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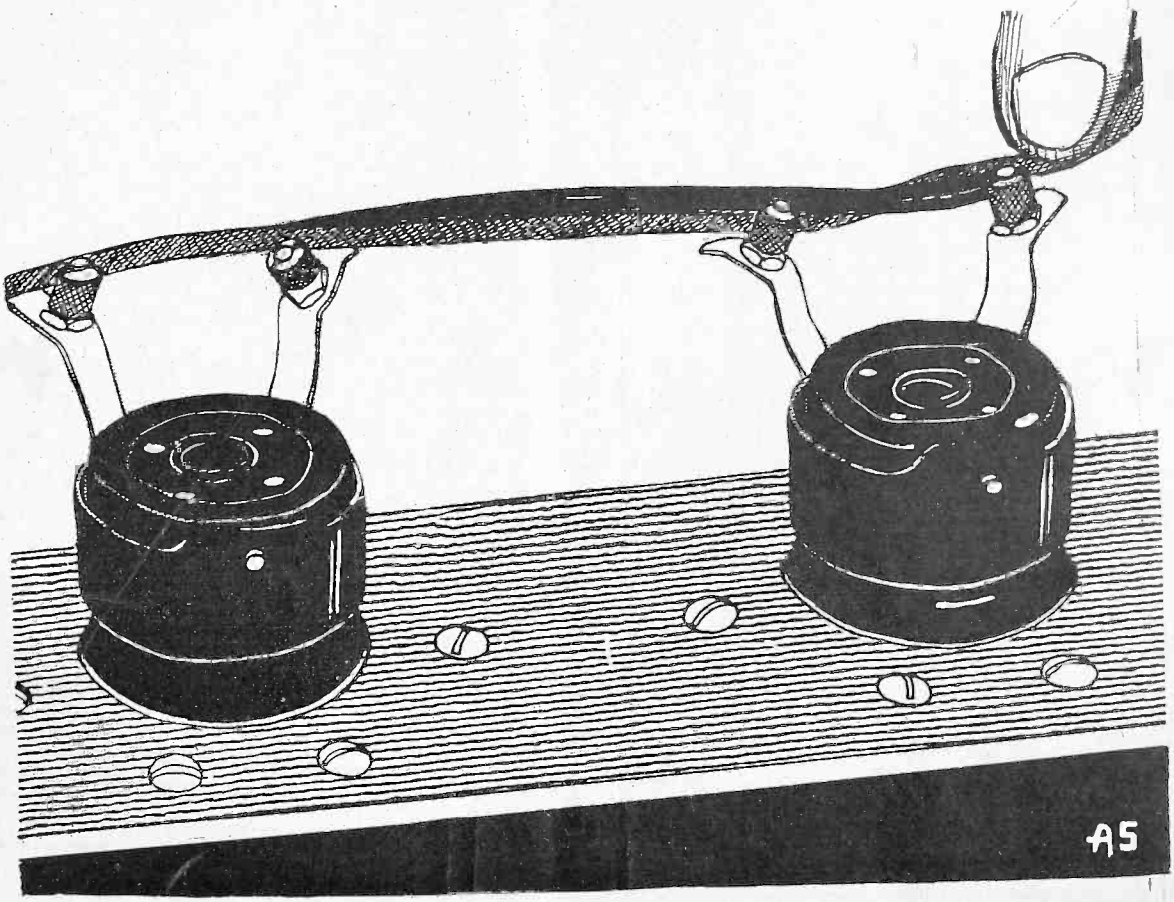
Vol-12 No-15 301



AC TUBES MAY BE USED ON A BATTERY MODEL SET BY INSERTING A NEW FORM OF SOCKET ADAPTER AND BY MAKING A FEW SIMPLE WIRING CHANGES. SEE PAGE 3

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Good Back Numbers of RADIO WORLD

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

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

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

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

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

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

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

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

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

JULY 23.—Building a 7-tube Super for your auto, using Victoreen IFT, by John F. Rider (Part 1). How to build a 6-tube neutralized set, using three tuned RF, two transformer AF, by John F. Rider. Inside dope on motorboating, by J. E. Anderson.

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

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

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

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

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

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

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

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SIXTH YEAR

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DC Sets Converted to AC Operation

By W. G. Masson-Burbridge

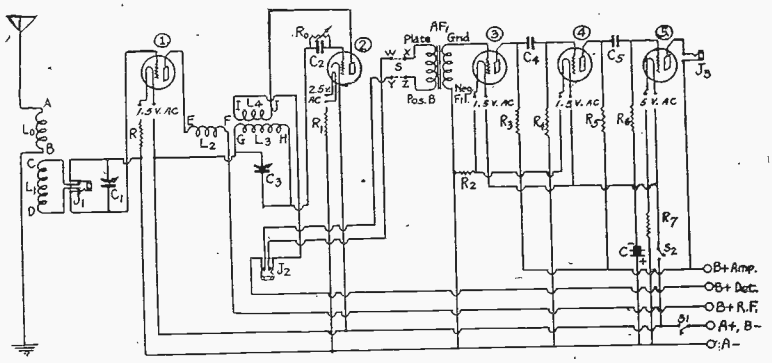


FIG. 1
SIMPLIFIED DIAGRAM OF THE FIVE TUBE DIAMOND OF THE AIR AS IT APPEARS WHEN THE ADAPTERS HAVE BEEN INSERTED INTO THE SOCKETS

TREND in radio design is toward AC operation. It is more than a trend; it is almost a stampede. Some persons who have no radio sets will have nothing but AC operated sets; others who want new receivers are looking for socket power operation, and their readiness has been hastened by their knowledge that socket power operation is practical. But still others—thousands of them—are looking for a means of converting their old receivers to socket power operation.

Manufacturers, dealers and technicians are striving to meet the demand for AC sets. In their haste some manufacturers have put undeveloped receivers on the market—receivers that hum and crackle more than the critical radio fans will tolerate.

Of the three classes of radio fans—those who have no sets and have the money to buy an AC outfit, those who can afford to buy an AC outfit and junk the old, and those who have an old type receiver and want some means of converting it to AC operations—the last is by far the greatest, and it is that class which will find an interesting solution to their problem.

How It Is Done

The solution of their problem is extremely simple and inexpensive. It has been made so by new devices about to become available to the public. By means of these any fan, however meagre his radio experience may be, can convert his own set into an AC operated set in about two hours. And he will need practically no tools. If he has a soldering iron he can use it to advantage, but if he has none he can do the job without one. If he has a pair of pliers with which to clean terminals they will be useful, but they are not necessary. But he will need a pair of cutters with which to cut heavy insulated wire.

Perhaps the best way of showing how to convert any set to AC operation is to go through the process with a typical and well known receiver such as the five tube Diamond of the Air.

The conversion is accomplished with the aid of adapter sockets such as the Na-Ald adapters made by Alden Manufacturing Co. Five are needed to convert the Diamond of the Air, as follows: One radio frequency type, one detector type and three audio frequency type. As for adaption of any other DC set, including A., or any home-made set, information A. or any home-made set, information may be obtained by addressing Milton Alden, 52 Willow Street, Springfield, Mass.

LIST OF PARTS

One Karas A-C-Former 110/5, 1½, 2½ and 5 volts (type 12).
One Na-Ald -27 type adapter for detector.
One Na-Ald -26 type adapter for RF tube.
Three Na-Ald -26 type adapters for audio amplifiers.
One 800-ohm Na-Ald resistor to fit RF socket.
One 400 ohm Electrad potentiometer.
One 2,000 ohm Davolim resistor.
Two Flechtheim 4 mfd. condensers, 300 volts DC test.
25 feet No. 18 or larger copper wire in the form of twisted pair.
Three CeCo M 26 tubes.
One CeCo J 71 tube.
One CeCo N 27 tube.

