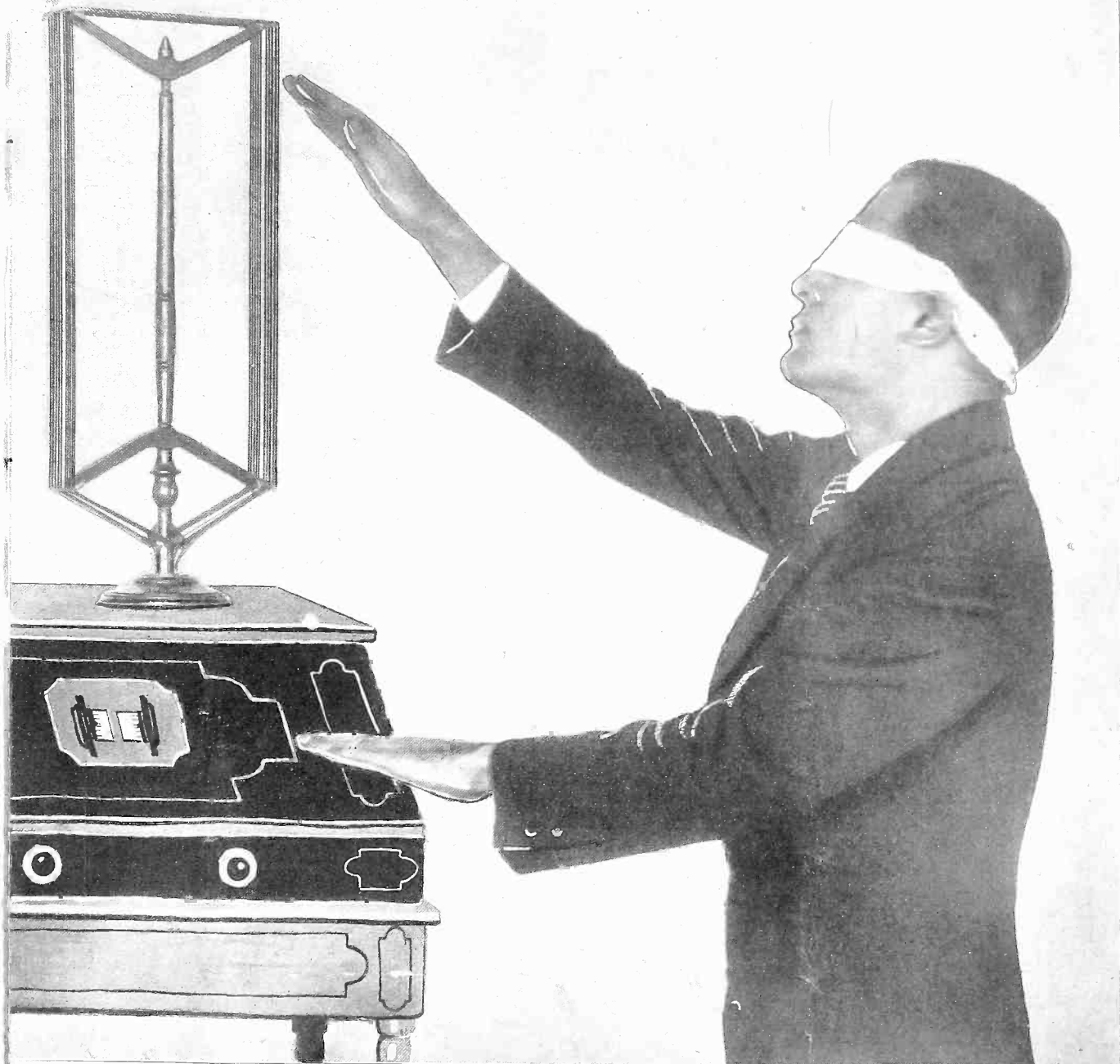


# RADIO WORLD

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America's First and Only National Radio Weekly

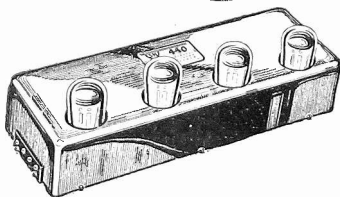
WHY BE FUSSY ABOUT FUSES?  
ALL BLASTS NOT WINTRY  
A 4-TUBE DX FOUNTAIN  
THE LABORATORY SUPER  
FENWAY AC CONCERTROLA



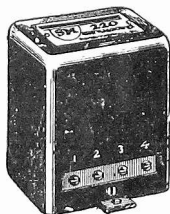
The Mystic Trouble Shooter. See Page 30

**SM**

## The Finest Long Wave Amplifier Ever Made



We Could Charge More—But A Better Transformer Can't Be Made



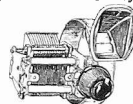
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## Talk About Gifts! And About the Gifted, Too!

The Holiday Gifts Number of Radio World will be the December 10 issue—alive with the Christmas spirit, full of ideas on what to buy for Christmas in the radio parts, accessories and set fields—Fit for Superlatives That Rightly Ride on Santa's Sleigh.

Dated December 10, to press on Wednesday noon, November 30, on the news-stands Wednesday, December 7, all over the United States, and in our subscribers' hands before December 7, the Holiday Gifts Number will be a resplendent, inspiring, stimulating, pulling number.

### EDITORIAL FEATURES INCLUDE

- "Three Months With the Great Recreator," by J. E. Anderson, Technical Editor.
- "High Mu Tubes as Detectors," by Robert W. Sandell.
- "Giving the Crackles the Gate," by Tim Turkey.
- "What Every Novice Should Know," by James H. Carroll, Contributing Editor.
- "Welcome Radio Christmas Gifts," by Herbert E. Hayden.
- "The Everyman Four," as designed by Fred H. Ehlart.
- Front cover in colors, I. Ticktin, "The Caroler."

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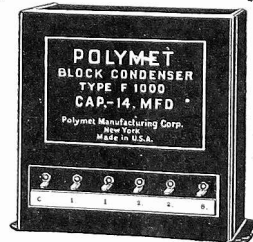
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# RADIO WORLD

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## All Blasts Are Not Wintry And All Motorboating Not Summery Pastime

By Brewster Lee

MANY violent inectives have been hurled at resistance coupling as a system of amplification, due partly to its noise-making proclivities and partly to the lack of knowledge on the part of some of those who have used it. There are two main difficulties met in resistance coupled amplifiers. One is "motorboating," the oscillation resulting from feedback through the common grid or plate impedances. The other is blocking of the grids, which is caused by insufficient leakage from grid to filament, or to excessive leakage from the plate to the grid or through the stopping condenser. Blocking is also induced by inadequate grid bias and by overloading of the grids.

In the case of blocking the remedy is usually very simple. A lower value of grid leak resistance will remedy the trouble in most cases. In nearly all cases where blocking starts in a set that has been giving good service for some time it is due to the disintegration of the resistance element in the leak. This happens quite frequently and the instant remedy is the substitution of a fresh leak for the one which has burned out.

If the resistance of the grid leak has to be very low before the blocking difficulty is cleared up, the trouble is probably due to a leaky stopping condenser, to leaky insulation of the grid and plate elements, or to serious overloading of the grid which blocks.

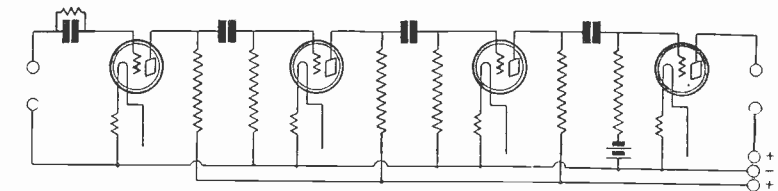
### Cut Down the Intensity

If overloading is the cause, the trouble is greatly reduced by reducing the signal intensity on the tube, which may be done in the radio frequency portion of the circuit. If the insulation of the grid and plate elements is defective, the substitution of a new and better made socket should remove the trouble. The same remedy is applicable if the condenser between the plate of one tube and the grid of the next is defective.

The insulation in the condenser and the insulation between the grid and the plate the high positive voltage of the plate of any one tube insulate the same grid from supply.

For proper operation of the tube as an amplifier it is essential that the grid leak conductance be so large in comparison with the conductance of the other possible paths that all the stray leakage can be neglected in comparison with the intentional leakage through the grid leak. When this is the case the circuit will behave properly even when the grid goes slightly positive now and then.

If the insulation of the grid is very high when the grid leak has been removed, the circuit will operate normally when a leak of from 1 to 10 megohms is inserted in the clips. But if the insulation is poor when the grid leak is out, the leak may have to be reduced to 50,000 ohms before the circuit is immunized from blocking. And



THIS FOUR CIRCUIT RESISTANCE COUPLED AMPLIFIER MAY MOTORBOAT AT A FREQUENCY BETWEEN 5,000 AND 20,000 CYCLES. A 1 MFD. CONDENSER ACROSS THE B VOLTAGE SUPPLY WILL CURE IT. OR IT MAY MOTORBOAT AT A FREQUENCY OF LESS THAN ONE CYCLE PER SECOND. SMALLER STOPPING CONDENSERS OR LOWER VALUES OF GRID LEAK RESISTORS USUALLY STOP IT.

then the amplification is so low that neither signals nor trouble will be obtained.

### Self-Oscillation

Blocking often results from an oscillation in the circuit, and the oscillation need not be at an audible frequency. It may be at radio frequency. If it is intense the grid of one or more tubes is overloaded and blocking will result. The rate of blocking and unblocking may be at an audible frequency, and usually is.

"Motorboating" is not so easily remedied as blocking, particularly when it is of a very low frequency, and is therefore more troublesome. In fact "motorboating," being an oscillation which may be violent, may give rise to blocking, both by overloading the audio tubes and by burning out the grid leaks. The cause of "motorboating" is coupling between the various amplifier tubes. Practically all of this coupling is the impedance of the B battery eliminator or the resistance in series with the B battery. The larger this impedance the more severe will be the "motorboating," if it occurs at all, except when it is so high that the circuit does not get enough effective plate voltage to amplify. Anything that reduces the impedance of the voltage source will reduce "motorboating" or regeneration.

### Where Big Capacity Is Needed

If the oscillation is above about 100 cycles a moderate size condenser across the plate voltage source will remedy the trouble, say a condenser of 4 mfd. capacity. If the frequency is of the order of 16 cycles per second, the condenser has to be of the order of 25 mfd.

But neither of these two frequencies is the most troublesome. Resistance coupled amplifiers often oscillate, or "motorboat," at a frequency less than one cycle per second. A condenser is not a practical remedy in this case, because it would have to be of the order of 5,000 mfd. to have much effect. Only electrolytic condensers would be practical and even they would be very bulky to have the required capacity at the high voltages used for amplifiers.

The only practical way of stopping this low frequency oscillation, as well as that of frequencies up to 25 cycles, is to design the amplifier so that it is inefficient at frequencies below 25 cycles. In order to cut the efficiency down at 25 cycles and below it is also necessary to sacrifice the amplification a little at all frequencies up to about 100 cycles.

### How to Reduce Amplification

There are several methods of cutting down the amplification of the low notes so as to avoid "motorboating" at low frequencies.

One is the use of small stopping condensers between the plate of one tube and the grid of the other.

Another is the use of low value resistors for grid leaks. These two methods can be combined to make the "cure" more effective.

Still another method is to put an audio frequency choke coil across the line. That is, to use an audio frequency choke coil in place of either a plate coupling resistor or a grid leak, or both, as is done in the double impedance method of amplification. In this method impedances are used to cut the amplification at the sub-audible range to prevent oscillation there, and then regeneration or tuning is used at the lowest audible frequencies to boost the amplification at these frequencies.

The result is a sharp cut-off with no amplification and very little tendency to oscillate at the sub-audible frequencies, and full amplification over the audible range.

Resistance coupling is not the only system which is subject to "motorboating" and like troubles. All forms of coupling are subject to such difficulties. In some cases there is no actual oscillation at any frequency but there are amplification peaks which transform the theoretical straight line characteristic of the system to a jagged line as irregular as the New York sky line, or as a cross section of the Rocky Mountains.

This irregularity can be detected readily by the listener. On certain notes the sound

(Concluded on next page)

# Navy Base Tube Can Go On a Push Type Base

By James Quam

Anybody who has tried to use an old UV tube in a UX socket knows what an unsatisfactory combination the two make. In nine cases out of ten the contacts will not be firm and the consequent arcing will completely ruin the operation of a receiver.

But it is not always necessary to throw away the old UV tube, or to provide a UV socket for it. Not if there is a defunct UX tube around, and by this time there are a good many of them. The UV tube can be fitted with a UX base.

How is it done? The bases of the two tubes are first removed. This is done by heating the bases until the sealing wax melts or softens, and by heating the tube prongs until the solder melts. This operation is not easily accomplished with a soldering iron, since this heats the base in spots and is likely to burn the composition badly.

## The Best Way

Also, if the wax is melted first and then the solder, the wax stiffens while the solder melts, and then if the wax is re-melted it will be found that the solder has set again.

The best way is to hold the base in a flame, turning continually as when softening glass. Most of the heat is applied to the tips of the prongs. When both the wax and the solder are melted at once,

the base of the tube can be removed by simply pulling it away from the tube.

When both of the tubes have been "de-based," the UV tube is mounted in the UX socket and the other parts are rejected.

In mounting the old tube in the new socket several precautions are necessary in order to get a good tube out of the operations. In the first place the prongs on the UX base must be cleared of solder so that a fine wire can be run through them. The wires from the elements in the UV tube may be too short for the new prongs. They should be lengthened by soldering extensions on them, copper wire extensions of the same size as the old. It is well to make these extensions several inches longer than ultimately necessary.

## No Contact Danger

The wires in the re-entrant tube of the glass envelope of the triode are bare. There is danger that they will get in intimate contact with each other after the job is completed. If they do the work will have been done in vain—or worse. Put a piece of spaghetti around at least three of the leads, and measure the spaghetti so that it will neither be too long nor too short. Insulate the soldered joints particularly well.

Now thread one of the long extension

wires through each one of the prongs, making sure that the wires are put through the right prongs. It will not do to put the plate where the grid should go and conversely. Neither will it do to put plus A to the plate prong. To be sure that all are threaded correctly, test every one before it is too late. The extra long extension leads come in handy here. Bend the wires back over the prongs or the test may have to be repeated. The wires slip out very easily, much more easily than they go the other way. Many things are contrary that way, and this is one of those things.

## Seat The Old Tube

Now let us assume that the leads are through the right prongs and that no mishap has taken place after the test which established the correctness.

The first thing that should be done now is to seat the old tube squarely in the new socket. Heating the wax until it is plastic will help to give the old tube a soft berth in the new socket. The wax must be heated so that it will stick to the glass. This means that the glass, too must be heated a bit. When you are satisfied that the old tube is "sitting pretty" hold it until the wax has hardened.

Now then, tug at each of the extension wires which are protruding out of the four prongs until they are straight inside. But don't tug so hard that the extension wire parts company with the element lead. That does not speed up the job.

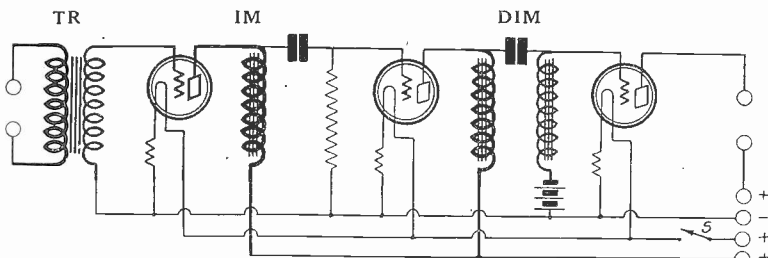
## When to Solder

When they are straight, apply a bit of solder to each tip, heating it with a hot "iron." The iron should be made of well tinned copper. Trim the extension wires off flush with the tips of the prongs and remove any excess gobs of solder.

If the job has been done carefully the tube should now be usable in a UX socket, but not vice versa. The pin on the side won't fit.

Does it pay to go through all this when a new UX tube can be obtained now and then for 89 cents? That is a question for each individual to decide for himself. It pays at least once just to get the experience and to learn how the tubes are put together. The second time it won't take so long.

# Irregular Amplifier Revealed by Ear Test



**BLASTING NOTES OCCUR MORE FREQUENTLY IN TRANSFORMER (TR), IMPEDANCE (IM) AND DOUBLE IMPEDANCE (DIM) COUPLED CIRCUITS THAN IN RESISTANCE COUPLED AMPLIFIERS.**

(Concluded from preceding page)  
is many times louder than it is on the other notes. Sometimes it is so loud that it blasts the speaker or crashes over the plate-current plate voltage characteristic. No matter how it appears, the noise is always unpleasant.

These blasting notes occur more frequently in transformer, impedance, and

double impedance coupled circuits than in resistance coupled amplifiers. The more nearly a reactively coupled amplifier is capable of straight line amplification over the entire audio scale, the more nearly it behaves like a resistance coupled circuit, except that transformer and double impedance circuits do not readily block although blast.

## New Power Tube Device Marketed

It is a known fact that many set owners are using receivers in which no provision has been made for the incorporation of a power tube. For the purpose of enabling these set owners to enjoy the advantages of power amplification, engineers of the Acme Apparatus Company have developed a power amplifier that may be attached to any set.

This amplifier consists of a stage of resistance amplification utilizing an im-

pedance leak, designed to prevent distortion through rectification and to prevent motorboating.

Provision is made for lighting the power tube filament from a transformer, while the proper grid bias is obtained automatically. All the set owner has to do is to connect his receiver to the amplifier and B supply, and plug into the electric light circuit.

The results are excellent.

## \$750,000 Belgian Station for Commercial Work

Washington.

A new powerful \$750,000 station has been installed by the Belgian government. The installation consists of a central station in Brussels, a sending station at Ruysselede and a receiving station in Liedekerke. The service is commercially to be known as "Belradio," has the call letters ORU. It is operated by the Government Telephone and Telegraph Administration under the Ministry of Posts, Telephones, Telegraphs, Marine and Aeronautics.

At Brussels all traffic will be concentrated, both on arrival and departure. All traffic will go by underground cables from and to the receiving station.

## Kolster Has New Beacon

A new radio beacon device has been perfected by Dr. F. A. Kolster, inventor of the Kolster radio compass. The device automatically transmits a warning signal over a 10 mile radius to other ships in its path, giving the exact location of the ship on which it is installed. The instrument which is housed in a cabinet 24 inches high, 15 inches wide and 12 inches deep, is installed in the pilot cab and is independent of the other radio apparatus aboard the vessel.

# Eliminators In Series

By C. J. M. Barton

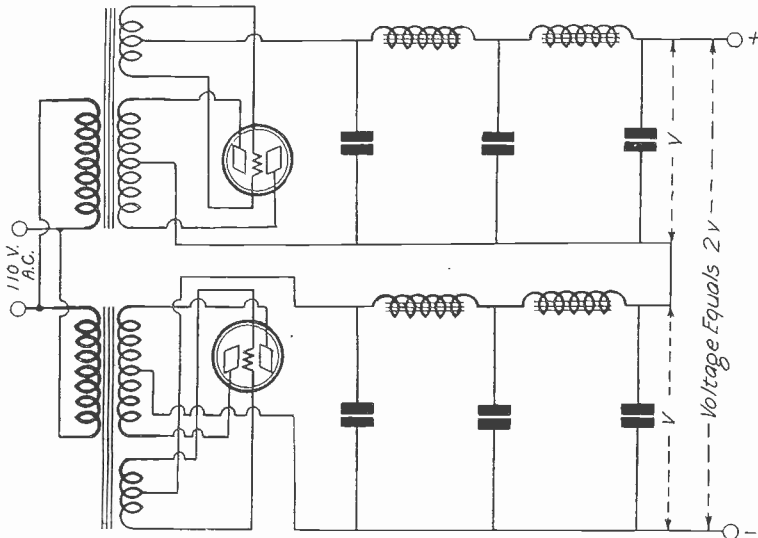


FIG. 1

A CIRCUIT DIAGRAM SHOWING HOW A HIGH DC VOLTAGE MAY BE OBTAINED BY CONNECTING TWO B BATTERY ELIMINATORS IN SERIES.

Voltagcs much higher than those obtainable with a single B battery eliminator can be obtained by connecting two or more eliminators in series, just as higher voltages than are obtainable from a single dry cell can be obtained by connecting cells in series. While the voltage can be stepped up in this manner by connecting eliminators in series, the current drain from the series must not exceed that for a single eliminator.

The advantage of stepping up the voltage in this manner may be questioned if a high voltage eliminator already is available. But there is hardly one on the market.

So it is an advantage to know that it can be done. There may be times when a high voltage is necessary and when a single available source of voltage is not high enough. Two or more eliminators of lower voltage will solve the problem.

### May Obtain Very High Voltages

But that is not the only advantage. The highest voltage now available for general reception purposes is 500 volts, given by eliminators designed for high power receivers. But there are cases when a voltage two and three times is wanted. Such high voltages can be obtained by connecting 500 volt units in series.

There are certain circuits available now which require very high voltages and low current drains. Others will be made public in the near future. These high voltage circuits seem to have certain advantages over the circuits now generally known.

### Two Separate Eliminator Hookup

In Fig. 1 is shown the circuit diagram of two full wave rectifiers connected in series so that their voltages add up. The filtering in this circuit is evidently very good since there are twice as many choke coils as usual in series with the line. The by-pass condensers, however, are not

connected across the entire output, but only across the output of each unit. The condensers will therefore not have to stand the entire voltage of the output but only that which they would be subjected to in a single eliminator.

