop in R is constant, only the bias being varied. Note that there is actually a B minus lead to the midtap M of the power transformer secondary. By the rheostat method B minus and C minus would be consolidated, e. g., if C minus and B minus above were shorted.

since the tube chokes on too little negative grid bias and suffers great volume loss on too much bias, so the working range, within which the actual experiment will be made, is small.

The previously discussed methods therefore may be applied as in the case of unchanged flow of plate current and unchanged voltage (except the grid bias voltage). The voltage drop is fixed. Only the bias is varied. The rheostat method varies both bias and drop at the same time, which complicates matters.

Use of Tube Characteristics

The average IpEp characteristic curve of a vacuum tube may be used in making tests that will give results that are perhaps only approximate, but satisfactory nevertheless. The plate current-plate voltage curve is the important one, where one lacks a milliammeter and desires to know the plate current or lacks a suitable voltmeter and wants to know the plate voltage. The curve shows the actual effective voltage, not the applied voltage, for the two would not be the same in the case of a receiver, the external load on the plate circuit intervening, serving to reduce the applied voltage to the effective voltage. But a tube circuit may be set up independently.

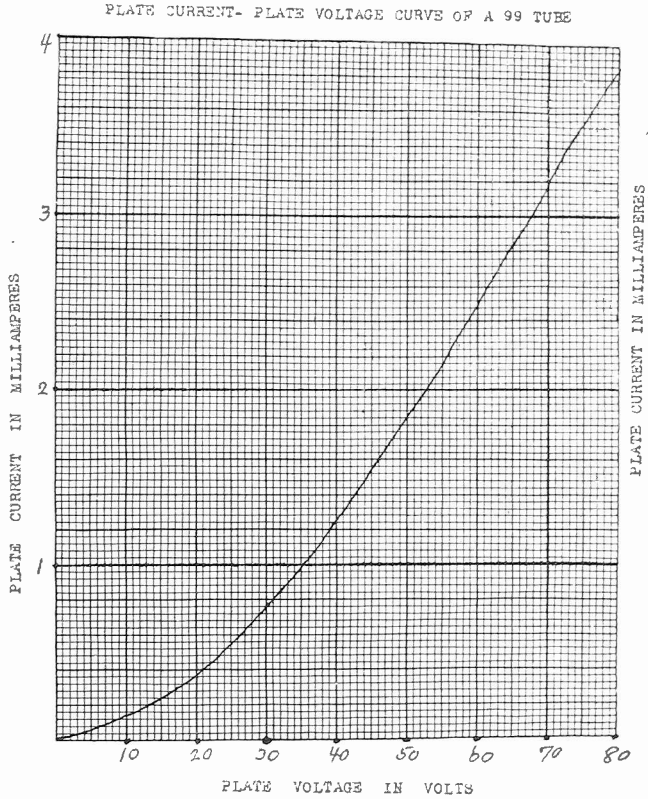
Figs. 6 and 7 show the characteristic curves of the 99 and —01A tubes. The grid bias must be zero, if these curves are to be of any value. Such a bias is obtained by connecting the grid return to negative F, with the tube worked as an amplifier. If the return were to positive A it would be worked as a detector, and not only would this increase the plate current flow, but current would flow in the grid circuit.

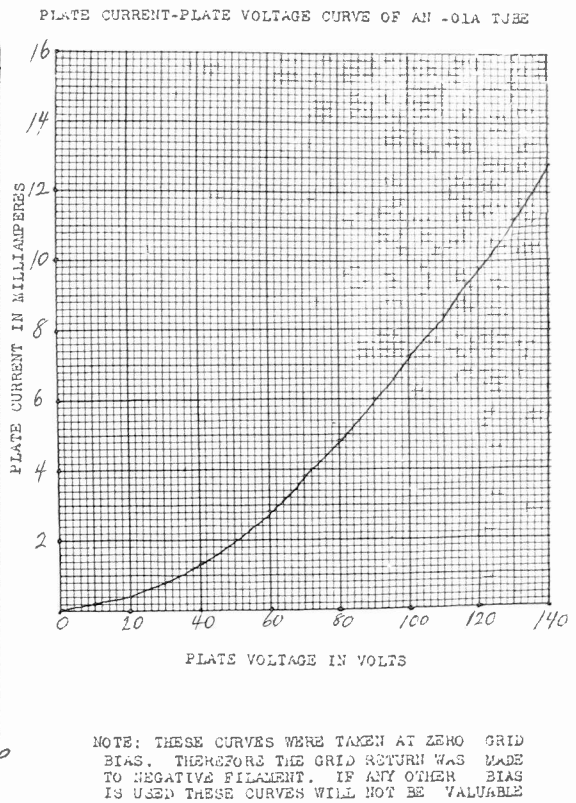
When hunting for the cause of trouble in a receiver the answer may be an incorrect grid return, and this would show up as a higher reading on a milliammeter than the curve calls for. Hence the curve is a good checkup even when one is supplied with milliammeter and B voltmeter, two instruments that are almost indispensable. In amplifier circuits it is common practice to connect the grid return to A minus (rather than F minus) and thus get about one volt free negative bias, or even to use a C battery, so the plate current drain should read less than what the curve shows, as the curve was taken at zero bias.

Why It's Handy

By using the tester one may determine which tubes are good, bad or indifferent; can match tubes, since those that give the same readings under the same conditions are matched; can improve receivers generally, by using the right tubes, especially in Super-Heterodynes; can quickly discover shorts or open circuits, and detect the presence of tube distortion, indicated by wabbling of the milliammeter needle (MA).

The grid current meter, specified as a 0-to-1 or 0-to-1.5 milliammeter, is more of an assurance meter than anything else. Usually it gives no reading. A 0-to-500 microammeter might well be used instead, but this is too costly.





NOTE: THESE CURVES WERE TAKEN AT ZERO GRID BIAS. THEREFORE THE GRID RETURN WAS MADE TO NEGATIVE FILAMENT. IF ANY OTHER BIAS IS USED THESE CURVES WILL NOT BE VALUABLE

FIGS. 6 AND 7

Harmonics In Amplifiers

Distort Little At RF, But More At AF

By J. E. Anderson

Contributing Editor; Consulting Engineer; Associate, Institute of Radio Engineers

IF a headset be inserted in the plate circuit of the first radio frequency amplifier in a circuit which is tuned to a given station, the signal from that station can be heard provided that the signal from the station is strong enough.

It makes little difference whether or not the other tubes in the receiver are operative at the time. If the headset be inserted similarly in the second radio frequency amplifier, the signal can be heard louder than in the first stage. Why can the signal be heard before the detector?

If the signal impressed on the receiver is unmodulated no sound can be heard when the headset is inserted in either the plate circuits.

But suppose that the first tuner be adjusted to the frequency of the unmodulated signal and that the second be tuned to twice that frequency. If now a radio frequency ammeter of sufficient sensitivity be inserted in the second tuned circuit an indication will be obtained showing that there is a current of double the signal frequency present. Similarly if the second tuner be adjusted to a frequency three times that of the unmodulated signal, the radio frequency ammeter will again give an indication of the presence of this higher frequency. This can be extended to frequencies four, five, six and more times the frequency of the incoming signal, provided that the radio frequency current meter be made progressively more sensitive.

All in First Plate Circuit

Thus all the harmonics of the unmodulated signal are present in the plate current of the first radio frequency amplifier. In the same way it can be shown that the higher harmonics are present in the plate current of the second radio frequency amplifier when the first two tuners are set to the frequency of the incoming signal and the third is tuned to the harmonics. Why are the harmonics introduced into the unmodulated signal?

If the signal is modulated the modulation frequency can be heard in the headset, as was stated above, and if the sensitive radio frequency current meter be also inserted, as outlined, an indication of the presence of the harmonics of the carrier frequency will be obtained. Thus when a modulated frequency be impressed on a radio frequency amplifier the plate current of the amplifier tube will contain not only the carrier frequency, but also the modulation frequency and the various harmonics of the carrier frequency. How do these frequencies arise in an amplifier tube?

The Ideal Amplifier

In an ideal amplifier no harmonics would be generated and it would not be possible to hear a modulated signal in the plate circuit when listening with a headset. An ideal amplifier has a straight line characteristic, that is, the plate current is accurately proportional to the voltage impressed on the grid. But such an amplifier does not exist. The characteristic of every practical amplifier is curved and the plate current is not proportional to the input voltage. That is the reason why the harmonics of the carrier frequency are introduced and why the modulation frequency can be heard in the plate circuit. It is the distortion in the tube which causes these extra frequencies, or rather, these frequencies constitute the distortion.

A detector is simply an amplifier tube in which the circuit has been so adjusted as to take advantage of the distortion, make it maximum. Whenever there is distortion, or whenever there is curvature of the characteristic, detection takes place, or something equivalent to it. When the modulated signal can be heard in the plate circuit of a radio frequency it simply means that the tube detects, that it is being operated over a curved portion of its grid voltage plate current characteristic. The production of harmonics is due to the same thing. The difference between a detector and an amplifier is simply that the detector is operated where the curvature of the characteristic is greatest and the amplifier where it is least. In a detector the circuit is so arranged as to increase the curvature, in an amplifier it is so arranged as to straighten it out.

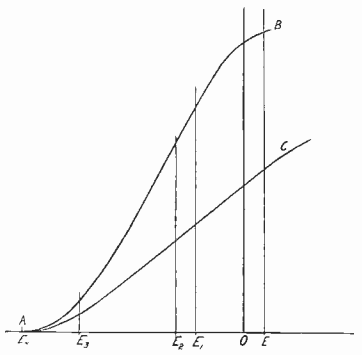


FIG. 1

Characteristic curves of a vacuum tube.

AB represents the curve when there is no load impedance in the plate of the tube. AC represents the curve of the same tube when there is a high impedance in the plate circuit. In AB there is greater curvature along the entire curve, but it is particularly great at the upper and lower ends. The lower curve AC has considerably less curvature and can be considered a straight line over a greater distance. If tube is operated at E3 without load impedance, amplification is small and distortion is great. Similarly if it is operated at 0 or at E' the distortion is great. If the tube is operated at E2 the distortion is small and the amplification is high. If the tube is operated at E3 with high load impedance the amplification is small and the distortion is medium. If it is operated under similar conditions at E2 the amplification is good and the distortion is practically zero. The same holds true of point E1 provided that the input voltage is smaller. Even at 0 the amplification is fair and the distortion is small. If the tube is operated at E' with a high load impedance the amplification is affected by the input impedance of transformer secondary, and great distortion is likely to occur. E2 is the best point of operation for amplification and E3 for detection. With grid condenser and resistance point E' is best for detection.

It is simple to show mathematically how the curvature of the grid voltage-plate current characteristic causes detection and harmonics, but the formulas used are rather involved.

Analysis of Operation

Suppose that a varying grid voltage is impressed on a tube, the grid voltage-plate current characteristic of which is curved is e, then the varying plate current resulting, i_p, is given by $i_p = ae - be^2 + ce^3 - \cdots$, in which a, b and c are constant, depending on the properties of the particular tube used. The first term in the series, namely ae, contains the same frequency as the impressed voltage e, and a is the mutual conductance of the tube with its load impedance, that is, it is the mu of the tube divided by the sum of the plate resistance of the tube and the load resistance. That is the important term when the tubes is used as an amplifier.

A numerical example will make the meaning of a clearer. Suppose that the mu of the tube is 8, that its plate resistance is 10,000 ohms and its load resistance is 40,000 ohms. The total resistance in the plate circuit is then 50,000 ohms and the mutual conductance of the circuit is 8/50,000. Hence a is equal to 160 microhms. If the amplitude of the input voltage is 5 volts, then the amplitude of the current in the plate circuit of frequency equal to that of the frequency of the input voltage 5x160 microamperes, or 800 microamperes.

The second term in the above series for the complete plate current gives the amplitude of the second harmonic current present in the plate current plus a portion of the direct current.

Equation for Second Harmonic

The amplitude of the second harmonic current is equal to the square of the amplitude of the input voltage times the square of one-half the mutual conductance used above, times the ratio of the plate resistance to the total resistance, times the slope of the charatceristic of the tube at the point of operation. Using the same tube as above and the same input voltage, the amplitude obtained is .032 s microamperes, where s is the change in the plate resistance produced by the change in the grid voltage. This is a very indefinite quantity and cannot be given. If the characteristic is linear the plate resistance is constant and the change is zero. This would also make the second harmonic zero. That would be the case in the ideal amplifier, but since there is always some curvature, s has a value different from zero and there is some second harmonic. The greater value of s the better the tube detects, or the more it distorts.

The third term ce^3 in the series, giving the complete plate current, is very small, even when the tube is poorly adjusted for amplification, and it is hardly ever necessary to consider it. It gives a current the frequency of which is three times the frequency of the input voltage, that is, the third harmonic.

Higher Harmonics Negligible

Terms in the series of higher power than the third give the higher harmonics but the amplitude of any one is very small and the decrease in the magnitude is very rapid. Hence if the circuit is reasonably well adjusted for amplification the second harmonic is the only one which will affect the output appreciably. There are certain excep-

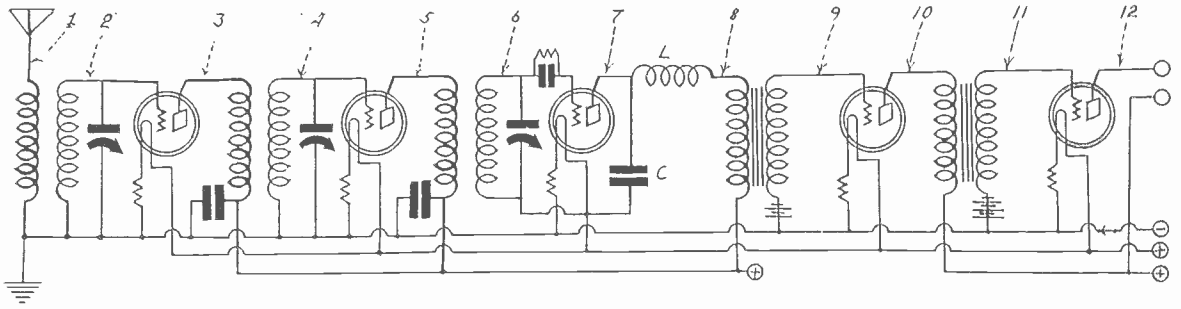


FIG. 2

Circuit illustrating the introduction and rejection of harmonics of the carrier frequency and the detection of the modulated frequency.

