March 10 1928 Vol-12 No-25

BY-PASS MAGIC

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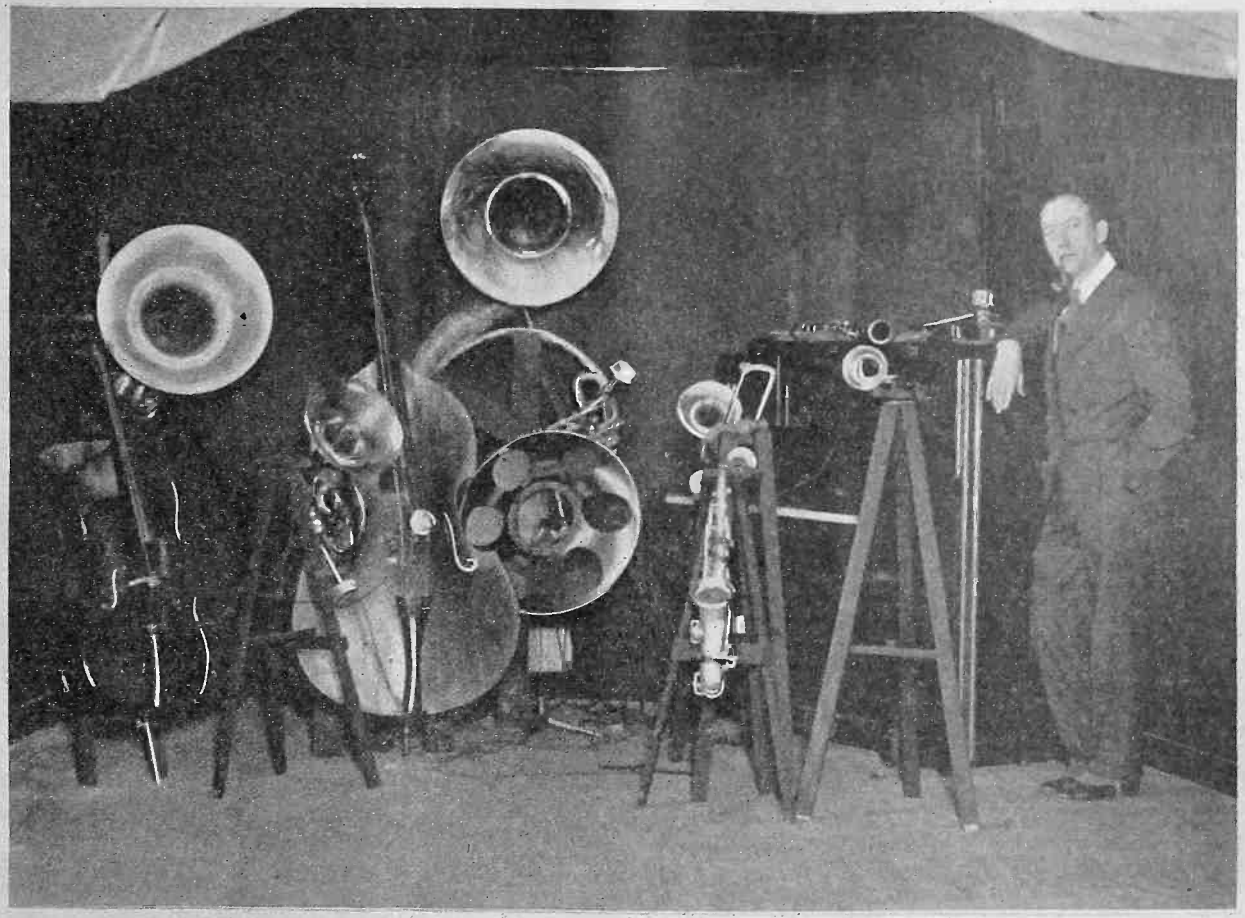

(Herbert Photos)

This unusual orchestra actually works. But instead of producing, it reproduces. It is a composite loudspeaker. A unit is attached to each instrument. See page 19.

SIXTH ANNIVERSARY NUMBER of RADIO WORLD

Dated March 31, 1928, will be an Outstanding Issue

(Forms close Noon, Wednesday, March 21. See Editorial Page (16) for Advertising Rates)

EXTRA SIZE! EXTRA CIRCULATION! EXTRA FEATURES!

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First Presentation of a Remarkable Short Wave Receiver, by J. E. Anderson, Technical Editor.

A New Method of Oscillator Coupling and Volume Control, by H. B. Herman.

How to Build a Sensitive Set in an Automobile, by Brunsten Brunn.

A Unipac for the New —50 Tube, by Brewster Lee.

Improvements I Made in My Set Without Any Cost, by Billy Honduras.

Coils for Shield Grid Circuits, by Knollys Satterwhite.

RADIO WORLD

Telephones: Bryant 0558-0559
145 WEST 45th STREET NEW YORK CITY
Published Every Week, Dated Saturday, Out Preceding Wednesday

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EVERY FRIDAY at 5.40 P. M. (Eastern Standard Time) Herman Bernard, managing editor of Radio World, broadcasts from WGBS, the Gimbel Bros. station in New York, discussing radio topics.

"UNINTERRUPTED READER INTEREST"
EVERY WEEK — EVERY YEAR

RADIO WORLD

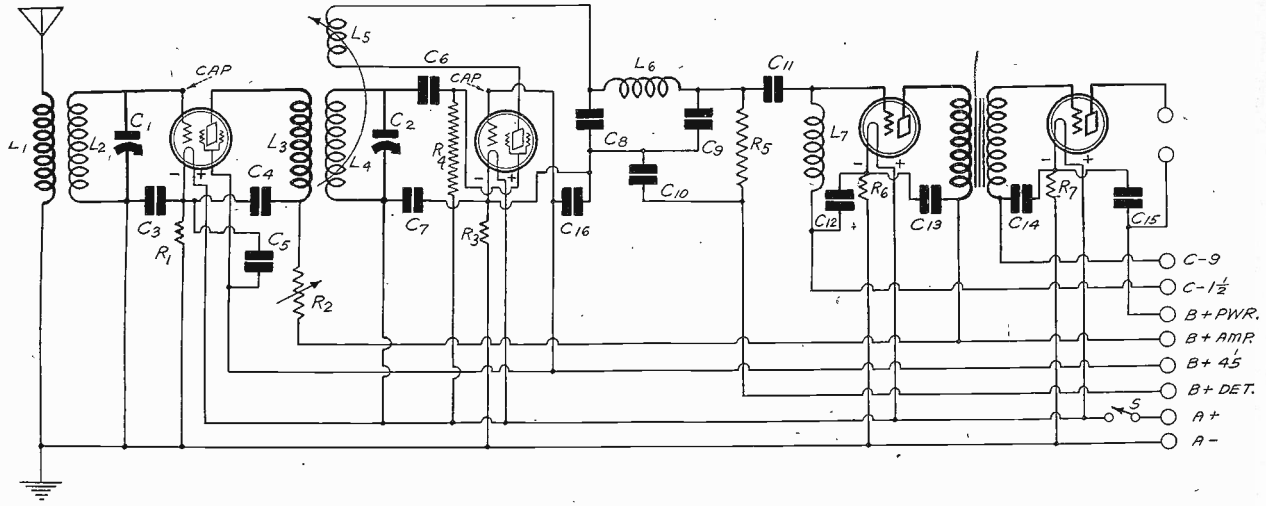
Vol. XII. No. 25. Whole No. 311
MARCH 10, 1928
15c per Copy. $6.00 per Year
[Entered as second-class matter, March, 1922, at the post office at New York, N. Y., under Act of March, 1879]

Technical Accuracy Second to None

A Weekly Paper Published by Hennessy Radio Publications Corporation, from Publication Office, 145 West 45th Street, New York, N. Y.

Phones: BRYant 0558 and 0559

By-pass Condensers Help



CIRCUIT ILLUSTRATING THE USE OF BY-PASS CONDEN SERS FOR STABILIZING THE RECEIVER AND IMPROVING THE QUALITY OF THE OUTPUT.

By Herbert E. Hayden

THERE is no subject in radio more important than by-passing. Yet it is very often neglected.

It is often found that a receiver is more sensitive when a by-pass condenser is omitted. It is immediately concluded that the condenser is not necessary, nor even desirable. So the next and the next by-pass condensers are also left out. The result may be that a receiver so mutilated oscillates uncontrollably.

And then the builder writes complaint:

"I built the receiver just as you described it but all I get out of it is squeals. I omitted the by-pass condensers. Are they necessary?"

Another embryonic investigator puts in a condenser much larger than that called for in some strategical position. He notices that the volume goes up. Consequently he puts in a still larger condenser. He does the same in all other similar positions. And then he complains:

"I built the circuit just as you described it, but I can't get any distinct signals. Everything is jumbled up."

By-pass Condensers Discussed

In the accompanying four tube screen grid tube receiver are many by-pass condensers. On seeing these the fan who has to watch his radio expenditures asks the question:

"Are all these necessary?"

The answer is that every condenser in that circuit has a very definite and useful purpose. Some of them, perhaps all of them, might be omitted. But the circuit will not work quite so well without these condensers as it will with them.

Since these condensers are very useful, let us take up their purpose, one by one.

C1 and C2 are tuning condensers and they do not enter this discussion.

C3 is the first by-pass condenser. To all appearances it by-passes only the amperite R1. It does more than that. It by-passes the leads, which may have a greater detrimental effect on the operation of the circuit than the ballast. But the amperite alone is sufficient reason for using the condenser in a screen grid tube circuit. Of course if the condenser is to be most effective it must be so connected that its own leads are short, in fact so that the path from the low potential side of the first tube circuit L2C1 to the negative end of the filament is the shortest possible.

The Matter of Size

There is no technical reason why the size of C3 should be limited. The larger it is, the better it does its work. Cost and physical size should determine the question. But there should be a minimum size, and that we may arbitrarily set at .006 mfd. But that does not prohibit the use of .01 or .1 or larger condensers.

We skip over to the plate circuit and encounter C4. It is connected from the low side of L3 to the negative end of the filament. This condenser has more to do than C3. It by-passes R2, the long leads and the B battery or eliminator. That is quite an assignment, and one which C4 must take care of. The remarks regarding leads of condenser and size made for C3 apply to C4 also.

And we drop down a notch to find C5 connected from the negative end of the filament to the screen grid binding post. Although the leads on the drawing are not indicated as short they are so in the actual wiring of such a set.

C5 has a very important function. It short-circuits the leads and the 45 volt source as far as high frequency currents are concerned. It is this short-circuiting which is very largely responsible for the effectiveness of the new electrode as a shield between the plate and the control grid. The larger it is the better for this purpose. We might put a minimum of .01 mfd. on this condenser and recommend values between this and 1 mfd.

Ascending to the top of the circuit we note C6 in the grid circuit of the detector —in the screen grid circuit, because the screen grid is used as control grid in this case. Well the size of that condenser may be .00025 mfd. as usual, but it is really none of our concern in this discussion of by-pass condensers.

Eyes Right

So we lower our eyes a bit and focus our attention on C7. But only to say that if we had come to C7 first we would have said the same thing about it as we said of C3.

Eyes right, and see C16. It by-passes the space charge grid (the inner) supply leads, and does it in as direct a manner

(*Concluded on page* 20)

Why Meters Are Much as Weapons for

By Jasper

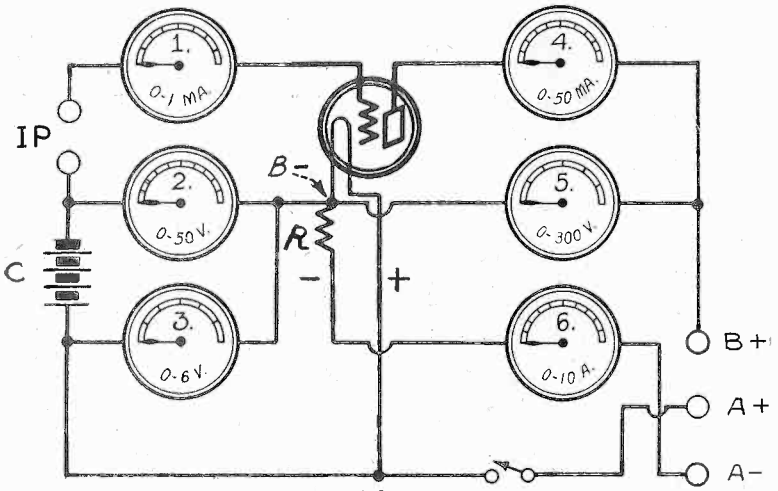


FIG. 1
A DIAGRAM SHOWING THE CONNECTIONS OF METERS IN A COMPLETE TUBE AND CIRCUIT TESTER. NOTE THAT B— IS CONNECTED TO FILAMENT MINUS. THIS AVOIDS A VOLTAGE DROP DUE TO B CURRENT THAT OTHERWISE WOULD FLOW THROUGH THE FILAMENT RESISTOR R. SOME TUBE TESTERS CONNECT TO A PLUS, INSTEAD OF F—, AND THIS IS SATISFACTORY, TOO.

A VACUUM tube of the ordinary variety, that is, a triode, has three electrodes. When such a device is connected up for operation three circuits are formed, one for each of the electrodes. And in each circuit are a steady voltage and a steady current. Therefore a complete circuit or tube tester should have three voltmeters and three current meters.

For measuring the grid current a microammeter or a 0—1 milliammeter should be used. But since the grid current in correctly operated tubes is practically zero, this meter may be omitted, as is done in commercial testers. When it is used, it should be placed in the grid lead with its minus terminal toward the grid and its positive terminal toward the filament. No. 1 in Fig. 1 is the grid current meter.

A meter of utmost importance in a circuit and tube tester is a grid bias meter, which of course should be a voltmeter. This meter should be connected as No. 2 in the drawing, with the positive terminal to the negative end of the filament of the tube and the negative to the grid battery C. The input device, whether a resistor or the secondary of a transformer, should be inserted above the point where the meter is connected. IP are the binding posts for inserting the grid exciters.

Avoids Voltage Drop

The object of connecting the negative terminal of the grid bias meter below the input device rather than to the grid is to avoid the voltage drop in this device when a current drawing voltmeter is used to measure the bias.

The range of the grid bias meter will depend on the service which it is expected to render. It will not be long now before the grid bias in some receivers using the new —50 tube will be as high as 100 volts. The maximum recommended is 84 volts but that does not prevent fans from exceeding the recommended plate and grid voltages. Hence to provide for the future the grid bias voltmeter should have a range of 0—100 volts. But in most cases a range of 0—50 will suffice since the —71A power tube takes only 40 volts negative grid bias. For that reason meter No 2 in the drawing has that range.

Filament and Plate Meters

The filament circuit should be adjusted to correct filament terminal voltage rather than to rated filament current, but it is also desirable to know what the filament current is. Hence both a filament voltmeter and a filament ammeter should be a part of the tube test set. Meter No. 3 in the drawing is a 0—6 DC voltmeter connected across the filament. This range will cover all tubes except certain power tubes, and when these exceptional tubes are used an AC voltmeter is usually required. Hence the 0—6 DC meter is the correct one to use in the test set.

Note that the filament voltmeter is connected across the tube terminals and not across the battery terminals. If the voltage of the battery is desired the meter should be shifted so that it is across A plus and A minus.

The filament ammeter might have a range of 0—10 amperes. This range is wide enough to measure the total current in a multitube receiver and it is sensitive enough to measure filament current of a single —99 with fair accuracy. This meter need not be so accurate, since the adjustment is set by voltage rather than by current. No. 6 on the drawing shows the connection

The two meters in the plate circuit are one milliammeter for measuring the plate current and one voltmeter for measuring the applied plate voltage.

The range of the milliammeter should be such that it will measure the plate current in the ordinary power tubes when they are delivering normal current or a little in excess of normal. Hence a 0—50 milliammeter is suitable for a tube and circuit tester. Such a meter is shown at No. 4 in the diagram. This meter is connected in series with the plate circuit, with the negative terminal of the meter pointing toward the plate and the positive pointing toward the source of plate voltage

No. 5 in the diagram is a 0—300 high resistance voltmeter for measuring the applied plate voltage. This range is suitable for use in a tube and circuit tester because it will read the low plate voltage required for detectors and RF tubes as well as the high voltages required for —71A type power tubes. If power pack output voltages are to be measured, use a 0—500 high resistance meter instead.

The negative terminal of the voltmeter should be connected to the negative end of the filament and the positive to the B plus terminal of the plate voltage supply.

Of the meters shown in the diagram of the tube and circuit tester Nos. 2, 3, 4 and 5 are the most important and should be in the test kit of every radio experimenter and receiver operator.

AC Voltmeters

There are many circuits in which the filaments are heated with alternating current. To measure the voltage in such cases an AC voltmeter is required. The usual AC voltages encountered in receivers are 1½, 2½, 5 and 7½ volts, and the meter selected to test an AC set should be capable of measuring any one of these. Perhaps the most suitable range is 0—10 volts, but 0—15 volts may be used also with about the same accuracy

The AC voltmeter should be connected across the same points on the filament as a DC meter, but since the AC meter has no polarity, no precautions need be taken about the plus and minus posts.

A meter test of the wiring in case of trouble often leads to the source of the trouble, even if the trouble is lurking in inaccessible corners. A meter test is the only practical and rapid way of locating trouble, and for this purpose a simple test set is valuable. Commercial models include 0—6 volts DC voltmeter and 0—10 DC milliammeter. This set should be augmented with independently obtained grid voltage meter and plate voltage meter. The combination will enable the operator to test for continuity of plate filament and the grid circuits.

The continuity of the plate circuit is directly indicated by a deflection on the plate circuit milliammeter. If there is a deflection there must be (1) voltage on the plate, (2) filament operation and (3) plate current. Hence a single reading on this meter will tell three important things about the circuit. And it will tell them more definitely than the minutest visual scrutiny of the wiring.

Now suppose the grid voltage is varied. The plate current should change if the grid

Sharper Than Any Eyes Trouble-Shooting

Jellicoe

circuit is continuous. Hence if the deflection on the plate milliammeter changes when the grid bias is changed, the grid circuit is continuous. And as before this test is much superior to any visual inspection. When the grid bias is increased the plate current should drop, and vice versa.

While these tests show that the grid and plate circuits are continuous they do not show whether some of the parts in these circuits are shorted. To determine that point special tests have to be made. For example, the primary of the transformer may be shorted. To test for that, short-circuit it purposely and note the deflection on the plate circuit milliammeter. If the primary was shorted before there should be no change. If the circuit was correct before, the short-circuiting should cause the plate current to increase. The same rule applies if the coupling coil in an impedance coupled circuit is shorted.

If the circuit is resistance coupled the normal reading on the plate circuit milliammeter should be very low. If it is high, say about 5 milliamperes, the resistor is probably short-circuited.

The applied plate voltage is measured with a high resistance voltmeter. This will tell whether the tube is getting the proper plate voltage when the circuit is correct otherwise.

