RADIO WORLD

REG. U.S. PAT. OFF.

America's First and Only National Radio Weekly

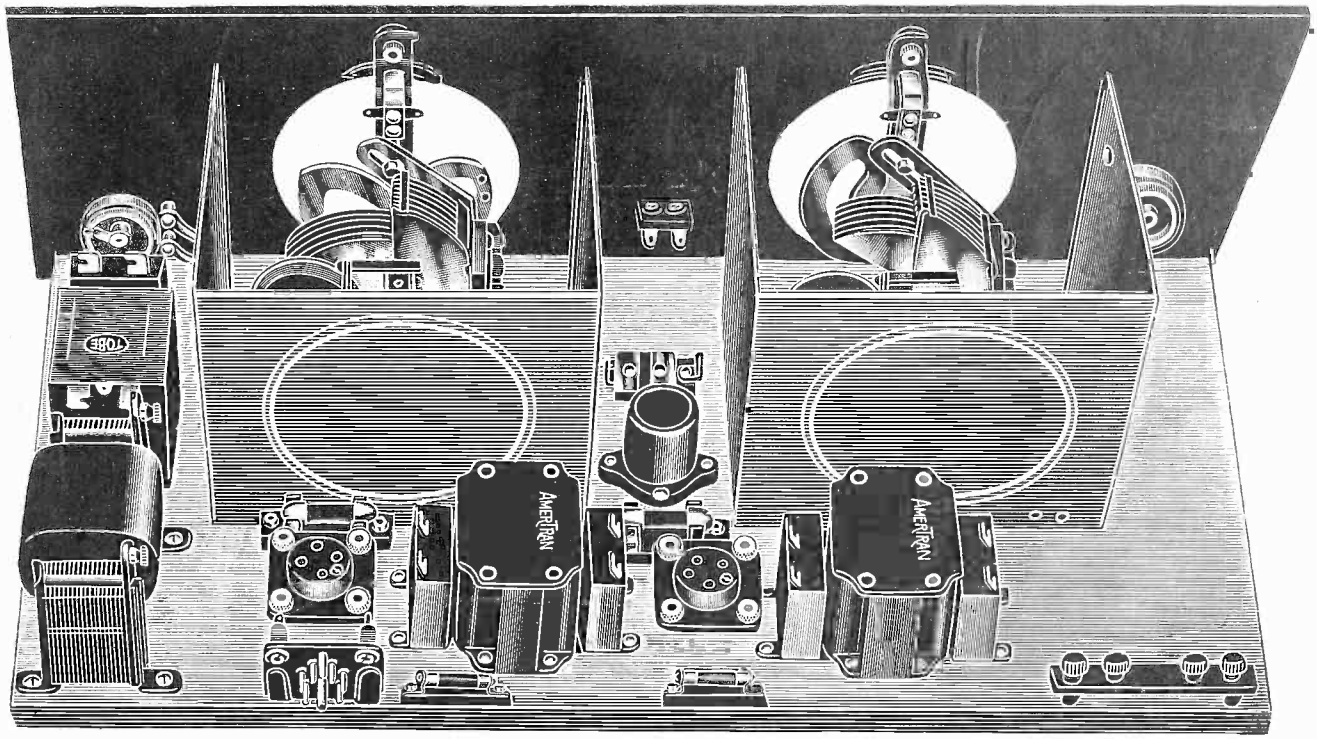
A FINE D C ELIMINATOR

A Set for Salesmen

THE UNIFIED DIAMOND

OCTOBER 1 1927 Vol. XII, No. 2. Whole No. 288 15 CENTS

THE WINNER—ONLY FOUR TUBES



THE NEAT, ELECTRICALLY ACCURATE layout of parts of the Winner, which contributes to the outstanding success of this remarkable receiver. See page 3 for constructional article.

MASTERY OF THE MYSTERY OF THE ATOMS EXPLAINED ON PAGE 8

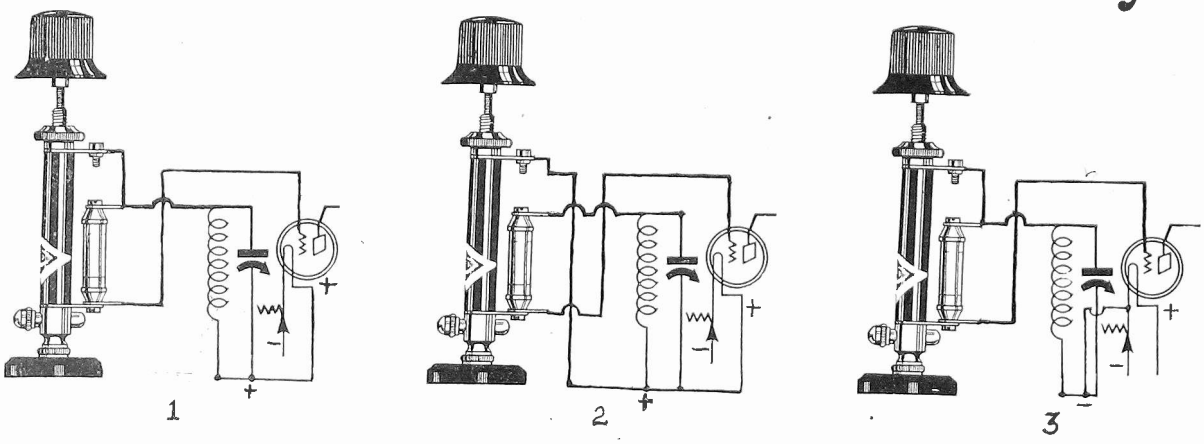
POWER BALANCED in New "Ford Six" Receiver

"KICK" in STROBODYNE Assured by Proper Balance

FRESHMAN'S FEAT in AC Equaphase Fully Revealed

QUALITY QUEST Is Made Much Easier

"YOU WILL When You Know Why"



THERE are a great many things a person will NOT do, because he does not know of a good reason for doing them. And that is a good reason for NOT doing them.

If you do not know why you should have a variable grid leak in your receiver, then you are satisfied to be without one. But if you know why you should have a variable grid leak, then you will be dissatisfied without a Bretwood!

ONE The main reason for using a variable grid leak is to obtain maximum efficiency from your detector tube. By turning to the correct leak setting you establish greatest sensitivity, fullest volume. Exactly what that resistance value should be can not be told in advance. You simply turn the knob of the Bretwood Variable Grid Leak until your ear tells you that best results are being achieved. Then you may leave the leak setting in that position forever afterward.

"My Good Luck"

I read about the Bretwood Variable Grid Leak and decided to buy one. I tore off and filled out the coupon. I enclosed my check with the coupon and you promptly sent me the leak. While I did not immediately become a millionaire after tearing off that coupon, nor had my salary raised $5,000 a year, I nevertheless consider it was my good luck and not yours that the leak was sold to me. Why? Because I can bring in stations with that Bretwood Leak in the set that I can not bring in with any fixed leak of any resistance. My advice to others is: Fill out that coupon!—B. A. Reiners, 127-A Clarkson Ave., Brooklyn, N. Y.

North American Bretwood Co.,
145 West 45th Street, New York City.

Gentlemen: Enclosed find $1.75. Send me at once one De Luxe Model Bretwood Variable Grid Leak on 5-day money-back guarantee. (Or $2.25 for leak with grid condenser attached.)

NAME .....

ADDRESS .....

CITY ..... STATE.....

Dealers: If your jobber can't supply you, write us.

TWO A variable grid leak atones for any discrepancy in the capacity of a fixed grid condenser you may be using, and dispenses with the necessity of a variable grid condenser. Leak and condenser together must equal a certain product. Use a fixed condenser and a variable leak to obtain the result.

THREE When you get a new detector tube you adjust the leak to the new tube's needs, instead of buying a new leak to match the tube.

How To Connect the Leak

In the diagrams the bullet condenser is shown attached to the leak.

No. 1 shows the commonest way of connecting a grid leak, that is, in parallel with the grid condenser, the grid return being made through the secondary coil to positive A. No. 2 shows the method of connection where the grid is to be returned to positive A, although the coil may be connected either to plus or minus. In the diagram it is shown going to plus, but it could be moved over to minus without short circuit. This hook-up is used for gang tuning condensers.

No. 3 is the same as No. 1, except that the return is to negative filament instead of to negative A. The No. 3 method is for the special detector tube, e. g., 200A, 300A, etc.

North American Bretwood Co.

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Four Tubes The Winner Two Controls

By Lewis Winner

Associate, Institute of Radio Engineers

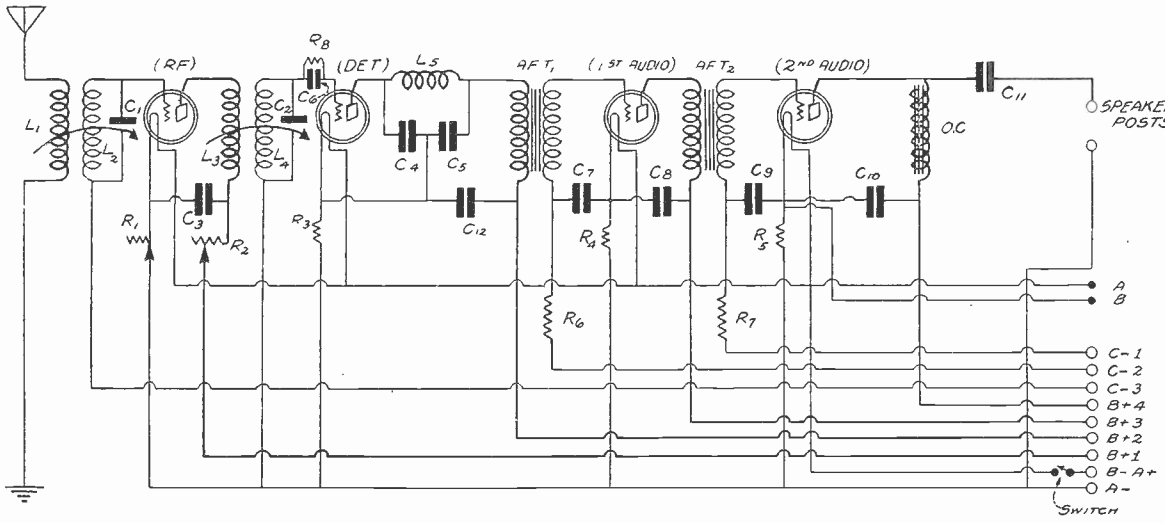


FIG. 1
The circuit diagram of the Winner.

PART I

"GEE, but you look happy," said my chum as he met me coming out of my laboratory.

"Why shouldn't I be?" I replied, "I have just finished constructing a set, which—oh, well, come on up for a moment and judge for yourself."

"It must be pretty good if you admit it." my chum remarked. I wondered if he was sarcastic.

Up we went to the laboratory, and soon he was seeking information on how to build this set. Said he:

"Never yet have I heard such startlingly realistic reproduction. I mean it!"

"Don't you think you're going a bit strong on that statement?" I queried.

"Strong? Say, my tongue isn't adept enough to do justice to that receiver," he replied.

"Thanks a lot, old man," I replied, bubbling over with joy. "It certainly is wonderful to get such comment."

"Well, I must be going," I continued. "If you'll come over the house tonight I'll give you the necessary constructional data."

Before leaving he hurriedly looked over the receiver again and remarked:

"Say, this looks to be a simple job."

"It is," I replied. 'The blue-ribbon parts and sound engineering circuit contribute largely to its success."

And a glance at the circuit diagram, Fig. 1. and the other illustrations will attest to this.

Four tubes are used, one being a radio frequency amplifier, the next a non-regenerative detector and the third and fourth, audio amplifiers. The detector and RF stages are shielded.

The RF Circuit

The tuning system employed in the radio frequency and detector circuits is unique. We know that when the lower wavelength stations are tuned in, a set has a greater tendency to squeal than when tuning in the high waves.

There are several ways of curing this, e.g., decreasing the number of turns on the primary, separating the primary from the secondary to a greater degree, or reducing the filament temperature of the tubes. However, if the number of turns on the primary is decreased, or the primary pushed farther away from the secondary, the signal intensity on the high waves will become quite low. In other words the system either becomes partial to the high or to the low waves. Suppose, though, that we employ a system which will automatically vary this coupling, as the high and low waves are approached. so that at the low waves, there is less induction between the primary and the secondary, while at the higher waves there is a greater. Such is the system used in this receiver.

Waves Equalized

The entire coil is mounted on the rear frame of the variable condenser. As the rotary plates are turned, the primary coil automatically moves upward, away from the secondary. And as the high waves are approached, the coil is dipped further into the secondary winding. The entire operation is automatic, a small cam on the rotary plate shaft actuating the rod to which the coil is attached. With the aid of this wave-equalizing system it is possible to use a larger primary, thus permitting a greater transfer of energy on all frequencies, and a consequent increase in signal intensity.

The volume controls in the radio frequency circuit are a plate voltage adjustor, (0 to 10,000-ohm variable resistance) and a filament temperature adjustor (a 20 ohm rheostat). Either one may be called a vernier control for the other, but both were found advisable for a fine control.

At Least 95 Per Cent Bypassed

Traveling away from the radio frequency end, we go to the output of the detector circuit, where a novel radio frequency filter system is employed. This filter is used to prevent radio frequencies from entering the audio channel and prevent consequent marring of the quality.

By connecting two .00025 condensers each in series across a choke coil, having an inductance of 60 millihenrys such as the general Radio, 95 per cent. of the RF energy or more is bypassed. Current flows through the condenser C4 as well as the radio frequency choke L5. Most of it is bypassed through C4, the rest flowing through choke and the condenser C5. However, there is a voltage drop in the choke coil, which is rejected. Only a minute amount of current is fed

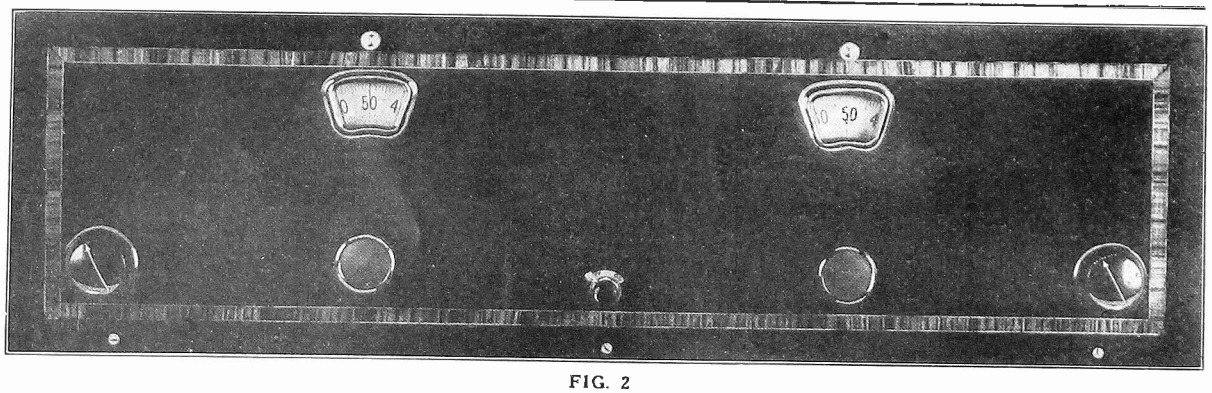


FIG. 2
The front panel makes an attractive appearance.

into the audio circuit, this being done via C5, since it is in this condenser in which the remaining voltage exists. But this is so small, that it is immeasurable.

The Audio Channel

We now enter the audio circuit, where it will be seen that transformer coupling is employed. Advances in speaker design have made it possible to hear frequencies which heretofore were not reproduced. To utilize the full benefit of these speakers it is necessary that an amplifier possessing such characteristics as to permit amplification over the entire tonal range be employed.

Only with transformer coupling is it possible to obtain amplification additional to that afforded by the tube alone, there being a step-up in the transformers. The chief difficulty to date with this type of coupling has been the difficulty to obtain flat amplification. Peaks were sure to arise somewhere along the frequency curve characteristic. To take care of this shortcoming manufacturers designed big transformers with large cores and windings. However due to the distributed capacity of the coils, as well as the capacity coupling between the coils, oscillograph tests showed that some peaks were still present.

A development by the engineers of the American Transformer Company of a special core material as well as an ingeniously arranged coil system solved both the size and peak problem. The booming of the bass drum or the plucking of the heavy bass viol strings, as well as the playing of the piccolo, is reproduced with trueness by these transformers.