Details of the Adapters

All these adapters fit into the sockets in the old set and the AC tubes fit into the adapters. With the adapters intervening between the AC tubes and the old sockets, the plate and grid terminals of the AC tubes make contact with the plate and grid springs on the old sockets. The filament terminals are not connected with any part of the old heating circuit.

Instead the heating prongs on the AC tubes make contact with special leads on the adapters, and these leads can be connected to a source of AC voltage such as the 5 volt secondary of the new Karas AC-former. Full information on its characteristics may be obtained from Karas Electric Co., 4039 Le, North Rockwell Street, Chicago, Ill. The detector adapter differs from the others in that it fits into a four prong socket but affords a five prong socket for a five prong tube, which makes it possible to use the heater type of tube as detector in the old detector socket. The audio frequency tube fits into a four tube socket and takes a four prong tube.

The RF type adapter differs from the AF in that it has a slot directly over the grid terminal into which a tiny wire-

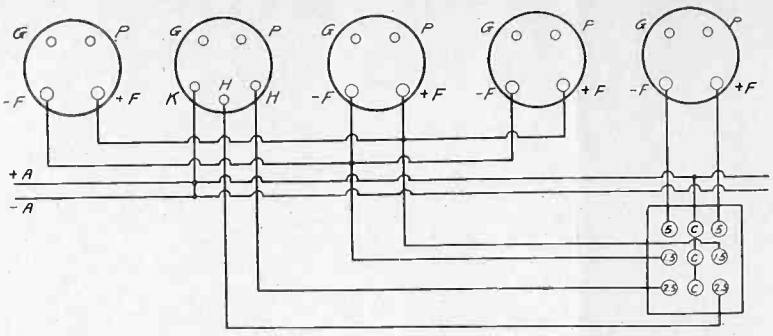


FIG. 2

DIAGRAM SHOWING THE AC CONNECTIONS BETWEEN THE TRANSFORMER AND THE ADAPTERS AS WELL AS THE CONNECTIONS TO THE OLD FILAMENT CIRCUIT. NO PROVISION FOR GRID BIAS IS MADE.

wound 1,000 ohm (or other value) resistor can be inserted. This resistor cuts the lead to the grid of the AC tube and automatically connects the resistance in series with it. The object of this resistance is to prevent RF oscillation in the converted receiver.

Wiring the Adapters

The filament or heater terminals which project from the adapters must be connected to suitable source of voltage. All those coming from sockets holding—26 type tubes should be connected to the 1½ volt winding of a Karas A-C-Former. Those coming from an adapter holding a heater type tube should be connected to the 2½ volt winding and those coming from the power tube should be connected to the 5 volt secondary.

All these connections should be made with heavy gauge, well insulated and twisted wire, and the leads should be as short as practicable. Use nothing finer than No. 18 wire. Each pair of wires should be twisted. Wherever possible the various leads should be bunched into a cable and bound with a strong cord or with a flexible metal ribbon. This ribbon should be grounded if used.

When two or more tubes are served from the same transformer winding, all the branch leads should be of the same length, measured from the point of divergence. This is necessary to insure that the current in all the tubes be the same.

The filament terminals on the adapters are provided with binding posts as well as soldering tabs, so that the leads may be either soldered or fastened with thumbnuts.

The filament and heater circuits are now completed for AC, but the receiver is not yet operative. The grid and plate returns have not been connected properly. The circuit as it now is can be represented by the diagram in Fig. 1. The old filament circuit is in place intact, except as it has been broken by the adapters. The connections of the AC circuit have been omitted for clearness, but the terminals have been marked.

It will be observed that there is no connection between the operative filaments and the grid and plate circuits. Therefore no electrons can circulate in the plate circuits and the grid potentials will be indefinite. There is one exception: the cathode of the heater tube is connected to the grid return of the circuit. This connection is made automatically when the adapter is inserted. The detector grid returns to zero or cathode potential without any bias. The fact that the cathode is connected to the positive side of the old DC line has no significance, since no A battery is used.

Short the Old DC Circuit

It is recommended that the filament switch in the old circuit be closed and that the A battery terminals be short circuited, or that simply a short circuit strap be connected between the minus A and plus. A bus bar on the receiver side of the switch S1 will do the trick. If that is done all the wiring pertaining to the old filament circuit will be at the same potential.

To establish the plate circuits in the amplifier tubes it is necessary to connect some point of the heating winding to the old DC supply system, to which the grid and plate returns are already connected. For hum-free output this point must be the electrical center of the filament or of the transformer winding. It is of utmost importance that this center be located accurately.

There are two methods available for locating the center and either may be used. The first is by means of a potentiometer across the filament and the second is by tapping the transformer.

The Two Methods

If the transformer used has not been tapped accurately enough then it is necessary to employ the potentiometer. But the potentiometer method requires more equipment and more room. If a properly center tapped transformer, such as the Kasas, is available, that should be used by all means.

The tapping of a transformer for the exact electrical center is not a simple matter. There are three conditions that must be satisfied. First, the resistances in the two sides must be equal; second, the inductances of the two sides must be equal, and third, the capacity of each half of the center point must be equal to the corresponding capacity on the other side.

These conditions demand that the two halves be placed symmetrically with respect to the tap, that is, so that the same amount of wire is used in each half and that the mode of winding be the same.

The Karas transformer satisfies these conditions because several months of research and experimentation were devoted to its development to the point where the tap is strictly at the electrical center, so accurately placed that connections can be made to it without any further adjustments. This adjustment holds for all three of the heating windings, and it holds for different current drains from these windings.

The Karas Transformer

The transformer is designed to accommodate eight type -26 tubes, two type -27 tubes and two type -71 tubes. That is, the transformer will supply heating current for any set having 12 tubes or less. Besides, the transformer has a plug receptacle for a B eliminator feed connection.

The transformer connections to the various tubes in the converted Diamond of the Air are shown in Fig. 2. The top, or 5 volt, winding supplies the last tube, which may be either a 112 or a 171, or 112A or a 171A.

The bottom, or 2½ volt winding, is connected to the heater terminals of the type -27 tube. The middle, or 1½ volt winding, is connected to the filament terminals of the remaining three tubes.

The plus A and minus A bus bars of the old filament circuit are shown in this drawing, and they are also shown to be short circuited. The cathode of the type -27 tube is also connected to the bus bars.

Grid Bias Provided

In the drawing all three of the center taps on the transformer are joined together and connected to the filament bus bars. Since the plate return, or the negative terminal of the plate voltage source, is also connected to this point no bias has been provided for the three type -26 tubes. The last tube derives its grid bias from the grid battery C.

Coupling Minimized

Now, if a resistor of suitable value be inserted in the lead running from the A bus bar to the center tap on the transformer windings, all the amplifier tubes will be given a grid bias equal to the drop in this resistor. This bias would be added to the voltage of a C battery so that the number of cells used here could be reduced.