(1) the antenna picks up currents of all frequencies. (2) The first tuner selects the carrier frequency desired and theoretically rejects all others. Hence the input voltage to the first tube contains only the desired carrier frequency. (3) The first tube introduces all the harmonics of the carrier frequency and it also detects, so that in the plate circuit of the tube there are present both radio and audio frequency components. (4) The second tuner selects the desired carrier frequency and rejects all the harmonics as well as the detected components. Hence the input voltage to the second tube contains nothing but the carrier frequency. (5) The second tube introduces all the harmonics of this carrier and it also detects if the carrier is modulated. Hence the plate circuit of this tube contains both radio and audio components. (6) But the third tuner selects the desired carrier and rejects all other frequencies, so that the voltage impressed on the detector grid contains only the modulated carrier frequency. (7) The detector produces all the harmonics of the carrier frequency as well as the modulation frequency with all its harmonics. Thus the current in the plate circuit of the detector is made up of the carrier frequency with all its harmonics and the modulation frequency with all its harmonics. The by-pass condenser C, the radio frequency choke coil L and the distributed capacity of the primary of the first audio transformer constitute a low-pass filter which prevents the transmission of all radio frequencies. (8) In the primary winding there is nothing but the audio frequency current, beside the direct current. But this audio current contains the modulation freqnency, which alone is desired, and all of its lower harmonics. The higher harmonics have been practically rejected by the low-pass filter. (9) The input voltage to the first audio tube contains the modulation frequency and its lower harmonics, but the intensity of the harmonics is very low. (10) The first audio frequency amplifier introduces all the harmonics of all the frequencies put into the tube. Thus the output of that tube contains an infinite variety of frequencies and its plate current is very complex. The higher of these harmonics, extremely weak to begin with, are practically eliminated by the distributed capacity of the windings of the transformer, so that at (11) only the fundamental and the lower harmonics are present. But the last tube introduces all the harmonics of all the frequencies that were put into the grid of that tube, and since the voltage swing on this grid is wide, the harmonics introduced are relatively intense. Still, if the last tube has not been seriously overworked, and if the grid, plate and filament voltages are right and if the impedance into which the tube works is large compared to the tube impedance, the intensity of the second harmonic need not be more than 5 per cent. of the fundamental. The higher harmonics are very much weaker than that. Hence at (12) there are present in appreciable magnitude the fundamental of the modulation frequency and its second harmonic. As long as the intensity of the second harmonic does not exceed about 10 per cent. of the fundamental its presence cannot be detected by ear. The second harmonic as a distortion source is usually disregarded so far as radio frequency goes.

tions to this rule, particularly when the higher harmonics are selected and amplified by succeeding stages.

In a radio frequency amplifier there is very little trouble from harmonics or from detection. If the first tube introduces considerable harmonic frequencies the succeeding tuner eliminates them from the signal transmitted to the next tube. Very little of the distortion reaches the detector grid. However, if the second harmonic of the carrier from one station is equal to the carrier of another, direct interference is likely to result, particularly if the signal from the lower frequency station is much stronger in comparison with the higher frequency, because the lower frequency station sets up a second harmonic in the receiver and this is selected and amplified together with the carrier frequency of the desired station. The higher frequency station, if strong enough, is capable of interfering with the lower frequency station because the difference frequency between the two is equal to the frequency of the station desired, which is selected and amplified.

Detection in RF Circuits

In a radio frequency amplifier the detected part of the modulated signal also causes no trouble, because the tuners effectively reject it, much more completely than it rejects the harmonics, because the frequency difference is much greater. Hence what is impressed on the grid of the detector, even after several stages of poorly adjusted radio frequency amplifiers, is pure modulated radio frequency voltage, that is, provided that the tuning is adequate.

By putting a modulated radio frequency voltage for *e* in the series for the complete plate current it can be shown that there is an infinite variety of components in the output. One of these is the radio carrier frequency. This is rejected by the by-pass condenser in the plate circuit and by any series inductance. Other radio frequencies which are present in the output are all the harmonics of the carrier frequency. These are also rejected by the condenser and by the series inductance. Then there is the modulation frequency. This is accepted, as it is the desired signal and is not affected by the low-pass filter, but is amplified by the tubes in the audio frequency amplifier.

Other Frequencies

Besides the modulation frequency, or first harmonic of the audio frequency, there are all the harmonics of the modulation frequency. The first few of these are accepted, as they are audio frequencies, and they are passed on to the audio amplifier and amplified just as the first harmonic. They constitute distortion. The relative intensity of these harmonics depends on the degree of modulation, as well as on the adjustment of the detector circuit. If the percentage of modulation is low, the amplitude of the second harmonic is small in comparison with the first harmonic or fundamental. Its effect on the signal can be neglected, as it is not appreciable. The third harmonic is still smaller in comparison, and, of course, that also can be neglected.

Another reason why the harmonics can be neglected is that they are true harmonics of the fundamental, and therefore they do not produce dissonance. They simply change the timbre of the sound slightly.

But the detector tube is not the only tube which introduces harmonics of the audio frequency tone. Just as the radio frequency amplifiers introduced harmonics of the carrier frequency, so the audio frequency tubes introduce harmonics of the modulation frequency. And in the audio amplifier they are all transmitted toward the speaker, since there is no selective device which will reject them. They are cumulative.

Action in First AF

The first audio amplifier introduces all the harmonics of each of the frequencies transmitted by the detector, and the output of that tube contains all the harmonics of the theoretically single frequency constituting the signal. The second audio amplifier introduces all the harmonics of all the frequencies that reaches it, and so on to the last tube. It is clear that the output of the last tube contains an infinite variety of frequencies, all arising from the single modulation frequency which alone is desired.

The relative values of the various harmonics introduced by any tube depends on the amplitude of the signal voltage, on the applied plate voltage, on the value of the grid bias voltage, and on the ratio of the impedance in the load of the tube to the internal resistance of the tube. It is quite possible to arrange the circuit so that the characteristic is nearly straight over the operating range, when the intensity of the second harmonic will be negligible in comparison with the fundamental.

Furthermore one audio amplifier tube partly neutralizes the distortion introduced by the preceding tube. The third and higher harmonics will be very small in all cases unless the tubes are very seriously overworked.

Small Total Distortion

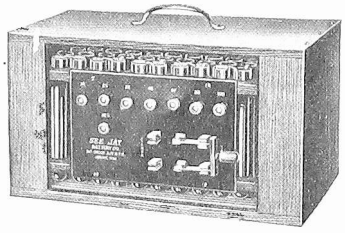
But if the circuit is so arranged that the maximum value of the second harmonic in the last tube is 5% of the fundamental, which is quite feasible, then the total distortion introduced by the audio frequency amplifier will be inappreciable. The distortion introduced in the tubes preceding the first will be wholly negligible.

It is fortunate that the intensity of the harmonics introduced decreases with such rapidity. If the decrease were slower the output would be so distorted that the signal would be unrecognizable. As it is, if the circuit is properly adjusted the distortion will be so small that even on very loud signals it is difficult to detect it aurally.

The Edison Element In Storage B Batteries

By James H. Carroll

Contributing Editor; Associate Institute of Radio Engineers



The Completed Battery, Ready for Use

There are as many differences in opinion as to the best type of plate current as there are regarding the best types of audio and radio circuits. Some fans swear by dry batteries and others are sold on elimination, while others prefer the storage units, and they are all correct in their preferences and as their individual circumstances extend, for all these render good service according to the needs of the user.

In spite of the popularity of eliminator types, there must be a great army of storage battery users, according to their demands for information.

So that we might do full justice to the subject and obtain the information at first hand, I visited a storage B battery factory, donning a pair of overalls, and with a liberal application of elbow grease got right to making such a battery. I selected the See Jay Battery Company and journeyed to their well-equipped factory, 915 Brook Avenue, in the Bronx.

The result of a day's labor was a handsome power unit with trickle charger built in. This works right from the light socket and has stood up beautifully.

The Edison Element

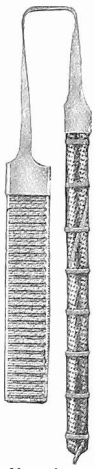
Of course I had the assistance of the full staff of experts; nevertheless, it was the work of my own hands, and in doing it I learned fully the why and wherefore.

Storage batteries are the best means of providing radio current for the filament circuit and are so far most popular for that use. For the plate circuit they have not become so popular due to sulphation of the leaden plates and critical charging. Another drawback is the necessity of adding distilled water, which can easily be done in the A battery, which has only two or three cells, according to the voltage, while in the storage B battery there are from 77 to 108 small cells to be filled. These cells with their tiny vent caps render it tedious to fill with a hyrdometer. Here the Edison element steps in, for it has rendered this type of battery possible and has made it efficient.

The Edison element battery has long been a wonder in the battery field because of its ability to thrive on rough handling, its extremely long life as compared to other types of batteries, and its remarkably good service during the duration of that life. This type of battery can be greatly overcharged time and time again without harm, and the cells can be short-circuited without injury to the cell or to the battery as a whole.

Nature of Solution

The solution used is a potassium hydroxide, which while working to supply the juice, tends to preserve the Edison elements and the connecting electrodes, instead of eating them away. The Edison element storage batteries are also extremely easy to charge and will last practically indefinitely. It is not necessary to bother with hydrometer readings with this type of battery, because the specific gravity does not change, once the battery is fully charged, due to the fact that the action and reaction takes place only between the electrodes, and that no additional water is formed. A simple voltmeter reading suffices.



Negative-Positive Genuine Edison Element Half Size

During my step-by-step construction of the battery I went through all the operations and found that each 100-volt Edison element B battery made at the factory contains 78 cells, and each 140-volt battery 108 cells. Each cell consists of a special annealed glass tube containing a positive and a negative element, and between each element is a perforated hard rubber separator. The construction of these separators is highly important to the efficiency of the battery. In the See Jay factory separators having over 300 perforations are used, thus allowing a full chemical action between the electrodes. The voltage in each cell is 1.3 volts.

Put In a Cabinet

When the proper number of cells for the type battery being constructed has been assembled and tested out for imperfections, if any, and perfect voltage, each tube is placed in an oak finished cabinet and rests on a rubber mat. This protects against jar, breakage and spills. When the cells are precisely placed in the holes provided for them in the cabinet, the wires leading to the panel that provides the varying voltages are soldered on to their respective terminals. At this point another test is made. Then the engraved Bakelite panel is mounted on the front of the cabinet. This panel contains all the terminals to provide voltages from 16-20-22-45-67-90-100 or up to 120-140, all nickled binding posts. A cover containing a handle is fastened in place on top of the cabinet, and the battery is then complete, ready for use.

To get the most out of a battery of this type it is necessary only to keep the battery fully charged. The capacity of the battery is approximately 1,250 milliamperes and on the average set will last from two to three weeks before needing recharge. When used with the built-in trickle charged or charged with the separate trickle charger, it affords the convenience of a fully charged battery at all times, also a long-lived battery. The separate trickle charger replenishes the battery at a slow rate, between 20 and 30 milliamperes, while the set is not in use, making the unit a practical B eliminator.

Pointers on Upkeep

Regarding the care of a battery of this type, its chief advantage is that it requires very little. If a regular charger of the chemical or bulb type is used, a good overnight charge, every two weeks, is all that is necessary, or in the built-in type, it recharges itself automatically when the set is not operating.

About every three months distilled water should be added so that the solution is always one-half inch from the top of the cell. A thin film of special transformer oil has been placed on the top of each cell so that there is no excessive evaporation. A good idea is to put a new solution of pottassium hydroxide in the cells about once a year. This can be had from the See Jay company at cost as a convenience to customers. The cost of a full amount of solution for the 100-volt battery is only fifty cents.

Baird to Show Television Here

Television is a most intriguing subject and whenever any demonstrations of it are conducted the public is keenly interested. J. L. Baird, young Scotch scientist, is planning to leave London for New York to demonstrate his invention. But his object is not only to show the American experimenters that he has advanced farther than any other worker in this fascinating field, but actually to arrange for tests of his system between New York and London.

Recently Baird conducted a successful test of his system between London and Glasgow, 400 miles.

Saw Clearly

So clearly were the features of the man in Glasgow reproduced in London that the man looking into the televisor in London could distinctly see every movement and twitch of the Glasgow man's eyes.

A corporation has been organized in London to develop and exploit the Baird invention. This corporation is capitalized at $600,000 and is backed by British and American capital.

The success of the Baird system is said to be due largely to a secret light-sensitive substance which is much more sensitive than any previously known.

Calls It Simple

It is a simple matter, according to Mr. Baird, to change the system so that it is applicable to television by radio. It is simply a question of increased power to transmit a still picture or moving scene thousands of miles.

He Measures Nations By Number of Sets

Radio is keeping Americans young by spreading youthful thoughts and ideas throghout the nation, according to V. Edward Scott, of the Freed-Eisemann Radio Corporation.

"If I were asked to decide whether a nation was a back number," Mr. Scott said, "or if it was an energetic, progressive people I would ask how many radio sets were in operation for each thousand of population. If the percentage was low I would know that the people were old in their ideas and generally out of touch with the world. If, however, it was high I would have no doubt that the nation was young in ideas, progressive and on its toes.

"The saying that man is as old as his thoughts has been proved by the radio. Here in the United States we have more radios per thousand of population than in any other country of the world. That is why Americans are so youthful in their ideas and this explains the leadership attained by our people since the war."

100 to 5,000 Cycle Range Called Sufficient for AF

How good is "good?" What are the requirements of a good amplifier?

It will be readily conceded by all that a perfect amplifier is one which will cause a reproducer to set up in a room exactly the same combination of sound waves as existed in the room where the transmitter microphone was placed.

The reproduced sounds depend on a great many factors besides the amplifier, and the original sound may be changed either before it enters or after it leaves the amplifier.

Before reaching the receiving audio amplifier, the sound passes through a microphone, several amplifiers, often several hundred miles of telephone line, a few or hundreds of miles of space, the radio frequency amplifier and detector.

Much Chance for Change

Each successive element of the system has an opportunity to alter the characteristic of the original sound, and most of them take advantage of it to a greater or less degree. The composite effect of these elements in the system includes both addition and subtraction.

In considering the amplifier, we are then confronted by the fact that the product delivered at the amplifier input terminals is no longer capable of reproducing the sound waves existing at the microphone. Even a "perfect" amplifier per se, then, can not deliver a perfect output. The amplifier cannot replace that which has been lost. Possibly, however, it can partly remove the sounds which have been added, without removing any of the original sound.

Many of the noises added to the signal as it traverses the transmitting and receiving systems occur at relatively high frequencies, about 5,000 cycles. The experiments of Dr. Harvey Fletcher of the Bell Telephone Laboratories have demonstrated the fact that frequencies above 4,000 or 5,000 cycles may be eliminated from speech any music without noticeable effect.

Cutoff at 5,000 Cycles

It seems then desirable that the amplifier be so designed as to cut off at about 5,000 cycles, and that such an amplifier would give more nearly perfect results than a "perfect" amplifier.

Under present conditions, says the General Radio "Experimenter," the signal probably suffers more between the time it leaves the amplifier and the time it strikes the ear than it does before reaching the amplifier. That is to say, the loudspeaker is probably a greater source of frequency distortion than all the rest of the system.

The loss of the lower frequencies is due principally to the inability of many loudspeakers to reproduce frequencies much lower than 200 cycles. It does not seem to be generally realized how high this actually is.

The sensitivity at low frequencies of two of the best types of present day speakers was checked at 60 cycles, by means of an oscillograph. The oscillograph was first connected to the input and the input signal adjusted for an exactly sinusoidal wave form. The oscillograph was then switched to a pickup and the sound wave in the room was seen to be of 120 cycles frequency. A stiff connection was made between the speaker and the pickup, and a 60-cycle wave appeared, showing that while the speaker was vibrating at 60 cycles, no measurable energy was being radiated at that frequency. Another test with a different type of speaker showed that the full output of a UX-210 tube was required to get an audible sound at 60 cycles.

A Practical Problem

Someone has made the suggestion that since reproducers are more or less peaked at the middle or upper frequencies, transformers should be designed to have a corresponding hollow. This is upsetting the perfect amplifier with a vengeance. It would seem more logical, however, for the loudspeaker manufacturer to equip his instrument with a filter to cut off the peaks of the curve in somewhat the same manner as telephone lines are "equalized." If the amplifier were made to match the speaker, it would be necessary to discard the entire amplifier every time an improvement was made in reproducers.