### A Better Way

This multiplication of coils and scat-

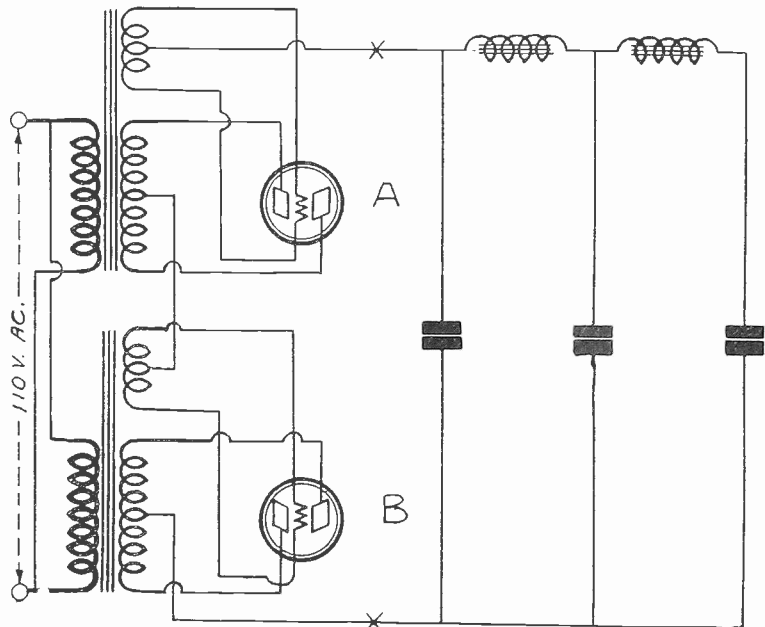


FIG. 2

TWO DOUBLE WAVE RECTIFIERS CONNECTED IN SERIES TO GET THE SUM OF THE TWO OUTPUT VOLTAGES AND THEN CONNECTED TO A SINGLE FILTER. THIS IS A BETTER METHOD THAN THAT SHOWN IN FIG. 1 BUT REQUIRES CONDENSERS OF HIGH VOLTAGE TEST.

tering of condensers is not especially desirable. A better method of getting a high voltage with the customary amount of filtering is shown in Fig. 2. The two full wave rectifiers A and B are connected in series before the filter and then a usual filter is connected to the combined output.

### High Voltage Condensers Essential

In this connection the by-pass condensers are subjected to twice the voltage and hence they must have been designed for the higher voltage. The choke coils need not be any different from the chokes in ordinary eliminators.

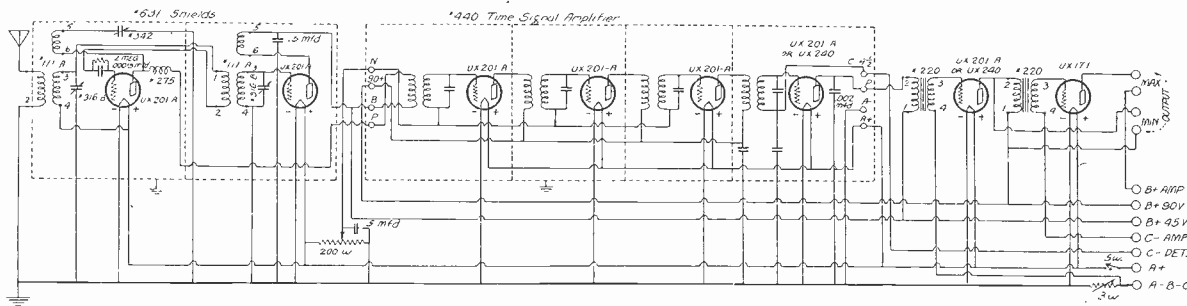
It is also apparent that when two eliminators are connected in series that the insulation between the primary and the secondary windings in one of the supply transformers must be able to stand twice as high voltage as in the usual connection, particularly when one side of the primary is grounded or connected to the low potential side of the output.

### Watch Type of Tubes

In hooking up the eliminator with the two double wave rectifier tubes, it is absolutely essential that both tubes be of the same manufacture. If one is different, then it is possible that the filter system will not function properly for one of tubes, with the result that you will hear a hum. Also, it is not advisable to use a single wave rectifier tube with a double wave tube in this type of circuit, for again an unbalancing of circuits will prevail. Of course, you can use two single wave rectifier tubes, but the results as far as humless output is concerned, will never equal the eliminator using double wave tubes.

# The Laboratory Super

By E. R. Pfaff



THE set's wavelength range with standard coils is from 30 to 3,000 meters. Regular broadcast range coils cover the range of 200 to 550 meters, but it can be seen that the receiver is adapted to any class of broadcast reception by virtue of its wavelength flexibility.

The parts required to build the 1927 Model Improved Laboratory Super have been most carefully selected for the perfect co-ordination of the operating characteristics of the receiver. It is imperative that the exact parts specified be used in building the set if its truly remarkable performance is to be realized to the fullest possible extent. Every item is the product of a well known and reputable manufacturer, and unconditionally guaranteed by him.

## Directions for Assembly

Upon the chassis should be mounted the detector and oscillator assemblies, inside the stage shield pans if shields are to be used. The end mounting screw of each 511 tube socket is used to join the A— to the chassis, so a lug should be placed under the screw head to be soldered to the F— socket terminal, and the under side of the chassis scraped bright for good contact with the fastening nut. One terminal of the .00015 grid condensers should be bent at right angles and fastened directly under the "G" terminal screws. The single long screw holds the 275 choke coil in the detector stage assembly.

The binding posts mount in the nine holes at the rear of the chassis using the insulating washers to positively insulate them from the chassis, as do the four tip-jacks. The "Ground" post grounds to the metal chassis, and the fastening screw of this post holds one end of the second ½ mfd. condenser tightly to the chassis, while the free end must be bent up clear and free of the metal chassis.

The A— connection is made to the amplifier through a contact between amplifier shield and chassis to which it is fastened with four screws. The two audio amplifier tube sockets mount using their rear fastening screws to connect the F— posts to the chassis.

## First Tackle Chassis

All possible wiring should be done on the chassis before proceeding further, leaving free the wire ends that will connect to the instruments on the front panel; and to the two audio transformers which mount last. The potentiometer should be mounted as shown, using insulating washers to thoroughly insulate its frame from the panel. The rheostat and the midget condenser are similarly mounted, except that care is taken to

make good contact between them and the panel.

The drive mechanisms of the dials should be dropped into the bracket bearings intended for them, the shafts pushed through the holes in the front panel, and the two brackets bolted to the panel using the screws provided.

One variable condenser fastens to either bracket, using the shaft mounting nut provided. A drum should be slipped over each condenser shaft, with set screw loosened, and pushed up until the drum scale edge is just ready to enter the crack in the drive mechanism shaft. With a knife blade this crack should be widened to receive one drum scale edge, and the drum pushed well up on the condenser shaft. The scale should then be adjusted to read 100 degrees against the indicator points in the panel windows, when the condenser plates are entirely disengaged, upon which the set screw in the drum dial hub should be tightened on the condenser shaft. With the knobs fastened on the drive shafts, the condenser dials should rotate if the knobs are turned.

## Where Slack is Left

The connections to the condensers, rheostat and potentiometer should be made before fastening panel to the chassis. After they have been put in, machine screws and nuts serve to hold panel and chassis together. The on-off switch mounts in the one remaining panel hole, with insulating washers to insulate it thoroughly from the panel and chassis. (It may have been previously connected in circuit, and allowed to hang on the wiring until ready to be mounted.)

In wiring, a little slack should be left in each connecting wire, which should be cut to fall about as shown in the bottom view of the chassis. After testing all wiring may be bunched and laced into neat cables, using very heavy waxed shoemaker's thread. Two leads should not be joined or included in the cable. They are the wires running from the detector stage along the bottom of the chassis and up to posts 1 and 2 of the oscillator coil socket.

## Data on Operation

To operate the set, all tubes (a total of six CX301A, one CX340, and one CX371 tubes, are needed) should be inserted, except the first detector tube. The CX371 goes in the right rear socket; the CX340 in the adjacent rear socket. With the on-off switch on, the rheostat should be turned to within ¼-inch to ½-inch of the full right position. If the potentiometer "GAIN" knob is turned to the right, a "plunk" will be heard at some point. This can be detected by varying

the oscillator drum, which should cause a number of shrill whistles to be heard.

The "GAIN" knob should always be operated just to the left of the "plunk" point—the right of which squeals were heard when the "OSCILLATOR" dial was varied. The receiver is least sensitive when the "GAIN" knob is at the left, and most sensitive when the "GAIN" knob is just to the left of the "plunk" point.

## Now Insert First Detector

The first detector tube should be inserted, and the midget condenser set all out. The antenna coil rotor should be set at 45 degrees—the oscillator rotor all in. A small antenna 30 to 60 feet long should be used, or even a larger one if the set is not too close to powerful local stations. Stations may be tuned in using the two drum adjustments only.

Weak stations may be intensified by turning up the "REGENERATION" condenser on the front panel. This condenser functions similarly to the "GAIN" knob, in that as it is turned to the right to interleave the plates, signal strength on weak stations will increase up to the point where the first detector oscillates, and the signal turns into a squeal. Adjusting the midget condenser will react slightly on the setting of the "ANTENNA" drum.

The position of the antenna coil rotor should generally be at about 45 degrees.

With a small antenna, it may work best all in—with a large antenna at nearly right angles. The sharpness of tuning of the antenna dial depends upon the setting of this rotor, as well as that of the midget condenser. The oscillator rotor should be adjusted once on a very weak signal at about 300 to 350 meters, and once set for maximum volume, may be left alone.

## Light Socket Operation

The Laboratory Super-Heterodyne may be operated from standard A, B and C battery equipment, or it may be operated from light socket power equipment, either partially or wholly—using the standard CX301A, CX340, CX112, and CX371 tubes; either a 6 volt storage A battery with trickle charger (known when both units are combined, as an "A power unit") or from a direct true A power unit such as the new Abox A Supply. As there is considerable variation in B power units, a type employing a glow tube voltage regulator is recommended.

[In last week's issue, dated November 19, the first part of this two-part article on the Laboratory Super-Heterodyne was published. Construction description is completed herewith. Some interesting sidelights on the circuit will be published next week.]

# Medium Plate Voltage Favored

**From Acme Apparatus Company**  
**I**S high plate voltage necessary for high quality radio reproduction? Many set owners, noticing the appearance of constructional articles dealing with B power devices having an output of 500 or more volts, and designed for the use of power tubes of the 210 type, are perhaps inclined to believe that real quality can only be obtained through the use of these voltages and tubes.

This, however, is not always the case. A moderately powered amplifier, using tubes of the 112 or 171 type, with plates supplied from a 150 or 180 volt source, in most circumstances can give results that will satisfy the most critical.

The main advantage to be expected through the use of high power is a gain in volume and the increased realism that comes in having, let us say, the volume of an orchestra as it comes from the speaker, equal or exceed that of the orchestra itself.

## Unpleasant for Small Room

However, it is obvious that the average set owner is not desirous of having a twenty or sixty piece orchestra going full tilt in his or her living room. In a small room—and most rooms are small nowadays—this would be unpleasant, even painful. Therefore, were an amplifier capable of giving this volume, it would seldom be used.

Now, in a case like this, where quality, rather than quality-plus-tremendous-volume, is the primary consideration, there is

nothing to be gained by the use of very high power. To be enjoyable, the very high voltage device would of necessity have to be operated at a point considerably under maximum output. If a proper means of controlling this volume were used, quality would not suffer, but it would not be better than the maximum output of an amplifier more in accordance with the tastes of the average set owner and the acoustical capacity of his home.

## A Close Association

Of course, there is no denying that power and fidelity in reproduction are, up to certain points, closely associated. The set owner should remember, however, that a moderately powered amplifier would put every bit as much energy into the loudspeaker as would a very high voltage device operated at half volume.

In the latter case, the energy, as expressed in the AC variations in the plate current, remains in reserve, or is dissipated by means of the volume control, which in most properly constructed sets is a variable resistance.

When control is attempted by means of reducing the filament voltage, or through slightly detuning the set, the results, particularly in the case of the high voltage amplifier, are far from satisfactory.

## Wanted: Freedom From Overload

In the case of sharply tuned receivers, serious distortion results from the suppression of the side bands when the set is detuned, while extraneous noises,

static, line disturbances, etc., are amplified out of all proportion to the signal.

In the last analysis, quality in the reproduced signal is not so much a matter of volume as freedom from overloading. Were it purely a matter of amplification, tubes of the 201A, or the high mu tubes, would be far superior to those of the 171 and 210 type. The superiority of the power tube, therefore, lies not in its ability to amplify but in its ability to handle great volume without overloading.

When, for example, a tube of the 201A is used in the last stage of an amplifier with, let us say, 90 volts on the plate, the sounds issuing from the loudspeaker are apt to be thin and with the tones in the lower end of the musical scale missing. Now as we increase the plate voltage, the quality of reproduction improves until a point is reached where, on loud signals, serious distortion occurs, owing to the fact that tubes of this type have a comparatively high amplification factor, so that signals of even moderate intensity drive the grid positive.

This overloading, in the case of the 201A, occurs long before the volume has reached a point commensurate with the requirements of the listener, and before sufficient current is flowing in the plate circuit accurately to reproduce the bass notes. In a broadcasting station, for example, the most that is expected of tubes of the 201A type are signals of little more than telephone intensity; whereas, in the set of the average radio enthusiast, they are expected to furnish unlimited volume.

# Pioneer DC Five Fills Standing Want

A great many inquiries about the Pioneer DC Five have been received showing that this circuit has aroused much interest. It was published last week, November 19. There are hundreds of thousands who live in districts served by direct current for lighting and power purposes. Little had been offered them in the way of a successful "electrified" receiver until this receiver appeared.

The Pioneer DC Five is a promise of relief. It is more than a promise; it is an obvious solution to a long standing problem—a solution made possible by the advent of the heater type of tube.

In view of the requests for additional information on the circuit a few more remarks on the circuit will not be out of place. The designations in the following paragraphs refer to the diagram of the receiver as first published in the Nov. 19 issue.

## Grid Bias Method

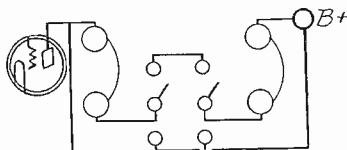
The grid biases for the various tubes in the circuit are obtained from voltage drops in resistance by suitably connecting the various cathodes of the amplifiers. The cathodes of the first two amplifiers are joined together in such a manner that the steady plate current from these tubes passes through the same resistor R6 before it reaches the negative terminal. The grid bias for these tubes, therefore, is obtained from the drop in this resistor. Let us determine its value. The voltage applied to the plates of these tubes is very nearly 110 volts, requiring a bias of 7.5 volts on the grids. With this combination of grid and plate voltages the plate current in each tube will be 4 milliamperes, so that the total steady current in R6 is 8 milliamperes. Therefore the value of R6 should be about 940 ohms. A 1,000 ohm variable resistor capable of carrying more than 10 milliamperes will serve.

The tubes in the push-pull stage operate on about 155 volts on the plates. The required grid voltage is about 10 volts. The plate current in each tube is about 5.5 milliamperes so that the total current in resistor R5 is 11 milliamperes. Since the voltage drop in this resistor gives the bias to the last two tubes, the value of R5 should be a little over 900 ohms. There it may be a 1,000 ohm variable resistor.

## Large Filter Condenser

Condenser C8 occupies a place in the first audio amplifier similar to that of C7 in the detector, in effect. Actually it is the usual filter condenser, and as such should be as large as possible. Condenser C9 by-passes the 45 volt dry battery as well as the line and the choke coil. A condenser larger than the 1 mfd. specified may be used if desired. But there is no great need for a larger condenser because of the balanced output stage. There is no signal current component in the common branch unless the opposite tubes are unbalanced. The unbalance at

## Switch Arrangement



**MANY FOLKS DESIRE TO KNOW IF SPEAKERS WORK BETTER WHEN THEY ARE CONNECTED IN SERIES OR PARALLEL. WITH THIS SIMPLE ARRANGEMENT USING A DPDT SWITCH, THIS CAN BE LEARNED**

low frequencies is negligible and at high frequencies the condenser specified is quite effective.

The choke coil Ch should have an inductance of at least 30 henrys when a steady current of 20 milliamperes flows through its windings. This inductance is enough to give satisfactory filtering in a circuit of this type, particularly when condenser C8 is large. The hum ordinarily found is greatly minimized by the heater type tubes and by the push-pull stage.

The first radio frequency input transformer T1 is a Genwin antenna coupler which matches the Camfield .0005 mfd. condenser C1. The three circuit tuner T2 is also a Genwin and it matches the Camfield .0005 mfd. tuning condenser C2.

T3 is a Silver-Marshall 220 audio transformer. T4 is a Silver-Marshall 230 push-pull input transformer. L1L2 is a Silver-Marshall 231 push-pull output transformer, though the diagram shows two separate coils. The primary of this transformer is used as a center-tapped choke, and the loudspeaker is connected between the two extreme terminals.

Since the impedances of the two tubes are in series, the speaker used should have a high impedance for best results, or else two speakers should be connected in series across the output. In case only one speaker of low impedance is available it may be connected in series with the secondary of the output transformer. The best connection in any case can always be found by trial.

Switch S is a Carter filament switch of the new type. This switch can be used in a 110 volt line even when considerable current is to be broken.

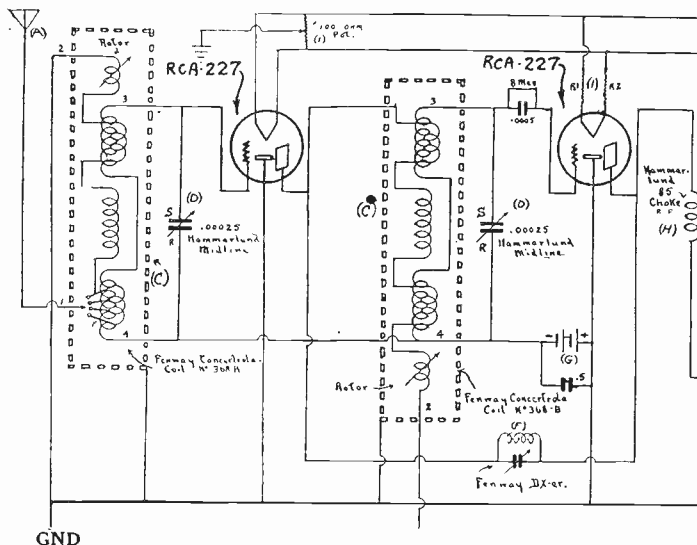
The cost of power for operating this set, exclusive of the cost of the 45 volt battery, is less than 1½ cents per hour.

# The Fenway Concertrola

## Three Radioteers Build the Circuit

By Leo Fenway

Associate, Institute Radio Engineers



**PASTE THIS DIAGRAM ON THE LARGE ONE PUBLISHED IN THE OCTOBER 12 ISSUE AND YOU HAVE THE COMPLETE WIRING OF THE FENWAY CONCERTROLA FOR USE WITH R. C. A. TUBES.**

[Here we have the Fenway Concertrola as an all-electric set, using AC tubes. The circuit was described in the November 5 and 12 issues for use of McCullough, Kellogg or Sovereign tubes, November 19 as a battery-operated set, and is presented this week in a new light. Always the same outstanding circuit—only a difference in tubes and sockets.—EDITOR.]

### PART IV

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NOT so long ago Fred Wundsam sat before a battery-operated Concertrola. And his manner was a sad one. And in his eye there was, perhaps, a tear. And his grief was, perhaps, an unjust grief.

"Why," he asked of his associates, with a gesture that was utter despair, "why didn't I build my set as an all-electric?"

Heterodyne Smith assumed a reclining posture, as he remarked, nonchalantly: "Who cares about that!"

Eder Franklin's long face, the deep downward lines of which gave an air of sagacity to his most trivial remarks, was lit by a sardonic smile.

"Well, Fred," he said, "you're so completely sold on the idea of battery-operated radios that if anyone attempted to upset your notions you'd come to hate them for having tricked you. How about it, Smithie?"

Heterodyne Smith lazily crossed one leg over the other. "I'd rather not hear any more about it!" he replied. "Besides," he went on, "I'm goin' to build my Concertrola with R. C. A. tubes—through-out. I mean I actually am!"

### Quite a Little Litter

The three buddies were in Fred's apartment-laboratory. Fred had the walls of the laboratory almost concealed by blueprints, RADIO WORLD articles and pictures of famous generals. An old style console, the top of which was littered with vario-

meters, condensers, coils, sockets, busted voltmeters, and square bus, stood by the window. Relics of many sets, half dismantled, apparently some day to be improved, were scattered everywhere. Franklin stood by the door, examining a Concertrola blueprint.

"You know, Franklin," Fred said, "if I were building radio sets only one week a year, I could think for fifty-one. As it goes, I build about every battery model that's published."

"That's the trouble with you," Eder replied, "you construct them so fast that you never get a chance to put something of yourself, something sincere and vital, into each one."

"That's a fine lot o' applesauce," Heterodyne exclaimed. "How much of this 'vital' stuff do you put into your work, Franklin? Let's see, now. You built the Concertrola as originally published in RADIO WORLD, that is, with three McCullough tubes and one power tube. You had the whole works playing in less than a week. Did it play any better or worse than Fred's battery outfit? No! Do you get any more stations? No! Is the quality any sweeter? Hardly. What's happened to all that 'vital' stuff you put into your set, old dear?"

### Franklin Does Not Choose

The deep downward lines of Franklin's face became deeper, but the twinkle of his eye was very friendly. "After all," he said, "I still can plug my set into the lamp socket, and forget it. Of course, Heterodyne, if you construct yours with R. C. A. electric tubes you can do the same. How do you mean to build yours?"

The ash tray was less than two feet from where Heterodyne was sitting, yet he dropped his cigar ashes upon the Persian. "I don't know, exactly," he said. "Perhaps I shouldn't have mentioned it. Anyway, Franklin, I do not choose to take advantage of your shielded testing

room, signal generator, voltage attenuating device, output voltmeter or dummy antennae. I can't be bothered with the actual effective value of the audio voltage existing across the output of the set. I—"

"You have overlooked two very desirable tests which I almost invariably insist upon—namely, sensitivity and radiation," Franklin cut in.

