JUNE 11 VACATION NUMBER 15c

RADIO WORLD

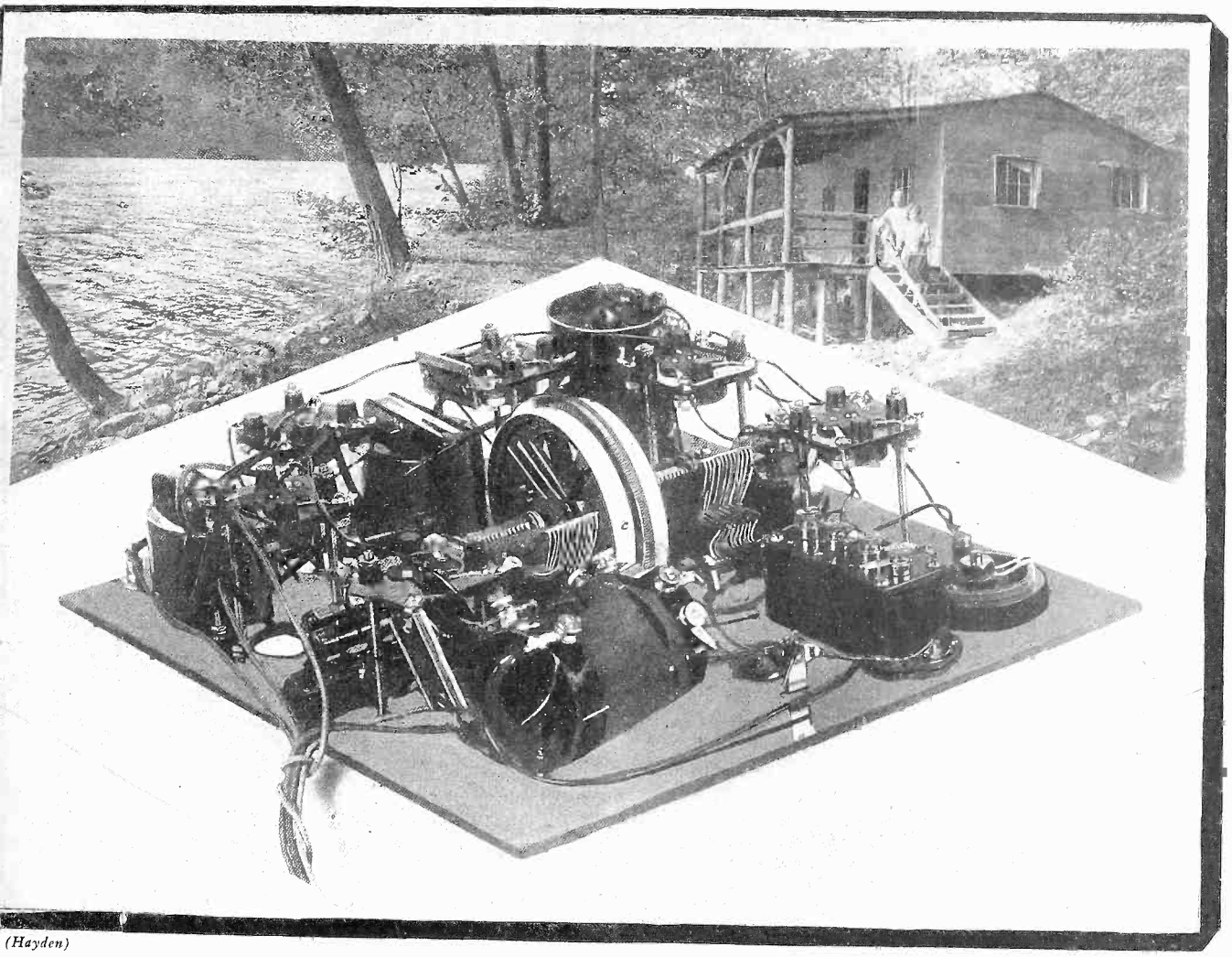
REG. U.S. PAT. OFF.

PUSH-PULL RESISTANCE AF SHOWN FOR FIRST TIME

LIST OF STATIONS; NEW WAVES

AN AC POWER AMPLIFIER AND 400-v B ELIMINATOR

THE SUITCASE SIX FOR OUTINGS



(Hayden)

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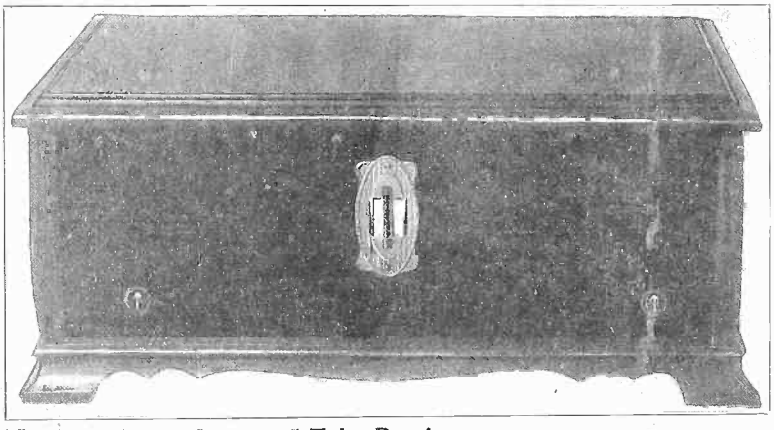

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145 WEST 45th STREET NEW YORK CITY

SIXTH YEAR

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Phones: BRYant 0538 and 0539

[Entered as second-class mater, March, 1922, at the post office at New York, N. Y., under Act of March, 1879]

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By J. E. Anderson

Contributing Editor; Consulting Engineer

THE great advantage of push-pull amplification is that it eliminates the even harmonics. Since most of the frequency distortion lies in the second harmonic it is evident that this type of amplification is relatively free from distortion.

Heretofore push-pull amplification has only been used in connection with transformer coupling, and then only in a stage or two. But the system is equally applicable to resistance coupling, and in this form other advantages become apparent. Two of these are the freedom from self-oscillation when all the tubes are served by the same B battery eliminator and the absence of hum even when no filter is used. These, of course, follow from the fact that the system eliminates the even harmonics.

A circuit of this type was first set up by me for eliminating motorboating. To give the system a thorough test the circuit was made odd, that is, in each half of the circuit an odd number of tubes was used. Such a resistance coupled amplifier, when one-sided, will motorboat violently.

No Filter, Still No Hum

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It is not difficult to understand why the push-pull resistance coupled circuit should be relatively humless even when the B voltage contains considerable hum. For the purpose of explanation we might take the four stage amplifier shown in Fig. 1. In this circuit Z is the impedance of the eliminator which is common to all the plate circuits. It is drawn in four different places for ocular convenience only. The corresponding plate and grid resistors and grid condensers are supposed to be identical in value, and the corresponding tubes are supposed to be identical in their characteristics. The audio frequency input to the circuit is impressed across the terminals ab and the loudspeaker is connected across the terminals AB.

Suppose now that the line voltage

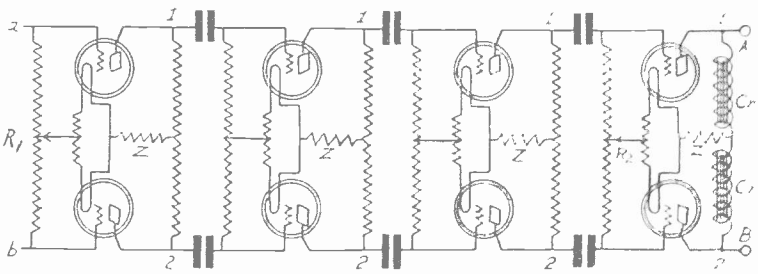

FIG. 1

Four stage push-pull, resistance coupled amplifier in which the tendency to motorboating and other oscillation is reduced to a minimum, and in which there is no audible hum even when the voltage supply contains considerable. Accurate balance of the two halves of the amplifier is essential to gain these advantages. Final balance is obtained by dividing input at R1 and equalizing the output at R2.

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Out-phased Currents

Hence there will be no change in the numerical difference between the voltage drops in two corresponding coupling resistors, or there will be no change in the potential between the points (1) and (2)). Hence the change in the plate voltage will not give rise to audible signal, that is, the hum will not be transmitted by the amplifier to the speaker.

The reason for the absence of motorboating also is plain. Suppose a signal current is sent through the potentiometer resistor R1. Divide the voltage between the two sides equally and accurately. The two halves of the amplifier therefore will be in opposite phase at all times. When the plate current to one tube increases, the plate current to the opposing tube decreases in exactly the same proportion. Hence in the common impedance Z there will be no change in the plate current. In other words, the signal is perfectly balanced out of the common impedance. This holds for every pair of tubes. Since there is no signal current present in the common impedance there can be no regeneration through it, and consequently all tendency to motorboat will be eliminated. It makes no difference whether the number of stages in the circuit is odd or even so long as every stage is balanced.

Discussion of Difficulties

Theoretically this circuit works perfectly. It will not motorboat or oscillate at any frequency, even when there is a high common impedance. It will not hum even if the ripple in the B voltage has not been filtered out. It will keep the even harmonics out of the signal, provided they are not a part of the signal. But in practice some difficulties arise. Some of these were expected, others were not.

The circuit works by virtue of balance, and the better the balance the more nearly it works in accordance with theory. But the practical difficulties in attaining adequate balance are very great. No two things can be found alike, and this is especially true of radio parts. Any two things having the same designation are the same by courtesy only. Of course, moderate deviations from rated values are of small importance so long as the crux of the matter is not that of identity of values. That it is, in this circuit. The coupling resistors in any one stage must have the same values. The same applies to the stopping condensers and to the grid leaks. It is of course possible to select pairs of these units which will have the same values within narrow limits when they are working under the same conditions.

And that takes us to the main difficulty,

(*Continued on next page*)

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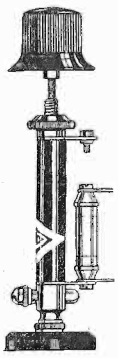

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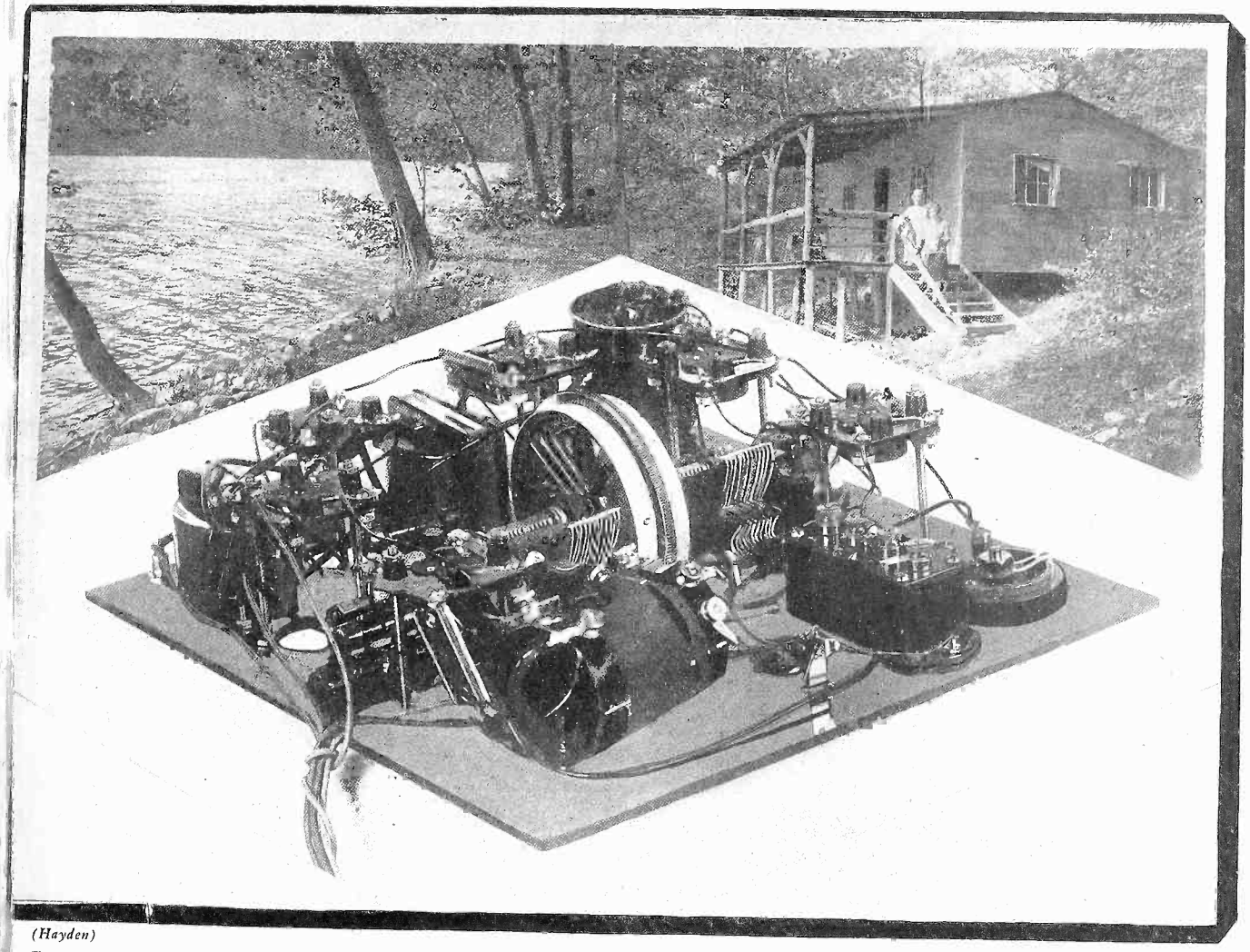

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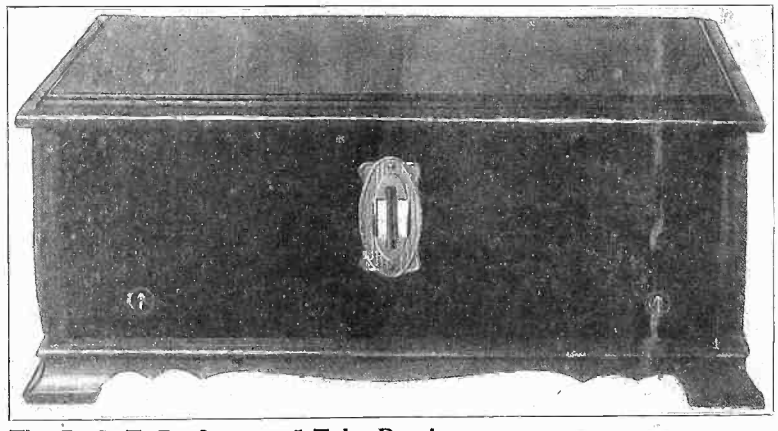

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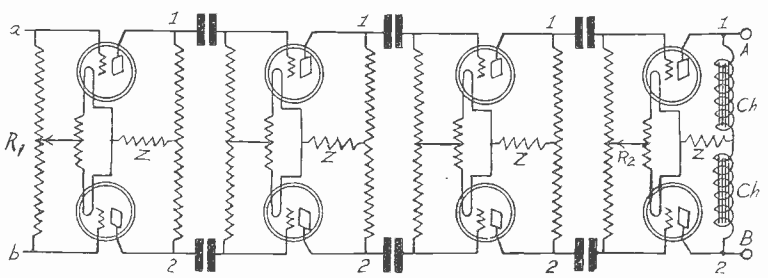

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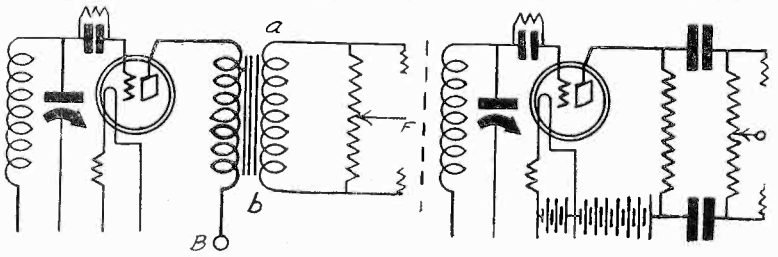

FIGS. 2 AND 3.

Circuit showing how the detected signal can be put into the balanced amplifier. (Fig. 2, left). The voltage applied at B must be filtered, otherwise the signal, which enters the push-pull amplifier, will contain hum as a signal. Fig. 3 (right) is a circuit showing another way in which the detected signal can be put into the balanced amplifier without the use of a transformer. This method requires a separate A and B battery for the detector tube, as shown above. Othewise one grid is grounded and the amplifier is dead.

(*Continued from preceding page*)

that of obtaining identical tubes. The characteristics of any two of a pair of tubes must be identical. They must have the same amplification constant, the same plate output resistance, the same filament requirements, the same inter-electrode capacities. Tubes differ widely, and to select a set of pairs of identical tubes would necessitate an almost unlimited supply of tubes. No experimenter has that good fortune. It is, however, possible with a limited supply to arrange the tubes, provided their actual characteristics are known, in such a way that differences will be partly neutralized.

At first thought it might appear that a small unbalance would not make much difference. But that is not so, particularly when there is a considerable common impedance. If there is any slight unbalance there will be an alternating current in the common impedance, because one side of the circuit amplifies more than the other. Now if the common impedance is considerable there will be an appreciable voltage drop in it because of this current. This voltage drop will increase the amplification in the stronger side and it will decrease it in the weaker side by the same amount. Thus the circuit is in a sort of unstable equilibrium. A small unbalance in the adjustment will cause a great unbalance in the effective amplification in the two sides. The primary effect of the unbalance is hum and motorboating.

Equalization Problems

When a circuit of this type has been built and balanced as nearly as possible with fixed units, the balance can still be improved by a judicious application of variables. Instead of fixed resistors, potentiometers could be used both in the plate and grid circuits for dividing the output of one pair of tubes and the input to the next.

But it is neither practical nor desirable to use a large number of these variables. One at the beginning and one at the end of the amplifier should be enough to effect a good balance, if reasonable care has been exercised in selecting the fixed parts. Thus the input potentiometer R will serve to divide the voltage equally between the two sides, or in such proportion as will be required to maintain the same signal level in both sides of the circuit. Again a voltage divider can be used to equalize the input to the last two tubes, or rather to vary the input so as to equalize the output currents. It is of great importance to equalize the AC plate currents in the last two tubes, because they are much greater than those in any of the others, and therefore their difference is likely to be large. It makes little difference where the equalization takes place, in the first pair of tubes or in the last.

Another method of equalization that can be resorted to is variation of the filament current. This is not applicable to the circuit in Fig. 1, but the filament wiring can easily be changed so that the two halves of the amplifier are independent in this respect and so that one master rheostat could be put in each half. This method is not recommended except as a minor adjustment.

Note that no condenser is used in the output of the amplifier. None is needed. The speaker is connected directly between the points A and B. No direct current will flow through the windings of the loudspeaker because the points (1) and (2) are at the same potential with respect to direct current. But AC current will flow as soon as there is an AC signal impressed on the amplifier. It is, of course, necessary that the output chokes Ch have a high inductance and a low DC resistance and that the two chokes be equal. A push-pull output transformer can be substituted for the two chokes, if desired. This is desirable if high impedance tubes and a low impedance speaker are used. It is apparent that the plate impedance of the two tubes are in series and that for this reason not much volume can be obtained from the circuit unless a load impendance of twice the ordinary value be connected across the line.

Detector Coupling

Instead of using an output transformer for matching impedances two speakers can be connected in series across the points A & B. If only one speaker is available it can still be connected directly across the line without the intervention of a transformer provided that such low impedance output tubes as 71 type be used. The output impedance of each of these is about 2,100 ohms, so that the impedance in series with the speaker would be 4,200 ohms, which is about right for a good match with the better speakers available.

There are other practical difficulties which must be taken care of before this circuit can be operated. One is that of coupling it to the detector. Suppose an attempt be made to operate the first two tubes in Fig. 1 as detectors in push-pull relation and putting a tuner across the points a and b. Nothing but queer grunts will be emitted from the reproducer. The effective audio component in the plate of the detector is the second harmonic, and this as well as all the other even harmonics the system effectively balances out. If we attempt to use one of the first tubes only as detector, one side of the circuit becomes a useless appendage as far as the amplification is concerned. It is still effective in keeping a certain amount of hum out of the signal, as well as subduing the tendency to oscillate, but there is no gain in the amplification. The first two tubes are ruled out as detectors, singly or in any combination.

One way out of this difficulty is to use a crystal detector. This can be connected in series with the (a) lead and then connected to the tuner in the usual way. When a crystal detector is used the resistance of the potentiometer R can have any value from 2,000 ohms upwards. The volume increases as the resistance increases. For very high values of this resistance the circuit is likely to oscillate at a very high frequency unless the output and all its leads are carefully shielded electro-statically from the input. This squeal is not a question of common impedance.

When a crystal detector is used selectivity must be gained in the radio frequency stages.

AF Input Options

Another way out of the difficulty of input is to employ the method shown in Fig. 2. This is satisfactory if a good transformr is used. However, it is necessary to eliminate thoroughly all ripple from the B voltage supply of the detector tube. Also the use of this method requires more complete balancing of the push-pull amplifier and removal of signal current from the common impedance, because if there is any residual current it will affect the plate current in the detector and either cause oscillation or damping of the amplification.

The use of a push-pull input transformer does not differ in any essential detail from the use of a single transformer and a potentiometer. But in the case of the push-pull transformer there is not a chance of suitably dividing the input between the two halves of the double amplifier.

If it is desired to avoid transformer coupling and still retain the tube detector, it can be done as shown in Fig. 3. Separate A and B batteries for the detector tube are required. If an attempt be made to use the same batteries for the detector as for the balanced amplifier it will be found that one side of the amplifier is dead. It has no input because the first grid on that side is grounded.

Separate Tuners

There may be a possibility of using the first two tubes in the push-pull amplifier as detectors, provided that two separate tuners be used. These must be entirely independent so that the phase of the output current can be chosen at will. This choice then has to be made in connecting the radio frequency transformer. It should always be possible to find a connection so that the audio frequency outputs of the two detectors add up across the grids

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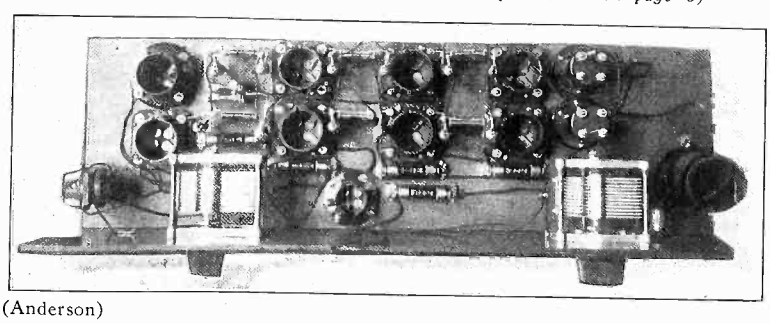


(Anderson)

FIG 4.

The receiver constructed by the author consisted of a stage of tuned RF, a tuned detector input and three stages of push-pull audio.