Whether the secondary of the input transformer or the input resistor is shorted can be determined by measuring the grid bias below and above the input device, that is, by connecting the negative terminal of the grid bias meter at minus C or at the grid. If the reading at both places is the same there is a short between. If the circuit is not shorted the reading on the grid should be much lower than the other reading.

A fundamental trouble-shooting test set may consist of two meters—one a filament voltmeter and the other a plate current milliammeter. Add a high resistance plate voltmeter. A socket is usually built into the test set into which the tube to be tested is inserted. A plug is obtainable, to be attached with suitable leads to the tester. The plug is then inserted into the socket from which the tube was taken. The meters are thus properly connected for making a test of the tube as well as of the circuit.

A meter must be connected correctly or it will not give the correct readings. It behooves the operator to connect the meters correctly every time.

The more sensitive a meter is, the more delicate it is, and the greater care must be exercised to protect it. A current meter is more subject to burn-out than a voltmeter.

A voltmeter is connected across the voltage source.

If such a meter is connected in series with a line including a voltage source no damage will be done to the meter provided that the range of the meter is not much less than the voltage in the circuit.

A current meter is always connected in series with the line. No damage will result to this meter if the current in the circuit does not greatly exceed the range of the meter. But if the current meter should be connected across a voltage source, there is a good chance of completely ruining it. The damage is usually instantaneous. Nothing but regrets remain.

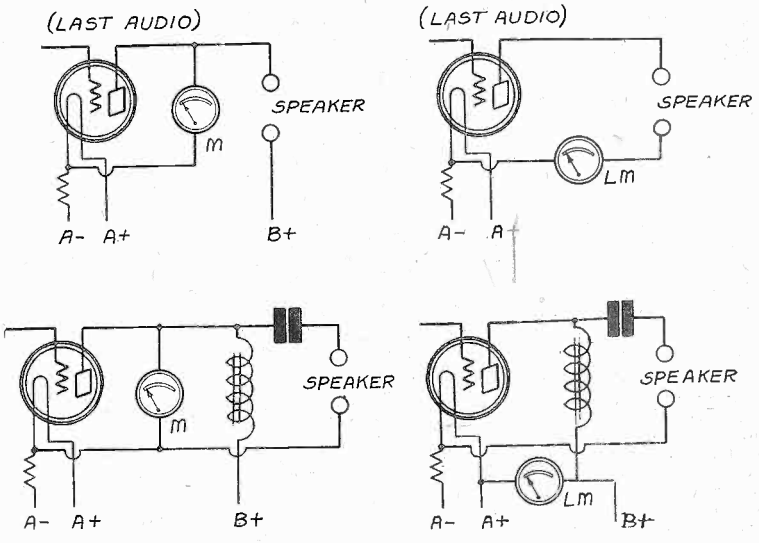


FIG. 2
HOW A HIGH RESISTANCE METER M SHOULD BE CONNECTED AS A DISTORTION TESTER. NOTE THE DIFFERENT METHOD FOR USING A RELATIVELY LOW RESISTANCE METER FOR THE SAME PURPOSE. FILTERED AND UNFILTERED OUTPUTS ARE SHOWN.

A voltmeter of the ordinary battery testing variety, that is, one with comparatively low internal resistance, can be used in the plate circuit of a vacuum tube to detect distortion. It is connected in series with the loud-speaker just like a milliammeter which is used for the same purpose. Distortion in the tube would show up as fluctuations on the meter. When no overloading distortion is present the needle of the meter stands still.

A high resistance voltmeter can be used for the same purpose, but it should be connected across the output, that is, from the plate to the filament. Distortion will show up as large fluctuations in the reading of the meter. This is due to changes in the effective plate voltage.

Blan Opens New Store

"Blan, the Radio Man," 145 East 42nd Street, New York City, has opened a new store at 89 Cortlandt Street, near West Street. Blan is also nationally known, having customers all over the country whose needs he fills by mail.

Gifts were given to every customer on the opening days, varying in value with the size of the purchase and every customer received free a "static reducer." This consisted of an envelope of special steel wool for the thorough cleansing of battery and other connections, which it was truly claimed will eliminate at least 80 per cent. of the so-called static.—J. H. C.

Why Airplane Cloth Makes Fine Speaker

Great interest has been displayed recently in air plane cloth as the sound radiating surface in loudspeakers. It has been discovered that this cloth is ideally adapted for this purpose, just as it is for wings and fuselages of airplanes. The reasons are the same in both cases, namely, light weight and high tensile strength.

For airplane use the cloth must be light so that it will not add materially to the weight of the plane, and it must have a high tensile strength to prevent breaking and rending when subjected to the enormous stresses occurring in flying.

For loudspeaker use the cloth must be light so that its inertia will not retard the motion of the sounding surface. It must be light if it is to follow faithfully the rapid vibratory movements occurring at high frequencies, as in the HBH airplane cloth speaker, described in the March 3 issue. It must be strong so that it will withstand stretching of a high order. If the surface is not stretched very taut the cloth will flap like a sail in the wind and make noises of its own quite foreign to the music and speech which might constitute the radio signal. Stretching is necessary to avoid distortion and high tensile strength is necessary to prevent ruin of the cloth in stretching.

World Choice of Programs

With Screen Grid Laboratory Super

By Ernest R. Pfaff

AN important feature of the Screen Grid Laboratory receiver is that it is provided with plug-in coils which enables the operator to use the receiver for tuning in any station in a band from 30 to 3000 meters by simply plugging in the appropriate coils.

Perhaps some persons will doubt the value of this feature at this time, but they will not do so in the near future, for great developments are going on in the short wave region. The thirty meter lower limit is low enough to cover virtually all the short wave broadcast now filling the ether. The 3,000 meter upper limit is high enough to embrace all the European broadcasts. Thus this receiver covers just about all the wave lengths which are of interest to a broadcast listener at the present time.

And if in the future any interest should develop either below thirty meters or above 3,000 meters it will not be necessary to get a new receiver to reach this new development, but only to get another set of coils. The tuning range may be extended in either direction.

Sensitivity High

But what is the need of providing such a wide tuning range in a receiver when all the American broadcast stations can be received on a single set of coils and most of the stations requiring different coils are from 3,000 to 12,000 miles away? For the person who is satisfied with the programs from the nearest station alone there is no need at all. He does not even need a tuner on his receiver. All he needs is a filament switch, and perhaps a volume control.

But this receiver has the amplification necessary to reach beyond the back yard fence and pull in signals from stations in every nook of the world. The operator of this set has a wide choice of entertainment. Difference in time alone handicaps him. If he does not like to listen to the discordant noises from a jazz band he may turn to Vienna for a soothing waltz. If he does not like the sermon of the local preacher he may perhaps find majestic organ music in London. If he does not like the faltering notes of the local soprano he may turn to grand opera in Berlin, Paris, New York, Buenos Aires.

Regenerative First Detector

The first detector is made regenerative in the receiver in order to eliminate certain types of interference which can only be excluded by sharp tuning the radio frequency level. This feature also boosts the sensitivity of the circuit very greatly. The regeneration is controlled by means of a midget condenser C3. One side of this condenser is grounded so that there will be no body capacity effects to nullify the purpose of the feature. Sharp tuning and critical regeneration can be effected without any difficulty. This can be appreciated only by those who have been annoyed with a tuned circuit in which body capacity played a part.

At first the operator of this receiver may find difficulty in bringing in DX signals, particularly if he has not operated a very selective receiver previously. But this difficulty will disappear just as soon as he learns that stations just snap in and out. That is the tuning dials must be in exactly the right place for a given station or no signals at all will come in. One fraction of a division on the oscillator dial either above or below the right place and there is no trace of a signal from the desired station. But right on the spot the signal bellows forth.

Tuning Secret

The secret of tuning for a distant station with this receiver is to turn the oscillator dial very slowly, keeping the modulator dial approximately in step all the time. When that is done, and if the volume controls are turned up to maximum at the same time, no station within range of the receiver will be passed while moving the oscillator dial from zero to maximum. The weak stations may have to be "touched up" a bit to bring them in with as great intensity as the circuit is capable. Whenever the operator is tuning in a local station the volume controls should be turned down so as to prevent damage to the loudspeaker by the signal when it bursts in with full intensity.

The construction of the eight tube Laboratory Super, using screen grid tubes in the three intermediate stages was described in the February 25 and March 3 issues.

70 CHANNEL CHANGES GO INTO EFFECT

WASHINGTON.

Seventy changes in broadcasting assignments to stations in California, Washington, Oregon and Colorado were announced by the Federal Radio Commission. They represent modifications in licenses effective on March 1, the Commissioner from the fifth zone, H. A. Lafount, stated.

By far the larger number of changes are new time divisions between stations, Mr. Lafount said. The changes are designed, he added, to improve local reception all along the Pacific Coast and in Colorado. Interference has been resulting, he said, mainly from the close proximity of channels on which the stations in those States were operating, and the wave length changes made were intended to widen the separation between such channels, said Mr. Lafount.

It was not found necessary at this time to change assignments in Utah, Idaho, Montana, Wyoming, New Mexico and Arizona, where reception was said to be good, generally, except for some heterodyne interference caused by the operation of eastern and western stations on the same frequency.

Mr. Lafount predicted that immediate improvement in the broadcasting conditions of the States in which changes were made would result.

EFFECT OF REASSIGNMENTS

The changes introduced by the Federal Radio Commission's reassignment order follow:

KYA transferred from 970 kilocycles to 830 kilocycles (361.2 meters) and power increased from 500 to 1,000 watts.
KGTT transferred from 1,450 kilocycles to 1,360 kilocycles (220.4 meters), sharing time with KJBS.
KJBS increased in power from 50 to 100 watts.
KRE transferred from 1,170 kilocycles to 1,220 kilocycles (245.8 meters), sharing time with KLS.
KZM transferred from 1220 to 1440 kilocycles (208.2 meters), sharing time with KFUS and KFQU.
KFUS transferred from 1170 kilocycles to 1440 kilocycles (208.2 meters), sharing time with KZM andKFQU.
KFQU transferred from 1200 to 1440 kilocycles (208.2 meters), sharing time with KZM and KFUS.
KFBK transferred from 560 to 1090 kilocycles (252 meters), sharing time with KTBI.
KFCR increased power, 50 to 100 watts.
KPPC transferred from 1310 to 950 kilocycles (315.6 meters), sharing time with KPSN.
KPLA transferred from 1190 to 1040 kilocycles (288.3 meters.)
KTBI transferred from 1040 to 1090 kilocycles (275.1 meters), and increased in power from 500 to 1,000 watts.
KWTC transferred from 1350 to 1100 kilocycles (272.6 meters), sharing time with KSMR.
KGEF increased in power from 500 to 1,000 watts.
KGFH transferred from 1340 to 1140 kilocycles (263 meters), sharing time with KGEF.
KFSG transferred from 1.090 to 1.190 kilocycles (252 meters), sharing time with KRLO.
KRLO transferred from 1390 to 1,190 kilocycles (252 meters), sharing time with KFSG.
KFQZ increased in power from 100 to 250 watts.
KFVD transferred from 1,440 to 1,390 kilocycles (215.7 meters), sharing time with KGER.
KFWC changed from 1,350 to 1,210 kilocycles (247.8 meters), sharing time with KFBC.
KMO increased in power from 250 to 500 watts.
KGY changed from 1.230 to 1,220 kilocycles (245.8 meters), sharing time with KFIO and KFPY.
KVI changed from 1,280 to 1,260 kilocycles (23 meters).
KPCB and **KGGL** each increased in power from 50 to 100 watts.
KXRO changed from 1,320 to 1,340 kilocycles (223.7 meters).
KVOS increased in power from 50 to 250 watts.
KRSC changed from 1,420 to 1,480 kilocycles (202.6 meters), sharing time with KKP and KRSC.
KKP changed from 1,130 to 1,480 kilocycles (202.6 meters), sharing time with KRSC and KVL.
KFJR increased in power from 100 to 500 watts.
KEX changed from 1,250 to 1,080 kilocycles (277.6 meters).
KWJJ changed from 1,310 to 1,200 kilocycles (249.9 meters), sharing time with KFJI.
KTBR changed from 1,060 to 1,310 kilocycles (288.9 meters), sharing time with KFIF.
KFIF changed from 1,400 to 1,310 kilocycles (288.9 meters), sharing time with KTBR.
KXL increased in power from 50 to 100 watts.
KMED changed from 1,200 to 1,450 kilocycles (206.8 meters), sharing time with KOOS.
KOOS changed to 1,450 Kilocycles (206.8 meters).
KLIT changed from 1,450 to 1,500 kilocycles (199.9 meters).
KFHA changed from 1,180 to 1,200 kilocycles (249.9 meters), sharing time with KFKA.
KFEL changed from 1,210 to 1,320 kilocycles (227.1 meters).
KOW changed from 1,210 to 1,370 kilocycles (218.8 meters).
KFXJ changed from 1,390 to 1,430 kilocycles (209.7 meters).
KPOF increased in power to 500 watts.

One Wave for a Chain Seconded By Reader

EDITOR RADIO WORLD:

In regard to the wave debate, I agree fully with Clarence A. Bradt of Columbine, Colo., whose article I have just read. In the first place there is no doubt that there are entirely too many stations on the air.

As Mr. Bradt says, it would be a good plan to put all the chain stations on one wavelength, that is one for each chain. There should be about six or seven meters between the stations, and not more than one station on a wavelength, no matter how far apart the cities may be, because somewhere in the country there is interference.

JAMES S. OPPENHEIMER.
5831 Bartlett St., Pittsburgh, Pa.

Big Gain Turns Loss When Tube Spills Over

The principle of regeneration as used in radio receiving sets, according to a popular definition, is that a part of the output of the detector tube feeds back into its own input and thus greatly increases the volume of the signal. We know that regeneration can be accomplished in several ways, by tickler feedback, by the tuned plate method or by other capacitative feedback. Of these various methods, the tickler feedback circuit is no doubt the more common.

It has been found that increasing regeneration up to a certain point will greatly increase the volume, sensitivity and selectivity of the receiver. This so-called point of maximum amplification borders very closely upon what is known as the oscillation point. Our next question is then, what is oscillation? It is the loss of control of radio frequency currents caused by allowing the set to over-regenerate.

Effects Analyzed

When a radio receiving set in a state of oscillation is tuned to a broadcast station, the following deleterious effects ensue:

It causes whistles in neighbors' radio receiving sets tuned to the same or even some other station. This interference may be heard up to a distance of several miles. Secondly, it distorts the quality of your own music. Thirdly, it may even cause howling and squealing sufficient to frighten every timid folk in the house.

Small Transmitter

Many of you may have had the experience of tuning in a station by means of hair-breadth adjustment so as to cut out the squeals just either side of the proper setting. In fact, you may have had to keep your hand on the dial for fear that the noise would recur. This condition is described as that of zero beat adjustment. When a radio receiving set in a state of oscillation is exactly tuned to a broadcast station it is said to be in the state of zero beat. This, however, distorts the broadcast reception and also interferes with neighboring receiving sets which are tuned to the same station. In a word, regeneration carried to over-oscillation causes great annoyance to your neighbors; poor reception, in distorted quality of reproduction and has no advantages whatever. A radio receiver in an over-oscillatory condition is a miniature but powerful transmitter, and since the law requires that a license is necessary to own and operate a transmitter, it is virtually an infraction of the law to allow one's set to continue in a state of over-oscillation.

The interfering and annoying whistle which you hear in your receiving sets may originate in your own set or it may be interference caused by your neighbor.

What to Do to Receive European Stations

NO great success was obtained during the international radio tests conducted a few years ago. Now and then it was reported that signals had been picked up from Europe, but in nearly every case these signals were so indistinct as to frustrate identification. They might have been European origin, or they might have been due to some queer prank of static.

But at that time radio conditions were not what they are this season. The European stations were of low power, but now there are many super-power stations in operation in several parts of Europe. These should carry a great deal farther than the low-powered stations of three or four years ago.

Conditions Now Good

It is generally conceded also that natural radio conditions are more favorable for distant reception now than they have been for several years, due to changes in solar radiation.

The advent of the screen-grid tube also has made conditions more favorable for reception of trans-oceanic stations. It is now possible to get a very high amplification with a small number of tubes.

Tube and battery noises can therefore be minimized. The importance of this can be seen readily when it is recalled that these noises are quite as effective in limiting the range of a receiver as noises of external origin.

In view of these favorable factors it would seem that this year is opportune for trying to receive the programs from Europe But the attempts should be made forthwith as the season is advancing.

It will be noted that only four of the above high power stations operate on frequencies which fall within the range of American tuners. But all the rest could be brought within range of the tuner by increasing the capacity and the inductance. Since Daventry is operating on the lowest frequency, and since that is the station which American enthusiasts stand the best chance of picking up, let us see what kind of tuner will include that station.

The frequency of Daventry is 187,500 cycles. Suppose the tuning condenser of the tuned circuit be increased from .0005 to .001 mfd., by adding a fixed .0005 mfd. mica condenser in parallel with the variable condenser. How much inductance will be necessary to tune in 187,500 cycles? We find that the inductance should be .7 millihenry. Of course, this coil could be used for all the European stations listed above, with the possible exception of OKP.

A coil of this inductance can be obtained approximately by winding 100 turns of wire on a 3-inch diameter.

STANDS PAT

PAT BARNES, ANNOUNCER, WHT, CHICAGO, WITH HIS S-M SHIELDED GRID SIX.

Corwico AC Harness Makes Set Batteryless

The Corwico AC Adaptor Harness enables any one to convert a battery set into a house current receiver without rewiring.

The Corwico Harness consists of a twisted cable of heavy Corwico Flexible wire and the necessary number of adaptors to fit into the sockets of the battery set to be converted. The adaptors pick up the plate and grid connections of the original circuit while the harness supplies the required new filament circuit.

Connect the harness to any standard step-down transformer, insert the AC tube into the adaptors and the old battery set is changed into an AC Receiver, eliminating all storage batteries or A eliminators.

Corwico AC Harnesses are made in two types—one with adaptors attached for R. C. A. and other AC type tubes and one without adaptors for Arcturus AC tubes. Full details will be supplied gratis by Cornish Wire Company, 30 Church St., New York City, if you mention Radio World.

The Mountain Peaks

If a loudspeaker is of such design that is possesses a response curve resembling the side view of the Rocky Mountains and has a multitude of peaks on various frequencies, it is possible that some of these resonance peaks are located on certain frequencies which would tend to accentuate certain overtones of the piano note, with the result that the characteristic of the piano would be lost and the instrument when heard through the speaker would sound more like a harp than like a piano.

In all of these considerations we are assuming the use of a well-designed audio amplifier.