But it is not conducive to good quality to use one resistor for the bias of all the tubes. There will be feedback through the resistor and that may cause oscilla-

(*Concluded on page* 5)

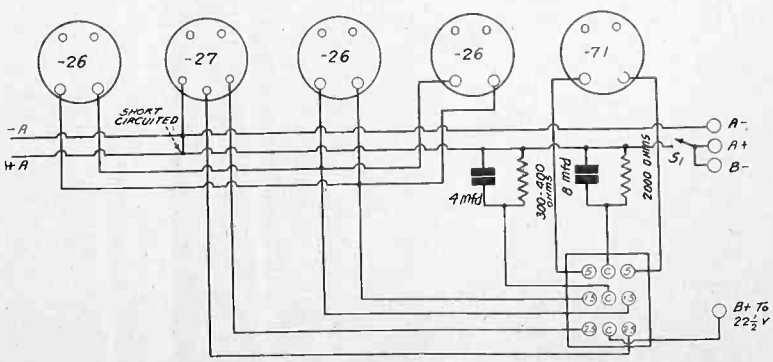
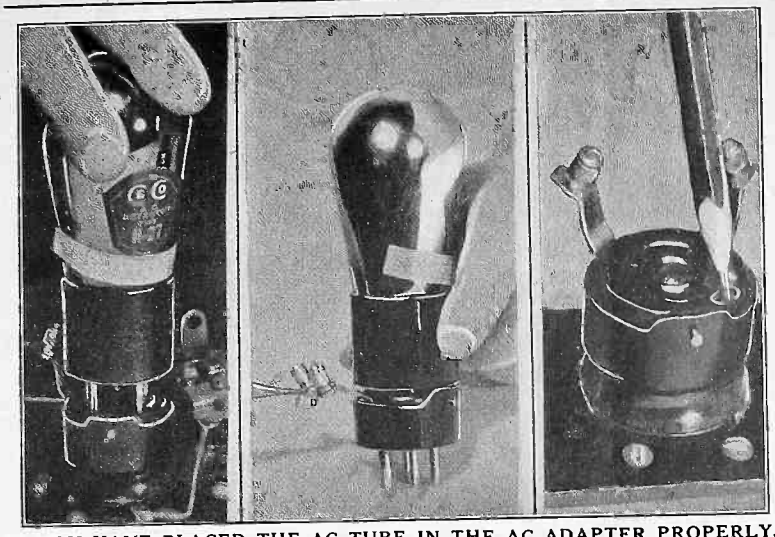


FIG. 3

DIAGRAM SHOWING THE CONNECTIONS BETWEEN THE HEATING TRANSFORMER AND THE ADAPTERS WITH GRID BIAS PROVIDED



IF YOU HAVE PLACED THE AC TUBE IN THE AC ADAPTER PROPERLY, THE AC TERMINALS ON ADAPTER WILL BE OPPOSITE TO THE PIN (RIGHT AND CENTER). THE HOLE IN THE RF AC ADAPTER FOR INSERTION OF THE SUPPRESSOR RESISTOR IS SHOWN AT LEFT.

(*Conluded from page* 4)

tion or serious distortion. We can use one resistor for the last tube and another for the three 1½ volt tubes.

Even when this division has been made there is undesired coupling between the tubes. But it can be minimized without sacrificing anything. The grid bias required on the three -26 tubes is small. Even on the last of them it does not have to exceed 3 volts. Hence it is not necessary to use a large value of resistance and the coupling between the tubes is small. To obtain a grid bias of 3 volts the resistance should be about 300 ohms, but if it is increased to 400 ohms neither the grid bias nor the coupling will be excessive. It can be by-passed with a condenser of about 4 mfd. to reduce the coupling still further if necessary.

Drop Affords Bias

All of the grid bias for the power tube can be obtained from the drop in a resistor placed in the lead to the midtap of the 5 volt winding. Its value should be 2,000 ohms if a —71 type tube is used. When this is used it is advisable to by-pass it with a condenser of 4 mfd. or more.

Sometimes it is found that a bias between the heater and the cathode in the —27 tube will improve the operation of this tube. The heater can be made positive with respect to the cathode by connecting the center point of the 2½ volt winding to a point of about 22½ volts on the B battery.

A schematic incorporating all the suggestions made above is shown in Fig. 3.

Recapitulation

When converting the five tube Diamond of the Air to AC first decide where the heating transformer is to be located. Put the adapters in the sockets. Then measure off the heavy leads which are to be used in the wiring, making sure that all the leads running to the —26 tubes are the same length. There should be six of them, or three twisted pairs. Then make a cable out of all the leads. Connect all the terminals of the cable at both ends.

Short circuit the old filament bus bars.

Insert a 300 to 400 ohm resistor in series with the lead to the center point on the 1½ volt winding and by-pass it with a 4 mfd. condenser.

Insert a 2,000 ohm resistor in series with the lead to the center tap on the 5 volt winding and by-pass it with a condenser of 4 mfd. or higher capacity.

Remove the old C battery and short circuit the gap where it was taken out.

Volume Control

A volume control is necessary in the converted Diamond of the Air, and it cannot be connected in the filament circuit. The simplest volume control that can be attached is a rheostat of about 2,000 ohms in series within the antenna and ground circuit. In some cases this is not sufficient to cut down the signals on the stronger stations, and then a variable resistor of higher value should be used. A Centralab modu-plug or an Electrad serves the purpose nicely.

Special Committee on Radio, Bloom Suggests

Washington.

Creation by the House of Representatives of a standing Committee on Communications, Radio and Broadcasting, is provided for in a resolution introduced in the House on December 19 by Representative Sol Bloom (Dem.), of New York. Mr. Bloom said he is convinced that legislation dealing with radio should be passed upon by a regular committee, and not be dealt with in a more or less haphazard way by a committee which has other matters to consume its time. A statement issued by Mr. Bloom explaining his resolution follows in full text:

My resolution provides for the creation by the House of a standing Committee on Communications, Radio and Broadcasting, to be constituted of 15 members to be designated in the usual way. I am doing this because I believe the time has come for the Congress to realize the importance of radio, not merely as a means of communication or for the entertainment it affords, but because of its commercial possibilities. The radio, as a means of communication, has already belted the globe and has obliterated time and distance. Yet its possibilities have hardly begun to be developed. I foresee the time when heat, power and energy will be transmitted by radio.

It has already been demonstrated that ships on and submarines under the sea, as well as trains and automobiles on the highways, can be guided by energy transmitted by radio. If we can transmit sufficient power to steer a ship or a motor car, it will be but a short while until we will be transmitting in the same way enough power to propel the ships and drive the automobiles. It is the beginning that is always most difficult. Once the first air flight was made, developments came with startling rapidity until men were soon flying across the continent, and now we have seen the oceans conquered in nonstop flights. Radio development will come with equal rapidity, and feats we look upon today as verging on the miraculous will soon be commonplace occurrences.

All this means the development of a great commerce and a great industry. There will be many important problems, all of which will have to be dealt with in one way or another by the Congress. Already the radio and broadcasting business is one of the leading industries of the country. I feel, and many other members of the House agree with me, that the importance of this industry, what it means internationally as well as nationally and to the individual citizen, merits the attention of an exclusive committee of the House, to which would be referred all bills and resolutions relating not only to radio, but to all lines of communication. The committee I am urging be created would handle all legislation relating to the radio, the wireless telegraph and the telegraph and telephone lines. Some of these matters are now handled by the Interstate and Foreign Commerce Committe and others by the Committee on Merchant Marine and Fisheries. These are important and busy committees, and have plenty of work to do to consider legislation relating to matters appropriately referred to them. My resolution would relieve these committees of work they may not have the time to do properly, and would assure full and mature consideration of radio problems by a committee which would properly devote its energies exclusively to these problems.

New Radio Distribution Sales Survey Inaugurated

The Department of Commerce recently issued the following statement regarding a new survey of radio sales distribution:

A survey of shipments of radio equipments made by manufacturers has just been inaugurated by the Electrical Equipment Division, Department of Commerce, in cooperation with the Radio Manufacturers' Association, in an efiort to provide a factual basis for efficient distribution and sales.

Results for the first survey will be available about January 12, 1928, and will be issued every three months thereafter. At the present time, statistics are not available showing periodic production of the industry as a whole. nor according to the different lines, such as receiving sets, tubes, batteries, etc.