Some Essentials

But with the transformers hooked up in indifferent fashion it is not likely one will capitalize their superiority. The bypass condensers, C7, C8, C9 and C10, and the resistors R6 and R7, are essential for success. Tube choice is also important. The first tube may be a standard amplifier, but the second one must be one of the power type. The lower frequencies, not because of their intensity, but because of the increase in energy necessary to reproduce them, have a tendency to overload the last tube. In this case, the grid voltage swings to such a point, that the positive peaks are chopped off, or the negative peaks arrive at such a point, where little plate current flows in the circuit, which of course, results in imperfect reproduction. Therefore the choice of a power tube which will carry the load. For ordinary house reception, a 112 type works very satisfactorily, while for large halls, the 210 should be used.

[*Part II of this article on the construction of the Winner will be published next week, issue of October 8.*]

Foreigner's Desire Finally Appeased

While passing the Grand Central Terminal the other day, one of the busiest spots in the world, the writer was accosted by a swarthy stranger in distress. He seemed to be seeking directions as to some place he wanted to get to and kept reepating the phrase, "Tiene usted un Altoparlante con un buque!" The writer, having a glimmering of Spanish, construed it to mean that he wanted to find his ship and desired to be told its whereabouts in a loud tone of voice. After several minutes of excited gesticulation and verbal fireworks, the writer happened to bethink himself that Blan, the Radio Man, 145 East 42nd Street, was only 200 feet away, so he guided the stranger there, where the linguistic ability of Blan solved the problem. The Spaniard in distress wanted to get a loudspeaker with a ship on it, and Blan demonstrated and sold him a Vitalitone Ship model speaker, to his great satisfaction. The writer was thanked in liquid Spanish, translated by Professor Blan, for his trouble and courtesy.—J. H. C.

NEXT WEEK!

Next week will appear for the benefit of the novice, a half page pictorial layout of the Knickerbocker Four which was described in the Sept. 17 and 24 of RADIO WORLD. Helpful directions for building the set will also be published.

LIST OF PARTS

L1, L2, C1; L3, L4, C2—Two-Hammarlund Auto-couple units, using Hammarlund Midline condensers.
L5—One General Radio 60 millihenry RF choke coils, type 379.
C3—One Tobe .1 mfd. bypass condenser, type 210.
C4, C5—Two Dubilier .00025 mfd. fixed mica condensers.
C6—One Dubilier .0001 mfd. fixed mica condenser.
C7, C8, C9, C10—Four Tobe 1 mfd. bypass condensers, type 201.
C11—One Tobe 4 mfd. output condenser, type 304.
C12—One Tobe .5 mfd. bypass condenser, type 250.
R1—One Electrad 10 ohm rheostat.
R2—One Electrad 0 to 10,000 ohm variable resistance, type G.
R3, R4—Two Daven No. 1 filament ballasts, with mounting base.
R5—One Daven No. 2 filament ballast, with mounting base.
R6, R7—Two Daven .1 megohm resistors, with mounting base.
R8—One Daven 3 megohm grid leak.
AFT1—One Amertran DeLuxe first stage audio transformer.
AFT2—One Amertran DeLuxe second stage audio transformer.
OC—One Amertran output choke, type 854.
One Yaxley No. 10 midget battery switch.
One Yaxley cable connector plug with phone tip jacks.
Four Benjamin sockets for baseboard mounting.
Four Eby binding posts (two plain, one Ant., and one Gnd.)
Two Hammarlund shields.
One strip of hard rubber, 5x3¾ inches.
Two Z shaped brackets.
Two Mar-Co Illuminated Controls.
One Lignole mahogany panel, inlaid, 7x24 inches.
Twelve lengths of Acme Celatsite.
One wooden baseboard, 11x23x¾ inches.

Grid Bias Detection Has Its Good Points

The grid bias method of detection has not been so popular because it is not nearly so sensitive as the grid condenser-leak method. Another reason why it is not used so much is that it is more critical to adjust for optimum response. Many persons do not care to go to the trouble of making the adjustments.

But the grid bias method of detection will stand more volume before the detector becomes overloaded. When the radio frequency amplification is great and when the volume control in the radio frequency level is not adequate it is well to employ the negative grid method of detection. The volume will be satisfactory and the quality will very likely be much better.

Warren F. Hubley Dies After a Heart Attack

Warren F. Hubley, president and general manager of the American Transformer Company, 178 Emmett St., Newark, N. J., manufacturers of Amertran parts, died suddenly of heart disease, which was preceded by an attack of acute indigestion, at his home, 77 Carlton Street, East Orange, N. J.

Mr. Hubley was born in Lancaster in 1880. He was educated at Franklin and Marshall College. He had been connected with the American Transformer Company since 1904. He was treasurer of the Institute of Radio Engineers.

160 Volts in DC Device

B Eliminator Used With 45-Volt Battery

By Halgarde Roderick

IN many sections of the country, including some of the larger cities, the electric power supplied for lighting purposes is 110 volts direct current. From a radio point of view such a supply is unfortunate because it cannot be used in ordinary an A, B, and C source where power tubes are employed. There are B eliminators which are intended for direct current power sources but these are limited to 110 volts or less. Since a higher voltage is desired for loudspeaker operation these eliminators alone cannot be used. Neither can the A battery be charged from the 110 volt line without a great waste of power, unless special arrangements are effected.

A circuit suitable for use with 110 volts direct current on a loudspeaker receiver is shown in Fig. 1.

The requirements of such a circuit are that it shall be safe, that it can be connected to the power line as easily as an electric lamp, that the storage battery can be charged from the source whenever the set is not in operation, that the battery can be switched from charge to receiver with a simple motion. that at least two plate voltages be available, that there shall be no hum when the set is in operation.

Needs More Than 110 Volts

Since the voltage in the line is only 110 volts no more can be obtained from the line. But it is desirable to have more than that on the power tube in the set. A dry battery of 45 volts can be connected in series with the power line and thus boost the voltage up to 155 volts. If the plate return leads be connected to the positive terminal of the A battery an additional 5 volts will be added to the total plate voltage on the last tube. Thus we have a voltage of 160 volts with which to operate the power tube or the other amplifiers. This is enough for most purposes.

The line voltage will not always be 110 volts. More often the voltage is 115 to 120 volts. There will be some voltage drop in the choke coil inserted into the line to remove the ripple. The extra 5 to 10 volts more than makes up for the loss in the choke coil. It may also be that the line voltage is less than rated voltage. In that case the total available voltage in the amplifier will be somewhat less than 160 volts, but still there will be enough with which to operate the set and the loud-speaker.

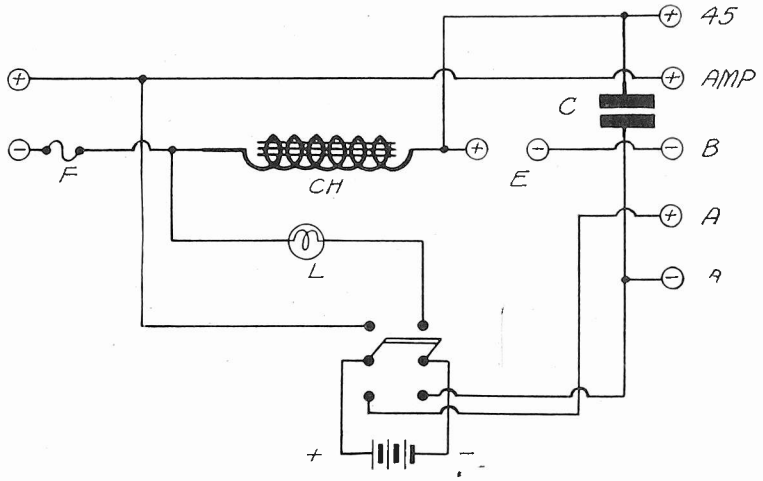
Observe Polarity

In Fig. 1, the two terminals at the left, marked "plus" and "minus," are in reality a screw plug of standard design which fits into any light socket. The screw plug must be used so that there is no chance of inserting the plug with the wrong polarity.

The screw plug terminates a well-insulated extension cord of suitable length, one end of which is attached to the eliminator. Since the positive side of the supply line is grounded, a low amperage fuse F is inserted in series with the negative lead to protect the installation. The size of this fuse should be determined by the highest rate at which it is desired to charge the storage battery.

Since the switch from charge to discharge is very convenient the battery can be thrown on charge whenever the set is turned off, and it will never be necessary to charge the battery at the maximum allowable rate. It should never be required to charge at a rate exceeding 5 amperes, and consequently 5 ampere fuse should be used in the fuse socket.

The fuse block should contain two sockets,



A CONVENIENT B battery eliminator for DC and an A battery charger can be assembled in accordance with this diagram (Fig. 1). A switch throws the battery from charge to discharge or vice versa.

LIST OF PARTS

Ch—One choke coil of from 5 to 10 henrys.
C—One 4 mfd. by-pass condenser.
F—One standard 5 or 10 ohm fuse.
FL—One two-socket fuse block.
E—One 45 volt battery.
One six-foot extension cord with screw plug.
One double pole, double throw knife edge switch.
Five binding posts or Fahnestock clips.
A wooden board about 5x8 inches.

and these two receptacles should be wired in series. One of these is to be used for an electric light or other resistor to determine the rate of charge of the battery.

A double throw, double pole knife switch of substantial construction is used for throwing the battery on charge and discharge. The storage battery terminals are connected to the middle terminals on the switch with the polarity as indicated. The positive or grounded side of the line goes directly to the plus side of the battery. The negative goes through the fuse, through the lamp L and finally to the negative side of the battery by way of the switch. To charge the storage battery the switch is thrown up and a suitable light or resistor is inserted in the light socket. To discharge the battery through the filaments of the tubes in the receiver the switch is thrown down.

The choke coil Ch used to filter out the hum is also inserted in the negative side of the line just above the fuse. That is, one terminal of the coil is connected to the strap joining F and L. To the opposite side of the choke coil are connected two binding posts. One is labeled 45 volts and is used for the RF and detector tubes in the set. and perhaps for the first audio. The other post is connected to the plus side of the auxiliary 45 volt dry battery E, the negative of which is connected to the B minus binding post in the set.

It is not connected to either the plus or minus A terminals in the eliminator because one or the other connections is already made in the receiver. It is left unconnected in the eliminator to prevent a possible short circuit of the A battery. But to take advantage of the extra six volts the B— and the A plus posts should be connected together in the set, rather than B— and A—.

The plus B binding post for the amplifier is connected to the lead coming directly from the power socket, that is, the positive. At this point the voltage is 160, more or less, above the voltage of A—. But the B plus post is grounded, not A—.

Operation of Filter Condenser

The filter condenser C is connected from the positive side of the line to —. Thus this condenser not only by-passes the impedance of the power line but also the impedance of the choke and the leads. Note that the condenser must not by-pass the choke alone because then the choke will serve little purpose. Another condenser may be put across the line where it emerges from the lead in cord, but it is not absolutely necessary.

Note that the detector and the RF tubes are served by the 45 volt battery alone. There is no hum in this part of the circuit except what little backs up from the amplifier. Hence there will be no hum even if the filter is not 100% perfect, unless the circuit oscillates.

Hum Elimination

The large condenser C short-circuits the points it bridges to radio frequency currents as well as to the higher audio frequency currents. This eliminates pick-up through the power line, both of the signal and noise variety.

If the ground binding post is connected to the negative of A in the set, as is usual, the binding post in the set must not be connected to ground. A short circuit would result. The ground is not necessary because A— is grounded through condenser C.

The degree to which the hum is the power supply is eliminated depends on the size of the condenser and choke. The larger they

(Concluded on page 18)

A Sales

Portability As Year-

to Lucky Possessor

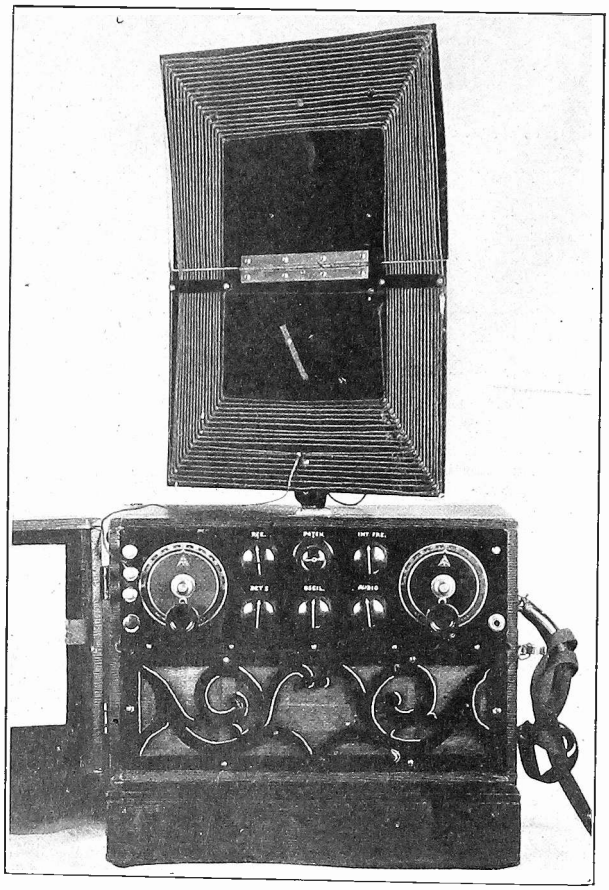


FIG. 1

How the set in a ready-to-operate condition appears. A log sheet can be pasted in one of the lids, as shown.

MANY portable receivers have been described from time to time. The object has nearly always been to fill the needs of the summer vacationist, the motor camper and the motor boater. For this reason the descriptions of portable sets always appear in the Spring and early Summer.

There is another need for a portable radio receiver, one which is as great in the Fall and Winter as in the Spring and Summer, and that is the requirements of the commercial traveler. This gentleman is rarely at home. He does not stay long enough in one place to install a radio receiver, and the receivers he finds in the hotels at which he stays do not satisfy him. His greatest need for a radio receiver is while he is actually traveling from one town to another. He craves entertainment on the trains or in his automobile. This gentleman wants a radio receiver which he can carry along.

Requirements Analyzed

What type should his receiver be, and what should its capabilities be? The first requirement is portability, because the traveler himself may have to carry it long and often. The second requirement is sensitivity, because the set must be able to get first class entertainment at all broadcasting hours no matter where the traveler may be. The third requirement is simplicity. The fourth is compactness. The entire set must be built into one containing case and it should be so arranged that it can be put into operation with a minimum of motions.

The condition of portability requires that everything be built on a small scale. Weight must be kept down to a minimum. Thus the set should be designed around dry cell tubes of the —99 variety or still smaller tubes. Not more than three No. 6 dry cells should be used to furnish the filament current. There is no need for carrying an extra supply around because these cells can be obtained everywhere the traveler may go. For plate voltage, small dry cells should also be used. Large batteries are not necessary because these also can be obtained everywhere. The voltage might be limited to 90 volts so that no more than four 22½-volt units need be used. This of course limits the volume that can be obtained from the set, but great volume is not necessary, because the set will never be called on to entertain more than a few people gathered around it. The volume will be great enough for that without any overloading.

Need of Grid Bias

Grid bias batteries are required. It would be a great mistake to leave them out just to lighten the set. Such small grid batteries can be obtained that they would not add any appreciable weight to the whole.

Much weight can be saved by judicious choice of parts. There are light sockets and heavy sockets, light transformers and heavy. The same applies to everything that goes into the set. It is easy to select standard parts for two electrically identical receivers in such a manner that one weighs five times as much as the other. For the commercial traveler the difference between 20 pounds and 100 pounds becomes of importance. The only thing that should not be selected by weight as the main requirement is audio transformers. But it is fortunate that one of the best audio transformers on the market is comparatively light in weight.

The requirement of sensitivity seems to limit the choice of portable receiver to the Super-Heterodyne. The number of tubes required for this receiver partially offsets the advantages gained by selecting light parts.

Question of Worth

But if an extra pound of material will increase the sensitivity 100 times it is well worth adding it. The usual number of tubes in a Super-Heterodyne is eight, and that is the number that seems most suitable for the traveler's receiver.

The need for sensitivity is greater in a portable set than in any other, because it will be called on to render service in more difficult locations. It may be set up in a hotel room in the midst of a network of steel structures; it may be set up in an underground railway station completely shielded with steel; it may be set up in a steel railway coach moving in electrically inaccessible places. It must be sensitive to receive under all these varied and varying conditions. Nothing but a Super-Heterodyne can do it.