"Oh, be-have yourself, Franklin!" Heterodyne again dropped his ashes. "I suppose," he went on, "you'll want to know if I intend to test my set against yours, as a means of comparison?"

### Worked Out Splendidly

"Naturally. From the standpoint of the set builder that is the most important thing of all. My Concertrola was put to just such a test. I found that the amplification is sufficient and adjustable, and remains constant over long periods of time, or as long as I desire it so. The selectivity of my Concertrola is as great as the constancy of frequency of the sending station permits. The McCullough model, I found, was simple to construct, easy to inspect, because of its new style housing, and all adjustments, although at mutual independence, afford ease and rapidity of tuning."

"I notice on my battery Concertrola," Fred intervened, "that the DX-er plays an important part in pepping up distance stations. It's great how that little device brings 'em in!"

"It certainly is," Franklin agreed. "It proves over and over that a little thing, like the DX-er, can be the pivot point on which a radio may turn into failure or success. But let's get on with Heterodyne's set. Come on, Smithie, elucidate; I'm all ears!"

"The fact that you admit you're a jackass," Heterodyne exploded, "has nothing to do with me building a Concertrola. However, I rather like the idea of using two R. C. A. type 227s, one 112A and one 171A. This combination ought to make a snappy set. And if you notice on the blueprint, I can use these tubes without changing any of the apparatus in the original model."

### Tells 'Em How

"I'll tell you how I mean to put it over. In the first socket of all, the radio frequency stage, I'll put a 227. Of course I could use a type 226 here but I've got a hunch in favor of the 227. It makes a good radio and audio tube besides acting as a detector. So, as I said, I'll place a 227 in the first socket and another in the second socket—the detector. Two Benjamin sockets, made especially for these tubes, will be used. The Concertrolastat, which you, Franklin, are using for your heater transformer for the McCullough tubes will do the work for the 227 tubes. In the third socket, which by the way, is a standard, I shall use a 112A tube. A 171A tube in the power stage will complete the job. The filaments of the 112A and the 171A tubes can be operated directly from the Thordarson Compact. Simple, isn't it? Wonder you didn't think of it, yourself, Franklin?"

"While the mind of the average set (Concluded on next page)



# The Last Straw in Fuses

By John Murray Barron

Contributing Editor

FUSES are put into the electric house lighting circuit to protect the house and its occupants, not to inflict inconveniences at critical moments. But very often, through carelessness, the fuses are the source of grievous annoyances. They give way when they are most needed and hurl the house into utter darkness, and they go without giving any warning beforehand.

Perhaps every user of electric current has tried to circumvent this by putting in larger fuses, not realizing that this procedure invites still greater inconveniences, such as being forced to run out in the snow unclad on a cold night because of fire, or even to make a trip down the dark cellar to replace a fuse there.

When the first fuse blows the average individual will take one look at the defunct protector, not to be able to replace it with one of the same rating but one of higher amperage. For example, if the defunct fuse was one of 10 amperes, the new one will be 15 or 20. The first fuse that blows is usually in the kitchen or in a hallway.

## Use Smaller Fuse Upstairs

Now the apartment may have been wired for a maximum of ten amperes. A fuse of that size is put in the kitchen or hallway. A somewhat larger fuse, say 15 amperes, is put in the basement, in a place not easily accessible on a cold, dark night. When the first ten ampere fuse blows, the householder replaces it with a 15 ampere fuse to make more certain that the mishap will not occur again.

The next time the fuse blows it may be upstairs or it may be in the cellar, depending on which of the two 15 ampere fuses could carry the more current. Let us assume that the fuse upstairs goes before the cellar fuse. This time a 20 ampere fuse goes in place of the original 10 ampere fuse. The culprit feels secure under a 20 ampere protection.

Deniamno Gigli is singing and a group of enrapt listeners sits around the loudspeaker, which is of the latest electrical

model. Wonderful, isn't it? With an opera star singing at the radio studio and with a high power, high quality receiver to reproduce the singing! Nay, still more wonderful, the reception, the house and its occupants are protected by a 20 ampere fuse!

## Tea for the Company

The concert is not half over when the hostess decides it is time to start the electric tea pot so that the guests may have hot tea as soon as the concert is over. She sacrifices the McNamee intermezzo for the tea pot. All is ready for the tea pot to boil and for Gigli to sing. There is a snap, and darkness falls on the house and silence envelops the loudspeaker. Gigli sings no more that night in that house.

"Get a candle," shouts the host, "strike a match," suggests a guest. "Another fuse, quick, or we will miss the rest of the concert," cries the hostess. But getting a candle and striking a match do not bring reception back. Another fuse must be inserted in the proper place. The match and the candle may help to find the fuse and the place and expedite the restoration of normality. A 30 ampere fuse is found and after a deal of groping in the dark, and this is inserted in the fuse socket upstairs. But no light results.

Meanwhile another song from Gigli's throat has knocked at the aerial. Another 30 ampere fuse is inserted in the fuse block with no results. By this time the announcer has thrown in his bit about the next number.

## A Fumbling Search

Then it dawns on the host who had rested secure under the illusion of a 20 ampere fuse protection that the fuse in the cellar has blown. This was still a 15 ampere fuse and was the weakest link in the circuit. Down the cellar he fumbles with a flickering and dripping candle. He finds the fuse block and replaces the defunct 15 with another of the same rating. There is a flash of light upstairs, a pop in the fuse box, and darkness in the whole house once more. The tea pot was still on the line and the load was still too much for a 15 ampere fuse. The host locates a 30 and puts it in the fuse

block. It carries the load, including the tea pot.

The radio set comes to life again; the loudspeaker speaks loudly. It does not sing nor play.

"This concludes this evening's concert," the speaker repeats after McNamee. And the guests take their departure, for the tea pot is still cold.

There is one safe way of circumventing a trip down to the fuse box in the cellar during an interesting program, and that is to have a fuse of lower rating upstairs than down in the cellar. If the fuse in the cellar is a 15, the fuse upstairs should never be larger than a 10.

If it blows replace it with a 10. It is there to blow before anything else fuses. If a larger fuse must be installed upstairs, put in a larger one downstairs first; but do that only after having made certain that the wiring in the house will carry the increased current without setting the house on fire. Changing the fuse in the cellar is a job for the power company, not one for the customer. If the customer changes the fuse there, that act may nullify the insurance on the house and its contents, and it may violate a city ordinance as well.

Another way of preventing accidents of this nature is to know at all times how much power is taken from the line, and what the limit is with the fuses at hand upstairs. If nearly the maximum power is taken do not add another power absorbing appliance until some other has been taken off the line. If a toaster or heater must be turned on when nearly the maximum power is already being taken, a safe margin may be created by turning off a few lights here and there in the house.

## Figure on Markings

Every light, every appliance is marked or its rating is well known. The radio set may be an exception. But that may be estimated. If the filaments of the tubes are heated with AC, the voltage and the current are known. The product of the two gives the power in watts, assuming unity power factor. The plates are working at fairly well known voltages and currents. The product again gives the wattage under the same assumption. Adding all the wattages in the radio set, and adding 50% of the sum for losses in the transformers, chokes and rectifiers give the wattage consumed by the receiver, at least for practical purposes. The wattage taken from the line is the sum of all the wattages of the various devices used.

When the total wattage is known, divide it by the voltage of the house supply line and the result is the current taken from the line, again assuming that the power factor is unity.

For example, the radio set may take 40 watts, there may be a dozen lights in the house of an average wattage of 50, then there may be a coffee percolator of 300 watts and a heater of 660 watts going all at once. Thus the total wattage is 1600 watts.

If the voltage of the line is 110, the current is close to 15 amperes. It may be a little more due to the fact that the power factor is not quite unity.

It is evident that if the fuses are rated at 15 amperes there is not much of a margin.

The fuses may carry the load with the radio off and all the other components on, but they may blow the instant the radio set is turned on. Or it may be an extra 50 watt light which acts as the last straw.

## When the A C Impulse Gets You

(Concluded from page 10)

builder might still be confused and befuddled by what you're talking about," Franklin retorted, "why not draw a picture of it?"

"O.K. Let's call it Fig. 11. Now you see what I'm going to do? Every part of the original set, except two sockets, will be used for the R. C. A. tubes, and no new parts other than two sockets will be added."

"I guess I've been 'too close to the trees to see the woods,'" Fred remarked. "While I am perfectly satisfied with my battery model, I've got a sneaking suspicion that I'm going to spend some more of the wife's money for R. C. A. tubes!"

"After all," Franklin put on his hat and coat, "Heterodyne's set is still in the offing, so to speak. My outfit built with McCullough tubes is working to please the Queen's taste. And you know, Heterodyne, there is something else to building a radio set besides the thought, 'I guess I'll build a radio.' A block of stone roughly cut may be a work of art, but perfection is never attained until the last touches finish up the surface. This principle from the arts can be successfully applied to radio construction. The

set must be gone over, 'retouched,' much the same as a photograph is retouched. In the picture, some of the high lights must be 'snapped-up' and made more 'contrasty.'

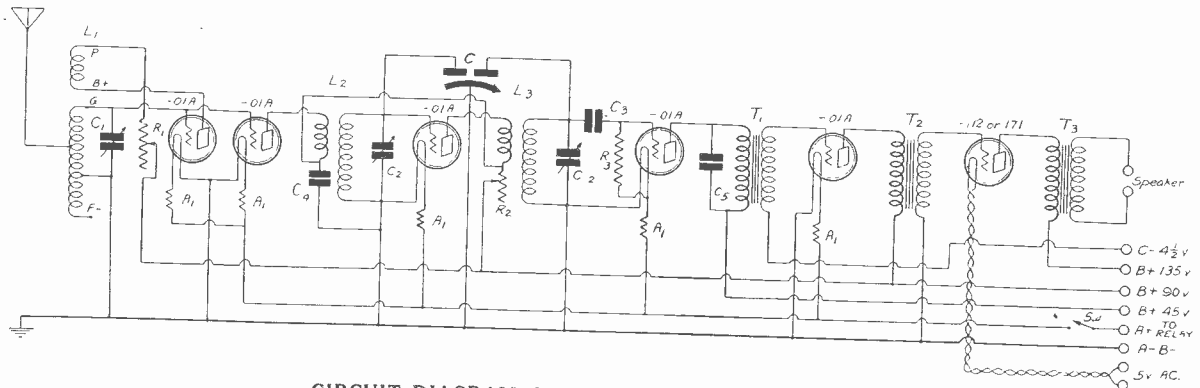
"In the radio set some of the wiring must also be snapped-up and made more efficient. How many times this old argument comes up, and how many times have set builders failed to carry through in their thinking to the right answer.

"Mistaken set building notions are long-lived. A mistaken notion that concerns a supposedly easy way to build a radio set never dies. Even misfortune will not kill it. At any rate, Heterodyne, old thing, I believe you've got a good idea. I've half a mind to change my set over to your plan. But then again, perhaps I'd better let well enough alone. Oh, I say. . ."

Franklin paced the room, the old air of sagacity coming back in his features. "Oh, I say, why not do away with the 112A tube in the first audio, and in its place use a 227, making three 227s in all? Then you could discard the 171A and use a 210, with a Thordarson 210 Compact?"

Heterodyne Smith appeared bored. "Now, why do you have to suggest that!" he said.

# Parallel Gain Tube Builds



CIRCUIT DIAGRAM OF THE SENSITIVE ALPHA SET

THE six-tube Alpha set is built in two portions, the receiver being a six-tube affair, built into a beautiful cabinet, while the power supply portion is built on a board and is to be stored in some sort of a compartment near the receiver. This can be one of the numerous radio tables on the market, that have this battery compartment. Buying one that will match the finish of the cabinet will make up a very pleasing and satisfactory ensemble.

The receiver is composed of two stages of tuned radio frequency amplification, the first stage employing a method of feeding back some of the RF energy by the use of an additional tube as a coupling medium. This adds to the sensitivity of the RF stages. The detector stage is tuned. The audio frequency amplifier follows. This is two stages of transformer coupling.

The first or antenna stage is tuned with a single .00035 variable condenser while the second and detector stages are tuned with a two-section variable condenser. When a condenser of this type is to be used it must be of a very rigid and efficient construction. The spacing between plates must be ample and even. However, even with a perfectly balanced condenser, some means are advisable for compensating for an uneven or unbalanced condition that will exist between the two stages which may be due to internal capacity of the vacuum tubes, capacity between leads, length of leads and capacity between parts.

#### Advise Compensator

Glancing at the diagram you will notice that we used a compensator condenser to bring the circuits in resonance should either of them be unbalanced. This is shown as C in the diagram and you will note that the rotor blade of the condenser connects to the common rotor of the large condenser (C2) and each of the stages that require more or less capacity, of C2. Then if either of the stages happens to be off, the compensator is turned either to the right or left depending on the stages that requires more or less capacity, if both stages are at resonance, the compensator is kept at a neutral point.

The coils used in the RF portion are binocular. This type of coil has low distributed capacity, low radio frequency resistance, constricted external field, and good gain and selectivity.

The first stage of audio employs the regular 201A amplifier tube while the second or last stage makes use of either the 112 or 171 type of power tube. The filament of the power tube is obtained direct from

the 5 volt AC winding on the power transformer in the supply portion.

The audio transformers reproduce the impressed signal faithfully, due to the mechanical as well as electrical construction. The primary inductance is high. Other factors that contribute to the good reproduction qualities of an amplifier are correct biasing voltages on the grid of each amplifier tube and an output transformer which prevents overload of the speaker windings from the DC plate component, which is also a cause of speaker distortion. A glance at the schematic diagram will show the protective transformer as T3. This has a turn ratio of 1 to 1.

#### Modus Operandi

It will be well to lay out the front panel before starting on any other portion of the receiver. This is to be a 7x21x3-16 Micarta panel and may be of a finish to suit the taste of the constructor.

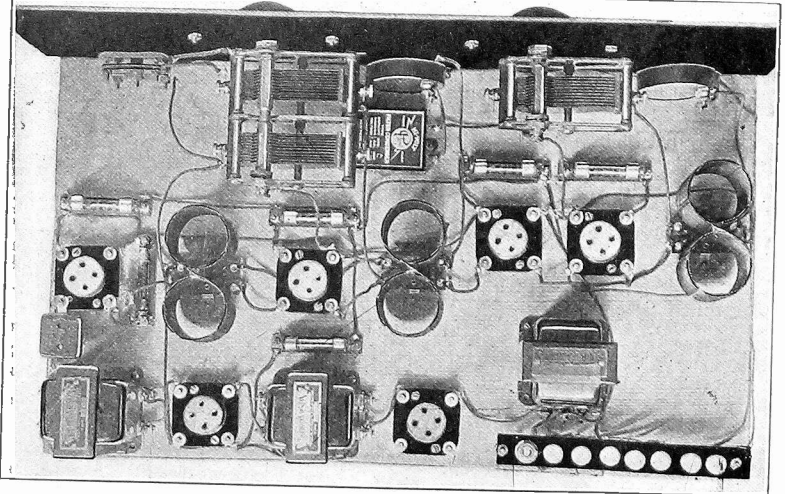
In the exact center of the panel and 2 3/4 inches from the bottom drill a hole to accommodate the shaft of the resistance R2. Six and three-quarter inches from the left and 3 1/2 inches from the bottom drill a hole to situate the variable condenser C1. The drill required here is from 3/8 to 1/2 inch. Mount the double condenser C2 by drilling a hole 6 1/2 inches from the right and 3 1/2 inches from the bottom. To mount the combined resistance and switch, drill a hole three inches from the left and

two inches from the bottom. On the opposite side of the panel three inches from the right and two inches from the bottom, drill the hole for the compensator condenser.

When preparing to drill the panel it will be well to ascertain which side you wish for the face and lay this down on a layer of newspapers. Then you may mark the back and drill the holes without fear of disfiguring the face of the panel. There are four extra holes to be drilled on the panel. These are to mount the vernier dials. A template furnished with these obviates the necessity of our giving the dimensions for drilling the holes.

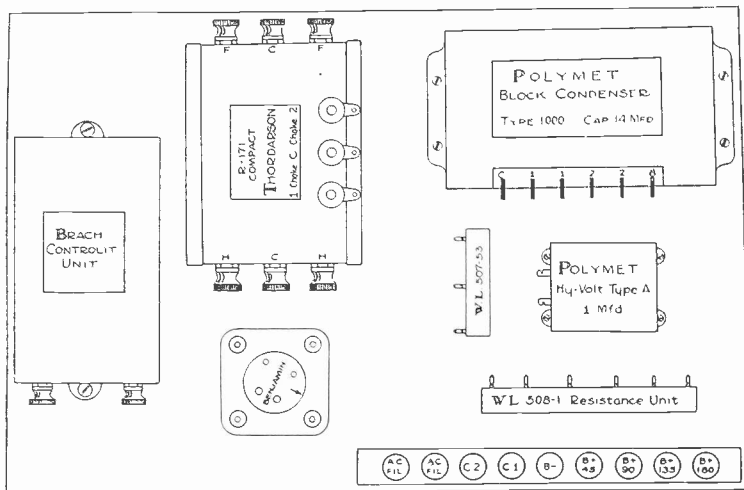
#### Mounting

The baseboard measures 12x20 inches and is to be about 1/2 inch thick. Fasten the panel to the baseboard before mounting any parts on it. Now on the extreme left-hand rear portion of the board (assuming that the constructor was facing the set from the front), mount an 8 inch strip of bakelite. This is to have 8 binding posts and a midget jack mounted on it. It should be raised about 1 inch from the surface by the aid of two brackets or long screws. The method of mounting the other parts is clearly shown in the photographs. The coils should be mounted so that the plate and B plus terminals are facing the left side of the board. The filament terminals of the first

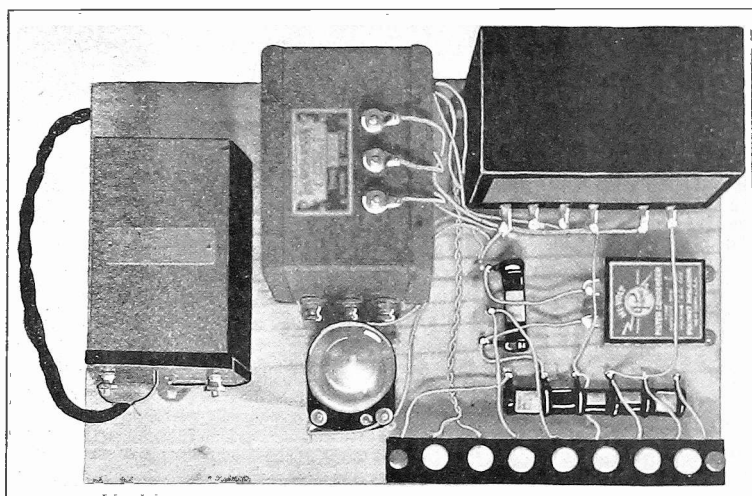


AN INTERIOR VIEW

# Up Tremendous Amplification



POWER SUPPLY DEVICE LAYOUT



THE POWER DEVICE SHOWN PHOTOGRAPHICALLY

four sockets should face the front panel, while the last two sockets (audio) should have their filament terminals facing the rear of the baseboard. The primary terminals of the two audio transformers should face the right side of the baseboard.

### Wiring

When wiring the set the fan will note that if he follows the placement of parts so that they coincide with the photo; the different leads will be quite short.

He should start with the first stage (antenna) and go by the following directions in order to have success with the completed receiver.

The coil (L1) has four posts, two on each side, marked P, B plus and G, F minus. The F minus terminal should be disregarded. A wire is brought from the grid of the first tube to G of the coil. From here it is to go to the stator connection on the condenser C1; from the plate of the tube to the B plus terminal of the coil (NOT THE P TERMINAL); from the P terminal (NOT B PLUS OF COIL) of the coil to the resistance R1.

Scrutiny of the coil will result in the fan

noticing that there are two taps brought out (which were intended for neutralizing purposes). Scrape the insulator off the top tap and bring a wire from here to the antenna binding post. The bottom tap is also scraped and a wire soldered to it which goes to the rotor or ground connection of the condensers and also connects to the ground binding post of the bakelite strip.