In circularizing the manufacturers, the department pointed out that full cooperation is essential to the success of the undertaking.

IRE CONVENTION HERE SOON

The third annual convention of the Institute of Radio Engineers, will begin on January 9, and last until January 12. It will be held, as usual in New York City. Such topics as, interference in broadcasting channels, new high power short and long wave transmitters, new receivers and recently concluded International, Radio Conference, will be discussed.

Canny Cures for

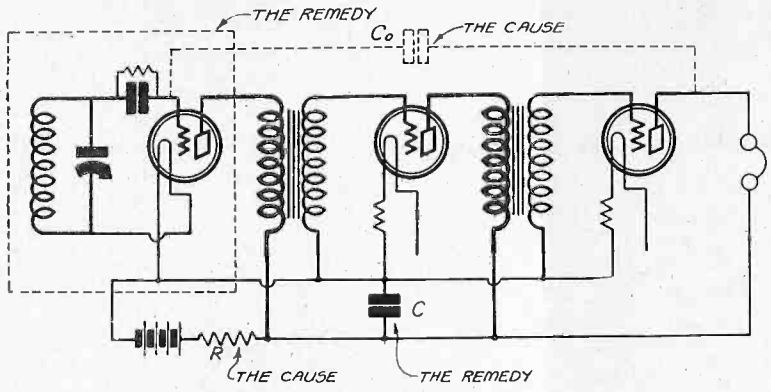


DIAGRAM OF A TWO STAGE TRANSFORMER COUPLED AMPLIFIER IN WHICH TWO CAUSES R AND CO OF DISTORTION ARE SHOWN TOGETHER WITH THEIR REMEDIES, CONDENSER C AND THE METAL SHIELD

By J. E. Anderson

Technical Editor

I BUILT the Qualitydyne receiver just as you described it, and I used nothing but the best parts that I could get, yet there is a great deal of distortion in the output and at times it howls terribly."

This statement has been made countless times by disappointed fans. And every one of those thousand or more fans wanted to know what could be done.

The assertion that the circuit was built just as described will usually not stand up under close investivation. In most cases where the circuit fails to work substitutions have been made, the parts have been rearranged, by-pass condensers used have been smaller than those recommended, or omitted, or the voltages used have been different from those specified.

But that begs the question.

The fact is that in many cases builders have followed specifications scrupulously only to be rewarded with intolerable quality.

Where Distortion Lurks

What are some of the causes of this distortion, when to all appearances the receiver should yield quality of a high order?

The question might be answered with one word, Regeneration.

Regeneration at radio frequency is not at fault. The regeneration occurs at audio frequency. The energy may be fed back inductively through the transformers, but this is not a strong probability. In nearly all cases energy transfer from one tube to the preceding tube or tubes takes place through the plate battery substitute. A resistance of a few ohms in series with the B battery may be the cause of changing a high quality receiver to one of intolerable quality. Ten to 25 ohms may be sufficient to make an otherwise high quality receiver into a loud oscillator. Distortion lurks in the common resistance in the plate circuits.

That a resistance in series with the plate battery has a very great effect on the quality and on the amplification can be demonstrated in a few minutes.

Just put a variable resistor, say a 0-1,000 ohms, in series with the negative lead to the B battery. Set it first at zero and note the quality and the volume. Then gradually insert resistance. The effect will largely depend on the type of amplifier used. In some cases the amplification will gradually decrease. In others the amplification on certain notes will be increased and the circuit might start oscillating. The frequency of this oscillation also depends on the type of amplifier, and, if transformer coupled, on the manner the leads to the transformers have been connected.

The intensity of the effect with the 1,000 ohm rheostat will depend on the amplification in the circuit. If that is low, nothing much will happen; if it is high, much may happen as soon as 10 ohms have been inserted.

Use a Fresh Battery

The B battery used in this experiment should be fresh, because an old battery will have more resistance than 1,000 ohms. When the battery is fresh its internal resistance is very low, but as the energy stored in it is drained out the resistance increases. Therefore a receiver may give first class quality while the battery is new but extremely poor quality when the battery is old.

When battery substitutes are used the resistance is usually high enough all the time to cause distortion and oscillation. But in these the by-pass condensers, if properly placed and of adequate capacity, will prevent oscillation at the higher frequencies. But trouble might occur, and usually does, at the low audio frequencies, in direct coupled circuits particularly.

Microphonic Tubes

Another source of distortion is regeneration through air coupling. This is extremely annoying at times, as it usually leads to singing of the circuit at some frequency in the most important region in the audio scale.

And if the regeneration is not enough to cause actual oscillation it is enough to give rise to a sharp amplification peak at the frequency. This appears as a ringing sound when notes of that frequency, or near that frequency, are sounded, or when complex sounds constitute the signal.

When this kind of disturbance occurs in a receiver it is almost invariably due to a defective tube, either the detector or the first audio.

The trouble is usually cured as soon as a more sturdy tube is put into the set in place of the microphonic tube. Very often the stem holding the elements is broken off near the base when a tube of the —01A tube is microphonic.

Tubes of the —99 variety may be microphonic when they are otherwise in good condition.

Interesting Curves

The effect on the amplification of microphonic tubes and resistances in the source of plate voltage has been studied both mathematically and experimentally. The curves obtained show strikingly why the quality of reproduction is not good when such regeneration is present. In Fig. 1 three curves are shown for a two stage transformer coupled amplifier. The normal amplification of this circuit when all regeneration has been suppressed is about 30.

Curve A shows the amplification of the circuit with 13 ohms in series with a fresh B battery and a certain polarity of the transformer connections. The gain has been increased tremendously throughout the range except for the highest audio frequencies, where there is a slight reduction over the normal amplification.

At a frequency of about 160 cycles the amplification rises to a sharp peak of about 175 times. If the regeneration were increased just a little more the circuit would oscillate at this frequency. A few more ohms in the B battery would have been sufficient to cause the oscillation.

The Leads Reversed

When the leads of the transformers are reversed the case is different. Curve C shows it. The amplification at most frequencies is depressed greatly below the normal amplification of 30. At about the same frequency, 3,160 cycles, where Curve A dips below the normal amplification, Curve C rises above it. Hence above that frequency there is regenerative amplification in the circuit. With this connection of the transformers the low notes would be suppressed and the high would be brought out too strongly. Oscillation is highly possible at a frequency of about 5,000 cycles. The quality of the output would be very poor even if the circuit did not oscillate.

The resistance in series with the B battery which gave rise to the depression of the low notes and regeneration at the high as indicated in Curve C was 43 ohms.

Curve B shows the amplification of the same circuit as it is affected by acoustic or air coupling between the loudspeaker and the detector tube as well as by electric coupling between the plate of the last tube and the grid of the detector when the grid leak and condenser method of detection is used.

The first peak in this curve is caused by air coupling between the loudspeaker and the elements of the detector tube. This peak is sharp, indicating that the vibrating element in the detector tube is feebly damped. Oscillation occurs at this frequency if the loudspeaker is close to the receiver.

The second peak in Curve B is caused by feedback through the capacity be-

Uncanny Noises

tween the plate of the last tube and the grid of the detector. This might lead to oscillation at about 2,000 cycles.

What To Do About It

The remedy naturally depends on the source of the oscillation or the distortion. To be safe it is best to apply a remedy for all of the three sources of distortion mentioned above.

Let us first consider the last, that is, coupling between the plate of the power tube and the detector grid, or between any plate and the grid of the detector. Since the feedback takes place through the capacity between the elements an effective cure can be looked for in a metal shield surrounding the grid of the detector or of the entire detector circuit. The shield should be grounded and it should not be too close to the grid of the detector nor to the high potential side of the grid input tuner.