To the manufacturer of coupling units, the problem of "how good is good" presents itself in a very practical manner. How far down in the low frequency region is it reasonable to go? How much of this band, which does not now exist in the input to the amplifier, and could not be reproduced if delivered to the speaker, should the amplifier be capable of passing?

Question of Economy

It boils down to: "Is the public willing, and justifiably so, to pay more for a transformer that will amplify as low as 30 cycles than for a transformer capable of amplifying frequencies of the order of 100 cycles, when no actual gain in quality of reproduction results from the higher cost?"

Fortunately, the low frequencies that our present reproducers will not radiate are not lost. These frequencies are reproduced in the ear from their harmonics and the fundamental pitch of the note is not lost, although if the cut-off of the amplifying and reproducing systems is too high, it loses "naturalness." It is to the detector action of the ear that most of the bass notes we hear are due, and they come from no farther out the "vasty" ether than the ear of the listener.

WILLARD HAS AB SUPPLY

A combination of the Willard A power and B power supply, with an automatic control to change from charger to current supply and vice versa, as the radio set switch is thrown on or off, has been announced.

Visitors Talk to Australia

Pittsburgh.

Eight members of the Australian industrial delegation to the United States, which went to Pittsburgh for a three-day visit, participated in two special broadcasts to Australia through KDKA. One morning at 4 o'clock Eastern Standard Time, the delegates gave five-minute talks which were broadcast on 62.5 meters. In the evening at 5:45 o'clock a 15-minute program was given.

Broadcasting stations in Melbourne and Sydney had been informed. Several programs from KDKA have been successfully rebroadcast by Australian stations during the last three years.

Four o'clock A. M. here corresponds to 7 P. M. in the greater part of Australia, and 5:45 P. M. here to 8:45 A. M. there.

The delegation has been touring the country for several months under the auspices of the United States Department of Commerce.

Radio and Aviation Combined for Show

Communication through the air may mean either by means of radio or aviation. It is this connection between these two new fields of endeavor which has caused Sheldon H. Fairbanks, managing director of the Seventh Annual Boston Radio Exposition, to hold New England's first airplane show in conjunction with the radio show, week of September 26.

The aeronautical exhibit will be held in the exhibition hall, while the radio show will be staged in the grand hall of the building.

JAPAN PROGRESSIVE

In Japan, a visitor said, he found radio already very popular, five government-owned stations furnishing programs regularly to a large audience. Nearly every house has an antenna, according to the visitor, but in Japan there is a tax of about 50 cents per month on all listening sets. Similarly, in the Philippines the government imposes a tax on listening, amounting to about 5 cents a month, in addition to collecting import duties on radio sets brought in, he added.

NEW JOBBER APPOINTED

The Telephone Maintenance Company, 123-5 So. Wells St., Chicago, has been appointed Freed-Eisemann distributor in Chicago and surrounding territory.

20,000 Ft. of Buried Wire New Station's "Ground"

Milwaukee

Wisconsin has a new station, WTMJ, owned by The Milwaukee "Journal," soon to go on the air. Upon completion of the new station the "Journal," following the suggestion of the Federal Radio Commission, will discontinue broadcasting over WHAD, which it has operated jointly with Marquette University since 1923. Marquette will retain the license of WHAD and operate as the station of an educational institution.

"Journal" officials also announce the purchase of WKAF. WTMJ will replace the old call letters.

A location outside the city was selected to conform to the Federal Radio Commission's recommendation that transmitting stations be removed, so far as is practicable from centers of population.

WTMJ's new transmitter, a Western Electric, has been purchased, together with the towers. The towers will stand 500 feet apart. So far as can be determined, this distance is the longest between the towers of radio stations anywhere and, according to radio engineers, this spacing will aid materially in providing excellent radio transmission.

A special feature of the transmitting efficiency, made possible by the removal of the equipment to a rural location, is the "ground" of the transmitter. This will be an extensive system of heavy copper wires, 20,000 feet in all, underground. This installation requires about an acre of ground.

How Air Was Cleared Is Told By Caldwell

By Orestes H. Caldwell

Federal Radio Commissioner

We have had about six years of radio broadcasting.

It was in 1921 that the first station, KDKA, started operating, and the next year other stations followed. From 1922 to the middle of 1926 radio grew and grew in popularity, sales mounted, and a great new industry was in the making.

Then something happened.

In July, 1926, just 10 months ago, the Attorney General of the United States rendered his famous opinion that the Secretary of Commerce, under the radio law of 1912, was without power to control the broadcasting situation or to assign wavelengths. Then, after five years of orderly development, control was off. Beginning with August, 1926, anarchy reigned in the ether.

As the result, many stations jumped without restraint to new wavelengths which suited them better, quite regardless of the interference which they might thus be causing to other stations. Proper separation between established stations was destroyed by other stations coming in and camping in the middle of any open spaces they could find, each interloper thus impairing reception of three stations—his own and two others.

Following the Attorney General's opinion, instead of the necessary fifty-kilocycle separation between stations in the same community, the condition soon developed where separations of 20 and 10 kilocycles, and even eight, five and two kilocycles existed. Under such separations, of course, stations were soon wildly blanketing each other, while distracted listeners were assailed with scrambled programs.

Canada Victimized

Wavelengths assigned to Canada were violated, in spite of repeated warnings from the Government and even personal appeals from members of the President's Cabinet that national good faith and international good will were at stake. Meanwhile, 250 new stations had injected themselves into the already overcrowded situation and undertook to find perches on which to light, without respect to the existing stations.

Some of the older stations also jumped their power, increasing five to 10 times their output, and, as a result, delivering terrific heterodyne interference to distant stations that had been previously undisturbed under the orderly radio pattern developed by the former supervising authorities. And heterodyne interference between broadcasters on the same wavelength became so bad at many points on the dial, the listener might suppose instead of a receiving set he had a peanut roaster with assorted whistles.

Selfishness Prominent

Indeed, every human ingenuity and selfish impulse seemed to have been exerted to complicate the tangle in the ether.

On February 23 of this year Congress passed the new Radio Law of 1927, putting great powers of radio control in the hands of a Commission, appointed by the President to serve full time for one year in clearing up the radio confusion. For the first 60 days of the law, or until April 23, no penalties were enforceable. But on April 24, when fines up to $5,000 and penitentiary sentences up to five years became effective, the Commission actively put into effect its plans and operations to clear out the interference.

What Steps Were Taken

The first steps were (a) to transfer all stations to authorized channels on "even tens" of kilocycles, (b) to clear the Canadian waves, and (c) to combine interfering stations and tuck them in wherever possible in the spectrum, in order to keep them in operation without interfering with those stations who had remained faithfully on their assigned channels. This was accomplished for the period of the temporary permits, beginning April 24.

Meantime, with the public given partial relief, it was possible for the Commission to make a careful study of the situation, and by painstaking planning, arrange for the second big step—a reallocation of all stations in the best interests of the listening public. When this reallocation took effect, June 15, listeners found that, (a) for each locality local stations were well distributed along the dial, with minimum separations of 50 kilocycles; (b) stations were recognized in terms of position and time, on the basis of their demonstrated capacity to serve the public; and (c) heterodyne interference between distant stations had been in general diminished.

Did Some Repacking

These improvements have been accomplished by repacking the channels according to an orderly plan, actually increasing the capacity of the 89 channels available, in much the same way that a lumber bin which appeared full when lumber had been carelessly thrown into it from all directions, can hold considerably more when the lumber is packed in an orderly fashion and the former wasted open space avoided.

Next week Commissioner Caldwell will tell why you should have a tone quality set.

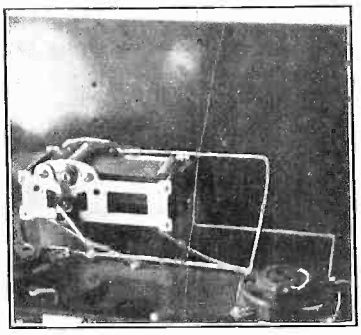
Missing Heirs Traced By Weekly Broadcast

Are you a missing heir? Professor Joseph A. Luria might tell you so if you listen in on station WOKO, of Peekskill, N. Y., each Friday morning at 10:30.

Prof. Luria has made it his life work to locate missing heirs and to make a collection of all unclaimed money held in banks. He now has a collection of thousands of such names and the unsettled estates. Every Friday he broadcasts from thirty to fifty of the names of missing heirs. He finds broadcasting a most valuable aid in locating the missing heirs and connecting them with the money that is theirs.

Many persons find this unique feature most fascinating, and a few find it financially profitable.

GROANS AT TOUCH



(Hayden)

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Greatest Opportunity For Music, He Says

Music in America is facing the greatest opportunity in its history, according to Frank A. Arnold, director of development of the National Broadcasting Company, who made this statement in a recent address before the General Federation of Women's Clubs' Convention in Grand Rapids, Mich.

"With the advent of radio broadcasting, new educational avenues immediately opened, in the development of which the best literary and musical minds in the country are now engaged," Mr. Arnold said. "The recent acceptance by Walter Damrosch of the important position of musical counsel of the National Broadcasting Company is an evidence of this. This move will be of great value to the future development of music in America.

"The fact that a musical genius of international reputation like Mr. Damrosch should resign his position as conductor of the New York Symphony Orchestra after forty-ones years of continuous service, in order that he might more completely devote his time and energy to reaching the larger audience of the radio, shows the extent to which this great new medium of communication is attracting men of genius and imagination.

"It is a great thing to interpret the works of the world's greatest musical composers to the great audiences which have filled the largest auditoriums of the country to hear the New York Symphony Orchestra, but it is a still bigger thing—so tremendously big that the human imagination balks at its contemplation—to deliver a complete symphony over the radio to an audience of many millions.

"Much is yet to be done in this country by way of educating the masses to an appreciation of good music. It is true that splendid service has been performed in many cases by introducing music into the curriculum of our public schools, but the final limitations governing all public school appropriations are such as to forbid to any great extent the employment of outside artists of high priced professional talent."

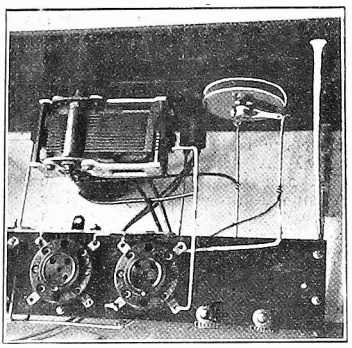
TRANSFORMER LIMIT

Don't attempt to use a bell transformer for lighting more than four one-quarter-ampere tubes, since the windings are quite thin and will not pass much more current.

BETTER TUNING

In critical circuits vernier dials make for accurate tuning.

MAKE 'EM HOLD FAST



Hayden)

O INSURE perfect contact solder all ads, especially when they are flexible. on't merely wrap them around, as illus- ated in the flexible connections to the rheostat.

Rectifier Tube Drop Can Be Pushed Too Far

One of the characteristics often men- oned in connection with the gaseous ectifier tube or Raytheon, is the voltage rop. By this is meant the difference etween the input voltage and the out- ut voltage to the filter system of the adio power unit. Obviously, the lower he voltage drop of the rectifier tube, the igher the output voltage from the radio ower unit in which the tube is employed. owever, as with all good things, there danger in excess.

The original S tube, which was the randfather of the present Raytheon, had voltage drop of 400, so that its use as limited to the rectifying of high- oltage alternating current for radio ransmission work. In fact, the S tube s its day was a prime favorite with adio "hams" or amateurs.

The Raytheon type B has a voltage rop of 120 at full load of 60 milliamperes. ater came the BH type, with the voltage rop reduced to 90 at the full load of 85 illiamperes. The Raytheons intended for peration of vacuum tube filaments in eries has a still lower voltage drop.

However, it is well to caution radio en- husiasts with regard to a still lower volt- ge drop in gaseous rectifier tubes. Bat- ery eliminator devices are designed for a even output voltage from the rectifying ube, so that the normal voltage drop of he rectifying tube is taken into considera- on. A lower voltage drop for a given apacity of tube may result in premature eterioration and therefore greatly hortened life.

Also, the filter system of the radio power nit, designed for a given output from the ube, is likely to become unbalanced with egard to the power being handled, re- ulting in a marked increase in the hum hich causes disagreable distortion in the oud-speaker rendition and even an aud- ble background. Lastly, the filter con- ensers, generally designed for a normal orking voltage, are seriously stressed nd, while they may not break down im- ediately, their life is very materially hortened.

WHERE TO PUT FUSE

A fuse may be inserted either after or efore the switch in the primary circuit onnected from the line to eliminators.

EFFECT OF BROKEN WIRE

A broken electric wire running close to e receiver will cause crackling noises, milar to static.

Studio in City's Heart, Aerial Remote, I Rule

By Chester Charlton

There is a general movement of transmitters into the wide open spaces outside the city limits, while the station's studio is in the heart of the city. There are several reasons for this general exodus. The first is that the Radio Commission has limited the power which broadcasters located in congested city districts may use, and favors the remote antenna as a policy. The second is that the broadcasters themselves desire to locate where their waves may have a chance to spread out over a large territory before they are absorbed by steel structures. A third reason is that certain localities have prohibited the use of broadcasters above a certain power within their limits and have imposed a license fee on all the smaller stations which desire to operate within the city limits.

Not only have these municipalities imposed this condition but they prohibit the simultaneous operation of two stations, even though their frequencies may be widely separated.

The purpose of the Radio Commission in limiting the power in congested districts is to safeguard the public interest by preventing any high-power station from blanketing all other stations to which people might want to listen. The purpose of the municipalities which have taken similar action is the same.

Want to Reach Out

The object the broadcasting stations have for moving is to be able to reach the greatest number of listeners with a given radiated power. Transmitting stations located in skyscraper districts are unable to project their wave out very far on account of absorption in the steel structures, and in many locations not far from the station the signal cannot be received with any degree of certainty.

One of the first to move its transmitter out of New York City was WJZ, which moved to Bound Brook, N. J. The power of this station was greatly increased at the time and the result of increased power and a more favorable location is that the station is now heard reliably over a vastly greater area. This station usually operates on 30 kilowatts but is able to go as high as 40 kilowatts.

Soon WEAF will move. Its new station is now in course of construction, under the guidance of Dr. Alfred N. Goldsmith, at Bellmore, Long Island. It is expected that the new station will give reliable daylight service over a radius of 50 miles, which will include the metropolitan district, a large part of New Jersey, Westchester and the southern sections of New England. In the present location at West Street and Hudson River, the signals from WEAF are extremely weak in Westchester County, N. Y., and in the State of Connecticut.

Will Use Large Power

The amount of power to be used by WEAF at Bellmore will be determined by experiment but will be from 20 to 50 kilowatts. This will make WEAF one of the most powerful stations in the United States, and it will also be the most modern. The new transmitter is expected to be in use early in September.

It is also the intention of the National Broadcasting Company, it has been learned on good authority, to move station WRC from Washington to some point in the country, probably midway between the Capital and Baltimore, and at the same time make the station more powerful. The new location and the Company through a special network of large cities but also a vast territory which has hitherto been in a "dead spot.'

Minneapolis is one municipality which has banished all stations of more than 500 watts from its confines. It has also prohibited the operation of more than two stations at the same time within its limits.

Charges $50 a Year

Any station desiring to operate in the city must obtain a license, costing $50 annually, and the permit to operate is revocable at any time by the City Council or by the Mayor.

The general exodus of the stations to the country will be a boon to the majority of the listening public. It will be disadvantageous to only a relatively small number of people living in the close vicinity of the transmitter. But the problems that these people will encounter can be solved.