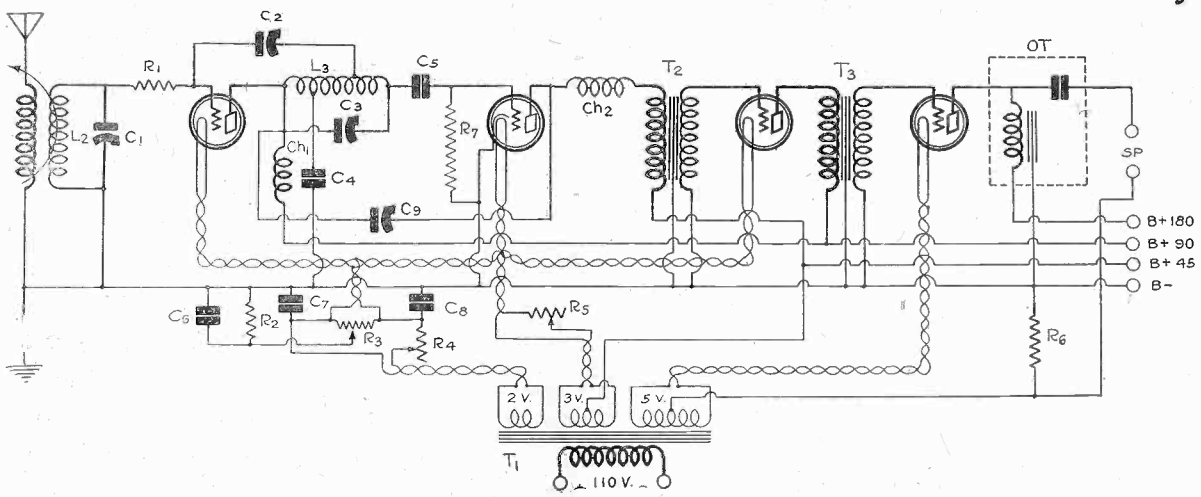
The cone and the exponential horn were great improvements; but new engineering principles mark other instances of progress.

LIST OF FOREIGN STATIONS, 5,000 WATTS OR MORE.

Call	City	Country	Wavelength	Power in Antenna
OKP	Prague,	Czecho-Slovakia	384.9	5,000
....	Warsaw,	Poland	1,111.1	8,000
RA42	Leningrad,	Russia	1,000	10,000
RA1	Moscow,	Russia	1,450	40,000
RA3	Moscow,	Russia	675	20,000
SASF	Karlsborg,	Sweden	1,365	5,000
....	Motala,	Sweden	1,304.5	40,000
....	Osmanieh,	Turkey	1,200	6,000
5XX	Daventry,	England	1,600	16,000
LON	Buenos Aires,	Argentina	210	5,000
LOS	Buenos Aires,	Argentina	291.2	5,000
JQAK	Darien,	Kwangtung	390	5,000
....	Vienna,	Austria	517.2	7,000

The AC Model of

By Jonn



THE CIRCUIT DIAGRAM OF THE AC EVERYMAN FOUR

FEW receivers of recent vintage have received the tremendous popular acclaim that was accorded the Everyman Four, as developed by Fred C. Ehlert. This receiver has been on the lips of every man in radio, every circuit hunter, and every prospective set builder.

Now the same receiver is found in countless homes, and the circuit is still on the lips of the owners.

There must be a good reason for this popularity.

We could proceed to enumerate many of the causes which have made this receiver a favorite with the fans, but it would be merely a repetition of facts which have reverberated in radio circles for several months.

Repetition is not our purpose, but our object is to answer one outstanding question about this receiver, a question which has come from every quarter in which the circuit is known, and which is only asked about receivers which have made good with the fans: Can the Everyman Four be adapted to AC operation?

It Has Been Done

The answer is a circuit diagram and a description of such an adaptation.

The starting point in the description of any AC operated circuit is the filament circuit. Two of the tubes used require a filament voltage of 1½ volts, one requires a voltage of 2½ volts and another a voltage of 5 volts. All these voltages are supplied by a Muter AC filament transformer. The output voltages of the 1½ and 2½ volt windings are actually 2 and 3 respectively, the excess being taken up by rheostats. This permits of a variation in the filament current to compensate for changes in the line voltage. The filament transformer is designated T1 in the circuit diagram.

All the leads carrying AC heating current are twisted and are so indicated in the circuit diagram. The twisting is necessary to eliminate hum. Incidentally it is of great assistance in tracing out the circuit diamond.

The Leads Are Twisted

Twisting the leads is not sufficient by itself to eliminate hum, and other precautions must be taken. Across the two 1½ volt filaments is connected a low resistance potentiometer R3 and the grid returns are connected to the slider on this potentiometer, which is then adjusted to the exact electrical center. To aid in the elimination of hum, and to minimize the coupling effect between the two tubes, two equal condensers C7 and C8 are connected from ground to the two ends of the potentiometer. R3 has a resistance of 30 ohms and each of the condensers C7 and C8 has a capacity of .5 mfd.

The ½-ohm compensating rheostat R4 must be connected between the transformer and the potentiometer, or its adjustment would upset the humless condition.

A rheostat is also put in the filament circuit of the detector to compensate for the excess voltage and line voltage fluctuations. This is a heavy duty rheostat with a resistance of 1½ ohms. It is designated R5 in the drawing.

THE PANEL VIEW

Note that the mid tap of the 3 volt winding is connected to the 45 volt terminal. The heater circuit is thus 45 volts higher than the cathode. The object of this is to prevent the heater from bombarding the cathode with electrons. With the connection shown the heater receives electrons from cathode, and hum is greatly reduced.

Absent Rheostat

The last tube is not so critical with respect to filament current as the others, nor to hum for lack of balance. Therefore no rheostat is used in the filament circuit of the last tube, and the grid is returned to the heater receives electrous from the cathode, and hum is greatly reduced.

The grid bias is obtained for the two 1½ volts tubes from a 750 ohm resistor R2. The combined plate currents of the first and the third tubes flow through this resistor, and since the plate voltage is 90 volts the total current is 7 milliamperes. The bias therefore is very nearly 5 volts. To prevent this resistor from acting as a coupler between the two tubes a 1 mfd. condenser C6 is connected across it.

Similarly a 2,000 ohm resistor R6 is connected in the grid and plate return leads of the last tube to give a bias of 40 volts.

The Tuner

The first radio frequency coil L1 and L2 is an RF coupler with an adjustable primary. This allows variations in the selectivity as well as the volume of the set. The secondary of the transformer is tuned with a .0005 mfd. condenser C1.

The interstage RF coupler L3 is a unique feature of the Everyman Four and is in large measure responsible for its characteristics. It consists of a specially wound and tapped coil in which both the primary and the secondary are tuned with a .0005 mfd. condenser C3.

Neutralizing is effected by connecting a midget condenser C2 between the grid of the first tube and to a suitable point on the grid portion of the coil L3. Adjustment of C2 effects neutralization.

The set is made regenerative by connecting another midget condenser C9 between the plate of the detector and the plate of the first tube. The primary portion of L3 thus becomes the tickler. C9 is put on the panel and serves as volume and sensitivity control.

The two RF chokes Ch1 and Ch2 serve

the Everyman Four

Murray Barron

LIST OF PARTS

T1—One Muter No. 3600 AC filament transformer
T2—One Muter No. 3300 Supreme AF transformer, first stage
T3—One Muter No. 3300 Supreme AF transformer, second stage
OT—One Muter No. 2700 Clarifier-output transformer
L1, L2, L3—One set of Everyman Four coils
R1—One Muter No. 2950 500 ohm resistance unit
R2—One Muter 2975, 750 ohm resistance unit
R6—One Muter No. 2902, 2000 ohm resistance unit
R3—One Muter No. 2331, 30 ohm potentiometer
R4—One Muter No. 2305, 1-2 ohm rheostat
R5—One Muter No. 2315, 1 1-2 ohm rheostat
C1, C3—Two .0005 microfarad "Camfield" condensers
C2—One Muter No. 1900 variable balancing condenser
C6—One Muter No. 508, 1 mfd. by-pass condenser
C5—One Muter No. 301 .0001 mfd. moulded grid condenser
C4, C7, C8—Three Muter No. 507, .5 mfd. by-pass condensers
C9—One "Camfield" midget 50 mmfd. condenser
Ch1, Ch2—Two Muter No. 2750 radio frequency chokes
One Muter No. 3710, one megohm heavy duty grid leak
One No. 800 grid leak mounting
One binding post strip, 1x6x1-8 inch
One AC Bakelite control panel, 2x6x1-8 inch
One No. 1650 approved power switch
One 17x21 Micarta panel, drilled and engraved
Three No. 9040 Benjamin Cle-Ra-Tone sockets
One No. 9036 five prong socket
Seven XL binding posts, (Ant., Gnd., B-45, B-90 B180, Sp, Sp)
One Fritts baseboard, 20 1-2x10 3-4 inch

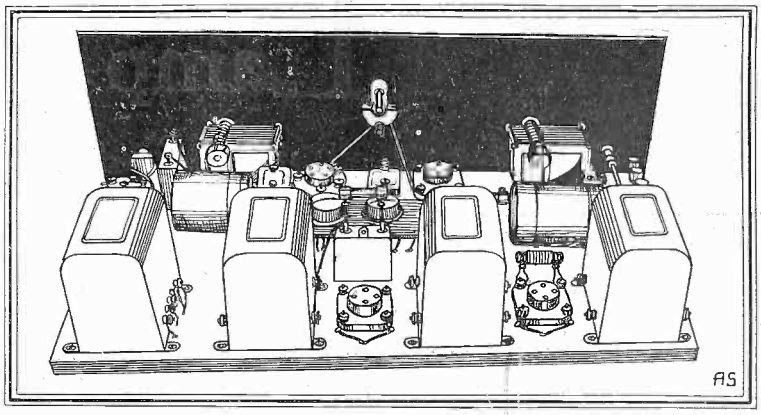
to force the fed back current through the proper channel.

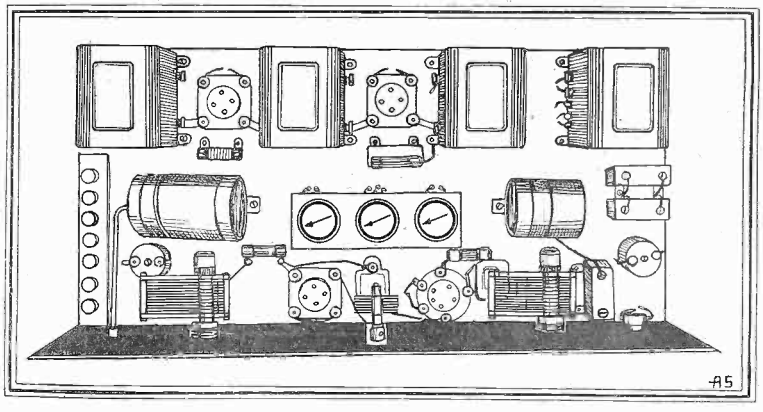
Coupling Determined

Condenser C4, which is of 1 mfd., completes the plate circuit with respect to the signal current. The number of turns between this condenser and the plate determines the primary circuit and the degree of coupling between the plate and the grid circuits. There are 20 turns in the primary portion, 23 turns between the condenser C4 tap and the neutralizer tap and also 23 turns between the neutralizer and the grid end of the coil.

In view of the fact that the direct plate voltage is on one side of the .0001 mfd. grid condenser the 1 megohm grid leak must be connected from the grid directly to the cathode of the grounded bus-bar.

The audio frequency transformers used in the circuit were selected for their minute fidelity to the tone of the original signal. They amplify all the essential frequencies with utmost impartiality and the result is music as realistic as the original and speech with the minutest shade of articulation present.





REAR VIEW
PLAN OF THE SET

This fidelity is not confined to the two regular transformer T2 and T3 but applies also to the output unit OT.

Layout of Parts

The order in which the various parts should be laid out on the panel for best effect is indicated in the photographic view of the baseboard. The filament transformer T1 is mounted in one corner and the output unit OT in the opposite. The two regular audio frequency transformers are mounted in between, interspersed with tube sockets.

The radio frequency portion of the circuit is in a row on or just back of the panel.

All the binding posts are lined up at the extreme left of the receiver, looking from the panel. Additional information as to the proper layout can be obtained from the rear view photograph of the receiver.

Work of Several Months

Mr. Ehlert spent several months perfecting the AC Everyman Four and did not release the circuit until he had perfected it.

He found that the AC tubes stood up excellently under severe life test. The one point of precaution that he found absolutely necessary in regard to the tubes was exact voltage conformity with requirements for the cathode detector tube. Short life of this tube, experienced in other sets, was due, he believed, to overheating, so the rheostat was provided, so this point of trouble is satisfactorily settled.

The line voltage may be a little higher than expected. If no harm will be done to the detector tube, for the rheostat is adjusted until that tube is heated at exactly the right temperature.

Tube Lights Dully

Remember that the tube is not supposed to light up so you can plainly see it, but it burns a dull, cherry red.

While it is true a little more volume may be obtained by overheating the tube, the life is greatly shortened, so be very carefuly to pay proper attention to the detector filament heating, keeping it at or, if need be, a little below the specified voltage.

The layout of parts is particularly important in the construction of an AC operated receiver, so it behooves all builders to adhere strictly to the plan as set forth on these pages.

The layout was copied exactly from Mr. Ehlert's expert design, and it fits in nicely not only with maximum performance of the receiver, but with full eye appeal as well. Indeed, the set was constructed with great pains, so that its functioning would be excellent, without sacrificing anything pertaining to beautiful appearance.

Attractive All Around

Everything about the set is attractive—performance, appearance and price—and there is every reason for thousands of home constructors of radio receivers, and the hosts of professional set builders as well, to take to this receiver with a vengeance.

Voltage Versatility, Complete Lamp in Victoreen

By Capt. Peter

Contributing

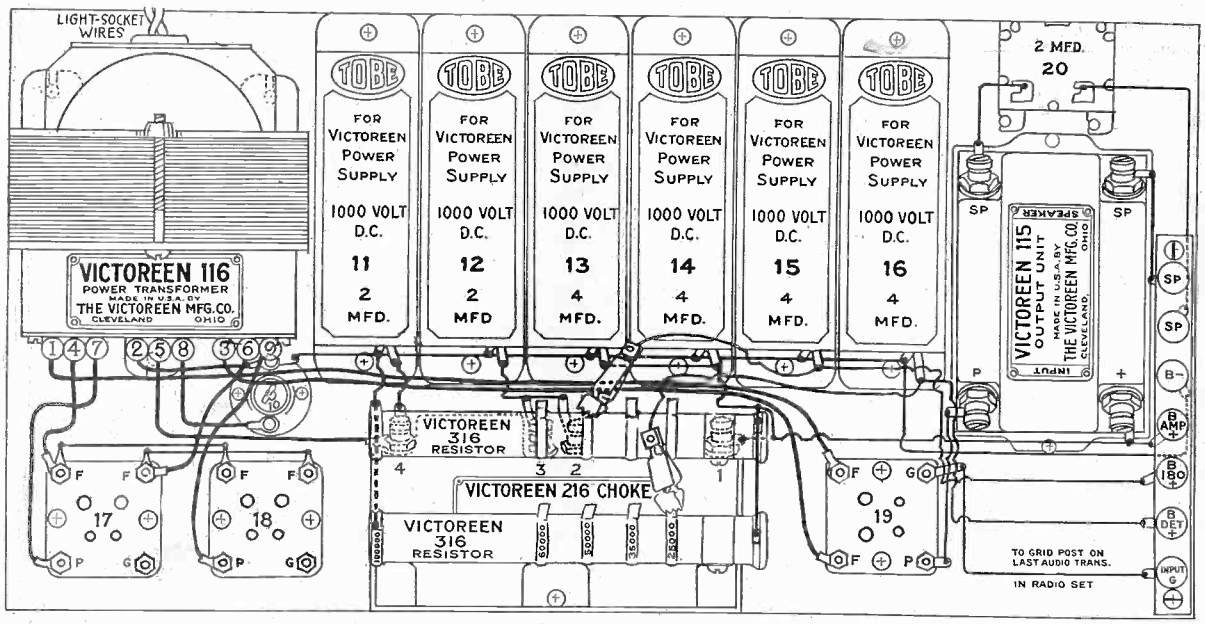


FIG. 1

THE PLAN OF THE VICTOREEN POWER SUPPLY UNIT AND POWER AMPLIFIER WITH ALL WIRING DISTINCTLY SHOWN. THIS SERVES BOTH FOR LAYOUT AND WIRING.

THE advantages of having an adequate and unfailing source of power for the radio set can be realized fully only by those who have used a really first-rate outfit. An inferior outfit may give fair results on a small set of low volume output, but it will fail when many tubes are used in the receiver.

A fair or good power source will do somewhat better both with respect to current delivery and voltage maintenance, but will not properly serve multi-tube receivers in which always at least one power tube is used for obtaining realistic reproduction.

A power source of greater capacity is necessary to handle the up-to-date quality receiver.

Yes, it is necessary to have a super-power outfit. The power supply unit which a year ago was considered a luxury is now regarded as indispensable by the radio devotee who wants his receiver to create the "illusion of reality" in his home. The question of free choice no longer enters into the selection of a power supply unit. Every one who compromises resolves that the makeshift is only temporary. His goal is one of the power units that can maintain a high output voltage regardless of how many and what type tubes are used in the receiver.

His Free Choice

That the free choice of those radio enthusiasts, who know good quality when they hear it and who can detect quickly any departures from the perfect "illusion of reality," should so often be the Victoreeen Power Supply is not surprising to those who have experienced the "illusion of reality" as that unit defines it, for the supply puts realism of a startling nature into the reproduced music and it puts life into reproduced speech.

The assembly of the Victoreen Power Supply is very simple, as is clearly seen from the pictorial view in Fig. 2. All the parts are mounted on a 9x18 inch ply wood baseboard. The layout suggested in Fig. 2 should be followed with as little deviation as possible, for it represents the most compact assembly consistent with thorough ventilation.

All the parts which otherwise might be damaged by high temperatures are separated from the heat-producing elements by air gaps so that the air can circulate freely and keep the power unit cool. Thus the condensers are not subjected to high temperatures from the tubes, from the resistor strips and from the transformer.

LIST OF PARTS

One Victoreen 116 power transformer.
One Victoreen 216 choke.
Two Victoreen 316 resistance units.
One Victoreen 115 output unit.
Two Tobe 2 mfd. 1,000 volt DC condensers.
Four Tobe 4 mfd. 1,000 volt DC condensers.
One Tobe No. 302 2 mfd. condenser.
One porcelain miniature socket.
One 6 volt flashlight bulb.
Three Frost UX type sockets.
Two CeCo R-81 rectifier tubes.
One CeCo —10 type power tube.
One 9x18 inch plywood baseboard.
One binding post strip.
Seven binding posts.

Wiring Directions

Some may hesitate to start building the power supply unit from the layout given in Fig. 2 alone, or even with the assistance of the wiring diagram given in Fig. 1. They may obtain a full size blueprint, which can not only be used as a mounting template but also as a wiring diagram. I will gladly have a blueprint sent to you with my compliments. Address: Capt. Peter V. O'Rourke, care of RADIO WORLD, 145 West 45th Street, New York City.