It must be simple to operate. The traveler will not have much time to while away solving radio puzzles. He wants to turn the set on with one motion, tune in the desired

LIST OF PARTS

C1, C6—Two Dubilier .00025 mfd. grid condensers with clips.
C2, C4—Two Continental .0005 mfd. variable condensers.
C3—One Aerovox .5 mfd by-pass condenser.
C5—One General Radio 50 mmfd. condenser.
C7—One Dubilier .002 mfd. by-pass condenser.
C8—One Aerovox 1 mfd. bypass condenser.
L3, L4—One oscillating coil of two windings.
L5—One pick-up coil in inductive relation to L4.
R1, R6—Two Lynch 2 megohm grid leaks.
R2, R4, R7—Three Carter 20-ohm rheostats.
R3—One Carter 25-ohm rheostat.
R5—One Carter 400-ohm potentiometer.
IF1—One DX input transformer.
IF2, 3, 4—Three DX-2H transformers.
AF1, AF2—Two audio frequency transformers.
J1, J2—Two Yaxley single circuit open jacks.
S1—One Yaxley filament switch.
S2—One Yaxley double pole, double through switch.
E—One Eveready 4½-volt grid battery.
A—Three No. 6 dry cells.
B—Four 22½ volt dry cell batteries.
Eight Benjamin UX sockets.
Two Vernier dials.
Three push-posts.
One loop as described.
One loud speaker.
One specially constructed cabinet.
Eight —99 type tubes.

man's Set

Round Asset is Delight of This Receiver

station with another, and recline in enjoyment with still another.

Convenience Served

The set must all be contained in one small package, easily carried. There must not be any necessity for assembling the set each time it is set up for service. There must not be any necessity for connecting the batteries, or the loud speaker, or even the loop. If the loop is not actually built in, it should be so arranged that it can be stowed away in the same box as the receiver and that it can be taken out and inserted in the proper place with a minimum of motions.

We have laid down the conditions that must have been in the mind of Robert S. Alter, Cincinnati, Ohio, when he designed and built his latest portable receiver, because they are virtually a description of his set. To complete the description it is only necessary to give the circuit diagram, the dimensions of the set and to illustrate with actual photographs.

In Fig. 2 we have the interior layout of the Mr. Alter's set. Seven tubes are visible; the eighth and oscillator tube is too close to the front panel to be visible. The intermediate frequency transformers are seen mounted on the rear wall of the cabinet. They are the coffin-like devices. One of the four transformers is directly under a by-pass condenser and cannot be seen.

Location Pointers

The first detector tube can be seen in part to the left of the lock, as can the grid leak and condenser that go with this tube. The three intermediate frequency amplifiers are in a row in the left middle of the set.

In the middle of the set is the loop jack standing vertically. The top of this jack extends through a small hole in the lid of the case, which is clearly visible. The second detector with its grid leak and condenser is placed to the right of the input jack. The two-stage audio amplifier is placed at the right end of the case, the two tubes being capped with soft rubber vibration killers.

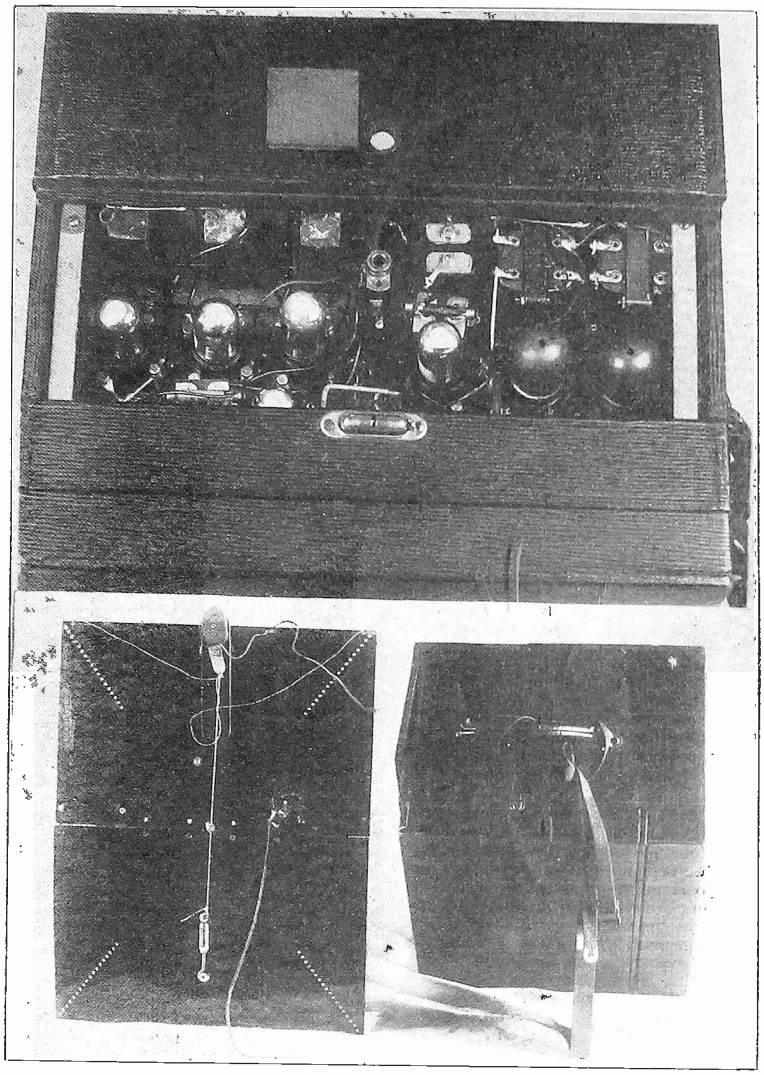
On the lid beside the loop jack hole is a square piece of soft rubber which has been cemented there as a protection for the last IF tube. One feature which is not visible in the photograph but which is a useful part of the receiver is a switch whereby one of the intermediate frequency amplifiers can be cut in and out of the circuit. One stage can be cut out for most reception, but the extra tube is necessary in some of the more difficult radio locations.

Constructional Details

Fig. 1 depicts the receiver set up for action. The loop, which is designed to open and close like a book, is mounted on top of the set in the jack provided. The terminals of the loop are brought to the two conductors on a plug, which has been securely mounted on the loop. A third lead from the loop runs directly to one of the input binding posts. These have been so wired that any other loop can be connected to the set in place of the folding loop.

The loop is made of two sheets of 1-16 inch bakelite. The flexible wire is held in place by means of eyelets. Some of the details of the construction can be more clearly seen from Fig. 3, left, particularly the method of mounting the plug and the method of holding the loop flat when it is open. A string is stretched across the back as taut as possible and then a wooden prop is put between the string and the middle of the loop directly over the fold line. This scheme flattens the loop satisfactorily. The

(*Concluded on page 21*)



FIGS. 2, 3 and 4

The upper photograph (Fig. 1) shows the interior of set. In the photograph at lower left (Fig. 3), we have a clear view of the rear of the loop. Fig. 3 at lower right shows set ready for carrying.

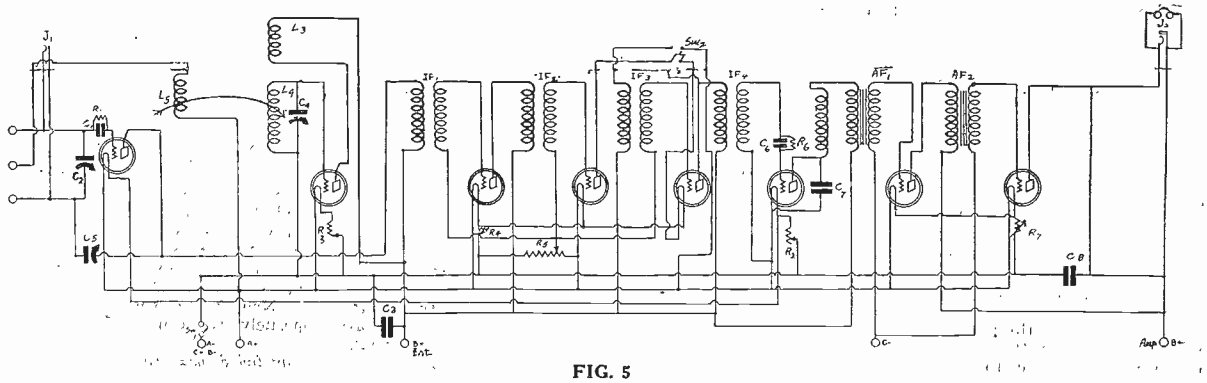


FIG. 5

Squirming Atoms!

Their Phenomena Utilized in Getting Better Quality Transmission

By Lewis Rand

UP to a few years ago the subject of magnetostriction was unknown except to a few scientists. Most students paid no heed to it, as it seemed a most unpromising field for research. Its importance was purely scientific; its practical utility was far beyond the horizon for most investigators. Yet today magnetostriction is of immense practical importance in the communication field. Radio, telephony and telegraphy are all dependent on it.

Magnetostriction is the change in physical dimensions of substances such as iron, nickel and cobalt when they are magnetized. For example, when an iron wire is magnetized its length is increased by a small amount. A piece of nickel wire behaves in just the opposite manner —it shortens on magnetization. These changes are magnetostriction effects.

The changes in the dimensions of these magnetizable metals are extremely small and difficult to measure. It is for these reasons that the importance of magnetostriction was not recognized sooner. It did not seem logical that changes so small as to be well nigh impossible of measurement would have any important significance. Yet they are now of immense importance.

It is the fact that iron and nickel behave oppositely that led to the practical application of magnetostriction, an application which was revolutionary in the communication field.

Molecules Rearranged

To magnetize a piece of iron requires a certain force. The force required depends on the purity of the iron and on its previous mechanical and heat treatment. Pure iron is more easily magnetized than impure; likewise iron which has been thoroughly annealed, or heat treated, is more easily magnetized than iron which has been subjected to mechanical operations. There are a few exceptions in regard to the purity.

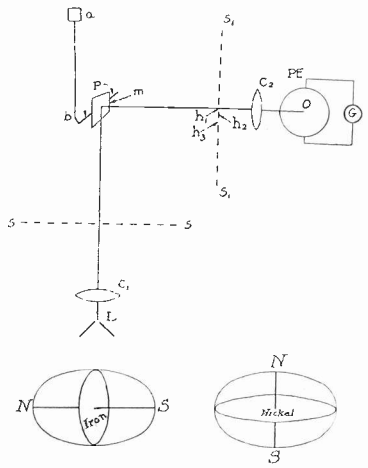
The force required to magnetize the iron is exerted in rearranging the molecular structure of the iron. Magnetization apparently consists in arranging the molecules so that all exert their magnetic forces in the same direction. The new arrangement of the iron molecules requires more space than the old, and consequently the result of magnetization of the iron is an increase in the length of the sample.

It also requires a certain force to magnetize a sample of nickel; and, as in the case of iron, the force required depends on the purity and on the heat and mechanical treatments that the sample has undergone previous to magnetization. Magnetization of nickel also consists of rearranging the molecules of the substance, and the force required to magnetize is that which is necessary to overcome molecular forces.

Unlike iron, the nickel requires less space after it has been magnetized. The sample therefore contracts on magnetization.

Striking Results

Whenever two things respond in opposite manner to the same cause there is always a chance for interesting and striking results when the two are combined. For example, the impedance of a choke coil is proportional to the frequency and the impedance of a condenser is inversely proportional to the frequency.



A SCHEMATIC DIAGRAM of the ultra-sensitive micrometer developed by P. P. Cioffi of Bell Laboratories for measuring changes in length of metals when magnetized (Fig. 1). Below (Fig. 2) is a prolate spheroid, at left, magnetized along its major axis. It represents an iron molecule. At the right is an oblate spheroid magnetized in the same manner as the earth. It represents a nickel molecule.

The combined impedance of a choke coil and a condenser in series will depend on whether the frequency impressed on the circuit is above or below a certain critical frequency. At that critical frequency the impedance is negligible or very small. This can be stated differently. For a given frequency there will be a certain proportion of inductance and capacity in the series circuit at which the impedance is negligible. This phenomenon is well known to radio fans under the name of resonance. Note particularly that the word "proportion" was used above. At resonance a certain electromotive force will drive an exceedingly large current through the condenser and the inductance coil. That is, at resonance, when the two impedances neutralize each other, the response to a given force is very great.

Extremely Small Changes

Since iron and nickel respond to magnetizing forces in opposite manner it is resonable to assume that mixtures of the two will behave toward magnetizing forces in much the same manner that a coil and a condenser respond to electromotive forces. And that is exactly what occurs. And the response depends on the proportion of each metal in the alloy.

Now it is possible to study the response of the iron-nickel alloy in two different ways. It is possible to study the permeablity of the alloy, that is, its magnetizability with given magneto-motive forces. This is perhaps the easiest way and it is also the method which gives practical results more directly.

It is also possible to study the change in dimensions that a sample of the alloy undergoes when magnetized to a certain intensity. This is the more dfficult due to the extremely small changes that take place in the dimensions, particularly for those proportions of the metals which are of most interest. But this method of attack is necessary in order that a more thorough knowledge of the iron-nickel alloys may be gained for further development. It is quite possible that this line of attack will lead to more interesting and useful results than have yet been discovered.

A Phenomenon Like Resonance

There is a certain proportion of iron and nickel which does not show any magnetostriction effects. That is, a sample of iron-nickel alloy having this proportion neither expands nor contracts under magnetization. And for this proportion it has been found that it requires an extremely minute magnetizing force to magnetize the sample. This is unusually stated by saying that the permeability of the alloy for that particular proportion is very great. It may, in fact, be a thousand times greater than the permeability of pure iron.

This phenomenon is analogous to the resonance in a circuit of two impedances of opposite character. That particular proportion of iron and nickel which shows the least change in dimensions under magnetization and the greatest permeability is called Permalloy, a recent contribution to the world's wealth by the Bell Laboratories. The proportion in this alloy is about 20% iron and 80% nickel.

Permalloy is rapidly displacing all other magnetic materials in electro-magnets, choke coils, transformers, relays and other instruments used in the communication field, as well as in many other electrical fields. It has already displaced the core material formerly used in all the loading coils used in long distance telephone lines, and it is daily playing a greater part in preserving the original quality of music and speech transmitted from studios to various broadcasting stations. It has also been applied to submarine cables between here and Europe and elsewhere with the result of greatly increasing the speed of signalling over these cables. It is being used in audio frequency transformers of the better type, in loudspeakers and in many other instruments in ever increasing numbers.

The effects of magnetostriction can be explained simply if we make certain assumptions regarding the molecules of which the metals are composed. Suppose each molecule is a spheroid of revolution, in effect, and that it constitutes a miniature magnet with its axis of magnetization parallel with the axis of rotation of the spheroid. The assumption of rotation is necessary only to establish the magnetic axis. Now, since iron and nickel behave oppositely we can make assumptions.

(Concluded next week)

Quality's There—Get it!

By Thomas F. X. McGuire

YOU may think that you have a particularly good receiving system in your home. Your friends may please your vanity by agreeing with you most heartily. The receiver may be an exceptionally good one, indeed. It may be capable of reproducing broadcast programs with great fidelity. But the fidelity is never 100%. Somewhere in the audible scale there is a deficiency. It may be weak on the very high frequencies, thus slighting the consonants and the harmonics of the higher tones. It may be weak on the extremely low notes, thus depriving the reproduced music of its fulness. It may be too strong in one or more regions in the audio scale, thus giving cause to unpleasantly predominating notes at times. The deficiency is most likely to be in the lower regions.

You listen to the reproduction and you think you hear the basses with full volume. But chances are you do not. At the next opportunity give close attention to the relative intensity of the basses and the higher notes in an orchestra rendition—not to a reproduction of the piece, but the original. Give particular attention to the bass drum, the tuba, the bass viol, the lower notes of the piano, the bassoon. It seems that these basses predominate and give the music its foundation and fulness. Without these basses in abundance the music is indeed empty. Try to fix in the memory the relative emphasis given to the low and the high notes in the original performace.