The Suitcase Six

A Sensitive Portable Easy to Operate

By James H. Carroll

Contributing Editor

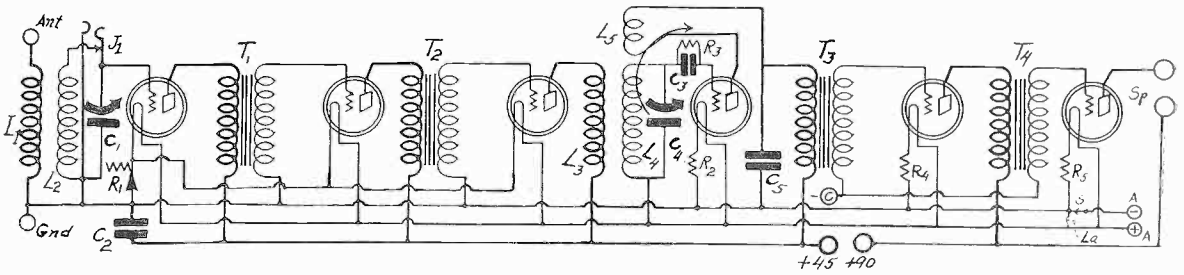


FIG. 1

Circuit diagram of the Suitcase Six, a portable set consisting of one tuned stage of RF amplification, two untuned stages of RF amplification, a tuned regenerative detector, and two stages of transformer coupled audio amplification.

THIS Summer the portable radio set will be an almost indispensable part of every camping outfit, and every one planning to go on an extended trip should provide himself with a good portable receiver now. When a good radio set is going in camp or other country or seaside resort, enjoyment of one's vacation is multiplied a thousand fold.

A rather sensitive receiver is required for woodland use, because many locations will be remote from any broadcasting stations, and many will be in semi-shielded areas, too, due to trees and mountains. A sensitive receiver insures reception in every place.

Since sensitivity is very largely a matter of radio frequency amplification, the design of the receiver must emphasize this end of the circuit. Yet for practical reasons more than two tunings controls should be avoided, even when localized tuning is employed. The only practical way of insuring sensitivity without multiplying wavelength tuning controls is to employ untuned radio frequency transformer to couple some of the RF stages, and embody regeneration. This has been done in this portable receiver.

Tracing of Circuit

Let us start at the beginning and trace the design of the Suitcase Six (Fig. 1) to the final binding posts. Provision has been made for use of either open circuit or loop antenna, and to change from one to the other it is only necessary to plug the loop in to the double circuit jack J1. Binding posts "Ant" and "Gnd" terminating the antenna input coil L1 have been provided in case it is desired to use an antenna. The antenna coupling transformer L1L2 is a Bruno RF coupler on 2 inch diameter tubing, to fit .0005 mfd. condenser, C1.

The next two RF tubes are coupled by means of Acme R3 and R4 radio frequency transformers T1 and T2.

Volume and oscillation in the circuit are controlled with a single rheostat R1 placed in the filament circuit of the first three radio frequency tubes. A twenty-ohm instrument is used. Since there are three—99 type tubes on this rheostat and since the filament battery has a maximum voltage of 4½ volts, the current in each of the three tubes can be cut down to 40 milliamperes. This gives adequate volume control at all times.

The next coupler, L3L4L5, is a small Bruno three-circuit tuner of the same electrical and mechanical dimensions as the antenna coupler. The tickler coil L5 contains 16 turns of fine wire and it is wound on a specially moulded bakelite form 1½ inches in diameter. This tickler, of course, serves to increase the selectivity and the sensitivity of the receiver to a very high degree. The secondary L4 of the three-circuit tuner is tuned with a .0005 mfd. condenser, C4. The grid condenser C3 has a capacity of .00025 mfd. and the grid leak R3 a resistance of 2 megohms. The by-pass condenser C5, which serves to facilitate regeneration and detection, has a capacity of .001 mfd.

LISTS OF PARTS

L1L2—One Bruno antenna coupler, for .0005 mfd. condenser.

L3L4L5—One Bruno three-circuit tuner, wound for .0005 mfd.

C1, C4—Two Bruno straight line frequency condensers, .0005 mfd., arranged for drum type localized control.

C2—One Dubilier by-pass condenser, .01 mfd. or larger.

C3—One Dubilier grid condenser, .00025 mfd. with clips.

C5—One Dubilier by-pass condenser, .001 mfd.

R1—One Bruno 20-ohm rheostat.

R2, R4, R5—Three Amperites, No. 4V-199.

R3—One grid leak, 2 megohms.

T1—One Acme R-3 radio frequency transformer.

T2—One Acme R4 radio frequency transformer.

T3, T4—Two Bruno Trutone audio frequency transformers.

J1—One Electrad single closed circuit jack.

SP—Two Yaxley tip jacks for loud speaker.

S—One Bruno pilot light switch (lamp La omitted when set is used away from home).

Two XL binding posts (ant., grid).

Six Benjamin sockets.

Two bakelite knobs, one for rheostat and one for tickler.

One Birnbach battery cable.

Six No. 6 dry cells for A battery.

Two 45-volt B battery blocks.

One 7½-volt C battery.

Six CeCo type BX tubes.

One speaker unit and Radion horn.

One loop.

One Formica panel, 12x13 inches.

One suitcase, 7½x13x24 inches.

Twelve 3-inch flathead 6-32 machine screws.

Ten feet of insulated connecting wire.

Three partition boards.

Two dozen half-inch roundhead machine screws 6-32.

If the set will not oscillate properly when the tickler is turned on maximum, this condition can be remedied either by doubling the capacity of condenser C5. However, before this change is made a new tube should be tried as detector. It may be that the tube is defective for detection, though it may serve nicely for audio amplification.

The audio frequency amplifier is standard in construction in that it employs two audio frequency transformers. T3 and T4. These have been selected because transformers give maximum amplification per tube.

The filament current in each of the last three tubes is controlled by amperites R2, R4 and R5, all of which are No. 4V-99.

The plates voltage on the first four tubes is 45 volts and that on the two audio frequency amplifiers 90 volts. This voltage is enough on the small dry cell tubes employed to give good speaker output. A by-pass condenser C2 is connected across the portion of the plate battery which serves the radio frequency tubes and the detector. Its capacity should be .01 or greater.

A grid bias of 4½ to 7 volts should be employed on the two audio frequency amplifiers. A lead in the battery cable is provided for this purpose so that the C battery can be placed in the compartment with the rest of the batteries.

The tuning condensers are of the Bruno, straight line frequency, drum controlled type, in which the control is localized at one point.

The panel arrangement can be seen from Fig. 2. The drum control is located in the center of the 12 x 13 inch panel.

Placement of Parts

The tubes are arranged in a crescent shaped formation, two at the left, two at the right, and two at the rear. The tickler knob is placed in the left front corner and the master rheostat in the corresponding right corner. The input binding posts and the loop jack are placed at the left rear corner, and the two tip jacks for the speaker are placed at the right rear corner. The panel, of course, is placed horizontally. The filament switch is placed directly in front of the tuning control, midway between the rheostat and tickler.

The six sockets are suspended from the panel by means of 3-inch flathead machine screws, two being required for each socket. In fact all the parts are attached to the panel. The arrangement is such

(Concluded on next page)

(*Concluded from preceding page*)

as to simplify wiring and to take full advantage of the space available.

The receiver has been built to fit into a 7½x13x24-inch suitcase. These can be bought in fabricoid for a few dollars. This case has been divided into four compartments. The largest of these, occupying about half of the available space, is for the receiver proper and the smaller compartments are for A, B and C batteries, speaker and collapsible loop.

Data on Loop

A loop may be built into the top of the suitcase, wound on four notched wooden cleats glued diagonally in the corners of the lid. It contains 14 turns of flexible insulated wire. The loop is concealed behind the lining of the case so that it cannot be seen when the set is in operation. The terminals are brought out near the binding posts provided for the antenna input. When using the loop it is necessary to provide a plug for inserting in jack J1.

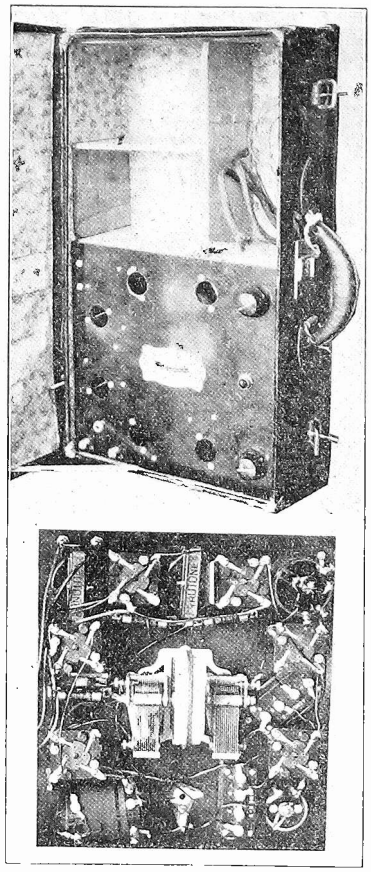
Attention should be called to the fact that no metal frame should be used in the construction of the suitcase, or the loop cannot be placed in the manner used in this set. The metal frame would form a complete electric circuit and it would be very closely coupled to the loop. Thus the frame would absorb most of the energy the loop picks up. If a metal frame suitcase is used the loop should be detachable so that it can be taken out when used, or else a cut should be made in the frame so that the circuit thus formed is open. This cut need not necessarily weaken the structure to any considerable extent.

Cable and Tubes

A battery cable is provided instead of binding posts. Each conductor in this cable is colored and marked appropriately to make correct connections simple. This cable makes it very easy to change the batteries when that becomes necessary.

All the tubes used in the set are of the —99 type and are CeCo type BX. These require a filament voltage of 4½ volts, which is supplied by three or six No. 6 dry cells. When light weight is a prime consideration three cells can be used, otherwise six of them should be used in series parallel as this combination is more economical in operation than the use of merely three cells in series. In other words, six cells will not last more than twice as long as three cells of the same size. The total current drain on the cells when no pilot light is used will be .36 ampere.

Two medium sized 45-volt B battery blocks should be employed, and one C battery having a maximum voltage of 7½



FIGS. 2 AND 3

One-half of the suitcase houses the receiver, the other half the accessories. The lower photograph (Fig. 3) shows an underneath view of the parts and wiring. The antenna coil is at upper right, the tickler coil at lower left.

Experts Debate Reason DX Is Harder to Get

By Karl L. Kohl

Distant stations are not so easily received now as they were two or three years ago, and radio engineers often discuss this subject heatedly. Some say that the great growth in the number of antennas has had an absorption effect on the transmitted wave.

Others say that interference is the main cause of making DX a harder to "catch." The drowning effect of strong stations, particularly locals, on frequencies near the desired station, is the form of intereference meant.

The absorption theory was undermined somewhat by recent measurements made by a leading radio engineering concern, when the field strength at a given distance was measured when no other or intervening sets were tuned to that wave, and when hundreds of sets were thus tuned. That there was absorption seemed clear, but it was of such tiny magnitude as to be almost negligible. In some of the tests the meters and circuits were not sensitive enough to disclose any difference.

That interest in DX is still high is proven by several facts discussion of DX by fans, enthusiasm of set-builders for receivers that possess distance-getting ability, and the demand for verification stamps or letters sent out by stations. However, the Radio Commission does not regard the protection of DX conditions as a public service, holding that wavelength accommodation for all stations, with minimum interference, comes first.

This plan is worked out in the new list of assigned waves. See page 16.

Resistance Audio, Using Push-Pull

(*Concluded from page* 4)

of the next two tubes. This is more of a possibility than a practical solution.

The two most practical ways of inputting this double amplifier are the use of a crystal detector in series with a high resistance potentiometer and a transformer coupled tube detector as shown in Fig. 2.

The most practical way of putting the amplifier to work is to use two tubes of very low output impedance in series with the reproducer and supply the plate current to these two tubes through high inductance choke coils of equal value.

Substitution of Resistors

Resistors of equal value can be substituted for the choke coils with fair effect, particularly when the available voltage for the plate is higher than otherwise necessary. The resistance of these units should be several times larger than the plate impedance of the tubes. If 71 type of tubes are used the values can be about 5,000 ohms each. If two speakers are used in connection with smaller output tubes, one speaker can be connected directly in the plate circuit in each side of the amplifier, without the use of chokes. If the speakers are identical the hum will not be noticeable, even if it is not balanced out until it gets into the air.

It is not to be expected that this will be a popular circuit. It takes too many tubes and too much filament current for that. But as a special purpose amplifier and for elaborate installations the advantages of this system should well repay the extra equipment and the care required in balancing the circuit.

The four stage, eight tube circuit is much easier to stabilize than a three stage circuit, provided that the output is shielded carefully from the input electrostatisically. The amplification will most likely be too great in the four stage circuit. Hence in order to limit the amplification controllable magnitudes as well as to limit the number of tubes used in the amplifier, it is desirable to use only three stages, even if more care is required in balancing.

Values of Resistors

The following are suitable values for the various parts. The six-plate coupling resistors used were El-Menco 250,000 ohms; the six intermediate grid resistors El-Menco 2.5 megohms; the six coupling condensers .01 mfd. The insulation in the condensers should be mica. It is better to use small coupling condensers with mica dielectric than large condensers with leaky dielectric. The coupling and grid resistors can be made larger if desired. But to insure success of a resistance coupled amplifier of this type it is essential that the grids be properly biased and that there is no leakage from the plate to the grid. The total resistance of the potentiometer R should be about 200,000 ohms. A similar potentiometer can be placed in series with the last two grid resistors and returning the grid battery lead to the sliding arm. By this means the voltage on the last two tubes can be equalized.

Dellinger Will Study State of Art Abroad

Washington.

Dr. J. H. Dellinger, chief of the Radio Laboratory, of the Bureau of Standards, will visit England, France, Germany, Switzerland, Holland and Czechoslovakia to study the application of radio beacons to aviation in those countries.

Dr. Dellinger will also make a general study in order to have first-hand knowledge of condition of radio conditions at the international radio conference, which is to be held in Washington this Fall.

A 400-Volt Power Source

A Quality B Eliminator and AF Stage

By Leonard Upham

FIG. 1 is the diagram of an easy-to-construct, yet efficient combination B eliminator and power ampifier. The half-wave filament rectifier, 316B or 216B is used in conjunction with the Thordarson Power Compact Unit, R210, 1grad condensers, and Kroblak fixed wire-wound resistors in the B eliminator portion. In the amplifier section, the 310 or 210 power tube, Thordarson, R76 output choke and R200 audio transformer are used. To regulate the voltage at the 90-volt tap, a voltage-regulator tube, 374 or 274, is used.

Placement of Parts

The proper placement of the parts when constructing this eliminator is as essential to the successful operation as is following the diagram and using good parts. Therefore Fig. 2, which shows the layout, should be followed carefully.

Instead of placing the rectifier, voltage regulator and power amplifier tubes in a line and close to one another the amplifier tube is placed at right. With the tubes in line the familiar drone was heard. This was due to the vibration of both tubes, the beat frequency produced being audible.

Where the amplifier tube would be ordinarily, the 4 mfd. condenser C4 was put. To reduce the length of leads from the audio transformer to the audio tube socket, as well as reduce electromagnetic interaction between the power transformer and the audio transformer, the audio transformer was placed at the opposite end and next to the audio tube. Next to it is the output choke. Between the power transformer unit, PTU, which also carries the choke coils, the remaining condensers, e.g., C1, C2, C3 each having a capacity of 2 mfd., and C5, of 1 mfd. capacity, are placed. Stock size brass lengths, aided by corner braces, hold these condensers down.

The Chimney Effect

The special way of mounting of the resistors is unique. A chimney stack effect of preventing the resistors from becoming hot is obtained by placing them upright, instead of horizontal. Small square pieces of asbestos, about ¼-inch thick, are used to hold them in place. In the center of these asbestos pieces portions are cut out, to fit the resistors. To hold these asbestos pieces to the board, screws are used. Washers are placed between asbestos and the board to keep the asbestos off the board. The hole in the asbestos helps keep the resistor firm. The three resistors R2 (8,000 ohms), R4 and R5 (10,000 ohms apiece), are placed in triangular form, between the 4 mfd. condenser and the two, 2 mfd. condensers. The fixed resistor, R1 which has a resistance of 1,000 ohms, with which the grid bias for the power amplifier tube is obtained, is placed near the amplifier tube. Flexible insulated wires connect the output leads from the eliminator to the binding posts on the B eliminator case shown in Fig. 3.

The maximum output voltage of this device is 400 volts at 65 mils.

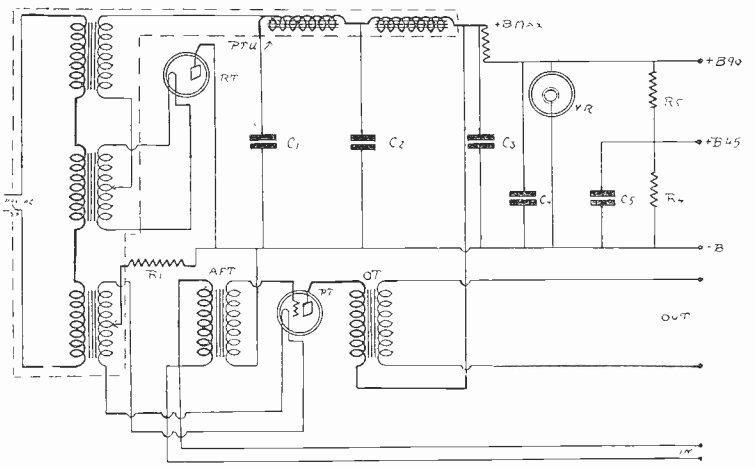
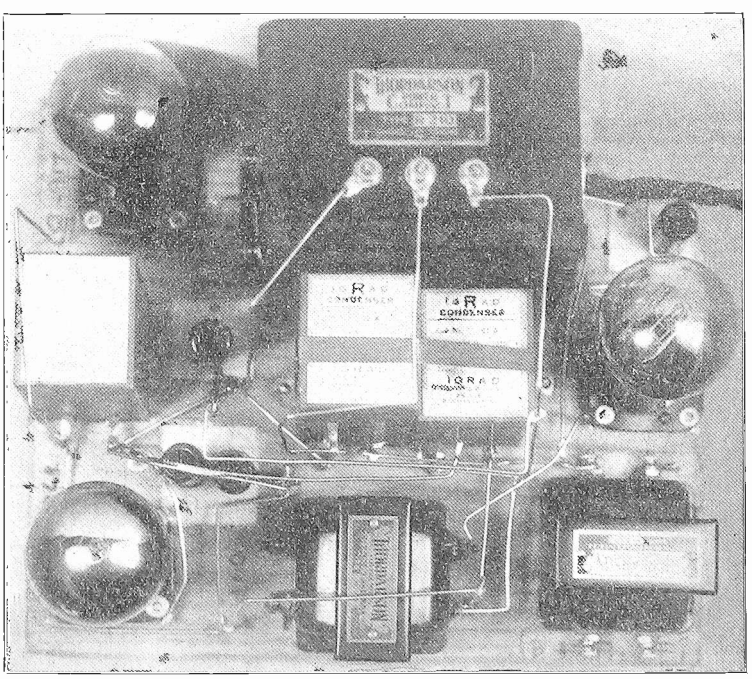


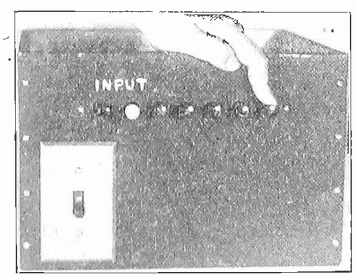
FIG. 1

The circuit diagram of the combination B eliminator and power amplifier. R2 is from +B Max. to +B90.



(Hayden) **FIG. 2**

How the parts should be placed, to obtain fine results. Note the distance between the rectifier tube (upper left) and the amplifier tube (right), which prevents the annoying drone, many times laid to the rectifier tube or the circuit. The other tube is the voltage regulator.



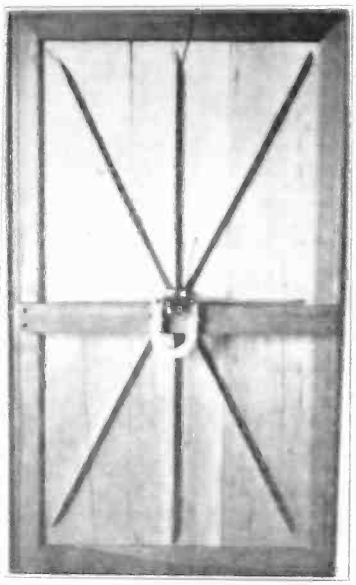
(Hayden) **FIG. 3**

The metal case in which the complete eliminator is placed. The ground post, to which one side of the A battery must be connected to filter out the hum, is placed on the same hard rubber strip as are the other posts.

Balsa Wood for Speakers

The New Sounding Board That Affords Realism

By H. B. Herman



(Hayden)

FIG. 1

The completed Lata Balsa wood speaker. The three wide pieces that occupy the interior of the frame, the seven radiating arms or fins, and the little square under the unit, to which the coupling rod is fastened, are Balsa wood. The rest of the pieces are hardwood.

THE quest for tone quality used to go only to the outposts of the set, never including the speaker, and with necessarily disappointing results. You could get 30 cycles through the audio channel, but any speaker would cut off the low notes. Even today many popular commercially made speakers have a high cut-off. For instance one, a suede-baffled parchment cone, suppresses 100 cycles 80 per cent., although it is exceptionally fine on the high notes.

Good audio circuits—resistance, impedance, double impedance or transformer—give you a relatively flat characteristic, that is, even amplification over the useful range of audible frequencies. While the response in the speaker can not be so nearly even, for mechanical or physical reasons, speakers can and do bring out low notes, and without sacrificing high notes to any marked extent. At least two commercial speakers will respond to 14 cycles with creditable energy. But the general average of speakers will fall short in the low audio frequency region.

Some Tests to Make

All the shouting about the low notes probably arises from the fact that these pitches give character and spirit to the music of an orchestra. You have probably heard a symphonic orchestra play in a concert hall, and when you saw the maestro poke his baton in the direction of the tuba player you heard the tuba. Also when the bassoon and bass viol joined in you heard them and, what was vastly important, you could distinguish the bars and strains played by each instrument, although any one was quite near, if not exactly in, the frequency range of the others. But when listening to radio you saw no conductor jabbing his baton toward any particular player, and if you did not hear the bass tuba, you might assume there wasn't any, or the thought wouldn't even enter your head. Try some time—tonight, if you can—to determine whether there is a tuba in the dance orchestra you listen to on the radio. The tuba is a wind instrument. Then try to judge whether there is a bass viol or violon cello at work. These are string instruments. There is a difference in the sound of the percussion and the string instruments. If you are sitting before the orchestra you can hear the difference. But if you are sitting before your set can you do so?

Then take as an illustration the dance orchestras. It is the rule that they are listened to, not danced to, in the radio-enlivened home. Some folk complain that they can not dance so well to radio music. In the grill room of the hotel where the orchestra is playing these same complainants could step around the waxed floor until dawn, and enjoy it all.

The Missing Element

What is lacking in the radio music? Full reproduction of the bass drum, the tuba, the bass viol, the bassoon, and their kindred of the lower regions of the audio world. These low-note producers accentuate the "time," enspirit the music, round out the rendition and contribute the quality of crispness and pronounced rhythm.