The 116 Victoreen power transformer is designed for supplying the filament current of one or two —10 power tubes and two —81 type rectifier tubes. It is also designed to deliver an effective AC voltage of 510 volts across the power output terminals. The design is based on a primary voltage of 110 volts and a frequency of 60 cycles. The windings for the —10 power tubes and the —81 rectifier tubes are not interchangeable, so that the wiring directions should be followed carefuly in this respect. The terminals are clearly numbered so that there is little

Filtration and Tell-Tale Power Supply

V. O'Rourke
Editor

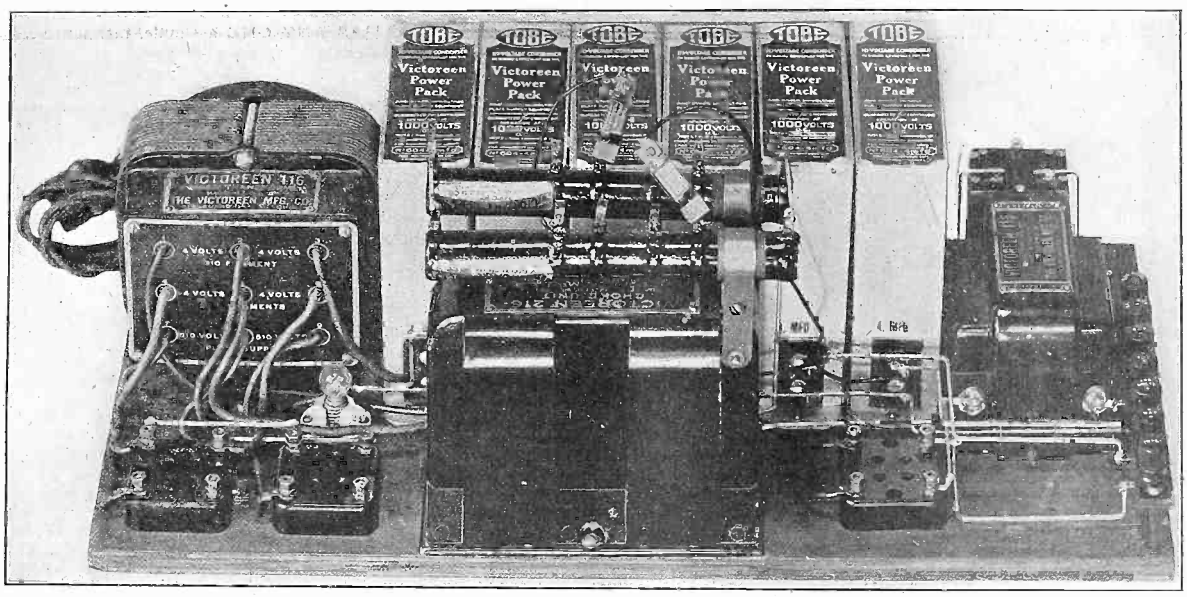


FIG. 2

HOW THE COMPLETED VICTOREEN POWER SUPPLY AND POWER AMPLIFIER LOOKS. NOTE THE SAFETY LIGHT BETWEEN THE POWER TRANSFORMER AND THE SOCKET. AN EXTRA CONDENSER, NEW RESISTANCE STRIP AND FLASHLIGHT BULB REPRESENT THE CHANGES FROM THE EARLIER MODEL.

chance of going astray. In this power supply is a safety lamp placed in the negative lead to the power transformer, that is, between B minus on the transformer and B minus on the receiving set. All the current delivered by the two rectifier tubes passes through this lamp. Under normal operation this current is not enough to light the filament. But should the first 2 mfd. condenser break down for any reason, the lamp will light up brilliantly and in a few seconds burn out, thus opening the circuit and preventing further damage.

If the second condenser should break down for any reason the safety lamp will light up but it will not burn out. Hence this indicates the location of the defect. Should the third condenser, or either one of the 4 mfd. units of which it is composed, blow out, the filament of the safety lamp will glow visibly. If either of the other two 4 mfd. units blows, the lamp will not light at all.

Checking the Location of Defects

In case of trouble the defect may lie in the rectifier tubes or the power transformer. This should show up if the first 2 mfd. condenser is short-circuited. If the safety lamp does not light up the defect is either in the transformer or in the tubes. Thus this little lamp is not only a fuse to protect the set against dangerous shorts, but also an indicator of where any possible trouble might lie.

The condensers employed in the power supply unit, with the exception of the loudspeaker series condenser, are of 1000 volt DC rating. This high test is necessary because the output voltage may momentarily rise to values as high as 750 volts or more and a 25% safety margin is required as additional security.

Note that the last condenser across the entire line is 8 mfd. and that each of the following two condensers is 4 mfd. These high final condensers are very effective in eliminating the last trace of hum from the output of the circuit and also in preventing the distortion. Smaller condensers should not be used.

The Victoreen 316 resistor units contain a number of taps for intermediate voltages and afford a range of choice greater than in a previously published model. The taps occur at 25, 35, 50 and 60 thousand ohms. By tapping in at the suitable point almost any desired voltage may be obtained. The proper point is determined best by a high resistance voltmeter. The measurement should be made while the receiver is in operation so that the reading will be the normal working voltage.

The Intermediate Voltages

The values of intermediate voltage on the various taps depends on the number of tubes used in the receiver, or on the plate current flowing. For this reason a high resistance voltmeter (Double R, No. 347) is highly desirable for checking up on the actual values of voltage.

The Victoreen 115 output unit is a choke coil and a series condenser. The condenser and speaker in series are connected across the coil. Thus the only steady stress across the condenser is the DC voltage drop in the resistance of the choke coil. This is not high. Hence the 2 mfd. condenser used in series with the loudspeaker need not be of higher test than 200 volts. Even that gives a high margin of safety.

The output voltage when used with the —10 tube is about 475 volts. This calls for a grid voltage of about 45 volts, which should be provided by a 45-volt dry cell battery. In some cases better results may be obtained with slightly higher or lower grid basis, which can be determined quickly by changing the bias and listening to the output.

Two in Parallel

Note that two of the 316 resistor units are connected in parallel across the output of the filter. Since each of these resistors has a total of 100,000 ohms, the effective resistance across the filter is only 50,000 ohms. When the two strips are connected the output voltage will be less than when only one is connected across. This then furnishes a means of varying the output voltage. If it is desired to raise the voltage a little it is only necessary to cut the wire connecting the two negative ends of the two strips. This wire is indicated by a dotted line in the wiring diagram.

Brilliant Answers to

Radio University

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

When writing for information give your Radio University subscription number. Be sure to put number on outside of envelope and at head of letter, also!

COULD I GET good service from a four tube receiver that does not have regeneration? I would like something simple, so my wife could tune it as well as I would. Tone quality should be fine, also.

A. J. M. BRADDOCK,
Miami Beach, Fla.

Yes. The set should not be relied on to bring in much distance if it is constructed by the simple formula you propose. However, a deviation from your plan still would give you almost exactly what you ask for, and would improve sensitivity considerably. See Fig. 603. Use a rheostat in the radio frequency tube filament leg to control self-regeneration almost certain to be present in this tube if the tube is not neutralized. Thus you could stand fairly high plate voltage, say 90 to 100, on the first tube. Also, by using coils that have primaries varying automatically with the motion of the tuning condensers you would improve selectivity. The diagram is adapted particularly to Hammarlund Autocouple or to Karas Equamatic coils and condensers, while the rest of the parts leave a wide range of choice. For an —01A tube the rheostat R1 should be 20 or 30 ohms, while R3, R4 and R5 are 1A Amperites. L5 is an RF choke coil, 60 to 85 millihenrys, and OC an output choke of the audio frequency variety. The bypass condensers may be 1 mfd., excepting C4 and C5, which must be .0005 mfd. each. R2 is a variable high resistance of about 100,000 ohms maximum, R6 is 100,000 ohms (resistor of the leak type), while C11 is 2 or 4 mfd.

* * *

I HAVE A SET that worked fine when I first used it, five years ago. Almost every night it's been in service. Now it doesn't work so well, in fact reception is very faint. Please tell me what to do.

AARON B. MACHEN,
Dubuque, Ia.

Get a new set. It's about time.

* * *

I HAVE A FIVE TUBE SET that works from an A battery and trickle charger, for filaments, and a B eliminator for the plate current. Please tell me what to do to stop an occasional sputtering sound. Sometimes the set works for an hour or so, or maybe a whole night. Then it sputters a little for some indefinite period. Signals are not as loud as they used to be.

ALICE MOORE RANKIN,
Vancouver, British Columbia.

Your rectifier tube is defective, probably due to your having consumed the rated hour-life of the tube. Get a new tube.

* * *

MY SET MOTORBOATS pretty badly. I use a 1,500 ohm resistor in the plate grid circuit to get grid bias for the RF and first audio tubes. How can I stop the nuisance?

WILBUR BARTON,
Jackson, Miss.

Decrease the resistance value of the biasing unit until motorboating stops. This it should do when the biasing resistance is more nearly equal to the common resistance of the B supply.

* * *

I AM CONSIDERING using a wire running around the moulding of my living room, in place of my outdoor antenna, as I understand selectivity will be improved. Is this a wise change?

ROGER FRANK,
Chicago, Ill.

If you have to depend on some particular type of aerial to obtain any degree of selectivity from your set you should fix up your set so that it will be much more selective than it is, and retain your outdoor antenna. You may regenerate the detector tube by connecting a 12 or 15 micro-microfarad condenser between plate and grid return (P and F plus of detector socket.) Mount the condenser on the front panel.

* * *

HAS ANY ONE a simple, inexpensive, satisfactory static eliminator?

CLARENCE FIELD,
Washington Courthouse, O.

Not to our knowledge or to the knowledge of any one we know. There is very little static any more, even in summer.

* * *

WHAT IS a phantom station? I saw that referred to in one of your back numbers. I should like to see this explained more fully in your paper.

ROBERT BURT,
Detroit, Mich.

A phantom station is the result of the intermodulation of the carriers of two broadcast stations to form a new carrier frequency equal to the sum of the carriers of the other two. The phantom frequency carries the programs of both the intermodulating frequencies. This will be explained more fully in a future issue.

* * *

OUR SET works fine nearly always. About once a month it stops for an hour or so. Then without us doing anything it starts anew? Why?

MURIEL HEMSTREET,
New Rochelle, N. Y.

There is a loose connection. If, when the set "plays dead," you will call in a service man, he can use his meter test set to see where the open or short circuit is, and fix it for you.

* * *

I HAVE AN AC TYPE of B supply with a stage of audio built in. There are two posts on it marked "input" and two marked "speaker," besides the B plus and B minus posts. There is nothing marked

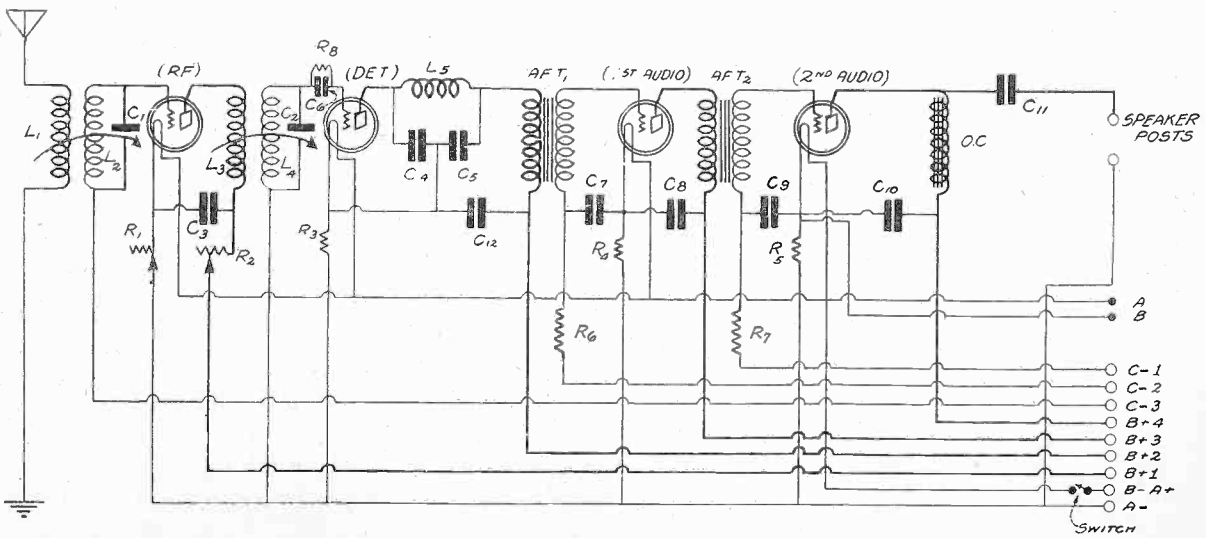


FIG 603

A FOUR TUBE SET SIMPLE TO TUNE AND WHICH HAS GOOD SENSITIVITY, DUE LARGELY TO SELF-REGENERATION CONTROL OF THE FIRST TUBE

Puzzling Questions

"C minus." Now, I had a five tube set that worked into this fairly well, although I did not get as much distance as I desired. I went to the home of a friend, who knows radio, and he had a four tube set working into a similar arrangement. This set I bought from him, but as he was about to leave town on a business trip, from which he would not return for three months, he did not have a chance to make the installation. I am sorely disappointed because I cannot get any signals whatsoever, just a faint squeal. I assure you the B voltage is on the speaker, for I hear the "thump" when the set is turned on. Why can't I get any signals—just station squeals? Can it be my friend forgot to give me the complete set, as there is only one lead coming from the set for "input" to the B supply, while there are two "input" posts? The set has a battery cable.

BERTRAM E. CLEANEST,
Brooklyn, N. Y.

Connect the single lead from the set, intended for input, to the P post of the input. Connect the B plus detector cable of the set to the B post of the "input." Then run a wire from this B post of the "input" to one of the low B voltage posts of the B supply. (Probably marked B plus Det.) Your trouble is due to utter absence of plate voltage on the detector, as B of "input" connects nowhere. As for C bias, this is no doubt provided in the B supply for the last tube and the bias for the rest of the tubes arises from connections properly made to filament resistors.

WILL YOU kindly show the circuit diagram of a complete power amplifier and power supply suitable for use with either phonograph pick-up or a radio receiver. The amplifier should be operated entirely with alternating current—Gordon Winslow, St. Joseph, Mo.

See Fig. 604, for the circuit diagram.

* * *

I BUILT the set described by Captain Peter V. O'Rourke in the Jan. 14 issue of RADIO WORLD. Can I use the shielded grid tube as detector in this circuit?

(2)—What changes will be necessary in the wiring?

(3)—What voltages should be used on the plate and the extra grid?

(4)—Will the selectivity and sensitivity be improved?

HEROLD MASEK,
Chicago, Ill.

(1)—Yes.

(2)—Make E2 a 622 Amperite. Connect the top terminal through a universal range Clarostat to plus 45 volts. Adjust Clarostat for best results.

(3)—Plate voltage 135, and top grid voltage 45 or less.

(4)—Yes, very much.

* * *

VERY OFTEN when I listen to station WOR I hear a sustained tone of low pitch, or a growl of variable pitch. This is very annoying at times and seriously interferes with the reception of the best program radiated from that station. What is the cause of this interference and what can I do to clear it up?

SAMUEL ISENBERG,
Brooklyn, New York.

The cause of the noise you hear is a low power station operating on the second harmonic of the frequency of WOR, that is, on 1420 kc. You might write to the Federal Radio Commission asking that no station be assigned to operate on the second harmonic of frequency of another in the same district.

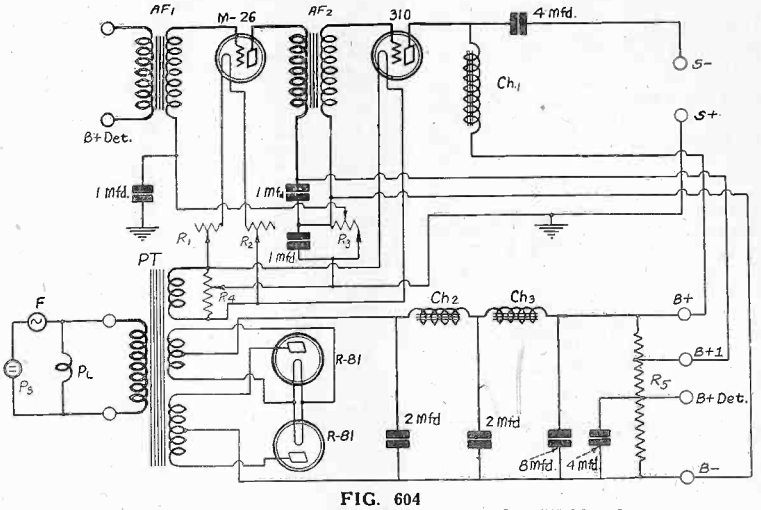


FIG. 604
THE CIRCUIT REQUESTED BY GORDON WINSLOW.

* * *

CAN THE shield grid tube be used as space charge detector in the Pre-Power Unit published by H. B. Herman in the Jan. 28 issue of RADIO WORLD?

(2)—Can the shielded grid tube be used as detector in the Four-tube Diamond of the Air? I have one and I should like to use one of the new tubes.

(3)—Will you explain how the shield grid tube should be used as a detector?

FRANCIS B. ELLERY,
Boston, Mass.

(1)—Yes.

(2)—Yes.

(3)—Read article in Feb. 18 issue of RADIO WORLD for a full discussion.

* * *

I HAVE a 5-tube Diamond of the Air which gave excellent results while I used B batteries on it, but since I have used an electrolytic B battery eliminator it has given a lot of trouble. The loudspeaker stutters. What can be done to remedy that condition, or is the circuit not supposed to be used with such an eliminator?

MILES SPENCER,
Butte, Montana.

(1)—Your circuit motorboats due to the high resistance of the eliminator. Connect an audio frequency choke coil across the last grid leak in the circuit. The choke may be one specially made for this purpose or it may be the secondary of an old audio transformer.

* * *

I HAVE an amplifier and B battery eliminator which I rewired according to the diagram in Fig. 3, page 5, RADIO WORLD for Jan. 21. When I measure the voltage between plus and the minus ends of the resistor strip, I get 230 volts. My meter is a 1,000 ohms per volt instrument and I think the value I get is correct. Should not this be 180 volts?

(2)—Would it not be better to connect the loudspeaker below the series condenser C4 than to use the connection as shown?

(3)—Is there any special advantage of connecting the speaker as shown in the diagram?

ELMER ROBERTSON,
Marion, Ind.

(1)—The voltage reading should be 220 volts. But 230 volts is all right.

(2)—As far as the operation is concerned it makes little difference which way the connection is made.

(3)—The object of conecting the loudspeaker above the condenser is to make it possible to use a section of a condenser block for the loudspeaker series condenser and another section of the same block for by-pass purposes.