The second source of oscillation is more difficult to remove. The best way seems to be in all cases to replace the microphonic tube with a sturdy one, as was stated above. Sometimes a heavy cap on the tube, such as a ring of lead, will stop the oscillation, because it puts the natural frequency of the tube below audibility, or so low that the amplifier cannot sustain the howl due to lack of gain.

Sometimes mounting the socket of the tube on a spring support will help; sometimes an absolutely rigid mounting is required. Sometimes a brake on the tube will keep it from bursting into vibration, and this brake can consist of a piece of felt, a handkerchief, a wad of paper and the like.

Placing the sensitive tube inside a box, either metal or wood, will help.

Other Remedies

Still other possible remedies in this case are to reverse the leads to the loudspeaker and to move the speaker far away from the set. But when the tube is very microphonic these remedies are very uncertain. The room may not be large enough to allow the speaker being moved far enough away. The speaker can also be moved a short distance to or from the set. Moving the speaker one-half wavelength of the sound wave corresponding to the howling frequency is equivalent to reversing the leads to the loudspeaker.

The distortion indicated by Curves A and C, being due to the same cause, can be removed by the same device, namely a large condenser across the common resistance.

If the circuit gives a response shown in Curve C, only a small condenser across the plate battery, say one of 1 mfd., is required to stop the oscillation. But the small condenser will not prevent the depression of the low notes. A very large one is necessary for that purpose.

If the circuit gives a response as shown in Curve A a 1 mfd. condenser will suffice to bring the amplification of the high notes up to normal. It will not be sufficient to bring down the amplification peak and the 160 cycle frequency to normal level. A very large condenser is necessary for that.

Hence in both cases very large condensers must be used to eliminate the distortion which the resistance of the B battery or B battery substitute introduces. The larger the condenser is the more nearly the amplification of the circuit will be what it would be if all the tubes were on separate B batteries.

When High Peaks Come Low

If the stable connection represented in Curve C is used it is obvious that an extremely large condenser must be used if the low notes are to be brought out. If the connection which gave Curve A is used the size of the condenser would depend on where the high amplification peak lies. The farther down the scale this peak is the larger the condenser will have to be. Also the larger the common resistance is the larger the condenser will have to be.

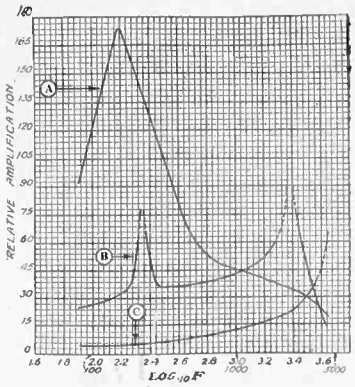


FIG. 1
CURVES SHOWING THE DISTORTION INTRODUCED IN A TRANSFORMER COUPLER AMPLIFIER BY STRAY FEEDBACK.

Suppose that the high peak falls at a frequency of 150 cycles, that the common resistance is 50 ohms, and that it is desired to cut down the effective resistance to 1 ohm by means of a condenser. What size of condenser is necessary? It would have to be close to 150 mfd. This calls for an electrolytic condenser. What size condenser will reduce the effective resistance to 5 ohms? In that case it will have to be about 64 mfd. This also calls for an electrolytic condenser.

Since 5 ohms in many cases will cause a serious distortion it is obvious that bypassing condensers of the ordinary sizes are not large enough to remove the distortion, although they may be large enough to stop an oscillation.

57 Stations Broadcasting Farm Economics Talks

One of the popular features of the Department of Agriculture's radio farm program for the winter is a series of talks on farm economics worked out in cooperation with the Bureau of Agricultural Economics and listed as a feature of the United States Radio Farm School. These talks are broadcast, one each week, by 57 large commercial radio stations in 34 States. C. A. Herndon, agricultural writer, Radio Service, has charge of the preparation of these talks for broadcast, in collaboration with department economists.

The farm economics talks grew out of last year's Chats with the Agricultural economist, but the new series is more comprehensive and of increased popular appeal.

The first talk was put on the air on October 4 and the whole group will require 30 weeks to complete. During the first 10-week period talks were given on the following subjects: The Business of Farming, Analyzing the Farm Business, Size of Farms in Relation to Returns, Crop Yields in Relation to Returns, Livestock Returns in Relation to Farm Returns, Labor Efficiency in Relation to Farm Returns, Farm Plans and Buildings in Relation to Farm Returns, The Farm Budget, Outlook Reports, and How Farm Returns Vary in the United States.

A new series of farm economics talks, featuring marketing subjects, began on December 14 and will include: The New Idea in Marketing, Standards in Marketing, Grading and Marketing, Market News, Warehousing as an Aid to Marketing, Packages in Marketing, Shipping to Market, Financing Marketing, Advertising in Marketing, and Direct Marketing by Producers (Parcels Post).

The final series of ten talks will deal with agricultural cooperation. This group will include this year's Radio Farm School popular course in farm economics.

Through the monthly Agricultural Situation reports the Bureau of Agricultural Economics cooperates with the Radio Service in still another way. Advance copy for the reports is furnished the Radio Service during the last week of each month. From this information, a special radio release, known as the Agricultural Situation Review, is prepared. Solon R. Barber, agricultural writer, puts this information into final form for broadcasting. Seventy-five radio stations broadcast the Agricultural Situation Review each month.

New Feature for Benefit of Ex-Gobs

Even the very saltiest of ex-gobs are finding something on their dials these days which recalls to their meories their days of service in the United States Navy.

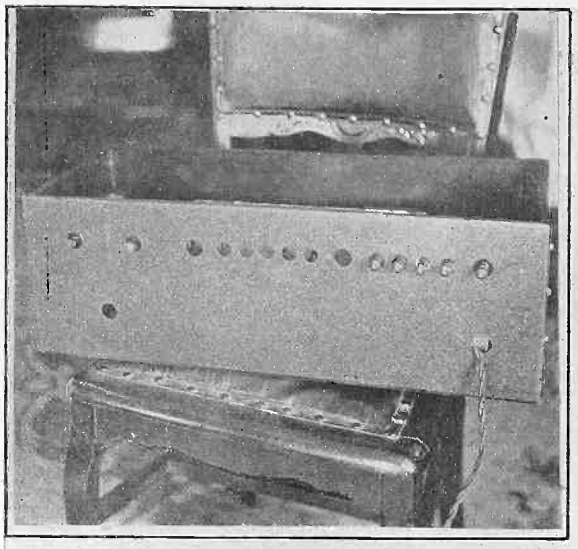
"Rise and Shine," a distinctly maritime program, is being broadcast by the National Broadcasting Company through WJZ, New York, each Monday evening at 9.00 o'clock. The action during this hour of entertainment, which is constructed by Charles A. Schenck, NBC announcer, a graduate of the United States Naval Academy at Annapolis, takes place aboard a warship at sea.

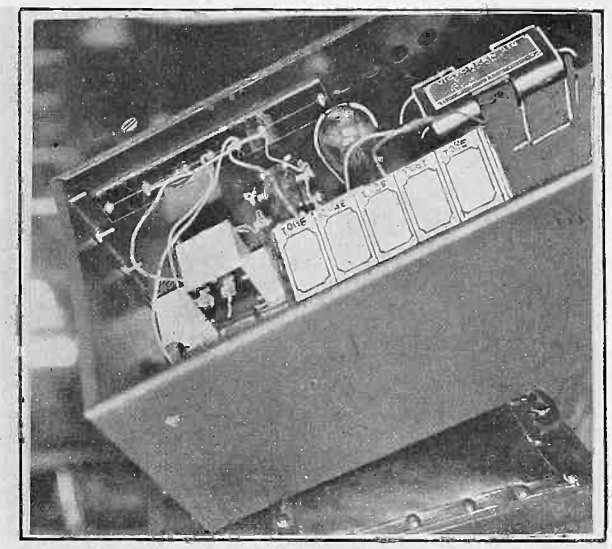
The title, although the program is heard in the evening, is taken from the sailors' traditional morning call. "Hit the Deck," the title of a highly successful musical comedy, is the other half of this well-known phrase.