Now, to get those desirable notes into your home you need an audio system that will carry them through with good amplification.

High audio frequencies may be lost in the radio frequency due to superlative selectivity attenuating sidebands, but low notes will not be lost there, because if your set were so selective as to intrude on their domain you wouldn't receive any signals, and you would have a more selective set than any other ever produced. So low notes are an audio, not a radio, problem in your receiver. Those who have built the popular receivers of the last year or so may feel themselves properly equipped for low note reproduction—provided the speaker will respond to them.

The low notes are important, so your audio amplifier and speaker should treat them kindly. But the high notes are not to be sniffed at, either, and the middle notes cry out for consideration, too. How can we be utterly impartial to them all?

In the Realm of Metaphysics

At this stage the discussion becomes complex. We must respect physical properties. If we have a piece of parchment or long fiber cover stock or wood we know that it has a natural period or a point of maximum sensitivity or response, depending on its shape, size, thickness and mass, just as we know that each reed of the organ has its own particular frequency. Yet we also know that we hear a wide range of notes, nevertheless, when we use the paper or wood as the diaphragm or sounding board which is driven by the coupling rod or stylus of a speaker unit. Also we know that the ear is a physical thing, yet it responds to all the frequencies we hear, and we assume it responds evenly, although physics rises to question the assumption.

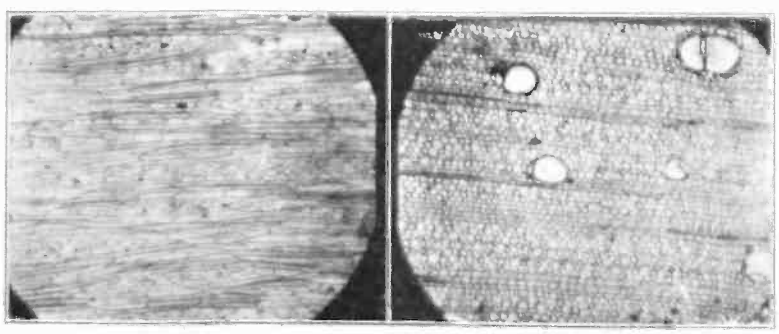
Man has not been able to produce life mechanically, and even the school of thought that hoped it might be done has about abandoned its creed in favor of the theory of the metaphysical origin of life. So we might as well agree that life, being metaphysical, is beyond our power of mechanical production, that man is wondrously made, and that we must regard the anvil, the tympanum and the stapes only with awe. We can not make an ear. I do not think we can successfully imitate an ear. The ear is a part of the animal, the animal is a part of life, and life is metaphysical, and metaphysicians can only be students and not producers. Having no recourse to the black art we must take things as they are.

What Is Balsa Wood?

That brings us to the sounding board or tympanum for our speaker. We can use as the material the most suitable substance we can contrive or find, and measure its frequency response with meters and with the much respected ear.

In our search we try many things and tap many sources, and then we go back to nature and try the lightest wood made—Balsa wood, from the jungles of South America, wood with pockets in it, each pocket filled with dead air, wood that is described as "Nature's sounding board," because it is used in its original state, only sliced very thin. In bulk it is strong, but cut to 3/32 inch it naturally requires gentle handling.

The botanical name of the wood species known as Balsa is "Ochroma Lagopus," a tree found in the tropical jungles. In appearance the tree resembles the North American Cottonwood, the bark being fairly smooth. The wood has somewhat the appearance of clear white pine or basswood, and to the touch has a smooth, velvety feeling. The name Balsa, the Spanish word for raft, came to be applied to this wood through the use of these



FIGS. 2 AND 3

How Balsa wood looks under the microscope. At left is a transverse section, at right a tangential section.

logs for rafts to float heavy woods down the rivers from the interior to the seacoast.

Balsa is the lightest wood that grows. The commercial product averages from 6 to 7 lbs. per cubic foot. This is approximately one-half the weight of good cork. This lightness results from its peculiar cellular structure, which differs from that of nearly every other wood. In ordinary wood the thickness of the cell walls generally forms a considerable part of their diameter while in Balsa, the cell walls are extremely thin and there is practically no lignification. This structural arrangement confines within its large, barrel-shaped cells a considerable quantity of dead air, that is, non-circulatory air, which represents 92 per cent. of the total volume.

A radial section of Balsa shows, even better than the transverse, the thin partitions dividing the cells into microscopic air spaces so small that heat passage is reduced to a minimum, thus making Balsa wood efficient for reproducers without temperature causing response variation.

The use of Balsa wood for radio reproduction is something new, but its use for other purposes is of long standing. It is used for stream lining of airplanes, hydroplane pontoons, swimming floats, shock absorption, shipping containers and scores of other purposes, for some of which is is specially treated and is an excellent insulation material in itself. But for radio purposes do not add anything to the Balsa wood. Do not paint, shellac, varnish or otherwise treat it. If decorative instincts are strong, light tapestry may be employed very handsomely. Decorators' material, such as cretonnes, chintzes, etc., for this purpose are commercially available.

An Enlightening Experience

And what does this wood accomplish?

It furnishes us with a ready, inexpensive and astonishingly effective means of bringing out those low notes, about which we are so anxious. It still gives us good response in the middle and higher audio frequency brackets. It enables us to hear low notes we possibly never heard before on the radio. It opens a new vista and challenges the constructional side of our nature, indeed, defies us to ignore the existence of Lata Balsa wood. Listen to how an orchestra sounds in a Balsa wood speaker, listen to a piano solo, and note the startling realism. Never judge any speaker by a violin solo, for even on a poor speaker this will sound well.

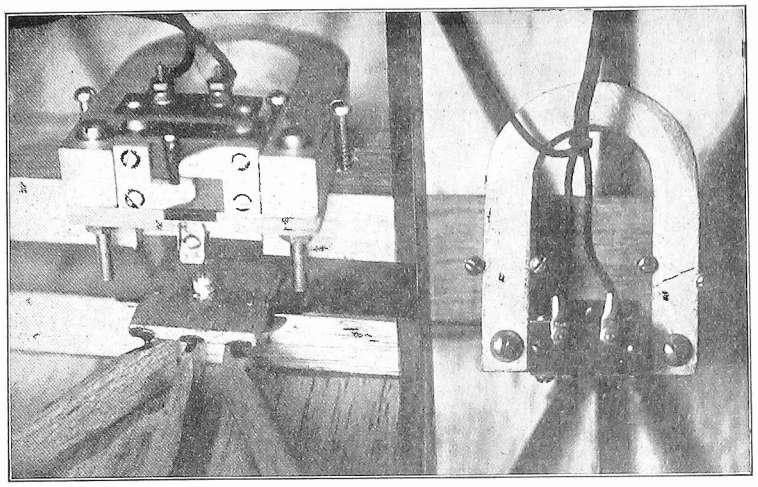
I connected a Balsa wood speaker to a set consisting of a TRF radio channel and three resistance-coupled audio stages. The constants of the AF circuit were: .25 mfd. stopping condensers, .1 meg. plate resistors and 2 meg. grid leaks. The output was filtered through a 100-henry choke and a 14 mfd. condenser. I cite these constants only to show that the suppression at 20 cycles was not more than 10 per cent., hence neglible.

I heard low notes that I had never heard before on that set and was able to distinguish between the bassoon and the tuba, the tuba and the bass drum, and the tuba and the bass viol. The speaker was a large one, hence low pitched, but it handled the higher frequencies with credit. The speaker I had been previously using was just as good on high notes, or perhaps brought these out with just a little more volume, but on low notes it simply did a filtering action. **"On les aura!"** The air was Paris just after the first Battle of the Marne. The low notes never got to Paris!

But with the Lata Balsa wood speaker there was an energetic response at even 14 cycles! This pitch had to be generated from an audio beat note oscillator, because no organ was on the air, and only the organ among musical instruments normally goes as low as that.

It was interesting to compare the one speaker with the other. This was done by connecting together one tip of each speaker cord at the filter output condenser, and alternately touching the free tips to the ground post of the set (A minus being grounded). It simply did not sound like the same orchestra. When the Balsa speaker was cut in the zoom—zoom was there, full-grown. Could you dance enjoyably to the music as it came from this speaker? Could you avoid dancing to it, would be a more logical question. Cut out Balsa and cut in the other—fine, strong high notes, but nothing much below 100 cycles, hence no character, personality, vivacity or fetchingness to the music. Reconnect the Balsa and you wondered what Thomas A. Edison possibly could have meant when he said that radio music wasn't worth listening to, it was so badly distorted. Maybe he referred to speakers with a high audio frequency cutoff or suppression hollow, attached to an audio amplifier suffering from core saturation and second harmonic distortion. But Mr. Edison had never heard a Balsa wood speaker when he made his famous remark. Perhaps he would be surprised to learn that the combination of set and speaker that I used—with a CX371 power tube in the last stage—was as good as the best in phonograph reproduction—Orthophonic or Panatrope or, indeed, Edison—and with electrically recorded records. The finest quality is on a par, in phonograph or radio. It must not be forgotten that when the record is reproduced on a radio speaker, as is common practice, speaker limitations affecting reproduction from a set apply to the phonograph.

A good speaker is simply a good sounding board and a good unit. If either component is poor, the speaker is poor. Therefore when you build a Balsa wood speaker be sure to use a good unit.



FIGS. 4 AND 5

The unit's coupling pin is secured to the small square piece of Balsa wood by insertion in the anchor screw and tightening down the thumb nut. The square is securely glued to the horizontal fin, which is one piece. The diagonal fins are in two sections each. Notice three of them in foreground, glued to the square, too. Place the thumb nut on the anchor screw BEFORE you mount the unit. At right (Fig. 5), four screws that secure the unit to the crossarm.

Care In Construction

The Balsa speaker may be most conveniently constructed in either or both of two popular sizes. The construction method is the same in both.

The speaker consists of an oblong hard wood frame with a hardwood crosspiece just below center, three pieces of Balsa wood, side by side, but not touching, occupying the space within the frame and glued to it; seven radiating Balsa wood ribs, a small Balsa wood square with coupling rod screw anchor and thumb-screw, and a unit mounted on the crossarm so that the coupling rod touches the center of the speaker at the point where the anchor is located. That's all there is to it—18 pieces of wood, a unit, a thumb-nut and screw anchor for the unit's rod and something with which to fasten the unit to the crossarm, e.g., four 1½" woods crews.

But the speaker can not be slapped together and be expected to live up to expectations. It must be made painstakingly. The gluing must be done with extreme care, so that, for instance, the square Balsa seat for the coupling rod housing is taut at all points, and proof against unseating on exertion of moderate finger pressure. Any play at this point means a rattle in the speaker, even at low volume reproduction. This is the only critical point of the speaker and must be given close and careful attention.

Do The Gluing Well

The gluing at all places should be firm and continuous. Especial care should be exercised at the ends of the fins, for the curling tendency may require a second application of glue to insure keeping the ends down.

These ribs, by the way, unite the respective sheets of wood with one another and the small driving square, and if even one of the seven ribs is omitted the low notes suffer, while if all the ribs are omitted you are working on virtually only one Balsa wood sheet, and you don't reproduce the low notes. So, follow style, and be careful in gluing, so that every glued piece adheres firmly throughout the length of intended contact.

Constructional Data

The eighteen pieces of wood are consituted as follows: (a) three wide strips of Balsa wood to be cut to desired width and length; (b), seven thin ribs or fins of Balsa wood, to be cut to desired length; (c), four pieces of hardwood for frame; (d). one piece of hardwood to be used as crossarm for mounting unit; also two small pieces of hardwood to elevate the crossarm suitably; (e), one small square piece of wood, Balsa or otherwise, for accommodation of bushing.

The accessories are one bushing, consisting of anchor screw and thumb-nut for holding stylus (or driving rod or coupling pin) of unit; brads, screws and a tube of glue.

The hardwood frame is made first. Glue the corners and also nail them with brads. The 3/32-inch recesses at the corners must make an even fit. This is important.

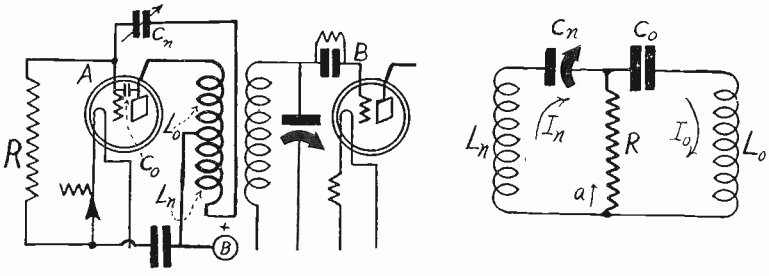
Next cut the ends of the wide strips

(*Concluded on page* 18)

The Need of Neutralization

Three Different Balancing Devices Analyzed

By Lester Harrison



FIGS. 1 AND 2

The bridge method of neutralization (Fig. 1, at left) in which the effect of the inter-electrode capacity Co is neutralized by the condenser Cn which feeds energy to grid A in reverse phase. Fig. 2 shows how the neutralization takes place. The various inductances and capacities are indified by the same symbols as in Fig. 1. R in the two figures represents the resistance of the parallel tuned circuit in the input of the tube. The value of this resistance is LrC, where L is the inductance of the tuning coil, R its resistance and C the capacity of the condenser when the circuit is tuned.

ONE of the greatest steps forward in the design of radio receivers was the introduction of neutralization for stopping radio frequency oscillation. That step was taken several years ago, and since then many different devices have been brought out with the same object in view.

Although all schemes for stopping radio frequency oscillations are called neutralizers, some of them do not neutralize anything but the power of the set to amplify. They are devices that introduce power losses to such an extent that oscillation is impossible. In true systems of neutralization the cause of oscillation is removed by preventing any power in the output of a tube from reaching the input circuit of the tube or any preceding tube. This is usually done by arranging a Wheatstone bridge network and balancing it so that there is no effective feedback. There will be some feedback through stray capacity and mutual inductance but this is offset by feeding back exactly the same amount in opposite phase.

The system of neutralization introduced by Hazeltine, and upon which the Neutrodyne is based, is shown in Fig. 1. There is between the grid and the plate of any tube, or between the parts on the plate side and the parts on the grid side, a certain capacity. This is represented by Co. in Fig. 1. Through this capacity energy will flow from the plate circuit to the grid circuit and it will be in such phase, provided that there is a large inductance in the plate circuit, that oscillation will result. Now if an equal amount of energy be sent back to grid A from the plate circuit in exactly opposite phase, the effect of either part of the fed-back energy will be nil in so far as oscillation is concerned. This neutralizing energy is supplied through the small variable condenser Cn and the coil Ln. The capacity of Cn is varied until the energy fed back by the two routes is the same.

The four reactances that form the bridge circuit are Cn, Ln, Co and Lo. These can be arranged as shown in Fig. 2, in which R represents the resistance of the parallel tuned circuit in the input of the tube. If the plate circuit should send any current through R in phase with the current sent through by the incoming signal, regeneration results and oscillation is likely. The phase of the incoming signal is indicated by arrow A. Now, it is evident that Io is in phase with this in the circuit RCoLo. If the circuitLnCn be added and coupled to the output of the tube in a suitable manner it is clear that a current In can be established in RLnCn. By suitably connecting the coil Ln the direction of In can be made opposite in phase to Io or so that these two currents buck in resistance R. Also by suitably selecting the capacity of Co the two bucking currents can be made exactly equal. When they are equal no current flows through R as a result of feedback and then there is no tendency to oscillate. However, this balancing does not affect the incoming current. It flows through R just as it did before neutralization.

Since the four branches of the bridge are reactances, it is possible to effect complete neutralization at one frequency and still have unbalance at all other frequencies. This is not a desirable condition. The circuit should be neutralized for all frequencies within the tuning range of the receiver. This can be brought about by making the two coils Lo and Ln equal. This will also require that the two condensers Co and Cn be equal. When neutralization has been effected under these conditions it will function over the whole tuning range

Another non-oscillating type of circuit is exemplified in the Loftin and White system, shown in Fig. 3. As stated above, a tube will not oscillate unless there is a high inductance load on it. If the load can be made capacitive or resistive there can be no oscillation as a result of capacitive coupling between plate and grid. This fact is made use of in the Loftin-White circuit. The values of the choke coil Lo, the coupling condenser Co, the coupling coil L1 and the coupling condenser C3 can be chosen so that the load on the tube is purely resistive for one frequency and slightly capacitive for the rest of the band. The circuit will not oscillate at any frequency with this adjustment.

The object of the dual type of coupling in the Loftin-White circuit is not to prevent radio frequency oscillation but to equalize coupling over the entire tuning range. The coupling between the primary coil L1 and the secondary L2 is greatest for the higher frequency end of the spectrum and therefore this will cause greater amplification and these frequencies than at the low. The low frequency amplification is built up by capacitive coupling between the primary and the secondary circuits. The primary current flows through C3, which is also a part of the tuned secondary circuit. More energy is fed into the tuned circuit by this means at the lower end of the tuning range than at the higher. The combined coupling of L1 and C3 is nearly constant throughout the tuning range.

Another method of preventing radio frequency oscillations is exemplified in the Phasatrol, invented by John F. Rider. This device changes the phase of the energy fed back in to the preceding tube so that it does not aid the incoming signal. In the Phasatrol device the plate receives its voltage through a high resistance potentiometer R. This high resistance itself changes the phase of the current forced through the inter-electrode capacity to grid A so that it does not aid the incoming signal. The phase control is still further aided by connecting the primary L1 through a condenser C to the sliding arm of the potentiometer and then adjusting the position of the arm until the tendency to oscillation disappears.

It will be noted that the phase of the fed-back energy is largely controlled by means of resistance variation. Consequently the degree of neutralization is not greatly dependent on frequency. One adjustment will serve for the entire tuning range, and there will be no appreciable difference in the amplification for the various frequencies. The control is also aided by the presence of condenser C, provided that it is not made too large. The correct size depends on the value of the inductance of the primary coil, and to some extent on the coupling between

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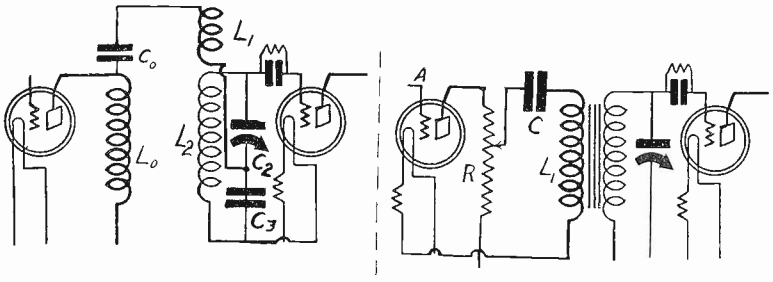


FIGS. 3 AND 4

The Loftin-White circuit (Fig. 3 at left) in which oscillation is prevented by making the load on the tube resistive or slightly capacitive. At right (Fig. 4) is the Phasatrol method of preventing oscillation in the radio frequency tubes. The phase of the energy is changed so that it is out of step with the input when it gets to the grid A. The load in this tube is also resistive or capacitive.

B Battery Conservation

Higher Efficiency Gained At Reduced Cost

By Thomas L. McKay

McKay Instrument Co.

THE A battery must be kept "up." In other words, do not let this battery become discharged below its efficient operating range. If dry cells are used for A power, do not use these cells after a meter test shows them to be below seventy-five percent of their efficiency when new. A new dry cell should read from 30 to 35 amperes when shorted with a high resistance ammeter. Never use a low-resistance meter to test batteries. The cell should not be used after it reads below 15 amperes.

Where a storage battery is used for A power be sure to keep this battery well charged. A trickle charger is handy as nothing has to be touched except that you add water. Distilled water should be added to the battery as often as is necessary to keep the water line above the lead plates in the battery.

The reason for so much concern about the A battery is simple enough. If you run your set when the A battery is down it is necessary to use more B battery current to gain the same volume as you obtained with your A battery in good condition. It is cheaper to buy new A cells or take ocasional care of your storage A battery than it is to buy new B batteries.

Get the Right Size

One of the first things to consider in the use of B batteries is the size of battery to empoy in a given set. For sets up to three tubes the small size battery is correct. An example is the type 772 Eveready. For sets using from three to five tubes the large size battery should be employed and sets using over five tubes should employ the extra large battery. The use of too small a battery means that a new battery must be purchased within a short time.

When purchasing B batteries do not buy them at a sale where you can obtain them "cheap." Such "bargain" batteries are likely to be seconds or have stood on the shelves for a long time. It does not pay to take the risk. It is well to remember that you usually get what you pay for.

Using the correct size of battery in your set, you will get six or more months service, depending on how much you use your set each day, what means you employ for conserving these batteries, and how efficiently you handle your set. For the average case the life of a B battery is probably eight to ten months.

Worn Out One a Drag

Where two or more B batteries are connected together do not connect an old worn-out battery with new batteries. This is, of course, always permissible where the old battery reads over 37 volts. The old battery should be tested frequently and should be replaced as after it drops below its efficient point. Not all B batteries should be discarded when they read under 37 volts, but satisfactory operation should be the test.

The use of poor tubes is costly. Have your tubes tested occasionally and discard any that do not come up to the average standard. The use of old tubes simply means greater B consumption for the same signal strength.

Using the proper value of C battery is an important method of conserving the B batteries. Fig. 1 shows how this C battery should be connected to the set. If the set does not now employ a C battery it is an easy matter to rewire for the use of one.

Where 90 volts are used on two audio plates a 4½-volt C battery should be employed. For 67½ volts B use 3 volts C and for 45 volts B use 1½ volts C. In resistance or impedance coupling three tubes are usually employed with 135 volts on the plates. But the plate resistors drop voltage, so the actual voltage applied to the plate is less than 135. The drop on the speaker is smaller. Hence 4½ volts of C for the first two AF tubes will suffice. For the last tube, as this may be a power tube, conditions vary.

Case of Power Tubes

Fig. 2 shows the system necessary where a 112, 120 or 71 power tube is used. The usual 4½ volt C battery is employed on the first stage of audio for it uses 90 volts on the plate. The 112 power tube requires a special 9-volt C battery. If the 120 power tube be employed, a 22½-volt C battery must be used. This battery can be an ordinary small size 22½-volt B battery. Due to the voltage drop in the speaker windings it may be advisable to use 16½-volt post on the C battery for the 120.

The proper use of C batteries cuts down B battery consumption at least one third. This means a worthwhile saving. It is also true that the drain on a C battery is so small that this battery will last from nine months to well over a year. Be careful not to use an old C battery. This again impairs the efficiency of your "saving system." Do not use a C battery that is below seventy-five percent of its rated voltage, is a good rate, but not inviolable.

The efficiency with which a set is operated is very important. It has been said that the human ear cannot detect a change in sound volume that is less than one-fourth of the original volume. It is, therefor, impossible to depend on the ear to tell whether you have your set adjusted properly.