The Disappearance Act

Then soon afterwards listen to the same or a similar composition as it is reproduced by the radio receiver. Where are those basses? Has the tube player left the orchestra? Has the bass violist lost the strength of his arm? Has the bass drum lost its boom? Has the lowest octave on the piano been muted? The notes from the basses are not in evidence in the radio reproduction. "Oh, yes!" the proud owner of the really good receiver says, "they are there all right. Just listen." You cup your ear and discover a trace of the notes which should have been present in force enough to give character and fulness to the music. What has become of the low notes in the original?

The low notes have not been given a chance to come through, that is all. They have been impeded and detoured. And what contributes most to the depression of the low notes? Condensers placed in series with the line, such as stopping condensers. Choke coils placed in shunt with the line, such as coupling impedances and the loud speaker filter choke. Inadequate cores and windings in the audio transformers. Inadequate radiating surface in the loud speaker, or inadequate length of loud speaker horn. Skimping on parts, or on the amount of material in the parts, is the cause of the weakness of the low tones.

Resistance AF Ace High

In a resistance coupled audio amplifier some of these causes are, or can be eliminated. There are no choke coils across the line except possibly the filter inductance across a louspeaker. This can be eliminated by connecting the speaker directly in the plate circuit. This also eliminates the stopping condenser in series with the speaker, which is one of the chief sources of weakness on the low tones. This also eliminates the output transformer, which is sometimes the cause of the weakness. If stopping condensers are small the low notes will not be amplified as much as the higher notes because too much voltage drop will occur in the condensers and not enough in the grid leaks. To offset the effect of too small stopping condensers the grid leak resistances can be increased.

When the circuit has been designed so that the amplification is even down to the lower limit of audibility, the output still lacks in the low notes. Now the deficiency is entirely due to the loudspeaker. It may have too low impedance on low frequencies, it may have too small sound radiating surface, or the horn if such it be may be too short. A great improvement in the quality of the output then can be obtained by listening in with a headset. It is necessary of course to cut the volume down to a point where it is endurable. The quality is improved in this case because the diaphragm and the ear are very closely coupled.

Tests With Reisz Phones

But even with the ordinary headset the best quality cannot be brought out. There is quality in that resistance coupled receiver of which the owner has no inkling, not even after he has listened with the headset, unless that headset happens to be working on the condenser principle, like that designed by Eugen Reisz, the noted German acoustical inventor. Listening with this device brings out all the low notes and their original strength. And it does not show any partiality. It brings out the extremely high and the middle just as well. There are no resonance peaks in the response of this headset.

The effect of series condensers and shunt choke coils can easily be studied with this headset. Suppose at first the headset is shunted with a pure resistance. The low notes come in normally. Then suddenly replace the resistance with a choke coil. This may be an ordinary choke coil, the primary of a transformer, or the windings of a loudspeaker. As soon as the inductance is cut in across the speaker the low notes are very noticeably depressed. It seems as if all the low tone instruments were suddenly removed to another room or to a point a long way off. The smaller the inductance of the choke coil the greater is this effect. A similar effect can be noted by suddenly cutting in a condenser in series with the speaker. The smaller the condenser the greater the effect.

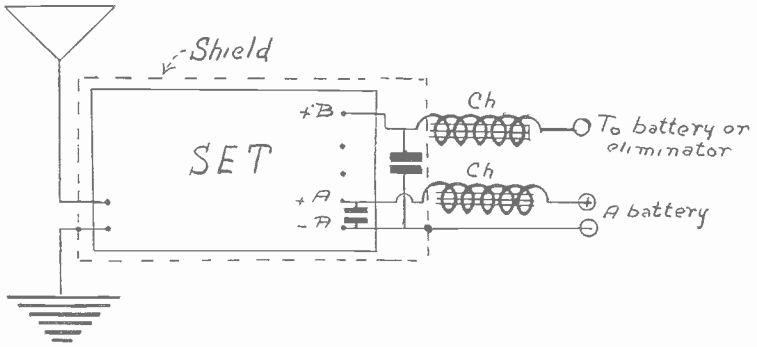
There are certain peculiarities about a condenser headset. In the first place it is a small condenser and as such it will not pass any direct current. Hence when it is put in the plate of a vacuum tube it must be shunted with a pure resistance or with a choke coil. Otherwise the plate current cannot flow in the circuit and no sound will be heard in the speaker.

May Use High Mu Output

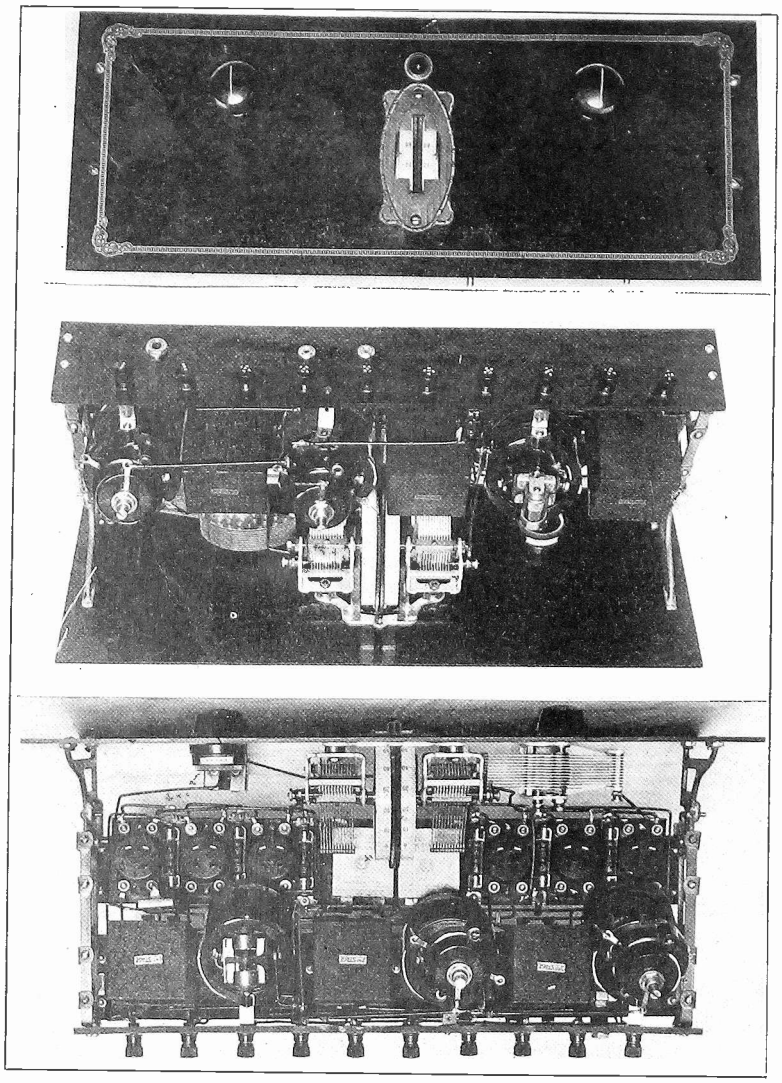
Another point of interest is that the impedance of the speaker is very high, particularly at low frequencies. This is a property of any condenser. Because of the high impedance the speaker can be connected in the plate circuit of a high mu tube and the output will be satisfactory as to volume and excellent as to quality. A resistance of one megohm can be connected across the terminals of the condenser speaker in this case. The greatest response will be obtained from the condenser headset when its impedance is equal to that of the tube to which it is connected.

When the condenser headset is connected to the output tube the voltage swing will be too great and it is necessary to connect a much lower resistance across the terminals. Depending on the direct voltage applied to the tube and on the type of tube used. The resistance may have any value from 25,000 to 500 ohms.

HOW TO SHIELD A FINISHED SET



TO PREVENT the leads of your A or B supply, whether it be an eliminator or a battery, from acting as a miniature antenna, picking up extraneous noises, it is wise to shield your receiver and employ the choke-condenser hookup system illustrated above. Since it is necessary to have the shield completely surround the set, it has to be used as a housing for the set at the same time. Either aluminum or copper may be used. The shield must be airtight, since the smallest opening will allow unwanted energy to seep in. The choke used in the B side may consist of the primary winding of a toy transformer. For the A side, it will be necessary to construct one at home, by winding 100 turns of No. 18 wire, on a 3-inch diameter tubing. The fixed condenser D should both have a capacity of 1 mfd.



FIGS. 2, 3 AND 4 (TOP TO BOTTOM)

An excellent idea as to the layout of the parts is obtained from the view at top. In center we have a rear view. In the bottom photo, the panel layout is shown.

THE prime requisites of a perfect receiver are true reproduction, selectivity, ease of operation and distance-getting ability. To reach these heights, perfect balancing in the radio frequency amplifier, detector and audio frequency amplifier circuits is necessary.

Thus a perfectly balanced radio frequency amplifier circuit is one that gives a high, even amplification without distortion over the entire wave-band of 200 to 600 meters or 1,500 kc to 500 kc. A balanced detector circuit must be free from excessive feedback, grid blocking and suppression of frequencies in the high or low end of the audible scale, or from 20 to 8,000 cycles. The audio amplifier must not have any peaks, should not damp out weak overtones and harmonics. It should amplify equally well over the entire output of the detector circuit.

The suppression of the side bands on the lower wave-lengths in the stabilized type of sets greatly affects the quality of reproduction, since the audio band, which covers at least 8 kc, is restricted to a channel of 4 kc at 200 meters. At 300 meters, it is about 6 kc, while at 600 meters it is 16 kc. As the higher waves are reached, the tuning becomes so broad that interference is sure to result, while at the lower waves, the sharp tuning kills the quality. So that the RF portion of this set should be balanced and yet allow the amplification to be equal throughout the entire range, two special devices, known as Phasatrols, are employed. These are once adjusted at 300 meters to prevent self-oscillation. Then with the aid of a control in the form of a Tonatrol, which is inserted in the first RF B lead, the volume is controlled with velvet-like ease.

The three circuits are all tuned by separate condensers. In the second and third RF stages, however, the condensers are hooked up to a drum type control. The rotor shaft is not common, though. They are just mounted close to each other, not connected, for simplicity of control. The connections are made in the same fashion as for single condensers. The set is known as the new Ford Six.

The Audio End

The choice of an amplifier is an important consideration, and we have a choice of three. There is the transformer-coupled; the resistance-coupled; and the impedance-coupled.

Lately there has been developed a new type of audio amplifier whose merits have well been established. It is known as the double impedance coupled amplifier. This type was chosen because in actual comparison tests and audibility measurements no doubt was left as to its excellent superior qualities. After having finally assembled and wired this receiver I placed a large cone speaker and connected to the output. All the notes of the piano, organ and the lower-noted instruments, from the thundering crescendo to the bell-like whispers of the French horn and oboe were heard with distinctness. The "quality was there"—it was unmistakable.

The

Assembling the Parts

The layout of the parts used was decided upon only after argumentative discussion as to whether placing the RF coils near to the other instruments would affect the stability of the circuit, had been conclusively ended. The arrangement of the parts has been made most compact, yet not crowded.

The front panel layout may be seen in Fig. 4. After all the holes are drilled in the panel, the adjustable brackets are attached and the drum dial mounted to the condensers. The single tuning condenser, volume control and light switch are then mounted.

A micarta strip is then drilled for mounting the six sockets, Amperites and two large fixed condensers. It is then fitted and fastened into place, and held there by means of brass brackets.

The third strip serves as a binding post rack, the loudspeaker jack, and jack tips being mounted on it, after which it is fastened to the end of the brackets.

Wiring the Set

The filament circuit is first wired. To distinguish between the various circuits, black covered wire is used for the filament circuits, green for the grid and red for the plate. After the filament circuit

LIST OF PARTS

L1L2, L3L4, L5L6—Three Bruno No. 55 RF coils.

C1—One Bruno No. 101 .0005 mfd. variable condenser.

C2, C3—One Bruno No. 2C Unitune unit.

C4—One Aerovox .006 mfd. fixed by-pass condenser.

C5, C6—Two Flechtheim .1 mfd. fixed by-pass condensers.

C7—One Aerovox .00025 mfd. fixed condenser.

C8—One Aerovox .002 mfd. fixed condenser.

R1, R2, R3, R4, R5—Six No. 1A Amperites.

R6—One No. 112 Amperite.

R7—One Improved Turn-it grid leak.

R8—One Electrad Tonatrol.

Ph1, Ph2—Two Electrad Phasatrols.

D1C1, D1C2, D1C3—Three FMC double impedance couplers.

Sw and PL—One Bruno light switch.

OJ—One Carter single circuit jack.

Six Pacent sockets.

Two Carter phone tip jacks for antenna and ground.

One Micarta 7x16 inch panel.

Three Micarta 2½x17 inch strips.

Two Bruno adjustable brackets.

Twelve lengths Acme Celatsite.

Assortment of 8-32 and 6-32 screws, ½ inch and ¾ inch long.

Two dozen lugs.

Three brass brackets, Z shape, 1 inch high.

Four brass brackets, L-shape, 2½ inches long.

One K-K rheostat knob for single condenser.

Balance of Power

The Feature of the New Ford Six

By Leon Adelman
Associate Institute of Radio Engineers

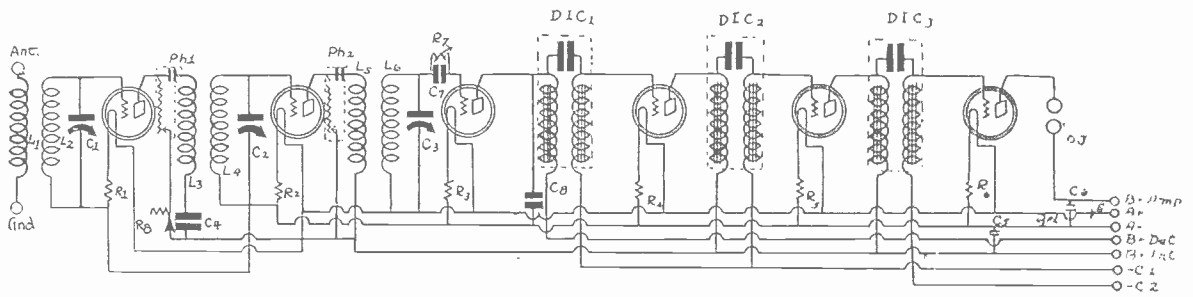


FIG. 1
The circuit diagram of Adelman's six-tube receiver.

with its pilot light switch is wired and tested, the RF coils are mounted by means of small brass angle brackets on the binding post strip. They also should lie in a 60-degree angle.

It will be noted that the binding post terminals of the coils have been turned around, so that the connections are made from the inside of the coils. This allows a closer grouping of the RF coils and impedance units, necessary because of the small limits of space available. When mounting and wiring the grid condenser and leak, care should be taken to have the grid leak on an even horizontal plane. The Phasatrols are mounted last and adjusted after the set is connected to the necessary batteries, or eliminator and speaker.

Balancing the Receiver

In adjusting the receiver for freedom from self-oscillation or stabilization, it is necessary to tune in a station on about 300 meters.

The condensers must be tuned to resonance, while the volume control must then be left at zero. The adjusting screws on the Phasatrols are then varied until the program comes in clearly, free from any rushing noise which would mean a condition of self-oscillation in the receiver.

If then, when the receiver is tuned to wave-lengths below 300 meters, there is manifest a hissing noise, the volume control will capably take care of it and eliminate it.

Hence, we achieve greater sensitivity, with resultant selectivity, and insure excellent quality of reproduction by keeping the set free from self-oscillation.

The use of the by-pass condensers across the B voltage supply will eliminate any normal fluctuation or internal noises.

How to Tune

The adjustment of any receiver has much to do with its ultimate performance and this one is no exception.

The grid leak is turned a few degrees until the detector circuit gives maximum response when all circuits are in tune or resonance.

Too much stress cannot be laid on the position of the volume control and its smooth action in the circuit. It is bypassed by a small condenser and the arrangement, no doubt, is the most successful possible to obtain.

The main tuning is done with the drum. This is set at the desired dial number, after which the single condenser is adjusted.

It should be remembered never to detune a circuit if a reduction in volume is desired. Always use the volume control instead. Its use will not affect the quality of reproduction.

No rheostats are in the filament circuit, thus doing away with filament control of volume, another vice which is responsible for loss of quality.

A few words about the use of various kinds of voltage supply sources will not be amiss. Either B batteries or an eliminator can be used. There is no danger from "motor-boating" if an eliminator is used.

The "C" battery voltage for the 112 type tube used in the last stage of audio can be 4½ or 9 volts, according to whether 135 or 180 volts are used in the plate circuit.