### LIST OF PARTS

For Receiver

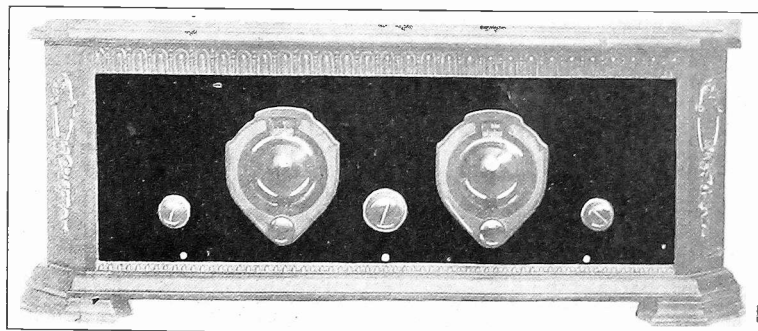
- C2—One De Jur Double Variable Condenser, .00035.
- C1—One De Jur Single Variable Condenser, .00035.
- One De Jur 7-Wire Flexatone Battery Cable
- L1, 2, 3—Three Benjamin Lekeless Transformers
- Six Benjamin Cle-Ra-Tone Sockets
- T1, 2—Two Thordarson R 200 Audio Transformers
- T3—One Thordarson R 76 Output Transformer
- C4—One Polymet 1 mfd. Condenser Type A
- C3—One Polymet .00025 Grid Condenser Bakelite
- C5—One Polymet .001 Condenser, Bakelite
- A1—Five Amperites, No. 1A
- R2 & SW—One Centralab, 0-200,000 ohm Radiohm, RS 200
- R1—One Centralab, 0-50,000 ohm Radiohm
- C—One Daven Compensator Condenser
- R3—One Daven 2 Meg. Leak, Glastor
- Two Kurz Kasch Vernier Dials
- Two Kurz Kasch 3/4" Bakelite Knobs
- One Micarta Panel, 7x21
- One Corbett 7x21 Cabinet, Model C, 12" depth
- Two Rolls Corwico "Braidite" Wire
- Eight Eby Binding Posts (2 ant. A plus, A-, C-, B45, B90, B amp.)
- One Carter Midget Jack

### LIST OF PARTS

For Power Supply

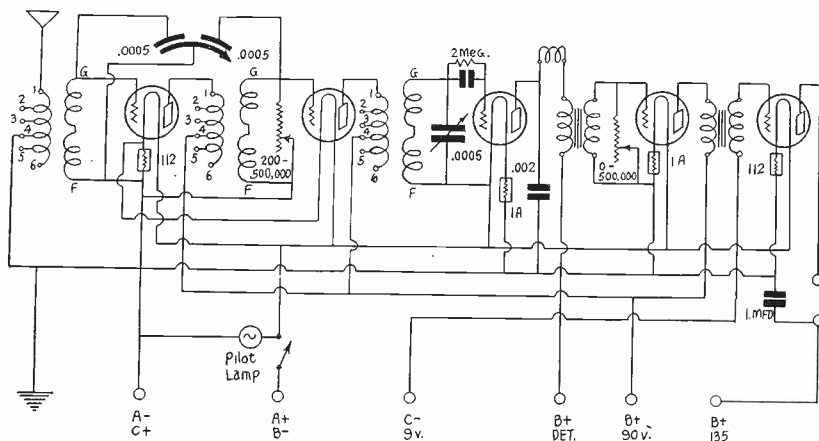
- One Polymet, Type F 1000 Condenser Block (14 mf.)
- One Polymet, Type A, 1 mfd. Condenser
- One Thordarson R 171 Power Compact
- R—One Ward Leonard, 508-1 Resistance
- R1—One Ward Leonard, 200 ohm Tapped at 100
- One Brach Controlit Relay
- One Raytheon BH Tube
- One Roll Corwico "Braidite" Wire
- Nine Eby Binding Posts (B-, B45, B90, B135, B180, C1, C2 and two blank)
- One trickle charger.
- One Benjamin Cle-Ra-Tone Socket

The rest of the set is wired from the diagram and is the standard. Of course the fan should remember that the plate and grid leads should be short and direct and when wiring the second RF and detector stages, he should plan his wiring so that the grid leads going to the condenser are of the same length. Long B battery wires such as those coming from the detector and first audio, should be (Continued on page 28)



THE SET IN A HANDSOME CABINET

# A Squealless 5-Tube



THE SCHEMATIC DIAGRAM OF THE SIMPLETROT

By Joseph Bernsley

THE importance of instruments incorporated within a receiver and their part in determining the efficiency of a set can never be too greatly stressed.

The usual procedure of the constructor to adopt any particular type of circuit or "hook-up" as being the best suited for his purposes and then to purchase haphazardly the necessary parts for the least possible amount of money has proven disastrous both to pocketbook and the equanimity of the person time and time again.

What the builder should consider first and uppermost as being the prime essential on which his receiver's efficiency is entirely founded are always the coil and condenser units—as far as the radio frequency end is concerned.

Virtually all present day audio apparatus is designed to operate at maximum effectiveness without any sacrifice in quality. Therefore, little heed will be paid to that portion of the receiver, except to make such recommendations as are necessary.

#### Trend Toward Stabilization.

Without a doubt the present trend of radio design is toward stabilized or non-oscillating receivers, with a minimum number of tuning controls. To construct a set which will always be free from disturbing squeals (oscillation), without any noticeable loss in radio frequency amplification, has always been the "bugbear" of the radio set constructor.

It is the intention of this article to describe a receiver in which the usual pitfalls are avoided by considerable forethought given to the type of parts to be included within the set and its general construction. This has resulted in a radio receiving machine which requires no aftermath such as balancing, stabilizing or adjustments, etc. The "Simpletrot" (five tubes) operates quietly and smoothly, employs only two controls for obtaining stations and two minor units, one for volume control, the other for sensitivity.

Before going into the general design of the set those factors which the writer thought essential for the successful completion of a receiver which would tune without the usual accompanying whistles and squeals and without any roaring or "steam escaping" background were summarized.

The above mentioned liabilities all go under the head of "oscillation," and

therefore a tuned radio frequency receiver in which satisfactory balancing or stabilizing means without complication could of necessity be the only solution.

It sounds pretty simple, but which system would be the most effective with least complications was a problem that only practical experience could solve.

#### Various Methods Reviewed.

After considerable experimentation the following data was compiled and will be found to be of importance to the average constructor.

**Hazeltine Method**—A system employed in all neutrodyne receivers; too intricate a method for the set builder. Necessitates peculiar placement of the coils and other instruments within the receiver and a balancing process which for extreme satisfaction would require laboratory facilities.

**Absorption Method**—Consists of placing the coil directly in back of the end plate of the variable condenser which is at ground potential. The end plate has a tendency to absorb energy from the coil and also limits or minimizes the magnetic field created by the coil when energy flows through it, preventing magnetic field reaction between stages. This system is technically referred to as the Foucault method. It is not very dependable and if improperly employed is detrimental to the efficiency of the receiver.

#### The Grid Suppressors.

**Grid Resistance Method**—Consists of placing sufficient resistance in the grid

circuit of each RF stage to suppress oscillation on the lower scale of the broadcast band. Not entirely dependable as far as the average constructor is concerned, since no certain value can be specified, this factor being dependent upon the coils employed, the wiring of the receiver, the position of the various instruments, etc. If the incorrect amount is employed a noticeable decrease in volume is experienced on those stations in the upper wave band.

These three are the more popular of the numerous schemes generally employed and yet were rejected because the writer in his experiments came across several factors which influenced him in favor of the adoption of a non-neutralized circuit.

#### Constructional Faults

It was demonstrated clearly and has generally been the consensus of opinion among radio engineers that oscillations are more apt to be created by faulty construction of a receiver—i.e., poor layout, careless wiring, etc.—plus inefficient coils.

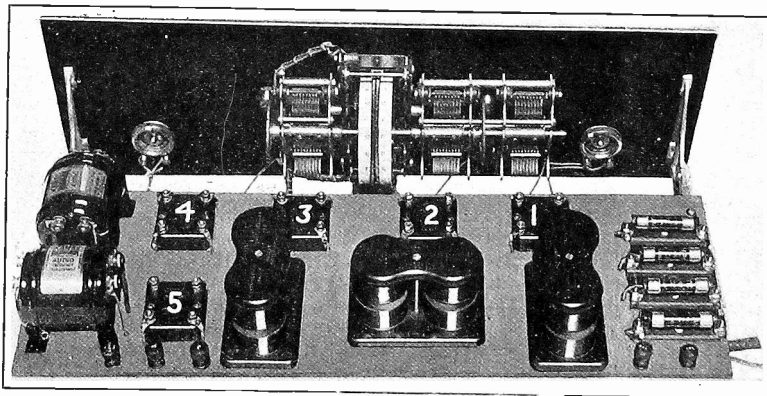
By inefficient coils we mean coils which are not advisable for use in a stabilized receiver, coils which would make stabilization extremely difficult—not necessarily non-low loss coils.

Most coils are to a great extent responsible for instable receivers because of that detriment called feedback. Feedback may be caused by either magnetic coupling or reaction between RF stages or by capacity coupling caused by capacity existing between the grid to filament to plate electrodes in a vacuum tube.

In the neutrodyne receiver magnetic field reaction is prevented by placing the RF coils at that particular angle at which their field is less likely to stray over into the preceding or succeeding stage.

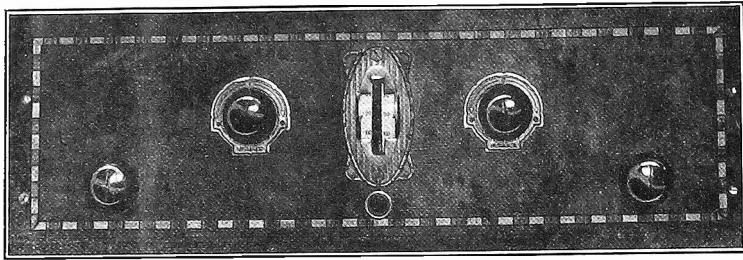
Capacity feedback is offset by small neutralizing condensers. But to a large extent feedback created by the field of the coils in a receiver were found largely responsible for uncontrollable oscillation in a set, as was proven in the aforementioned experiments. Setting the coils at right angles to each other to prevent this action is not entirely satisfactory, since it is essential to ascertain, first, the peculiar characteristics of the coil employed, shape and size of the magnetic field and to determine the proper angle at which to place the coils.

Then, again, if a receiver is carelessly wired the wires help to create feedback by carrying over the stray field or by "capacity coupling," which refers to nothing more than the condenser effect created by running wires parallel to each other. The



A REAR VIEW OF THE RECEIVER

# That Packs a Kick



THE PANEL VIEW

writer even tried many toroid coils—commonly referred to as "doughnut coils" and supposed to be inherently neutralized, etc. Theoretically, these coils are supposed to be the ideal thing, since they have no existing outside magnetic field, due to their peculiar construction, and therefore there should be no possibility of magnetic interstage coupling.

However, it was found that they never accomplished what they were supposed to—in fact, when placed within a receiver they resulted in a broad tuning set, due to the increased resistance of such coils over the solenoid type.

#### Characteristics of Coils

In the Simpletrol receiver coils are employed whose inherent characteristics prevent possibilities of reaction. This type of coil is constructed of two ordinary solenoid or cylindrical coils, with windings so wired that they oppose or neutralize each other.

An additional feature is a tapped primary in each, which not only permits the constructor to more easily adjust his receiver as close to the sensitive point as may be desired, but also allows him to obtain any desired selectivity simply by using fewer primary turns.

These coils are sometimes referred to as binocular, twin cylinder, figure eight, etc., but all, nevertheless, employ similar principles and ideas of construction.

The Simpletrol tuning unit incorporates all that is considered "up to the minute" in present day radio set construction. Two drum type dials, so mounted that they form a single unit but could, nevertheless, be tuned separately; pilot lights for lighting up the fact of the dial; geared vernier controls which show up as two plain neat knobs (see photograph); the detector tuning is isolated (and insulated) from the RF tuning units, since their grid returns are not alike in this particular receiver. This unit comprised the main tuning control and assures positive and smooth tuning from station to station.

Two additional minor controls will also be noted in the photographs and schematic diagram of the receiver. They are both variable resistances—one for volume, the other for sensitivity control.

#### Position of Parts

The Simpletrol receiver employs the transformer coupled type of audio amplification, although resistance coupled or other methods can be used in its place. The writer personally believes, however, that two good audio transformers will operate as satisfactorily (with less complications) as other favored types of amplifiers as far as quality is concerned. For volume it is a well known fact that transformer coupled audio stages are capable of amplifying more per stage with ordinary tubes than any other system of audio amplification.

Constructors should particularly note

the position of each part in the receiver before proceeding with the actual drilling, assembly and wiring of the receiver. The placement of the coils are precariously critical and in the position shown will tend to eliminate any later troubles. They are approximately six inches apart, from centre to centre, the second coil being placed at right angles to the first and second coils.

The audio transformers are at the extreme end of the subpanel and are also at right angles, even though they are of the shielded type. The Brunotrol condenser unit is easily mounted; four machine screws which serve to hold the condenser in place also hold the drum plate.

An additional machine screw is needed on both sides of the centre plate to keep the condenser unit rigid and the vernier gears in positive contact. The area which must be cut out of the panel so that the drum dials may protrude is exactly  $2\frac{1}{2} \times 1\frac{3}{4}$  inches, and, of course, when laying out the panel should be measured off exactly in the centre. All bypass condensers are mounted underneath the subpanel.

Holes must be drilled in the base near each terminal of the various instruments, so that all wiring is brought beneath the subpanel. This is a characteristic feature of most present day manufactured sets which adds considerably to the inside appearance of the receiver.

#### Wide Choice

Many constructors will note the use of the "harness" or "cable" type of wiring in this receiver. Although seemingly complicated, it is very simple to employ and gives the receiver that air of commercial construction which is greatly desired.

Nevertheless, the constructor may wire the receiver in any fashion he desires, without fearing detrimental effects, provided RF leads are isolated and run at right angles to battery connections wherever possible. The construction of the cable will be found to be exceedingly simple if all battery and audio connections are run close together and then the entire mass served up with ordinary thin twine. The cable serves to form a large bypass condenser in the battery and audio circuits and will, therefore, eliminate any

#### LIST OF PARTS

- 1—Simpletrol triple condenser unit .0005 mfd. each, with drum dials, face plates, etc.
- 3—RF transformers for .0005 mfd.
- 5—Frost UX sockets
- 4—Amperites, 2 type 112 and 2 type 1A
- 1—Carter variable resistance 0-500,000 ohms
- 1—Carter variable resistance 200-500,000 ohms
- 1—Bruno pilot light switch
- 2—Karas all-stage ratio audio transformers
  - 1—.00025 grid condenser
  - 1—Turnit improved grid leak
  - 1—Fletcheim 1 mfd. bypass condenser
  - 1—Hammarlund 85 millihenry RF choke
  - 1—.002 mfd. fixed bypass condenser
- 2—Bruno aluminum brackets
- 1—7x21 inch Lignole panel
- 1—7x20 inch hard rubber panel for subpanel
- 2—Rolls Celatsite wire
- 1—6 wire battery cable (Acme).

possibility of stray RF currents reaching these portions of the receiver.

It is always advisable to check the wiring of a receiver for mistakes when the constructor thinks he has completed it. Do not put all five tubes in their sockets with the batteries connected to it until a preliminary test is made with only one tube testing each socket individually or unless a 100 or 150 watt lamp is placed in series with the B+ 135 lead. If this lamp lights, then you have the assurance of misconnected B batteries or an incorrectly wired receiver.

If no mistakes are made, then the receiver will work immediately after being connected up and the usual tuning procedure gone through. If certain tubes fail to light and the possibility of failing socket contact eliminated, then check the amperite which controls that particular filament circuit.

#### Distortion Considered

Distortion — continuous whistling or howling, etc., can be remedied by the placement of a .0001 or .00025 mfd. fixed condenser across the secondary winding of either audio transformer.

For greater selectivity, a factor which those constructors might desire who are in the immediate vicinity of a powerful broadcast station, employ taps 3 or 2 on each "twin cylinder" coil, depending on the degree of selectivity one might want.

The tone reproduction and volume will more than exceed one's expectations. The sample receiver herewith described and illustrated has been demonstrated to many in conjunction with a 3 foot Powertone cone speaker, bringing praise from listeners on its faithful reproduction ability and because of the absence of any background of noise which is indicative of most radio reproduction.

## Cathedral Echoes from KGO

Selected church music of nations throughout the world will provide a unique setting for a new feature to be called "Cathedral Echoes," which will be heard weekly from KGO, the Pacific Coast broadcasting station of the General Electric Company, on Tuesday nights, beginning December 6 at 8 p. m. The broadcasting will be done from the

studios of the station and will consist of a number of collections of organ numbers, solo and concerted voices, offering hymns and anthems, and special instrumental presentations. These programs have been planned by Howard I. Milholland, studio manager of the station who has made a study of this type of broadcast.

## USES COSMETICS IN BROADCAST



ETHEL LAWRENCE, VIVACIOUS BEAUTY OF A CURRENT BROADWAY MUSICAL COMEDY SUCCESS, "GOOD NEWS," APPLYING HER BEAUTIFYING METHODS WHILE SHE BROADCASTS A BEAUTY TALK FROM THE CRYSTAL STUDIO OF THE GIMBEL BROTHERS STATION WGBS, IN NEW YORK CITY.

## Major White New Head of Columbia Chain

The Columbia Broadcasting System at a recent meeting of stockholders and directors, elected Major J. Andrew White president. I. D. Levy was named vice-president.

The Chairman of the Board, Jerome H. Louchheim, Philadelphia capitalist, stated that the selection of Major White as the administrative head of the broadcasting chain was governed by the desire to place its operations in the hands of a pioneering executive in broadcasting with a ripened experience of sixteen years in the radio field, since a considerable expan-

sion in the business of the company and extension of its network is planned. Major White announced the signing of a contract with the American Telephone and Telegraph Company to provide permanent service over the present network of sixteen stations, which has been operating on a basis of 10 hours per week.

Under the new management, the Columbia System will have wire facilities for its exclusive use in broadcasting programs 16 hours a day. The wire contract becomes effective at once, with July 14, 1931 as the expiration.

## A TRIBUTE TO THE



(International Newsreel)  
TIGE, THE WONDER DOG, LISTENING IN TO THE VOICE OF HIS MASTER, FRED LYNCH, WHO BROADCAST A SONG RECITAL FROM KOMO, SEATTLE. HE RECOGNIZED THE VOICE.

## New Type M Used for O

A new type "mixing" panel for the simultaneous co-ordination of eighteen or more microphones has been designed and built by Eugene F. Grossman, operating engineer of the National Broadcasting Company. He is responsible for the "pick-up" of many of the important network programs of national interest. This panel or "transmitter attenuator" was developed particularly for use in the Auditorium Theatre, Chicago. It was used for the first time when the Chicago Civic Opera Company broadcast the second act of "La Traviata" inaugurating the new series of opera broadcasts in the Balkite Hour which is heard weekly through the N. B. C. blue network.

Preliminary tests on the panel were made by Mr. Grossman at Soldier Field, Chicago, during the Tunney-Dempsey bout at which time listeners-in reported that the click of telegraph keys and sports writers' machines were clearly heard above Graham McNamee's announcements.

"The opera is the most difficult of all 'pick-ups,'" Mr. Grossman said, "due to the great size of the Auditorium stage and the fact that the artists sing from widely separated positions on it.

"This makes it practically impossible to follow each performer by microphones, therefore this type of 'pick-up' calls for a special system in order to cover the stage and orchestra pit effectively. Enough microphones must be placed so that performers singing from any part of the stage will be in proper position to one of the transmitters.

"In other broadcasts of this nature it was necessary to have an observer in the audience, who, by means of telephonic communication, advised the control operator back stage, of the movements of the singers in order that the microphone nearest the performer could be cut into

## QUINTET OF HARPISTS PROVE DELIGHT AT WBAL



THE HARP HAS LONG BEEN A FAVORITE MUSICAL INSTRUMENT, PARTLY BECAUSE OF ITS ANTIQUITY AND PARTLY BECAUSE OF THE EXQUISITE MUSICAL TONES WHICH CAN BE PLUCKED FROM ITS STRINGS. THE HARP QUINTET, SHOWN ABOVE, HEARD FREQUENTLY FROM WBAL, BALTIMORE, IS ESPECIALLY ADEPT AT ENTICING SWEET SOUNDS FROM THE HARP, AND DEMONSTRATES ITS SKILL TO AN EVER-INCREASING APPRECIATIVE RADIO AUDIENCE.

## king Panel era Pick-up

the circuit; or the control operator himself sat in the audience and made his adjustments on bulky equipment which he held on his lap.

The disadvantages of these methods were that the microphones 'cut in' near the performer caused a change in volume which was noticeable to the listeners.

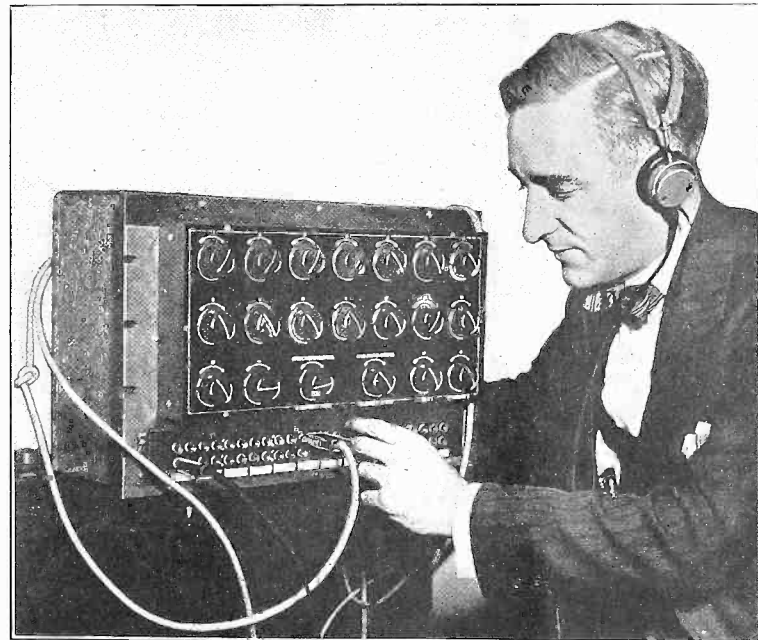
It is physically impossible to 'fade in' microphones near the performers with any degree of technique, unless the control operator knows the opera as well as the musical conductor and can anticipate when the chorus and various soloists are to start singing.

Our limitations requiring these 'cut-outs' and 'cut-ins' were realized during our preparations to broadcast last year's opera series from the same stage and the means of overcoming these disadvantages were studied. The new panel is the result.

Last year's panel could handle sixteen microphones, but only twelve of them simultaneously. This did not provide a sufficient number to cover the stage and orchestra pit.

In the new system, we took this into consideration and eighteen mikes are in the circuit with two others to be used by the announcer. It is not necessary to make 'cut-ins,' as all of the microphones are in the circuit throughout the presentation. By means of two dials, one for stage microphones and the other for those in the orchestra pit, the operator can blend together the pick-up of the various microphones.

Aided by Gerard Chatfield, supervisor of programs of the N. B. C., who sits beside the panel, the operator tunes out the orchestra microphone when the score calls for the voices to dominate or when in the necessary mikes when it is necessary to support the soloists or chorus.