Fig. 3 shows a simple system that tells you whether or not your set is adjusted properly. This method helps save B

(*Concluded on page 22*)

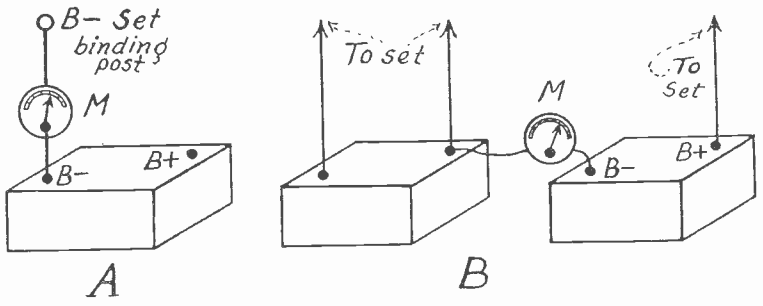


FIG. 3

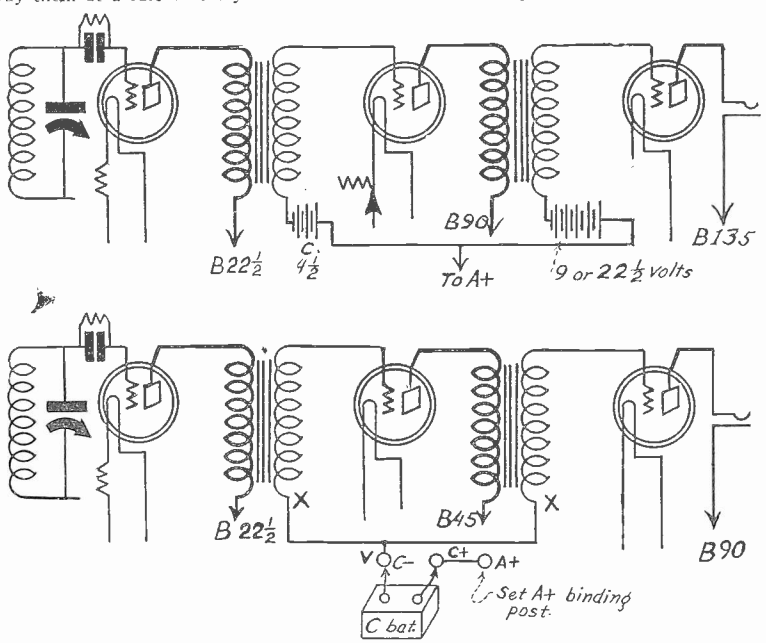


FIG. 1 (bottom) and FIG. 2 (top).

$17,500 for New Voices Offered by Atwater Kent

Philadelphia.

Very extensive plans for a "National Radio Audition" for young men and women for the purpose of finding by test the best undiscovered voices in the United States were announced by the Atwater Kent Foundation, an institution established for scientific and educational purposes.

Every community in the United States will be given an opportunity, first to select by popular vote the best voices, of young women and young men; and then to enter these singers in a test of state, sectional and national auditions to be broacast.

Awards aggregating $17,500, with one and two years' tuition in an American conservatory for certain winners, will be offered as an incentive to young people to enter the tests, which will be held in each of the forty-eight states.

Kent's Statement

A. Atwater Kent, president of the Foundation, said:

"The discovery of one of these rare voices, of which each generation produces a very few, seems to me an event of profound national importance. Even when such a voice could give pleasure to only a few thousand people in a year it was a national treasure. Now that millions may enjoy it on the same evening through the medium of radio, such a voice has become priceless.

"The National Radio Audition, supported by the Atwater Kent Foundation, is an undertaking to search the entire country for beautiful voices and to offer these singers an opportunity for full development, recognition and reward.

"In Europe, when a singer of promise appears, the entire family will gladly make any necessary sacrifice to provide means for a proper cultivation of that voice and the support of the singer until fame is achieved. It is in this spirit that we hope each community in the country will receive this Audition idea and devote whatever effort is required to discover and present its candidates for state and national honors."

Opportunity for Youth

The primary purpose of the Audition is to provide opportunity for recognition to every young man or woman in every community, no matter how isolated, and to give to the world of music through radio the best voices thus discovered.

After a series of state and district auditions, five young men and five young women will be brought to New York for a final audition, which will be broadcast over a nation-wide network of stations.

In the finals—the National Audition—five awards for merit will be given to women and five to men. The two who get first place in the National Audition—a man and a woman—will each receive a gold decoration, $5,000 in cash and two years' tuition in a leading conservatory.

Winners of second awards will each receive $2,000 in cash and one year's tuition.

Winners of third awards will each receive $1,000 and one year's tuition.

Winners of fourth awards will each receive $500.

Winners of fifth awards will each receive $250.

Musical, civic and women's clubs in each community in each state will be invited to hold local tests to select the best young man and best young woman singer of their towns. These winners will then be certified to a state audition, which will be broadcast by a radio station in each state. A state winner of each sex will be chosen and will receive a silver medal.

The next step is a district audition. The young men and women who have won state honors will be taken to a central broadcasting station in one of five districts, where an audition will be broadcast to select the two winners—a young man and a young woman—from that district.

The two winners in each district will receive gold medals and the ten finalists thus selected will be brought to New York for the final National Audition.

Each national winner will also be well started on the road to fame as a radio concert artist, with a successful musical career ahead. All expenses of contestants the district and final auditions, including railroad fare, hotel bills, entertainments, etc., will be paid by the Atwater Kent Foundation.

Judging of contestants will be by vote of radio listeners and juries made up of the musical authorities of each community, state or district. Listeners-in will participate in the state and district auditions, their votes counting sixty per cent and the vote of the jury forty per cent. For the final National Audition in New York, a jury of great figures in the musical world is being created. Its decisions will be made without participation by the radio public and will be announced immediately after the broadcasting of the finals.

Qualifications for Tests

The principal qualifications for contestants are as follows:

They must not be more than twenty-five years old; must never have been associated with a professional theatrical or operatic company; must never have been a paid principal in any concert held outside their own states; must declare an intention to follow a musical career and must be free from theatrical or musical contracts.

This limitation permits choir singers to enter the auditions, even though they may have received financial compensation for singing in churches. It is expected that many of the contestants will be the leading young choir singers of their communities. Other groups from which entries are anticipated are students in musical schools and locally prominent singers in high schools and colleges. Musical organizations in each state are also afforded an opportunity to put forward their best talent and to assist in holding local auditions.

Preliminary organization for holding the auditions will start soon under the direction of the Atwater Kent Foundation. It is expected that the first state auditions will get under way early this Fall, followed by the district auditions in November, with the finals in New York early in December.

CROSLEY CONVENTION HELD

The annual convention of the Crosley Radio Corporation's distributors was held in Cincinnati June 8 and 9. Announcements of new developments in the Crosley line were made and plans for the coming year will be discussed.

SIGNALLY HONORED

LORETTA LEE, first vocal graduate from the Peabody Conservatory of Music since Mabel Garrison, who obtained her diploma in 1911. Miss Lee was the third one to receive the diploma in the Conservatory's existence of 57 years. She recently gave a song recital from WBAL Baltimore.

VARIATION OF C BIAS

If in doubt as to the proper ohmage fixed resistance to be used for providing C bias from a B eliminator, a variable resistance of about 2,000 ohms maximum resistance, with a carrying capacity of watts may be substituted.

Misleading Over Air

Washington.

Federal punishment for stations which misrepresent articles over the radio is planned in a bill that probably will be introduced during the next session of Congress by Senator C. C. Dill or Representative Wallace White.

Numerous complaints have reached the Federal Radio Commission against stations which through direct advertising over the air have offered articles for sale and which, according to the complainants, have not entirely lived up to the promises. The complaints have been most vigorous about a few stations in the Middle West.

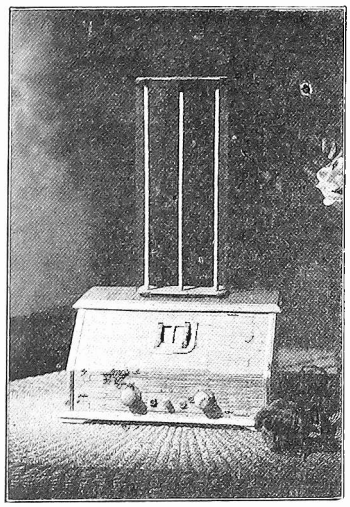
According to one letter received by the Radio Commission, a station broadcasted an announcement about radio tubes. The announcement was that a special price had been fixed for the tubes and anyone who sent in the money for the tubes was guaranteed satisfaction or else the money would be refunded.

He Buys the Tubes

A listener-in in another state heard the announcement and sent in the money for four tubes. In the letter containing the money was a description of the kind of tubes desired. In about two weeks tubes were forthcoming, but they were not of the kind ordered nor were they suitable for use.

The tubes were returned to the station with a request that the proper kind of tubes be sent or the money refunded. Up to the time of writing to the Commission, the listener had received neither the money nor the tubes.

SET MADE OF MATCHES



PAUL R. WOTTON, of Friendship, Maine, made this model of the Radiola No. 20 entirely from matches. It took Mr. Wotton's spare time for four months. More than 2,200 matches were used. The drum dial and volume control knobs turn and the switch pulls and pushes, as on the Radiola. The loop also was made of matches, but wound with thread to give the appearance of metal. No nails or pins were used. Every match was glued. The set is perfectly proportioned to the original.

dvertising Under Fire

There is said to be no Federal statute by which action could be taken against the station.

It is not believed that the station was attempting to defraud. The opinion is that a rush of orders was responsible for the delay.

The Legal View

Commissioner Eugene O. Sykes, the legal member of the Federal Radio Commission, believes that a law extending the Postal Act to cover attempts to defraud over the radio would be a very good thing.

"The Federal Radio Commission has not the authority to exercise censorship programs," says he. "It therefore follows that we cannot attempt to say what a station shall or shall not broadcast, whether it is direct or indirect advertising or something else.

"It is up to the listeners entirely and if they think the station is rendering a public service, it is up to us to keep our hands off.

"Of course, if conclusive evidence of intent to defraud by any station were presented to the Federal Radio Commission, an effort would be made to deprive the station of its license. But it does seem that a law covering the subject might help to clarify matters."

BANQUET BOARD TO MEET

The organization meeting of the committee for the Fourth Annual Radio Industries Banquet wil be held at the Stevens Hotel on Wednesday, June 15.

Highest Type Programs Predicted for Daytime

Hot Springs, Va.

The inauguration of a daytime broadcasting schedule on a nationwide scale, comparable to the best features now transmitted between 8 P. M. and midnight, was forecast in an addreses by George F. McClelland, vice-president and general manager of the National Broadcasting Company, at the annual meeting of the National Electrical Manufacturers Association here. Probably 10,000,000 listeners would be added to the radio audience of the United States if a sixteen-hour day broadcasting service were regularly established, he said. Mr. McClelland added:

"There is a good reason, of course, why radio should have settled first at the American fireside. It was brought into the home by the boy and finally embraced by the man of the house. Then, too, the predominantly entertainment features of radio made it natural that the best program features be concentrated during the hours when the family usually seeks entertainment.

Too Big for Small Clothes

"But broadcasting has outgrown the narrow limits of its early experimental days. It has a greater destiny to fulfill than mere entertainment. Is mission to the home is to carry to it every form of cultural influence and service which this system of mass communication is preeminently equipped to do.

"Broadcasting, theoretically at least, already covers the outermost limits of space. But it has still far to go in time before we may be said to have established the best possible broadcasting service commensurate with the requirements of a population of 117,000,000 people.

"Of the more than 30,000,000 women in this country over 21 years of age, less than 9,000,000 are employed in duties outside of the home. Radio broadcasting has made a start, it is true, in bringing a daytime service of information and entertainment to the home. Yet much remains to be done in order to provide an adequate daytime program for 21,000,000 women in the United States, most of whom are anxious and eager to receive the musical, educational and informative features which radio can bring.

The School Children Audience

"There are 25,000,000 school children in the United States, the vast majority of whom are still awaiting an organized plan of service that will bring radio to the classroom, as an established factor in musical education. The decision reached by Walter Damrosch, the distinguished dean of musical education in this country, to broadcast a series of educational concerts to the schools, is a very great step in the right direction.

"It may seem an anachronism in this day of super-radio programs when the greatest stars of the opera and the concert stage, when the most distinguished figures in educational and public life, have been featured on the air, that hundreds of thousands of people whose homes are equipped with radio sets have never had the opportunity to hear an outstanding radio program. For we must remember that in many professions and many trades there are millions who labor while most of us sleep. Daytime broadcasting of a primary character would prove a great boon to this element of our population.

"The last but not the least factor that would call for the extension of daytime radio programs is the need of the great buying public when it is in the market for radio sets. It is the unique position of radio that it is an industry built around a broadcasting service. It can be demonstrated only in connection with that service. The best possible reception of the poorest possible program is an inadequate recommendation for any set. A high class broadcasting program, therefore, transmitted during the day hours, would be of inestimable value to the radio industry.

z z zz

"It is plain that any program which advances the radio manufacturing industry advances the interests of broadcasting and therefore the interests of the public."

Mr. McClelland in his address also detailed the great technical progress made by engineers of the National Broadcasting Company in broadcast transmission.

Technical Achievements

"A new science of electro-acoustics has been created for broadcasting," he said. "Remarkable progress has been made in the technique of handling sound in the air.

"Microphone technique has been improved to the extent that not only the middle register but the high notes of music or the speaking voice can now be handled by the microphone.

"Modulation systems have been worked out by which distortion in radio transmission practically has been eliminated.

"Sound control systems have been developed by which an invisible radio conductor mixes and controls the output of the microphone, so that a concert might be transmitted in perfect form by the broadcasting station."

The greatest contributions thus far to the development of broadcasting in the United States, Mr. McClelland declared, have been made by the communication, the electrical and radio manufacturing industries of the country.

WLW Short Waves Heard World Over

Short wave broadcasts from WLW, Cincinnati, are being heard consistently in countries throughout the world. Three reports from three different individuals in London were received in a single day and other reports have come in from Mexico, Trinidad, the Canal Zone and several other foreign points.

The short wave transmitter, 52 meters, uses only 500 watts as compared with the 5,000 watt power of the long wave Crosley station. The short wave transmission, however, far outdistances the other.

WLW will put on a special program for Australian listeners at 3 A. M. (E. D. S. T.) Sunday morning, June 29 (8:00 P. M., Monday, in Australia).

AMERICA'S LEADERSHIP

Scientists of every nation are looking to the United States in radio development, and the majority of the new wonders in tubes and devices for transmission and reception, to be shown at the next Radio World's Fair, in New Madison Square Garden, New York City, will be the product of American inventive genius and research.

A THOUGHT FOR THE WEEK

JUST as millions of people a few years ago declared there wasn't anything practical in radio, and then were shown to be silly unbelievers, so does that flying eagle of the West, Charlie Lindbergh, come along and prove to a breathless but doubtful world that Paris is only across the way to those who know how to make it; and that same world is still divided as to whether intrepidity or modesty is the flyer's middle name.

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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SUBSCRIPTION RATES

Fifteen cents a copy. $6.00 a year. $3.00 for six months. $1.50 for three months. Add $1.00 a year extra for foreign postage. Canada, 50 cents.

Receipt by new subscribers of the first copy of RADIO WORLD mailed to them after sending in their order is automatic acknowledgment of their subscription order. Changes of address should be received at this office two weeks before date of publication. Always give old address; also state whether subscription is new or a renewal.

ADVERTISING RATES

General Advertising

1 Page, 7¼"x11"	462 lines	$300.00
½ Page, 7¼"x5½"	231 lines	150.00
½ Page, 8¼" 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
Per Agate Line		.75

Time Discount

52 consecutive issues	20%
26 times consecutively or E. O. W. one year	15%
4 consecutive issues	10%

WEEKLY, dated each Saturday, published Wednesday. Advertising forms close Tuesday, eleven days in advance of date of issue.

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.

WJAZ Primes Its Guns Against Law's Validity

Washington.

Notice that the Zenith Radio Corporation of Chicago, owners of WJAZ, is prepared but has no present intention, to enter the courts to dispute the constitutionality of the Radio Act of 1927, was given to the Federal Radio Commission by Irvin Herriott, attorney for the station, preliminary to the formal opening of a public hearing before the Commission so the station could enter a protest to the wavelength assignment of the station.

Mr. Herriott asserted that the Zenith Radio Corporation does not at present intend or expect to test the authority of the Commission, but that he was entering possible contentions "solely for the purpose of preserving the record." It was his belief that WJAZ could prove its public service value fully enough to the satisfaction of the Commission so that it would be assigned a frequency other than the one allocated it, effective June 15, namely 1,140 kilocycles (263 meters).

Prepared to Dispute

However, Mr. Herriott continued, the Zenith Radio Corporation proposes to be the first organization on record as prepared to dispute the constitutionality of the radio law passed by Congress last February.

If suit should be entered in the proper court of jurisdiction, the Federal district courts, it will be on the following grounds, he said:

1. The Act permits of deprivation of property without due process of law.

2. The regulatory power of Congress does not extend to a subject of this character.

3. Orders of the Federal Radio Commission "undoubtedly" amount to confiscation.

Prefers 389.4 Meters

Representatives of the Zenith Radio Corporation, however, disavowed any definite intention of going to the courts. Required under the Commission's procedure to name the frequency to which they feel they are better entitled, they named 770 kilocycles (389.4 meters).

E. F. McDonald, Jr., president of the Zenith Radio Corporation, asserted on the witness stand that the station was willing to accept a frequency assignment anywhere in the wave band between 300 and 425 meters.

Mr. McDonald testified that Commissioner Bellows specifically promised him that Station WJAZ would be assigned a wavelength between 300 and 400 meters when the 60-day licenses were issued, to become effective June 15.

Cites Broken Promise

Relying upon this promise, the Zenith Radio Corporation was surprised and concerned, he said, when the 263-meter allocation for Station WJAZ was made known.

Mr. McDonald said that the 263-meter wavelength was not suitable for Station WJAZ's range of service, and that broadcasting upon it would largely disrupt its value to its listeners. Station WJAZ cannot be heard on 263 meters by the type of receiving apparatus that was manufactured up to about the first of this year, he said, and under the Commission's plan of frequency separation will not be heard suitably.

President McDonald said it was his opinion that the majority of receiving sets now in use cannot catch programs transmitted on waves below 250 meters. He regarded the continued operation of WJAZ as "essential and necessary" to carry on the Zenith Radio Corporation's business, which is primarily the manufacture and sale of radio apparatus.

Zenith Was the "Starter"

It was when the Zenith Radio Corporation won its suits in the Federal district court against the authority of the Department of Commerce to control and regulate radio, that Secretary Hoover sought an opinion from the Attorney General regarding this authority. The opinion, rendered last July, stated that the Department of Commerce had no authority over radio under the Communication Law of 1912.

Thereupon Federal control of broadcasting broke down. There was no regulation until February, 1927, when Congress enacted the law creating the Federal Radio Commission and defining its functions and powers.

Under the "public service" clause of this act, the Commission has reallocated conditions of broadcasting within the program band. Station WJAZ is one of these required to shift its frequency.

"Ask Me Another" Stunt Is Worked by WLW

"Now we'll ask one," is the answer of WLW, the Crosley station at Cincinnati, for the current "Ask Me Another" craze.

Every night at 8 o'clock, Eastern Standard Time, the announcer will ask five questions, and every night he will give the answers to the questions of the night before.

The queries will be taken from all of the fields of knowledge entering into a liberal education—music, art, literature, history, politics and current events. The musical questions will be answered musically as well as verbally. For example, "What famous composition did Schubert write in a beer garden?" The following night the announcer gives the answer.

Mathilde Harding Weds Radio Official

Mathilde Harding, hostess-accompanist at WEAF, was married recently to Donald Withycomb. The romance began at the formation of the National Broadcasting Company in November, 1926. Mr. Withycomb, is assistant secretary of the N. B. Co.

Miss Harding was born in Washington, Pa. She early planned a musical career and after her graduation from the Washington Seminary came to New York to study the piano.

Last season Miss Harding served as accompanist for Ethel Hayden, who will be remembered by WEAF's audience as the soloist during the "Atwater Kent Radio Hour," when the Oratorio Society of New York was heard. In her tour with Miss Hayden she went as far West as St. Louis and toured extensively throughout New England and northern New York State.

Before her appearances at WEAF, Miss Harding had never played on the air, and in her first appearance before WEAF's microphone she accompanied "Silver Masked Tenor." On two occasions she appeared as the soloist with the Russian Symphony Orchestra in engagements in Pennsylvania, and in 1923 gave her own recital in Aeolian Hall, New York City. To her many friends at WEAF she is known as "Billie."

Donald Withycomb was born July 4, 1896, in Montreal, Canada, and attended high school and the Lower Canada College in that city. He entered the executive offices of the Canadian Pacific Railway and later became a salesman for the International Equipment Company of Montreal, in which capacity he traveled throughout Canada.

He joined the British Royal Air Force in 1915 and served overseas as a pilot during the World War, returning to Canada after the Armistice. Early in 1924, he came to the United States to accept the position of private secreary to Merlin H. Aylesworth, then managing director of the National Electric Light Association. With Mr. Aylesworth's appointment as President of the N. B. Co., Mr. Withycomb became assistant secretary of the company.

NEW WAVES IN EFFECT JUNE 15

Washington.

Postponement until June 15 of the effective date of the new radio allocations originally ordered to go into effect on June 1, was ordered by the Federal Radio Commission so stations would have time to adjust themselves to the new requirements.

This was announced by the Commission when it made public its General Order No. 13, continuing in force the temporary operating permits under which all of the 694 stations in the United States are now operating. Nearly all of the stations are affected by the reallocation plan whereby the Federal Radio Commission granted 60-day licenses to all applicant stations and prescribed new conditions of broadcasting.

Stations Need Time

The postponement for two weeks of the plan, which re-logs the whole program broadcasting scheme, was also ordered in consideration of the fact that more time is needed by stations to make technical changes. The full text of the order follows:

"In consideration of the fact that a certain amount of time is required in many cases for making the changes of equipment required by changes of station frequency, and for securing suitable control equipment to maintain frequency without serious variations, the Federal Radio Commission hereby amends General Order No. 11, dated May 21, 1927, to read as follows:

"'The Federal Radio Commission hereby orders that all temporary permits to operate radio broadcasting stations under the terms of the Radio Act of 1927, shall terminate at 3 o'clock, local standard time, on the morning of Wednesday, June 15, 1927, and that thereafter all radio broadcasting stations subject to the provisions of the Radio Act of 1927, shall be operated solely in accordance with the provisions of the licenses issued as of June 1, 1927, by the Federal Radio Commission.'

Permits Continued

"The Federal Radio Commission hereby orders that all licenses for the period of 60 days, issued as of June 1, 1927, shall not become effective until 3 o'clock, local standard time, on the morning of Wednesday, June 15, 1927, and shall continue in effect, unless previously revoked or modified by order of the Commission, for a period of 60 days after June 15, 1927."

Public hearings on disputed frequencies are being held continuously and all cases decided as quickly as possible, it was stated by Commissioner Henry A. Bellows.

Less Interference, Bellows' Prediction

Washington.

The new assignment of wavelengths should result in a considerable reduction in interference, in the opinion of Federal Radio Commissioner Henry A. Bellows.

"Of course there will continue to be some interference," says Mr. Bellows. "The law fortunately makes no provision for taking care of thunderstorms and troubles inside the set. But aside from those things, interference should be greatly relieved."

VACATION ADVICE

Don't forget to disconnect the trickle charger when going away on your vacation.