Non-Licensees Seek Some Legal Opening

Radio Protective Association, Inc., 134 South La Salle Street, Chicago, made the following announcement:

"To protect its members against infringement suits threatened by the Radio Trust in connection with the tuned radio frequency situation, the Radio Protective Association has retained a nationally known firm of patent counsellors, of New York City, to defend these members and their dealers against suits anywhere in the United States.

"The law firm which has been retained is the same one that was employed by Henry Ford, in his successful litigation to break the Selden patent.

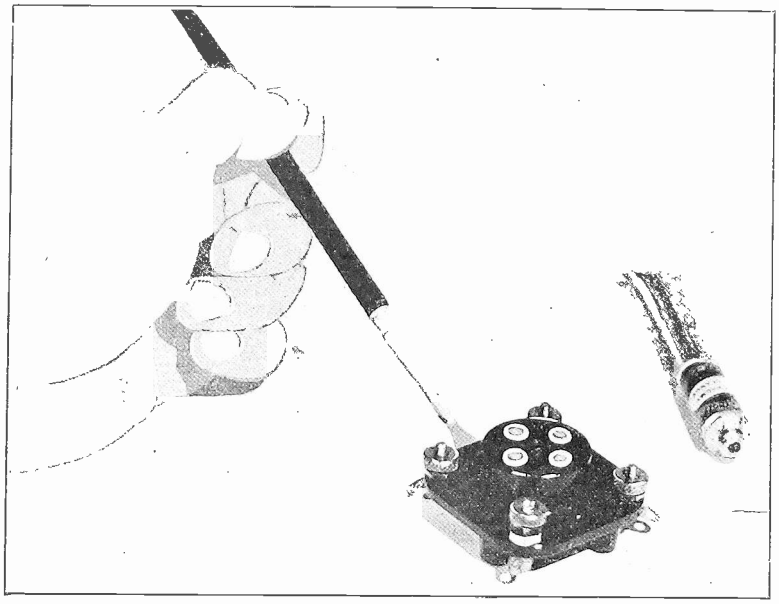
"'This is an important step in our campaign to prevent a monopolization of the radio industry,' said Oswald F. Schuette, executive secretary of the Radio Protective Association at the Chicago headquarters in announcing the retainer. 'With this backing our members can sell their sets to the public, confident that they will have the fullest protection of the patent laws. But it is only one item in our program. We shall continue to insist that the anti-trust laws also shall be enforced against the trust. For it is the violation of these laws by the trust which constitutes the greatest menace to the future of the radio industry.'"

BOY SCOUTS BUILD IN BIRD HOUSES

Wide World Photo
At the Fourth Annual Radio World's Fair, boy scouts exhibited their unique radio receivers at Madison Square Garden. Left to right the scouts are Alfred Holzinger, Bod Mahan, and Henry Vaiedn.

Old Bill's Self-Defense

or, The Light That Did Not Fail



Hayden

HOW OLD BILL painted the sockets of the receiver with luminous paint to help his failing eyes to find the sockets in a dark cabinet.

By H. W. Monstier

The ancient banking house of Struthers & Hallowell had a liability which it had inherited from a former generation in the person of William Jabine, the present nominal head bookkeeper. Old Bill, as everybody called Mr. Jabine, saw none too well, and had been thus afflicted for many years. Yet he refused to aid his failing eyes with glasses lest it would appear to the younger men and his own subordinates that he was losing his value to the firm. He would grope over the books of the firm with dimly seeing eyes, as if checking each item of account, but really trusting that the actual bookkeepers had performed their work correctly.

It was not the efficiency of Old Bill that kept him on the payroll of the ancient firm. It was rather the close friendship which existed between him and Mr. Hallowell, the present senior member of the firm, a friendship which had its origin in the school-days of the two veterans. Besides, Mr. Hallowell had trouble with his eyes, too.

Hallowell Knew

The head of the firm was fully aware of Old Bill's shortcomings physically and his consequent lack of value to the firm. But he kept Old Bill around more for old times' sake and companionship than for his value to the firm.

But pressure was brought to bear on Mr. Hallowell during a profitless season for keeping his old crony at the firm's expense. At first this had no effect because Hallowell was the greater part of the firm. But when the pressure took the form of threatened resignations of the more active members, the head was forced to take action in his own defense, for he himself was no longer able to carry on. So Hallowell concluded that Old Bill would have to go.

Now, Old Bill was quite a radio enthusiast. He had experimented and had gained a measure of familiarity with receivers. During his experiments he had met trouble inserting tubes in their sockets. He could not clearly see the sockets in the dingy interior of the cabinet, much less the tiny holes on the sockets into which the prongs of the tubes must be inserted. Necessity gave Old Bill an idea in this respect. He applied his new idea to his own set and found that it was thoroughly practical. He resolved to introduce the innovation into Mr. Hallowell's set also.

Old Bill Was Service Man

This resolve was not actuated so much by his desire to help his friend, but rather to help himself, for he was the undisputed service man whenever anything went wrong with Hallowell's set. Usually Old Bill had trouble when experimenting with his friend's set, because of his own ocular condition, and because of the darkness in Hallowell's set.

On the very night before the day Hallowell had resolved to inform Old Bill of his dismissal from the firm he had trouble with his radio set. So he sent his car for Old Bill, asking him to be prepared for trouble as well as reminiscences. While Old Bill was on the way, Hallowell ventured to try remedying the trouble with the receiver. He succeeded in getting a collection of unattached vacuum tubes. He did not know what to do with them.

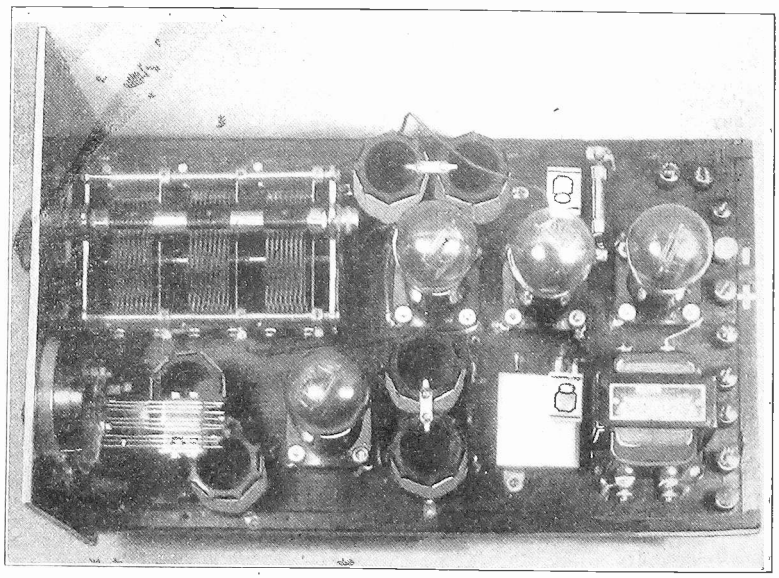
When Old Bill arrived he found the receiver in the condition in which Hallowell had left it, all tubes out and ready for Old Bill to go to work. He proceeded immediately. He pulled out a camel's hair brush and a tube containing luminous paint from his pocket. With the brush he applied a tiny circle of luminous paint around each little hole on all the sockets in the set. This made the location of the holes visible in the dark.

The Situation Saved

Old Bill inserted all the tubes into the receiver without difficulty and there was no other trouble evident. He turned on the set and it worked.

It so happened that a male quartet was singing old-time songs that night, and the two old cronies settled down in silent companionship and sang with the radio.

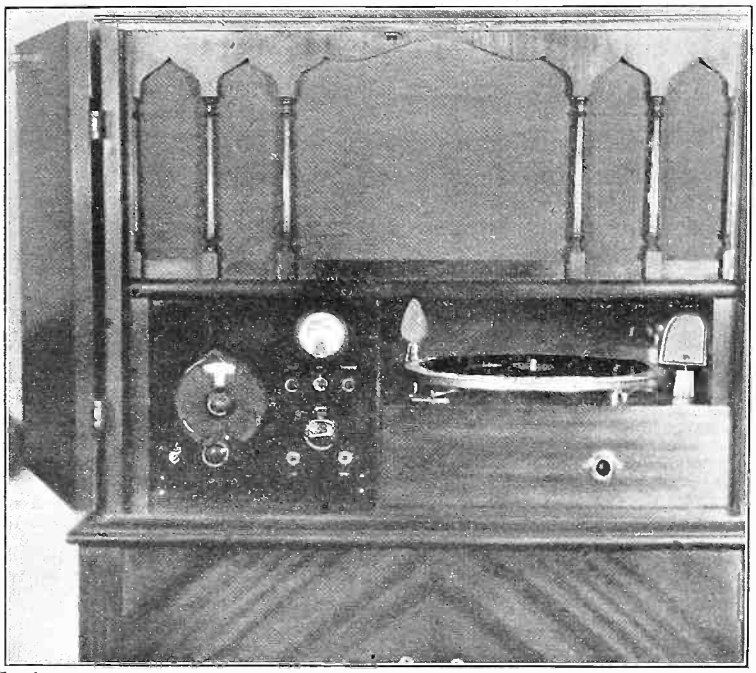
Hallowell was greatly pleased with Old Bill's demonstration of usefulness as well as companionship. He refrained from communicating to his friend the decision which his younger associates had dictated. When Old Bill rode home that night in Hallowell's luxurious car he still had his job and a closer friend.



Hayden

HOW THE RECEIVER installed in the console has been laid out. The set contains two stages of RF, a detector and two stages of audio. The last stage of audio is not in this layout, but is housed below.

More Brains than Money, and See What He Did



Hayden

A PHONOGRAPH at the right and a radio receiver at the left are here shown installed in a console which formerly only held a radio set. Below is a compartment for the power plant and above is a horn type of loudspeaker. A jack has been provided for an external loudspeaker. Note the phonograph pickup—a Phonovox—at right.

By Winsted Cushing

Many spacious consoles have been built for radio receivers the last few years. Most of the interior has been either empty or else filled with a loud speaker horn. The radio set and the accessories occupied a comparatively small part of the whole, particularly as to the depth of the console. One particular radio fan who had such a console ripped out the old set, made a few changes in the layout, and found room enough for the receiver as well as a phonograph operating in conjunction with the radio loud speaker. More room had to be devoted to the phonograph than to the radio set, hence it was necessary to build the radio set with a very small panel and a deep baseboard.

The requirements imposed by the shape of the console and the necessary space devoted to the phonograph made it particularly desirable to use a three section condenser operating on the same shaft. Consequently this type of receiver was selected as a companion for the phonograph.

One of the illustrations shows a view of the front of the combination of radio receiver and phonograph. A single National dial is mounted in the center. In one corner is a voltmeter and below that is a volume control potentiometer. Various knobs, switches and jacks are mounted between the main dials and knobs.

In the compartment to the left of the radio receiver the phonograph can be seen. There is an electric light in one corner of the compartment as an aid in operating the phonograph. At the extreme right of this compartment a Pacent Phonovox pick-up is visible.

A spring motor is used to turn the record. This motor must be wound up now and then and the most suitable place for the crank socket is on the front panel of the phonograph section. There is room inside in a corner for the crank when not in use.

The loudspeaker is built into the top of the console, but provision has also been made for an external speaker which is capable of handling higher powers. Below the receiver and the phonograph is a compartment for the power plant of the set. This comprises a storage A battery with an automatic trickle charger, a B battery eliminator, and a power audio frequency amplifier with its associated choke and condenser.

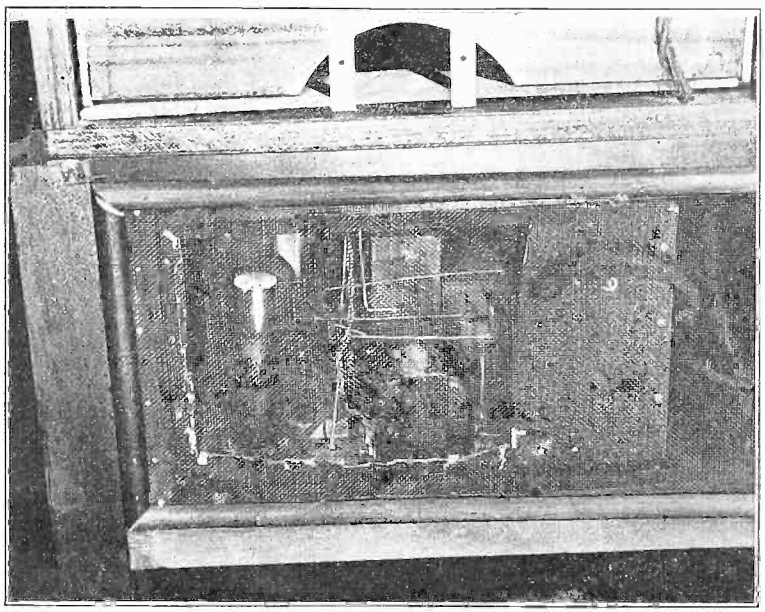
The layout of the radio receiver installed in the console is also shown. There are three astatic inductance coils, one three-section tuning condenser, four tubes, one audio transformer, and the necessary binding posts, by-pass condensers and switches.

In the view showing the back of the console and part of the power plant, the back panel has been removed and a wire screen has been substituted. This has been done to provide the necessary ventilation of the rectifier and the power tube. Just above the power plant is a crescent-shaped opening i the back. This leads into the phonograph motor compartment. Its purpose is to provide access for oiling the motor.

16 Governors' Wives Act as Kent Judges

Mrs. Alfred E. Smith, wife of the Governor, has accepted the invitation of The Atwater Kent Foundation to serve as honorary chairman of the New York State Sponsorship Committee, which will supervise community and state participation in the Foundation's National Radio Audition. She is one of sixteen governors' wives to accept such responsibility.

Miss Isabel Lowden, of the National Music Week Club, New York City, will serve as active chairman for Eastern New York and Mrs. L. Vibbard, of Syracuse, President of the Federated Music Clubs of New York will be active chairman for Western New York.



Hayden

THE REAR of the console, showing how the wooden panel has been removed and a wire screen substituted to furnish ventilation of the power plant. The crescent-shaped opening at the top gives accessibility to the spring motor for lubrication.

The New All-Electric Freshman Receivers

By James H. Carroll

Contributing Editor; Associate, Institute of Radio Engineers.

The Freshman broadcast receivers, of which millions have been manufactured and sold to pleased fans all over the world, have long been famous under the trade name of "Masterpiece," and in the new 1928 line offered to the public, Charles Freshman has achieved his masterpiece of masterpieces.

The line embodies six new and beautiful models, from table style up to several different exquisite console models, all worthy of being styled specimens of the cabinetmaker's art, both for storage battery operation and all-electrically operated direct from the power line. The chief feats, however, are the electric sets, using the new A. C. tubes of the R. C. A. and licensed under the Radio Corporation patents. This means that the layman, who knows nothing at all about radio or electricity, can go out and safely purchase a set which he can plug in on his outlet and get the best there is in radio. If the world has been waiting for the sunrise, it has just as impatiently been waiting for the real electric set.

A New Circuit

The great feature of the new Freshman line aside from this is the Equaphase circuit, a new method of suppressing oscillation, with all the good and none of the bad features of the old methods. This is the joint development of Albert Franklin, George Eltz and Henry Dunn, chief engineer and associates, respectively, of the Charles Freshman Company. It was the result of long research in the effort to better the circuit along the line of greatest efficiency, tuned radio frequency.

The problem seemed unsurmountable, as controlling the oscillations of radio frequency circuits where two or more stages are employed, while at the same time holding to a high degree of sensitivity and selectivity, is hard enough in the case of battery operated receivers, but when you add the problem of controlling the oscillations of a set operating entirely from the alternating current house supply and at the same time obtaining maximum efficiency from the circuit, you get an idea of the feat accomplished by these engineers.

The Equaphase Feature

In the Equaphase, an outstanding feature and one that does not obtain in the usual methods of stabilization is that a minimum, if any, absorption of energy takes place, thus leaving the receiver to function as it should, being then entirely free of handicaps in this respect. The Equaphase stabilizer circuit in itself consists of inductance, capacity and resistance, of which only the capacity is variable. It is so arranged to permit the neutralization of any stages without affecting the others. The method of stabilizing the receiver consists of but making one adjustment in the midget variable condensers, and this is done in the factory, needing no alteration at any time thereafter. This makes for greater sensitivity and selectivity as it makes it possible to use a greater degree of coupling between succeeding tubes of cascade tubes than by any other method.