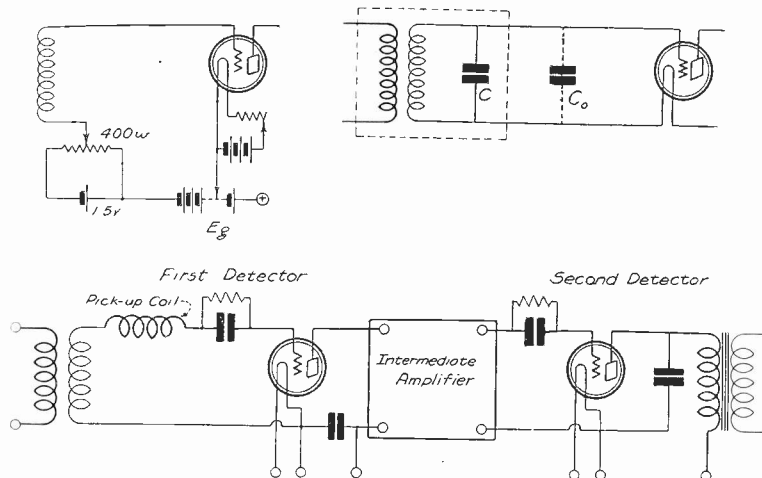
E. F. GROSSMAN, OPERATING ENGINEER OF THE NATIONAL BROADCASTING COMPANY, MAKING FINAL TESTS WITH HIS "TRANSMITTER ATTENUATOR" FOR THE SIMULTANEOUS CONTROL OF 18 MICROPHONES.

## Heavy Leads Needed for AC Tube Filament

As long as tubes drawing less than an ampere per filament were used there was no need of worrying about the filament circuit leads. While bus wire was used in most receivers, it was no crime to wire the filament circuit with wire as fine as 22, except, perhaps, in a few cases or multi-tube receiver which re-

quired a total filament current of 2½ to 5 amperes. With the AC tubes the situation is different. All of these tubes require very heavy filament currents. The —27 takes 1¾ amperes, the —26 takes 1.05 amperes, the —10 takes 1.25 amperes. There are other tubes which take as much as 2½ amperes per filament.

# The Two Secrets of DX In a Creative Receiver



DIAGRAMS ILLUSTRATING DETECTION AND AMPLIFICATION

The circuit at left, top, shows how the grid bias on a detector can be varied in minute steps. Eg is a dry cell battery which can be varied in steps of 1.5 volts. Across one of the 1.5 volt cells is connected a 400 ohm potentiometer and the grid return is connected to the slider. Possible variation of about .015 volt steps. At right is a tuned intermediate frequency transformer inclosed in dotted square. The condenser C is adjusted in the laboratory so that the transformer responds to one standard frequency. Co is the capacity of the leads and of the tube elements which is connected in parallel with C as soon as the transformer is installed. This lowers the actual intermediate frequency. At bottom is the schematic diagram of a double detector receiver in which an intermediate frequency amplifier is interposed between the two detectors. The oscillator to which the pick-up coil is coupled is not shown.

By J. E. Anderson

Technical Editor

There are two things in a radio receiver which contribute to its sensitivity, or DX getting ability. And they are the detecting efficiency and the amplification. The difference between a dud set and a commander-in-chief of the air lies in these two qualities.

Every tube in the circuit detects more or less. Amplifier tubes are operated so that they detect as little as possible; detector tubes so that they detect as well as possible.

If a circuit is to be sensitive to the feeble radio signals emanating from a remote station, every amplifier tube must amplify as much as possible and the detector, or detectors, must operate at maximum detecting efficiency.

## Great Variation in Detection

The variation in the detecting efficiency of a tube with varying grid bias is great. It is usually stated that tubes of the general purpose type are not critical as to grid bias and detecting efficiency. It would be better to state that they are not supercritical, for critical they are. The grid bias may be varied by as little as  $\frac{1}{2}$  volt and the detecting efficiency will drop to about one-fourth of its maximum value. This fact has been abundantly proved in technical papers. It is therefore of utmost importance that the grid bias on a detector be adjusted to that value which gives maximum detecting efficiency, and that the adjustment be made accurately. That is a prime condition for reception of distant stations.

When the receiver is of the double detection type both detectors, of course, must be adjusted for maximum detection efficiency, or the receiver will not be as sensitive as it is when properly adjusted. The adjustments of the first and the

second detectors are not necessarily the same. The two detectors do not operate in the same frequency levels, and the load impedances on the two are widely different. The optimum adjustment depends on these factors. It also depends on the type of tube used.

## Use of a Potentiometer

Since there are two types of detection there will be two modes of adjusting the grid bias. When the anode bend method of detection is used the grid is made negative by an amount depending on the plate voltage applied and on the mu of the tube. Since grid batteries cannot be had in units smaller than  $1\frac{1}{2}$  volts, and since a variation of  $\frac{1}{2}$  volt is enough to throw the detector out of adjustment, it is necessary to have some means for splitting the voltage of one cell, if the plate voltage is unaltered. This is accomplished with the aid of a potentiometer of from 200 to 400 volts connected across one or two  $1\frac{1}{2}$  volt cells. With such a potentiometer it is possible to change the voltage on the grid by the voltage drop in one turn of the potentiometer. Suppose there are 100 turns. The drop in each turn, then, when the drop across the entire potentiometer is  $1\frac{1}{2}$  volts is .015 volt. This will give an adjustment which is fine enough.

In the grid circuit method of detection the effective grid bias is not what it appears to be. The grid return is usually made to the positive end of the filament, but this does not give the grid a bias equal to the drop in the filament.

## Effect of Grid Current

The grid current which flows when the grid is positive reduces the effective value greatly. In fact, it is so effective in re-

ducing the grid voltage that it is almost impossible to make the grid as much as one volt positive.

In one particular case it was necessary to return the grid to a point 60 volts higher than the negative end of the filament before the effective grid voltage was one volt positive. For the same tube and circuit the maximum detecting efficiency occurred at .15 volt positive, and the grid was returned to a point 3.4 volts positive to get it.

In this case the mu of the tube was 20, the grid leak 3 megohms, and the grid condenser 200 micro-microfarads (.0002 mfd.). The detection took place from radio to audio frequency. In a double detection circuit the first detector works between radio frequency and the intermediate frequency, and the second works between the intermediate and audio frequencies.

The adjustments in both cases will be slightly different from the adjustment necessary when the detector works between radio and audio frequencies. But the adjustment can always be done by changing the grid resistor, by varying the applied plate voltage, by varying the filament current in the detectors.

When both detectors in the double detector type of receiver have been adjusted to maximum detecting efficiency, no further sensitivity can be achieved by manipulating these tubes, or their associated circuits. But much can be gained by manipulating the amplifiers and the inputs.

## How Proportion Works Out

In a double detector type of receiver the sensitivity of the circuit can be increased by suitably coupling the oscillator to the modulator tube, as well as by obtaining a good pick-up of the radio frequency signal. The strength of the signal in the intermediate frequency level is proportional to the product of the amplitude of the signal picked up by the loop or antenna and the amplitude of the local oscillation which is impressed on the modulator grid. Close coupling between the oscillator and the modulator, therefore, increases the sensitivity of the receiver. But increasing the sensitivity in this way also increases interference from other stations.

Skillful design is necessary if the maximum sensitivity and the minimum of interference are to be obtained at the same time.

When the detectors have been adjusted to maximum detecting efficiency and the pick-ups adjusted to suitable values, it remains to arrange the amplifiers so that each one will contribute as much gain as possible. In a double detector type of receiver most of the amplification is obtained in the intermediate frequency amplifier, and therefore its adjustment is of prime importance when building a DX receiver.

## Solution of Coil Problem

The most important thing is that all the intermediate transformers be tuned to exactly the same frequency. It will not do to have them tuned to approximately the same frequency, not when DX is the main object. It is a comparatively simple matter to tune all the transformers to the same standard frequency in the laboratory. All the best transformers are so tuned. But this only insures that all the coils are alike at that time and when they are isolated, and not parts of a circuit. It is in the circuit that they must be alike, not necessarily in the shipping carton. But making all the coils exactly alike goes a long way toward making them alike in the circuit. Making them stay right is a feat of mechanical sturdiness and careful testing. If all the stages are exactly alike, with respect to tubes,

(Concluded on next page)



sockets, leads, voltages and so on, the transformers will be turned to the same frequency in the circuit as well as out.

This frequency will not be the same as the frequency used as the standard in the laboratory. The difference is due to stray capacities which will lower the frequency a little. This is of no importance as long as the stray capacities in all are the same.

Another contribution to amplification, and hence to DX, is the proportioning of the coil and tube impedances. This does not mean that the impedance of the coil should be equal to the impedance of the tube. No, it means that the impedance of the primary side of the coil should be very large as compared with the impedance of the tube. As much of the effective voltage in the plate circuit as possible should be impressed across the primary of the coil. This can be done only if the tube impedance is small as compared with the impedance of its load.

The question of turns ratio also enters into the condition for sensitivity. The higher the ratio the higher the sensitivity, as a rule. But the ratio is limited by the resonance condition in the secondary. The capacity across the secondary cannot be decreased indefinitely. There must be a certain capacity across the coil so that small variations in the tube capacity will not upset the tuning appreciably. When the capacity is fixed, as well as the intermediate frequency, the secondary inductance is also fixed. Hence there is no great latitude left for selecting a ratio. However, by experiment it is always possible to choose impedance, turns, mutual inductance, and frequency so that the amplification per stage with given tubes and voltages will be a maximum. This has been done in at least one commercial coil.

#### Four to Five Stages Used

Sensitivity of a high order also demands that several stages of intermediate amplification be used. Four to five intermediate transformers with appropriate tubes should be used when extreme sensitivity is desired.

It should also be pointed out here that high mu tubes are more sensitive than general purpose tubes. When a receiver is used for bringing in extremely weak signals high mu tubes should be used in the detector sockets.

A good audio amplifier with a high gain ratio is also essential for high sensitivity. But if the set is also to be used for reception of local programs of high quality, the audio amplifier should be chosen more for its faithfulness to the signal and for its power handling capacity than for its voltage step-up. When it is possible by the choice of transformers of exceptional characteristics to combine fine quality, great volume, and a high gain, of course, such possibility should not be overlooked.

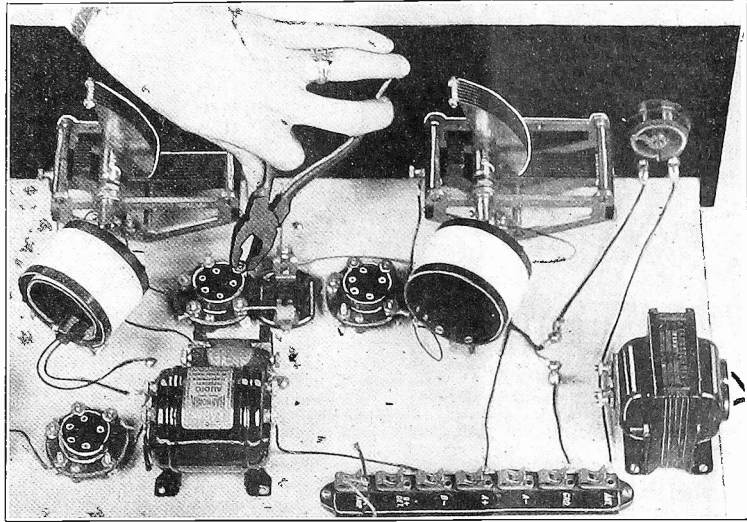
When all the conditions for high sensitivity have been met, the owner of the intermediate amplifier type of receiver has a great opportunity for pulling in DX. It devolves on him to take full advantage of the chance. It requires careful tuning to bring in the extremely weak signals. And by tuning here is also meant the manipulation of the volume controls.

#### Modulator Dial No Selectivity Test

It is of no avail to have a sharply tuned intermediate amplifier with high gain if the oscillator dial is not manipulated so that the intermediate frequency coincides with the peak. The intermediate signal must exactly straddle the peak with the carrier at the tip. To put it there the oscillator must be very accurately adjusted. To keep it there while the volume is built up with the aid of the first condenser and the volume controls it is necessary to readjust.

For highest sensitivity as well as for minimum of interference the first tuner

## FIVE PLACES TO TIGHTEN, REMEMBER!



SETS USING THE 227 TUBES REQUIRE FIVE-PRONG SOCKETS.

## Science Main Goal of Home Builders Abroad

On his return from a seven weeks tour of Europe, L. R. Beardslee, treasurer of Arthur H. Lynch, Inc., reports that in the design of radio receivers for the broadcasting fan there is little in the foreign market which can compare with the receiving devices being offered for general sale in this country.

Mr. Beardslee says that the home construction of radio receivers on the other side seems to be of an entirely different nature. He says that most of the work of this character is being done by folk who are not as much interested in receiving broadcast programs as they are in making a study of the electrical characteristics of the receivers they make. Some of the more advanced home constructors, he says, are doing a very fine job, but in most instances they are materially handicapped as the material does not in any way match up with the quality of the parts being sold in America.

Furthermore, the distribution of these parts is not general, although a marked improvement is shown in this phase of the business in two years.

He said: "The majority of receivers constructed at home, on the other side remind one of the receivers constructed in this country about two years ago. However, a great many radio designs and radio parts of American origin, are finding their way into Europe and home constructors there are eagerly applying our ideas.

"Even in the matter of completed receivers, we find that the mechanical design is of somewhat different nature from our own. There are as a rule a great many more dials and switches and the tubes which are called valves, usually protrude from the top of a flat case instead of being completely concealed in the cabinet as is the case of most of the receivers here."

must be tuned accurately, where the incoming signal is weak. It is then tuned to the radio frequency carrier which is desired. Otherwise it need be tuned only to approximately the incoming frequency.

The apparent selectivity of the modulator tuned circuit as evidenced on the first condenser dial (at left, usually) is no test of the selectivity of a double detector receiver. The main object of the first tuner is to select and intensify by resonance weak signals which would not be heard without exact tuning. On weak signals the first control is very critical; on strong signals it seems very broad because any local station will come in all over the dial provided that the oscillator is set for this station.

#### Condenser and Dial

The choice of condenser and of dial is important in a DX receiver. Since accurate tuning is a necessary condition for DX reception it is also necessary to have a condenser which turns easily and

a dial with which the condenser can be turned without appreciable effort. The motion of the condenser must be smooth and free from jumps. Just one tiny jump of the oscillator condenser may be sufficient to skip over a weak signal from a remote station. Even when the condensers run smoothly and when the operator turns the dials too fast the weak signals may be lost entirely. Hence dials with a fairly slow vernier controls should be used with a DX double detecting receiver.

The skill of the designer of a double detecting receiver is reflected in the type of condensers and dials he chooses as well as in the intermediate frequency and type of volume control he chooses.

(Continued next week)

\* \* \*

[What are the requirements for achieving outstanding design in a receiver using an intermediate amplifier? Quality and selectivity's tug of war was discussed last week, issue of November 19.]

## A THOUGHT FOR THE WEEK

**D**ID you read about the crippled Kansas boy who had never seen a picture show, heard an orchestra or a phonograph play and who, when presented by his neighbors with a radio set, said: "The world is so wonderful a place that I must get well and stay in it."

*Aren't those simple words swelling up from a boy's heart, a lyric song to the greatness of radio?*

SIXTH YEAR

# RADIO WORLD

*The First and Only National Radio Weekly*

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

TELEPHONES: BRYANT 0558, 0559

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(Dated Saturday of same week)

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

## WRC After New Site

Washington.

Relying on the possibility of being able to procure the 5,000 watt transmitter formerly used by WEAf, scouts have been sent out by officials of WRC Washington, to seek a new site outside this city. The station is owned by the Radio Corporation of America and operated by the National Broadcasting Company.

One site which has been considered is in the vicinity of Sandy Spring.

# Why I'm a Scoundrel

By Moe Hare Cogswell

If you want to convert your friends and neighbors to enemies do one of the following things: Give them for nothing the best set ever built; sell them at a great loss to yourself a high grade set; fix up a set which they have bought elsewhere. Neither of these things ever fails to stamp you as an unspeakable ingrate or as a cheating scoundrel in the opinion of those whom you would help.

A certain craftsman and owner of the house in which a radio man lived had taken a model 1922 receiver in payment of a bad debt. The set had been manufactured in an auto repair shop by somebody who knew nothing about radio. As a radio set it was worth just nothing. The bad debt had been \$7.50 and the craftsman thought he had made a wonderful bargain. He asked the radio man in his house to confirm his judgment. Out of courtesy to the landlord the radio man stretched his imagination to the extent of \$10 and named that as the value of the piece of junk.

"Is that all?" exclaimed the disappointed landlord.

He had expected to hear \$50 at least.

## Not Free, Shocked to Learn

But a radio set without tubes and batteries and antenna is of no use even if an imaginary value of \$10 can be set on it without committing a felony. So the landlord asked the radio man how much he would take to equip the receiver. The price named staggered the landlord because it was several times the estimated value of the receiver. But it could not be made lower if the radio man was to break even. The radio man got the commission to do the work at the price named, after the landlord had been warned that it would be a waste of money unless he got another receiver.

Well the radio man did the job, losing the sum of \$1.50 in cash and considerable time in testing and gathering the parts. For a while the set worked better than had been expected.

The storage battery ran down, and no more signals could be received. The landlord claimed he had been cheated because he had expected a storage battery that would not run down. He was persuaded to take the battery to a service station for charging. He did so a few times as needed. Finally the storage battery fell to pieces. Another evidence of being cheated by the radio man—not by the service station that had given him an old battery for his new one.

Then the landlord threatened to sue the radio man!

## She Gets Particular

An experience befell the writer. He built a first class resistance coupled receiver equipped with power tube in the last stage. It received all but 45 volts from the DC lighting line, with a suitable filter for taking out the ripple. A storage battery was used to supply the filaments and a charger was used which took the charging current from the line.

For six months that set gave satisfactory service to the writer. The set was played nearly every evening. A certain woman in the house heard the set work, saw it occasionally, and admired it frankly. She said that it was the best set she had ever heard; and the set fully deserved the praise she and others gave it.

The woman wanted to buy it—if the price was not too high. Well, a price was set reluctantly which represented a loss to the writer. The set was installed in her apartment exactly as it had been

in the writer's when she had heard it. And the receiver was no respecter of apartments. It worked exactly the same in both places.

But immediately the woman was dissatisfied. She thought she had been cheated. There was too much noise in the loudspeaker; some signals were not loud enough; it cost too much to operate; it was too difficult to tune. A cone speaker was taken out and replaced with a phonograph unit and connected to the horn. She thought that was an improvement. And so it was, in her opinion. The substitution was gladly made, since the cone speaker was one of the best.

## Power Cost "Too Much"

The signals were not loud enough, was one complaint. WEAf, the closest station, happened to move about the time she got the set, and from its new location the station was very weak. But all the other stations that could be expected on the set came in satisfactorily to the writer.

Some stations, she said, came in too loud. She refused to touch the volume controls by means of which the strongest station could be completely suppressed. She expected all the stations to come in with the same strength regardless of their location and power.

The most painful complaint was that it took too much power to operate the set. The first electric bill she got after she had had the set installed was staggering.

In all she had operated the set about five hours between the time the set was installed and the time the electric meter was read. She had charged the battery about 12 hours at a .5 ampere rate. That was the only power she had taken from the line for radio purposes because the power required for the plates was not measurable.

## And It Cost About 5 cents

The cost of the power she had taken was about 5 cents, yet the bill was staggering as a result of the connection of the radio set to the line. She conceded that part of the increase that month was the result of the seasonal shortening of the day, the use of electric heaters as the apartment grew colder, the use of electric curling irons, toasters, vacuum cleaners, and so on.

This woman is experiencing so many imaginary difficulties with her set that she never turns it on except when some preacher is discoursing on Sunday mornings. The cost of operating the set at a cent an hour is so high that she cannot afford to tune in on opera music.

Those who dabble in radio "experting" on the side for charity or friendship open up a Pandora's box every time they sell a set at a loss, give a set away, or merely fix one up for somebody. All of the recipients of the favors become parasites and attach themselves to the expert for continual free assistance, and they do it with the idea that he owes it to them.

## Before the Notable Program

If the expert has scattered his favors so widely, half a dozen of the parasites will call up at once twenty minutes before some program of national importance is to start. "Come over at once!" is the demand, not the request or invitation. "We want to hear the program, and our set is not working well." Some demand a new rectifier tube, some a power tube,

(Concluded on next page)

## MICHIGAN BANS SETS IF CHIRPERS

Lansing, Mich.

Steps have been taken by the Legislature of Michigan to localize radio control. To this end the State Public Utilities Commission has been authorized to prohibit the use of sets which interfere, and ban the operation of stations broadcasting simultaneously wherever interference results.

Small municipal organizations are to be in charge of local cases and only when the trouble is such as to involve the state, will the commission act.

One man will be employed by the commission. He will meet the heads of the civic organizations and help solve their problems. He will also be given authority to institute court proceedings against any violator. Failure to abide with the rules and regulations of the commission will result in a fine of \$500 or imprisonment not to exceed three months.

## Vocal Appraisal Made Easier, Director Finds

Washington.

Radio serves as an excellent means of appraising the richness of voices, according to Eduoard Albion, director of the Washington Opera Company.

"Radio has also helped national appreciation of music tremendously," Mr. Albion continued, "but we now need to go further and provide outlets for creative expression, which should result from increased appreciation."

## Flying Station Founded By Defence Officers

Washington.

The Flying Broadcasters, Inc., a newly organized company of Army and Navy officers, who are seeking to develop airplane broadcasting, were recently granted a license by the Federal Radio Commission.

The new station's call letters are KHAC. Operation will be on a wavelength of 204 meters (1,470 kilocycles), 50 watts.

## SPOKANE CLUB ENDS DUES

Spokane, Wash.

All dues in the Spokane Radio Listeners association at Spokane, Wash., have been abolished. Hereafter any radio listener in Spokane may become an association member by registering his name with the organization.