Chain Defies Distance with Expert Ingenuity

Great attention has been centered upon the fact that through the use of network broadcasting, listeners in all parts of the country can be reached by the same radio program at practically the same instant. The size and geographical distribution of the network audience appears a continual source of wonder. The stage of the network radio theatre is just as extensive as its audience, although this phase of the matter has received but scant consideration.

The four walls of the broadcast theater have been moved to the boundaries of the United States, and the accomplishments of network transmission indicate that this broadcasting of the stage will not cease until Shakespeare's pronouncement that "All the world's a stage" has been given a more comprehensive significance than ever before.

A notable instance of this extension of network pick-up occurred during the Red Cross Relief program transmitted a few weeks ago by the National Broadcasting Company through a special network of stations associated with the Red and Blue chains. Halves of this half-hour period originated in Chicago and in Memphis, approximately 500 miles apart, and in addition, the announcements which were an essential part of the program were given from New York City, about 700 miles air distance from Chicago and 950 miles from Memphis.

Not one hitch was experienced.

Board Shelves Protests; Stations Must Try Out

Washington.

The Federal Radio Commission decided on a new policy regarding the new wavelength and power assignments. All licenses under the new assignments are for 60 or 90 days from June 15, and complaints will be heard only on the basis of grievances arising from actual experience. The stations must work under the new conditions, which means that for the present the June 15 allocations generally stand.

Commissioner Henry A. Bellows said many more changes may be expected, and that some revocations of licenses are probable, such action being in view already in several cases either for violation of the radio law itself or of the Commission's orders and regulations.

Mr. Bellows said he expected a continued decline in the number of stations due to what he called "natural mortality." Many stations, he said, sought wavelengths for speculative purposes, expecting to sell them to high bidders when Federal control was restored. These stations, he said, for the most part have found that they have been relegated to such undesirable waves that they have nothing to sell.

Expects General Solution

In general, Mr. Bellows said, he expected the new allocations will largely solve the radio problem. If any dissatisfied stations have any intention of taking court action to prevent the allocations from going into effect, he said, the Commission has not been definitely notified of the fact.

Commissioner Bellows said he spoke with President Coolidge relative to the plans of the Commission as set forth in its statement and order. He said the President expressed gratification with the progress made by the Commission and thoroughly approved its plans for the future.

Appropriations for the Commission having failed at the last session of Congress on account of the failure of the Deficiency Bill. Mr. Bellows said that after June 30, the end of the present fiscal year, the Commission will share the appropriation for the Radio Division of the Department of Commerce. The amount available is small, he said, but the Commission expects to meet its needs through the exercise of strict economy.

Bellows' Statement

Commissioner Bellows in his statement said:

"The new broadcasting allocations will, in the judgment of the Federal Radio Commission, provide the satisfactory basis for the future development of broadcasting throughout the United States. At the same time, it must be recognized that the problem of interference can never be fully solved on the basis of theoretical measurements. Interference between stations depends very largely on geographical conditions, and is greatly influenced by the transmission characteristics of individual stations.

"Accordingly, the only way in which interference can be adequately tested is by actual experience. Furthermore, this experience depends a good deal on conditions prevailing at different seasons of the year. Two stations which may not interfere with one another at all in the summer may cause very serious heterodyning in the late fall or winter.

Result of 3 Months' Work

"The Federal Radio Commission has provided the basis for all its further activities in the new allocations of broadcasting stations. It has in three months built up an efficient organization, has collected an enormous amount of necessary information regarding the broadcasting stations, and has worked out its entire plan of operation under the Radio Act of 1927.

"During the remaining nine months during which, under the present law, the Federal Radio Commission will have full charge of radio broadcasting, its chief purpose will be to improve radio reception throughout the United States by the eliminating of such interference as may become apparent under the new allocation system. It is not the present intention of the Commission to fix conditions definitely by issuing broadcasting licenses for periods of more than 60 or 90 days. Its plan is to continue these short-time licenses until actual experience during the months of best radio transmission has demonstrated exactly what interference between stations is likely to develop."

The General Order

In its General Order No. 15 the Commission set forth:

"For the purpose of providing an orderly method for the reduction and eventual elimination of interference between radio broadcasting stations operating on the same or on closely adjacent frequencies, the Federal Radio Commission announces the following procedure:

"At any time after July 15, 1927, any radio broadcasting station operating under license from the Federal Radio Commission may file with the Commission an affidavit certifying that unreasonable and injurious interference with its signals is being caused by the simultaneous operation of another radio broadcasting station, the name or call letters of which must be specified in the affidavit.

Rules for the Application

"The affidavit must likewise specify not less than two occasions on which such interference was observed, with the name and address of the person making each of such observations, the type of receiving set used, and the date and hour thereof.

"On receipt of such affidavit, and if in the judgment of the Federal Radio Commission the interference complained of is actually unreasonable and injurious to the affiant, the Commission will appoint a date for a hearing, at its convenience, will notify thereof the parties interested, and on the basis of the testimony presented at such hearing will order such changes of frequency, power or hours of operation as may appear best to serve public interest, convenience or necessity."

Coolidge in Touch With Board's Plans

Washington.

President Coolidge was informed by Federal Radio Commissioner Henry A. Bellows of plans of the Commission for getting rid of interference and conflicting wavelengths in broadcasting.

There are three ways of eliminating interference, Mr. Bellows stated after his conference with the President. One is by dividing the time; the second is by cutting the power, and the third by changing the wavelengths.

Mr. Bellows said that the elimination to be made is merely the basis for the settlement of the whole problem of interference.

Wave Defense Is Successful

Washington.

A defense of their assignments to the frequency of 810 kilocycles (370.2 meters) under the new radio allocations was entered before the Federal Radio Commission by WMCA, Hotel McAlpin, New York City, and WEBJ, owned by the Third Avenue Railroad Company, New York City. Both stations use 500 watts and were assigned to divide time on this frequency.

Their assignment was disputed by WGCP, owned by the May Radio Broadcast Corporation, of Newark, N. J., and WLWL, owned by the Paulist Fathers, New York City. Each was dissatisfied with its assignment, WGCP having been placed on 1,070 kilocycles (280.2 meters) and WLWL on 1,020 kilocycles (293.9 meters).

The Commission announced that the hearing scheduled for WSM, owned by the National Life & Accident Co., of Nashville, Tenn., which had sought an assignment to 710 kilocycles (422.3 meters) has been cancelled by agreement.

WSM shifted on 880 kilocycles (340.7 meters), using 5,000 watts power instead of the 2,000 originally assigned it. Shifting from 880, KTHS, owned by the New Arlington Hotel, of Hot Springs, Ark., went on 940 kilocycles (319 meters).

By this settlement, WOR, owned by Bamberger & Co., Newark, which at a previous hearing successfully defended its assignment to 710 kilocycles (422.3 meters), will not be required again to defend itself, WSM having designated that frequency as the channel it preferred.

Delegates to Parley Named by Coolidge

Washington.

President Coolidge announced the appointment of the American delegation to the International Radio Conference which will be held in Washington October 4, as follows:

Herbert Hoover, Secretary of Commerce; Senator James E. Watson, of Indiana; Senator Ellison D. Smith, of South Carolina; Representative Wallace H. White, Jr., of Lewiston, Me.; William R. Castle, Jr., Assistant Secretary of State; Alternate, William R. Vallance, Assistant Solicitor of the Department of State; Maj. Gen. Charles M. Saltzman, Chief Signal Officer, U. S. A.; Capt. Thomas T. Craven, Director of Naval Communications, U. S. N.; W. D. Terrell, Chief of Radio Division, Department of Commerce; Owen D. Young, Chairman of the Board of Directors, General Electric Company; Alternate, Samuel Reber, Colonel, U. S. A., retired; John J. Carty, Chief Engineer, American Telephone and Telegraph Company; Stephen Davis, former Solicitor, Department of Commerce; John Beaver White, Electrical Engineer, and John Hays Hammond, Jr.

Weather Reports Sent by Greenland Station

A mailed report from the Vice Council at Copenhagen, Ellis A. Johnson, states that the new wireless station at Julianehaab, Greenland, has commenced broadcasting weather bulletins, a service instituted in accordance with the desires of the Icelandic Government and expected to be of special value in sending out storm warnings to the fishing industry.

Europe's Science Adonis to 'Rescue' Sopranos

To demonstrate a device said to render even a soprano voice perfect in reception, Manfred, Baron von Ardenne, of Berlin, arrived in the United States the other day.

Baron von Ardenne is one of the busiest scientists of Europe and probably the handsomest. He is here to discuss development with the American leaders in radio engineering and manufacturing.

From his earliest years he has been interested in wireless telegraphy. His first important discovery, made shortly after the introduction of broadcasting in Europe, was that of a method of resistance-capacity coupled audio amplification. He is now considered an authority on audio frequency amplification.

In collaboration with Dr. Siegmund Loewe, of Berlin, an inventor well-known in America, he developed the multiplex valve, which features a complete multi-stage radio or audio frequency amplifier enclosed in a single tube. This tube was brought to America last year by David L. Loewe, brother of Siegmund.

MANFRED, BARON VON ARDENNE, one of the handsomest scientists of Europe, who is on a business trip to the United States.

Baron von Ardenne's recent achievements include the evolving of exact theories and formulas for the reason for distortion present in amplifiers of all descriptions, plate-bend rectification, the optimum dimensions and working characteristics of last-stage power tubes.

Baron von Ardenne is the author of books on wireless telegraphy and telephony. He was accompanied to the United States by Edward R. Dietze, of Hamburg, his associate in research.

He will visit, of course, many of the American broadcasting stations and manufacturing plants, imparting and obtaining important information.

Cone and Eliminator Invade Germany

The development of radio apparatus in Germany was shown in exhibits at the recent Leipzig Fair, according to a report received in the Department of Commerce from the American Consul at Leipzig, Hernando de Soto. His report follows in full:

"While radio supplies at the Leipzig Spring Trade Fair, 1927, did not show as much development as that attained in the United States, many improvements had been made since last year's fair. Not infrequently these were called forth to meet new requirements and possibilities resulting from the general increase of transmitting power in all large German broadcasting stations, as well as from the recent redistribution of wavelengths.

"New developments were to be noted, for example in crystal receiving sets operating on the lighting current and especially adapted for listening to nearby stations.

"Great attention had evidently also been directed toward the production of Neutrodyne sets which, due to their greater selectivity, are gaining in popularity throughout Germany. Battery eliminators were much in evidence at the fair. These can be of relatively simple construction due to the fact that municipal lighting systems thoughout Germany use direct current. At present battery eliminators retail in Germany for about 50 marks ($14.15). A large variety of loud speakers of both the cone and horn types was on display. It is not yet clear which type finds the most favor with the German public."

VACATION NUMBER OF RADIO WORLD

This issue contains a complete list of broadcasting stations with the new wavelengths. Features that will fascinate the home constructor: Push-Pull Resistance AF, by J. E. Anderson; The Suit Case Six, a Sensitive Portable, by James H. Carroll; A 400-Volt B Eliminator and Power Amplifier, by Leonard Upham; Balsa Wood for Speakers, by H. B. Herman; The Need of Neutralization, by Lester Harrison, and B Battery Conservation, by Thomas L. McKay. These features are profusely illustrated. Send 15 cents for copy of June 11 issue (Vacation Number.) Radio World, 145 W. 45th St., New York City.

Kent Audition 'A New Epoch'

M. H. Aylesworth, president of the National Broadcasting Company, Inc., in a statement received by the Atwater Kent Foundation, declares that the benefit to radio music from the National Radio Audition, sponsored by the Foundation, will not be confined to the enjoyment of the voices of the winners alone, but will include the advantage of listening to the innumerable sweet singers who will take part in the preliminaries.

Whether the contestants become national winners or not, Mr. Aylesworth believes, some of them will be so developed by their experiences that audiences in their own sections will seek them. The effect will be to increase the music consciousness of the American public, already aroused by the improving excellence of radio musical programs.

Beginning a New Epoch

Joy Elmer Morgan, editor of "The Journal of The National Education Association," whose endorsement also has been received by the Foundation, feels that the audition will mark the beginning of a new epoch in American musical education, and is a tremendous opportunity to make America a singing nation.

"The auditions will almost certainly bring forth a few glorious voices and many good ones, to the joy of the music-lovers of the country," Mr. Aylesworth wrote to A. Atwater Kent, president of the Foundation. "There has never been a lack of incentive for the development of voices of native quality, but the means for their discovery have been limited.

Discovered Many Already

"Radio, in its tendency to increase the music consciousness of the American public, already has discovered many beautiful voices, but no such spectacular or comprehensive plan as the National Radio Audition has before been proposed for finding the hidden singers. The Auditions should receive the hearty support of all who desire to have music take its rightful place in our national life."

State units of the National Radio Audition are now being set up. All states will be organized immediately. State committees will create local units for community auditions, whose winners, step by step through state and district auditions, may progress to the final or national audition to be broadcast over national hook-up from New York next December.

A total of $17,500 in prizes and certain periods of training in an American conservatory, will be awarded to winners in the national audition.

Earphones Eagerly Discarded at KFI

Los Angeles.

Because of reverberation in the control room at KFI, the operators have been forced to listen to the outgoing program on headphones, which, as any crystal set owner can testify, is a very tiring procedure when extended over four or five consecutive hours.

Recently a new ceiling and moulding of an acoustic material was installed, the necessary amount of the material having been scientifically ascertained. The result has been so to improve the acoustic properties of the room that the headphones have been discarded and the entire monitoring is done by the use of an oversized cone speaker.

According to the operators better results can be obtained this way than ever before, as they can hear the program exactly as it sounds upon being received over a receiving set.

How Air Was Cleared Is Told By Caldwell

By Orestes H. Caldwell

Federal Radio Commissioner

We have had about six years of radio broadcasting.

It was in 1921 that the first station, KDKA, started operating, and the next year other stations followed. From 1922 to the middle of 1926 radio grew and grew in popularity, sales mounted, and a great new industry was in the making.

Then something happened.

In July, 1926, just 10 months ago, the Attorney General of the United States rendered his famous opinion that the Secretary of Commerce, under the radio law of 1912, was without power to control the broadcasting situation or to assign wavelengths. Then, after five years of orderly development, control was off. Beginning with August, 1926, anarchy reigned in the ether.

As the result, many stations jumped without restraint to new wavelengths which suited them better, quite regardless of the interference which they might thus be causing to other stations. Proper separation between established stations was destroyed by other stations coming in and camping in the middle of any open spaces they could find, each interloper thus impairing reception of three stations—his own and two others.

Following the Attorney General's opinion, instead of the necessary fifty-kilocycle separation between stations in the same community, the condition soon developed where separations of 20 and 10 kilocycles, and even eight, five and two kilocycles existed. Under such separations, of course, stations were soon wildly blanketing each other, while distracted listeners were assailed with scrambled programs.

Canada Victimized

Wavelengths assigned to Canada were violated, in spite of repeated warnings from the Government and even personal appeals from members of the President's Cabinet that national good faith and international good will were at stake. Meanwhile, 250 new stations had injected themselves into the already overcrowded situation and undertook to find perches on which to light, without respect to the existing stations.

Some of the older stations also jumped their power, increasing five to 10 times their output, and, as a result, delivering terrific heterodyne interference to distant stations that had been previously undisturbed under the orderly radio pattern developed by the former supervising authorities. And heterodyne interference between broadcasters on the same wavelength became so bad at many points on the dial, the listener might suppose instead of a receiving set he had a peanut roaster with assorted whistles.