The receivers have been adapted to the universally popular drum control, making it practically a single unit. Operating directly on the shafts of the condensers, as shown in the illustration, no gears or other reduction mechanisms are employed. The wave-length scale is pleasingly illuminated by a small six-volt light placed inside the drum. Three stages of tuned radio frequency amplification, a non-regenerative detector and two stages of transformer coupled amplification, an ideal combination for all-around efficiency, are used in the circuits of the new Freshman sets. In the all-electric models, type UX-226 tubes are used in the three radio frequency stages, a type UX-227 tube is used in the detector circuit, a type UX-226 tube is used in the first stage of audio amplification and a UX-171 tube is used in the last audio frequency stage. The power pack used with this receiver is operated by a type UX-213 tube as rectifier. In the battery operated model, UX-201A tubes are used in the radio frequency stages, the 200A is used as a detector, while the first audio stage takes a 201A and the last audio stage a UX-112 tube.

Ease of Operation

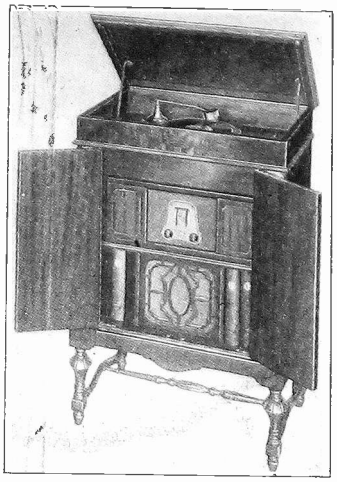
The operation of the new Freshman line of receivers has been reduced to extreme simplicity. The panel is beautiful and exquisitely balanced. One drum type tuning dial is located in the exact center controlling the rotation of all the four variable condensers of the receiver. On the left of the drum dial is a knob which works the small vernier condenser in the antenna circuit of the set. The only adjustment that needs to be made with this knob is when it is desired to bring the set up to the point of maximum sensitivity while tuning for distance. On the right of the drum dial is the volume control knob. These knobs are set below the edges of the drum, on the right and left, all encased in and enhanced by a beautiful ornamental shield.

Mechanically, the new receivers are as nearly perfect as it is possible for human ingenuity to make them, and the details thereof provide interesting study both for the layman and the trained radio fan. Even the layman can readily see the sturdiness and stability shown, while the expert fan will delight in the constructional details seen and the expert workmanship evidenced. In the illustration of the chassis shown herewith, one will note that the four variable condensers that tune the three radio frequency stages and the detector circuit are mounted in a horizontal position directly in back of the front panel. In operating the receiver, lost motion in the tuning control is eliminated by connecting the shafts of the condensers directly together and by causing the drum control to act directly on the condenser shafts. The tuning dial is calibrated in wave-lengths and the illuminating feature not only aids in tuning by showing the degrees plainly but also provides a most pleasing effect to the bystanders.

Note that in the mounting of the tubes and the radio frequency stages another very interesting feature is to be found, in that the illustration shows that the tubes, the two audio frequency transformers and the radio frequency stages are mounted on a shelf which is suspended entirely on springs. All excessive vibrations are suppressed by means of two soft rubber bumpers. The tubes, therefore, are so mounted as to be able to operate at their best, in freedom from all vibration and michrophonic troubles.

Solidity of Construction

The construction is solid and made for durability, all metal being used which has come to the fore in the making of the best of the modern receivers. The tube shelf and the mounting shelf are both of metal. All the metal parts of the set are connected directly with the ground, and all ground connections are made directly to the shelves. This simplifies wiring, minimizes trouble shooting and eliminates all losses. All chassis in all models are the same, thus giving the purchaser the finest kind of protection, as the man who buys the lowest-priced model knows that he is getting as good as the buyer of the costliest, the difference in price being the difference in cost of cabinet, console, electrification, etc. All models are six tubes, the most being gotten out of the tubes employed, in tone quality and distance-getting.



CONSOLE MODEL Freshman Equaphase receiver, showing phonograph and set compartments.

Advanced Electrical Features

In the all-electric models, a power unit is supplied, and several new and interesting features can be found in this device. For the plate supply, the "B" part of the circuit resembles the standard eliminator as we know it. It employs a high voltage power transformer of standard design, consisting of one primary winding, a center tapped high-voltage secondary winding and a low-voltage secondary winding is used to supply the power. For rectification, a UX-213 full-wave type of tube is employed. The high voltage from the transformer is supplied to the two plates of this tube, and the current from the low voltage winding is used to heat the filament of the rectifier. The filter system consists of two choke coils connected in series in the positive wire and three condensers having a total capacity of 10 mfds. connected across the positive and negative wires at various points in the circuit. The output voltage is divided by means of a tapped resistor.

Unique Phonograph Pick-up

Each of the console models is notable for its built-in cone speaker, also having the power pack built in. Another model, which will undoubtedly prove popular, has also incorporated an electric phonograph pick-up. This is shown in the illustration. A novel, and important feature of this is that, unlike many other sets which are equipped with a jack to which a pick-up may be connected, this receiver contains the turn-table itself as well. This gives the users, when radio signals are not being received, an orthophonic phonograph reproducer of the highest order. With the improved type of pick-up used and the excellent audio amplification consonants of the receiver itself, the phonographic component will render reproduction that will compare favorably with the signals sent out by the highest grade broadcasting station.

Parts Business Leads in Britain and France

By Herbert H. Frost

General Sales Manager, E. T. Cunningham, Inc.

[Maj. Frost, on his recent return from a trip to Europe, where he studied radio trade situations, analyzed the British and French markets. His observations follow.]

The French storekeeper appreciates the sales value of good display and makes use of show cards, window trim, etc., to a much greater extent than the average American dealer. For this reason beautifully colored backgrounds and counter cards are in evidence in even the smallest stores.

I must confess that the French radio set is a mystery to me. There seems to be no agreed upon method of control devices as we know them and each set seems to be different from all other sets. Prices range from about $4 for a small crystal set up to $1,400 for an elaborate 9-"lampe" set, which is generally loop operated and has built-in speaker.

The home construction business is a big factor, although the average run of radio parts of French make is crude in design and of fragile construction.

Patience of a Saint Needed

It would seem that the construction of a set by the French radio fan would necessitate the utmost patience and perseverance. There seems to be no attempt at mass production of a standardized item and this naturally imposes an extra burden on the French purchaser. This situation brought forcefully to mind the great benefit which has come to the American public through the standardization work of the Radio Manufacturers' Association.

In the appearance of the loudspeaker, the French have shown their artistic trend and it must be said that in appearance each speaker is most pleasing to the eye. Speakers are made in every conceivable size, shape and color. Those selling at above average prices have the appearance of being hand-carved or hand-colored. There seems to be no predominance of type: horns, cones, cabinets, each securing a share of the market. Tubes and batteries (lampes and accumulateurs) are made in all sizes, voltages and with different non-standard bases, etc.

These articles are in great variety and are the products of various makers in Austria, Germany, Holland and Great Britain. With the exception of tubes and batteries very little apparatus or parts is of foreign make. The one outstanding exception seems to be the British-made Amplion loudspeaker, which is very popular.

The British Situation

The British public are very much interested in all phases of radio and willingly pay the ten-shilling government tax, imposed yearly upon the owner of a radio receiving set. British people and American people are very much alike, as far as the kind of programs desired are concerned.

In my opinion, the average Englishman has a greater appreciation of good music than his American cousin. This is evidenced by the predominance of high-grade music of the operetta type rather than lots of jazz. The public follow the trend of radio development and are interested in things new.

Crowds of people flock to the radio stores at noon and on the way home, and listen with intense interest to demonstrations of new sets, speakers, etc. The battery eliminator is just beginning to come into popularity.

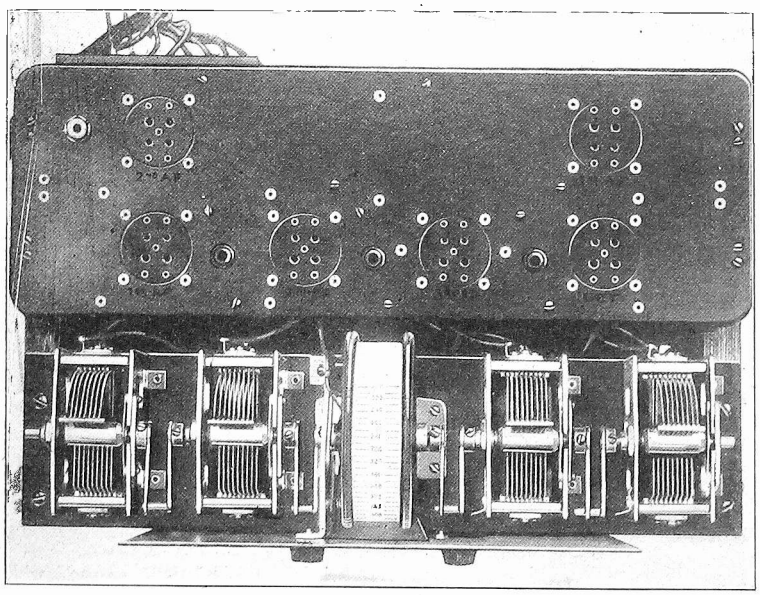
The system of broadcasting as now in effect is very satisfactory. Programs are selected with a great deal of care and offer diversified entertainment. The entire British audience are heartily in accord with the past efforts of the B. B. C. and their future plans. The opening of the new Daventry high-power stations was of great interest throughout Great Britain and with this station on the air with regular programs, the desire to own a receiver becomes ever more urgent than before.

Parts Business Leads

Technically, the B. B. C. seem to have a most enviable staff, headed by Capt. Eckersley.

Ceremonies of national interest are generally broadcast, one of the recent events being the dedication of the Menin Gate. Inter-Empire wireless is receiving a great deal of attention.

London is naturally the center of all things wireless in Great Britain and well stocked wireless stores are in evidence in all parts of the city. The average stock consists of about 80% parts and accessories and 20% sets. The parts business is the predominating business and will be for some time, due to the economy effected by building the set at home. This situation, however, does not apply to the higher priced field and many beautiful receivers are offered the man who can afford to pay. The trend is all towards sets in cabinets and with built-in accessories.



CHASSIS of the Freshman Equaphase Receivers, showing tube shelf. All chassis are uniformly constructed.

Fletcher Is Promoted to Vice-Presidency

H. R. Fletcher, director of sales of the Algonquin Electric Company, 245 Fifth Avenue, New York, manufacturers of the Algonquin Speaker, and Master Control Thermiodyne Receivers, has been made a vice-president and director of that organization.

Before identifying himself with the Algonquin Electric Company, ten months ago, Mr. Fletcher was connected with the Apco Manufacturing Company as sales director. Previous to entering the radio industry, Mr. Fletcher was connected for eighteen years with the automobile industry. He was first a distributor of Hudson cars and Stewart Trucks, later an officer and sales manager of the Stewart Motor Corporation of Buffalo, resigning to become vice-president and manager of C. T. Silver Motor Company, eastern distributor of Overland and Willys-Knight cars, and was also general manager of the Stutz Motor Company.

Sarvas Is Marketing Tritox Trickle Charger

The Sarvas Electric Company, New York, has been appointed a licensee of the Westinghouse Electric Manufacturing Company under the Rectox patents. The new Tritox trickle charger, made and sold under this agreement was a Sarvas-Westinghouse product by Sarvas Electric, employs the unique dry-rectifier developed by Westinghouse. This rectifier has a special metal and does not deteriorate with age or use.

The new Sarvas-Westinghouse unit is housed in a metal case, contains an automatic relay for the operation of B eliminator and storage battery and has a trickle taper-charge which starts at approximately 0.75 amperes. The new trickle charger is to be distributed nationally.

WJR SENDS PHILCO HOUR

Detroit.

The Philco Hour, prominent feature on the National Broadcasting Company's Blue network, every Friday evening at 9 p.m., E.D.S.T., is now also being sent out through WJR.

A THOUGHT FOR THE WEEK

AS times change, so do minds, and especially those of the editorial type. Motion pictures were for years a more or less potent factor in the lives and business of our people before the daily press paid much attention to them—and it was only a few years ago that the big metropolitan newspapers began to devote space to critical reviews of the photodrama. These same papers have not lost much time in devoting important space to radio, which today takes up a greater number of columns in our papers than is devoted to all the activities of various branches of the theatre, including motion pictures. Perhaps by their space ye shall know them!

SIXTH YEAR

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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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Music From Moving Ship To Be Broadcast

Arrangement have been made by the Radio News station WRNY to broadcast from the ball-room of the S.S. Vollendam, a concert by the ship's orchestra, while she is sailing down the bay on Sept. 24 at ahout 11 a. m. This will be accomplished with a short wave transmitter, which will be in stalled aboard the vessel. The signals of this outfit will be picked up in New York and re-transmitted on WRNY's regular wave of 309.1 meters.

AF Resistors Must Keep Cool At Work

The failure of resistance coupled amplifiers to continue to give good and undistorted quality is sometimes due to the breaking down of the resistance elements. In the days of the carbon paper type of resistor it was said that the carbon disintegrated with use, and the failure of the amplifiers was then attributed to that. Complete failure was preceded with a period of noisy and scratchy reception.

Metal film resistors were substituted for the carbon type and it was thought that the trouble of noisy reception was at an end. But metal film resistors, while splendid when not overtaxed, break down when they are subjected to abuse, that is, when they are required to dissipate a higher wattage than intended. One may use the general run of present day resistors with safety, except in a few exceptional cases.

What are the wattage requirements of some of the resistors in a typical resistance coupled amplifier? Let us begin with a plate resistor of 0.1 megohm in the plate circuit of an —01A tube.

The voltage applied might be as high as 180 volts. The resistance of the tube may be taken as 25,000 ohms, or twice that of the internal plate impedance. Hence the total current in the resistor will be 180/125,000 ampere, or 1.44 milliamperes. This is a mean value of the varying current in the plate circuit. The heating effect of the varying current will be a little more than the heating effect of the mean value. Let us assume that it is that of 1.5 milliamperes. The wattage dissipated in the 0.1 megohm plate resistor is then 225 milliwatts. This is not a high wattage but it may be high enough to make the film of the resistance element red hot, at least in spots. If the film gets too hot in one spot the resistance element disintegrates at that spot and the heating is transferred elsewhere. When there is no continuous path for the current and the resistor is useless, a resistor of this size and type should stand a power dissipation of at least one watt without appreciable rise in temperature of the resistent film.

Case of High Mu Tubes

Let us now take the case of a high mu tube with a plate resistor of .25 megohm and a plate voltage of 180 volts. The direct current resistance of the tube may be taken as 250,000 ohms. The total resistance is therefore .5 megohms, and the current will be .36 milliampere. We can then assume that the effective heating current is .4 milliampere. The power dissipated in the .25 megohm resistor is then 40 milliwatts. This is much smaller than the dissipation in the .1 megohm resistor in the previous case. If the resistance element in the .25 megohm resistor is evenly distributed, there would be no undue heating, yet the resistor used should be rated at least .1 watt to give a large factor of safety.

It is obvious that the plate resistors are subjected to heating when in use, but it is not so obvious that the grid resistors are not so subjected. Yet it is the grid resistors which usually break down first, particularly the resistor on the grid circuit of the power tube. There are two causes for this failure of the grid leaks. One is the alternating current which flows through them and which gives rise to signal voltage on the tube succeeding. The other is the grid current which will flow when the grid goes positive. This is often aided by leakages through the insulation.

Suppose there is no direct current leakage through the resistance but that we have a heavy signal voltage across the resistor. The maximum input voltage to a —71 type tube is 40 peak volts. This is equivalent to 28.3 effective volts. Now if the resistance of the leak is 2 megohms the current will be 14.1 microamperes. The power dissipated in the resistor is then .4 milliwatt. This is very small and it seems too small to cause any damage to the resistance element. If the resistance film is evenly distributed there would be no danger but if there are thin spots in the element the resistance would be concentrated at these spots, and most of the power would be dissipated at them. The excessive heating at such spots would break up the resistance element and the heating would be still further concentrated elsewhere. Usually the resistance element is not evenly distributed in commercial leaks, as can be seen with the unaided eye. The conducting film is thinner near the middle of the leak.