Changes No Panacea, But Good, Says Bellows

Washington.

Distance reception is not facilitated by the new wavelength assignments of the Federal Radio Commission, according to Commissioner H. A. Bellows.

Proceeding on the theory that the law does not authorize the Commission to require anybody to get off the air, the Commission assigned wavelengths for approximately 694 broadcasting stations.

Commissioner Bellows regards the new wavelength assignments as the very best that can possibly be done under the circumstances. He says there will be an adequate separation between stations to prevent their interfering with one another. Power was reduced to a point where three stations can operate simultaneously in different parts of the country without interfering with one another.

The Two Theories

The new arrangement of the Commission is predicated on two theories. They are:

(1) That the actual service area of a broadcasting station does not exceed 200 miles, and that distance hunting does not constitute a service.

(2) That it would be unconstitutional to deprive existing stations of their licenses and therefore it is necessary to squeeze all stations into the picture.

Commissioner Bellows displayed confidence, but little pride, in discussing the new plan.

"There is going to be a tremendous amount of grief," said he. "It will take time to relog sets We are asking the broadcasting stations to ask their listeners to exercise patience in the new logging process."

Without creating a "languishing band," the Commission has made wavelength assignments to some stations so bad that the stations are not expected to remain long on the air. In fact Commissioner Bellows predicted that within the next year the total number of stations will be reduced to around 450.

Believe Board Has Power

Both Senator C. C. Dill and Representative Wallace White, co-authors of the Radio Law, believe that the Commission has full authority to reduce the number of stations.

They said the wording of the law "public service, necessity or convenience" provided ample authority for the Commission to reduce stations, if such a step seemed best in tangled condition of broadcasting. Senator Dill said that if the law were unconstitutional, it would be better for the Commission to test it out immediately so that additional legislation might be provided.

Commissioner Eugene O. Sykes, the legal member of the Commission, said:

"It is not the duty of the Commission to pass upon the constitutionality of the law. It will assume that every part of the law is constitutional, legal, valid and binding, and the Commission will enforce the law as written."

Without definitely committing themselves, the members of the Federal Radio Commission have indicated that they believe the only satisfactory solution of the broadcasting problem is a reduction of the number of stations.

The list of broadcasting stations, with the new wavelengths, frequencies and power, is published in this issue. See next page.

Stations' Wave Plea To Fans Boomerangs

Washington.

Inspired propaganda by broadcasting stations which have urged their listeners to write the Federal Radio Commission in their behalf has had a boomerang effect, according to Commissioner Henry A. Bellows, spokesman for his associates.

In the case of two middle western stations, which asked their listeners to write in to the Commission beseeching a good wavelength and plenty of power, more than half of the letters reaching Washington voiced dissatisfaction with the stations and some of them even went as far as urging the Commission to put them off the air altogether.

According to Commissioner Bellows, the Commission accepts such propaganda as evidence that the station is afraid it can not stand on its own merit.

The stations about which there has been the least fan mail, Mr. Bellows says, are those which are rendering the highest grade of service.

He made a personal tally.

Flying Field Aerial Masts Emblazoned

WASHINGTON.

Increased safety in flying in the United States is the aim of a standard program for marking and lighting obstructions to air navigation just approved by the Department of Commerce, the Army Air Corps and the Bureau of Aeronautics, Navy Department.

According to provisions of the approved report, all obstruction towers, such as radio masts, transmission poles, flag poles, etc., in the vicinity of airports, intermediate landing fields or civil airways, must be painted to insure maximum visibility from the air. The method followed will be to use alternate bands of white and chrome yellow, separated by black bands running horizontally about the obstructions.

At night the obstructions will be marked at the top with flashing red lights. These will be lit from sunset to sunrise. Addition fixed red light will be used on radio towers, one-third and two-thirds of the height from the ground.

Compass Station Quits, Due to Shore Erosion

The radio compass station maintained by the Department of the Navy at Hog Island, Va., a little above the entrance of the Chesapeake Bay, was abandoned, due to erosion of the shore line and consequent danger to personnel and material, the Department announced.

Immediate replacement of this station is not contemplated, and in the interim the Chesapeake Bay entrance group, which advises both vessels and airplanes as to their bearings, will comprise only the stations at Virginia Beach and Poyners Hill.

For the time being, therefore the Chesapeake Bay Entrance Group will only furnish two bearings; viz., Virginia Beach and Poyners Hill. If a third bearing is required it can be obtained by calling the Cape Henlopen Group. In addition, ships carrying a radio compass can take a bearing on the Cape Henry radio beacon. A radio beacon will be established on Cape Charles Light Vessel within a few weeks, it was announced.

$17,500 for New Voices Offered by Atwater Kent

Philadelphia.

Very extensive plans for a "National Radio Audition" for young men and women for the purpose of finding by test the best undiscovered voices in the United States were announced by the Atwater Kent Foundation, an institution established for scientific and educational purposes.

Every community in the United States will be given an opportunity, first to select by popular vote the best voices, of young women and young men; and then to enter these singers in a test of state, sectional and national auditions to be broacast.

Awards aggregating $17,500, with one and two years' tuition in an American conservatory for certain winners, will be offered as an incentive to young people to enter the tests, which will be held in each of the forty-eight states.

Kent's Statement

A. Atwater Kent, president of the Foundation, said:

"The discovery of one of these rare voices, of which each generation produces a very few, seems to me an event of profound national importance. Even when such a voice could give pleasure to only a few thousand people in a year it was a national treasure. Now that millions may enjoy it on the same evening through the medium of radio, such a voice has become priceless.

"The National Radio Audition, supported by the Atwater Kent Foundation, is an undertaking to search the entire country for beautiful voices and to offer these singers an opportunity for full development, recognition and reward.

"In Europe, when a singer of promise appears, the entire family will gladly make any necessary sacrifice to provide means for a proper cultivation of that voice and the support of the singer until fame is achieved. It is in this spirit that we hope each community in the country will receive this Audition idea and devote whatever effort is required to discover and present its candidates for state and national honors."

Opportunity for Youth

The primary purpose of the Audition is to provide opportunity for recognition to every young man or woman in every community, no matter how isolated, and to give to the world of music through radio the best voices thus discovered.

After a series of state and district auditions, five young men and five young women will be brought to New York for a final audition, which will be broadcast over a nation-wide network of stations.

In the finals—the National Audition—five awards for merit will be given to women and five to men. The two who get first place in the National Audition—a man and a woman—will each receive a gold decoration, $5,000 in cash and two years' tuition in a leading conservatory.

Winners of second awards will each receive $2,000 in cash and one year's tuition.

Winners of third awards will each receive $1,000 and one year's tuition.

Winners of fourth awards will each receive $500.

Winners of fifth awards will each receive $250.

Musical, civic and women's clubs in each community in each state will be invited to hold local tests to select the best young man and best young woman singer of their towns. These winners will then be certified to a state audition, which will be broadcast by a radio station in each state. A state winner of each sex will be chosen and will receive a silver medal.

The next step is a district audition. The young men and women who have won state honors will be taken to a central broadcasting station in one of five districts, where an audition will be broadcast to select the two winners—a young man and a young woman—from that district.

The two winners in each district will receive gold medals and the ten finalists thus selected will be brought to New York for the final National Audition.

Each national winner will also be well started on the road to fame as a radio concert artist, with a successful musical career ahead. All expenses of contestants the district and final auditions, including railroad fare, hotel bills, entertainments, etc., will be paid by the Atwater Kent Foundation.

Judging of contestants will be by vote of radio listeners and juries made up of the musical authorities of each community, state or district. Listeners-in will participate in the state and district auditions, their votes counting sixty per cent and the vote of the jury forty per cent. For the final National Audition in New York, a jury of great figures in the musical world is being created. Its decisions will be made without participation by the radio public and will be announced immediately after the broadcasting of the finals.

Qualifications for Tests

The principal qualifications for contestants are as follows:

They must not be more than twenty-five years old; must never have been associated with a professional theatrical or operatic company; must never have been a paid principal in any concert held outside their own states; must declare an intention to follow a musical career and must be free from theatrical or musical contracts.

This limitation permits choir singers to enter the auditions, even though they may have received financial compensation for singing in churches. It is expected that many of the contestants will be the leading young choir singers of their communities. Other groups from which entries are anticipated are students in musical schools and locally prominent singers in high schools and colleges. Musical organizations in each state are also afforded an opportunity to put forward their best talent and to assist in holding local auditions.

Preliminary organization for holding the auditions will start soon under the direction of the Atwater Kent Foundation. It is expected that the first state auditions will get under way early this Fall, followed by the district auditions in November, with the finals in New York early in December.

CROSLEY CONVENTION HELD

The annual convention of the Crosley Radio Corporation's distributors was held in Cincinnati June 8 and 9. Announcements of new developments in the Crosley line were made and plans for the coming year will be discussed.

SIGNALLY HONORED

LORETTA LEE, first vocal graduate from the Peabody Conservatory of Music since Mabel Garrison, who obtained her diploma in 1911. Miss Lee was the third one to receive the diploma in the Conservatory's existence of 57 years. She recently gave a song recital from WBAL Baltimore.

VARIATION OF C BIAS

If in doubt as to the proper ohmage fixed resistance to be used for providing C bias from a B eliminator, a variable resistance of about 2,000 ohms maximum resistance, with a carrying capacity of ½ watts may be substituted.

Misleading Ads Over Air Banned

Washington.

Federal punishment for stations which misrepresent articles over the radio is planned in a bill that probably will be introduced during the next session of Congress by Senator C. C. Dill or Representative Wallace White.

Numerous complaints have reached the Federal Radio Commission against stations which through direct advertising over the air have offered articles for sale and which, according to the complainants, have not entirely lived up to the promises. The complaints have been most vigorous about a few stations in the Middle West.

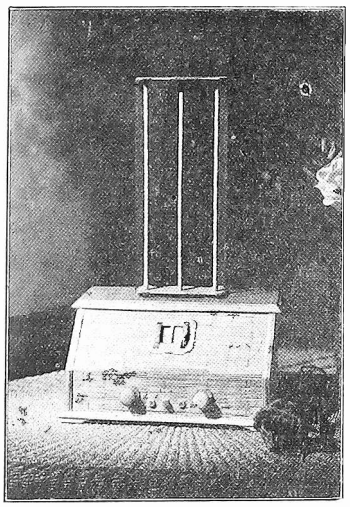
According to one letter received by the Radio Commission, a station broadcasted an announcement about radio tubes. The announcement was that a special price had been fixed for the tubes and anyone who sent in the money for the tubes was guaranteed satisfaction or else the money would be refunded.

He Buys the Tubes

A listener-in in another state heard the announcement and sent in the money for four tubes. In the letter containing the money was a description of the kind of tubes desired. In about two weeks tubes were forthcoming, but they were not of the kind ordered nor were they suitable for use.

The tubes were returned to the station with a request that the proper kind of tubes be sent or the money refunded. Up to the time of writing to the Commission, the listener had received neither the money nor the tubes.

SET MADE OF MATCHES



PAUL R. WOTTON, of Friendship, Maine, made this model of the Radiola No. 20 entirely from matches. It took Mr. Wotton's spare time for four months. More than 2,200 matches were used. The drum dial and volume control knobs turn and the switch pulls and pushes, as on the Radiola. The loop also was made of matches, but wound with thread to give the appearance of metal. No nails or pins were used. Every match was glued. The set is perfectly proportioned to the original.

dvertising Under Fire

There is said to be no Federal statute by which action could be taken against the station.

It is not believed that the station was attempting to defraud. The opinion is that a rush of orders was responsible for the delay.

The Legal View

Commissioner Eugene O. Sykes, the legal member of the Federal Radio Commission, believes that a law extending the Postal Act to cover attempts to defraud over the radio would be a very good thing.

"The Federal Radio Commission has not the authority to exercise censorship programs," says he. "It therefore follows that we cannot attempt to say what a station shall or shall not broadcast, whether it is direct or indirect advertising or something else.

"It is up to the listeners entirely and if they think the station is rendering a public service, it is up to us to keep our hands off.

"Of course, if conclusive evidence of intent to defraud by any station were presented to the Federal Radio Commission, an effort would be made to deprive the station of its license. But it does seem that a law covering the subject might help to clarify matters."

BANQUET BOARD TO MEET

The organization meeting of the committee for the Fourth Annual Radio Industries Banquet wil be held at the Stevens Hotel on Wednesday, June 15.

Highest Type Programs Predicted for Daytime

Hot Springs, Va.

The inauguration of a daytime broadcasting schedule on a nationwide scale, comparable to the best features now transmitted between 8 P. M. and midnight, was forecast in an addreses by George F. McClelland, vice-president and general manager of the National Broadcasting Company, at the annual meeting of the National Electrical Manufacturers Association here. Probably 10,000,000 listeners would be added to the radio audience of the United States if a sixteen-hour day broadcasting service were regularly established, he said. Mr. McClelland added:

"There is a good reason, of course, why radio should have settled first at the American fireside. It was brought into the home by the boy and finally embraced by the man of the house. Then, too, the predominantly entertainment features of radio made it natural that the best program features be concentrated during the hours when the family usually seeks entertainment.

Too Big for Small Clothes

"But broadcasting has outgrown the narrow limits of its early experimental days. It has a greater destiny to fulfill than mere entertainment. Is mission to the home is to carry to it every form of cultural influence and service which this system of mass communication is preeminently equipped to do.

"Broadcasting, theoretically at least, already covers the outermost limits of space. But it has still far to go in time before we may be said to have established the best possible broadcasting service commensurate with the requirements of a population of 117,000,000 people.

"Of the more than 30,000,000 women in this country over 21 years of age, less than 9,000,000 are employed in duties outside of the home. Radio broadcasting has made a start, it is true, in bringing a daytime service of information and entertainment to the home. Yet much remains to be done in order to provide an adequate daytime program for 21,000,000 women in the United States, most of whom are anxious and eager to receive the musical, educational and informative features which radio can bring.

The School Children Audience

"There are 25,000,000 school children in the United States, the vast majority of whom are still awaiting an organized plan of service that will bring radio to the classroom, as an established factor in musical education. The decision reached by Walter Damrosch, the distinguished dean of musical education in this country, to broadcast a series of educational concerts to the schools, is a very great step in the right direction.

"It may seem an anachronism in this day of super-radio programs when the greatest stars of the opera and the concert stage, when the most distinguished figures in educational and public life, have been featured on the air, that hundreds of thousands of people whose homes are equipped with radio sets have never had the opportunity to hear an outstanding radio program. For we must remember that in many professions and many trades there are millions who labor while most of us sleep. Daytime broadcasting of a primary character would prove a great boon to this element of our population.

"The last but not the least factor that would call for the extension of daytime radio programs is the need of the great buying public when it is in the market for radio sets. It is the unique position of radio that it is an industry built around a broadcasting service. It can be demonstrated only in connection with that service. The best possible reception of the poorest possible program is an inadequate recommendation for any set. A high class broadcasting program, therefore, transmitted during the day hours, would be of inestimable value to the radio industry. z z zz

"It is plain that any program which advances the radio manufacturing industry advances the interests of broadcasting and therefore the interests of the public."

Mr. McClelland in his address also detailed the great technical progress made by engineers of the National Broadcasting Company in broadcast transmission.

Technical Achievements

"A new science of electro-acoustics has been created for broadcasting," he said. "Remarkable progress has been made in the technique of handling sound in the air.

"Microphone technique has been improved to the extent that not only the middle register but the high notes of music or the speaking voice can now be handled by the microphone.

"Modulation systems have been worked out by which distortion in radio transmission practically has been eliminated.

"Sound control systems have been developed by which an invisible radio conductor mixes and controls the output of the microphone, so that a concert might be transmitted in perfect form by the broadcasting station."

The greatest contributions thus far to the development of broadcasting in the United States, Mr. McClelland declared, have been made by the communication, the electrical and radio manufacturing industries of the country.

WLW Short Waves Heard World Over

Short wave broadcasts from WLW, Cincinnati, are being heard consistently in countries throughout the world. Three reports from three different individuals in London were received in a single day and other reports have come in from Mexico, Trinidad, the Canal Zone and several other foreign points.

The short wave transmitter, 52 meters, uses only 500 watts as compared with the 5,000 watt power of the long wave Crosley station. The short wave transmission, however, far outdistances the other.

WLW will put on a special program for Australian listeners at 3 A. M. (E. D. S. T.) Sunday morning, June 29 (8:00 P. M., Monday, in Australia).

AMERICA'S LEADERSHIP

Scientists of every nation are looking to the United States in radio development, and the majority of the new wonders in tubes and devices for transmission and reception, to be shown at the next Radio World's Fair, in New Madison Square Garden, New York City, will be the product of American inventive genius and research.

A THOUGHT FOR THE WEEK

JUST as millions of people a few years ago declared there wasn't anything practical in radio, and then were shown to be silly unbelievers, so does that flying eagle of the West, Charlie Lindbergh, come along and prove to a breathless but doubtful world that Paris is only across the way to those who know how to make it; and that same world is still divided as to whether intrepidity or modesty is the flyer's middle name.

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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Receipt by new subscribers of the first copy of RADIO WORLD mailed to them after sending in their order is automatic acknowledgment of their subscription order. Changes of address should be received at this office two weeks before date of publication. Always give old address; also state whether subscription is new or a renewal.

ADVERTISING RATES

General Advertising

1 Page, 7¼"x11"	462 lines	$300.00
½ Page, 7¼"x5½"	231 lines	150.00
½ Page, 3½" 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
Per Agate Line		.75

Time Discount

52 consecutive issues	20%
26 times consecutively or E. O. W. one year	15%
4 consecutive issues	10%

WEEKLY, dated each Saturday, published Wednesday. Advertising forms close Tuesday, eleven days in advance of date of issue.

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.

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Every night at 8 o'clock, Eastern Standard Time, the announcer will ask five questions, and every night he will give the answers to the questions of the night before.

The queries will be taken from all of the fields of knowledge entering into a liberal education—music, art, literature, history, politics and current events. The musical questions will be answered musically as well as verbally. For example, "What famous composition did Schubert write in a beer garden?" The following night the announcer gives the answer.

WJAZ Primes Its Guns Against Law's Validity

Washington.

Notice that the Zenith Radio Corporation of Chicago, owners of WJAZ, is prepared but has no present intention, to enter the courts to dispute the constitutionality of the Radio Act of 1927, was given to the Federal Radio Commission by Irvin Herriott, attorney for the station, preliminary to the formal opening of a public hearing before the Commission so the station could enter a protest to the wavelength assignment of the station.

Mr. Herriott asserted that the Zenith Radio Corporation does not at present intend or expect to test the authority of the Commission, but that he was entering possible contentions "solely for the purpose of preserving the record." It was his belief that WJAZ could prove its public service value fully enough to the satisfaction of the Commission so that it would be assigned a frequency other than the one allocated it, effective June 15, namely 1,140 kilocycles (263 meters).

Prepared to Dispute

However, Mr. Herriott continued, the Zenith Radio Corporation proposes to be the first organization on record as prepared to dispute the constitutionality of the radio law passed by Congress last February.

If suit should be entered in the proper court of jurisdiction, the Federal district courts, it will be on the following grounds, he said:

1. The Act permits of deprivation of property without due process of law.

2. The regulatory power of Congress does not extend to a subject of this character.

3. Orders of the Federal Radio Commission "undoubtedly" amount to confiscation.

Prefers 389.4 Meters

Representatives of the Zenith Radio Corporation, however, disavowed any definite intention of going to the courts. Required under the Commission's procedure to name the frequency to which they feel they are better entitled, they named 770 kilocycles (389.4 meters).

E. F. McDonald, Jr., president of the Zenith Radio Corporation, asserted on the witness stand that the station was willing to accept a frequency assignment anywhere in the wave band between 300 and 425 meters.

Mr. McDonald testified that Commissioner Bellows specifically promised him that Station WJAZ would be assigned a wavelength between 300 and 400 meters when the 60-day licenses were issued, to become effective June 15.

Cites Broken Promise

Relying upon this promise, the Zenith Radio Corporation was surprised and concerned, he said, when the 263-meter allocation for Station WJAZ was made known.

Mr. McDonald said that the 263-meter wavelength was not suitable for Station WJAZ's range of service, and that broadcasting upon it would largely disrupt its value to its listeners. Station WJAZ cannot be heard on 263 meters by the type of receiving apparatus that was manufactured up to about the first of this year, he said, and under the Commission's plan of frequency separation will not be heard suitably.

President McDonald said it was his opinion that the majority of receiving sets now in use cannot catch programs transmitted on waves below 250 meters. He regarded the continued operation of WJAZ as "essential and necessary" to carry on the Zenith Radio Corporation's business, which is primarily the manufacture and sale of radio apparatus.

Zenith Was the "Starter"

It was when the Zenith Radio Corporation won its suits in the Federal district court against the authority of the Department of Commerce to control and regulate radio, that Secretary Hoover sought an opinion from the Attorney General regarding this authority. The opinion, rendered last July, stated that the Department of Commerce had no authority over radio under the Communication Law of 1912.

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Last season Miss Harding served as accompanist for Ethel Hayden, who will be remembered by WEAF's audience as the soloist during the "Atwater Kent Radio Hour," when the Oratorio Society of New York was heard. In her tour with Miss Hayden she went as far West as St. Louis and toured extensively throughout New England and northern New York State.

Before her appearances at WEAF, Miss Harding had never played on the air, and in her first appearance before WEAF's microphone she accompanied "Silver Masked Tenor." On two occasions she appeared as the soloist with the Russian Symphony Orchestra in engagements in Pennsylvania, and in 1923 gave her own recital in Aeolian Hall, New York City. To her many friends at WEAF she is known as "Billie."

Donald Withycomb was born July 4, 1896, in Montreal, Canada, and attended high school and the Lower Canada College in that city. He entered the executive offices of the Canadian Pacific Railway and later became a salesman for the International Equipment Company of Montreal, in which capacity he traveled throughout Canada.

He joined the British Royal Air Force in 1915 and served overseas as a pilot during the World War, returning to Canada after the Armistice. Early in 1924, he came to the United States to accept the position of private secreary to Merlin H. Aylesworth, then managing director of the National Electric Light Association. With Mr. Aylesworth's appointment as President of the N. B. Co., Mr. Withycomb became assistant secretary of the company.

NEW WAVES IN EFFECT JUNE 15

Washington.

Postponement until June 15 of the effective date of the new radio allocations originally ordered to go into effect on June 1, was ordered by the Federal Radio Commission so stations would have time to adjust themselves to the new requirements.

This was announced by the Commission when it made public its General Order No. 13, continuing in force the temporary operating permits under which all of the 694 stations in the United States are now operating. Nearly all of the stations are affected by the reallocation plan whereby the Federal Radio Commission granted 60-day licenses to all applicant stations and prescribed new conditions of broadcasting.

Stations Need Time

The postponement for two weeks of the plan, which re-logs the whole program broadcasting scheme, was also ordered in consideration of the fact that more time is needed by stations to make technical changes. The full text of the order follows:

"In consideration of the fact that a certain amount of time is required in many cases for making the changes of equipment required by changes of station frequency, and for securing suitable control equipment to maintain frequency without serious variations, the Federal Radio Commission hereby amends General Order No. 11, dated May 21, 1927, to read as follows:

"'The Federal Radio Commission hereby orders that all temporary permits to operate radio broadcasting stations under the terms of the Radio Act of 1927, shall terminate at 3 o'clock, local standard time, on the morning of Wednesday, June 15, 1927, and that thereafter all radio broadcasting stations subject to the provisions of the Radio Act of 1927, shall be operated solely in accordance with the provisions of the licenses issued as of June 1, 1927, by the Federal Radio Commission.'