Selfishness Prominent

Indeed, every human ingenuity and selfish impulse seemed to have been exerted to complicate the tangle in the ether.

On February 23 of this year Congress passed the new Radio Law of 1927, putting great powers of radio control in the hands of a Commission, appointed by the President to serve full time for one year in clearing up the radio confusion. For the first 60 days of the law, or until April 23, no penalties were enforceable. But on April 24, when fines up to $5,000 and penitentiary sentences up to five years became effective, the Commission actively put into effect its plans and operations to clear out the interference.

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Meantime, with the public given partial relief, it was possible for the Commission to make a careful study of the situation, and by painstaking planning, arrange for the second big step—a reallocation of all stations in the best interests of the listening public. When this reallocation took effect, June 15, listeners found that, (a) for each locality local stations were well distributed along the dial, with minimum separations of 50 kilocycles; (b) stations were recognized in terms of position and time, on the basis of their demonstrated capacity to serve the public; and (c) heterodyne interference between distant stations had been in general diminished.

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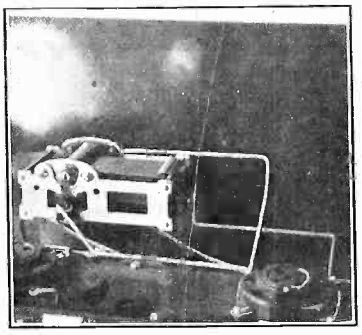

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"With the advent of radio broadcasting, new educational avenues immediately opened, in the development of which the best literary and musical minds in the country are now engaged," Mr. Arnold said. "The recent acceptance by Walter Damrosch of the important position of musical counsel of the National Broadcasting Company is an evidence of this. This move will be of great value to the future development of music in America.

"The fact that a musical genius of international reputation like Mr. Damrosch should resign his position as conductor of the New York Symphony Orchestra after forty-ones years of continuous service, in order that he might more completely devote his time and energy to reaching the larger audience of the radio, shows the extent to which this great new medium of communication is attracting men of genius and imagination.

"It is a great thing to interpret the works of the world's greatest musical composers to the great audiences which have filled the largest auditoriums of the country to hear the New York Symphony Orchestra, but it is a still bigger thing—so tremendously big that the human imagination balks at its contemplation—to deliver a complete symphony over the radio to an audience of many millions.

"Much is yet to be done in this country by way of educating the masses to an appreciation of good music. It is true that splendid service has been performed in many cases by introducing music into the curriculum of our public schools, but the final limitations governing all public school appropriations are such as to forbid to any great extent the employment of outside artists of high priced professional talent."

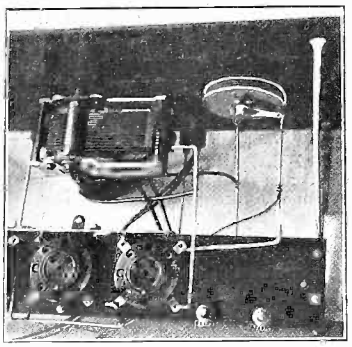
TRANSFORMER LIMIT

Don't attempt to use a bell transformer for lighting more than four one-quarter-ampere tubes, since the windings are quite thin and will not pass much more current.

BETTER TUNING

In critical circuits vernier dials make for accurate tuning.

MAKE 'EM HOLD FAST



Hayden)

O INSURE perfect contact solder all ads, especially when they are flexible. on't merely wrap them around, as illus- rated in the flexible connections to the rheostat.

Rectifier Tube Drop Can Be Pushed Too Far

One of the characteristics often men- ioned in connection with the gaseous ectifier tube or Raytheon, is the voltage rop. By this is meant the difference etween the input voltage and the out- ut voltage to the filter system of the adio power unit. Obviously, the lower ie voltage drop of the rectifier tube, the igher the output voltage from the radio ower unit in which the tube is employed. lowever, as with all good things, there danger in excess.

The original S tube, which was the randfather of the present Raytheon, had voltage drop of 400, so that its use as limited to the rectifying of high- oltage alternating current for radio ransmission work. In fact, the S tube i its day was a prime favorite with adio "hams" or amateurs.

The Raytheon type B has a voltage rop of 120 at full load of 60 milliamperes. ater came the BH type, with the voltage rop reduced to 90 at the full load of 85 illiamperes. The Raytheons intended for peration of vacuum tube filaments in eries has a still lower voltage drop.

However, it is well to caution radio en- usiasts with regard to a still lower volt- ge drop in gaseous rectifier tubes. Bat- ery eliminator devices are designed for a iven output voltage from the rectifying ube, so that the normal voltage drop of ie rectifying tube is taken into considera- ion. A lower voltage drop for a given apacity of tube may result in premature eterioration and therefore greatly hortened life.

Also, the filter system of the radio power nit, designed for a given output from the ube, is likely to become unbalanced with egard to the power being handled, re- ulting in a marked increase in the hum hich causes disagreable distortion in the oud-speaker rendition and even an aud- ble background. Lastly, the filter con- ensers, generally designed for a normal orking voltage, are seriously stressed nd, while they may not break down im- ediately, their life is very materially hortened.

WHERE TO PUT FUSE

A fuse may be inserted either after or efore the switch in the primary circuit onnected from the line to eliminators.

EFFECT OF BROKEN WIRE

A broken electric wire running close to ie receiver will cause crackling noises, milar to static.

Studio in City's Heart, Aerial Remote, I Rule

By Chester Charlton

There is a general movement of trans- mitters into the wide open spaces outside the city limits, while the station's studio is in the heart of the city. There are several reasons for this general exodus. The first is that the Radio Commission has limited the power which broadcasters located in congested city districts may use, and favors the remote antenna as a policy. The second is that the broad- casters themselves desire to locate where their waves may have a chance to spread out over a large territory before they are absorbed by steel structures. A third reason is that certain localities have pro- hibited the use of broadcasters above a certain power within their limits and have imposed a license fee on all the smaller stations which desire to operate within the city limits.

Not only have these municipalities im- posed this condition but they prohibit the simultaneous operation of two stations, even though their frequencies may be widely separated.

The purpose of the Radio Commission in limiting the power in congested dis- tricts is to safeguard the public interest by preventing any high-power station from blanketing all other stations to which people might want to listen. The purpose of the municipalities which have taken similar action is the same.

Want to Reach Out

The object the broadcasting stations have for moving is to be able to reach the greatest number of listeners with a given radiated power. Transmitting sta- tions located in skyscraper districts are unable to project their wave out very far on account of absorption in the steel structures, and in many locations not far from the station the signal cannot be received with any degree of certainty.

One of the first to move its transmitter out of New York City was WJZ, which moved to Bound Brook, N. J. The power of this station was greatly increased at the time and the result of increased power and a more favorable location is that the station is now heard reliably over a vastly greater area. This station usually oper- ates on 30 kilowatts but is able to go as high as 40 kilowatts.

Soon WEAF will move. Its new station is now in course of construction, under the guidance of Dr. Alfred N. Goldsmith, at Bellmore, Long Island. It is expected that the new station will give reliable day- light service over a radius of 50 miles, which will include the metropolitan dis- trict, a large part of New Jersey, West- chester and the southern sections of New England. In the present location at West Street and Hudson River, the signals from WEAF are extremely weak in West- chester County. N. Y., and in the State of Connecticut.

Will Use Large Power

The amount of power to be used by WEAF at Bellmore will be determined by experiment but will be from 20 to 50 kilowatts. This will make WEAF one of the most powerful stations in the United States, and it will also be the most modern. The new transmitter is expected to be in use early in September.

It is also the intention of the National Broadcasting Company, it has been learned on good authority, to move sta- tion WRC from Washington to some point in the country, probably midway between the Capital and Baltimore, and at the same time make the station more powerful. The new location and the Company through a special network of large cities but also a vast territory which has hitherto been in a "dead spot.'

Minneapolis is one municipality which has banished all stations of more than 500 watts from its confines. It has also prohibited the operation of more than two stations at the same time within its limits.

Charges $50 a Year

Any station desiring to operate in the city must obtain a license, costing $50 annually, and the permit to operate is revocable at any time by the City Council or by the Mayor.

The general exodus of the stations to the country will be a boon to the majority of the listening public. It will be dis- advantageous to only a relatively small number of people living in the close vicin- ity of the transmitter. But the prob- lems that these people will encounter can be solved.

Chain Defies Distance with Expert Ingenuity

Great attention has been centered upon the fact that through the use of network broadcasting, listeners in all parts of the country can be reached by the same radio program at practically the same instant. The size and geographical distribution of the network audience appears a continual source of wonder. The stage of the net- work radio theatre is just as extensive as its audience, although this phase of the matter has received but scant considera- tion.

The four walls of the broadcast theater have been moved to the boundaries of the United States, and the accomplishments of network transmission indicate that this broadcasting of the stage will not cease until Shakespeare's pronouncement that "All the world's a stage" has been given a more comprehensive significance than ever before.

A notable instance of this extension of network pick-up occurred during the Red Cross Relief program transmitted a few weeks ago by the National Broadcasting Company through a special network of stations associated with the Red and Blue chains. Halves of this half-hour period originated in Chicago and in Memphis, approximately 500 miles apart, and in addition, the announcements which were an essential part of the program were given from New York City, about 700 miles air distance from Chicago and 950 miles from Memphis.

Not one hitch was experienced.

Board Shelves Protests; Stations Must Try Out

Washington.

The Federal Radio Commission decided on a new policy regarding the new wavelength and power assignments. All licenses under the new assignments are for 60 or 90 days from June 15, and complaints will be heard only on the basis of grievances arising from actual experience. The stations must work under the new conditions, which means that for the present the June 15 allocations generally stand.

Commissioner Henry A. Bellows said many more changes may be expected, and that some revocations of licenses are probable, such action being in view already in several cases either for violation of the radio law itself or of the Commission's orders and regulations.

Mr. Bellows said he expected a continued decline in the number of stations due to what he called "natural mortality." Many stations, he said, sought wavelengths for speculative purposes, expecting to sell them to high bidders when Federal control was restored. These stations, he said, for the most part have found that they have been relegated to such undesirable waves that they have nothing to sell.

Expects General Solution

In general, Mr. Bellows said, he expected the new allocations will largely solve the radio problem. If any dissatisfied stations have any intention of taking court action to prevent the allocations from going into effect, he said, the Commission has not been definitely notified of the fact.

Commissioner Bellows said he spoke with President Coolidge relative to the plans of the Commission as set forth in its statement and order. He said the President expressed gratification with the progress made by the Commission and thoroughly approved its plans for the future.

Appropriations for the Commission having failed at the last session of Congress on account of the failure of the Deficiency Bill, Mr. Bellows said that after June 30, the end of the present fiscal year, the Commission will share the appropriation for the Radio Division of the Department of Commerce. The amount available is small, he said, but the Commission expects to meet its needs through the exercise of strict economy.

Bellows' Statement

Commissioner Bellows in his statement said:

"The new broadcasting allocations will, in the judgment of the Federal Radio Commission, provide the satisfactory basis for the future development of broadcasting throughout the United States. At the same time, it must be recognized that the problem of interference can never be fully solved on the basis of theoretical measurements. Interference between stations depends very largely on geographical conditions, and is greatly influenced by the transmission characteristics of individual stations.

"Accordingly, the only way in which interference can be adequately tested is by actual experience. Furthermore, this experience depends a good deal on conditions prevailing at different seasons of the year. Two stations which may not interfere with one another at all in the summer may cause very serious heterodyning in the late fall or winter.

Result of 3 Months' Work

"The Federal Radio Commission has provided the basis for all its further activities in the new allocations of broadcasting stations. It has in three months built up an efficient organization, has collected an enormous amount of necessary information regarding the broadcasting stations, and has worked out its entire plan of operation under the Radio Act of 1927.

"During the remaining nine months during which, under the present law, the Federal Radio Commission will have full charge of radio broadcasting, its chief purpose will be to improve radio reception throughout the United States by the eliminating of such interference as may become apparent under the new allocation system. It is not the present intention of the Commission to fix conditions definitely by issuing broadcasting licenses for periods of more than 60 or 90 days. Its plan is to continue these short-time licenses until actual experience during the months of best radio transmission has demonstrated exactly what interference between stations is likely to develop."

The General Order

In its General Order No. 15 the Commission set forth:

"For the purpose of providing an orderly method for the reduction and eventual elimination of interference between radio broadcasting stations operating on the same or on closely adjacent frequencies, the Federal Radio Commission announces the following procedure:

"At any time after July 15, 1927, any radio broadcasting station operating under license from the Federal Radio Commission may file with the Commission an affidavit certifying that unreasonable and injurious interference with its signals is being caused by the simultaneous operation of another radio broadcasting station, the name or call letters of which must be specified in the affidavit.

Rules for the Application

"The affidavit must likewise specify not less than two occasions on which such interference was observed, with the name and address of the person making each of such observations, the type of receiving set used, and the date and hour thereof.

"On receipt of such affidavit, and if in the judgment of the Federal Radio Commission the interference complained of is actually unreasonable and injurious to the affiant, the Commission will appoint a date for a hearing, at its convenience, will notify thereof the parties interested, and on the basis of the testimony presented at such hearing will order such changes of frequency, power or hours of operation as may appear best to serve public interest, convenience or necessity."

Coolidge in Touch With Board's Plans

Washington.

President Coolidge was informed by Federal Radio Commissioner Henry A. Bellows of plans of the Commission for getting rid of interference and conflicting wavelengths in broadcasting.

There are three ways of eliminating interference, Mr. Bellows stated after his conference with the President. One is by dividing the time; the second is by cutting the power, and the third by changing the wavelengths.

Mr. Bellows said that the elimination to be made is merely the basis for the settlement of the whole problem of interference.

Wave Defense Is Successful

Washington.

A defense of their assignments to the frequency of 810 kilocycles (370.2 meters) under the new radio allocations was entered before the Federal Radio Commission by WMCA, Hotel McAlpin, New York City, and WEBJ, owned by the Third Avenue Railroad Company, New York City. Both stations use 500 watts and were assigned to divide time on this frequency.

Their assignment was disputed by WGCP, owned by the May Radio Broadcast Corporation, of Newark, N. J., and WLWL, owned by the Paulist Fathers, New York City. Each was dissatisfied with its assignment, WGCP having been placed on 1,070 kilocycles (280.2 meters) and WLWL on 1,020 kilocycles (293.9 meters).

The Commission announced that the hearing scheduled for WSM, owned by the National Life & Accident Co., of Nashville, Tenn., which had sought an assignment to 710 kilocycles (422.3 meters) has been cancelled by agreement.

WSM shifted on 880 kilocycles (340.7 meters), using 5,000 watts power instead of the 2,000 originally assigned it. Shifting from 880, KTHS, owned by the New Arlington Hotel, of Hot Springs, Ark., went on 940 kilocycles (319 meters).

By this settlement, WOR, owned by Bamberger & Co., Newark, which at a previous hearing successfully defended its assignment to 710 kilocycles (422.3 meters), will not be required again to defend itself, WSM having designated that frequency as the channel it preferred.

Delegates to Parley Named by Coolidge

Washington.