A THOUGHT FOR THE WEEK

EVEN the man in the street has, through radio, come to know the marvelous elasticity of the eight basic notes of the staff and all their flashing cascades of variants. This minute the chanted glory of "The Pilgrim's Chorus," a few minutes later the liquid sweetness of "The Spring Song"; then the wild, eerie bars denoting the passing of the mother in the "Peer Gynt Suite"; the fretful, peppery fuss of a jass number; the grace and charm of a Chaminade ballet; the simple majesty of a Haydn symphony, the rollicking lilt of an Irish song—all these things delight, annoy, please or madden us, as it may be, but they are ours without even the asking.

SIXTH YEAR

RADIO WORLD

The First and Only National Radio Weekly

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

TELEPHONES: BRYANT 9558, 9559
PUBLISHED EVERY WEDNESDAY
(Dated Saturday of same week)
FROM PUBLICATION OFFICE
HENNESSY RADIO PUBLICATIONS CORPORATION
145 WEST 45TH STREET, NEW YORK, N. Y.
(Just east of Broadway)
ROLAND BURKE HENNESSY, President
M. B. HENNESSY, Vice-President
HERMAN BERNARD, Secretary
Chicago: 55 West Jackson Blvd.
Kansas City, Mo.: E. A. Samuelson, 800 Coca Cola Bldg.
Los Angeles: Lloyd Chappel, 611 S. Coronado St.
European Representatives: The International News Co.
Breams Bldgs., Chancery Lane, London, Eng.
Paris, France: Brentano's, 8 Avenue de l'Opera

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James H. Carroll, John Murray Barron and
Capt. Peter V. O'Rourke

SUBSCRIPTION RATES

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

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

CLASSIFIED ADVERTISEMENTS

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

Entered as second-class matter March 22, 1922, at the Post Office at New York, N. Y., under the Act of March 3, 1879.

Short Wave Assignments

The Radio Corporation of America has had already assigned to it some 57 short waves out of a total of 119. The Ford Motor Car Co. and the Firestone Rubber Co. have short-wave licenses for communication between their various plants. The Graham Bros. Truck Co., Elgin Watch Co., various pipe-line companies and airplane transport firms have short wave-lengths for point-to-point use. The question arises, Shall these short waves be used by individual companies for purely selfish commercial purposes?

What interest has the public in these short waves? That is a question fraught with great difficulty. The Commission has the means of solving it.

It is hoped, therefore, that Congress will not for the present pass any rigid laws concerning the short wave because so comparatively little is known about it. But in any event, in view of these pending and important problems, the life of the Commission must be extended.

Ejection of Stations Classed as Ruthless

By Emanuel Celler

Member of Congress from New York

Complaint has been registered that the Radio Commission has not made an equitable distribution of wavelengths contemplated by the radio act of 1927.

Some Congressmen have charged that New York, New Jersey, Pennsylvania, Illinois, California, Florida, Nebraska, Washington, Virginia, Iowa, and New Mexico, have more broadcasting stations than they are entitled to.

I believe that these arguments are untenable.

Section 9 of the radio act provides for an equitable distribution of radio services and not of stations. About one-quarter of the total number of families in this country comprise the radio audiences and that audience uses seven and one-half million radio sets. Measured by service and considering its limitations and difficulties the Radio Commission has allotted stations equitably.

Range of WEAF and WGY

WEAF and WGY, which are New York's two largest stations, the first involving 100,000 watts and the second involving 50,000 watts, serve the entire country. They can be heard in every State. They are thus rendering a service to every State. WGY has been heard on every continent. You might say that every country on the face of the globe is being served by that station.

Would the radio public be any better off if WEAF or WGY or the two large New Jersey stations, WJZ and WOR, were stationed at Kalamazoo, Oshkosh, or Painted Post? It may be that Arizona, Montana, Maine, Arkansas, Alabama, or Georgia have an allocation of stations or a maximum license power or a share of channels that is not commensurate with their radio populations. But that is not the test.

The large eastern stations and far western stations supply sufficient and attractive services to those States which are deficient in number of stations and station power.

Points a Dilemma

If some of the Congressmen, raising the shibboleth of "State rights" insist upon a numerical division of stations among the States in accordance with populations, then the country is faced with this delimma:

First. Either the 700 stations existing must be reallocated with consquent taking away from New York, New Jersey, Pennsylvania, Illinois, and so forth, and the giving to Texas, Missouri, Indiana, South Carolina, Utah and so forth.

Second. Or the number of stations must be augmented to a number far above 700.

To increase the stations would be to blur further the radio spectrum. The commission was set up to eliminate interference and has fairly succeeded in doing so. To increase stations would undo its work and would make confusion worse confounded.

To follow out the first alternative and to take away stations from some States and add them to others would be most unjust and inequitable. The great advances made in radio have been due to those entrepreneurs who were willing to take a chance.

Lauds Pathfinders

They were willing to invest their money with no assurance of return. They were the pathfinders and inventors and pioneers. They established themselves principally in New York, New Jersey, Pennsylvania and Illinois. They invested millions of dollars. They have rights of priority. They have vested rights. Even the Government cannot ruthlessly deprive them of that which they have acquired by patient endeavors. Priority in time gives them superiority in right. For that reason the commission must maintain the status quo as to the allocation of these stations.

Chairman White, of the Committee on the Merchant Marine and Fisheries, who has given great study to the question, has criticized the commission for not reducing the number of stations. The commission properly replies that to do so would have tangled up the radio situation with lawsuits and injunctions. It is my belief that the Commission was justified in refusing to take a station off the air, because it could not do so legally.

Praises Commission

Even the power of Congress is not strong enough to take away a man's property in a radio station which was established before Congress legislated. Congress can limit for the future. It can not take away what the past has given. Furthermore, the Commission wisely sought to cut down the use of various channels by persuading in some instances as many as four stations to share time on the same wave length. In New York, for example, many stations divide time on the same wave. That is equivalent to a reduction. Then, too, we can expect shortly inventions that will permit synchronized broadcasting, where the same channel and time is used by several stations by the use of what is scientifically known as matched crystals.

WGHP at Detroit and WAIU in Cleveland have successfully experimented along these lines. I am opposed as much as anyone to the monopolistic tendencies of the so-called radio combinations, but would not wholesale reduction of stations play directly into the hands of this combine?

Doesn't Want "Horses Swapped"

It is much easier to gobble up and thus effect control of most of a few hundred stations than of 700 stations. In other words, reduce stations and the radio combine has its work simplified.

Furthermore, the life of the commission should be extended another year. One does not swap horses while crossing a stream. We have not as yet plumbed the depths of radio inventions.

There are the questions of television, wireless telephony, and short waves, all of which bring in turn new and intricate problems. The Commission has started on the solving thereof. It must be given time to bring about solutions.

Canada is insisting upon having assigned to it more than its present 12 channels. The Commission is now working on that difficulty. The State Department is insisting that Canada have its way. American broadcasters are insisting that the Commission intervene in their behalf to prevent more channels going to Canada. That problem alone would justify continued existence of the commission.

Recently public hearings were held by the Commission on the subject of short waves. The public is not aware of its rights in this regard. Short waves have a high trajectory.

Short waves by suddenly being lifted high into the air suffer little from interference from tall buildings or the static usually caused by metal objects on the earth's surface or minerals below the earth's surface.

HOUSE RIDER LEVELS ALL ZONE POWER

Washington.

The House Committee on Merchant Marine and Fisheries voted a favorable report on a bill (Senate 2317) to continue for one year the powers and authority of the Federal Radio Commission under the Radio Act of 1927, but amended the measure to provide for an "equitable" distribution of wavelengths and station power."

At the instance of Representative Davis (Dem.), of Tullahoma, Tenn., the Committee wrote into the bill an amendment to Section 9 of the Radio Act by striking out the second paragraph and inserting the following in lieu thereof:

"Licensing authority shall make an equal allocation to each of the five zones established in Section 2 of this Act of broadcasting licenses, of wavelengths and of station power: and within each zone shall make a fair and equitable allocation among the different States thereof in proportion to population and area."

Section 3 of the Senate bill authorizing the granting or renewing of broadcasting licenses for six months and other classes of stations for one year was amended by the House to read for three months and six months, respectively.

The House Committee also eliminated Section 4 of Senate bill, which stipulated that the term of office of each member of the Commission shall expire on February 23, 1929, and thereafter the Commissioners shall be appointed for terms of two, three, four, five and six years, respectively.

Stoner & Heath Sell Licensed AC Converter

Stoner & Heath, Inc., Manufacturers' representatives, 122 Greenwich Street, New York City, have added to their lines the new Enterprise AC converter Unit which makes any battery set into a modern AC receiver. This unit is complete, with battery harness and adapters as a part of the unit itself. An exclusive feature is a built-in radio frequency filter, eliminating oscillation. It provides, sockets for the UX-226, CX326, UY227, CY327, UX171, or CX-371 alternating current tubes. It also provides C voltages by automatic control. The Converter Unit is compact. It is licensed by the R. C. A. and associated companies. Full information on this unit may be had from the above concern upon application. —J. H. C.

Pat Kiley Gives Up Frost-Remler Line

Pat Kiley, well-known New York representative of radio manufacturers announced he has severed connections with Herbert H. Frost, Inc., and no longer represents the Frost and Remler lines of radio apparatus in the New York territory.

Very shortly, he will be in a position to advise what radio factories he will undertake to represent in lieu of those he relinquished.

He may be addressed as follows: Mr. Pat Kiley, care RADIO WORLD, 145 West 45th Street, New York City.

ABBOTT IS SALES CHIEF

H. Curtiss Abbott, of Chicago, has been appointed general sales manager of the Crosley Radio Corporation.

Caldwell Exasperated; Attacks "Wreck" Bill

Washington.

Enactment of the "redistribution clause" added as an amendment to the radio bill reported favorably by the House Committee on Marine and Fisheries, would "wreck" the present broadcasting structure, the Commissioner from the first radio zone, O. H. Caldwell, New York, asserted in a letter to the manager of Station WCAP, Asbury Park, N. J., Thomas F. Burley.

The redistribution feature provides that an equal allocation of wavelengths and station power shall be made to the five radio zones in proportion to population and area.

Commissioner Caldwell points out the variance in the ratio of radio listeners, particularly farm listeners, in different parts of the country and shows that the redistribution plan would deprive many existing stations of favorable operating conditions permitting them to reach the largest possible audience.

Calculates Effect

Following is the full text of his letter to Mr. Burley:

"In answer to your inquiry about the possible effects of the 'equal-distribution of radio' amendment favorably reported to the House of Representatives by its Committee on radio matters, I have just made some rough calculations to find out what the radio supervising authority will be required to impose on your State, New Jersey, if this clause becomes law.

"The clause requires first that 'equal' powers, wavelengths and licenses be granted to the present five radio zones.

"Since the Southern Zone (Third), has only 45,000 watts total power, this figure would also become the limit of power for the important First one, which includes New Jersey, the Eastern States and New England.

3,200 Watts for New Jersey

"Of this 45,000 watts total First Zone power, New Jersey would be entitled to its 'equitable' proportion under the clause—presumably based upon its population and area. New Jersey has one-eighth of the population and one-twentieth of the area of the First Zone. Striking an average between these fractions, we obtain one-fourteenth. One-fourteenth of 45,000 watts is 3,200 watts.

"Thus 3,200 watts would, under the proposed redistribution of the radio-station powers, be the total power available for the entire State of New Jersey (which now has nearly 50,000 watts.)

"With 3,200 watts available for all 17 stations in New Jersey, several alternatives are offered.

Alternatives Cited

"A. All New Jersey stations might be closed down, except the two which undoubtedly have the largest audiences, WJZ and WOR. These stations, with powers and investments respectively, of (WJZ 30,000 watts, $500,000) and (WOR 5,000 watts, $175,000), could then be continued to serve the public, but with their powers cut to say, 2,600 watts and 600 watts, respectively. So we would have: WJZ, 2,600 watts; WOR, 600 watts; all other stations closed down.

"B. Or, if it is assumed that the clause indicates that New Jersey must have its equitable proportion of the total number of stations per zone (which is 93), one-fourteenth of 93 gives, say seven stations for your State. Power of 3,200 watts, among the present seven largest stations in New Jersey could then be divided proportionately as follows:

"WJZ, 1,920; WOR, 320; WPG, 320; WLWL, 320; WODA, 65; WGL, 65; WHAP, 65.

"All other stations closed down.

Case in New York

"Similarly, in New York State WEAF and WGY would have to be cut to 5,000 watts each, WNYC to 50 watts, WHN to 50 watts, and so on.

"Corresponding calculations can be performed for other States, showing the havoc to radio listeners East, South and North, which such a law would bring—for these New York and New Jersey stations furnish programs to the whole country, and particularly to the South.

"Having thus wrecked some of the greatest and pioneer stations of New Jersey and the East, let us see, for a minute, in whose interest this destruction would be done.

Sets on Farms

"Taking the States of the Third Zone, and considering the farm population in whose behalf these changes are dedicated, we find the following proportion of radio listeners (families with receiving sets) to the total farm population in these Southern States:

"Percentage having radios—Mississippi, 1; Louisiana, 2; Alabama, 3; North Carolina, 3; Tennessee, 4; South Carolina, 5.

"Contrasted with these low saturations, it is interesting to note that 52 per cent. of the farmers in the State of New Jersey have radios, and in New York State, 32 per cent. have radios.

Western Situation

"Many of the Western States, which it is proposed to deprive of their stations by the redistribution, have similar high percentage of families with radio sets:

"Nebraska, 53; Montana, 40; Kansas, 33; Colorado, 32.

"If the American people want to see our present wonderful radio broadcasting structure wrecked, enactment of this abominable "re-distribution" clause is the surest way for Congress to carry out that purpose.

"After setting up a Radio Commission in 1927, Congress promptly failed to appropriate any funds on which such Commission could operate, employ aids or experts or purchase necessary apparatus. To date, three Radio Commissioners have received no salaries whatever.

Awkward Situation

"And now, after a year of the Commission, and three months of the present session of Congress, the Radio Commission is still without a quorum confirmed by the Senate, and so finds itself hampered on every hand —authority, funds, personnel and equipment —in its efforts to proceed with its carefully considered plans to bring good radio to every home in America."

Commissioner Caldwell signed himself "Yours in exasperation."

An Electromagnetic Unit

By Clyde J. Fitch

IN the modern radio set, whether of the latest AC or battery operated type, quality of reproduction has received utmost consideration. The aim has been to produce a combination of set and loudspeaker that would reproduce the full orchestral range of tones from the highest notes of the flute to the lowest of the bass viol, with plenty of volume, under control. Not the high-pitched, irritable metallic blasting kind of volume so prevalent in many radio sets, but the mellow and natural tones that seem to indicate enormous volume and carrying power in themselves, and produce a soothing effect even when played with the greatest degree of loudness.

Thus the full volume of an orchestra may be had with ease and naturalness and without any blasting, choking, or distortion due to forcing of the tubes; or the volume may be toned down to reproduce the merest whisper and still retain its life-like qualities, which means in other words that the bass does not fade away when the volume is reduced.

Factors in Result

This achievement in radio reproduction has been accomplished by the use of power tubes, power amplifiers, power supply units, and the power loudspeaker. One may ask, Why use such powerful sets, capable of delivering enormous volume, in homes where only moderate or normal volume is desired?

One can answer this question by comparing the powerized set with a high priced car, which can be driven with ease and grace at normal speed not approached by a smaller car.

Sets nowadays are made so powerful that unless precautions are taken in operating there is danger in damaging the loudspeaker, the average type of speaker being the weakest link in the chain.

It has always been my opinion that a loudspeaker unit could be made much bigger and stronger than usual, in fact such a unit seems almost a necessity to carry faithfully the output of the modern set.

The construction of such a unit presented some interesting problems, but the experiments turned out satisfactorily and it was found that the manufacture presented no serious problems, it being simpler to make a large unit than a small one.

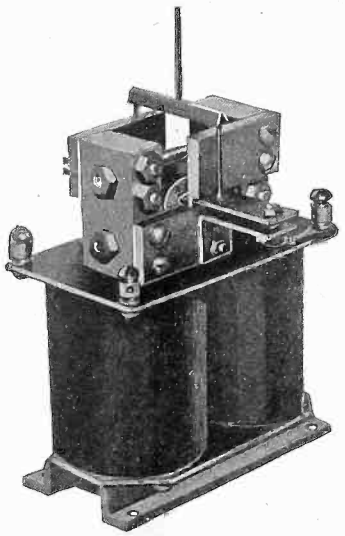


FIG. 1

AN ELECTROMAGNETIC UNIT, WHICH EMPLOYS AN ELECTROMAGNET INSTEAD OF A PERMANENT MAGNET. THE COILS ARE ENERGIZED FROM A 6-VOLT SOURCE. THE UNIT HANDLES TREMENDOUS POWER.

Uses Electromagnet

In building the power unit it was first decided to combine the good points of existing units and enlarge upon them. Perhaps the most radical departure from the conventional type is in the use of an electromagnet for the field instead of a permanent magnet. This was selected for the same reason that a dynamo gives greater output than a magneto, and in the modern set the small amount of direct current required to energize the field presents no serious difficulties.

The next step was to use the balanced type of armature, this being the most sensitive and giving the best quality when properly designed.

Third, a direct drive mechanical connection between the armature and cone apex was employed, this being the most efficient from a quality standpoint. Any leverage system for stepping down or up the mechanical vibrations alters the tone and pitch of the unit.

Excellent Reproduction

The finished unit, built with these three points in mind, is shown in Fig. 1. When used with a two-foot cone its performance far exceeded expectations. Bass reproduction was excellent, on both low and high volume, and the upper register came through clearly, without any muffling.

Careful tests showed that its remarkable tone was due largely to the use of the electromagnetic field. The use of the large electromagnet gave enormous field strength, making it possible to employ comparatively long air gaps between the armature and the pole tips without any reduction in sensitivity. For true bass note reproduction, long air gaps are required because the armature swings at a greater amplitude on the lower frequencies than on the higher.

The ordinary unit with short air gaps chatters on bass notes, which is overcome by tuning the vibrating mechanism to a higher pitch so that the amplitude of the bass vibrations is no greater than that of the higher frequencies, and the tone quality of the unit, of course, is impaired. The bass is weak.

Vibrator Low-Pitched

The direct drive feature of this electromagnetic unit makes possible the use of a low-pitched vibrating mechanism, which includes all the bass and does not in any way diminish the higher frequencies because of the extra strong magnetic field. Another advantage of the use of long air gaps is that chattering is virtually impossible on even the most powerful sets.

As to its physical size, the unit measures 2¾ by 3¾ by 6 inches high and weighs 4 pounds. However, it is of such shape that it will fit nicely into the average 18-inch double cone. Strips of brass, bent to fit, are used for attaching the unit to the back ring of the speaker. Thus it is comparatively easy to powerize your loudspeaker by replacing its present unit with the power unit.

Excellent reproduction is obtained with the use of a 24-inch cone or a flat wood diaphragm.