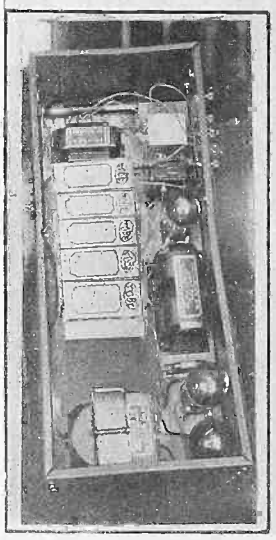
Victoreen Power Supply

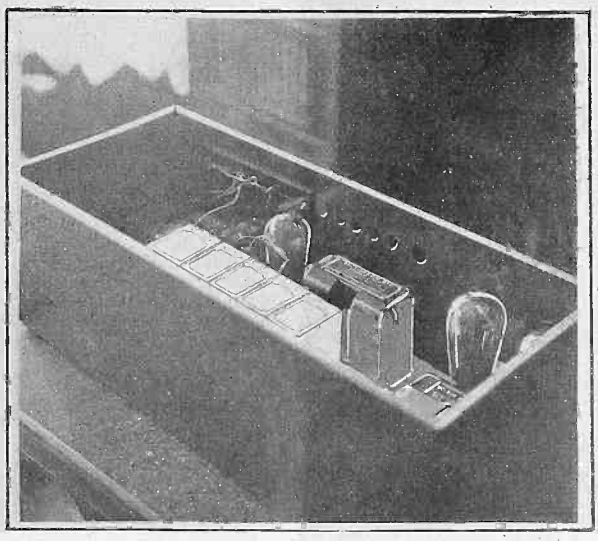
By H. B. Herman

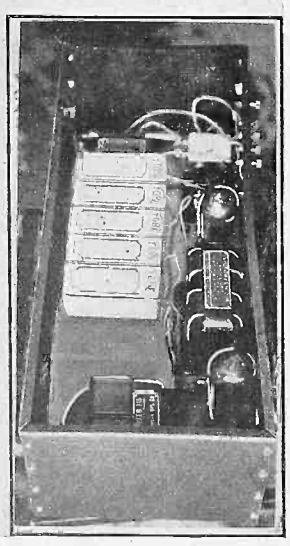
Acoustical Expert











SOME EXCELLENT VIEWS OF THE VICTOREEN POWER SUPPLY. THE LEADS FOR THE SET ARE ATTACHED TO THE BINDING POSTS ON THE REAR OF THE POWER SUPPLY CASE (UPPER LEFT). TO PREVENT THE CONDENSERS FROM BECOMING HEATED, TWO RECTIFIER TUBES, CECO R81, AND THE 210 AMPLIFIER TUBE, ARE PLACED AWAY FROM THE CONDENSERS, AS WILL BE SEEN AT THE LOWER RIGHT. THE RECTIFIER TUBES ARE TO THE FRONT, WITH THE 210 ALONG THE RIGHT SIDE. OTHER PHOTOS THROW FURTHER LIGHT ON THE PLACEMENT OF THE PARTS.

[*Part I of this article on the Victoreen Power Supply with a stage of Audio was published last week. The final instalment follows.*]

THE operation of the Victoreen Power Supply, with a stage of audio, in conjunction with any receiver with usual speaker audio, gives much more volume on locals than even the 210 tube will stand, but does build up the volume of distant stations, otherwise rather weak, so that stations a thousand miles away, or more, can be heard "all over the house," as the saying is.

The situation of too much volume, but never too little, is exactly what most persons really want. If the speaker rattles and blasts due to overloading of the 210 tube, or indeed some previous audio tube, then the simple remedy is to cut down the volume ahead of the detector, or at least in the first audio stage. For such a purpose as this does a volume control exist.

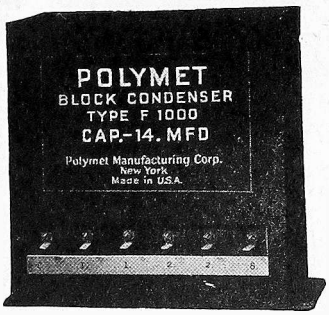
More than mere rectification and amplification is achieved with the Victoreen Supply and stage of audio. One dips into the realm of real quality about as deeply as radio or phonograph dipping is done these days. You yourself get out of reception a depth of enjoyment that you didn't know existed. Even your friends who bragged about the quality of their sets surely and always grow quiet and finally restless. The restlessness is accounted for by the itching desire to possess one of those power supplies.

All you need to do with any receiver is to operate it as usual, then switch over to the extra audio stage with the Victoreen B Supply. The low notes now come booming through as much as your audio amplification system renders possible. This is more than many engineers imagine, for the reluctance of the speaker mechanism to being driven by low-note power is very considerable, or, to put it differently, it takes often a thousand times as much power to get as much action out of the speaker at 50 cycles as at a frequency five times as great. So when you use the high voltage —475 applied volts—on a 210 tube, you have a power-operating output that will overcome the stubbornness of the speaker in this respect. Then, if the preceding audio channel is a faithful reproducer, you may gain full effect, but at all hazards the improvement will be very considerable.

By this system the music takes on life and character, both of which are lacking when low notes are slighted. Besides, the

(*Concluded on page* 19)

Polymet Makes Units With Scope of Capacity



To satisfy the popular demand for condensers in block form to be used in connection with the various types of B eliminators and power amplifiers, the Polymet Mfg. Corp. have placed on the market a number of condenser blocks containing the correct total capacity tapped in the proper places for the most popular of these circuits.

The working voltage under which these condensers are to operate has been carefully studied and only the proper condenser sections incorporated in these blocks. Thus all doubt as to the voltages the condensers will be subjected to is eliminated. One simply buys the block made for the desired purpose. Poly Block Condensers not only improve the appearance of the set, but also greatly simplify the wiring, save time and space in assembling.

The Spur to Better Quality

A young man built radio sets. His latest was an attraction to the neighborhood. Everybody who heard that set praised the quality of its reproduction, not excluding his next door neighbors who were entertained at times by that set at unconventional hours. The boy grew in self-esteem.

Then a radio engineer moved into the house, and he played his own set, or rather his assembly of parts. The wife of the next door neighbor praised the quality of that set to the boy's mother. Then the next door neighbor himself alluded to it. The boy has not heard this new intruder, but he already is building a better set.

BIG NEW STATION FOR CANADA

Washington.

The recently organized Maple Leaf Radio Co., Ltd., of Hamilton, Ontario, Canada, is planning to construct a large broadcasting station at Hamilton, Ontario. The project is being supported by the Hamilton radio dealers and other firms. The wavelength of the new station will be 340.7 meters and the call letters CHML.

NOW, WHAT WOULD YOU DO?

Los Angeles.

As the height of incongruity KFI presents this one. On one night recently a station broadcast two talks, one on where to shoot ducks and the second on the conservation of ducks.

160,000 SET OWNERS IN ARGENTINA

Washington.

A recent survey in Argentina shows that 160,000 persons hold receiving set licenses. Most of the people own crystal sets, although there are quite a few tube sets in use.