President Coolidge announced the appointment of the American delegation to the International Radio Conference which will be held in Washington October 4, as follows:

Herbert Hoover, Secretary of Commerce; Senator James E. Watson, of Indiana; Senator Ellison D. Smith, of South Carolina; Representative Wallace H. White, Jr., of Lewiston, Me.; William R. Castle, Jr., Assistant Secretary of State; Alternate, William R. Vallance, Assistant Solicitor of the Department of State; Maj. Gen. Charles M. Saltzman, Chief Signal Officer, U. S. A.; Capt. Thomas T. Craven, Director of Naval Communications, U. S. N.; W. D. Terrell, Chief of Radio Division, Department of Commerce; Owen D. Young, Chairman of the Board of Directors, General Electric Company; Alternate, Samuel Reber, Colonel, U. S. A., retired; John J. Carty, Chief Engineer, American Telephone and Telegraph Company; Stephen Davis, former Solicitor, Department of Commerce; John Beaver White, Electrical Engineer, and John Hays Hammond, Jr.

Weather Reports Sent by Greenland Station

A mailed report from the Vice Council at Copenhagen, Ellis A. Johnson, states that the new wireless station at Julianehaab, Greenland, has commenced broadcasting weather bulletins, a service instituted in accordance with the desires of the Icelandic Government and expected to be of special value in sending out storm warnings to the fishing industry.

Europe's Science Adonis to 'Rescue' Sopranos

To demonstrate a device said to render even a soprano voice perfect in reception, Manfred, Baron von Ardenne, of Berlin, arrived in the United States the other day.

Baron von Ardenne is one of the busiest scientists of Europe and probably the handsomest. He is here to discuss development with the American leaders in radio engineering and manufacturing.

From his earliest years he has been interested in wireless telegraphy. His first important discovery, made shortly after the introduction of broadcasting in Europe, was that of a method of resistance-capacity coupled audio amplification. He is now considered an authority on audio frequency amplification.

In collaboration with Dr. Siegmund Loewe, of Berlin, an inventor well-known in America, he developed the multiplex valve, which features a complete multi-stage radio or audio frequency amplifier enclosed in a single tube. This tube was brought to America last year by David L. Loewe, brother of Siegmund.

MANFRED, BARON VON ARDENNE, one of the handsomest scientists of Europe, who is on a business trip to the United States.

Baron von Ardenne's recent achievements include the evolving of exact theories and formulas for the reason for distortion present in amplifiers of all descriptions, plate-bend rectification, the optimum dimensions and working characteristics of last-stage power tubes.

Baron von Ardenne is the author of books on wireless telegraphy and telephony. He was accompanied to the United States by Edward R. Dietze, of Hamburg, his associate in research.

He will visit, of course, many of the American broadcasting stations and manufacturing plants, imparting and obtaining important information.

Cone and Eliminator Invade Germany

The development of radio apparatus in Germany was shown in exhibits at the recent Leipzig Fair, according to a report received in the Department of Commerce from the American Consul at Leipzig, Hernando de Soto. His report follows in full:

"While radio supplies at the Leipzig Spring Trade Fair, 1927, did not show as much development as that attained in the United States, many improvements had been made since last year's fair. Not infrequently these were called forth to meet new requirements and possibilities resulting from the general increase of transmitting power in all large German broadcasting stations, as well as from the recent redistribution of wavelengths.

"New developments were to be noted, for example in crystal receiving sets operating on the lighting current and especially adapted for listening to nearby stations.

"Great attention had evidently also been directed toward the production of Neutrodyne sets which, due to their greater selectivity, are gaining in popularity throughout Germany. Battery eliminators were much in evidence at the fair. These can be of relatively simple construction due to the fact that municipal lighting systems thoughout Germany use direct current. At present battery eliminators retail in Germany for about 50 marks ($14.15). A large variety of loud speakers of both the cone and horn types was on display. It is not yet clear which type finds the most favor with the German public."

VACATION NUMBER OF RADIO WORLD

This issue contains a complete list of broadcasting stations with the new wavelengths. Features that will fascinate the home constructor: Push-Pull Resistance AF, by J. E. Anderson; The Suit Case Six, a Sensitive Portable, by James H. Carroll; A 400-Volt B Eliminator and Power Amplifier, by Leonard Upham; Balsa Wood for Speakers, by H. B. Herman; The Need of Neutralization, by Lester Harrison, and B Battery Conservation, by Thomas L. McKay. These features are profusely illustrated. Send 15 cents for copy of June 11 issue (Vacation Number.) Radio World, 145 W. 45th St., New York City.

Kent Audition 'A New Epoch'

M. H. Aylesworth, president of the National Broadcasting Company, Inc., in a statement received by the Atwater Kent Foundation, declares that the benefit to radio music from the National Radio Audition, sponsored by the Foundation, will not be confined to the enjoyment of the voices of the winners alone, but will include the advantage of listening to the innumerable sweet singers who will take part in the preliminaries.

Whether the contestants become national winners or not, Mr. Aylesworth believes, some of them will be so developed by their experiences that audiences in their own sections will seek them. The effect will be to increase the music consciousness of the American public, already aroused by the improving excellence of radio musical programs.

Beginning a New Epoch

Joy Elmer Morgan, editor of "The Journal of The National Education Association," whose endorsement also has been received by the Foundation, feels that the audition will mark the beginning of a new epoch in American musical education, and is a tremendous opportunity to make America a singing nation.

"The auditions will almost certainly bring forth a few glorious voices and many good ones, to the joy of the music-lovers of the country," Mr. Aylesworth wrote to A. Atwater Kent, president of the Foundation. "There has never been a lack of incentive for the development of voices of native quality, but the means for their discovery have been limited.

Discovered Many Already

"Radio, in its tendency to increase the music consciousness of the American public, already has discovered many beautiful voices, but no such spectacular or comprehensive plan as the National Radio Audition has before been proposed for finding the hidden singers. The Auditions should receive the hearty support of all who desire to have music take its rightful place in our national life."

State units of the National Radio Audition are now being set up. All states will be organized immediately. State committees will create local units for community auditions, whose winners, step by step through state and district auditions, may progress to the final or national audition to be broadcast over national hook-up from New York next December.

A total of $17,500 in prizes and certain periods of training in an American conservatory, will be awarded to winners in the national audition.

Earphones Eagerly Discarded at KFI

Los Angeles.

Because of reverberation in the control room at KFI, the operators have been forced to listen to the outgoing program on headphones, which, as any crystal set owner can testify, is a very tiring procedure when extended over four or five consecutive hours.

Recently a new ceiling and moulding of an acoustic material was installed, the necessary amount of the material having been scientifically ascertained. The result has been so to improve the acoustic properties of the room that the headphones have been discarded and the entire monitoring is done by the use of an oversized cone speaker.

According to the operators better results can be obtained this way than ever before, as they can hear the program exactly as it sounds upon being received over a receiving set.

A THOUGHT FOR THE WEEK

AS the value of the broadcasters' programs is the chief item in an evening's entertainment, and as those same broadcasters have made arrangements for a Summer program that have never before been equalled, let's all look forward to a warm weather listening-in period full of real interest and complete satisfaction for everybody.

SIXTH YEAR

RADIO WORLD

The First and Only National Radio Weekly

Member, Radio Publishers Association

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

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ADVERTISING RATES

General Advertising

1 Page, 7¼"x11"	462 lines	$300.00
½ Page, 7¼"x5½"	231 lines	150.00
½ Page, 8½" D. C.	231 lines	150.00
¼ Page, 4½" D. C.	115 lines	75.00
1 Column, 2¼"x11"	154 lines	100.00
1 Inch		10.00
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52 consecutive issues	20%
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CLASSIFIED ADVERTISEMENTS

Ten cents per word. Minimum 10 words. Cash with order. Business Opportunities ten cents per word, $1.00 minimum.

Entered as second-class matter March 23, 1922, at the Post Office at New York, N. Y., under the Act of March 3, 1879.

Talk on "Our Flag" Delivered by Preacher

In the belief that many patriotic Americans were ignorant of the essential facts about their country's Flag, its origin, history and development, the Rev. Joseph F. Folsom gave an address at WAAM entitled "Our Flag."

Beginning with the real designer of the flag (not Betsy Ross), Dr. Folsom told of the many events and people in American history that gradually changed the form of the flag.

The second part of Rev. Folsom's speech was devoted to the deeper significance of the bright piece of bunting—what it means and may mean to Americans, both native and adopted, and what is the responsibility of Americans for perpetuating the flag and its best tradition.

Although this talk was planned for adults, it was of interest to school children, particularly as a radio supplement to their history and civic courses.

Studio Road to Fame Shut to Mediocrity

By H. W. J. Spencer

In the beginning of broadcasting, artists were anxious to perform before the microphone for the publicity they got out of it, or for the sake of novelty. Next they lost interest in this performing without remuneration. They asked for fees, and some of them got them. This led others to ask for fees, large ones, and some of them got the fees, too. But only artists of high merit could get placed on the air for pay, and the others went on plugging.

What chance is there for unknown and aspiring artists to gain fame and fortune by the broadcasting route? There is always a good opportunity to gain fame for anyone having talent to give in return, and fortune will come with the fame. But there is not much chance for poor and medicore performers to gain attention. The radio audience is spoiled when it comes to enduring mediocre performances. They have acquired the habit of turning dials. They may be tuned in on a certain station when an unknown performer starts to sing or play. At the first false note the hand that turns the dials automatically throws the performer out and brings in someone else.

Easy to "Walk Out"

The ease with which anyone in the radio audience can "walk out" on a performer without disturbing anybody is a great inducement to do so when a bad performance is projected into his home.

If going from one theatre to another were as easy and inexpensive as going from one radio station to another, many would leave one playhouse and try some other until a satisfactory performance were discovered. As it is, one must endure the theatrical performance in the hope that it will improve.

This ease of turning dials leads most persons to tune in one of the few larger and better stations. Many performers before the microphones of the small stations will only have a small audience, and few in that audience would be of enough consequence to add much to the fame and fortune of the performer. Those really appreciating the good would be listening to the better stations.

Mediocrity Penalized

Those of mediocre talent would be forced to perform before the smaller stations, which are not able to pay for services. Stations cannot afford to pay for the talent unless there is some financial return either directly or indirectly. If no one listens to a poor performance no one could be induced to sponsor the broadcast, and the station itself could not do it because no good will would accrue to it for such performances. It might pay to accept the performances without pay just to keep the station going, but that would do the performer very little good, either financially or otherwise.

Hence in broadcasting as in other lines of entertainment, the chance for fame and fortune depends entirely on the ability and the talent of the performers. A good artist will be sought by the larger and financially stronger stations, the mediocre artist will have to do his turn on the stations of lesser artistic and financial status. The performer with more ambition than talent will be crowded to the smaller and financially weaker stations or stay off the air altogether.

THE RAYTHEON CARTRIDGE

A small device that serves as a rectifier and which can be used in connection with chargers and A battery eliminators as a rectifying element has been developed by the Raytheon Laboratories. Send 15 cents for the May 21 issue that contains full information on this new product. Radio World, 145 W. 45th St., New York City.

Station Consolidation Would Enlarge Audience

By Reginald Fawcett

As one method of clearing up the befuddled broadcast situation, Commissioner Bellows suggested that small stations in a community unite in supporting one large station, share time on this station, but use different call letters. This may not be an acceptable solution to the difficulty of clearing up the air, but it certainly is a sensible solution. If several stations pooled their resources and built one powerful and high-class transmitting station much of the overhead and operating expenses would be saved and this money could go to buying better features. More people would listen to the single station when it was on the air than now listen to all the smaller separate stations.

The only thing that the anticipating stations would sacrifice would be time on the air. If several stations contributed to the support of the one station, time on the air would necessarily have to be shared. But this would not mean that any one participant station would reduce its audience. If a station spends an evening a week entertaining 50,000 persons with high-class music it will gain more in good-will than if it spent every evening entertaining next to nobody.

The potential audience would soon learn that every evening one of the participant stations broadcast something worth while from the consolidated station and they would tune in regularly. They would give the station a chance. Now they will not. While tuning they sweep past the station just as if it were not there, or so fast that it can't make an audible squeal in the receiver. They know where to expect something good and they linger around those stations.

Davis Defends Fees for Music

Stephen B. Davis, formerly a judge and who will retire as solicitor for the Department of Commerce to serve as counsel for the National Utility Association, has written a book, "Law of Radio Communication." In this book, discussing copyright, he says:

"Whatever may be argued as to the legal rights to take from the ether and appropriate to one's own unauthorized use, matter, the existence of which is due to another, few would contend that such an act is within accepted standards of fairness or good morals. It is but a new example of the appropriation of the result of another's skill or labor, the obtaining without effort or expense of that which required both in its creation. The situation is not novel in principle. While the decisions are not wholly in harmony as to the legal grounds for their determinations, they are in accord as to results. In all of them the courts dealt with new methods of invasion of underlying moral rights in an attempt to get something for nothing, and they had no trouble in determining the fundamental question of right and wrong between the parties."

Industries Dinner To Be Held Sept. 21

Chicago.

Setting the date for the Fourth Annual Radio Industries Banquet for September 21, this coming Fall, members of the Radio Industries Banquet Committee, at their organization meeting at the Stevens Hotel, in Chicago, made plans for the coming banquet that will carry out the pledge of Paul B. Klugh, General Chairman of the Banquet Committee, that the fourth annual affair would exceed all previous radio banquets both in attendance and in excellence of program broadcast.

Board Makes Changes In New York Area

Washington.

Decisions by the Federal Radio Commission made the following effective in the Metropolitan District:

WLWL, New York—Authorized to operate on 810 kilocycles; divides time with WMCA.

WMCA, New York—Authorized to divide time with WLWL, instead of WEBJ.

WGL, New York—Authorized to operate on 1,020 kilocycles; divides time with WODA.

WODA, New York—Authorized to divide time with WGL, instead of WLWL.

WJBI, Red Bank, N. J.—Authorized to operate on 1,170 kilocycles; divides time (one-quarter) with WBBR and WEBJ.

WBBR, Rosaville, N. Y.—Authorized to operate on 1,170 kilocycles; divides time (one-half) with WJBI and WEBJ.

WEBJ, New York—Authorized to operate on 1,170 kilocycles; divides time (one-quarter) with WJBI and WBBR.

WBNY, New York—Authorized to operate on 1,270 kilocycles; divides time with WHAP and WMSG.

WHAP, New York—Authorized to operate on 1,270 kilocycles; divides time with WBNY and WMSG.

WMSG, New York—Authorized to operate on 1,270 kilocycles; divides time with WBNY and WHAP.

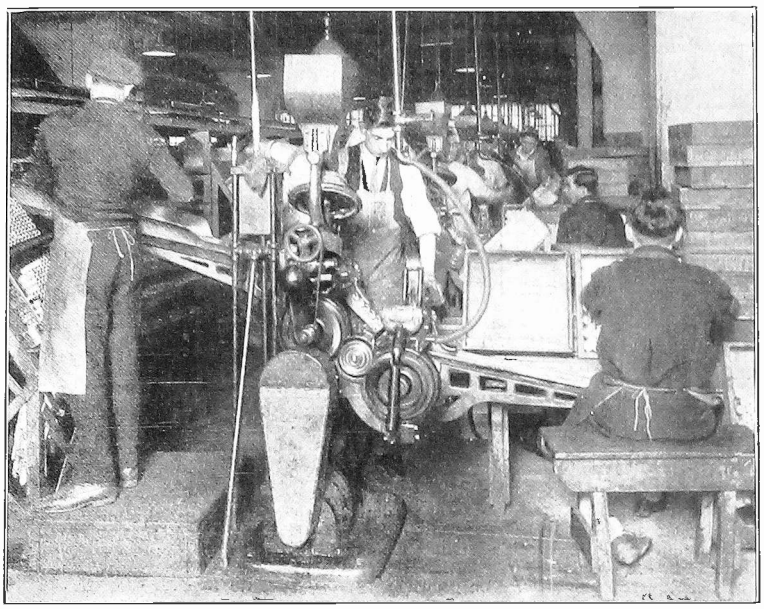
NEVER MIND HOT TUBE

Do not become alarmed when the glass wall of the eliminator tube becomes so hot that you cannot touch it. There is a heat limit, but it can't be judged by touching.