Many Omit Filtration

In operation it is not necessary to employ an output transformer or choke coil and condenser between the set and the speaker except where the B battery voltage exceeds 250. The armature coil of this unit is insulated to withstand this potential.

The electromagnetic field coils are wound for a 6-volt direct current circuit, from which they draw less than ½ ampere. These coils should be connected to the 6-volt A battery, preferable inside the set by the tube sockets, so that when the set is turned on, current passes through the speaker field winding.

If you are using an A battery eliminator, or an AC operated set and have no 6-volt A battery, a trickle charger should be used for supplying direct current to the unit. The field coils may be connected directly to the output of the trickle charger, which is in turn connected to the 110-volt AC line.

Low Notes Often Fall On Insensitive Ears

By John F. Rider

"Investigation of human aural response and the operating characteristics of loudspeakers is bringing to light many interesting facts," says W. B. Whitmore, of the Air-Chrome Studios, "facts which will in time change the attitude of the public toward loud speaker performance, bringing about a closer alliance between the two."

"Consider the variations in sensitivity of the human ear to frequency, not to small variations in frequency, such as from 1,000 to 1,100 cycles, but in the zones between 30 and 60 cycles and from 4,000 to 7,000 cycles and higher.

"I had occasion to conduct several experiments in a small way in the effort to determine the response of the human ear to frequency at various amplitudes. The results were surprising. Very few people could hear a 40 cycle signal of small amplitude, the response increasing gradually as the amplitude of the signal was increased.

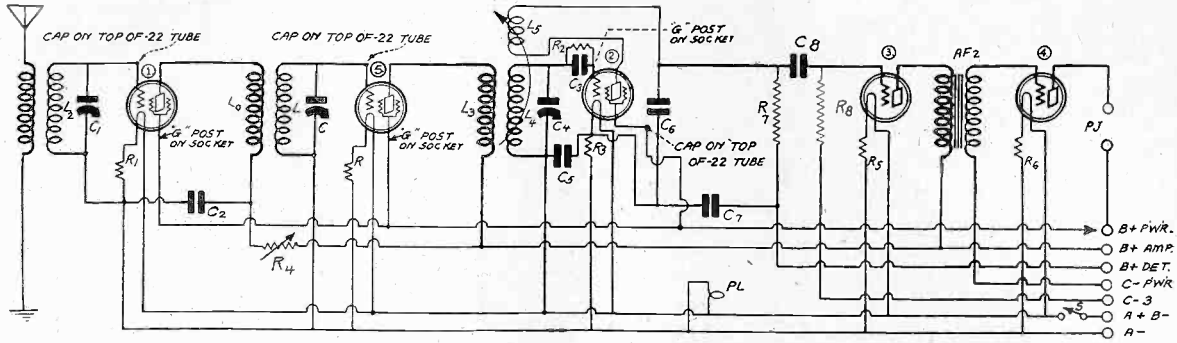
"This brings up the subject of low notes in orchestrations. Many persons complain of the lack of low notes, entirely overlooking the possibility that perhaps their ears are not sensitive to these low notes until a certain amplitude is reached, which amplitude often is not available in actual reception.

"Investigation has shown that response of the human ear at 30 cycles is approximately 90% of normal hearing. When we consider that the range of normal hearing is between 300 and 4,000 cycles with response at 500 and 2,000 cycles the loss of low notes is not very surprising."

But many hear them well.

Diamond With SG Tubes

By H. B. Herman



THE CIRCUIT DIAGRAM OF THE FIVE TUBE SCREEN GRID DIAMOND OF THE AIR.

THE use of a screen grid tube as a radio frequency amplifier ahead of a regenerative detector was shown in the Four Tube SG Diamond in the Feb. 4 issue of RADIO WORLD and the use of the tube as a space charge detector followed in the Feb. 18 issue. These two circuits created a wide interest. The reception accorded the first two circuits indicated that a large number of fans wanted an extension of the circuit to two screen grid RF amplifiers.

The circuit diagram of this five tube receiver is more or less self-explanatory, particularly when read in conjunction with the original articles. Essentially the circuit is the one which appeared March 3 with the fifth tube interposed between the first screen grid stage and the detector.

The first and the second stages in this receiver are practically identical except that a variable resistance R4 is put in the plate circuit of the first stage and not in the second. Also a by-pass condenser C2 may be added in the second stage. It would be placed in a corresponding position.

Much misunderstanding exists about the screen grid tube and the circuits built around it. On account of the very high amplification constant of the tube fans expect an enormous increase in distance-getting ability and at the same time phenomenally sharp selectivity. The tube does not in the least upset general laws of radio circuits. As the amplification goes up, the selectivity goes down. It applies to this tube just as it does to other tubes. Hence the peak amplification is not used in this circuit, and instead the selectivity is sent high.

Should this circuit be shielded or will it work without shielding? It should be shielded but it will work without shielding.

LIST OF PARTS

L2, L3L4L5—Hammarlund HR 23, consisting of one antenna coupler and one three-circuit coil, both for .0005 mfd. tuning.

LoL—One HR Hammarlund RF transformer for .0005 mfd. tuning.

C1, C, C4—Three Karas .0005 mfd. condensers, type 23.

C2, C5. C7—Three Aerovox .006 condensers, Type 1450

C3—One Aerovox .00025 mfd., Type 1475.

C6—One Aerovox .001 mfd. condenser, Type 1450.

C8—One Aerovox .01 mfd. condenser, Type 1450.

R, R1, R3—Three No. 622 amperites with three mountings.

R2—One Lynch 5 meg grid leak.

R4—One volume control Clarostat.

R5, R6—Two No. 1A amperites with two mountings.

R7—One Lynch 50,000 ohm resistor.

R8—One Lynch 2 meg. grid leak.

S—One Yaxley No. 10 battery switch.

PL—One Yaxley No. 310 pilot light bracket (with lamp extra).

PJ—Two Frost phone tip jacks.

Four Frost Bakelite sockets, No. 253.

Two Eby binding posts (Ant. Gnd.).

One 7x21 inch Bakelite front panel (Cortlandt Panel Co.).

One 10x20 inch sub-panel or baseboard.

Three Marco dials No. 210.

Three Pee-Wee clips (No. 45 Universal clips).

Set of three Karas sub-panel brackets.

Three Vac-shields for the screen grid tubes.

ACCESSORIES

Three screen grid tubes (CeCo RF22).
One CeCo type A.
One CeCo type F.
One roll flexible Acme Celatsite.
One 7-lead Acme battery cable.
One set of cable markers.
A, B, C supplies.
Cabinet.

KFI from Pittsburgh on Screen Grid Diamond

RESULTS EDITOR:

I have completed constructing the new 4-tube Shield Grid Diamond of the Air. I am more than pleased with the results. I logged 42 stations in two and one-half hours and brought KFI, Los Angeles, Calif., on speaker (2,300 miles).

What more would a fan want? My set is built very neat, according to blueprint directions.

LEO F. WOLF,
140 Fairview Avenue,
W. E., Pittsburgh, Pa. (Wabash P. O.)

Phantom Orchestra A Group of Speakers

We have become accustomed to the versatility of a loudspeaker and are not a bit surprised to hear it reproduce the music of an orchestra one time, the singing of an opera star some other time, and the speaking of an announcer at still some other time. We would be surprised if the loudspeaker did not thus behave.

We are all more or less aware that the output of a loudspeaker is not entirely faithful to the original, that is, we are aware that what we hear is reproduction and not the original. This means that the loudspeaker, as well as the rest of the radio equipment intervening between the performer and the listener, is not as versatile as it could be.

It is Unmanned

W. Dexter Smith realized this particularly in orchestra music and he set about correcting the difficulty. He devised a phantom orchestra, a photograph of which is published on the front cover. Mr. Smith himself is in the picture but he is not an integral part of the orchestra, for it is entirely unmanned.

Unmanned though this orchestra is, it plays jazz about as well as if the original performers were present in person, instead of being represented by wooden tripods and loudspeaker units.

A Composite Loudspeaker

This phantom orchestra is a composite loudspeaker, composed of as many unit speakers as there are instruments in the orchestra. Note the entangling wires, each pair leading to one of the instruments. Some of the loudspeaker units are clearly visible, particularly those on the bass viol, the tuba and the violin on the piano.

It is claimed for this phantom orchestra that the music is uncanny because of its startling realism. And why should not the music be realistic? The bull fiddle does its own croaking, the tuba its own tooting, the violin its own screeching, the trombone its own zooming, and each of the other instruments its own characteristic sound. No paper cone, no exponential horn, no cloth diaphragm does vicarious duty for any of the instruments composing the orchestra.

(Photograph on Front Cover)

By-passing Improves Quality of Reception

(*Concluded from page 3*)

as practicable. The drawing does not show any particular brevity of leads, but the leads are short nevertheless. In regards to capacity of this condenser, it would be the same as for C5.

Note the by-pass twins C8 and C9, as useful a pair of by-pass condensers as was ever soldered into a detector plate circuit. Their function is to separate the high frequency currents in the plate of the detector from the audio frequency currents, letting nothing but the audio currents into the audio amplifier. And this they do very effectively, assuming that L6 has been selected reasonably well, if each is .00025 mfd., and a little more effectively if each is .0005 mfd. Neither of them should be less than .00025 nor larger than .0005 mfd.

That is about all there is to say about these by-pass twins except that the detector regenerates a little better if the .0005 mfd. size condenser is used.

A Change of Frequency

Up to the present we have been dealing with by-pass condensers for radio frequency currents. From now on we shall deal with by-pass condensers for audio frequency currents. And we have to speak in much higher numbers.

While the RF stability of the circuit depends on the use of the radio frequency by-pass condensers, not only does the AF stability of the circuit depend on the audio frequency by-pass condensers but also does the quality of the output of the receiver. The larger the by-pass condensers C10, C12, C13, C14 and C15 are the better they will function. If each of these condensers is a 1 mfd. it will have some good effect. If each is a 2 mfd. condenser, the effect will be just twice as beneficial as it was with 1 mfd. But neither 1 nor 2 mfd. is quite adequate. The value of each should not be less than 4 mfd.

C15 is the only one that need be designed for high voltage. It should be able to stand at least 600 volts. C13 might be a 400 volt and the others can all come in the 200 volt class.

The audio frequency condensers listed above have exactly the same functions at AF as the radio frequency condensers have at RF.

C11 is not a by-pass condenser but it is worthy of mention, nevertheless, it may well be a .1 mfd. buffer condenser, but it should not be less than about .01 mfd.

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Incidental Resonance In Super-Heterodynes

(*Concluded from page 7*)

they did when n and m were always equal. In fact that case was just a special case of the more general in which n and m had different values.

There is an infinite number of combinations of the signal and oscillator frequencies which can produce the intermediate frequency of the filter, and every one is a possible "repeat." Some of these points may give intelligible signals, others a mere growl. Some may be too weak to cause a disturbance, others may be of first magnitude. Much depends on the design of the receiver.

Coupling Suggestions

As has already been stated, the intensity of the signal at any repeat point depends on the coupling between the oscillator and the detector. It would seem that the use of the same tube for both oscillator and detector is out of the question if the object is to get the smallest number of repeat points and the least amount of heterodyne growl in the receiver. There may be exceptions of special tubes and special designs.

It would also seem that non-selective coupling between two separate tubes is not admissible for the same reason. Non-selective coupling would include capacity, direct inductive and resistive coupling. In some cases coupling by means of a parallel tuned circuit might be selective enough even when that coupling is direct.

Strictly selective coupling between the two tubes would probably never be practical as it would require an additional tuned circuit. But when mutual inductive coupling between a pick-up coil and the oscillator tuned circuit is used there is little chance for the harmonics of the oscillator to be transferred over to the detector, for the oscillating current in the tuned circuit is almost free of harmonics, and thus the pick-up coil is not greatly exposed to any of them. And but little would be transmitted to the input circuit of the detector.

To minimize stray, non-selective coupling between the oscillator and the detector, ample use should be made of by-pass condensers and radio frequency choke coils. Also, the mutual inductance between the pick-up coil and the oscillator coil should be low so that only the fundamental would induce any appreciable voltage in the detector input.

This reduction in the coupling between the oscillator and the detector would greatly reduce the sensitivity of the receiver, but this is not serious for almost any amount of amplification is available in the intermediate amplifier. Any loss in sensitivity would be more than made up for in purity of signal and freedom from howls, growls and repeats.

Greatest Broadcast Misses Big Audience

By Herman Bernard

Without anywhere nearly enough advance fanfare to attract all the attention it deserved, a tabloid version of "La Traviata" recently was broadcast by WJZ and a chain, in what constituted the greatest program ever transmitted by radio, for the singers were Beniamino Gigli, Lucrezia Bori and Guiseppe de Luca.

These three gifted vocalists sang brilliantly and reached the new high water mark in radio programs during the Victor Hour. Happily, the opera abounds in melody, and the most engaging tunes found their way quite naturally into the condensed presentation. Gigli's warm, emotional tenor, La Bori's versatile soprano, and de Luca's able baritone combined to constitute a thrilling performance.

It so happens that La Bori fits into few operatic parts better than she does into that of Violetta Valery, the sacrificing unfortunate around whose life the story pivots.

Memorable Night

It is the story of "Camille," as the stage play is known, and both the play and the opera are founded on Dumas' "The Lady of the Camellias."

Bori's voice easily accomplished all the requirements, and besides she is an actress of high talent, a combination not frequently found. But the radio audience,

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MAGNAVOX M7 cone speaker, List $15, A1 condition, used two weeks. Fine tone. Price, including baffle, $9. Send M. O. on 5-day money back guarantee. I. Andersen, 118 Goodrich St., Astoria, N. Y. City.

if they knew not La Bori before this memorable night, came to know the fine dramatic power with which she is gifted, for she put her full histrionic genius into Violetta's death song.

Opera is not ordinarily the most popular medium for attracting the attention of the public in general, but with such great voices as Gigli, Bori and de Luca even those who are not particularly fond of opera would enjoy the treat.

The plot was explained by John B. Kennedy, special announcer for the occasion, mostly from the "The Victrola Book of the Opera."

"World's Greatest Tenor"

Gigli, as Alfred Germont, did nothing to deny himself the title that his concert manager gives him in advertisements—"the world's greatest tenor." He swept with sure vocal stride through every passage. The demands on the tenor voice in this opera are not severe, so such a master as Gigli had an easy and evidently enjoyable time of it.

At the particular home in which I listened to the Victor Hour that night a visitor suddenly came. He knew little about opera and voices. But when he heard some of the singing he exclaimed:

"These people are great singers. I've heard some of those tunes before. What voices!"

"Nothing in the Papers"

After the delightful hour was over, the visitor remarked he hadn't seen enything in the newspapers about it. We looked up the programs. Most of them simply announced "Victor Hour." Maybe "Victor Hour" has come to be known as something so outstanding that other details are unnecessary, but I don't believe it.

Nor do I believe that the newspapers would have been so secretive in their news columns had not the Victor Talking Machine Company evidently reduced its advertising in newspapers to go more strongly into magazines and broadcasts.

Just as Unjust

Nor did the Victor Company itself seem to realize its finest opportunity to win listeners' attention from other stations, and confine it to its own hour on this occasion. "La Traviata," one of the greatest operas, by Verdi, one of the greatest composers, sung in tabloid form by the leading tenor of the Metropolitan Opera Company, a prima donna soprano of the same company, and the outstanding baritone of that same company! Too bad that so many who would have liked to have tuned in naturally missed the entire performance through ignorance of its broadcast!

The company seemed to concentrate on winning over to the record-buying division of the public any who just happened to be listening in. If the newspapers were unjust to the Victor Hour maybe the Victor Hour was just as unjust to itself!

I've asked nineteen persons—regular listeners in—and six say they never knew "La Traviata" was broadcast and listened to something else; four stumbled into the program unawares; seven consciously tuned it in; two didn't listen in that night.

But amid the pleasure of listening one forgot all about any annoying points. The condensed opera and the voices and orchestra that delivered it compelled 100 per cent. attention.

"Ah, Fors' e Lui," a duet that comes early in the piece, and merges into the soprano solo "Sempre Libera," so that they are really one, is one of the most melodious parts of "La Traviata." Everybody is familiar with the tune, although perhaps not many can identify it by title or operatic residence. Bori and Gigli were a great combination for this rendition.

de Luca's fine chance came in the poetic song, "Di Provenza Il Mar," wherein Violetta's father paints a rosy view of his errant son's fair home in Provence, where his mother waits for him, and his sister, too, whose marriage to a nobleman is being endangered by Alfred's intimacy with Violetta.

Orchestra Superb

The Victor Salon Orchestra made the fourth leg of the operatic quadrangle, and held up its end on a level with the ends supported by the three singers. To lose sight of the splendid orchestral work would be an injustice, indeed, but in the face of such fame as rests on the shoulders of personalities like Gigli, Bori and de Luca, it is often hard for a rather impersonal thing like an orchestra to get its just share of the honors.

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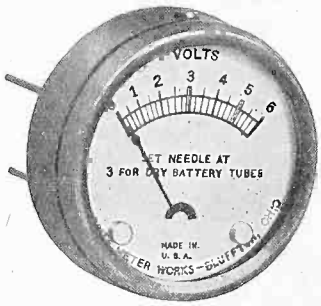


This 0-6 voltmeter, No. 306, is especially useful for the No. 25 and No. 28 Radiolas, because it is equipped with pin jacks which fit into the plugs with which those sets are provided. The meters may be used in any home-constructed set, too, where the builder desires to place tip jacks on the front panel, so the meter can be plugged in for obtaining reading. The meter may be kept permanently in circuit, if desired.

No. 306, 0-6 volts DC..... **$2.50**

Also Track Down Trouble in a Jiffy and Permanently Cure It with the Aid of These Fine Meters

It is absolutely necessary to use a high resistance voltmeter in measuring the voltage of B eliminators, either across the total output or at any intermediate voltage. A low resistance meter at least partly short-circuits the eliminator and causes the voltage reading to be away off. Sometimes the reading is as little as 25 per cent of the total actual voltage.

All "Double R" meters are accurate to 2½ per cent, plus or minus, and all, except the ammeters Nos. 1 and 338, may be kept permanently in circuit.

Panel meters take 2 5/64-inch hole.

Our Complete Meter Catalogue is contained in this advertisement.

High Resistance Meters for B Eliminators

Here is the meter you've been wishing for! A 0-300 DC voltmeter with a very high resistance. Specially made that way so it will test the output voltages, from maximum to any intermediate voltage, of any B eliminator or grid biasing resistor. It also makes all the measurements of any other meter of its voltage range, hence will give correct readings of B batteries, C batteries, cells, or any other DC voltage source not exceeding 300 volts. Full nickel finish. Portable type (fits in sack coat pocket easily). Accurate to 2½ per cent, plus or minus. Fully guaranteed. Requires 35 different dyes to make. Furnished with long connecting cords and convenient tips. May be kept permanently in circuit.