Enthusiastic Reports On "Everyman Four"

Radio Kit Company, 72 Cortlandt Street, New York City, official service station on the "Everyman 4," recommend using only the specified parts throughout. They report the receipt of hundreds of enthusiastic commendations. The set was designed by Fred G. Ehlert. G. L. Taylor, San Diego, California, telegraphed on December 8, "Kit received and assembled Stop Wonderful reception Stop Heard stations never received before Stop Quality excellent Stop Thanks Stop"

H. S. Greager built the set and installed it at 581 West 161st Street, New York City, and reports the following log in one night with all the locals on: WMBB, WOK, WPG, WGN, KDKS, WBZ, WLS, WCBN, WSAI, WGY, WBBM, WTAM, CECA, Toronto, Canada, at 6:15 P. M.; WLIT, WHT, WJR, WHAS, WNAC, WSB, WIP and KYW, before he had even learned to operate the set.

Charles Sulaman, of Flatbush, enthusiastically commends the tone quality from the standpoint of the musician, and as a fan, admitted that the "Everyman 4" ran rings, as he expressed it, around some of his prized sets. Hundreds of enthusiastic testimonials are on file at their office which they will gladly show, and which speak well for the sterling qualities of this new and fine circuit which truly brings satisfaction to "everyman." Radio Kit Company will gladly supply information or answer any question on this set upon application.—J. H. C.

Durham Resistors for Manufacturing Trade

The International Resistance Company announced a new type of fixed resistor made expressly for the manufacturing trade. This

type of unit is identical electrically to Durham Metallized Standard Resistors, the mechanical difference being that it is made with metal insert ends and in a manner which effects some economy in price.

Baldwin's New Speaker

One of the pioneers in the speaker field and the manufacture of units of the highest order, Professor Nathaniel Baldwin, has placed on the market his Baldwin "99" loud speaker. This comes in two types, a table model and a pedestal model. Both models possess to an extreme degree the qualities of eye, ear and purse appeal. The Baldwin "99" speaker is designed for and built to house the latest Baldwin unit employing the balanced armature. An extremely scientific tone chamber, which combines expontential and conical curves in an entirely new way, distributes the sound to advantage. Each speaker is tested on a 210 tube at 400 volts.

Full information and handsome literature on these speakers, also on the full line of Baldwin products, headphones, units, phonospeakers and adapters and the new Baldwin needlephone, may be had on request from J. W. & W. L. Woolf, 227 Fulton Street, New York City, Eastern distributors for Nathaniel Baldwin, Inc.—J. H. C.

Next week — issue of January 7 — an important shielded grid tube circuit.

C. R. A. Rectifier Tube Features Long Life

Charles R. Ablett Co., 22 Reade Street, New York City, have perfected and put on the market the new C. R. A. Rectifier tube, which they guarantee for a full year of life. This concern has been in the lamp manufacturing business for twenty years and all the skill and research of their engineers have gone into the perfecting of this tube. What is technically known as "gas fatigue" is the condition responsible for the demise or breakdown of many otherwise good recifier tubes. Ablett engineers assert that the C. R. A. tube is exempt from this failing, because all parts are purified in hydrogen atmosphere so that no impurities can combine with the helium. The C. R. A. tube is filled with 99-78/100 per cent. pure helium gas. Every tube is thoroughly tested, in addition before shipment. This rectifier has been approved by such leading radio concerns as Thordarson, Muter, Cornell, Mayolian, Bosch, Patch and others. It has also been commended by Leo Fenway designer of the already famous Concertrola and the Fenway for DX which has been built and used all over the world. Fans, dealers and jobbers will do well to get further information on this tube, which will be furnished upon request by the above concern.—J. H. C.

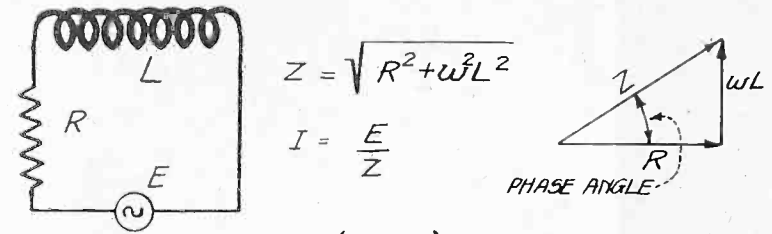
A Word or Two About The Three Radioteers

In the November 26 issue we run into three chaps who have built Concertrolas. Who are these fellows? They are you, and you, and you. They could live in California or in Maine. It doesn't matter where. They bring out the important point that the Concertrola can be constructed by anyone with only a slight knowledge of radio. They show you, these three "radioteers," that any one of the adaptations of the Concertrola will work as well as another. They even explain how simple it would be to use RCA tubes in the set.

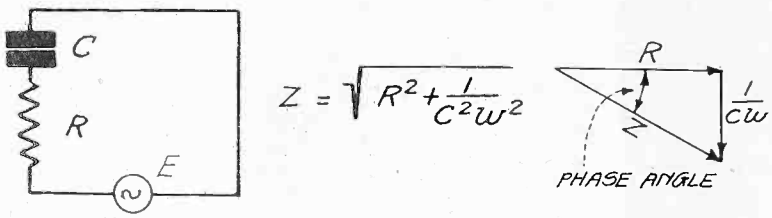
And the "radioteers" show us the benefits to be derived from the "DX-er." This is the little instrument that assists in producing double-regeneration. This is something else that is decidedly *new*.

As we look into the Concertrola we find that in many respects it differs from other electric receivers. Especially is this true in its construction, which is along new lines. We discover that the power compact can be placed rather close to the detector tube without bad effects. We see how advantageous it is to have the power tube located in the eliminator compartment. We see the necessity of having the Electrad Truvolt on the detector tube. We know the importance of using dry C batteries for the grid voltages. What we want to find out is, what combination of tubes will make the finest receiver. And this is the final dope. The first two tubes should be either McCullough-Kellogg, or RCA type 227's. The next tube, which is the first audio, should be a type 112A; the final tube, either a 171A or a 210. The heating device for the first two tubes is the Concertrolastat; the filaments of both the 112A and the 171A are supplied by the Thordarson 171 Compact. This makes an ideal arrangement.

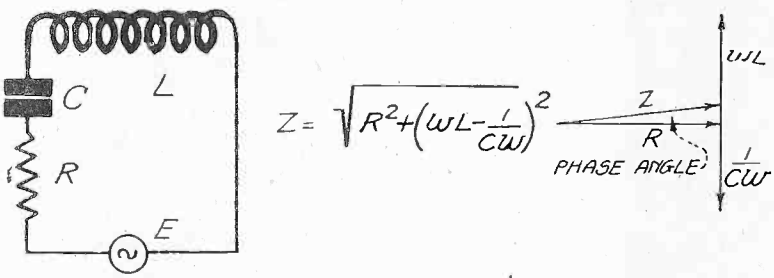
Phases that Shift Like

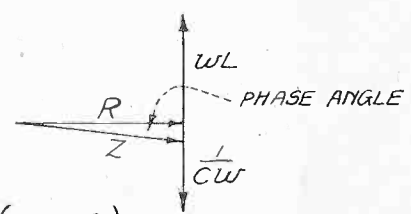


(FIG. 1)



(FIG. 2)





(FIG. 3)

FIG. 1 SHOWS A CIRCUIT CONTAINING INDUCTANCE AND RESISTANCE IN SERIES WITH AN ALTERNATING EMF E.
FIG. 2 IS A CIRCUIT CONTAINING CAPACITY AND RESISTANCE IN SERIES WITH THE EMF E.
FIG. 3 CONTAINS RESISTANCE, INDUCTANCE AND CAPACITY IN SERIES WITH THE EMF E.
THE FORMULAS AT THE RIGHT OF THE CIRCUIT SHOW THE MANNER IN WHICH THE IMPEDENCE IS OBTAINED, AND THE VECTOR DIAGRAMS SHOW THE SAME THING GRAPHICALLY.