BE SURE OF LOCATION

Don't condemn a receiver for not possessing distance-getting qualities until you are certain that the location is a satisfactory one.

MACHINES MAKE A, B AND C BATTERIES



AUTOMATIC MACHINES used to place brass caps on carbon electrodes and pasteboard washers into the cell taps, in the manufacture of dry cells for A, B and C batteries. The photograph was taken in the plant of the National Carbon Company, makers of Eveready radio batteries.

Radio Death Penalty for Songs Is Repealed

By Roger Fanton

That popular musical compositions may be broadcast to death is the contention of the American Society of Composers, Authors and Publishers, and steps have been taken by that organization to restrict the use of compositions of their members. It is contended that it has been proved by experience that excessive broadcasting of a composition quickly destroys its market in printed and phonograph recorded forms.

"It is not at all unusual to hear a number in popular demand broadcast in any particular area from six to a dozen times in an evening," said E. C. Mills, representative of the society. "Long before the public has had opportunity to purchase the rolls and phonograph records, or the music in sheet form, the public is weary of hearing it.

Once a Night Enough

"No composition should be rendered more than once in an evening in the same form. If played by an orchestra it should not be included in the program of another; if sung once during an evening, it should not be sung again. From the broadcaster's viewpoint, as well as for the welfare of the composition and its owner, the public appetite should not be surfeited."

This is the composer's point of view. It is but natural that he does not wish his composition killed by too much broadcasting before he has had time to realize as much profit as possible out of it. He wants to sell it in sheet form, in phonograph records, in piano rolls, in orchestral royalties, and finally in broadcasting. If its publication by broadcasting is overdone the other forms will undoubtedly suffer.

There is also the point of view of the public, and that is not widely different from that of the composer. A radio enthusiast tunes in and hears the composition. Perhaps he is already tired of it because he has heard countless times before during the last twenty-four hours.

Same Dose All Over Again

He turns to another station in the hope of hearing something else. He gets tuned just in time to hear the orchestra leader announce that the next number will be the self-same composition. And he starts to blaze away before the unfortunate can escape.

All he can do, is perhaps, to turn the set off for a little while, only to hear the same composition in the same or some other form the instant he returns to the set.

But if he will watch the daily programs he can select the classics and the light opera and other forms of stable music. Surely the radio fan will not buy what he cannot escape without a great deal of mental and manual manouvering!

The society has a variety of restrictions, usually following a member's desire. For instance, a producer or publisher may want to restrict the playing of a piece to once a week at any given station. This actually has been done in the case of "Hallelujah," from the musical comedy, "Hit the Deck." WJZ, for instance, had an orchestra about to open a program one evening, when the strains of this piece were heard for what would have been the second time in a week. The announcer quickly explained the situation and WJZ was silent for the length of time it took to play the song.

Radio University

A FREE Question and Answer Department conducted by RADIO WORLD for its yearly subscribers only, by its staff of Experts. Address Radio University, RADIO WORLD, 145 West 45th ST., New York City.

When writing for information give your Radio University subscription number

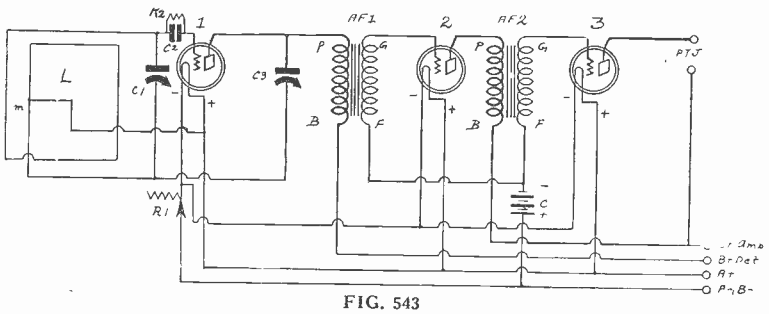


FIG. 543

The circuit diagram of the three-tube regenerative loop-operated set requested by Clarence Rollands.

I WISH to build the special loop described in the Jan. 22 issue of RADIO WORLD, on page 13.

(1)—I cannot get the specified triple tinned and double insulated wire. Can plain rubber covered leadin wire be used instead?

(2)—I have a flag pole over my home, about twenty-five feet high. Could I place the antenna on top of this pole?

(3)—Would it be a good stunt to use guy wires to strengthen the hold on the antenna?—CHARLEY J. GOODMAN, Plattsburgh, N. Y.

(1, 2 and 3)—Yes.

* * *

I HAVE the circuit diagram of a five-tube receiver, using two two radio frequency stages, a non-regenerative detector and two stages of transformer audio-frequency coupling. I would like to build this set, but am in doubt as to several things.

(1)—Solenoid coils having fifteen-turn primaries and fifty-turn secondaries wound on two-and-three-quarter inch diameter tubing with No. 22 double cotton covered wire are specified. The windings are spaced one-quarter inch apart. I have basketweave coils having the same characteristics as the solenoids specified, except that No. 24 double cotton covered wire is used and there is no spacing between the primary and secondary. Could they be used?

(2)—The circuit calls for a double circuit jack after the detector tube. Could this be left out? How?

(3)—The filaments of the detector and the audio frequency amplifiers are controlled by a single rheostat. The value is not stated. What type should be used to control the filaments of two -01A tubes and one 112 tube?

(4)—The radio frequency filaments are controlled by a fifteen-ohm rheostat. Is this all right?—JAMES H. COLLINS, Los Angeles, Calif.

(1)—Yes.

(2)—Yes. Connect the plate post of the detector socket to the P post of the first audio transformer. The B post of the transformer is brought to the B plus post.

(3)—Use a two-ohm rheostat.

(4)—Yes.

* * *

I AM going to build the Nine-In-Line Super-Heterodyne set described in the April 2, 9, 16 and 23 issues of RADIO WORLD, and would like to have some points cleared up.

(1)—Would I get good results if I substituted the rheostat in the RF filament circuit with a ballast resistor?

(2)—I wish to use an antenna and ground. How can this be done, using a tickler to obtain regeneration in the detector tube, instead of the midget condenser?—MICHAEL BOLDER, Memphis, Tenn.

(1)—No.

(2)—Procure one three-inch and one one-and-three-quarter inch diameter tubing, some No. 22 double cotton covered and some No. 26 single silk covered wire. Wind ten turns on the larger diameter tubing. Leave one-quarter-inch space, and wind forty-five turns more. Use the No. 22 dcc wire for this. Then take the smaller tubing and wind thirty-four turns, using the finer wire. This form is inserted in the larger tubing, near the secondary winding. The beginning of the primary or ten-turn winding is connected to the antenna. The end goes to the ground. The beginning of the larger winding on this tubing (secondary) is brought to the rotary plates of the variable condenser and to one terminal of the pickup coil L3. The other terminal of this winding is connected to the stationary plates of the variable condenser and to the G post of the socket. The remaining terminal of the pickup coil is brought to the plus F post on the socket. One terminal of the tickler or small diameter winding is brought to the plate post of this socket. The other terminal of this winding is brought to the plate post of the first intermediate frequency transformer ICT1.

* * *

I HAVE a three-tube set, using a regenerative detector with a variometer in the plate circuit and two stages of transformer coupled audio frequency amplification. The set is not selective enough. I tried reducing the number of turns on the primary, but to no avail. I would like to add a stage of radio frequency amplification, which I think would help increase the selectivity a great deal. The primary of the antenna coil contains ten turns, the secondary containing forty-five. I am using a .0005 mfd. variable condenser. Both are wound on a two-and-three-quarter inch diameter tubing using No. 22 double cotton covered wire. Please state how this should be done.—RALPH THOMAS, Poughkeepsie, N. Y.

Wind ten turns on a two-and-three-quarter inch tubing. Allow one-quarter inch. Then wind fifty-five turns. The number of turns on the secondary of the coil already in the set should also be increased to fifty-five to balance up circuits. Across the secondary of this new coil, shunt a .0005 mfd. variable condenser. Use a twenty-ohm rheostat for filament control. Insert it in the negative leg. The antenna is connected to the beginning of the primary of the new coil. The end goes to the ground. The beginning of the new secondary winding goes to the rotary plates of the new condenser and to the minus A post. The end of this coil is brought to the G post on the new socket and to the stationary plate post of the new condenser. The plate post of the new socket is brought to that terminal of the old coil winding that formerly went to the antenna. The end of this coil is brought to the B plus 45 volt post. The plus F post is connected to the plus F post of the other socket.

* * *

LAST WEEK I was presented with a three-foot box loop, containing twelve turns of what appears to me to be No. 18 stranded wire. Also I got two audio frequency transformers with a ratio of three to one. Could I have the circuit diagram of a three-tube set, using these parts and any other that may be necessary? I only want to hear the local programs, and since I live fairly close to several stations, I don't think I will need a super-sensitive receiver.—CLARENCE ROLLANDS, N. Y. City.

In Fig. 543 you have the circuit diagram of a receiver which should suit your needs. L is the loop, which is tapped at the sixth turn, or center. This lead should be flexible and brought to a binding post or some type of connector on the base. In the grid circuit, a .0005 mfd. variable condenser is used for tuning. A midget condenser C3, having a capacity of .00005 mfd. is used for regeneration control. The two transformers are indicated at AF1 and AF2. To control the filaments of the three tubes which should be the —01A type, use a ten-ohm rheostat, R1. The plate of the first tube receives forty-five volts. The plates of the audio amplifiers receive ninety volts. The C bias is four-and-one-half volts negative. The grid leak has a resistance of six megohms, while the condenser has a capacity of .00025 mfd. To tune the set, simply turn the loop in the direction in which the station lies. Then adjust the larger variable condenser. The midget condenser should be used to increase the intensity of signals. At the output, binding posts, a single circuit jack or clips may be used.

* * *

I WISH to rebuild my four-tube set, which consists of two stages of tuned radio frequency amplification, a regenerative detector and a single stage of transformer audio frequency amplification.

(1)—The filament of each RF tube is controlled by twenty-ohm rheostat. Could I use a single ten-ohm rheostat to control both?

(2)—Would I get better results if I replaced the tickler with a thirty-five turn coil wound on a three-inch diameter tubing using No. 22 double cotton covered wire, shunted by a .00035 mfd. variable condenser?

(3)—In the antenna circuit, a single winding inductance is used. Could I replace it with a separate primary and secondary winding? In the other circuits twelve turn primary and forty-seven secondary coils, wound on three-inch diameter tubings are used, using No. 22 dcc wire.—EDWARD M. MYER, Rice Lake, Wis.

(1)—Yes.

(2)—No.

(3)—Yes. Procure a three-inch diameter tubing. Wind ten turns for the primary and forty-seven turns for the secondary, using No. 22 double cotton covered wire.

* * *

COULD A double condenser be used to tune the secondary circuits in the four-tube set described by Herbert E. Hayden in the Nov. 13 issue of RADIO WORLD? What changes are necessary, other than connecting the common rotor to the points where the rotors of the single

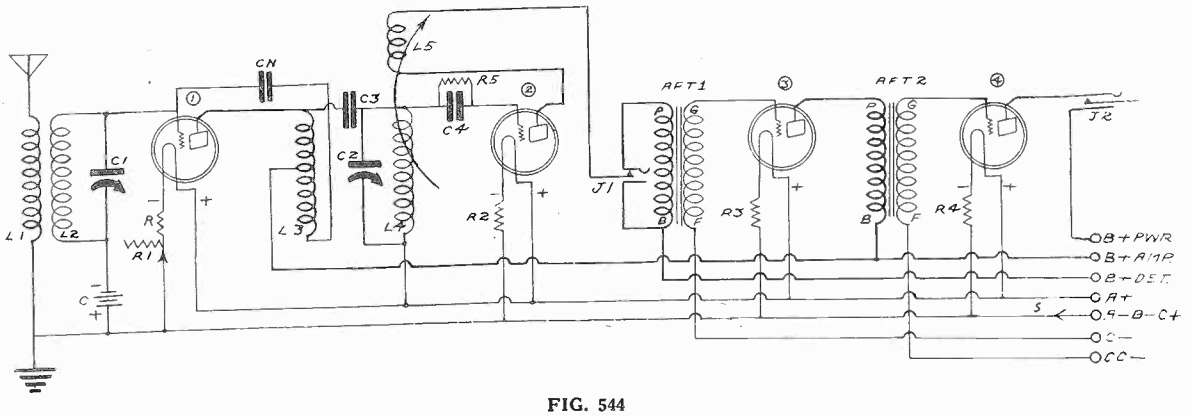


FIG. 544

The circuit diagram of the four-tube regenerative receiver requested by Dave Jouskerson.

condensers are now connected? The —01A tubes are to be used.

(2)—Must the C battery be used in the first audio circuit?

(3)—Would it be feasible to insert some kind of a variable resistance in series with the RF plate lead, for oscillation control? If so, what type?—JOSEPH RENNIE, Atlanta, Ga.

(1)—The double condenser can be used. Since the common rotor is to be connected to the minus A post, the plus A connection, which went to the rotor of the single condenser, has to be broken, a short resulting otherwise. The —01A tube which is being used as a detector requires a positive return. Therefore, instead of having the grid leak connected across the grid condenser, it is brought from the G post of the socket to the plus F post on the socket. A small balancing condenser having a maximum capacity of about 15 mmfd. should be shunted across the secondary circuit of the detector coil.

(2)—To lengthen the life of the B battery and also to increase the quality reproduction, it is essential.

(3)—Yes, 2,000 ohms or more.

* * *

REGARDING THE five-tube receiver described in the Feb. 5 issue of RADIO WORLD, on pages 8 and 9.

(1)—Could storage battery tubes, e.g., —01A type, be used instead of the —99s?

(2)—Can this set be used successfully on a loop? If so, how?

(3)—Could regeneration be employed in the detector circuit, with much success?

(4)—Could a pilot light be used? How would it be connected?—ARTHUR H. RICE, Albany, N. Y.

(1)—Yes. Use the proper ballast resistors in the filament circuits of the detector and the amplifiers. Be sure that the windings of the rheostat used for the RF filaments will pass one-half ampere.

(2 and 3)—No.

(4)—Yes. Connect one terminal to the plus A post and the other terminal to the minus F post of the last socket, not to the minus A post on the battery.

* * *

PLEASE SHOW me the circuit diagram of a four-tube set, employing a neutralized stage of tuned radio frequency amplification, coupled to a regenerative detector using a tickler via a condenser, in impedance tuned fashion and two stages of transformer coupled audio frequency amplification. I wish to use —01A tubes throughout the set. The constants of the coils, condensers would also be very much appreciated. — DAVE JOUSKERSON, Houston, Tex.