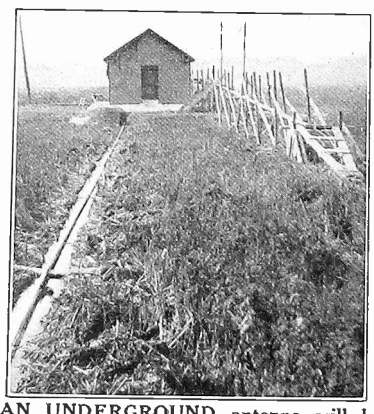
Now let us investigate the effect of the direct current which flows when the grids go positive. In high mu tubes, such as are ordinarily used in resistance coupled circuits, the grid current is very large when the grid goes positive. The grid current is comparable to the plate current and in some cases may exceed it.

Effect of Voltage Drop

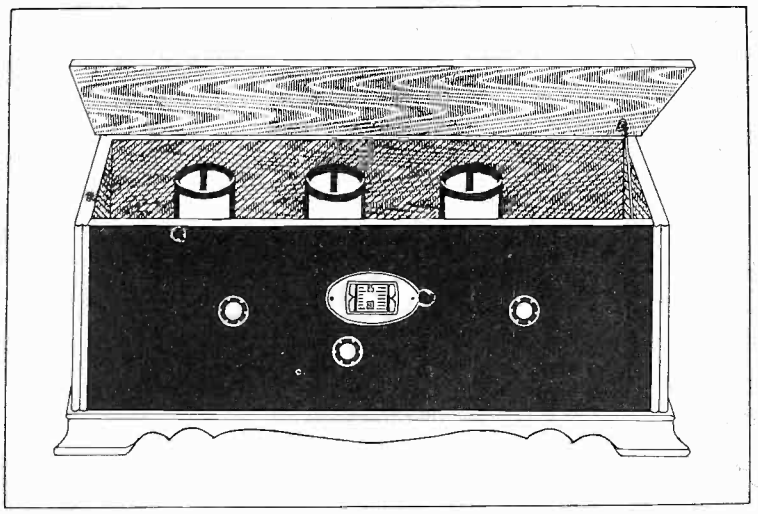
But if there is a high resistance leak in the grid circuit the grid voltage cannot go very much positive because as soon as grid current flows the voltage drop in the resistance tends to make the grid less positive. A balance is established with the grid voltage such that a few milliamperes will flow. Let us assume that it may go as high as 20 microamperes. The power dissipated would then be .8 milliwatt. The total power dissipated in the leak would then be 1.2 milliwatts. This is very small but if it is all dissipated near the center of the grid leak it is enough to break up the resistance element.

In purchasing grid leaks for resistance coupled amplifiers it is well to get leaks which are guaranteed to dissipate continuously a wattage several times that required in the set. It is better to buy one leak which will stand up in service even if it costs three or four times as much as leaks which will not stand up. The better leaks are a guarantee against interrupted reception.—J. E. A.

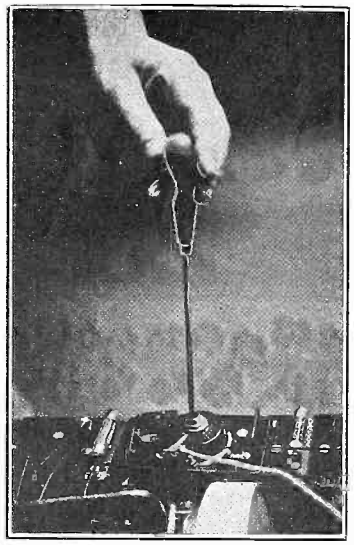
A SUB-ANTENNA



AN UNDERGROUND antenna will be used by WGL at its new location in Secaucas, N. J. Here it is shown just prior to submergence.



A VIEW OF THE SET in a cabinet.



ADJUST the Phasatrol carefully.

The Unified Diamond Is Readily Balanced

By the Laboratory Staff

PART III

The balancing of the Unified Diamond consists of two operations—the synchronization of the tuning and the stabilization of the tuning. The Remler three-in-line condenser, comprising really three separate condensers, has built-in trimmer condensers, and these are easily reached with a screwdriver or a stick of wood with a sharpened driving end.

Getting the three circuits to tune in step is the trick, but it is not difficult. After that much is accomplished one may find that the receiver squeals badly, and if it does, so much the better.

A set that does not give squeal prior to stabilization is likely an insensitive receiver, so welcome the squeals.

These are gotten rid of easily enough, too. That is what the Phasatrol does—renders the set operative and efficient at all broadcast wavelengths.

The First Operation

Now, to take up the tuning synchronization. You will find the trimming condensers have a considerable capacity variation, and you will want to use only as much of this additional capacity as necessary, since whatever is used becomes a part of the total minimum capacity. Hence set the condensers for low capacity, which a turn or so with the driver, in right-to-left fashion, will do. Now you do not know whether the three circuits represent the same capacity in each at any one setting, nor do you know what effect the antenna capacity may have on the first tuned stage. But you do know that when the circuit is resonant, or very close to resonant, that at the higher frequencies it should squeal.

So you select some station, preferably one from which the signals are not ordinarily loud, and see that it is a station somewhere on the lower part of the broadcast band.

We would recommend that a wavelength of less than 350 meters be used for the matching of the tuning devices.

Now you will turn the trimmer knob of the Remler three-in-line condenser until you bring in the station as loud as is possible. Be sure that the Phasatrol is set with adjustment at or near the extreme left-hand side, and that the B voltages are of the recommended values.

Setting Trimmers

Now you are ready to adjust the trimmers. You turn any one of them in either direction. Let us say you choose the extreme right-hand one and you turn it "out," meaning to the left. Assuming that the volume decreases, you know that you are moving in the wrong direction. When you turn it back to where it was the volume does go up, but when you proceed beyond that point, let us say, the volume diminishes once more. Well, it is obviously best to leave the trimmer in its original position, something easily to remember. Proceed in the same manner with the other trimmers, being guided by the fact that squealing is your best friend, and that when you bring it about you are where you want to be.

In the process of synchronizing the first stage be sure to take advantage of the adjustable primary of the Aero Universal coil. Laboratory experiments proved that the set worked best when the primary was pushed down almost to maximum position, but in other locations other situations may develop.

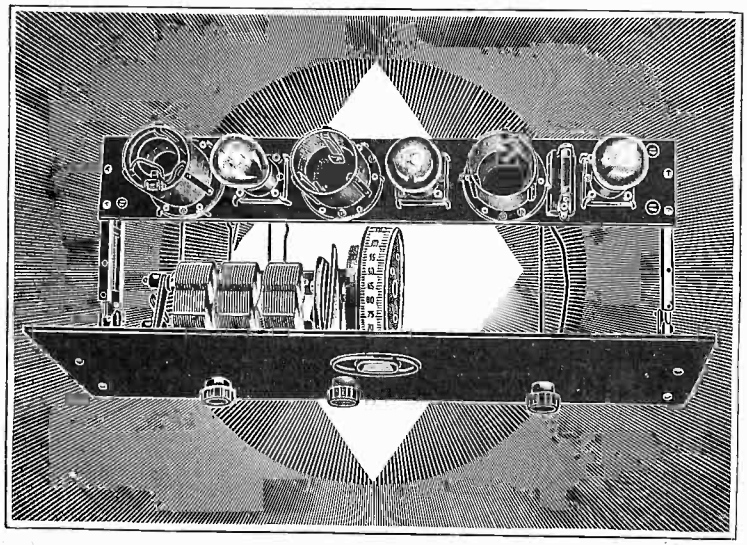
Assuming that squealing has been gained, this is gotten rid of by adjusting the Phasatrol by right-hand turning. A critical point will be reached, before which there is squealing but after which there is a severe drop in volume.

Squeeze In

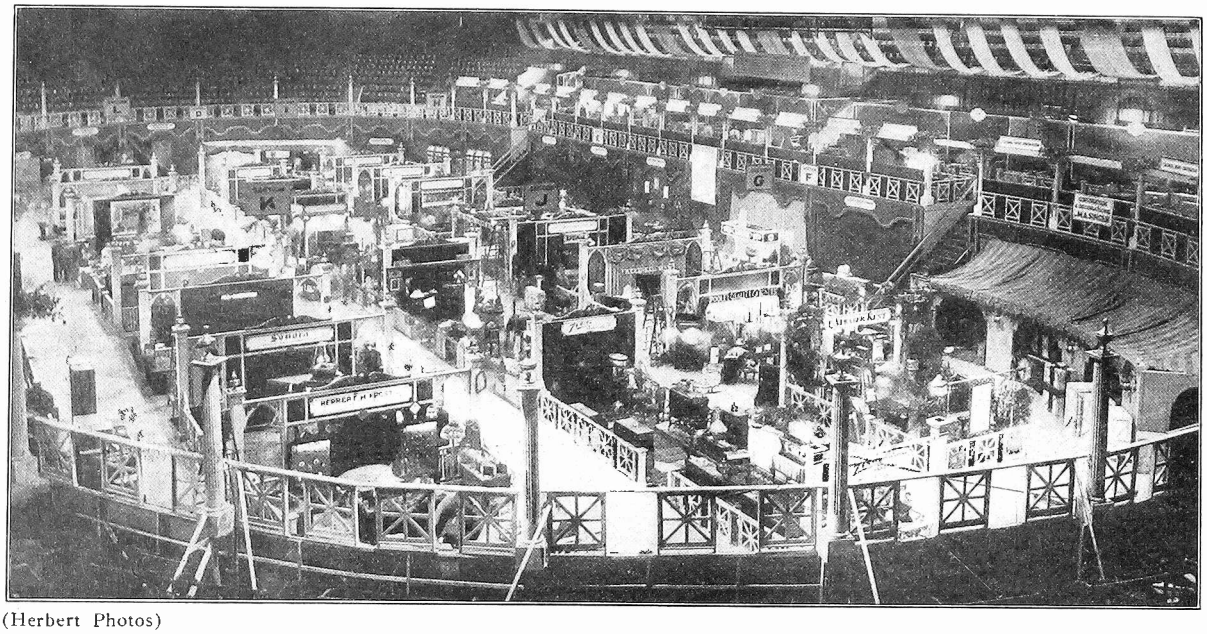
You want to squeeze between these. If the turning of the Phasatrol does not accomplish the desired result it is evidence that the RF plate voltage is too high for the electrical constants, including antenna coil position. Therefore reduce this voltage somewhat and then adjust the Phasatrol until the squealing stops. Your set then is synchronized and balanced.

The only kink is that adjusting the Phasatrol affects the period of the first RF tube and to a somewhat lesser degree the second RF tube. So compensate with the first trimmer (extreme left, nearing the front panel), when a new adjustment is made of the Phasatrol.

[*This concludes the articles on the Radio Frequency Fountain, begun in the Sept. 17th issue. Next week, the Audio Frequency Basin.*]



TOP VIEW of the Radio Frequency Fountain



(Herbert Photos)

A GENERAL VIEW of the main exhibition hall of the Madison Square Garden, where the Fourth Radio World's Fair was held.

Dubilier Sues R. C. A. Over Power Patents

THREE suits were filed against the Radio Corporation of America, the results of which may involve millions of dollars, affecting the entire radio industry as far as power-operated sets and battery eliminators are concerned.

These suits were filed in the United States District Court at Wilmington, Delaware, by the Dubilier Condenser Corporation, charging infringement of patent rights. The bills of complaint allege that the Dubilier Corporation is the exclusive licensee under patents 1,455,141, granted May 15, 1923; 1,606,212, granted November 9, 1926; and 1,635,117, granted July 5, 1927, and charge that the Radio Corporation has infringed upon the patents by reason of the sale of certain radio receiving apparatus and loudspeakers. Dubilier asks the court for an injunction restraining the manufacture and sale of infringing apparatus for an accounting of profits and for damages.

Called Greatly Valuable

The patents are claimed to be of great value in the radio art, and to cover the means whereby radio receiving sets and loudspeakers are operated from alternating current electric light circuits.

The Dubilier Company developed the first battery eliminator and placed the original Super Ducon on the market more than three years ago, anticipating the public requirement that batteries in use with radio sets must be eliminated. Over $500,000 was spent by the Dubilier organization in pioneering and developing this eliminator, with the result that at present practically every big company is supplying units to operate from electric light lines or with battery eliminators for that purpose.

The first Super Ducons supplied on the market did not prove successful because the tubes proved inoperative, but later when the tubes were developed the Super Ducon battery eliminator was changed over, with the result that the eliminator then produced was the basis for constructing all the eliminators on the market.

Some Have Signed Up

Besides the three issued patents, there are over twenty pending applications, and these patents have already been recognized by many of the prominent manufacturers, such as Fansteel, Philco, Willard, Grigsby-Grunow-Hinds, Timmons, Federal-Brandes and others, which companies obtained licenses. Suits were started over a year ago against other companies. These suits will probably be decided this Winter.

A separate eliminator, such as is being manufactured by many companies, when sold to operate with radio sets, infringes the patents, says the plaintiff, so that if the patents are held valid, the Dubilier Corporation may be in control of the industry as far as the batteryless or power-operated set is concerned. Not only do these patents cover the radio sets, but they cover the power amplifiers and the loudspeakers as well, say Dubilier attorneys.

D.C. Charger and Eliminator

(*Concluded from page 5*)

are the better the elimination. The condenser is limited by the pocketbook and by the space allowed for the eliminator. The inductance of the choke coil is limited by the type of receiver with which it is to be used. If the inductance is large and is wound with fine wire the voltage drop in it will be excessive, particularly if a multi-tube set with power tubes is used. Also, if the circuit is resistance coupled, or if it is coupled with good transformers or chokes, a large inductance and high resistance in Ch will cause motorboating and kindred difficulties. Hence it is desirable to keep the inductance and resistance of Ch down as much as possible. But it should not be reduced in size. It should be wound with heavy wire.

Works Splendidly

As long as the circuit does not oscillate at any frequency, or as long as it is not very close to the oscillating point, there will be no trouble from hum even if the filter choke and condenser are small. As the circuit adjustment nears the oscillating point the hum increases rapidly. But it is not well to operate any circuit, except a Super-Heterodyne, with an oscillating condition anywhere. Hence the eliminator is practical. Although the normal operation in a Super-Heterodyne calls for oscillation, the eliminator can be used even on that circuit, because the oscillation is not in one of the detectors or in the amplifier.

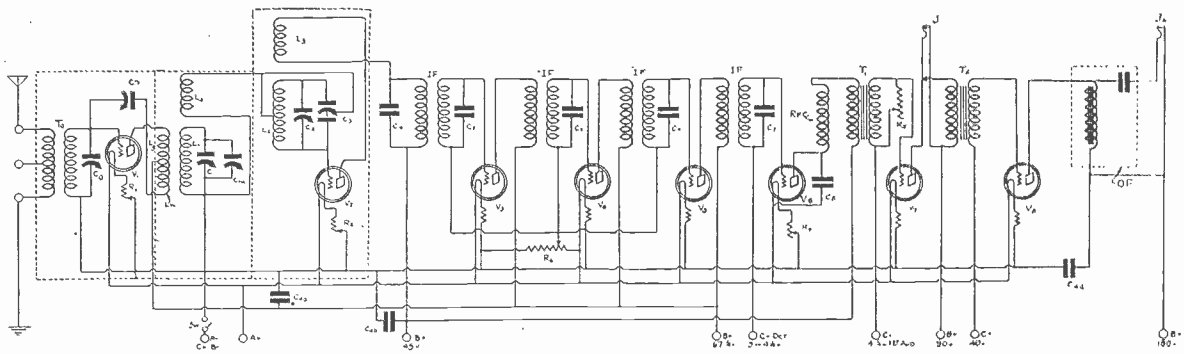
An eliminator of the above type has been used by the writer for a long time with excellent results in various types of circuit. In a five tube receiver of one stage of RF, a regenerative detector, and three stages of resistance coupling it gives exceptionally good results. If the choke is of the order of 30 henrys the circuit motorboats, but if the primary of an old power transformer is used there is no sign of motorboating nor audible hum, except when the detector is very near the oscillating point.

4 Mfd. Works Well

The coil used contains 1,500 turns of No. 26 enameled wire on a square silicon core ¾-inch on the side. The same number of turns, or even more, could be wound on the form using wire several sizes large. This would reduce the resistance without altering the inductance much.