## Recipients of Gifts Command Donor

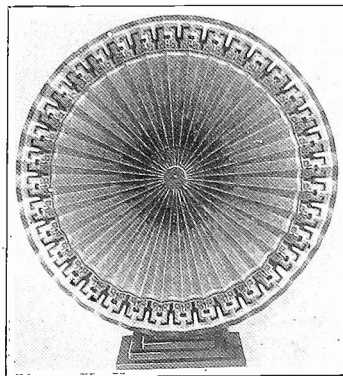
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some a B battery, some a whole set of tubes, some the installation of a new antenna, some a new A battery.

We heard of an authentic case in which a man in the business had given away a receiver without a cabinet. A short time after the set had been delivered the wife of the recipient wanted to know when shipment would be completed by sending a cabinet. She even specified an expensive period console. Having been given free of charge a \$50 radio set, why should not the same donor add a \$400 console to complete the gift?

Another case was that of a member

## Fanspeaker Makes Its Bow to Public



The Fanspeaker, designed by Clyde J. Fitch, is now ready for distribution to the trade. Stoner & Heath, Inc., 122 Greenwich Street, New York City, have been appointed sole representatives for this territory. The Fanspeaker employs the Lumiere type of pleated diaphragm, 20 inches in diameter, attached at the center to a direct-drive unit. There will be kit and assembled models.

Dealer information for the East may be had from Stoner & Heath. Those in other parts of the country may obtain terms and information from Fanspeaker Radio Co., 199 Fulton Street, New York City. This concern particularly invites jobber inquiries.—J. H. C.

## Harold A. Lafount New Board Member

Washington.

Harold A. Lafount has been appointed by President Coolidge as a member of the Federal Radio Commission to succeed John F. Dillon, who died recently.

Mr. Lafount, a graduate of the Agricultural College of Utah, has made a special study of radio broadcasting. He was in the hardware business.

## Signal Corps Improves Radio to Los Angeles

Washington.

The Signal Corps of the Army has established an improved radio service to Los Angeles, thus making possible the transmission of dispatches by radio direct to that city.

The Signal Corps facilities will be located in the Federal Building, Los Angeles.

of a prominent research laboratory who built receivers of high quality for his friends. Having placed a few sets he was so overwhelmed with service demands that he had no time left for himself. A close relative of this man was a bond salesman who stimulated his own sales by promises that his kin would be glad to come and fix the radio sets of his prospective bond customers. This did not ease the burdens of the research man. So serious did his case become that he had to refuse all service calls. As a result he has scores of former friends and acquaintances who now consider him an ingrate.

## FARM TALKS BY U. S. GET TO BIG AREA

One-hundred and seventeen representative commercial and agricultural college radio stations are now broadcasting radio programs prepared by the Radio Service of the United States Department of Agriculture. This is 24 stations more than were on the schedule on October 4, the date the 1927-'28 broadcasting season opened, and is a material increase over the October, 1926, number.

### Pennsylvania Leads

Pennsylvania leads the States in number of stations broadcasting the department's programs, with nine stations regularly subscribing to Radio Service releases. New York, with eight stations, is second, and Texas, California, and Missouri are tied for third place with six stations each. Radio stations in 38 states and the District of Columbia are now regularly broadcasting department programs.

### Stations Using Service

The list of states, and the number of subscribing radio stations in each, follows: Pennsylvania, 9; New York, 8; California, 6; Missouri, 6; Texas, 6; Iowa, 5; Michigan, 5; New Jersey, 5; Washington, 5; Minnesota, 4; Tennessee, 4; Virginia, 4; Colorado, 3; Florida, 3; Illinois, 3; North Dakota, 3; Ohio, 3; Oklahoma, 3; Wisconsin, 3; Arkansas, 2; Connecticut, 2; Indiana, 2; Kentucky, 2; Montana, 2; Nebraska, 2; Oregon, 2; Utah, 2; and Idaho, Arizona, Wyoming, South Dakota, New Mexico, Alabama, North Carolina, Maine, District of Columbia, Georgia, West Virginia, and Massachusetts one each.

## Copenhagen-New York 'Phone Calls Soon

Washington.

Telephone calls may soon be made between Copenhagen and New York City via the new Copenhagen-London circuit and the trans-Atlantic radiophone, the Transportation Division of the Department of Commerce stated, on the basis of a report received from the American vice consul at Copenhagen, Ellis A. Johnson.

Mr. Johnson reported that Copenhagen now has phone connections with both Paris and London, the charge from the Danish capital to the British capital being about \$4.25 for the first minute and \$1.40 for each additional minute. The expectation is, it was stated, that this land and underwater circuit will permit a hook-up with the London-New York transoceanic wireless telephone circuit.

## Columbia Short Waves to Begin December 1

The Columbia chain programs beginning December 1, will be sent out simultaneously from the short wave station 9XU and the sister station KOIL at Council Bluffs, Iowa. The short wave station will use 500 watts and transmit on 61.06 meters or 4,190 kilocycles.

Plans are being made whereby stations in foreign countries will pick up the broadcast on short waves and rebroadcast it on the standard waves.

# Radio University

When writing for information give your Radio University subscription number.

I AM going to construct a three receiver, employing a regenerative detector, with a tuned plate and a loop input, and two stages of transformer coupled audio frequency amplification. I was told by a friend of mine, that if I would install a radio frequency choke and a bypass condenser (.0005 mfd.) in the detector circuit, in the standard hookup fashion, the results would be improved. Do you think this is true? Isn't it possible that there will be a tendency on the part of the detector tube to oscillate beyond control, when this choke is inserted?

(2)—I have a two foot loop. Would I get louder signals, if I used a four foot loop?—Joseph Mehlenger, Houston, Tex.

(1)—This will work out all right.

(2)—The signals will be louder, when this is done.

\* \* \*

I WOULD like to build the coils that are described in the Nov. 5 issue of RADIO WORLD, Radio University department, but want to use .00035 mfd. variable condensers, instead of .0005 mfd. This will, as I see it, necessitate the use of the entire form for the secondary winding. Will it be all right to wind the primary over the secondary at the low potential end. Will 59 turns be satisfactory for the secondary and 15 turns for the primary windings?—Edgar Wentell, Brooklyn, New York.

You can wind the form as you suggest. Use the number of turns you specify.

\* \* \*

IS IT good practice to ground the cores of audio and power transformers?

(2)—Is the cathode the electron emitter in a vacuum tube?

(3)—Is the anode the plate or the target which attracts the electrons emitted from the cathode?—Henry W. Hutchinson, Albany, New York.

(1)—Yes.

(2)—Yes.

(3)—Yes.

\* \* \*

I AM building a B eliminator, wherein a 216 B rectifier tube will be used. The power obtained therefrom will be fed onto the plate of a 210 tube. I would like to know if a 1 ampere fuse will fit the bill, when inserted in series with the primary circuit of the power transformer.

(2)—I am going to place the entire power device in a metal container. Is it best to incorporate the fuse outside of the case?

(3)—Should a porcelain receptacle be used?—George L. Nandelberg, San Francisco, Calif.

(1)—Yes.

(2)—Yes.

(3)—Yes.

\* \* \*

WHILE LOOKING over the miscellaneous apparatus in my laboratory, I found that I have the following parts which I would like to use in a 5-tube receiver, the diagram of which I would appreciate: one .0005 mfd. double condenser; two tuned radio frequency transformers with secondaries matched for these .0005 condensers; one .00025 mfd. fixed condenser; one variable megohm grid leak; three dual impedance transformers; one 500,000 potentiometer; two 1 A Amperites; one  $\frac{3}{4}$  ampere ballast resistor; one .0005 mfd. fixed condenser; one pilot light and switch, and eleven binding posts. Intend using —01A tubes.—Elliot Magdeline, Baton Rouge, La.

The circuit diagram of a receiver containing the parts you have is shown in Fig. 577. L1L2 and L3L4 represent the primary and secondary windings of the tuned radio frequency transformers. C2 is the double condenser. H indicates the double impedance audio couplers. R1 and R2 are the Amperites. R3 is the  $\frac{3}{4}$  ampere ballast. R4 is the variable grid leak. Lg is the pilot light. S is the switch. P1 is the potentiometer. C3 is the .00025 mfd. fixed condenser. The binding posts are used for the batteries, output and antenna and ground. C1 is the .0005 mfd. fixed condenser.

I HAVE a pair of audio frequency transformers. One has a ratio of 2 to 1, while the other has a ratio of 5 to 1. I would like to place them into a 5-tube tuned radio frequency receiver. Which one would you suggest placing first.

(2)—Will 01A tubes work out all right?—Randolph Clifford, Mt. Vernon, New York.

(1)—Use the 2 to 1 in the first stage and the 5 to 1 in the second stage.

(2)—Yes.

WHAT ARE the advantages, if any, of beam radio communication over the present day system?—Beatrice Kazlow, Brooklyn, N. Y.

All the radio flux is directed to the one point where it is desired and all other points are left in radio darkness as far as that beam is concerned. Only a small amount of power in the antenna will be required to communicate with a given station when all the power is directed squarely on the receiver. Besides economy in power, there is the freedom

from interference. When the beam is confined in a narrow space and in one direction only, there will be only a small number of receivers which will intercept the signals. Thus it will interfere with only a small number of stations, those which are directly in its path. It follows that the system is also much more secret than any other. If only a few stations can receive the signals at all it will be more difficult to eavesdrop.

\* \* \*

IN REFERENCE to the Winner 4-tube receiver described in the October 1, 8, 15, 22 and 29 issues of RADIO WORLD,

(1)—Can I use another stage of tuned radio frequency amplification?

(2)—My antenna is 200 feet long. This is, exclusive of the leadin which is 50 feet in length. Could I use this antenna on the Winner? I think it is too long.

(3)—I have four separate B batteries of the Edison element type, each one having a total voltage of 110 volts. Could I use them on this set, using a separate B supply for each plate?

(4)—I have four 1 mfd. fixed condensers which are built in one metal container. Could they be used?

(5)—Should I place the audio transformers closer together, and place the condenser block to one side, or should I place the condenser block in between the two transformers?

(6)—Could I use binding posts?—Leonard Kennelly, Chicago, Ill.

(1)—No. This is not advised. The set would become too erratic and there would be little gain in all around efficiency.

(2)—It will be necessary to decrease the number of turns on the primary of the first coil. Scrape off some insulation on the 6th turn from the beginning of the winding. Connect this to the antenna.

(3)—Yes. This is the best method of connecting up the B supply. As a matter of fact, if it were not for the expense involved in the purchase of separate batteries, this method would always be recommended, as it assures one of eliminating feed back through the batteries, causing howls and other noises.

(4)—Yes.

(5)—Place the condenser block in between the transformers.

(6)—Yes.

\* \* \*

I HAVE a 10 watt frosted bulb, which I would like to use to indicate the "on" and "off" position of my eliminator, by connecting it across the primary circuit of the transformer, as illustrated in the Radio University department of the October 8 issue of RADIO WORLD. Is this all right?

(2)—I intend building a separate audio amplifier in conjunction with a B eliminator. I find it will be necessary, in order to get all the parts into the housing, to place the audio transformers on top of each other, separated by an aluminum shelf. Will this work out all right?—Alexander Berlin, Houston, Tex.

(1)—Yes. You can even use a smaller

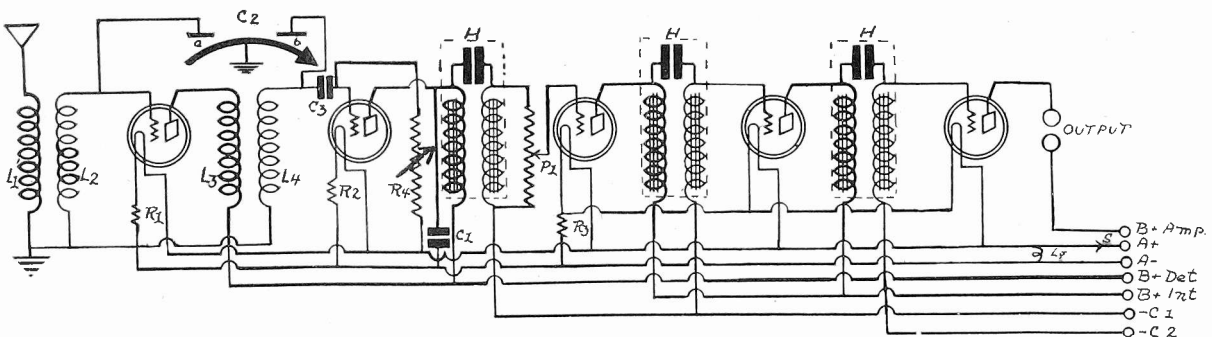
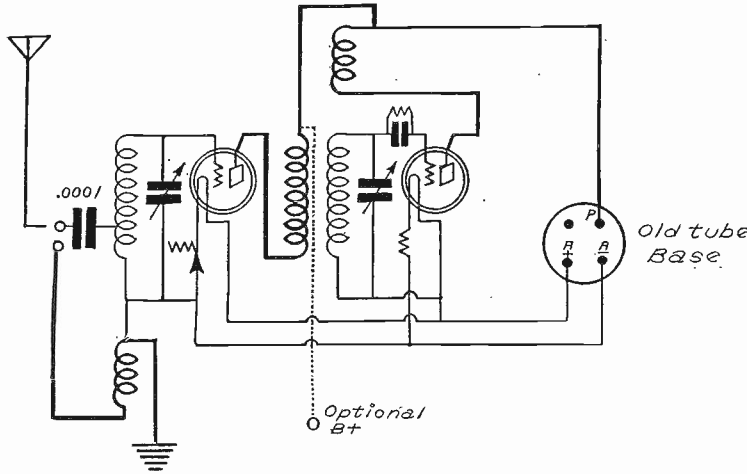


FIG. 577

THE CIRCUIT DIAGRAM OF THE 5-TUBE RECEIVER REQUESTED BY ELLIOT MAGDELINE.



**FIG. 578**  
**THE CIRCUIT DIAGRAM OF THE DETECTOR AND RADIO FREQUENCY UNIT, WHICH CAN BE USED TO TEST OUT DIFFERENT TYPES OF AUDIO AMPLIFIERS.**

value, as long as it operates off the 110 volt line.

(2)—Yes. Suggest you run a wire from the cases of the transformers as well as the shelf, which can be used as a shield, to the ground. Be sure that these leads touch nothing else.

\* \* \*

**I BUILT** a 2-tube receiver, using a regenerative detector with a condenser controlling the regeneration and one stage of transformer coupled audio frequency amplification, about three months ago. Although the results are satisfactory, the tuning is very critical. I was told by a chum of mine, that if I used the tickler method, the results would be improved. The primary of the coil contains 12 turns. The secondary contains 50 turns, tapped at the 25th turn. The windings are wound on a 3 inch diameter tubing with No. 22 double silk covered wire, spaced 1/4 inch. Across the secondary winding is shunted a .0005 mfd. variable condenser. A .00025 mfd. variable condenser is used in the plate circuit. If advisable, how can I fix the set up, so as to incorporate the tickler?—John Emery, Kansas City, Mo.

You can use the tickler method. Procure a 2 inch diameter tubing and some No. 24 single silk covered wire. Wind 35 turns on this tubing. Then insert it in that portion of the tubing carrying the high potential end of the secondary winding. The 50th turn of the secondary winding, which originally went to the rotor plates of the variable condenser in the plate circuit, is now brought to the plus A post. The tap is not used. The tickler winding can either be wound in two sections so that the shaft is placed in between the windings, or it can be wound on one section with the shaft placed at one end of the tubing. To connect the tickler, simply run a wire from the beginning of the winding to the plate post and another wire from the end of the winding to the P post on the audio transformer.

\* \* \*

**I HAVE** been looking high and low for a circuit diagram of a standard 5-tube tuned radio frequency type of receiver with transformer coupled audio frequency amplification. Did you ever publish a description of such a set, together with a circuit diagram?—Henry King, Port Jervis, N. Y.

Yes. See page 6 of the December 26, 1925 issue of RADIO WORLD.

\* \* \*

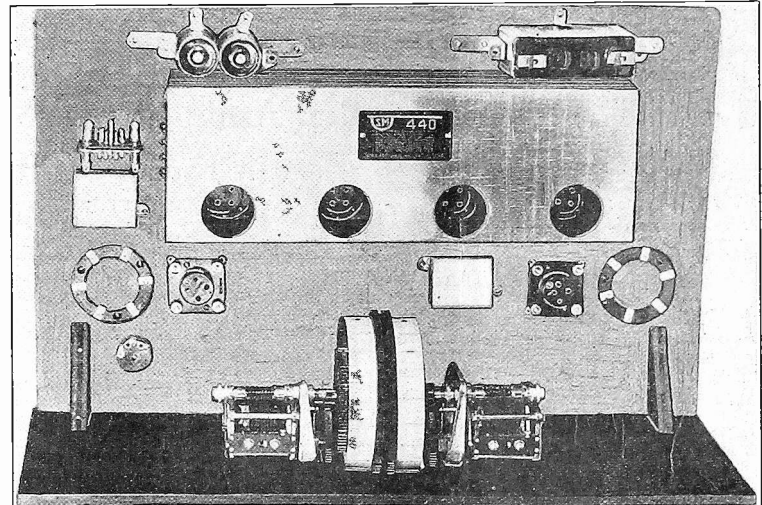
**I AM** a bug on different systems of audio frequency amplification. I would like to construct a detector and radio frequency unit, which I could attach to the different types of audio amplifiers I

build, without rebuilding the entire set. Would you please give me a diagram

which would illustrate how to do this. Give the exact constants of all the parts.—Jacques Lorraine, Quebec, Canada.

How this can be done is shown in Fig. 578. A standard radio frequency coil and 3-circuit tuner can be used. The primaries of both coils should contain 10 turns. The secondaries should contain 45 turns. Both should be wound on 3 inch tubings, with No. 22 double cotton covered wire. Between the primary and the secondary windings, there should be a space of 1/4 inch. The tickler containing 35 turns, should be wound on a 1 3/4 inch tubing with No. 26 single silk covered wire. Across the secondary windings, .0005 mfd. variable condensers should be inserted. To control the RF filament, use a ten ohm rheostat. For the detector filament, use a 1A Amperite. The grid leak should have a resistance of 4 megohms. The grid condenser should have a capacity of .00025 mfd. The antenna can either be connected to the tenth turn of the secondary winding through a fixed condenser, or to the primary of the radio frequency transformer. The voltage for the RF and detector tubes can either be common or separate. The separate connection for the RF tube is indicated by the dotted lines. The base is inserted in a socket and leads brought from there to the audio input.

### THE RADIO PART OF A SUPER



**ONE FAN DECIDED TO BUILD A SUPER-HETERODYNE WITH ONLY THE DETECTOR, OSCILLATOR AND INTERMEDIATE CHANNEL IN ONE CABINET, THE OUTPUT TO BE ATTACHED TO AN EXTERNAL POWER AMPLIFIER AND B SUPPLY. HIS LAYOUT OF THE PARTS IS SHOWN ABOVE WITH C BATTERIES FOR THE DETECTOR IN THE UPPER LEFT AND THE INTERMEDIATE CHANNEL C BATTERY IN THE UPPER RIGHT.**

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Have your name entered on our subscription and University lists by special number. Put this number on the outside of the forwarding envelope (not the enclosed return envelope) and also put at the head of your queries. If already a subscriber, send \$6 for renewal from close of present subscription and your name will be entered in Radio University. No other premium given with this offer.

[In sending in your queries to the University Department please paragraph them so that the reply can be written under or alongside of each query. Write on one side of the sheet only. Always give your university number.]

**RADIO WORLD**, 145 West 45th Street, New York City.  
 Enclosed find \$6.00 for **RADIO WORLD** for one year (52 nos.) and also enter my name on the list of members of **RADIO WORLD'S** University Club, which gives me free information in your Radio University Department for 52 ensuing weeks, and send my number indicating membership.

Name .....

Street .....

City and State .....

## Literature Wanted

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

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

I desire to receive radio literature.

Name .....

Address .....

City or town .....

State .....

- John Saunders, 7 Elm Place, Brooklyn, New York.
- David J. Myers, 440 North Queen St., Lancaster, Pa.
- Albert H. Schmith, 133 East 3rd St., Winnemucca, Nevada.
- H. Fulbright, Fulbright Cabinet Co., Hickory, North Carolina.
- E. Byers, 347 W. College St., Canonsburg, Pa.
- M. A. Velasques, 419 East 73rd St., New York City, New York.
- R. D. Reitz, Box 58, Gypsum, Ohio.
- Clofford Nay, 203 East St., Lipton, Ind.
- J. Flunt, 920 Batavia St., Royal Oak, Mich.
- Alon Sales Agency, 215 Belleville St., Algiers, La.
- David Abell 5027 Market St., Philadelphia, Pa.
- A. E. Koethe, 2630 Osage, St. Louis, Mo.
- J. B. Thomas, 11800 Superior Ave., Cleveland, Ohio.
- C. W. Marggraf, 700 8th Ave., Long Island City, N. Y.
- L. Hauser, 405 Glenwood Ave., Buffalo, N. Y.
- A. F. Day, Sergeant, Ky.
- Cotter Randall, care of Boutell Bros., Inc., Minneapolis, Minn.
- Harry Abelow, 651 Madison St., Brooklyn, N. Y.
- P. W. Goodwin, 430 East 28th St., N., Portland, Ore.
- Ira E. Weigle, 900 East Main St., Rockwood, Pennsylvania.
- Charles A. Hartung, 15 South Cornwall Ave., Ventnor, N. J.
- W. I. Poole, 905 Carter Road, Roanoke, Va.
- C. E. Shaad, Burbank, O.
- S. J. Ia Paint, 4468 Tweedy Blvd., Home Gardens Calif.
- Neil D. Baker, 216 Jefferson Ave., Hasbrouck Hts., N. J.
- Delos Johnson, 615 East 18th St., Minneapolis, Minn.
- C. H. Albitz, 1500 1/2 Kamp Blvd., Wichita Falls, Tex.
- E. Jaffe 136 22d Ave., San Francisco, Calif.
- C. S. Bixby, Box 5, Asawatomie, Kans.
- Ivor W. Sears, 913 S. Cascade Ave., Colorado Springs, Colo.
- J. P. Robert, 1093 St. Vallier St., Quebec, Canada.
- W. G. Larquemain, 177 Berkshire Ave., Buffalo, N. Y.
- J. H. Banks 103 Hemphill Ave., Chester, S. C.
- Thomas F. Creed, 132 East 127th St., New York City, N. Y.
- Ira F. Albury, 100 West 7th St., care Muller, New York City, New York.
- L. C. Newman, 1180 Commercial St., Portland, Ore.
- A. Davis, 140 Palm St., Hot Springs Ark.
- R. Branstorn, 13 East Madison Ave., West Hazelton, Pa.
- John J. Maczmarczyk, 570 West Market St., Mahanoy City, Pa.