Permits Continued

"The Federal Radio Commission hereby orders that all licenses for the period of 60 days, issued as of June 1, 1927, shall not become effective until 3 o'clock, local standard time, on the morning of Wednesday, June 15, 1927, and shall continue in effect, unless previously revoked or modified by order of the Commission, for a period of 60 days after June 15, 1927."

Public hearings on disputed frequencies are being held continuously and all cases decided as quickly as possible, it was stated by Commissioner Henry A. Bellows.

Less Interference, Bellows' Prediction

Washington.

The new assignment of wavelengths should result in a considerable reduction in interference, in the opinion of Federal Radio Commissioner Henry A. Bellows.

"Of course there will continue to be some interference," says Mr. Bellows. "The law fortunately makes no provision for taking care of thunderstorms and troubles inside the set. But aside from those things, interference should be greatly relieved."

VACATION ADVICE

Don't forget to disconnect the trickle charger when going away on your vacation.

Changes No Panacea, But Good, Says Bellows

Washington.

Distance reception is not facilitated by the new wavelength assignments of the Federal Radio Commission, according to Commissioner H. A. Bellows.

Proceeding on the theory that the law does not authorize the Commission to require anybody to get off the air, the Commission assigned wavelengths for approximately 694 broadcasting stations.

Commissioner Bellows regards the new wavelength assignments as the very best that can possibly be done under the circumstances. He says there will be an adequate separation between stations to prevent their interfering with one another. Power was reduced to a point where three stations can operate simultaneously in different parts of the country without interfering with one another.

The Two Theories

The new arrangement of the Commission is predicated on two theories. They are:

(1) That the actual service area of a broadcasting station does not exceed 200 miles, and that distance hunting does not constitute a service.

(2) That it would be unconstitutional to deprive existing stations of their licenses and therefore it is necessary to squeeze all stations into the picture.

Commissioner Bellows displayed confidence, but little pride, in discussing the new plan.

"There is going to be a tremendous amount of grief," said he. "It will take time to relog sets We are asking the broadcasting stations to ask their listeners to exercise patience in the new logging process."

Without creating a "languishing band," the Commission has made wavelength assignments to some stations so bad that the stations are not expected to remain long on the air. In fact Commissioner Bellows predicted that within the next year the total number of stations will be reduced to around 450.

Believe Board Has Power

Both Senator C. C. Dill and Representative Wallace White, co-authors of the Radio Law, believe that the Commission has full authority to reduce the number of stations.

They said the wording of the law "public service, necessity or convenience" provided ample authority for the Commission to reduce stations, if such a step seemed best in tangled condition of broadcasting. Senator Dill said that if the law were unconstitutional, it would be better for the Commission to test it out immediately so that additional legislation might be provided.

Commissioner Eugene O. Sykes, the legal member of the Commission, said:

"It is not the duty of the Commission to pass upon the constitutionality of the law. It will assume that every part of the law is constitutional, legal, valid and binding, and the Commission will enforce the law as written."

Without definitely committing themselves, the members of the Federal Radio Commission have indicated that they believe the only satisfactory solution of the broadcasting problem is a reduction of the number of stations.

The list of broadcasting stations, with the new wavelengths, frequencies and power, is published in this issue. See next page.

Stations' Wave Plea To Fans Boomerangs

Washington.

Inspired propaganda by broadcasting stations which have urged their listeners to write the Federal Radio Commission in their behalf has had a boomerang effect, according to Commissioner Henry A. Bellows, spokesman for his associates.

In the case of two middle western stations, which asked their listeners to write in to the Commission beseeching a good wavelength and plenty of power, more than half of the letters reaching Washington voiced dissatisfaction with the stations and some of them even went as far as urging the Commission to put them off the air altogether.

According to Commissioner Bellows, the Commission accepts such propaganda as evidence that the station is afraid it can not stand on its own merit.

The stations about which there has been the least fan mail, Mr. Bellows says, are those which are rendering the highest grade of service.

He made a personal tally.

Flying Field Aerial Masts Emblazoned

WASHINGTON.

Increased safety in flying in the United States is the aim of a standard program for marking and lighting obstructions to air navigation just approved by the Department of Commerce, the Army Air Corps and the Bureau of Acronautics, Navy Department.

According to provisions of the approved report, all obstruction towers, such as radio masts, transmission poles, flag poles, etc., in the vicinity of airports, intermediate landing fields or civil airways, must be painted to insure maximum visibility from the air. The method followed will be to use alternate bands of white and chrome yellow, separated by black bands running horizontally about the obstructions.

At night the obstructions will be marked at the top with flashing red lights. These will be lit from sunset to sunrise. Addition fixed red light will be used on radio towers, one-third and two-thirds of the height from the ground.

Compass Station Quits, Due to Shore Erosion

The radio compass station maintained by the Department of the Navy at Hog Island, Va., a little above the entrance of the Chesapeake Bay, was abandoned, due to erosion of the shore line and consequent danger to personnel and material, the Department announced.

Immediate replacement of this station is not contemplated, and in the interim the Chesapeake Bay entrance group, which advises both vessels and airplanes as to their bearings, will comprise only the stations at Virginia Beach and Poyners Hill.

For the time being, therefore the Chesapeake Bay Entrance Group will only furnish two bearings; viz., Virginia Beach and Poyners Hill. If a third bearing is required it can be obtained by calling the Cape Henlopen Group. In addition, ships carrying a radio compass can take a bearing on the Cape Henry radio beacon. A radio beacon will be established on Cape Charles Light Vessel within a few weeks, it was announced.

LIST OF STATIONS

With new wavelengths, frequencies and power, effective June 15. Time sharers in parenthises.

Station	Kc	M	Watts
WAAD—Cincinnati, O.	1120	267.7	25
WAAF—Chicago, Ill. (WBBM, WJBT)	770	389.4	500
WAAM—Newark, N. J. (WGBS)...	860	348.6	500
WAAT—Jersey City, N. J (WGBB), WSOM)	1200	245.8	300
WAAW—Omaha, Nebr. (Before 7 p. m. only)	800	374.8	500
WABC—Richmond Hill, N. Y. (WBOQ)	920	325.9	2500
WABF—Pringleboro, Pa.	1460	205.4	250
WABI—Bangor, Me. (WGBX).....	770	389.4	100
WABO—Rochester, N. Y. (WHEC)..	1290	232.4	100
WABQ—Philadelphia, Pa.	1410	212.6	500
WABR—Toledo, O. (WTAL).....	1070	280.2	50
WABW—Woester, O.	1210	247.8	50
WABY—Philadelphia, Pa.	1210	247.8	50
WABZ—New Orleans, La.	1210	247.8	50
WADC—Akron, O.	1250	239.9	1000
WAFD—Detroit, Mich. (WTHO)....	1370	218.8	250
WAGM—Royal Oak, Mich.....	1330	225.4	50
WAGS—Somerville, Mass.	1390	215.7	5
WAIT—Taunton, Mass	1400	214.2	10
WAIU—Columbus, O. (WEAO).....	1060	282.8	5000
WALK—Bethayres, Pa. Portable)..	1490	201.6	50
WAMD—Minneapolis, Minn.	1330	225.4	500
WAPI—Auburn, Ala.; daytime only..	610	491.5	1000
WARS—Brooklyn, N. Y. (WSDA, WBBC)	1320	227.1	500
WASH—Grand Rapids, Mich.....	1170	256.3	250
WASN—Boston, Mass. (daytime only; WSSH)	1300	230.6	100
WATT—Boston, Mass.	1490	....	100
WBAA—West Lafayette, Ind (WRM)	1100	272.6	500
WBAK—Harrisburgh, Pa. (WPSC)..	1000	299.8	500
WBAL—Baltimore, Md.	1050	285.5	3000
WBAO—Decatur, Ill.	1120	....	100
WBAP—Fort Worth, Tex. (WFFA)	600	499.7	1500
WBAW—Nashville, Tenn.	1210	247.8	100
WBAX—Wilkes Barre, Pa. (WBRE).	1200	249.9	100
WBBC—Brooklyn, N. Y. (WARS, WSDA)	1320	227.7	500
WBBL—Richmond, Va.	1210	247.8	100
WBBM—Chicago, Ill. (WJBT, WAAF)	770	422.3	1000
WBBP—Petoskey, Mich.	1250	239.9	100
WBBR—Rossville, N. Y. WGL)....	1170	256.3	1000
WBBW—Norfolk, Va.	1270	236.1	50
WBBY—Charleston. S. C.....	600	499.7	75
WBBZ—Chicago, Ill. (Portable).....	1470	204.0	100
WBCN—Chicago, Ill. (WENR).....	1040	283.3	250
WBES—Takoma Park, Md.....	1010	296.9	100
WBET—Boston, Mass.	1240	241.8	500
WBKN—Brooklyn, N. Y. (WWRL, WIBI, WBMS)	1120	267.7	100
WBMH—Detroit, Mich. (WMBC)...	1420	211.1	100
WBMS—Union City, N. J. (WBKN, WWRL, WIBI)	1120	267.7	100
WBNY—New York, N. Y. (WKBQ, WFRL, WKBO)	1,370	218.8	500
WBOQ—Richmond Hill, N. Y. (WABC)	920	325.9	500
WBRC—Birmingham, Ala.	1230	243.8	250
WBRE—Wilkes Barre, Pa. (WBAX)	1200	249.9	100
WBRL—Tilton, N. H.	1290	232.4	500
WBRS—Brooklyn, N. Y. WCDA. WCGU, WRST)	1420	211.1	100
WBSO—Wellesley Hills, Mass. (WDWF)	780	384.4	100
WBT—Charlotte, N. C.	1160	258.5	500
WSMK—Dayton, Ohio	1010	296.9	200
WBZ—Springfield, Mass.	900	333.1	15000
WBZA—Boston, Mass.	900	333.1	500
WCAC—Mansfield, Conn. (WDRC)..	1090	275.1	500
WCAD—Canton, N. Y.	820	365.6	500
WCAE—Pittsburgh, Pa.	580	516.9	500
WCAH—Columbus, Ohio	560	535.4	250
WCAJ—Lincoln, Nebr.	860	348.6	500
WCAL—Northfield, Minn. (KFMX).	1270	236.1	500
WCAM—Camden, N. J.	1340	223.7	500
WCAO—Baltimore, Md. (WCBM)...	780	384.4	250
WCAT—Rapid City, S. D.	1210	247.8	100
WCAU—Philadelphia, Pa.	1150	260.7	500
WCAX—Burlington, Vermont	1180	254.1	100
WCAZ—Carthage, Ill.	880	340.7	50
WCBA—Allentown, Pa. (WSAN)....	1350	222.1	100
WCBD—Zion, Illinois (WLS).....	870	344.6	5000
WCBE—New Orleans, La.	1320	227.1	5
WCBH—Oxford, Miss	1240	241.8	100
WCBM—Baltimore, Md. (WCAO)....	780	384.4	100
WCBR—Providence, R. I. (Portable)	1490	201.6	100
WCBS—Springfield, Ill.	1430	209.7	250
WCCO—Minneapolis, Minn.	740	405.2	5000
WCDA—Brooklyn, N. Y. (WRST, WBRS, WCGU)	1420	211.1	500
WCFL—Chicago, Ill. WLTS).....	620	493.6	1500
WCGU—Coney Island, N. Y. (WCDA, WBRS. WRST)	1420	211.1	500
WCLO—Camp Lake, Wisc.....	1320	227.1	100
WCLS—Joliet, Ill. (WKBB).....	1390	215.7	150
WCMA—Culver, Ind.	1160	258.5	250
WCOA—Pensacola, Fla.	1200	249.9	500
WCOC—Columbus, Miss.	1300	230.6	100
WCOM—Manchester, N. H.....	1260	238.0	100
WCOT—Olneyville, R. I.	1330	225.4	50
WCRD—Chicago, Ill. (WFKB & WPCC)	1340	223.7	500
WCSH—Portland, Me.	830	361.2	500
WCSO—Springfield, Ohio	1170	256.3	500
WCWK—Fort Wayne, Ind. (WOWO.	1310	228.9	500
WCWS—Bridgeport, Conn. (Portable)	1490	201.6	100
WDAD—Nashville, Tenn.	1330	225.4	500
WDAE—Tampa, Fla.	1120	267.7	500
WDAF—Kansas City, Mo.	810	370.2	1000
WDAG—Amarillo, Texas	1140	263.0	250
WDAH—El Paso, Texas	1280	234.2	100
WDAY—Fargo, N. Dak.	830	361.2	250
WDBI—Roanoke, Va.	1300	230.6	250
WDBK—Cleveland, Ohio	1320	227.1	250
WDBO—Winter Park Fla.....	1250	239.9	500
WDBZ—Kingston, N. Y. (WOKO)..	1390	215.7	50
WDEL—Wilmington, Del.	1130	265.3	100
WDGY—Minneapolis, Minn. (WRHM)	1150	260.7	500
WDOD—Chattanooga, Tenn.	1180	254.1	500
WDRC—New Haven, Conn. WCAC)	1090	275.1	250
WDWF—Cranston, R. I. (WBSO)..	780	384.4	500
WLSI—			
WDWM—Newark, N. J. (WHAP, WMSG)	1270	236.1	500
WDZ—Tuscola, Ill. (Daytime only).	1080	277.6	100
WEAF—New York, N. Y.	610	491.5	5000
WEAI—Ithaca, N. Y. (WOAX).....	620	483.6	250
WEAM—North Plainfield, N. J....	1250	239.9	250
WEAN—Providence, R. I. (WNAC).	1130	265.3	500
WEAO—Columbus, O. (WAIU).....	1060	282.8	750
WEAR—Cleveland, O. (WTAM).....	750	399.8	1000
WEBC—Superior, Wisc.	1240	241.8	250
WEBE—Cambridge, Ohio	1210	247.8	10
WEBH—Chicago, Ill. (WJJD).....	820	365.6	2000
WEBJ—New. York, N. Y. ,WMCA).	810	370.2	500
WEBQ—Harrisburg, Ill.	1340	223.7	15
WEBR—Buffalo, N. Y.	1240	241.8	200
WEBW—Beloit, Wisc.	1160	258.5	500
WEDC—Chicago, Ill. WGES).....	1240	241.8	500
WEEI—Boston, Mass.	670	447.5	500
WEHS—Evanston, Ill.	1390	215.7	100
WEMC—Berrien Springs, Mich.....	1260	238.0	1000
WENR—Chicago, Ill. (WBCN).....	1040	283.3	500
WEPS—Gloucester, Mass.	1010	296.9	100
WEW—St. Louis, Mo.	850	352.7	1000
WFAA—Dallas, Texas (WBAP).....	600	475.9	500
WFAM—St. Cloud, Minn.....	1190	252	10
WFBC—Knoxville, Tenn.	1280	234.2	50
WFBE—Cincinnati, Ohio	1220	245.8	250
WFBG—Altoona, Pa.	1070	280.2	100
WFBJ—Collegeville, Minn.	1100	272.6	100
WFBL—Syracuse, N. Y.	1160	282.8	750
WFBM—Indianapolis, Ind.	1330	225.4	250
WFBR—Baltimore, Md.	1330	225.4	100
WFBZ—Galesburg, Ill. (WRAM).....	1210	247.8	50
WFCI—Pawtucket, R. I.	940	319.0	50
WFDF—Flint, Mich.	860	348.6	100
WFHH—Clearwater, Fla.	820	365.6	500
WFI—Philadelphia, Pa. (WLIT).....	740	405.2	500
WFIW—Hopkinsville, Ky.	1220	245.8	500
WFKB—Chicago, Ill. (WCRW & WPCC)	1340	223.7	500
WFKD—Philadelphia, Pa.	1460	205.4	10
WFLA—Boca Raton, Fla.....	1410	212.6	1000
WFRL—Brooklyn, N. Y. (WKBQ, WKBO, WBNY)	1370	218.8	500
WGAL—Lancaster, Pa. (WKJC).....	1190	252.0	15
WGBG—Freeport, N. Y. (WAAT, WSOM)	1220	245.8	400
WGBC—Memphis, Tenn.	1080	277.6	15
WGBF—Evansville, Ind.	1270	236.1	250
WGBI—Scranton, Pa. WQAN).....	1300	230.6	100
WGBS—Astoria, L. I., N. Y. (WAAM)	860	348.6	500
WGBX—Orono, Me. (WABI)	770	389.4	500
WGCP—Newark, N. J. (WNJ).....	1070	280.2	500
WGES—Chicago, Ill. (WEDC).....	1240	241.8	500
WGHP—Mt. Clemens, Mich.....	1230	243.8	1,500
WGL—New York, N. Y. (1,000 watts 7 a.m. to 1 p.m.; WBBR)	1170	256.3	500
WGM—Jeannette, Pa.	1440	208.2	50
WGMU—New York, N. Y., Portable (WRMU)	1490	201.6	100
WGN—Chicago, Ill. WLIB).....	980	305.9	15000
WGR—Buffalo. N. Y.	990	302.8	750
WGST—Atlanta, Ga. (WMAZ.....	1110	270.1	500
WGWB—Milwaukee, Wisc.	1370	218.8	500
WGY—Schenectady, N. Y. (WHAZ).	790	378.5	30000
WHA—Madison, Wisc. (WLBL).....	940	319.0	750
WHAD—Milwaukee, Wis. (WTMJ).	1020	293.9	500
WHAM—Rochester, N. Y.	1080	277.6	500
WHAP—New York, N. Y. (WDWM, WMSG)	1270	236.1	1000
WHAR—Atlantic City, N. J. (WPG)	1100	272.6	750
WHAS—Louisville, Ky.	650	461.3	500
WHAZ—Troy, N. Y. (WGY).....	790	379.5	500
WHB—Kansas City, Mo. (WOQ)....	890	336.9	500
WHBA—Oil City. Pa.	1150	260.7	10
WHBC—Canton, Ohio	1270	236.1	10
WHBD—Bellefontaine, Ohio	1350	222.1	100
WHBF—Rock Island, Ill.	1350	222.1	100
WHBL—Chicago, Ill. (Portable-Carrell)	1470	204.0	100
WHBM—Chicago, Ill. Portable-Carrell)	1490	201.6	100
WHBN—St. Petersburg, Fla.....	1010	296.9	10
WHBP—Johnstown, Pa.	1310	228.9	250
WHBQ—Memphis, Tenn.	1290	232.4	100
WHBU—Anderson, Ind.	1360	220.4	15
WHBW—Philadelphia, Pa. (WIAD).	1360	220.4	50
WHBY—West De Pere, Wisc.....	1200	249.9	50
WHDI—Minneapolis. Minn (WLB)..	1220	245.8	500
WHEC—Rochester, N. Y. (WABO)..	1290	232.4	100
WHFC—Chicago, Ill.	1390	215.7	200
WHK—Cleveland, Ohio (WJAY).....	1130	265.4	500
WHN—New York, N. Y. (WQAO).	760	394.5	500
WHO—Des Moines, Iowa	560	535.4	5000
WHPP—New York, N. Y.	1450	206.8	10
WHT—Chicago. Ill. (WIBO).....	720	416.4	5000
WIAD—Philadelphia, Pa. (WHBW).	1360	220.4	50
WIAS—Burlington, Iowa	630	475.9	100
WIBA—Madison, Wisc.	12050	239.9	100
WIBG—Elkins Park, Pa. Sunday, day time only)	680	440.9	50
WIBI—Flushing, N. Y. (WBKN, WWRL, WBMS)	1120	267.7	100
WIBJ—Chicago, Ill. (Portable-Carrell)	1490	201.6	100
WIBM—Chicago, Ill. (Portable-Carrell)	1490	201.6	100
WIBO—Chicago, Ill. (WHT)	720	416.4	500
WIBR—Steubenville, Ohio.	1200	249.9	50
WIBS—Elizabeth, N. J. (WTRC, WLBX)	1470	202.6	150
WIBU—Polynette, Wisc.....	1380	217.3	20
WIBW—Chicago, Ill. (Portable-Carrell)	1470	204.0	100
WIBX—Utica, N. Y.	1260	238.0	100
WIBZ—Montgomery, Ala.	1300	230.6	15
WICC—Bridgeport, Conn.	1400	214.2	250
WIL—St. Louis, Mo.	1160	258.5	250
WIOD—Miami Beach, Fla.....	1210	247.8	1000
WIP—Philadelphia, Pa. (WOO).....	590	508.2	500
WJAD—Waco, Texas	670	447.5	500
WJAG—Norfolk, Nebr.	1350	222.1	250
WJAK—Kokomo. Ind.	1280	234.2	50
WJAM—Cedar Rapids, Ia. (KWCR)	780	384.4	100
WJAR—Providence, R. I.	620	483.6	500
WJAS—Pittsburgh, Pa. (KQV).....	1110	270.1	500
WJAX—Jacksonville, Fla.	890	336.9	1000
WJAY—Cleveland, Ohio (WHK)....	1130	265.3	500
WJAZ—Mt. Prospect, Ill. (WMBI)	1140	263.0	5000
WJBA—Joliet, Ill.	930	322.4	50
WJBB—St. Petersburg, Fla.	870	344.6	250
WJBC—LaSalle, Ill.	1320	227.1	100
WJBI—Red Bank, N. J.	1120	267.7	250
WJBK—Ypsilanti, Mich.	1360	220.4	15
WJBL—Decatur, Ill.	1410	212.6	250
WJBO—New Orelans, La.	1140	283.3	100
WJBR—Omro, Wisc.	1320	227.1	100
WJBT—Chicago, Ill. (WBBM, WAAF)	770	389.4	100
WJBU—Lewisburg, Pa.	1400	214.2	100
WJBW—New Orleans, La.	1250	238.0	30
WJBY—Gadsden, Ala.	1280	234.2	50
WJBZ—Chicago Heights, Ill.	1440	208.2	100
WJJD—Mooseheart, Ill. (WEBH)..	820	365.6	1000
WJPW—Ashtabula, Ohio	1440	208.2	30
WJR-WCX—Pontiac, Mich.	680	440.9	5000
WJZ—Bound Brook, N. J.	660	454.3	30000
WKAF—Changed to WTMJ Milwaukee, Wis.	880	340.7	500
WKAR—East Lansing, Mich. (WREO)	1300	230.6	1000
WKAV—Laconia, N. H.	1340	223.7	50
WKBB—Joliet, Ill. (WCLA)	1390	215.7	150
WKBC—Birmingham, Ala.	1370	218.8	10
WKBE—Webster, Mass.	1310	228.9	100
WKBF—Indianapolis, Ind.	1190	252.0	250
WKBG—Chicago, Ill. (Portable) ...	1490	201.6	100
WKBH—La Crosse, Wis.	1360	220.4	500
WKBI—Chicago, Ill.	930	322.4	50
WKBL—Monroe, Mich.	1460	205.4	15
WKBM—Newburgh, N. Y.	1440	208.2	100
WKBN—Youngstown, O. (WMBW)	1400	214.2	50
WKBO—Jersey City, N. J. (WKBQ WBNY WFRL)	1370	218.8	500
WKBP—Battle Creek, Mich.	1410	212.6	50
WKBQ—New York, N. Y. (WKBO WBNY WFRL)	1370	218.8	500
WKBS—Galesburg, Ill. (WLBO)...	1380	217.3	100
WKBT—New Orleans, La.	1190	252 0	50
WKBU—New Castle, Pa. (Portable)	1470	204.0	50
WKBV—Brookville, Ind.	1380	217.3	100
WKBW—Buffalo, N. Y.	1380	217.3	500
WKBZ—Ludington, Mich.	1500	199.9	15
WKDR—Kenosha, Wis.	930	322.4	15
WKJC—Lancaster, Pa. WGAL)...	1190	252.0	50
WKRC—Cincinnati, Ohio	900	333.1	500
WKY—Oklahoma City, Okla.	1040	283.3	150
WLAP—Louisville, Ky.	1120	267.7	30
WLB—Minneapolis, Minn. (WHDI)	1220	245.8	500
WLBC—Muncie, Indiana	1430	209.7	50
WLBF—Kansas City, Mo.	1430	209.7	50
WLBG—Petersburg, Va.	1400	214.2	100
WLBH—Farmingdale, N. Y. (Portable)	1490	201.6	30
WLBI—East Wenona, Ill.	1260	238.0	250
WLBL—Stevens Point, Wis. (WHA)	940	319.0	1000
WLBM—Boston, Mass.	1420	211.1	50
WLBN—Chicago. Ill. (Portable).....	1470	204.0	50
WLBO—Galesburg, Ill. (WKBS).....	1380	217.3	100
WLBP—Ashland, Ohio	1480	202 6	15
WLBT—Crown Point, Ind.	930	322.4	50
WLBR—Belvidere, Ill.	930	322.4	15
WLBT—Crown Point, Ind.....	930	322.4	50
WLBV—Mansfield, Ohio	1450	206.8	50
WLBW—Oil City, Pa.	1020	267.7	500
WLBX—Long Island City, N. Y. (WIBS, WMBQ, WTRC and WLBX)	1470	204.0	250
WLBY—Iron Mountain, Mich.	1430	209.7	50
WLBZ—Dover-Foxcroft, Me.	1440	208.2	250
WLCI—Ithaca, N. Y.	1210	247.8	50
WLIB—Chicago, Ill. (WGN)	980	305.9	500
WLIT—Philadelphia, Pa. (WFI)	740	405.2	500
WLS—Chicago, Ill. (WCBD)	870	384.4	5000
WLTS—Chicago, Ill. (WCFL).....	670	483.6	100
WLW—Cincinnati, Ohio	700	428.3	5000
WLWL—New York, N. Y. (WODA)	1020	293.9	1000
WMAC—Cazenovia, N. Y. (WSYR)	1330	225.4	500
WMAF—South Dartsmouth, Mass...	700	428.3	500
WMAK—Lockport, N. Y.	550	545.1	750
WMAL—Washington, D. C.	1310	228 9	100
WMAN—Columbus, Ohio	1280	234 2	50
WMAQ—Chicago, Ill. (WQJ).....	670	447.5	1000
WMAY—St. Louis, Mo.	1210	247.8	100
WMAZ—Macon, Ga. WGST)	1110	270.1	500
WMBA—Newport, R. I. (Portable)..	1470	204.0	100
WMBB—Chicago, Ill. (WOK).....	1190	252 0	500
WMBC—Detroit, Mich. (WDMH)....	1420	211.1	100
WMBD—Peoria Heights, Ill.....	1460	205.4	250
WMBE—St. Paul, Minn.	1440	208.2	10
WMBF—Miami Beach. Fla.....	780	384.4	500
WMBG—Richmond, Va.	1450	206.8	15
WMBH—Chicago, Ill. (Portable-E. D. Aber.)	1470	204.0	100
WMBI—Chicago, Ill. (WJAZ).....	1140	263.0	500
WMBI—Monesson, Pa.	1290	232.4	50
WMBL—Lakeland. Fla.	1310	228.9	50
WMBM—Memphis, Tenn.	1430	209.7	10
WMBO—Auburn, N. Y.	1360	220.4	100
WMBQ—Brooklyn, N. Y. (WTRC, WIBS, WLBX)	1470	204.0	100
WMBR—Tampa, Fla.	1190	252.0	100
WMBS—Harrisburg, Pa.	1280	234.2	250
WMPU—Pittsburgh, Pa.	1380	217.3	50
WMBW—Youngstown, O. (WKBN)	1400	214 2	50
WMRY—Bloomington, Ill. (WNBL).	1500	199 9	15
WMC—Memphis, Tenn.	580	516.9	500
WMCA—New York, N. Y. WEB)..	810	370.2	500
WMPC—Lapeer, Mich.	1280	234.2	30
WMRJ—Jamaica, N. Y. (WTRL, WHPP)	1450	206.8	10
WSMG—New York, N. Y. (WDWM, WHAP)	1270	236.1	500
WNAB—Boston, Mass. (Changed to WASN).			
WNAC—Boston, Mass. (WEAN).....	1130	265.3	500
WNAD—Norman, Okla.	1250	239.9	500
WNAL—Omaha, Nebr. (KOCH, KFOX)	1160	258.5	250
WNAT—Philadelphia, Pa. (WRAX).	1040	263.0	100
WNAX—Yankton, S. D.	990	302.8	250