The condenser used with the same circuit and eliminator is 26 mfd. When no condenser is used there is a great deal of hum and a high-pitched squeal. The hum is not so much due to the lack of filtering as to the oscillation at audio frequency. When the condenser is 4 mfd. there is no squeal and the hum is also absent. Hence it would seem that for this circuit 4 mfd. is all the capacity that is actually required, though not all that is desirable.

Instead of employing a regular choke or the primary of a power transformer, the primary of a 40-watt toy transformer can be used for the choke.



THE CIRCUIT diagram of the Strobodyne.

Right Balance Puts Snap into Strobodyne

By Brunsten Brunn

WHEN selecting the bridge balancing condenser C3 it should not be forgotten that this condenser is in parallel with the oscillator tuning condenser, and that the capacity of the balancing condenser is in effect a large zero setting condenser as far as the oscillator circuit is concerned. Hence if the capacity of C3 is too large the tuning range of the oscillator will be limited. This, of course, is not desirable.

But the capacity of the midget condenser is not so large as its dimensions would indicate, because in effect the balancing condenser consists of two small condensers in series. The capacity of this series is less than the smallest of the two sections. When the rotor is set in the middle the capacity of the series is just half that of either section. This will be the normal setting if the midpoint on the oscillator coil has been located accurately. Suppose then that the capacity of each section of the balancing condenser is 30 mmfd. The capacity across the tuned circuit as a result of the balancing condenser is then only 15 mmfd. This is not excessive in the oscillator.

Capacity of the Balancers

The fact that the capacity of the balancing condenser is small does not militate against its value as a balancer. The only object of the arrangement is to make access to the potential midpoint possible, or access to a point of such potential as will exactly balance the bridge with the point chosen on the inductance coil.

The rotor of the balancing condenser should be capable of being locked securely after the adjustment has been effected. If it cannot be locked, jarring of the set will upset the balance and render the operation unsatisfactory until the circuit has been readjusted.

For most purposes it is not necessary to touch the vernier condenser Ca connected across tuning condenser C1 because the tuning with the common control will be sharp enough for all settings of the dials. But in some cases it aids in clearing up a signal from an extremely long distance station. It is well to have it available when DX hunting.

The balancing condenser Cn, which is connected between coil Ln and the grid of the first tube, can be adjusted in the following way. Tune in a loud station accurately. Open rheostat R1, that is, turn out the tube but leave it in the socket. There will undoubtedly be some signal left.

LIST OF PARTS

C0, C1, C2—Three Hammarlund .00035 mfd. condensers.

T0—One Hammarlund Auto Couple coil, specially tapped.

L1, L4, L5—One Hammarlund Auto Couple coil, special.

L2, L3—One Hammarlund Auto Couple coil, regular.

IF—Four Radio Electric Lab. R.F. units (tuned).

C4, C7—Five Radio Electric Lab. matched condensers.

T1, T2—Two Samson audio frequency transformers.

OF—One Interstate Sales Co., output filter.

RFC—One Samson No. 85 radio frequency choke coil.

C3—One Cardwell compensator condenser, one rotor, two stators.

R1, R2, R7—Three 20-ohm Carter rheostats.

R6—One 400-ohm Carter poteniometer.

C4abcd—Four .5 mfd. Dubilier by-pass condensers.

C8—One .002 mfd. Dubilier condenser.

Sw—One Carter filament switch.

J1, J2—Two Carter jacks.

Four 1-A Amperites.

One No. 112 Amperite.

C1a, Cn—Two Hammarlund balancing condensers.

R5—One 100,000-ohm Electrad variable resistor.

Three Hammarlund aluminum shields.

Eight Benjamin UX sockets.

Twelve X-L push type binding posts.

Two National vernier dials.

One 8x24x3/16 inch Micarta panel.

One 12x25¼x¼ inch Micarta sub-panel.

Six doz. 6-32, 1 inch machine screws, with nuts.

One and one half feet angle brass ½x½ inch.

Two rolls of Belden rubber covered wire.

Spaghetti.

One Fritts cabinet to match panel.

One Hammarlund brass shaft ¼ inch diameter and 10¼ inches long.

Seven CeCo—01A type vacuum tubes.

One 112 type CeCo vacuum tube.

Tune until this is as loud as it will get with the volume controls set at maximum, if that is possible. Now adjust the setting of condenser Cn until the volume is minimum or entirely absent.

The stage is then neutralized. This method can be used when both the old and the new type of tube is used. If the old is used it is better to open the filament circuit by putting a piece of paper over the positive filament contact spring in the socket and then inserting the tube over it.

On many stations the volume given by this circuit will be great enough so that the loudspeaker can be inserted into the first jack. When that is done it is well to have larger tube to deliver the power to the speaker. Since the 112 type of tube is a good power tube when moderate volume is desired this is recommended. But the plate voltage should be raised from 90 to 135 or 157 volts. The grid bias should be raised simultaneously to 9 or 13 volts. It will do no harm to leave this tube in the circuit permanently even when the last tube is used to drive the loud speaker.

When the first audio tube is made a 112 or its equivalent the Amperite V7 should be made the same size as that used for the -71 type tube, that is, it should be a No. 112 Amperite.

Question of Loop

It is not necessary to use an output filter with the 112 tube so that it is safe to connect the loud speaker directly into the plate circuit of that tube.

While an open circuit antenna, even a short indoor one, is generally preferable to a loop pick-up system, many persons prefer a loop with super-sensitive circuits. The Strobodyne can readily be changed over to loop operation. All that is necessary is to remove transformer To and connect the loop terminals where the secondary of To were connected.

The substitution of the loop antenna may start the first tube to oscillate at the lower wave settings. If this is so, it is because the loop has a much lower resistance than the antenna. It may be necessary to neutralize the stage again to reduce the back coupling.

The one advantage of the loop is that it is directional in its pick-up. Now and then this property can be taken advantage of when there is image interference between two stations. This trouble is severe in ordinary super-heterodynes but in this it only gives rise to a feeble whistle when it is at its worst, and it is a rare occurrence in the Strobodyne.

The Power Tube

The loop can be used for eliminating a whistle arising from this cause by simply training the loop so that it picks up nothing of the interfering station. This is always possible by simply turning the loop at right angles to the interfering station.

[*The construction of the Strobodyne was described by Brunsten Brunn in the September 17 and 24 issues.*]

Radio University

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HOW can the capacity of two or more condensers connected in series be found?

(2)—How is the capacity of two or more condensers connected in parallel determined?

(3)—Please publish a diagram showing how condensers are connected in series and in parallel.—Albert Wagner, San Diego, Cal.

(1)—The capacity of two or more condensers connected in series is found by adding the reciprocals of the capacities of the several condensers and then taking the reciprocal of this sum. For example, let the capacities of two condensers be 1 mfd. and 2 mfd. The reciprocals of these numbers are 1 and .5 respectively, the sum of which is 1.5. The reciprocal of 1.5 is 2-3 or .667 mfd.

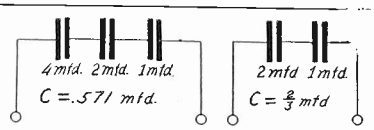
(2)—The individual capacities are added to get the total capacity.

(3)—Fig. 566 shows condensers connected in series and Fig. 567 shows them in parallel.

* * *

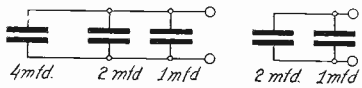
IS THERE a simple rule whereby one can estimate the maximum current which a copper wire will safely carry? If so, please give it.

(2)—Will the same rule hold for resistance wire like the nickel-chrome alloys?—Lloyd Baker, Portland, Oregon.



Series Connections of condensers

FIG. 566



Parallel Connections of Condensers

FIG. 567

(1)—It is usually safe to allow one milliampere per circular mil of wire, the rule being a mil per mil. (A circular mil is the area of a circle the diameter of which is 001 inch). Thus a No. 36 copper wire, which has a diameter of .005 inch is 25 milliamperes. The rule holds where there is reasonable ventilation of the wire.

(2)—The same rules does not hold for resistance wire because it develops much more heat in the same volume of wire.

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DATA ON the new Raytheon rectifier cartridge appeared in the May 21 issue of RADIO WORLD. Send 15c for this issue or begin your sub. with this issue. RADIO WORLD, 145 West 45th St., New York City.

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HOW TO BUILD RADIO WORLD'S Four-Tube Universal Receiver fully described by Herman Bernard in the March 12, 19 and 26 issues of RADIO WORLD. Send 45c and get these three numbers. RADIO WORLD, 145 West 45th Street, New York City.

The Salesman's Set

(Concluded from page 7)

tap of the loop is also brought out from the back side and the lead terminates in a phone tip.

When the loop is folded it fits into the front cover directly over the list of stations and the log book seen there, in Fig. 1.

The filament switch is at the extreme left end of the front panel, in the lower corner. Then follows the vernier dial for the loop tuning condenser. The oscillator condenser dial is at the opposite end, and an output jack matches the filament switch.

Six Volume Controls

The various volume controls are placed in the center of the panel. There are six of them, all labelled to facilitate operation. Heading the knobs from right to left, the first controls the regeneration condenser in the first detector, the second controls the grid bias potentiometer, the third the filament current in the intermediate frequency amplifiers. The knobs in the lower row control the filament currents in the detectors, the oscillator and the audio tubes in the order named.

The middle section of the cabinet displays nothing but scrollwork and a curtain of silk. Back of these are the loud speaker horn and some of the batteries. The lower compartment—that part which is not covered by the lid—contains tools, wire and spares, and so on.

The completed receiver closed up for carrying is seen in Fig. 4 right. Fig. 2 depicts the receiver from the rear with the back cover removed. The loud speaker is in the central compartment and here also is the grid battery. The four 22½-volt dry cell batteries are at the sides and the three No. 6 dry cells for the filament current are directly over the speaker compartment.

The circuit diagram of the receiver is shown in Fig. 5.

The size of the specially constructed cabinet is 14¾ inches wide, 9½ inches deep, and 12½ inches high. The panels, both front and rear, are 14x4½ inches. The front panel is hard rubber and the rear panel The loop is 17½x13¾ inches.

Good Back Numbers of RADIO WORLD

The following illustrated articles have appeared in back issues of RADIO WORLD in 1927.

MAY 21.—Part I of a three-part article on the Victoreen Portable receiver, by Capt. P. V. O'Rourke. Data on the new Raytheon cartridge.

MAY 28.—A three-tube reflex, using a special low pass filter system, by Edgar B. Francis. Part II on the Victoreen portable receiver with layout data, by Capt. P. V. O'Rourke.

JUNE 4.—Part III of a three-part article on how to construct an efficient portable Victoreen Super-Heterodyne, by Capt. P. V. O'Rourke. A complete discussion on the RCA AC tubes.

JUNE 11.—Detailed discussion of a four-stage push-pull resistance coupled audio amplifier, by J. E. Anderson. The Suitcase 6, using a tuned RF stage, two untuned RF stages, regenerative detector and two transformer AF stages, by James H. Carroll. Balsa Wood for speakers, an excellent discussion on how this wood may be employed for speakers, by H. B. Herman.

JUNE 18.—The six-tube Equamatic, a neutralized two-stage tuned RF, three-stage AF resistance coupled set, by Herbert E. Hayden. How to get the low notes with transformer or impedance AF, by Dennis J. O'Flaherty.

JUNE 25.—The Lindbergh Plane Speaker, an excellent cone type reproducer, by Herbert E. Hayden. A tube and set tester, by Herman Bernard.

JULY 2.—The Planofier 7, single control super-sensitive set using resistance AF by R. F. Goodwin and S. S. Bruno. Discussion on the new Freshman Equaphase, by Robert Sagala. Data on the six types of units used for loud speaker operation, by J. E. Anderson.

JULY 9.—How to build a DC A supply where the line voltage is 220 or 240, by Frank Logan. Important data on RF choke coils, by Horatio W. Lamson.

JULY 16.—How to use a voltmeter as a milliammeter, by D. Barretti. How to build a 4-tube, 2-control regenerative portable set.

JULY 23.—Building a 7-tube Super for your auto, using Victoreen IFT, by John F. Rider (Part I). How to build a 6-tube neutralized set, using three tuned RF, two transformer AF, by John F. Rider. Inside dope on motorboating, by J. E. Anderson.

JULY 30.—A 5-tube standard TRF set adapted to AC operation by the use of the QRS 400 mill rectifier tube, with the aid of series filament connections, by RF Goodwin and S. S. Bruno. Shielding the 11-tube Melo-Heald Super-Heterodyne receiver, by Clifford Denton. Part II of the two part article on the Super in the auto by John F. Rider. How to control volume in AC sets by D. Ferrup.

AUG. 6.—A three-tube regenerative portable with portion of the cabinet as the speaker, by M. J. O'Reilly. The Cashbox Unitune, an ingeniously contrived four-tube quality receiver by Wendell Buck. How to use AC tubes by C. T. Burke.

AUG. 13.—Hints on constructing a portable set, by Herbert E. Hayden. A seven-tube, two-control AC operated receiver by Capt. P. V. O'Rourke. Obtaining the C bias in an ABC unit, using the BA Raytheon 85 mill tube.

AUG. 20.—The Four AC, a four-tube regenerative set employing AC tubes. Tim Turkey's argument on why rheostats should not be used as volume controls. The Drum Powertone, a five-tube single control set, using resistance coupled audio.

AUG. 27.—Part I of a four part article on building the 1-Dial Witz, a single control, voluminous selective 5-tube set, by A. Irving Witz. A detailed explanation of the exponential type of horn by H. B. Herman. Details on the revolutionary Reisz condenser type of speaker. Constructional data on a special 5-tube, 2-dial regenerative set, with three stages of AF, by Tim Turkey.

SEPT. 3.—Part I of a four-part discussion on the new 1928 Victoreen Universal, a super-sensitive 8-tube Super-Heterodyne, by Capt. P. V. O'Rourke. Complete data on the three types of phonograph pickups, by J. E. Anderson. Part II of the 1-dial Witz, wiring hints emphasized.

SEPT. 10.—The Puratone AC set, a 6-tube duo-control receiver, using AC tubes, by R. F. Goodwin and S. S. Bruno. Part II of the 1928 Victoreen Universal, discussing the placement of parts. Part III of the 1-Dial Witz on the special placement of the coils.

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Electrical Constants in AF Play Vital Part

By John F. Rider

Associate, Institute of Radio Engineers

When discussing audio amplification one should not fail to mention some of the electrical constants in the audio system. These figures are advantageous for two reasons—first, to explain the action of the units in the circuit, second, to acquaint the fan with the data which may prove of great utility later on, if not at present.

Let us consider, by instances, the various audio coupling units in a push-pull audio circuit like the one I described in last week's issue, using Samson parts. The inductance of the primary of the input push-pull audio frequency transformer is approximately 32 henrys at 60 cycles, with direct current in the windings. The reactance is therefore 12,032 ohms at 60 cycles. Because of the high-phase angle of the iron, the impedance of this circuit is practically equivalent to its reactance. Fear of burnout due to excessive plate current flow is eliminated in the design of the winding, since the primary winding will safely carry 60 milliamperes, which figure is many times the maximum value encountered in actual practice.

A similar situation is found in the plate coupling impedances. The inductance of the plate coupling unit at 60 cycles with DC in the windings is 175 henrys. This means an approximate impedance of 64,000 ohms at 60 cycles. The DC resistance of the winding is only 3200 ohms and there is very little voltage drop across the impedance winding. The inductance of each of the grid chokes is 225 henrys. The inductance of each leg of the push pull output impedance is 18 henrys at 60 cycles and the DC resistance of the windings is only 650 ohms. The voltage drop across this choke and the reduction in effective plate voltage upon the output tubes is therefore negligible.

With respect to the energy transfer from the tube to the coupling unit. As a concrete example, let us consider the tubes which I used in an installation. These were Zetka 112As and 171s. The tube which fed the audio amplifier, and still feeds the amplifier, is a Zetka 112A. The output impedance of this tube is approximately 6,000 ohms at 100 volts. With the high value of load impedance and this small value of tube output impedance, the energy transfer on even the lowest frequency, 60 cycles, is excellent.

The same applies to the tubes feeding the impedance coupling units, except that at the plate voltage of 135 the tube output impedance is around 4800 ohms. The impedance of the 171s at 180 volts, is approximately 2000 ohms.

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Interesting Issues of Radio World

MAY 14.—The distinction between voltage and power amplification, by Spaulding Spencer. Operating the Six-Tube Adams-Griffin Shielded Set, by Dana Adams-Griffin. (Part II.)

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