### NEW CORPORATIONS

- Radio Jobbers, N. Y. City, New York, \$50,000. (Atty. O'Connell and Aronowitz Albany, N. Y.)
- Radio Station WKEN, Kenmore, New York, \$50,000. (Atty. L. P. A. Eberhardt, Kenmore, New York.)
- WMAK Broadcasting System, Buffalo, N. Y., \$75,000 preferred, 750 shares common. (Atty. Stee, Obrien Hellings and Elsh, Buffalo, New York.)
- Modern Radio and Electric Company, Inc., Westwood, New Jersey, \$25,000. (Atty. Harry Randall Westwood, New Jersey.)
- Acoustic Products Manufacturing Corporation, New York, 1000 shares, no par. (United States Corporation Co., Dover, Delaware.)
- Suburban Radio Laboratories, White Plains, New York; \$4,000 (L. Roth, 1400 Broadway, New York.)
- Hurd Radio and Electric Shop, Inc., Elizabeth, New Jersey; 100 shares, common (Atty., Archie Josephson, Elizabeth, New Jersey)

# The Radio Trade

## Electrical Stores Lead In Carrying of Radio

Even undertakers and confectionery stores are handling radio nowadays, according to an analysis of returns made in a recent survey of radio stocks just completed by the Electrical Equipment Division of the Department of Commerce.

Fifty-eight varieties of radio dealers were indicated. Coal and lumber dealers are not exempt, nor are groceries, seed stores, nurseries, pet shops, or printers.

Innumerable combinations, such as plumbing and heating, hardware and furniture, and music and radio stores were found; in such cases the stores were listed under each classification involved. Replies from 3,546 dealers indicated their principal business activities, out of a total of 7,718 replies being received.

Stores specializing in single lines totalled 2,903, the remaining 643 carrying two or more lines.

Electrical supply stores, 941 in number, lead the list, followed by radio stores with 709, and hardware stores with 482. The

results of the analysis are shown in the following table.

Line of business	Number of stores	Per Cent of stores
Electrical goods	941	26.45
Radio goods	709	20.00
Hardware	482	13.54
Musical instruments	311	8.50
Automobiles	206	5.80
Batteries and ignition supplies	202	5.53
Tires and tire repairs	156	4.40
Drugs	147	4.15
Garages	143	4.05
Furniture	130	3.66
General and Department stores	117	3.30
Automobile service stations	47	1.32
Automobile accessories	37	1.04

All the rest are less than 1 per cent.

## Ben Aplin Pioneer In Radio Selling



BEN APLIN

Ben J. Aplin, successful manufacturer's representative and a radio pioneer, was a prominent figure in the electrical and central station industry throughout the East for years prior to the advent of radio. He foresaw the enormous possibilities of the new industry and almost with the first announcement of public broadcasting, took over the representation of the new merchandise, scoring a line of unbroken successes from the start.

With offices at 30 Church street, New York City, he handles the Thordarson transformer line, Trav-Ler Portable and Sickles Coils. He recently founded the Aplin Radio Laboratories for producing "The Homekaster." This novel little device affords much joy, entertainment and instruction to radio fans. This little home broadcaster has leaped instantaneously into popular favor.

### NOTE OF OPTIMISM

Polymet Mfg. Corp., which supplies a large number of the nationally known set and power unit manufacturers, is going night and day. Even though they are employing the largest force in their history, and working twenty-four hours a day, this organization cannot keep up with their orders. This would indicate that the radio business is in a flourishing condition.

### A. B. C. APPOINTS SAMPSON

H. P. Sampson was recently made program director of stations WABC and WBOQ, both of which are owned and operated by the Atlantic Broadcasting Corporation.

## Hartzell Handles Perfection Speakers

The new line of Perfection Speakers that are going so well in the trade and that have made such a hit with discriminating fans are being handled by the Hartzell Sales Co., 50 Church Street, New York City.

### Speaker is Handsome

These speakers are well designed and built of good materials and give efficient performance on all types of sets. They also measure up to the new standards of beauty demanded by fans, of late. Model E is a table type speaker, complete with eight foot cord. The cone is suspended within a tastefully carved frame and the unit is mounted on an unusually big sounding board that reproduces the low notes with velvety sweetness.

### Of Sturdy Manufacture

The unit is sturdy and will take any amount of power. Model B is a floor type, complete with 8-foot cord and three-foot stand. The stand is metal in a finish of two-tone antique gold bronze. There are three beautiful walltype speakers in the line. One plain, one a picture model with a rich hand-painted design on black velvet; this is square. The other is oval with a beautiful design interpreted in six colors, bound by a two-tone silver frame. All these speakers will harmonize with any type of home furnishing and are all unusually low-priced for speakers of their quality. Interesting data with illustrations on this line may be had from the Hartzell Sales Co. on application.—J. H. C.

### GUTHMAN APPOINTED

Edwin I. Guthman has been appointed sales manager for the Transformer Corporation of America, 1428 Orleans St., Chicago, formerly the Wilson Electrical Laboratories, manufacturers of transformers and chokes for all types of power supply apparatus and AC sets.

# Some Hints From Trade On Tracking Down Noise

If there is a hum in your loud-speaker, or a crackle like that of a spark coil, or a noise as of coal rolling down an iron chute, you are attempting radio reception under a needless handicap.

The Radio Manufacturers' Association long ago recognized the danger to radio of sporadic and eliminable noises. Its advice is:

"First, test your set."

In the steps required for determining the extent to which the receiver itself is responsible for the noise it goes without saying that aerial and ground should be disconnected as a preliminary move—the input terminals being short-circuited with bare wire.

## When to Call Company

If the noise is blotted out by this test, call up your power company and make a report, for it is obvious that the trouble originates somewhere outside and is being picked up by the collector system. If it persists, look for defective batteries, bad connections in cables, worn insulation in cables, corrosion, loose joints, greasy socket prongs, bent jack springs, broken speaker cords, microphonic tubes, or a defective rectifier or filter in a plate supply unit.

Once the set is eliminated as a source of trouble take an inventory of the electrical appliances in your home. Turn them off one after another, noting the effort, if any, in the loud speaker. Check over every light socket and every convenience

outlet, for not infrequently serious disturbances arise from devices left turned on when not in use—heating pads forgotten in a bedroom, flatirons burning up current unobserved on the back of the kitchen stove.

## Fasten Bulbs in Sockets

See that all light globes are screwed tightly into their sockets. Make the same test of fuse plugs.

If the plan is feasible cut off the current at the point where it leaves the meters after entering the house. This, of course, is a test not universally applicable. Where alternating current tubes or a rectified AC plate supply is used, the throwing of the master switch will immediately end all noise by putting the radio set out of commission—a dubious experiment.

But where the test can be applied it has the effect of narrowing the field of investigation at once. If the noise ceases and the set is still running it definitely locates the source of interference somewhere in the house. If the disturbance persists the only resource is to call upon the power company engineers for aid.

The Association's survey showed that assistance from this source is always obtainable. Power companies are glad to be informed of noises in their lines inasmuch as noises generally indicate a leak and leaks represent a loss of power and money.

Their assistance is usually prompt.

## Import Duty Greatly Reduced In India

Washington.

A recent modification of the British Indian customs provides that component parts of apparatus for wireless telegraphs are subject to an import duty of 2½ per cent ad valorem when imported into British India under existing regulations, instead of 15 per cent ad valorem as formerly, according to a cable report from the American Vice Consul at Calcutta, Richard R. Willey.

The duty, the report states, applies to wireless apparatus parts designed either for transmission or reception, whether by telegraphy or telephony, which are essential for its workings and have been given for that purpose some special shape or quality which would not be essential for their use for any other purpose.

## Muter Parts in Demand

The Leslie F. Muter Company, 76th Street and Greenwood Avenue, Chicago, now makes a full line of parts for the particular fan, almost enough to make a complete set. The new Muter Supreme Audio Transformers make for pure and complete tone. The low notes are amplified with naturalness, without distortion or curtailment of the high, and the high, middle and low frequencies are completely covered. The Muter Supreme Audio Transformers, Clarifier, panel switch, heavy duty grid leak and mounting, molded Bakelite condenser, RF choke, bypass condensers, tubestats have been selected after two years intensive research for the "Everyman 4" by Fred C. Ehlert, its designer. Radio Kit Company, 72 Cortlandt Street, New York City, exclusive service station on this kit, reports that they sold several hundred of them in the past three weeks.

## Berlin Photographs to Go to Tokio Via Radio Route

Berlin.

Upon the completion of the installation of a new short wave photographic transmitter at Nauen it will be possible to send photographs from Berlin to Tokio.

A special short wave transmitter, which is to be connected up for trans-Asiatic telephone service will also soon be pressed into service. It will then be possible to pick up the telephone receiver and talk to someone in Tokio as simply as one would talk to one in Munich over the phone.

## ARMOR AC TUBES MOVING FAST

As an index of the fast growing popularity of the new AC tubes, reports from prominent tube makers show that the output of these new valves is being rapidly absorbed. This is not only due to manufacturer demand for electrified set purposes, but hundreds of fans are becoming interested. The Armstrong Radio & Electric Mfg. Co., 351 Halsey street, Newark, makers of the Armor brand, report that they are working night and day to supply their market with the Armor AC tubes, as well as with their full line of tubes for all radio purposes.—J. H. C.

## THOMPSON RADIO REORGANIZES

The Thompson Radio Company, 66 York Street, Jersey City, N. J., has been reorganized and has begun production on its five-tube Neutrodyne sets. The present owners have bought out the R. E. Thompson Manufacturing Company, The R. E. Thompson Radio Corporation and the Wireless Improvement Company. In charge of the new organization are Alfred Zipser and Otto A. Martini. Mr. Zipser was formerly general manager of Freed-Eisemann.

## Double Grid Tube Made by Shieldplate

The Shieldplate Tube Corporation, 206 South La Salle Street, Chicago, Ill., is manufacturing a radio frequency amplifying tube with a shielded grid, known as type SP 122. The tube is self-neutralized and may be used in multiple stages of RF amplification without any oscillation troubles. The amplification constant is 175. The filament is lighted from 5 volt source. At that voltage the drain is only .131.

The base is standard, the extra grid terminal being brought through the glass envelope on the top.

## Bertha Brainard Wins Promotion from N. B. C.

Bertha Brainard, one of the best known broadcasting executives in the field, was recently promoted from managership of WJZ to the Eastern program managership of the National Broadcasting Company.

Miss Brainard has been connected with WJZ ever since its inception in Newark, over five years ago.

## Wanted: a Plug Softener

Keen perception and ready wit are among the many requisites of the successful radio dealer. Blan, "the Radio man," possesses these in addition to his other qualifications of innate courtesy, a gift of tongues and a profound knowledge of human nature, as evidenced in the following true episode. On one of the writer's recent weekly visits to his store on east 42nd street, a fellow walked in and asked for a plug softener. Several customers were in the store and all hands looked at one another in astonishment; this was a new one on all of us. One chap suggested that the inquirer wanted a blow torch, another, a blast furnace. The newcomer waxed impatient and walking toward a set pointed to a jack. "See deesa john," said he, "de ploog goes ina hera, I wanta de ting to make heem softa!" It was slowly dawning on the writer, but Michael Blan beat him to it; walking forward and reaching up to the shelves he brought down a—Centralab Modulator Plug, ergo, a plug softener.—J. H. C.

## PARIS STATION TO CLOSE

Washington.

The radio receiving station maintained in the office of the United States Naval Attache at Paris will be closed December 1.

Messages previously sent to this station for transmission to points in continental Europe will, when filed with the Federal Message Center, be transmitted to the Shipping Board radio receiving station in London, England, and will be received from the several departments of the Government for further relay to other parts of the United Kingdom and continental Europe.

## BRISK DEMAND BY CZECHS

Washington.

There is a great demand for radio sets and parts in Czecho-Slovakia, according to the Department of Commerce.

Holiday Gifts  
Number  
of RADIO WORLD  
Dated Dec. 10. Forms Close  
Wednesday, Nov. 30, at Noon

# Two Short Waves Asked In Trans-Ocean Tests

Washington. A special request for an assignment of two short wavelengths to be used in an international broadcasting transmission system has been made by Dr. Alfred N. Goldsmith, chief engineer of the Radio Corporation of America, to the Federal Radio Commission.

The plan, he states, is contemplated as a regular service of the National Broadcasting Company, which proposes to exchange programs with the British Broadcasting Company via a rebroadcast relay. British programs will be received in the United States, under the plan, through the medium of the receiver to be erected and American programs will be transmitted with 20,000 watts to Great Britain.

These programs will be rebroadcast through stations in both countries.

## Wants to Start Soon

"It is the intention of the National Broadcasting Company, subject to approval by the Federal Radio Commission, to endeavor to establish systematic international broadcasting at the earliest possible date," stated Dr. Goldsmith in his letter of application to the commission.

"The first interchange of programs is planned as between England and the United States.

"In the United States it is intended to operate between the hours of 7 and 11 in the evening, Eastern Standard Time, throughout the year.

"Our experience in this field has shown us that two short wavelengths at least will be required to enable British reception of American programs.

## Secret Broadcasting

"The transmitter for the service in question will deliver approximately 20 kilowatts of power modulated telephonically. It will be installed at Boundbrook,

N. J., in the same building as the present broadcasting transmitter of WJZ.

"The programs to be transmitted will be sent, not for broadcasting to the public, but as an addressed message to the British Broadcasting Corporation corresponding receiving station in England, and the service is regarded as a point-to-point service. It is entirely possible that commercial arrangements relative thereto will be worked out, and, in any case, the program will not be available for rebroadcasting purposes except by those to whom it is addressed.

"The purpose of this restriction is to make certain that the rebroadcasting shall be conducted by responsible agencies capable of giving good service to the public abroad, and in such efficient fashion that a fair idea of the nature and quality of American programs can be gained by the public in foreign countries.

## Waves Asked

"The two wavelengths which are desired to be used for the purpose are as follows: No. 1—a wavelength of 27,207 meters (corresponding to a frequency of 11,020 kilocycles.) No. 2—a wavelength of 18,175 meters (corresponding to 16,020 kilocycles).

"The first of these wavelengths falls within a band already assigned for relay broadcasting. The second of these wavelengths falls within a point-to-point service band.

"A ruling from the Federal Radio Commission to the effect that the above wavelengths are assigned and reserved for the international broadcasting transmission (relay broadcasting point-to-point service) in question would be greatly appreciated. The receipt of such a ruling from the Federal Radio Commission will enable the project to be carried forward, and, it is hoped, will lead to the early Anglo-American program exchange."

# Channels Established For Non-Interference

The Federal Radio Commission has in a recent order, set aside twenty-six broadcasting channels between the wavelengths of 299.8 and 499.7 meters (1000 to 600 kilocycles), to provide program reception without heterodyne interference. After a series of hearings the stations which will be allowed to operate on these wavelengths will be announced. On January 1 designations will become effective.

"In order to improve radio reception throughout the United States, particularly for the very large audience of rural and remote listeners who are situated far outside of the local service range of any broadcasting station, as well as to reduce generally interference from heterodyning between stations, the Federal Radio Commission hereby designates channels from 600 kilocycles to 1,000 kilocycles inclusive as frequencies to be maintained free from heterodynes or other interference," the order states.

"Stations now operating on any of the channels so designated which are not free of interference as of December 1, are ordered to clear these channels of heterodyning during the present license period, by sharing of time, control of power, control of frequency, or any other method which will eliminate mutual interference on their respective channels.

"In the case of each channel not freed of heterodyning by such mutual action between stations now sharing that channel, the Commission, before the expiration of the present license period, will, as provided by law, call a public hearing at Washington for the purpose of determining which stations, in the public interest, shall be relicensed to continue on the channel so as to preserve it in a clear and non-heterodyning condition."

## Traffic By Amateurs Aids In Flood Relief

The recent disaster in the New England States again brought the amateurs into the limelight. It was their poignant messages of the sad plight that rushed aid to the thousands of homeless and sick.

Among those who played the biggest part were stations 1 BBJ, operated by George P. Wallstrom and 1 BEB, operated by Ralph J. Harris, both located at Montpelier, Vt. It was only with the aid of the tireless efforts of these youthful operators that the outside world was informed of the inundated condition of Montpelier, when all other methods of communication were cut off.

## Bureau Activities Outlined by Terrell

The Department of Commerce, Washington, increased staff urged for radio division of commerce department. Lack of sufficient personnel and inadequate equipment hampering efficiency of operations, annual report declares. Credit given to amateur operators for work in developing short-wave transmission.

A considerably augmented staff and better equipment are essential for efficient functioning of the newly created Radio Division of the Commerce Department, according to the annual report of W. D. Terrell, chief, made public recently.

Since the radio law passed by the last Congress became effective last February, Mr. Terrell points out, the demands for services by radio, broadcasting station operators and the listening public have increased to such an extent that the Radio Division with its present facilities is unable to adequately cope with them.

## Began in February

The Radio Division came into operation on February 26, 1927, taking over the functions formerly exercised in the Bureau of Navigation. It provides the working machinery for the Federal Radio Commission which according to law has power to license radio stations and operators, to fix wave lengths, power, hours of operation, etc. During the fiscal year which ended June 30, 1927, 9,330 inspections were made of radio installations on American and foreign vessels clearing from American ports. Examinations were given to 3,328 applicants for commercial operator's licenses and 5,597 applicants for amateur operator's licenses.

Three new radio test cars have been added to the equipment of the division, the report reveals. These test cars constitute portable laboratories and inspection offices, being equipped with complete radio direction finders and sensitive radio receivers by the use of which it is possible to measure the frequency on which transmitting stations are operating. The new cars contain many improvements over the earlier model which was first put into operation about two years ago.

## Tests Improved

Among these improvements are a number of individual pieces of apparatus for the measurement of frequencies or field strength into one compact unit. With this equipment it is possible to determine the field strength of transmitting stations at different points operating on wave lengths from 50 to 600 meters. With the same apparatus it is also possible to check accurately the frequencies of transmitting stations operating on wave lengths from 50 to 1,250 meters. In addition to the measurement of frequencies and field strength, space is provided on the cars for the examination of applicants for radio operator's licenses.

Experiments of amateur radio transmitters have been responsible in no little degree for the development of short-wave transmission, the report reveals. These amateurs were able to render most valuable assistance during the periods immediately following the Florida hurricane and the Mississippi flood by handling important and urgent messages for the Red Cross consisting of requests for food, medical supplies, and doctors.

## Use of Photographs

Radio photographs are being used to an increasing extent, it is stated. The Weather Bureau makes use of the radio to transmit maps to vessels at sea, these being recorded with pen and ink on base maps. A variation of the radio photograph service is the facsimile reproduction.



# Why One Manufacturer Favors Midline Tuning

By Lloyd A. Hammarlund

Variable condensers have been through the same process of evolution experienced by the rest of the radio art. Early enthusiasts will remember the first types of worthwhile mention—the straight line capacity condensers. These performed remarkably well considering that the number of broadcast stations on the air at that time were few. As the number of broadcast stations grew, the listener-in complained of difficulty in tuning-in low wave stations.

The straight line wavelength condenser next made its appearance and was eagerly received, as its design represented a step forward. Crowding still was experienced at the lower part of the dial, although by no means as much as in the straight line capacity type condensers.

With the advent of the straight line frequency condenser, set builders looked

upon it as the ultimate in variable condenser construction, for it separated the stations practically equally over the entire scale, greatly opening up the separation between low wave stations, though closing up considerably those on the higher part of the scale where most of the better and more powerful stations operate. Another point was that the condenser took up much room, owing to the shape of the plates.

Realizing these two major difficulties, the Hammarlund Manufacturing Co. created a condenser with almost straight line frequency characteristics at the lower end of the dial and straight line wavelength tuning at the upper end of the scale. Thus was accomplished the tuning curve which is characteristic of the line of Hammarlund midline variable condensers.

## Rochester Philharmonic from WHAM All Season

The complete series of matinee concerts by the Rochester Philharmonic Orchestra will be broadcast during the Winter season by the Stromberg-Carlson station, WHAM, at Rochester. The series is made available for the radio audience by the Rochester Chamber of Commerce. The extensive programs by the 100-piece philharmonic orchestra have long been among the outstanding musical events, and the series planned for this Winter is of even greater magnitude than those of past years.

WGY, Schenectady, WFBL, Syracuse, and WMAK, Buffalo, will also broadcast these concerts.

The first of these concerts was broadcast November 10. There will be seven more, two each month, lasting until February. Each concert begins at 3:15 P. M. and runs for two hours.

Eugene Goossens, internationally known conductor, is the director of these concerts.



### VICTOREEN

Super Coils

Send for Folder

Geo. W. Walker Co.  
2825 Chester Avenue  
Dept. B Cleveland, O.

HOW TO build the Lynch-Five was described in the Nov. 5 issue of RADIO WORLD. "Send 15c for issue.

### BRIDGE LESSONS OVER WRNY

A series of bridge lessons was recently inaugurated by Mrs. May Blackman, bridge and whist authority, over WRNY. The bridge broadcasts are made every Monday at 3:15 P. M.