Station	Kc	M	Watts
WNBA—Forest Park, Ill.	1440	208.2	200
WNBF—Endicott, N. Y.	1450	206.8	50
WNBH—New Bedford, Mass.	1150	260.7	250
WNBJ—Knoxville, Tenn.	1450	206.8	50
WNBL—Bloomington, Ill. (WMBY).	1500	199.9	15
WNBO—Washington, Pa.	1420	211.1	15
WNBQ—Rochester, N. Y.	1480	202.6	15
WNBR—Memphis, Tenn.	1310	228.9	20
WNJ—Newark, N. J. (WGCP)	1070	256.3	500
WNOX—Knoxville, Tenn.	1130	265.3	1000
WNRC—Greensboro, N. C.	1340	223.7	250
WNYC—New York, N. Y.	560	535.4	500
WOAI—San Antonio, Texas	990	302.8	2000
WOAN—Lawrenceburg, Tenn.	1050	260.7	250
WOAX—Trenton, N. J. (WEAM)	1250	239.9	500
WOC—Davenport, Iowa	850	352.7	5000
WOCL—Jamestown, N. Y.	1340	223.7	25
WODA—Paterson, N. J. (WLWL)	1020	293.9	1000
WOI—Ames, Iowa; 5000, daytime, 6 to 6 (WSUI)	1130	265.3	2500
WOK—Chicago, Ill. (WMBB)	1190	252.0	5000
WOKO—Peekskill, N. Y.	1390	215.7	250
WOKT—Rochester, N. Y.	1430	209.7	500
WOMT—Manitowoc, Wis.	1350	221.1	50
WOO—Philadelphia, Pa. (WIP)	590	508.2	500
WOOD—Furnwood, Mich.	1150	260.7	500
WOQ—Kansas City, Mo. (WHB)	890	336.9	250
WOR—Newark, N. J.	710	422.3	500
WORD—Batavia, Ill. (WTAS)	1090	275.1	5000
WOS—Jefferson City, Mo.	760	394.5	500
WOW—Omaha, Nebr.	590	508.2	1000
WOWO—Ft. Wayne, Ind. (WCWK)	1310	228.9	1000
WPAB—Norfolk, Va.	1430	209.7	100
WPCC—Chicago, Ill., (WFKB, WCRW)	1340	223.7	500
WPCH—New York, N. Y. (WRNY).	970	309.1	500
WPDQ—Buffalo, N. Y. (WSVS)	1460	205.4	50
WPEP—Waukegan, Ill.	1390	215.7	250
WPG—Atlantic City, N. J. (WHAR)	1100	272.6	2500
WPRC—Harrisburg, Pa.	1430	209.7	100
WPSC—State College, Pa. (WBAK)	1000	299.8	500
WPSW—Philadelphia, Pa.	1480	202.6	50
WQAA—Parkersburg, Pa.	1390	215.7	500
WQAE—Springfield, Vt.	1200	249.9	50
WQAM—Miami, Fla.	930	322.4	750
WQAN—Scranton, Pa. (WGBI)	1300	230.6	100
WQAO-WPAP—Cliffside, N. J. (WHN)	760	394.5	500
WQJ—Chicago, Ill. (WMAQ)	670	447.5	500
WRAF—La Porte, Ind.	1440	208.2	100
WRAH—Providence, R. I.	1500	199.9	250
WRAK—Escabana, Mich.	1060	282.8	50
WRAM—Galesburg, Ill. (WFBZ)	1210	247.8	50
WRAV—Yellow Springs, Ohio	880	340.7	100
WRAW—Reading, Pa.	1260	238.0	50
WRAX—Philadelphia, Pa. (WNAT)	1040	283.3	250
WRBC—Valparaiso, Ind.	1260	238.0	250
WRC—Washington, D. C.	640	468.5	500
WRCO—Raleigh, N. C.	1380	217.3	250
WREC—Memphis, Tenn.	1180	254.1	50
WREN—Lawrence, Kans. (KFKU)	1180	254.1	750
WREO—Lansing, Mich. (WKAR)	1300	230.6	500
WRES—Quincy, Mass.	1380	217.3	50
WRHF—Washington, D. C. (Daytime only)	940	319.0	50
WRHM—Minneapolis, Minn. (WDGY)	1150	260.7	1000
WRM—Urbana, Ill.; 1000 watts before 6 p.m. (WBAA)	1100	272.6	500
WRMU—New York, N. Y. (Portable)	1490	201.6	100
WRNY—New York, N. Y. (WPCH)	970	309.1	500
WRPI—Terre Haute, Ind.	1440	208.2	100
WRR—Dallas, Texas	850	352.7	500
WRRS—Racine, Wis.	930	322.4	50
WRSC—Chelsea, Mass.	1460	205.4	15
WRST—Bay Shore, N. Y. (WCDA. WBRS, WCGU)	1420	211.1	250
WRVA—Richmond Va.	1420	211.1	250
WSAI—Cincinnati, Ohio	830	361.2	5000
WSAJ—Grove City, Pa.			250
WSAN—Allentown, Pa. (WCBA)	1350	222.1	
WSAR—Fall River, Mass.	1190	252.0	100
WSAX—Chicago, Ill.	1470	204.0	100
WSAZ—Huntington, W. Va.	1240	241.8	100
WSB—Atlanta, Ga.	630	475.9	1000
WSBC—Chicago, Ill. (WWAE)	1290	232.4	500
WSBT—South Bend, Ind.	1350	222.1	250
WSDA—New York, N. Y. (WARS, WBBC)	1320	227.1	250
WSEA—Virginia Beach, Va.	1370	218.8	250
WSIX—Springfield, Tenn.	1410	212.6	150
WSKC—Bay City, Mich.	610	491.5	250
WSM—Nashville, Tenn.	940	319.0	2000
WSMB—New Orleans, La. (WAAT)	930	322.4	500
WSMK—Dayton, Ohio	1010	296.9	500
WSOE—Milwaukee, Wis.	1100	270.1	500
WSOM—New York, N. Y. (WGBB,			
WSRO—Hamilton, Ohio	780	384.4	100
WSSH—Boston, Mass. WASN)	1300	230.6	100
WSUI—Iowa City, Iowa (WOI)	1130	265.3	500
WSVS—Buffalo, N. Y. (WPDQ)	1460	205.4	50
WSYR—Syracuse, N. Y. (WMAC)	1330	225.4	500
WTAD—Quincy, Ill.	1270	236.1	250
WTAG—Worcester, Mass.	1040	283.3	500
WTAL—Toledo, Ohio (WABR)	1070	280.2	100
WTAM—Cleveland, Ohio (WEAR)	750	399.8	3500
WTAQ—Eau Claire, Wisc.	1180	254.1	500
WTAR—Norfolk, Va.	1090	275.1	500
WTAS—Batavia, Ill. (WORD)	1090	275.1	3500
WTAW—College Station, Texas	970	309.1	500
WTAX—Streator, Ill.	930	322.4	50
WTAZ—Lambertville, N. J.	1360	220.4	15
WTHO—Detroit, Mich. (WAFD)	1370	218.8	250
WTIC—Hartford, Conn.	650	461.3	500
WTMJ—Milwaukee, Wisc. (WHAD)	1020	293.9	500
WTRC—Brooklyn, N. Y. (WIBS, WMBQ, WLBX)	1470	204	50
WTRL—Midland Park, N. J. WJBI, WIBI, WBMS)	1120	267.7	100
WWAT—Chicago, Ill. (WSBC)	1290	232.4	500
WWJ—Detroit, Mich.	800	374.8	1000
WWL—New Orleans, La.	1090	275.1	100
WWNC—Asheville, N. C.	1010	296.9	1000
WWRL—Woodside, N. Y. (WBKN, WJBI, WIBI, WBMS)	1120	267.7	100
WWVA—Wheeling, W. Va.	770	389.4	100
KDKA—East Pittsburgh, Pa.	950	315.6	30000
KDLR—Devils Lake, N. D.	1300	230.6	15
KDYL—Salt Lake City, Utah	1160	258.5	100
KELW—Burbank, Calif. (KPPC)	1310	228.9	250
KEX—Portland, Ore.	1250	239.9	2500
KFAB—Lincoln, Nebr. (5000 before 7 p. m.)	970	309.1	2000
KFAD—Phoenix, Ariz.	1100	272.6	500
KFAU—Boise, Idaho (4,000 watts daytime)	1050	285.5	2000
KFBB—Havre, Mont.	1090	275.1	50
KFBC—San Diego, Calif.	1210	247.8	100
KFBK—Sacramento, Calif.	560	535.4	100
KFBL—Everett, Wash.	1340	223.7	50
KFBS—Trinidad, Colo.	1260	238.0	15
KFBU—Laramie, Wyo.	700	428.3	500
KFCB—Phoenix, Ariz.	1230	243.8	125
KFCR—Santa Barbara, Calif.	1420	211.1	50
KFDM—Beaumont, Texas	800	374.8	500
KFDX—Shreveport, La.	1270	236.1	250
KFDY—Brookings, S. Dak.	760	394.5	500
KFDZ—Minneapolis, Minn.	1300	215.7	10
KFEC—Portland, Ore. (KFIF)	1400	214.2	50
KFEL—Denver, Colo.	1210	247.8	250
KFEQ—St. Joseph, Mo.	1300	230.6	1000
KFEY—Kellogg, Idaho	1290	232.4	10
KFEQ—St. Joseph, Mo.	1300	230.6	1000
KFH—Wichita, Kansas	1220	245.8	500
KFHA—Gunnison, Colo.	1180	254.1	50
KFHL—Oskaloosa, Iowa.	1410	212.6	10
KFI—Los Angeles, Calif.	640	468.5	5000
KFIF—Portland, Ore. (KFEC)	1400	214.2	50
KFIO—Spokane, Wash. (KEPY)	1220	245.8	100
KFIQ—Yakima, Wash.	1440	208.2	100
KFIU—Juneau, Alaska	1330	225.4	10
KFIZ—Fond du Lac, Wisc.	1120	267.7	100
KFJB—Marshalltown, Iowa	1210	247.8	15
KFJF—Oklahoma, Okla.	1200	249.9	750
KFJI—Astoria, Ore.	1200	249.9	15
KFJM—Grand Forks, N. Dak.	900	333.1	100
KFJR—Portland, Ore. (KTBR)	1060	282.8	100
KFJY—Ft. Dodge, Iowa	1250	239.9	100
KFJZ—Fort Worth, Texas	1200	249.9	50
KFKA—Greeley, Colo.	750	399.8	200
KFKB—Milford, Kansas	1240	241.8	1000
KFKU—Lawrence, Kansas (WREN)	1180	254.1	500
KFKX—Hastings, Nebr. (KYW)	570	526.0	2500
KFKZ—Kirksville, Mo.	1330	225.4	15
KFLR—Albuquerque, N. M.	720	416.4	100
KFLU—San Benito, Texas	1270	236.1	15
KFLV—Rockford, Ill.	1120	267.7	100
KFLX—Galveston, Texas	1110	270.1	100
KFMR—Sioux City, Iowa	680	440.9	100
KFMX—Northfield, Minn. (WCAL)	1270	236.1	500
KFNF—Shenandoah, Iowa (KMA)	1110	270.1	1000
KFOA—Seattle, Wash.	670	447.5	1000
KFON—Long Beach, Calif.	1240	241.8	500
KFOR—Lincoln, Nebr.	1380	217.3	100
KFOX—Omaha, Nebraska (KOCH, WNAL)	1160	258.5	100
KFOY—St. Paul, Minn.	1050	285.5	100
KFPL—Dublin, Texas	1090	275.1	15
KFPM—Greenville, Texas	1300	230.6	15
KFPR—Los Angeles, Calif. (KFQZ)	1290	232.4	250
KFPW—Carterville, Mo.	1140	263.0	50
KFPY—Spokane, Wash. (KFIO)	1220	245.8	250
KFQA—St. Louis, Mo.	930	322.4	50
KFQB—Ft. Worth, Texas	1150	260.7	1000
KFQD—Anchorage, Alaska	870	344.6	100
KFQU—Holy City, Calif.	1200	249.9	100
KFQW—Seattle, Wash.	1380	217.3	100
KFQZ—Hollywood, Calif. (KFPR)	1290	232.4	100
KFRC—San Francisco, Calif.	660	454.3	50
KFRU—Columbia, Mo.	1200	249.9	500
KFSD—San Diego, Calif.	680	440.9	500
KFSG—Los Angeles, Calif.	1090	275.1	500
KFUL—Galveston, Texas	1160	258.5	500
KFUM—Colorado Springs, Colo.	1270	236.1	100
KFUO—St. Louis, Mo. (KSD)	550	545.1	500
KFUP—Denver, Colo.	1320	227.1	100
KFUR—Ogden, Utah	1330	225.4	50
KFUS—Oakland, Calif. (KRE)	1170	256.3	50
KFUT—Salt Lake City, Utah	600	499.7	50
KFVD—Venice, Calif. (KGFJ)	1440	208.2	250
KFVE—St. Louis, Mo.	1280	234.2	1000
KFVG—Independence, Kans.	1330	225.4	50
KFVI—Houston, Texas	1260	238.0	50
KFVR—Denver, Colo.	630	475.9	250
KFVS—Cape Girardeau, Mo.	1340	223.7	50
KFWB—Los Angeles, Calif.	830	361.2	500
KFWC—San Bernardino, Calif.	1350	222.1	100
KFWF—St. Louis, Mo.	1400	214.2	250
KFWH—Eureka, Calif.	1180	254.1	100
KFWI—San Francisco, Calif.	1120	267.7	500
KFWM—Oakland, Calif. (1000 watts day time)	1270	236.1	500
KFWO—Avalon, Calif.	1370	218.8	250
KFWV—Portland, Ore.	1310	228.9	50
KFXB—Los Angeles, Calif.	190	252.0	500
KFXF—Denver, Colo.	1060	282.8	500
KFXH—El Paso, Texas	1240	241.8	100
KFXJ—Near Edgewater, Colo.	1390	215.7	15
KFXR—Oklahoma City, Okla.	1400	214.2	15
KFXY—Flagstaff, Ariz.	1460	205.4	25
KFYF—Oxnard, Calif.	1260	238.0	25
KFYR—Bismarck, N. Dak.	1250	239.9	250
KGA—Spokane, Wash.	1150	260.7	2000
KGAR—Tuscon, Ariz.	1280	234.2	100
KGBS—Seattle, Wash.	1480	202.6	100
KGBU—Ketchikan, Alaska	1310	228.9	500
KGBX—St. Joseph, Mo.	1040	283.3	100
KGBY—Shelby, Nebr.	1480	202.6	50
KGBZ—York, Nebr.	1410	212.6	100
KGCA—Decorah, Iowa	1480	202.6	10
KGCB—Oklahoma City, Okla. (KGFG)	1390	215.7	50
KGCG—Newark, Ark.	1340	223.7	100
KGCH—Wayne, Nebr.	1020	293.9	250
KGCI—San Antonio, Texas (KGDR)	1480	202.6	15
KGCL—Seattle, Wash. KPCB)	1300	230.6	50
KGCN—Concordia, Kansas	1440	208.2	50
KGCR—Brookings, S. Dak.	1440	208.2	15
KGCU—Mandan, N. Dak.	1440	208.2	100
KGCX—Vida, Mont.	1230	243.8	10
KGDA—Dell Rapids, S. Dak. (Day time only)	1280	234.2	15
KGDE—Barrett, Minn.	1460	205.4	50
KGDJ—Cresco, Iowa	1480	202.6	10
KGDM—Stockton, Calif.	1380	217.3	10
KGDP—Pueblo, Colo.	1340	223.7	10
KGDR—San Antonio, Texas (KGCI)	1480	202.6	15
KGDW—Humboldt, Nebr.	1450	206.8	100
KGDX—Shreveport, La.	1410	212.6	250
KGDY—Oldham, S. Dak.	1450	206.8	15
KGEF—Los Angeles, Calif.	1140	263.0	500
KGEH—Eugene, Ore.	1490	201.6	50
KGEK—Yuma, Colo.	1470	204.0	10
KGEN—El Centro, Calif.	1330	225.4	15
KGEO—Grand Island, Nebr.	1460	205.4	100
KGEQ—Minneapolis, Minn.	1480	202.6	50
KGER—Long Beach, Calif. (KRLO)	1390	215.7	100
KGES—Central City, Nebr.	1470	204.4	10
KGEU—Lower Lake, Calif.	1320	227.1	50
KGEW—Fort Morgan, Colo.	1370	218.8	10
KGEY—Denver, Colo.	1490	201.6	15
KGEZ—Kalispell, Mont.	1460	205.4	100
KGFB—Iowa City, Iowa	1340	223.7	10
KGFF—Ava, Okla.	1460	205.4	25
KGFG—Oklahoma City, Okla. (KGCB)	1390	215.7	50
KGFH—La Crescenta, Cal. (KMIC)	1340	223.7	100
KGFI—Ft. Stockton, Tex.	1360	220.4	15
KGFJ—Los Angeles, Calif. (KFVD)	1440	208.2	100
KGFK—Hallock, Minn.	1340	223.7	50
KGFL—Trinidad, Colo.	1350	222.1	50
KGFM—Yuba City, Calif.	1420	211.1	15
KGFN—Aneta, N. Dak.	1500	199.9	15
KGFO—Terra Haute, Ind.	1470	204.0	100
KGFP—Mitchell, So. Dak.	1410	212.6	10
KGO—Oakland, Calif.	780	384.6	5000
KGRC—San Antonio, Texas	1360	220.4	50
KGRS—Amarillo, Texas	1230	243.8	150
KGTT—San Francisco, Calif.	1450	206.8	50
KGU—Honolulu, T. H.	1110	270.1	600
KGW—Portland, Ore.	610	491.5	1000
KGY—Lacey, Wash.	1230	243.8	50
KHJ—Los Angeles, Calif.	740	405.2	500
KHQ—Spokane, Wash.	810	370.2	1000
KICK—Anita, Iowa	650	461.3	100
KJBS—San Francisco, Calif.	1360	220.4	50
KJR—Seattle, Wash.	860	348.6	2500
KKP—Seattle, Wash.	1130	265.3	15
KLDS—Independence, Mo.	1260	238.0	1500
KLIT—Portland, Oregon	1450	206.8	10
KLS—Oakland, Calif. (KZM)	1220	245.8	250
KLX—Oakland, Calif.	590	508.2	500
KLZ—Denver, Colo.	1120	267.7	250
KMA—Shenandoah, Iowa (KFNF)	1110	270.1	500
KMED—Medford, Oregon	1120	267.7	50
KMIC—Inglewood, Calif. (KGFH)	1340	223.7	250
KMJ—Fresno, Calif.	820	365.6	50
KMMJ—Clay Center, Nebr.	1310	228.9	500
KMO—Tacoma, Wash.	1180	254.1	250
KMOX—St. Louis, Mo.	1000	299.8	5000
KMTR—Los Angeles, Calif.	570	526.0	500
KNRC—Santa Monica, Calif.	800	374.8	500
KNX—Los Angeles, Calif.	890	336.9	500
KOA—Denver, Colo. (10,000 until 7 p. m.)	920	325.9	5000
KOAC—Corvalis, Ore.	1110	270.1	500
KOB—State College, N. M. (KWSC, KTW)	760	394.5	5000
KOCH—Omaha, Nebr. (WNAL, KFOX)	1160	258.5	250
KOCW—Chickasha, Okla.	1190	252.0	250
KOIL—Council Bluffs, Iowa	1080	277.6	1500
KOIN—Portland, Ore.	940	319.0	1000
KOLO—Durango, Colo.	1500	199.9	5
KOMO—Seattle, Wash.	980	305.9	1000
KOWW—Walla Walla, Wash.	1000	299.8	500
KPCB—Seattle, Wash. (KGCL)	1300	230.6	50
KPJM—Prescott, Ariz.	1400	214.2	15
KPNP—Muscantine, Iowa	1420	211.1	100
KPO—San Francisco, Calif.	710	422.3	1000
KPPC—Pasadena, Calif. (KELW)	1310	228.9	50
KPRC—Houston, Texas	1020	293.9	500
KPSN—Pasadena, Calif.	950	315.6	1000
KQV—Pittsburgh, Pa. WJAS)	1110	270.1	500
KQW—San Jose, Calif.	1010	296.9	500
KRAC—Shreveport, La.	1360	220.4	50
KRE—Berkeley, Calif. (KFUS)	1170	256.3	100
KRLD—Dallas, Texas	1350	222.1	500
KRLO—Los Angeles, Calif. (KGER)	1390	215.7	250
KROX—Seattle, Wash. (KRSC3)	1420	211.2	50
KRSC—Seattle, Wash (KROX)	1420	211.1	50
KSAC—Manhattan, Kans.	900	333.1	500
KSBA—Shreveport, La.	1120	267.7	1000
KSCJ—Sioux City, Ia (KWUC)	1230	243.8	500
KSD—St. Louis, Mo. (KFUC)	550	545.1	500
KSEI—Pocatello, Idaho	900	333.1	250
KSL—Salt Lake City, Utah	990	302.8	1000
KSMR—Santa Maria, Calif.	1100	272.6	100
KSO—Clarinda, Iowa	1320	227.1	500
KSOO—Sioux Falls, S. D.	1430	209.7	250
KTAB—Oakland, Calif.	1070	280.2	500
KTAP—San Antonio, Texas	1310	228.9	10
KTBI— Los Angeles, Calif.	1040	282.3	500
KTBR—Portland, Ore. (KFJR)	1060	282.8	50
KTCL—Seattle, Wash.	1080	277.6	500
KTHS—Hot Springs, Ark.	880	340.7	750
KTNT—Muscatine, Iowa	1170	256.3	3500
KTSA—San Antonio, Tex. (formerly WCAR)	1130	265.3	2000
KTUE—Houston, Tex.	1410	212.6	5
KTW—Seattle, Wash. KWSC, KOB)	760	394.5	1000
KUJ—Seattle, Wash.	1500	19.9	10
KUOA—Fayetteville, Ark.	1010	96.9	500
KUOM—Missoula, Mont.	800	374.8	500
KUSD—Vermillion, S. D.	620	483.6	250
KUT—Austin, Texas	1280	232.4	500
KVI—Tacoma, Wash.	1280	232.4	50
KVOO—Bristow, Okla.	860	348.6	1000
KVOS—Seattle, Wash.	1430	209.7	50
KWBS—Portland, Ore.	1500	199.9	15
KWCR—Cedar Rapids, Ia. (WJAM)	780	384.4	250
KWG—Stockton, Calif.	870	344.6	50
KWKC—Kansas City, Mo.	1350	222.1	100
KWKH—Shreveport, La.	760	394.5	1000
KWLC—Decorah, Iowa	1210	247.8	50
KWSC—Pullman, Wash.	760	394.5	500
KWTC—Santa Ana, Calif.	880	340.7	5
KWUC—LaMars, Iowa (KSCJ)	1230	243.8	1500
KWWG—Brownsville, Texas	1080	277.6	500
KXL—Portland, Ore.	1360	220.4	50
KYA—San Francisco, Calif.	970	309.1	500
KWY—Chicago, Ill. (KFKX)	570	526.0	2500
KZM—Oakland, Calif. (KLS)	1220	245.8	100