No. 346 ..... **$4.50**

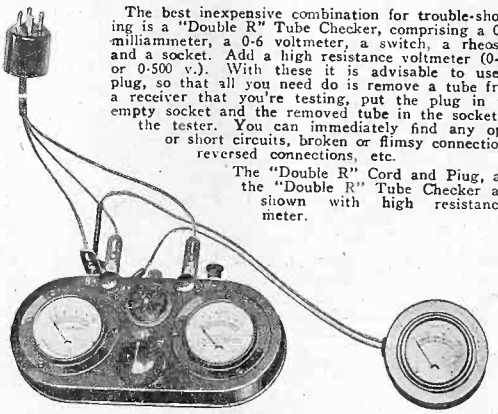
[Note: 0-500 volts, instead of 0-300 volts, is No. 347. Tests ALL power packs—Price $5.50.]

MULTI-TUBE SET MILLIAMMETER

Panel model. Recommended for sets having six tubes or more, particularly if a -71, -10 or -50 tube is used as the output. May be kept permanently in circuit. For DC measurements 0-100 milliamperes.

No. 390 ..... **$1.65**

TROUBLE-SHOOTING TEST SET



The best inexpensive combination for trouble-shooting is a "Double R" Tube Checker, comprising a 0-10 milliammeter, a 0-6 voltmeter, a switch, a rheostat and a socket. Add a high resistance voltmeter (0-300 or 0-500 v.). With these it is advisable to use a plug, so that all you need do is remove a tube from a receiver that you're testing, put the plug in the empty socket and the removed tube in the socket of the tester. You can immediately find any open or short circuits, broken or flimsy connections, reversed connections, etc.

The "Double R" Cord and Plug, and the "Double R" Tube Checker are shown with high resistance meter.

PANEL VOLTMETER FOR A BATTERIES

One of the most popular meters, the 0-6 panel voltmeter, DC. May be kept permanently in circuit. Panel model.

No. 326 ..... **$1.65**

SERVICE MEN!

No. 210 Tube Checker, consists of 0-6 volts DC Voltmeter, 0-10 DC Milliammeter, Grid Bias Switch, Rheostat, Socket, Binding Posts (with instruction sheet)..... $6.50
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No. 346 DC Voltmeter (high resistance)..... $4.50
No. 347 DC Voltmeter (high resistance)..... $5.50

The cord terminals of the plug leads correspond with the binding posts of the tube checker.

Now connect the 0-300 or 0-500 volts high resistance voltmeter from A+ to B+ posts and you get all necessary readings. You can test plate voltage from B eliminators, or any other B supply, DC plate current and DC filament voltage, as well as the efficacy of the tube, by throwing the grid bias switch, for the plate current should change within given limits, depending on the type of tube.

Equip your testing outfit with the indispensable combination that constitutes the Trouble Shooting Test Set and Time-Saver. You quickly locate trouble while others flounder about.

Complete Combination Nos. 21 and 210 (with 0-300 Voltmeter, No. 346)..$12.00
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No. 1 For testing dry cells, 0-40 ampere DC scale pocket meter.$1.50

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No. 50 For testing B batteries, dry or storage, but not for B eliminators, 0-50 volts DC scale 1.65
No. 39 For testing B batteries, dry or storage, but not for B eliminators, 0-100 volts DC scale 1.85
No. 40 For testing A and B batteries, dry or storage, but not for B eliminators; double reading, 0-8 volts and 0-100 volts DC scale..... 2.25
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No. 348 For testing AC current supply line, portable, 0-150 volts 4.50

VOLTAMMETERS

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No. 307 Desk type voltmeter with cord, 0-6 volts DC..... 2.50

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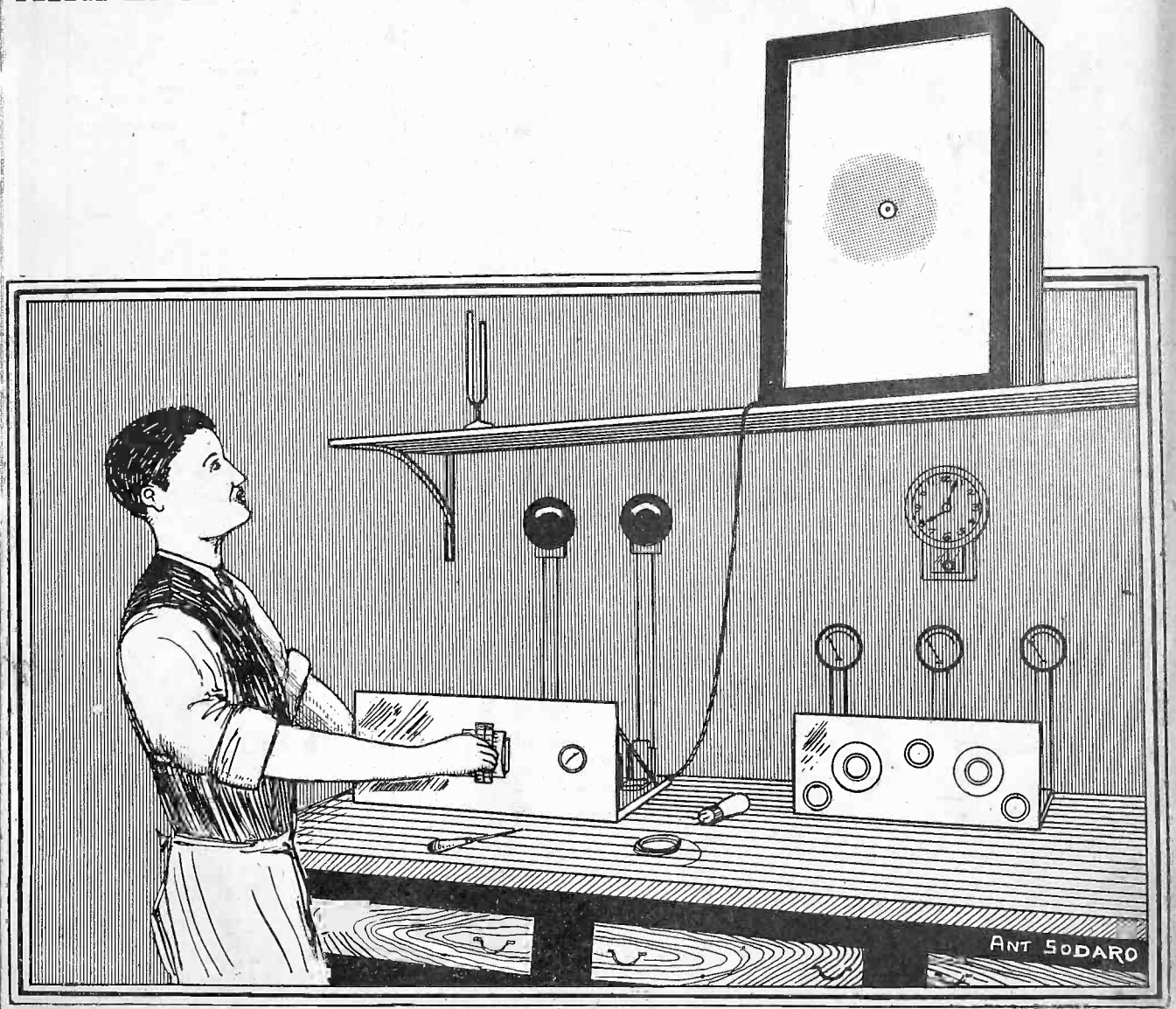

Airplane Cloth Speaker Proves Outstanding in Tests. See pages 4 and 5

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Vol. XII. No. 24. Whole No. 310
MARCH 3, 1928
15c per Copy. $6.00 per Year
[Entered as second-class matter, March, 1922, at the post office at New York, N. Y., under Act of March, 1879]

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New-50 Power Tube Takes

84 Negative Grid Volts!

By Chisholm W. Parker

WERE vacuum tubes endowed with consciousness and were they subject to jealousy, they would all be emitting a green glow of hatred at this time.

A new king of power tubes has risen.

And what is this new king? It is the new —50 power tube, the latest addition to the radio "balance of power."

The characteristic table follows:

	Recommended				Maximum	
Plate voltage	250	300	350	400	450	volts
Negative grid bias	45	54	63	70	84	volts
Plate current	28	35	45	55	55	m. a.
Plate AC resistance	2100	2000	1900	1800	1800	ohms
Mutual conductance	1800	1900	2000	2100	2100	micro-mhos
Voltage gain factor	3.8	3.8	3.8	3.8	3.8	———
Max. Undistorted output	900	1500	2350	3250	4650	milli-watts

Filament: 7.5 volts, 1.25 amperes (oxide coated).
Max. overall: height 6¼ inches, diameter 2 11/16 inches.
Base, large standard push type (X)
Rating: as amplifier, max. 4.65 watts; oscillator, 25 watts.

In looking over this table of normal characteristics one is struck by the many similarities between this tube and the —71. In fact it sems like the —50 is an overgrown —71. The amplification constant of the new tube is 3.8 while that of the —71 is 3. The internal plate AC resistance of each is about 2,000 ohms for the recommended grid and plate voltages. The mutual conductance of the —50 is considerably greater than that of the —71, indicating that the new tube is a superior power amplifier.

Where Similarity Ends

When the —50 and the —71 tubes are compared with respect to power handling capacity the similarity ceases. The new tube is in a class by itself. With 450 volts (maximum) on the plate of the —50 tube the maximum undistorted output is 4,650 milliwatts while that of the —71 with 180 volts (maximum) on the plate is only 700 milliwatts. Thus the maximum output of the new tube is about 6.6 times as great as the maximum output of the other.

Of course, a much higher voltage is required on the plate of the —50 than on the plate of the —71.

While the new tube has been compared with the —71, it was really developed to replace the —10 power tube, and therefore the new tube should be compared with that also.

We find that the —50 takes the same filament current as the —10 and that the required filament terminal voltage is the same. Thus the new tube can be used in any circuit designed for a —10 power, except that the coupling coil in the plate circuit must be able to stand a far greater load.

Current Question Serious

The new tube's physical dimensions are slightly larger, but in few cases will the substitution be frustrated for lack of room.

The recommended and the maximum plate voltages are about the same for both the —50 and the —10 tubes. Therefore plate voltage supply units developed for the —10 power tube can also be used for the —50 tube as far as voltage goes, but some of them may not be able to deliver the necessary plate current and maintain a high voltage.

The first thing that one should ascertain in this respect is whether the plate choke coil or the primary of the output transformer will carry all the current necessary. The carrying capacity has to be more than double the current carrying capacity of a coil or transformer designed for either a —71 or a —10 power tube. Few coils now available will carry enough current to supply one of the new tubes, but more will appear soon. The current required for the higher plate voltages is 55 milliamperes, almost enough to heat the filament of a —99 type tube.

The maximum undistorted power output of the —10 tube with 425 volts on the plate is 1,540 milliwatts and the corresponding output of the —50 tube with 450 volts on the plate is 4,650. That favors the new tube in the ratio of 3 to 1. Thus for a given output power the distortion in the —50 will be about 1/9 as great as that in the output of the —10 tube, assuming that the input to the —50 is as pure as that to the —10 tube.

The low amplification constant of the —50 tube requires that the input voltage be much higher than that for the —10 tube for equal output. Hence there is a greater chance for distortion to creep into the signal in the stages preceding the power tube. But in this respect the —50 is much superior to the —71 tube.

Also because of its low amplification constant the required grid bias on the —50 tube must be high for given plate voltages. Thus when the plate voltage is 250 the negative grid bias should be 45 volts, and when the plate voltage is 450 the required grid bias should be 84 volts.

The grid bias can be obtained in any one of several ways. The two most common are the dry cell battery method and the drop-in-resistance method. The former is electrically the better in all cases but it may be objectionable on the ground of space requirements. This is accentuated in the case of the —50 tube. The negative grid bias at 450 plate volts is almost as high as the last tube plate voltages common two years ago.

The Stage Ahead

If a resistor is used and the plate current from a single —50 tube flows through that resistor, then the value of the resistance should be about 1,500 ohms. This is also the resistance required for a —10 tube so that no change is necessary when substituting tubes, provided that the resistance already in the circuit can carry 55 milliamperes. Somewhat lower values of resistance may also be used, especially when the lower plate voltages are used. The 1500 ohm value was based on a plate voltage of 450 volts.

When this tube is used it is necessary to make sure that the tube preceding it is able to handle all the AC voltage required without distortion. It has hardly ever been necessary to raise this point in connection with previous power tubes.

Since the plate current in the new tube may be as high as 55 milliamperes it is obvious that no present loudspeaker can be connected directly into the plate circuit without burning it out. A coupling device is necessary, and this may be either a transformer or a choke and condenser filter.

The tube is suitable for reproduction in halls, clubs, auditoriums, theatres, and in institutions having dozens of telephone receivers. Home conditions hardly require its use.

An Airplane Cloth New Vistas

How a Kite Model Repr with a Rich, Clear, Pure

By H.

Acousti

NOT since the highly developed cone forced the old-fashioned horn out of the throne of popular favor has a parlor speaker appeared that for modest outlay offers such advanced performance as the box type speaker made with airplane cloth diaphragm.

The speaker looks like a box kite, and indeed it could be used as such, particularly as it is so generously equipped with a high-flying diaphragm—an airplane cloth surface 18 by 24 inches.

Wings, and sometimes fuselage, of airplanes are made of this material. Indeed, the Spirit of St. Louis itself was so equipped when Col. Charles A. Lindbergh flew that famous craft alone across the Atlantic, and, more recently, on a good-will trip to South America.

So you may well imagine that airplane cloth, to withstand such use, is durable. Also it is light. Moreover, it is not expensive. But not its durability, its economy or its lightness constitutes its outstanding asset for the chief purpose we have in mind. Rather, its performance when used as the sounding "board" of a reproducer.

And when we investigate that, we find it is the most intriguing medium of all.

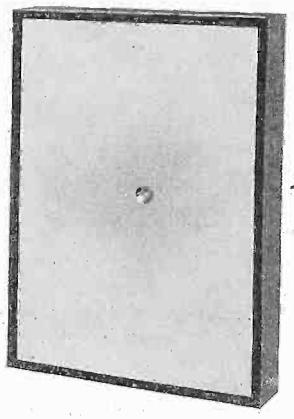


FIG. 1
FRONT VIEW OF THE HBH AIRPLANE CLOTH SPEAKER THAT REPRODUCES WITH SUCH AMAZING PURITY AND CLARITY OF TONE THAT IT HAS BEEN HAILED AS A SENSATION

Stretch It Tight

Purity of tone, clarity beyond one's previous experience, almost take our breath away, for we had passed through seven years of radio reception without enjoying the eye-opening realism made possible by this sensational speaker.

Indeed, one must dip into past experience to bring forth the new airplane cloth speaker, the HBH model of which is illustrated herewith.

One takes standard airplane cloth, of best quality, and stretches it upon a rectangular wooden frame, on the back of which is a small square of the same cloth, so that as the centers of the two pieces are drawn tightly together and sealed by the two meeting apexes, the necessary strong tension upon the large diaphragm thus being assured.

The old principle of using two diaphragms is not invoked, since modern engineering practice has discovered loopholes aplenty in the theory that a larger diaphragm responds to the low notes and a smaller one to the high notes, so that the combination gives almost ideal reproduction. Indeed, the two-diaphragm might well give ideally miserable results, with two strong resonance peaks, one high, one low, to torment the listener with booming and trilling that persist after the original notes have ceased.

No, it is not in any double diaphragm that the airplane cloth speaker gets its plenitude of virtues, but in the tautness to which the treated light, responsive cloth is stretched. It is assumed a good unit is used, and of course it must be of the pin or stylus type, with the rod sticking out so that it will move the speaker diaphragm.

Builder Treats Cloth

Treatment of the cloth by painting or spraying it with a special preparation gives the stiffness required for reproduction purposes. When the tautness is supplied by flexing the tension of the larger oblong span against the smaller square one, you have a speaker that will give you low notes that you have never heard before, and also will afford excellent reproduction on the highest notes.

The frequency characteristic, while not flat, is wider in effective range than almost anything you have ever heard, and certainly surpasses anything else that can be purchased or assembled for a few dollars. Real quality at next to no cost is what you get, and you acquire a speaker that not only fills you with pride and delight as you listen to its marvelous work, but which wins the praise of all guests privileged to hear your set work this speaker in your home.

A great deal of engineering thought has been centered on proper reproduction of low notes, and the point soon was reached where receivers were better able to do justice to low notes than were the generally available commercial speakers. Such is the case even now. Audio transformers amplify low notes and have relatively even amplification throughout the scale of useful frequencies. Other forms of amplification do as well or better, but speakers have curves that look much like the teeth of a bucksaw.

At the lower end of the audible frequency spectrum the response is very feeble.

Lo, the Low Notes

With a properly constructed airplane cloth speaker the low notes get a more sympathetic reaction than do the high notes, so that the slight unbalance existing in reproduction, due to the receiver characteristics, so justly composed for, and amazing reproduction is obtained even down to 30 cycles, which is about the lower limit of audio frequency modulated by broadcasting stations.

You can hear the tuba on the airplane cloth reproducer so that it has individuality, character and force all its own, since the fundamental brings forth active response from this newly adopted diaphragm whereas under normal conditions you depend on a distorted harmonic of that low fundamental note for any response you might get from the speaker.

The organ sounds just as an organ should sound, and if the transmission is down to 16 cycles, the minimum of the organ, and if your receiver can handle this extremely low frequency, you can rely on a properly constructed airplane cloth speaker of the kite type to pick up the note and toss it to you in as delightful a fashion as one's fondest expectations could concoct. The bass viol stands out, too, as do all the other low-note instruments. Since the faithful reproduction of low notes gives character and life to music, you get an absolutely new and superior form of enjoyment from listening to such a speaker.

Some Fundamental Tests

If you flick the taut diaphragm with your finger you will hear a response much like what you get from a drum. It therefore follows that the bass drum and the kettle drum beat their enspirited tattoo upon your eager ears, and make you fidget with keen delight in your listener's chair.

If you will build yourself such a speaker and, holding it at the top, let the bottom board of the frame strike the floor,

Elliptical Dead Spot Discovered In Speaker

One of the peculiar facts concerning the Airplane Cloth Speaker is that, when constructed with the diaphragm pulled in by the tension of the small sheet, there is an elliptical part of the surface, about six inches from the center, where the diaphragm hardly vibrates at all.

For instance, at the center, just around the apex, the vibration is strong, and it continues to be so for several inches, when there is a gradual reactive decline. Then suddenly comes the round area where there is next to no vibration. Progressing toward the frame, one finds great activity again.

The tightening of the diaphragm, by stretching it almost as much as possible with the unaided hands, causes stress to be exerted principally on that part of the cloth where the bend toward the center begins. The pull is inward, while the edges of the speaker tend to resist this pull. Hence where the pull begins to converge into the resistance, or where the opposite forces meet, a form of acoustical neutralization sets in.