Fig. 544 shows the circuit diagram of such a set. The antenna coil consists of the primary L1, ten turns, and the secondary L2, forty-seven turns, both wound on a three-inch diameter tubing, with No. 22 double cotton covered wire. Across this secondary winding, a .0005 mfd. variable condenser, C1, is shunted. The special plate coil L3 consists of thirty turns wound on a three-inch tubing, tapped at the fifteen turn, or in the center. L4 consists of forty-seven turns also wound on a separate three-inch tubing. Use No. 22 dcc wire in both cases. Both these tubes are placed in line with each other, horizontal to the panel. Across the L4 winding, another .0005 mfd. variable condenser is shunted. Coupling these two coils, is a .0005 mfd. fixed condenser, C3. CN is a midget variable condenser, having a maximum capacity of .00005 mfd. L5 is the tickler coil, which consists of thirty-five turns of No. 26 single silk covered wire, wound on a one-and-three-quarter inch diameter tubing, and inserted in the secondary coil L4. C4 is a .0001 mfd. fixed condenser, while R5 is a two or three megohm grid leak. R, R2, R3 and R4 are all 1A Amperites. R1 is a ten-ohm rheostat. The C battery, in the grid circuit of the radio frequency tubes, has a voltage of four-and-one-half volts maximum. It is composed of three one-and-one-half-volt dry cell batteries. To obtain best results it is necessary to vary the voltage here until best results are obtained, then leave the voltage alone. J1 and J2 are single-circuit jacks. Phones are plugged in at J1 to adjust for best volume or quality. J2 is, of course, for the loud speaker. To the plate of the radio frequency amplifier apply sixty-seven-and-one-half volts. To the plate of the detector tube apply forty-five volts. To the plate of the first audio amplifier, apply ninety volts. To the plate of the last tube, apply one hundred and thirty-five volts. Use a nine-volt C battery for this last tube. A four-and-one-half-volt C battery should be used in the first audio stage. The transformers should be of the low ratio variety. S is the filament switch.

* * *

I AM going to rebuild my Victoreen Super-Heterodyne and would like to know if it would be satisfactory to use a wooden baseboard.

(2)—Could flexible stranded hookup wire, equal to about No. 18 be used? The blueprint calls for No. 14 bus bar wire.—JOHN L. FASSADORF, Baltimore, Md.

(1 and 2)—Yes.

* * *

I HAVE a seven-tube set, consisting of three stages of tuned radio frequency amplification, a non-regenerative detector and three stages of double impedance coupled audio frequency amplification. The first stage of radio frequency is tuned by a single condenser, while the other two and the detector is controlled by a triple condenser. Could I add two more radio frequency stages, and supplant the single condenser with another triple condenser, which would tune the extra two stages and the old stage?—CLAUD FISHER, Troy, N. Y.

No. The problem of neutralizing becomes too difficult after three tuned stages.

* * *

WOULD I get good results if I used a standard one hundred foot long inverted L shaped broadcast antenna with a three-tube short wave regenerative receiver, in which the detector tube is made to oscillate by a variable condenser tuning the plate, e.g., Hartley system of feedback?—JAMES FRIEBACK, New Orleans, La.

Yes. Suggest you insert a .00001 mfd. either fixed or variable condenser in series with the antenna.

Good Back Numbers of RADIO WORLD

The following illustrated articles have appeared in back issues of RADIO WORLD: 1926-1927:

Oct. 9—A Practical "A" Eliminator, by Arthur H. Lynch. Building the Equamatic, by Capt. P. V. O'Rourke.

Oct. 16—The Bernard, by Herman Bernard. How to Box an "A" Supply, by Herbert E. Hayden.

Oct. 23—The 5-tube P. C. Samson, by Capt. P. V. O'Rourke. Getting DX on the Bernard by Lewis Winner.

Oct. 30—The Singletrol Receiver, by Herbert E. Hayden. How to Get Rid of Squeals, by Herman Bernard.

Nov. 6—Reduction of Interference, by A. N. Goldsmith. Variations of Impedances, by J. E. Anderson

Nov. 13—The 4-tube Hi-Power Set, by Herbert E. Hayden. A Study of Eliminators, by Herman Bernard.

Nov. 20—Vital Pointers About Tubes, by Capt. P. V. O'Rourke. The 4-tube Diamond of the Air, by Herman Bernard.

Dec. 4—The regenerative 5-tube Set, by Cap. P. V. O'Rourke. The 8-tube Lincoln Super, by Sidney Stack.
Winner's DC Eliminator, by Lewis Winner.

Dec. 18—Selectivity on One Tube, by Edgar Speare. Eliminating Interference, by J. E. Anderson.

Dec. 25—A New Coupling Device, by J. E. Anderson. Function of Eliminators, by Herman Bernard.

Jan. 1, 1927—The 2 Tube DeLuxe Receiver, by Arthur H. Lynch. The Twin-Choke Amplifier, by Kenneth Harkness.

Jan. 8—Tuning Out Powerful Locals, by J. E. Anderson. A Choice Superheterodyne, by Brunsten Brunn. The 2-Tube De Luxe Receiver, by Arthur H. Lynch (Part 2).

Jan. 15—The DeLuxe Receiver, by Arthur H. Lynch (Part 3) The Simple Meter Test Circuit by Herbert E. Hayden. The Superheterodyne Modulator Analyzed, by J. E. Anderson.

Jan. 22—The Atlantic Radiophone feat, by Lewis Rand. An Insight Into Resistors, by J. B. Anderson. A Circuit for Great Power, by Sidney Stack.

Jan. 29—The Harkness KH-27 Receiver (Part 1), by Kenneth Harkness. Use of Biasing Resistors, by J. E. Anderson.

Feb 5—5-Tube, 1 Dial Set, by Capt. P. V. O'Rourke. The Harkness KH-27 (Part 2), by Kenneth Harkness. What Produces Tone quality, by J. E. Anderson.

Feb. 12—Phone Talk Put On Speaker, by Herbert E. Hayden. All Batteries Eliminated, by Herman Bernard. The Harkness KH-27 Receiver, by Kenneth Harkness (Part 3). Conclusion.

Feb. 19—The 6-Tube Victoreen, by Herman Bernard (Part 1.) The Big Six Receiver, by Wentworth Wood. "B" Eliminator Problem, by Wm. P. Lear. The Phasatrol Circuit, by Capt P. V. O'Rourke. The 3-Tube Victoreen, by Herman Bernard (Part 2). Conclusion.

Feb. 26—The 5-tube Diamond in a Phonograph, by Hood Astrakan. How To Read Curves, by John F. Rider. Proper Tubes for 5-Valve Receiver, by J. E. Anderson.

Mar. 5—Introduction of 4-tube Universal, by Herman Bernard. Discussion on DX, by Capt. P. V. O'Rourke. Sensible Volume Control, by Chas. Gribben.

Mar. 12—Ten Tell-Tale Points, by J. E. Anderson. How To Figure Resistors, by Frank Logan. The 4-tube Universal, by Herman Bernard, (Part .)

Mar. 19—Psycho-Analyzing Circuits by Thomas L. McKay. The Universal, by Herman Bernard (Part 2). How To Use a Wave Trap, by James H. Carroll.

Mar. 26—The Universal, by Herman Bernard, (Part 3). Flow of Current in a Vacuum Tube, by Radcliffe Parker. Broadcasting Hypnotism.

April 2—Facts Every Experimenter Should Know, by J. E. Anderson. A Ship Model Speaker, by Herbert E. Hayden. The 3-tube Compact, by Jasper Henry. The Nine-in-Line Receiver, by Lewis Rand (Part 1.)

April 9—A 5-tube Shielded Set, by Herbert E. Hayden. The Power Compact, by Lewis Winner. The Nine-in-Line Receiver, by Lewis Rand, (Part 2.)

April 16—The Schoolboy's Set, by Wally Frost. The Melo-Heald 11-tube Set, by Herbert E. Hayden. The Nine-in-Line Circuit (Part 3), by Lewis Rand.

April 23—The Melo-Heald Set, by Herbert E Hayden (Part 2). The Nine-in-Line, by Lewis Rand. (Conclusion). How Frequencies Are Cut-off, by J. E. Anderson.

April 30—A 1-tube Portable, by Jasper Jellicoe. A Ship Model Receiver, by Smedley Farnsworth. A Double Three Foot Cone, by W. H. Sinclair.

May 7—The Adams-Griffin 6-tube Set, by Dana Adams-Griffin (Part 1). A 2-tube Portable, by Hood Astrakan. How to Improve Superheterodyne Sets, by John L. Barrett.

May 14—A 3-tube Portable, by Herbert E. Hayden. The Adams-Griffin Receiver, by Dana Adams Griffin. (Conclusion).

May 21—The Victoreen Portable Receiver, by Capt. P. V. O'Rourke. A Low-Pass Filter, by J. E. Anderson.

May 28—The Console Cone, by Thorvald Larsen. The 3-tube Reflex by Edgar B. Francis. The Victoreen Portable Receiver, by Capt. P. V. O'Rourke. (Part 2).

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THE RADIO TRADE

Exports Up $179,079 for Month of April

Washington,

With receiving sets nearly doubling in export value, the April radio trade of the United States showed a large increase over that of April, 1926, the Electrical Equipment Division of the Department of Commerce has just reported. The full text of the report follows:

"Exports of radio equipment from the United States in April of this year were valued at $664,594 and represented an increase of $179,079 over the total of $496,525 exported in April, 1926.

"The greatest single increase was recorded in exports of receiving sets, which gained to $211,029, as compared with $11,692 in April of last year. Shipments of radio tubes also increased to $78,998, as against $69,406 in April, 1926. Exports of transmitting sets and parts increased slightly to a total of $38,379 from the total of $37,654 sent abroad in the same month of last year. Shipments of receiving set components amounted to $175,261, as against $149,704 in the comparative period of 1926, and exports of receiving sets accessories totaled $160,927, as compared with $127,069 in April, 1926."

Nine-in-Line Super

Described in the issues dated April 2, 9, 16 and 23 in such a clear manner that the veriest novice can learn all about it. This circuit has proven its worth in distance, selectivity, volume and tone quality. Send 60c for these issues or send in your subscription for one year and get these copies as a premium. RADIO WORLD, 145 West 45th St., New York City.

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THE NEW AC TUBES

Everybody should have on hand for ready reference full data on the new AC tubes. The filaments of these tubes are heated by alternating current from a step-down transformer and anybody having AC can put these tubes into a set by making some wiring changes. Those who have AC and who are about to build a set also should possess this full information. Send 15c for the June 4 issue that contains the data on the AC tubes and also on two new rectifier tubes for B eliminators. Radio World.

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Kennedy Is Elected Lynch Vice-President

James A. Kennedy, who for the past year has been acting in the capacity of special sales representative for Arthur H. Lynch, Inc., resistor manufacturers, was elected to the vice-presidency of that corporation at a meeting of the Board of Directors.

Mr. Kennedy, like most of the other officers in the Lynch organization, has been in the radio business for many years. At various times he has been in the employ of the Marconi Wireless Telegraph Company of America, the Signal Corps of the U. S. Army and the Radio Corporation of America. Mr. Kennedy is known throughout the radio business in all parts of the country. His activities are to be in connection with the promotion of sales.

Another advancement in the Lynch organization is that of A. C. Massias, who has been placed in the capacity of comptroller. Mr. Massias was formerly associated with The New York Credit Clearing House, the General Motors Corporation and several other large organizations.

Data on Resistance Published in Folder

A technical data folder has been prepared by the International Resistance Company giving information relative to the sizes and construction of the various types of resistors used in radio communication. This folder applies generally to resistance units, and more particularly to the Durham Metallized Resistor concerning which graphs and curves are illustrated giving the characteristic operating data of the Durham Resistors of various types including the Powerohm units.

Those interested in resistor construction or resistor uses may obtain copies of this technical booklet by mentioning RADIO WORLD and writing your request to the International Resistance Company, 522 Perry Building, Philadelphia.

LITERATURE WANTED

H. Altbach, 152 Minor St., New Haven, Conn.
T. G. Cooney, 1623 Temple St., Los Angeles, Calif.
J. Held, 23 Dennison Ave., Weston, Ontario, Canada.
Eddie Sanders, Box 524, Toronto, Ohio.
W. G. Davis, 685 Academy St., New York City, N. Y.
George Harrington, Coldwater, N. Y.
Roman Debes, 449 36th St., Brooklyn, N. Y.
Everett Artcliff, 1906 East 8th St., Superior, Wis.
W. Douglas Fisher, 552 7th Ave., N. W., Roanoke, Wis.
E. L. Desilets, 73rd Ave. S., Sherbrooke, Quebec, Canada.
L. J. Miscuraca, 240 South Broadway, Los Angeles, Calif.
Nat. Wales, 829 Park Ave., New York City, N. Y.
Fred J. Bennett, 11224 S. Irving Ave., Chicago, Ill.

COMPLETE LIST OF STATIONS

With the new wavelengths, frequencies and power. All the 694 stations in the United States given alphabetically by call letter with the location cited and also the identity of station or stations which share time on the air. Send 15c for the June 11 issue that contains this complete list. Radio World, 145 W. 45th St., New York City.

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Circulation Manager, RADIO WORLD, 145 West 45th Street, N. Y. City.

MacMillan In New Dash; Will Receive Programs

Boston.

Members of the Rawson-MacMillan-Field Museum Expedition to the Arctic this Summer will be able to keep in close touch with relatives and friends in the States through weekly radio messages broadcast by WBZA, Springfield and Boston. The expedition with Captain Donald B. MacMillan at its head will start from Wincasset, Maine, on Saturday, June 25.

Captain MacMillan hopes to transmit messages from his flagship, "The Bowdoin," back home. The expedition will carry a shortwave transmitter, and the signals picked up here will be rebroadcast from WBZ-WBZA.

This dash will be the sixth which the famous explorer has made to the Far North. Its primary purpose is the establishment of a scientific station for experimental work at Nain, Labrador. The little band setting sail from Wiscasset harbor will number twenty men and six scientists. The Bowdoin will freeze in the ice for one year, while its companion ship, "The Radio," will return home about September 15.

Both vessels will first explore the Eastern coast of Baffinland as far north as the Arctic Circle. Scientists from the Field Museum will search the region carefully for specimens of bird and animal life. Others will hunt for fossil remains in the vicinity of Frobisher Bay.

After an experimental station has been located at Nain, the explorers will pursue their special researches.

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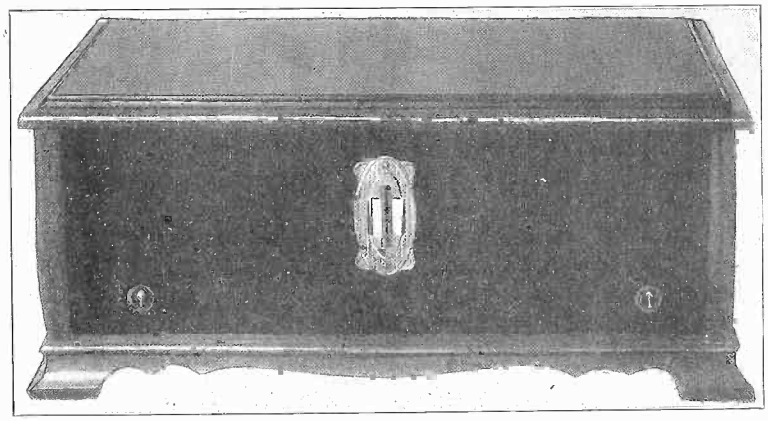

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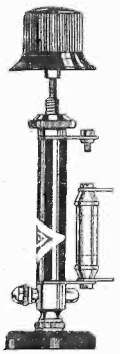

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