### Interesting Issues of Radio World

MAY 7.—Part I of the Six-Tube Adams-Griffin Shielded Set, by Dana Adams-Griffin.

APRIL 30.—The Equamatic mixer which can be used with almost any "super" coils, by Herman Bernard.

APRIL 23.—How to measure the cut-off in the resistance AF, by J. E. Anderson. Constructional data on the Melo-Heald, an eleven-tube Super-Heterodyne, by Herbert E. Hayden, (Part II). Part IV of the four-part article on how to obtain best results with the Nine-in-Line Super-Heterodyne, by Lewis Rand.

APRIL 16.—Part I of the description of the Melo-Heald Super-Heterodyne, by Herbert E. Hayden. Part II of discussion on the Nine-in-Line Super-Heterodyne, by Lewis Rand.

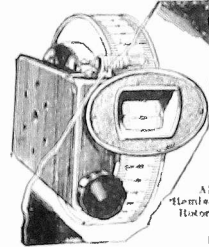
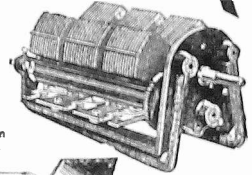
APRIL 9.—A five-tube shielded set employing transformer AF, by Herbert E. Hayden. Part II of constructional data on Power Compact, by Lewis Winner. Part II of the four-part article on the Nine-in-Line Super-Heterodyne, by Lewis Rand.

APRIL 2.—(Fifth Anniversary Number) Part I of the four-part article on the super-sensitive Nine-in-Line Super-Heterodyne, by Lewis Rand. The three-tube regenerative set by Jasper Henry. Part I of the two-part article on a Power Compact, the B eliminator with a stage of power audio frequency amplification by Lewis Winner.

15 cents a copy—all 6 issues for 70 cents  
Radio World, 145 W. 45th St., N. Y. City

# REMLER

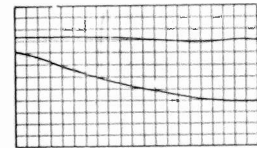
Parts Specified by Herbert E. Hayden for DX Fountain in this issue



New this Season  
Remler 3 In-Line Condenser No. 433 (Illustrated)  
Max capacity (each section), 000.15 mfd  
List Price, \$15.00  
Remler Drum Dial No. 119 (Illustrated)  
List Price, \$4.50

Also specified by Hayden's  
Melo-Heald Model 3501, Twin Motor Condenser No. 634  
List Price, \$5.00

Remler Division of  
GRAY & DANIELSON MFG CO.  
Chicago 260 First St., San Francisco New York



CECO TUBES  
AVG. OF 15 OTHER MAKES

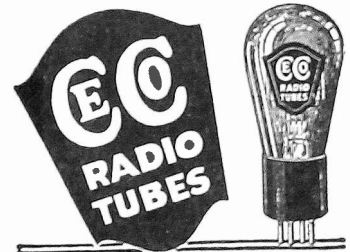
## Steadier Performance - Longer Life!

A nationally known set maker tested CeCo Tubes, and 15 other kinds.

The results are shown by the graph printed above. After 1000 hours (the average life of most 201A Type Tubes) CeCo Tubes proved to be as efficient as at the beginning of the test. (See upper line of graph). The average decline in efficiency of the other 15 makes is shown by the lower line.

There's a CeCo Tube for every radio need to make a good receiver better!

ASK YOUR RADIO DEALER  
C. E. MFG. CO., Inc., PROVIDENCE, R. I.



## Radio World's CLASSIFIED ADS for Quick Action

10 Cents a Word—10 Words Minimum—Cash With Order

**DIRECT FACTORY SALE—Wholesale prices. Tremendous Savings. Selling direct to you. Here are some of our many items:** 30 Henry Choke, 100 M.A., \$2.19; 10 Henry Choke, 400 M.A., \$5.48. Power Transformers for all kinds of Eliminators and for all types of A.C. Tubes, at Special Low Prices. EVERY ITEM FULLY GUARANTEED. Promptly shipped, upon receipt of order. Send for free illustrated catalog today. Todd Electric Co., Inc. (Manufacturers) 36 West 20th Street, Dept. D, New York City.

**RADIO CABINETS AND CONSOLES—**Before buying your radio cabinet or console see our catalog. A postal card will bring it to you. Odd sizes built to your specifications. Standard sizes shipped promptly. FULBRIGHT CABINET CO., HICKORY, NORTH CAROLINA.

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HERMAN BERNARD, managing editor of Radio World, discusses radio topics of popular interest every Friday at 6:40 P. M. from WGBS, 348.6 meters, the Gimbel Bros. station in New York City. Listen in.

COMPLETE AND LATEST LIST OF STATIONS appeared in Radio World, dated Oct. 29. Sent on receipt of 15c, or start your subscription with that number. RADIO WORLD, 145 West 45th St., New York City.

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 or start your subscription with the first of these numbers. RADIO WORLD, 145 West 45th Street, New York City.

# ALL PARTS IN STOCK FOR CIRCUITS LISTED IN THIS MAGAZINE

Set builders will find in this new Newark directory of kits, itemized lists of parts used in all the new circuits.

Newark's central location near the center of population makes it possible to serve the greatest part of the country in the least time.

Large stocks of all popular merchandise are always on hand and orders are filled at once.

Send ten cents in stamps to cover mailing and handling charges for this new kit supplement.

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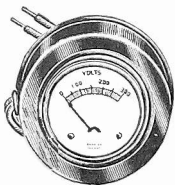
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You will be delighted at the enjoyment that will be afforded by the use of a panel meter.

The DOUBLE R meters are sturdily built and accurate, yet priced very modestly.

You send us nothing yet we send the meters. All you have to do is to let us know what meters you want. Order by catalog number, which appears on the left in the list printed herewith. When the postman delivers the meter you pay him the price listed below, plus a few cents postage. Then you will put your meter into action and enjoy the fruits of your wise buy. Note AC meters for new AC tubes.

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# Power Pack Assembly for the Alpha Outfit

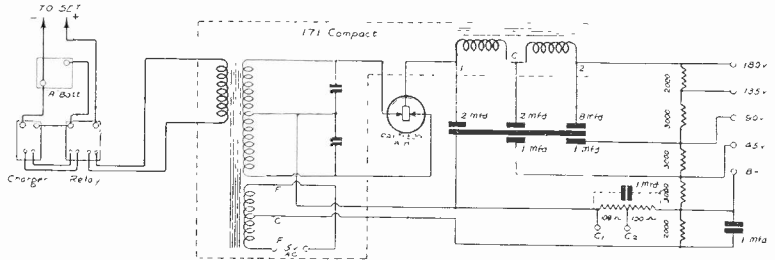


DIAGRAM OF THE POWER SUPPLY

(Concluded from page 13)

tacked along the back of the baseboard. Flexible wire is used throughout and makes a neat looking job. It also greatly simplifies the wiring operation, since it is not necessary to skin the wire with a knife. The wire is cut and the insulation is pulled back over the wire; after the joint is soldered, the insulation is pushed back into place.

### Power Supply

The power supply portion of the Alpha Six is remotely controlled by a switch located on the receiver panel. Turning the switch in an "on" position will make the set ready for reception, while turning it off will automatically turn off the B eliminator and will connect the trickle charger into the circuit. This is made possible by the use of the control relay placed in the battery circuit.

The unit consists of the control relay, and parts for the B eliminator circuit. All these are mounted on a wooden baseboard. As the parts are made up into unit form, the fan will find it comparatively easy to assemble and wire the complete unit. The two filter chokes and the power transformer are mounted in one

unit; this is called the power compact. All the condensers, except one 1 mfd., are also mounted into a container. The voltage divider resistance takes care of the B voltage and the grid bias voltage for the power tube. The other tapped 200 ohm resistance gives two bias voltages 4½ and 9. The rectifier tube is the 85 mill BH type of tube.

### Assembly

To assemble the power compact unit, procure a baseboard measuring about 13½ x 8¼ and about ¾ inches thickness. On the extreme left-hand side and about the center, mount the relay. This should have the terminals facing to the fore. To the right of this, leaving about ½ inch of space between, mount the power compact. The 5 volt filament side of this unit should be flush with the back of the baseboard. Directly in front of the compact, with the two filament terminals facing it, situate the rectifier tube socket.

On the right hand, rear corner of the board, mount the condenser block with its terminals facing the front.

Before this, on the right side, mount the 1 mfd. condenser and to the left of this the 200 ohm tapped resistance is situated. At the right hand front portion of the base, screw down the binding post strip. This is to have nine posts mounted on it and measures 8" x ¾". Behind this strip, mount the resistance bank. This can be fastened with a long bracket or may be screwed down with two wood screws, running through the holes of the two end lugs.

### First-Insert Tube

The 5 volt AC wires going to the two binding posts on the left-hand side of the strip should be twisted together. The fan will note that, with the suggested layout of the parts, any leads of undue length are unnecessary. The condensers shunting the C Bias resistances are necessary and should not be left out. The metal coverings of both the condenser block and compact unit should be grounded.

After the unit is completed, temporarily (Concluded on next page)

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No better "A" Socket Power Unit can be obtained even at twice this amazingly low price. No hum or noise. Operates on 50 or 60 cycles at 110 volts A. C. Approved by rigid laboratory tests of Radio News and Popular Radio. Fully guaranteed. Shipped complete, subject to inspection, on receipt of price—or C.O.D. If you wish, 5% discount if cash in full is sent with order. Send order NOW! WORLD BATTERY CO., 1219 South Wabash Ave., Dept. 64, Chicago, Ill.

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(Concluded from page 28)  
connect it to the house current, first inserting the tube in its socket. With the 0-300 high resistance voltmeter, check the different voltage taps and be assured of the fact that these are the required voltages. You may now connect the trickle charger and other apparatus to the relay. With the six wire cable, connect the power supply to the receiver. The two 5 volt AC filament leads should not be included in the cable, but should be a twisted pair of wires.

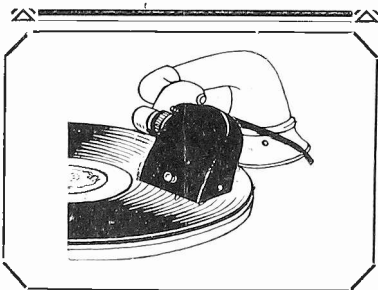
Now that the power supply is connected to the receiver and everything is in place, before inserting the tubes, connect to house current and with the voltmeter, check the readings at the terminal strip of the receiver. This way you can be sure that the different portions of the set are to receive their proper voltages.

Insert the tubes into their respective sockets. Turn the resistance R1 and R2 all the way to the right and the compensator at a neutral position. Now with the main tuning dials, tune in on a signal, at about 50. This will come in with a squeal. Turn the resistance R1 slightly to the left and the resistance R2 to the left until the squeal disappears. Now adjust the compensator until signal strength is at a maximum. This can be left where it is and need never be touched except when tuning in on distant stations. The important tuning controls are the two large ones and the RF control (R2).

Shifting the tubes from one socket to the other often helps reception and if the fan is experimentally inclined, he may try different tubes in the first two sockets (RF) such as hi-mu.

**KFVE JOINS BLUE CHAIN**

KFVE, a 1,000 watt transmitter located atop the Hotel Chase, St. Louis, recently became a member of the Blue Chain of the National Broadcasting Company. WJZ is the key station of this chain.



**Gives New Enjoyment to Your Favorite Records**

For the small sum of \$12.50 you can, with the Pacent Phonovox (the electric pick-up) and your radio, convert your old Phonograph into reproducing your favorite records with the wonderful tone quality rivaling that of the costly Electric Phonograph.

Simple and easy to attach, without tools or changes in wiring, in a few seconds. Can be used on any standard phonograph with any radio set.

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AUDIO FREQUENCY TRANSFORMERS  
Type AF3...\$12.00 Type AF 4...\$8.50  
No Better Transformers Available

**Bell Co. Will Test Aerials from Plane**

So that it will be possible to study the field strength of radio waves in the air, as well as on the ground, a specially constructed airplane with a combination transmitter and receiver is being designed by the engineers of the Bell Laboratories, who have an elaborate radio experimental laboratory in Whippany, N. J.

"We have much to learn about antennas," said one of the Bell Laboratory engineers, "but it is a long and difficult job to study the waves as they reach different sections. We now have several motor cars equipped with receiving apparatus whereby the field strength of the broadcasts can be measured, but by airplane we can cover the surrounding territory and much greater area in much less time than we can by automobiles."

**Thompson's Book War Enlists Broadcast Lessons**

Chicago.

As a part of the drive against the anti-American propaganda which it is said is being disseminated through the history text books, Mayor William H. Thompson is planning to install radio receivers in classrooms, so that the pupils may hear lectures on the American viewpoint.

It is intended to send out these special lessons through station WHT, located atop the Wrigley building. The station is partly owned by Mayor Thompson.

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Flexible stranded Celatsite is composed of fine, tinned copper wires with non-inflammable Celatsite covering in 9 bright colors. Strips clean, solders readily. Sold only in 25' coils, in cartons colored to match contents. Solid Celatsite has same colored covering, but over bus bar wire. Write for folder to The Acme Wire Co., Dept. Y, New Haven, Conn.

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# 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 Unitone, 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 Power-tone, 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.

Any Copy 15c. Any 7 copies, \$1.00 All these 17 copies for \$2.00, or start subscription with any issue. Any 8 of these numbers sent as premium with NEW yearly subscription. No other premiums allowed. RADIO WORLD, 145 West 45th St., New York City.

# Mystic Trouble Shooter Amazes Admiring Flock

By H. B. Herman

The esoteric sciences always have held both savagery and civilization in awe. The psychic who receives messages by telepathy, the mesmerist who puts his subject into solacing sleep, and the necromancer, too, have had and still have wide followings. Scoffers do not dim the name of the psychically elite. False or true, the claims of these performers attract world-wide notice.

If one knows the riddle of creation, the destiny of mankind, then he is entitled to affirm or deny any esoteric science, but otherwise he should state his belief, extend charitable tolerance to those who differ with him, and stop.

Now, in the field of trouble shooting in radio receivers you might not expect to find anything bordering on the powers of (Concluded on page 30)



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**FREE** The New Bretwood with Con-hookups, supplied with each purchaser Attached. chase. Just fill out and mail the (Less than half actual size.)

**Don't Send a Solitary Cent!** The Bretwood Leak may be baseboard or panel mounted. Works the same in any position. No fluid used.

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Please mail me at once one New and Improved 1928 Model De Luxe Bretwood Variable Grid Leak (price, \$1.75) and attach one Bretwood Bullet Condenser (50 cents extra), for which I will pay the postman \$2.25 on receipt. Both must be the genuine Bretwood articles, imported from England.

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Your heart will beat pitter-patter with joy when you turn on the switch after completing the Unified Diamond of the Air. This design consists of a balanced two-stage RF amplifier and detector, constituting the Radio Frequency Fountain, and a three stage resistance coupled channel constituting the Audio Frequency Basin. Any other form of audio may be used. Send 50c for complete description of construction (issues of Sept. 17, 24, Oct. 1, 8, 15).

Radio World, 145 W. 45th St., N. Y. C.

**Unified DIAMOND**

(Concluded from page 30)

a mystic. Surely no alchemy will turn into working gold the rebellious phospor bronze and aluminum of a wooden radio set that has become subject to electric metabolism. Yet a psychic force may be at work, and a man may possess so much actual experience and scientific theory as a background, that he can diagnose the ill with a certainty that seems uncanny.

And such indeed is the power that Bertram Remholdt, of Brooklyn, N. Y., proves he possesses, for he has made so many sets work, that others had given up as hopeless, and has performed his magic so often without laying a hand to the receiver, that his admiring flock of clients regard him with awe and gratitude.

It is young Remholdt's opinion—he is only twenty-four—that the pit into which trouble shooters fall is that they can not diagnose. So skillful has he himself become that he sends out his symptom investigators while he sits home and tells them what to do. You would think they could tell how to remedy the troubles they encounter, but Remholdt proves that a theoretical as well as a practical knowledge of radio is necessary for quick-action shooting.

**Has Eight Symptomicians**

He is very matter-of-fact about it himself. Although for the edification of his friends he will put a handkerchief about

his eyes in blindfold fashion, and prescribe the remedy for a mysteriously ailing set without laying a finger upon it, he otherwise foregoes any such dressing-up, and scientifically addresses himself to the task at hand.

Remholdt, who operates his business under a trade name, for he is averse to personal publicity, has eight expert symptomicians working for him. But he does not depend on them for the diagnosis itself. No. They give him simply their report on what happens when the set is operated. Or if the set does not work, they describe conditions. He hears about the symptom, asks many questions when they report to him by telephone, frequently instructs them to make a new analysis or a more complete report on some certain phase, and occasionally manifests a deep interest in something his investigator considered most trivial.

**Experiments a Great Deal**

Remholdt has a true sense of values. Besides, he spends six to eight hours a day on his hobby of actually experimenting with receivers. Many are factory-made. The manufacturers are glad to send him their product, for he does more to rectify trouble when it arises in his bailiwick than anybody else they know of. They rely on him, and yet he charges them nothing. All expenses are borne by the set owner.

**The Big Thrill of DX, and at very Small Cost to You**

Everybody who owns a radio set likes to tune in far-distant stations now and then because not only is there a thrill in hearing a voice or instrument thousand of miles away but one verifies the fact that he has a powerful receiver and that it is in good condition, if it is able to pick up these weak signals. Now that the broadcasting stations are more suitably distributed as to wavelength or frequency, fans are in a better position to tune in distant stations. Besides, the weather is in their favor these days. But what kind of a set shall be used? You know very well that if the set can tune in distance once in a while, you can develop sufficient skill to make it tune in far-distant stations very often, virtually every night. Then when you have visitors you need not boast about the DX qualities of your set but simply tune the receiver and let them listen to stations thousands of miles away. You must be sure to have a receiver capable of responding to your distance-getting desires. You also want this set to have faithful tone quality, so that your own critical ears cannot detect even a single flaw in the reproduction. Indeed, even music lovers who may be guests at your home will comment admiringly upon the bewitching tone of your receiver. Then you know you have something real. The ability to get distance and to reproduce the original music without distortion depends largely on the circuit design, and you will find that the Diamond of the Air, either the 4-tube or the 5-tube model, will live up to your highest expectations. How are you going to know which to build? Carefully inspect the textual data as well as the blueprints that fully expound the theory, operation, characteristics and amplification of these two outstanding receivers that differ principally in the type of audio amplification.

**The 5-Tube Diamond**

Can be constructed in a couple of hours. The authorized blueprints that make this speed and efficiency possible are just off the press and will be shipped at once, together with the new booklet of full textual exposition of construction, including the winding of coils, how to connect terminals, what values of condensers and resistors to use, etc. The receiver consists of a stage of tuned radio frequency amplification, a specially sensitized detector, first stage of transformer audio and next two stages of resistance audio. It is easily adapted to playing phonograph records through the set and on your speaker. Get acquainted with this new delight.

**The 4-Tube Diamond**

represents the most that is obtainable from four tubes. A stage of tuned radio frequency amplification, a specially sensitized detector and two stages of transformer coupled audio. Follow the blueprint to amazing success. Build the set from parts you have. Full instructions cover utilization of such apparatus. Thousands are eager to build an economical set of surpassing performance and amazing achievement and this one is the most economical, the most scientific, and the least expensive in cost of parts and upkeep. Works splendidly from batteries, either type 99 or type 1A tubes, and can be used with A and B eliminators, power packs, etc., with great success.

Look over both of these blueprints and read the text in both cases before choosing the receiver you are to build.

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Please send me one newly-printed official blueprint of the 5-tube Diamond of the Air, one newly printed official blueprint of the 4-tube Diamond, and the textual data giving full directions for constructing these sets. I agree to pay the postman 75 cents on delivery. Also, you are to send me, without extra cost, one Auto Strop Safety Razor, one blade and one automatic razor strop.  
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# THE R IS MADE STRAIGHT LINE!

**I**N electricity in all its forms, including radio, "R" stands for resistance. Any resistor that is variable should vary directly in proportion to the adjustment. In variable grid leaks this asset of "straight line R" has been missing. But now it is supplied—efficiently, perfectly—in

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The improvements made in the new model—imported from England and released for the first time—are:

(1) Constant readings, (2) even distribution of the resistance element, (3) support provided for optional base-board mountings.

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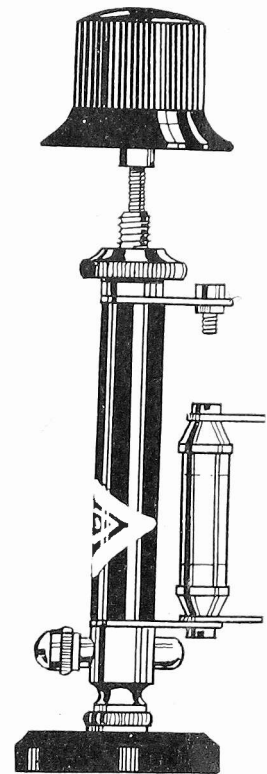
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The DE LUXE MODEL with Condenser Attached

*The De Luxe Model Bretwood Variable Grid Leak specified by Herman Bernard for Radio World's Four-Tube Universal Receiver.*

1. The knob is hard rubber.
2. The shaft is durable brass, and can not jam or stick.
3. The brass lock nut, with milled edge, enables single hole panel mount.
4. The barrel is of hard rubber and houses the the resistance element and plunger.
5. The lugs are adjustable to any position within the sweep of a circle.
6. The grid condenser is securely fastened to the lower lug and requires no extra room, as it is within the projection of the lugs.
7. The syphon container distributes a constant supply of resistance element, making the reading straight line resistance, and preventing uneven distribution of the resistance element.
8. The hard rubber pedestal affords the option of perpendicular mounting, as on a base-board.

Each Bretwood Variable Grid Leak and Bretwood Bullet Condenser is guaranteed against mechanical or electrical imperfections and is sold on an absolute five-day money-back guarantee.

If you're not delighted with results, then we're not even satisfied!