Freshman Power Speaker

The Charles Freshman Company have developed, and are now offering for sale a combination high quality amplifier and loudspeaker, housed in a small mahogany table. The combination, called the Freshman "Power Speaker," is designed for use with any type of radio set, having one stage of audio frequency amplification or the equivalent. The amplifier in the Power Speaker takes the place of the second stage of audio frequency in the radio set, thus eliminating the source of 90 per cent. of the distortion. The amplifier requires no batteries. It obtains its power directly from the 110 volt 60 cycle house lighting system. As an amplifier tube the R. C. A. UX 210 is used, as a rectifier the R. C. A. UX 216. Full voltage for proper amplification is supplied the power tube, the result being clear pure reproduction at any volume.

The cone speaker supplied with the Power Speaker is of the diaphragm type, the unit being one capable of properly handling the great volume and fine quality available from the amplifier. The Power Speaker is a complete audio frequency amplifier unit and reproducer, capable of the best in quality reproduction at any volume.

Because of the self-contained feature of the Power Speaker it may be conveniently used with any radio set. Receiving sets which have been condemned as no longer useful because of their distorted reproduction, can be made to equal and surpass the best and latest designs on the market, says the manufacturer, adding:

"This statement may appear extravagant until it is considered that practically the only improvement in radio sets in the last three years has been in mechanical design and the audio frequency amplifier. If an old radio set is still operating the mechanical design must be correct—replace the old audio amplifier with a Freshman Power Speaker and the set is up to date in results.

"Even on sets of latest design some manufacturers, for reasons of cost, have not improved the audio amplifier to the fullest extent. Indeed this is true of most sets, since the voltage required for an amplifier, such as that used in the power speaker, is so great it cannot be economically supplied with batteries."

The mahogany table in which the Power Speaker is housed is of conservative and attractive design. It is intended for use as a separate unit detached from the radio set. The size is correct, however, to permit placing the radio set on top if desired.

Need of Neutralization

(*Concluded from page* 10)

the primary L1 and the secondary. The value is not at all critical in this circuit. The maximum size is around .00075 mfd.

Another method of preventing oscillations depends on the absorbtion of energy in eddy currents. This method is not strictly one of neutralization but a losser method. However, it is possible to adjust the losses so that the oscillation just stops. It is then possible to retain a little advantageous regeneration at the higher frequencies. The loss by this method is greatest where the need of it is greatest. Hence the eddy current method of preventing oscillation yields a fairly even amplification characteristic over the entire scale. There is danger, however, of overdoing the loss so that the circuit will amplify much less at the higher frequencies than at the lower and middle frequencies, but this can be avoided by correct design.

Methods depending on variation of grid bias should be avoided. If the bias is made positive, the plate current will be excessive when the amplification has been reduced to the point of stopping oscillation. If the bias is made negative very large C batteries will be required and it is necessary to operate the tube so far down the characteristic that it is virtually a detector.

Filament current control is sometimes effective in stopping oscillations. The filament current is stopped down to a point where oscillation is impossible. But this method is not to be considered as a practical substitute for one of the neutralizing methods.

The Balsa Wood Speaker

(*Concluded from page* 9)

of Balsa wood (not the ribs), so that they will just fit into the recesses specially cut in the hardwood frame to receive them. A sharp pen-knife or razor blade will cut the Balsa wood nicely. Also trim the side edges of these strips, so that when the strips are finally glued to the frame, there will be a space of about 1/16-inch to 1/8-inch between adjoining strips. When you have fitted the strips, fasten them into the recessed groove in the frame with glue. Glue in the end strips first. Work with the long side or length toward you, so that the ends are at left and right.

After the glue has set for fifteen or twenty minutes under suitable weight, turn the frame over so that the Balsa strips in the frame can rest flush on top of a table or desk. It is well to place a sheet of paper underneath so that excess glue will not stick to the table top.

Fasten Ribs Upright

Now you are ready to glue the ribs to the Balsa wood strips. First find the center of the frame by drawing diagonal pencil lines lightly from corner to corner. Now draw two lines, centered on the width and the length, each line through the point where the diagonals meet, which is at the center of the frame. Hence these two lines are at right angles. Take one of the ribs and cut off the ends so that when glued later at right angles to the length, that rib will extend about one inch from the long sides of the frame as a cross rib. Notice that this is one rib, whereas the corner-to-corner ribbing will be made up of two pieces in each instance, due to the presence of the cross rib. Now cut the corner-to-corner ribs so that they will extend to within two inches of the corners. Then cut the lengthwise ribs so that they will come to within two inches of the left and right sides of the frame.

Spread a sizing of glue along the lines you have just drawn and also put glue on the edge of the ribs. These ribs will be glued in on edge. The sizing is on the 3/32-inch edge. In other words, the ribs are put on upright, not flat. When the sizing is dry, spread another layer of glue on the cross rib line and its rib and glue the rib in. Cut the three other ribs in half and glue them in. This accounts for the two-piece ribbing previously referred to, and also for the total of seven under previous classification (b). Be sure all ribs come together at the center like the spokes of a wheel which all join in the hub. In making this glue job, be sure that all parts are thoroughly glued, for there is likely to be a rattle on the high-pitched tones if they are not tightly glued. There is an extra rib in the kit in case one is broken.

Take the square, which may be either hardwood or Balsa wood. Bore a 3/16-inch hole so that the screw shank of the bushing will pass through. Cut out enough around this hole on one side to countersink the little nut so that when you glue the square to the ribs the square will lay flush on them. The nut must be less than flush with this square. After fastening the bushing in the square and turning the bushing tap loosely on the screw, glue the square on the ribs at the center where they all meet. Be sure that it is glued on firmly at all points and to all ribs.

Test Eradicates Rattling

Now center the speaker unit on the hardwood cross piece so that the stylus will fit into the expansion screw of the bushing Cut off the stylus to required length. Then fasten the cross-piece to the hardwood frame. This is done with wood screws. One elevating block goes between cross-piece and the frame at each of the two ends. The stylus must be in the center of the speaker, which will throw the hardwood crossarm off center. Tighten the expansion screw by compression (not screw motion) so that the stylus is gripped firmly in the cup-like device. You can tighten down the nut with extra pressure of the fingers. Do not use a pair of pliers, as you may overdue it, and unseat the square from the ribs When the glue is dry the speaker is ready for testing.

Pluck the Parts

Now take any one rib and pluck it gently. There will be a low-pitched reverberation. Pluck each rib this way, also each of the three wide strips. The object is to be sure that plucking produces no rattle. If you hear a rattle remove the cause, which is always a loose part. This looseness is likely due to poor gluing. Thus, if one of the wide strips produces a rattle when plucked, but nothing else produces this result, you know that the trouble is in that section. Do some more gluing at the weak place.

Remember that the small square must be securely glued to the crossrib and to the other ribs.

In other words, any tendency to rattle can be overcome before the speaker is actually connected to a set.

Never connect the speaker to a receiver until all the gluing is positively dry, as the operation of the speaker will separate wet-glue joints.

Avoid Hollows

Also be very sure there are no hollows along the ribs, due to failure of the glue to stick to the wide strips for the entire length of the ribs.

With everything testing 100 per cent. satisfactory, and with every speck of glue positively dry, connect the speaker cords to the receiver.

When building your Balsa speaker, and you surely must build one, if you want the ultimate in tone quality be certain that your kit is marked Lata Balsa, which is made of scientifically treated and cared for Balsa wood. Such kits may be obtained from any good dealers.

Further information on the aucoustical properties of Lata Balsa wood may be had from Balso Wood Co., Inc., 331 Madison Avenue, New York City, manufacturers of the genuine Lata kit.

The Radio University

I HAVE a five-tube tuned RF receiver, built exactly as outlined on page 14 of the January 9 issue of RADIO WORLD. This set was built about a year ago, and until last month behaved very nicely. The set has become very hard to control. When a station is tuned in, the set starts to squeal terrifically. It is also impossible to get stations at certain settings of the dials, e.g., 50-50-50 or at 65-65-65. At these points, nothing but a combination of scratches and intermittent noises are heard. I tested the batteries and found them to be all right. The antenna and ground were also found to be satisfactory. Please tell me how to recondition this set.—GEORGE SQUIRES, N. Y. City.

Undoubtedly the trouble lies in variable condensers, where several plates are shorted. They touch each other, probably at those points where you cannot receive a station. It is also possible that there may be an open circuit in the condensers, it being complete at some points and open at others. The best way to find out, is with the aid of a small four and one-half volt C battery or a one and one-half volt battery and a pair of phones. One terminal of the phones is connected to a terminal of the battery, leaving you two terminals, which go to the terminals of the unit to be tested. Clicks indicate shorts. Disconnect one lead from the condensers, going to the set, when testing. Also test your rheostats. The arm may be making poor contact with the resistance wires, or the screws may have worked themselves loose, and are causing a make and break circuit.

* * *

IN THE April 9 issue of RADIO WORLD on page 21, there appeared a circuit diagram of a single tube reflex. I built this set, and although the results are good, I have a bit of trouble with the crystals which burn out on me. I would, therefore, like to rebuild this set into a single regenerative tube model, without the reflexing. Please explain how this may be done.—EDGAR WAIL, Providence, R. I.

First break all the leads of the transformer. Take out the small condenser running from the G post to the F post on the transformer and rheostat. Now connect the terminal that formerly went to the G post on the transformer, to the plus A post. Break the lead in series with the G post of the socket. Procure a .00025 mfd. fixed condenser and a 2 megohm grid leak. Shunt the leak across the condenser. Then connect both in series with this broken G lead. Disconnect the end of L4, the primary coil of the radio frequency coil, from the end of the tickler, L3. Connect the end of the tickler lead to a terminal of a single circuit jack or a binding post. Run the other terminal of the jack or the other binding post to the B plus, 45 volt post. The phones are inserted here.

Reception Makes Many Real Critics of Music

Radio has brought about a change in the mind of the public about music.

A few years ago the mention of a musical composition or composer frequently brought a titter of laughter. It was rare to find any except the musically educated who could pronounce the names of such composers as Liszt and Rachmaninoff.

Radio has changed this. Announcers must use extreme care in their pronunciation of the titles of compositions and the names of composers or they are likely to receive call downs from very unexpected quarters.

The name Tannhauser no longer calls for a shifting of the dials. Perhaps the program will include "The Evening Star" from this opera, which is one of the most tuneful and beautiful pieces ever composed—so tuneful in fact that with only a slight change in arrangement and time it became one of the most popular of modern song hits.

Perhaps the public has not yet completely associated the name of the composer and the name of the composition with the number itself, but when the music starts, the listener finds himself whistling or humming the tune of some old classic as if it were one of the latest popular songs.

Of course, radio has not yet educated all of its listeners to the point where they are always able to appreciate the heavier classics, but the radio audience today does thoroughly enjoy the orchestrations of the lighter classics that have lived for generations because of their melody and tunefulness.

A program which is causing more and more comment continuously as it is being discovered by more and more people is that period every other Sunday afternoon between 5:30 and 6:30 (E. D. S. T.). These programs are presented by the Crosley Moscow Art Orchestra on the Red Chain from New York, comprising twenty-two stations. This period is devoted entirely to the lighter classical music of present and bygone days.

Quality Now Rules, Though DX Is Wanted

Of all the recent mechanical and electrical developments perhaps none has undergone so many changes as radio. Two years ago "volume" and "distance" were all the rage, and a set which could not regularly pull in distant programs with a volume sufficient to rattle the windows, was considered useless.

Today the situation is radically different; radio sets, it is true, still pull in distant stations better than ever, and with as great a volume, but the determining factor by which a set is judged is the quality of reproduction.

This change in public taste is a logical change, and indicates more strongly than anything else the transition of radio from the class of a novelty, to the field of recognized legitimate entertainment.

As a result of this demand for quality reproduction, programs from radio stations have improved to a point where, with a good radio set and loudspeaker, the reproduction in quality and volume is equal to the actual efforts of the artists themselves.

Two factors make possible the high quality reproduction; first, improved loudspeakers, and second, improved vacuum tubes. The first improvement, loudspeakers, may be applied to any set, no matter what the design, or how old, but with uncertain results. Unless the radio set delivers quality to the speaker, the results will be unsatisfactory. The second improvement, vacuum tubes, may only be used to advantage in sets especially designed for them, and even here, full advantage is not taken of the improved tubes. To take full advantage of the improvement in speaker and tubes, both must be used together.

Gernsback's Time Chime Is Pinnacle of Accuracy

The "Time Chime," a new instrument that broadcasts exact Western Union time in a wholly automatic fashion went on the air recently for the first time through station WRNY, and proved entirely successful, according to its inventor, Hugo Gernsback, editor of "Radio News" magazine. The advent of the device was announced three months ago, but because of the labor involved in the perfection of the automatic feature, it was not completed until recently.

WRNY has installed the chime because of its desire to furnish the maximum service to the listening public, it was stated. It is the only radio station now giving exact hourly time.

Many technical details had to be overcome in the design of the "Time Chime," the inventor declared after the successful tryout. He explained its operation as follows:

"At the exact stroke of the hour, the Time Chime automatically sounds a beautiful Westminster chime sound. So exact is the time that it cannot vary more than one-half a second.

Greater Exactitude

"Listeners may therefore set their watches more exactly than has been possible heretofore, the only time signals of equal accuracy being those transmitted from Arlington, Va., by the Government station. These time signals, however, are given only twice a day, whereas, the time chime operates every hour."

Several innovations have been made, among them the following: 19 seconds before the Time Chime goes on the air, a red warning light flashes in the studio of WRNY. If no program is on the air, the announcer will say: "You will now hear the Time Chime. The sound which you hear gives the exact Eastern Daylight Saving Time of 9 o'clock"—then immediately the Time Chime sounds. If there is a program going on which runs over the hour, the Time Chime cannot break into it, for the reason that the announcer must press a button, which releases a contact, before the chime can go on the air. It is therefore impossible for the Time Chime to become mixed with the program.

All of the contact arrangements, such as the flashing of the warning light ten seconds before the Time Chime is sounded, and the actual sounding of the Chime, are done by the clock itself. No human hands interfere with or adjust anything.

Correction Problem Solved

One of the most intricate problems that had to be solved was the correcting signal sent out by the Western Union Telegraph Company every hour. The electrical contacts had to be arranged in such a manner that the correcting signal did not interfere with the normal operation of the Time Chime. This problem was finally solved.

The Time Chime uses no batteries at all, it being Mr. Gernsback's idea to have an electro-magnetic pickup, located about ⅛ of an inch away from the gong chime. No microphone is used, but the effects of the sound are translated into electrical vibrations and are at once fed into WRNY's transmitter, without going through microphones of any kind. This is said to be the first time the sound of chimes has been transmitted in this manner. The intensity of the sound can be varied simply by moving the electro-magnetic pickup nearer to or further away from the Chime. The clapper that hits the gong is nothing but a relay, to the armature of which a clapper is attached; the head of the latter is made of hard rubber. This strikes the chime spring-gong one stroke only.

All of the technical and research work on the Time Chime was performed in the laboratories of "Radio News" magazine. The actual construction was done by M. J. Cuttler, director of the laboratories.

THE AMPERITE BOOK

"The Amperite Book, a new book containing diagrams of eight of the season's most popular circuits, (including the Diamond of the Air), and other valuable construction data, will be found of real interest to set builders and radio engineers. This book has been published by Radiall Co., 50 Franklin Street, New York, and will be sent to anyone writing for it. Mention RADIO WORLD.

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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 DeLuze 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 2.)

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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Battery Economy

(*Concluded from page 11*)

battery current and helps you in tuning your set.

All that is necessary is to connect a direct current milliammeter in series in the line between the B- set binding post and the B- post on the battery. This is shown in "A" of the figure where M represents the meter. This meter should have a scale range of at least O-15 milliamperes. The largest meter that should be employed is the 0-100 milliammeter. Deflections are not noticeable on a larger meter and the smaller models are to be preferred.

In case the B- is connected directly to the set's A battery, the meter can be cut in series in this line. This is shown in "B" of the figure.

Since the meter is connected in the negative side of the B battery lines, it registers the total B current being consumed.

When tuning in a station it will be noticed that the meter reads greatest when the station is exactly in tune. This means that more current is used when the station is properly tuned in and that a slight amount of detuning will decrease the volume and save current. This may be done on loud signals but there is a more efficient method.

The real value of the meter lies in the adjustment of the filament rheostats. The station should first be tuned in until the meter reads maximum and then the rheostats should be adjusted. It will be found that this adjustments can be so made as to preserve the desired volume and still cut the B battery consumption to a marked degree. It is usually necessary to experiment with a given set until you are familiar with the necessary adjustments. After this is done it is but the work of a few moments to set the rheostats so as to preserve the desired volume and still save considerable B current. Tuning without this method you are virtually a blind man.

Louis Lager Resigns From Bruno Radio

Louis Lager has resigned as secretary and treasurer of the Bruno Radio Corporation, 40 Payntar Avenue, Long Island City, N. Y. His holdings revert to the corporation.

Lewis F. Rodrigues, who has been associated with the corporation for eighteen months, in a general capacity, has been elected secretary and treasurer.

Mr. Rodrigues was formerly connected with G. Amsinck & Co., Inc., and A. P. Villa and Bros., Inc., merchants.

William A. Bruno retains his controlling interest and remains as president and general manager. The same policy of quality that has always been associated with Bruno radio products will be continued, with the addition of several interesting innovations that will be released for the Fall season.

New Streamline Store

The Streamline Radio Store is one of the imposing additions to the downtown radio center in New York City. This store is operated by Louis Lager at 223 Fulton Street, and was formerly the Enter City Radio Co., occupying smaller quarters next door.

"The Streamline store will specialize in selling direct from manufacturer to public, as we manufacture a large list of radio parts," said Mr. Lager, just prior to motoring with his wife and young son to the Chicago radio show. "Also we carry a full line of parts for all circuits and purposes, besides our own line of products.

"We are working on a set using the 3-gang Wireless Specialty Co. condenser and Streamline space-wound coils."

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