This you can verify by passing your fingers about the cloth when the speaker is operating.

When you feel next to no vibration you will know you've "hit the spot."

Speaker That Opens of Delight

ucer Brings Out Notes ne That Astonishes All

Herman

Expert

you will hear a sound somewhere around 150 cycles, and this is approximately the natural period of the speaker, provided the diaphragm is stiff and taut.

But if the diaphragm is loose, or without being loose is still not tight enough, there will be an acute resonant peak that will boom forth unpleasantly as the aftermath of any note struck at about the fundamental frequency; also the quality throughout the scale will be thin and lifeless. The reason is that the airplane cloth is more useful for reproduction purposes the greater the tension and stiffness—and it easily acquires both of these, while still retaining lightness, thus making the most acceptable combination.

The Four Steps

The speaker is so easy to make that almost anybody can complete the entire construction in an hour and a half, and that includes every piece of work and presupposes a leisurely and painstaking manner of construction. There are four essential moves:

(1) Construction of the frame.
(2) Placement of the crossarms.
(3) Placement, stiffening and tautening of the big diaphragm and the small square tension guard.
(4) Mounting the unit.

Each operation is as simple as possible, there is next to no possibility of failure, if the stated precautions are taken, and the result is that for a few dollars you get as fine a quality reproducer as you would want. And after you've listened to it delightedly you may decide to drape it with brocade, chintzes or the like, so that it may occupy a niche of importance on the moulding of your parlor, or adorn a marble table or, indeed, squat on the Chinese rug that graces your most tastily appointed room.

How to Assemble

The outside frame is assembled as shown by Fig. 1. The cloth is then cut of sufficient size to cover the front, stretched on and tacked.

The manner of stretching is very important and is as follows:

Place the cloth on the frame and tack at the center of the left-hand side. Now take hold of the cloth at the lower left-hand corner of the frame, stretch down tightly toward the left-hand corner and tack. Fill in between with tacks about one-half inch apart.

With the right hand take hold of the cloth at the center on the right-hand side of the frame, stretch across tightly and tack down. Then take hold of the cloth at the upper right-hand corner and pull upward tightly and tack. About one-half inch apart place tacks in between. You now have the main stretching done.

It doesn't matter just where you take hold of the cloth now, but stretch on

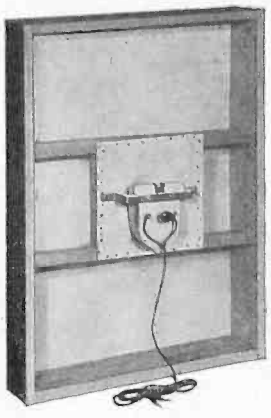


FIG. 2
THE REAR VIEW SHOWS THE CROSS-ARMS, TENSION GUARD (THE SMALL SQUARE), BRACKET AND UNIT. THE PIN IS ON THE OTHER SIDE OF THE UNIT, POINTING AWAY FROM YOU.

tightly all around and fill in, always remembering that the tighter you stretch the better your speaker will be.

Now assemble the rear frame. Take the two long narrow wooden pieces and measure out the center point on each. Measure off 3 inches on each side of the center of both of these. Now place the two short narrow wooden pieces between these long ones so that the inside of the small pieces is six inches apart, forming a square six inches large. Nail together in this position, using only one nail for each joint.

The Rear Piece

The small rear cloth or tension guard is then cut and tacked on in the same manner as the large one.

DON'T PLACE THIS SMALL FRAME INSIDE THE LARGE ONE YET.

You are now ready to insert the apex, consisting of two pieces, one for the center of each cloth.

The center of each cloth is found by laying a yard stick across the diagonal corners and drawing light lines near the center. Where these lines meet is the center. Pierce a small hole at the center in each cloth.

NOW place the large frame face down on a table and the small one face up inside the large one, with the centers over each other. The apex is now inserted, one plate on the outside of each cloth, and both pointing toward each other. The center of the apex is inserted with the adjustable part on the front.

Feller Needs a Friend

Now you need the help of a friend. Ask your friend to stand on each side of the speaker and take hold of the two legs of the small frame, one leg in each hand. You do the same on the other side. Now both of you pull up slowly, stretching the cloth until the small frame is flush with the edge of the large frame. You now have to let one leg go, to nail the other one up. The one you let go will drop a little, of course, but after you sink the first nail you can draw up the leg and finish nailing it.

All Finished

Now go over to your friend's side and nail up that side. This causes the two cloths to converge.

Now apply two coats of the special stiffening fluid, allowing each coat to dry for twenty minutes. The bracket is now assembled to the unit (Fig. 2). Screw the bracket to the frame as shown. First put the pin of the unit inside of the apex. Tighten the apex.

The moulding is now placed on the front of the speaker, over the tacks. The speaker may be painted any desired color, or may be otherwise decorated.

[Follow the articles in RADIO WORLD *from week to week on the new and fascinating Airplane Cloth Speaker.]*

Still Picture Receiver Under Way by R. C. A.

A commercial form of radio still picture receiver for sale to home users is being developed by the Radio Corporation of America group of manufacturers, according to Dr. A. N. Goldsmith, chief broadcast engineer of America.

Two types of receiver are contemplated, one which combines visual and aural reception and one which can be plugged into any good radio receiver to convert that to a picture receiver.

The first public demonstration of the system was made on Jan. 27 when the photograph of Mayor James J. Walker of New York was transmitted over WEAF and received by Dr. Goldsmith in his home in New York. The transmission of Mr. Walker's photograph required ninety seconds.

Sensitive Reproducer Coupled Through Air

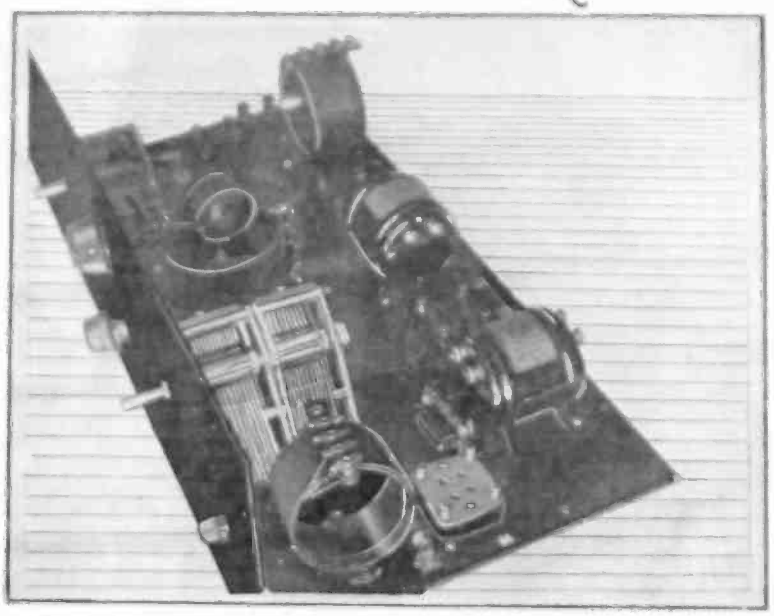
The usual practice in cone speaker construction is to have the diaphragm point outward, that is, toward the point of the pin or stylus of the unit. But in the Airplane Cloth Speaker the real sounding board, that is, the large surface, points inward, and, incidentally, so does the small cloth guard.

In effect, the large surface takes up most of the vibration, in fact, nearly ten times as much as the smaller one. The pull and the armature is almost exclusively by the large surface, since the smaller one serves as a brace, and the fact the smaller guard takes up vibration is purely incidental and unavoidable.

Indeed, were another speaker of the same type as the airplane cloth model placed even a few feet away, while the first speaker was acutated by the output of a receiver, the second speaker would send forth reproduction on its own account, having taken up vibration from the first one. This is acoustical coupling and is of about the same order of non-intensity when the distance of the two is one foot as is the coupling between the large diaphragm and the small tension guard.

How to Add to the Shield

By Keith



A SIDE VIEW OF THE FIVE TUBE SHIELDED GRID DIAMOND OF THE AIR. THE EXTRA TUBE ADDS NO TUNING CONTROL OR ANY OTHER VARIABLE OF ANY SORT TO THE FRONT PANEL DEVICES.

A FIFTH tube may be added to the Four Tube Shielded Grid Diamond of the Air, if subpanel dimensional instructions given in the February 4 and 11 issues of Radio World were followed.

The subpanel, if 10 inches deep, with all parts placed according to the blue-print pattern, permits of the addition of a stage of tuned radio frequency amplification between the first RF tube and the detector.

You do not have to alter the front panel in any way. In fact, the total work concerns these additions: fifth socket behind the tickler coil; third tuning condenser in tandem with the second tuning condenser, by using one shaft running through both; a coil, just like the antenna coil, placed at right of the ganged condensers; a No. 622 Amperite with mounting, placed near the new socket.

The wiring is changed only so far as connecting to these parts.

The added tube may be a shield grid tube, so that you have two stages grid RF amplification, regenerative detector and two stages of transformer coupled audio—a five tube set of remarkable sensitivity and selectivity. The same tone is preserved.

Volume Control Option

The volume Control, R4, is left in the same position on the front panel, but as a tendency toward self-oscillation may arise in the first tube when the fifth tube is added, it is optional to connect the volume control in series with the first RF B plus lead, as diagrammed; or you may leave it across the secondary of the first audio transformer.

The fifth tube, utilized as described and diagrammed, adds about 500 miles to the receiving range.

There are a few pointers on installation that should be watched carefully.

The main one concerns the ganging of the Karas condensers.

This is done by mounting the new condenser right back of the detector tuning condenser, but securing the new one to the subpanel. The existing tuning condenser, attached by single hole mounting to the front panel, is thus kept firmly in place, and probably has not been bolted to the subpanel.

The condenser frame, at bottom, has holes that easily pass 6/32 screws. The half-inch length type is plenty long enough. Use two on the new condenser, but be sure to find the drill hole locations with strict accuracy, otherwise the two condensers will not team up properly.

How to Rectify Mistake

If you drill a hole in the wrong place you are up against it, for the hole will not permit of a new one right next to it, in fact half including it, since the drill will slip into the existing aperture. Probably as good a remedy as any under the circumstances would be to drill the erroneous hole sufficiently oversize to pass the screw properly, and tighten a large hex nut against the underneath plane of the subpanel to get the proper "bite."

Should the condensers not be in alignment there will be torque on the common shaft. This would bend a metal shaft. A hard rubber or Bakelite shaft will take up a little torque nicely. If a brass or other metal shaft is used the most extreme care must be taken to get the condenser mounting holes precisely right.

Separate Grid Return

It is therefore preferably to use Bakelite or hard rubber shafting, 5½ inches long. That also affords complete insulation between rotors of the teamed condensers.

Naturally, when mounting the second condenser you will not permit the front part of its frame or the bushing thereon to touch the corresponding part of the back of the existing condenser. But if metal shafting is used, this precaution is useless.

The advantage of the insulated shaft is that it permits the detector grid return to be made to negative F for the special de-

LIST OF PARTS

Vital Kit

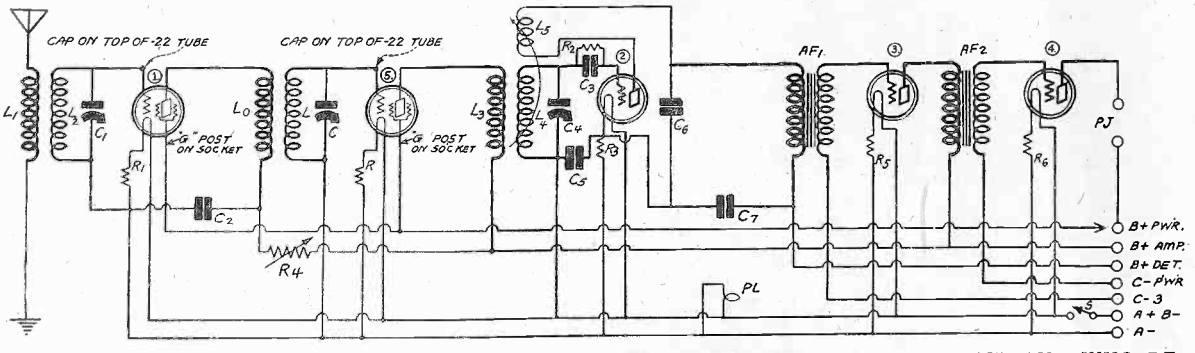
L1L2, L3L4L5—Hammarlund HR 23, consisting of one antenna coupler and one three-circuit coil, both for .0005 mfd. tuning.
LLo—One Hammarlund RF transformer, same as antenna coil above.
C1, C6—Three Karas .0005 mfd. SFL condensers, type 23.
AF1, AF2—Two Karas Harmonik audio frequency transformers.
R, R1—Two No. 622 Amperites with mountings.
R3, R5, R6—Three No. 1A Amperites with three mountings.
R2—One Lynch 5 meg. grid leak.
R4—One Volume Control Clarostat.
C2, C5, C7—Three Aerovox .006 mfd. fixed mica condensers.
C3—One Aerovox .00025 mfd. mica grid condenser, with clips.
C6—One .001 mfd. Aerovox mica fixed condenser.
S—One Yaxley No. 10 battery switch.
PL—One Yaxley No. 310 pilot light bracket (with lamp extra).
PJ—Two Frost phone tip jacks, No. 253.
Five Frost Bakelite sockets, No. 530.
One 5½" shaft, ¼" diameter.
Two Eby binding posts (Ant., Gnd.).
One 7 x 21 inch front panel.
One 10 x 20 inch subpanel or baseboard.
Two Mar-co dials.
Two Pee-Wee clips (No. 46 Universal clips).
Set of three Karas subpanel brackets.

ACCESSORIES

Two shielded grid tubes, Ce Co RF22, for sockets 1 and 5.
Two Vac-Shields for shielded grid tubes.
One Q. R. S. 200A detector tube or CeCo type H, for socket No. 2.
One CeCo type A for socket No. 3.
One CeCo type F (112) for socket No. 4.
One roll flexible Acme Celatsite.
One 7-lead Acme battery cable.
One set of cable markers.
A, B and C supplies.

a Fifth Tube Grid Diamond

Lauderdale



THOSE WHO HAVE BUILT THE FOUR TUBE SH IELDED GRID DIAMOND OF THE AIR AND WHO DESIRE TO ADD A FIFTH TUBE, SO AS TO INCREASE THE RECEPTION RANGE ABOUT 500 MILES, MAY DO SO BY MAKING THE FIFTH TUBE THE SECOND RADIO FREQUENCY AMPLIFIER. THIS IS SHOWN ABOVE AS A SCREEN GRID TUBE. (5) THE CHANGE IS EASILY MADE.

tector tubes, while the RF tube's grid is returned to minus A. Therefore the RF tube gets a free bias equal to the voltage drop in R, or 2.7 vols (6 minus 3.3). With 135 volts on the plate of the RF tube, or even a little less, this is a suitable bias, and heightens the selectivity.

Of course, with separate grid returns made possible, the detector may be returned to F+ for any tube, including Q. R. S. 200-A or other special detector. Sometimes signals are made louder.

Should a metal shaft be used a different connection for the grid leak would have to be made. Instead of the clips on the grid condenser being utilized for leak mounting, a special mount must be provided, and it is connected from the G post of the detector socket to the F minus (or F plus) post of the same socket. Then the leak is mounted in the new holder.

System Excellent

The system of ganging the Karas condensers works out excellently, especially since the tickler of the Hammarlund coil has a sufficiently high inductive effect upon the adjoining secondary to afford compensation, if such is necessary. In most cases the simultaneous tuning of these similar stages with a single motion works out with splendid balance, requiring no trimmers.

The best way to include the fifth tube is to get the blue-print of the Four Tube Shielded Grid Diamond, lay out all the parts as shown thereon and add those previously mentioned in this article. (The list of parts includes all save the extra mounting for grid leak if a metal shaft is used.) Connect up the filament wiring, then wire the new stage first and continue from the blueprint with the rest. Visually it turns out to be very simple, although words may make it seem harder than it is.

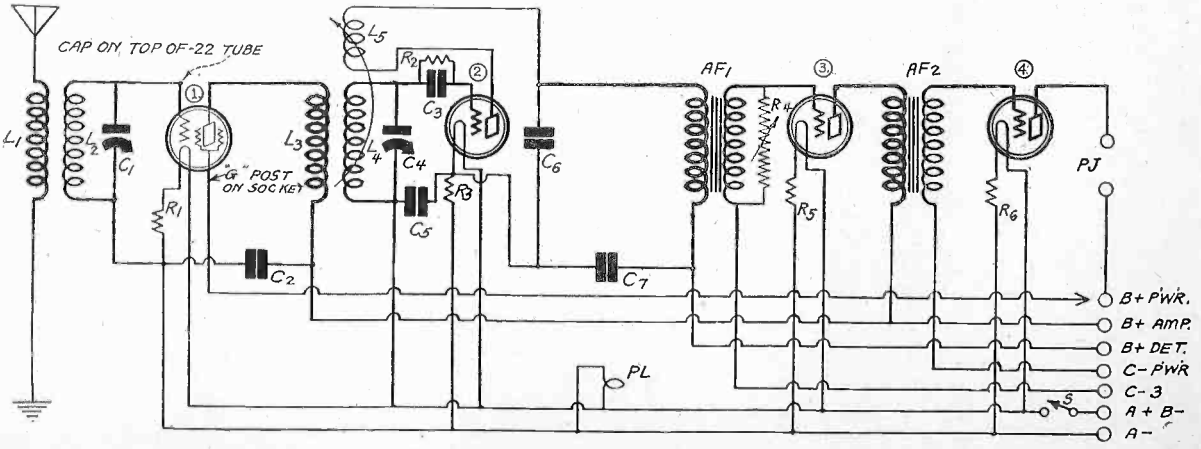
Build the Four First

How to incorporate a fifth tube is described here solely for the benefit of those who have already built the Four Tube S-G Diamond. The changes are so few and so simple that any one starting anew should still build the four tube model first, and make the change later if he desires.

So extraordinary is the performance of the four tube model that many will not care much about making the addition. Yet the fellow who hungers for that extra 500 miles, which may bring him Denver from New York regularly, instead of only Chicago through locals, may set his heart on that fifth or specially DX tube.

Still another option presents itself. If you desire to use three shield grid tubes you may use the third one as the detector. Change over to a 622 Amperite here, also. Connect the cap of the shield grid tube to B plus 22 to 67, and use resistance coupling in the first audio stage. Followed by a Karas transformer, this gives sufficient volume.

The incorporation of a shield grid tube as a space charge detector was fully described, for the first time anywhere, in the February 18 issue.



THE FOUR TUBE MODEL. WHEN THE FIFTH T UBE IS ADDED IT IS PLACED ELECTRICALLY JUST AHEAD OF THE DETECTOR. THE VOLUME CONTROL CLAROSTAT IS PUT IN THE B+ AMP. LEAD AT THE ANGLE OF THAT LINE JUST BELOW WHERE C2 JOINS IT.