By J. E. Anderson

Technical Editor

WHY is it that phase offers such a stumbling block in radio? As soon as the term "phase" is mentioned in an article the layman stamps that article as deep, technical, abstruse.

But phase is no more incomprehensible than time. As a matter of fact, in one sense phase and time are identical. But phase includes the idea of aspect—the aspect of something at a given instant of time. It is in this dual sense of phase that the term is applied to the moon.

It is customary to define phase as the total time that has elapsed after an arbitrary start of a periodically recurrent phenomenon. Thus the phase in the Gregorian calendar is now 1927. The phase of the moon is expressed in quarters of the time of a complete revolution since new moon. In racing, the phase of each contestant is usually expressed in laps. The phase of the day could be expressed in hours since midnight. The phase of the tide is visible on the piles of a pier. The shifting sands leave their mark, too.

Phase is also defined as the total angle that has been described by the periodic phenomenon since the arbitrary start; but this is merely a special case of the previous definition, since time is nearly always measured in some kind of angular unit.

One complete period of the periodic phenomenon, or one complete cycle, such as a year, a lunar month, a day, a lap around a race course, a complete change of an alternating current, is a measure of time or of phase and each cycle contains 360 degrees in angular measure.

It's the Differences

But we are not often concerned with the total phase of a recurrent phenomenon in radio. We are interested in the difference in phase, and in the instantaneous aspect of one or more phenomena. For example, we are greatly interested in the difference in the phases of an emf (voltage) and the current which that emf drives around a given circuit. When alternating currents and voltages are considered the phase of each is counted from that instant when each is zero and is increasing. Each starts at zero, rises to a maximum, falls again to zero, decreases to a minimum, and finally rises to zero, thus completing a full cycle. The absolute values of the current (or voltage) at maximum and minimum are exactly equal, but they are in opposite directions. But the current may not reach a maximum value at the same time as the emf which is driving it through the circuit. The current may lag behind the emf or it may lead it.

When the two are not together there is a difference in phase between them. The extent and the direction of this difference depend on the type of impedance through which the emf has to drive a current.

If the impedance is a pure resistance, the phase difference is zero and the two are always together, that is, they reach corresponding values at the same instant.

When the impedance is a pure inductance the current lags behind the emf by 90 degrees, or a quarter period.

When the impedance is a pure capacitance the current leads the emf by 90 degrees, or by a quarter period. The difference in phase between the voltage and the current is usually spoken of as the phase angle or the phase difference, or even as the phase angle difference or phase difference angle.

When Two Are Together

When inductance and resistance exist together in a circuit the current lags behind the emf by an angle less than 90 degrees, that is, by a time less than a quarter period. The actual lag depends on the ratio of the reactance to the resistance. The reactance is the product of the frequency by the inductance by 6.28. The lower this ratio is, the smaller is the lag of the current behind the voltage. This case is illustrated in Fig. 1. L is the inductance, R the resistance, E the emf or voltage of the generator, and w is the frequency times 6.28. The current is obtained by dividing the emf E by the impedance Z, as shown at the right, and the impedance is obtained as also shown at the right. The impedance is numerically equal to the hypotenuse of the right triangle, of which R and wL are the short sides. The angle subtended between Z and R is the phase angle, or the angle by which the current lags behind the emf.

When the circuit contains resistance and capacity the current leads the emf by an angle less than 90 degrees, or less than a quarter period. The amount of lead depends on the ratio of the reactance to the resistance, just as in the case of the inductive circuit. But in this case the reactance is the reciprocal of the capacity times the frequency times 6.28, and it is negative, whereas the inductive reactance is positive.

In symbols the capacitive reactance is

the Sands and the Tides

—1/wC. As in the previous case, the current through the circuit is obtained by dividing the emf, E, by the impedance.

In this case the impedance is obtained as shown to the right of Fig. 2. The reactance due to the condenser is represented by an arrow drawn at right angles to R but downward. The hypotenuse is the impedance. The angle between R and Z is the phase angle, or the angle by which the current leads the emf producing it.

There is nothing unique about this phenomenon of the effect leading the cause. It occurs whenever a force acts against something springy or resilient. For example, in compressing a spring with a given periodic force the motion is greatest when the force is zero and the motion is zero when the force is maximum. The motion leads the applied force by a quarter of a period.

A Little of Each

Most radio circuits contain both capacity and inductance in addition to resistance. Such a circuit is shown in Fig. 3. The total reactance in this circuit is the difference between the inductive and the capacitive reactances. The impedance, as before, is the square root of the sum of the squares of the resistance and the net reactance. This is indicated at the right of the circuit in Fig. 3. If the inductive reactance predominates over the capacitive, the current in the circuit lags behind the emf. This case is illustrated graphically at the right of Fig. 3 where the arrow for Z is above that for R.

If the capacitive reactance predominates over the inductive the current leads the emf. This is indicated in the vector diagram at the bottom of Fig. 3. The arrow for Z is now below that of R.

In these cases the angle of lag or lead is small because the inductive and the capacitive reactances are nearly equal When they are exactly equal there is no reactance at all in the circuit and the impedance reduces to a pure resistance. The circuit is then said to be in resonance with the emf. When this condition obtains the current is in phase with the emf, that is, they both reach corresponding values at the same instants.

The Curves Of It

The heavy line E in Fig. 4 represents an alternating emf over one and one-quarter cycle. If this voltage be impressed on a circuit such as that shown in Fig. 1 the resulting current wave will be of the form marked I. This curve is always behind the voltage curve, that is, it is always to the left of the emf line.

If the voltage E is impressed on the circuit in Fig. 2 the resulting current would be as shown by the light curve marked I. This is always ahead of the voltage curve.

When there is no reactance in the circuit the current curve coincides with the emf curve, or at least they cross the zero line at the same time and reach maximum and minimum values at the same instants.

Other Cases of Phase Difference

The idea of phase difference is not confined to emf and current but may be applied to two or more emfs having the same frequency, to two or more currents having the same frequency, and by extension to variable phase difference, it can be applied to currents and voltages having different frequencies.

When the phase angle of an impedance

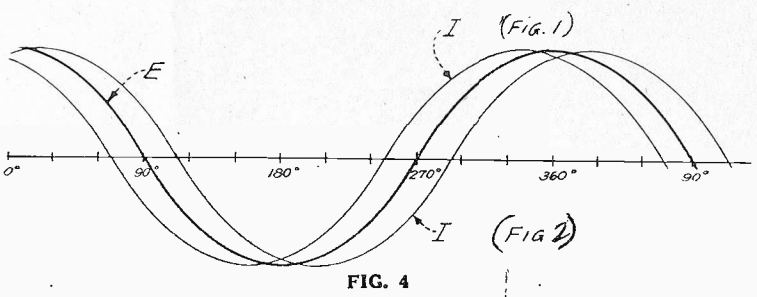
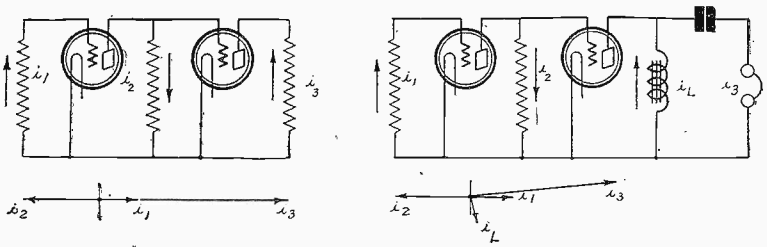


FIG. 4

THIS DIAGRAM SHOWS VOLTAGE AND CURRENT CURVES IN WHICH THERE IS A PHASE DIFFERENCE BETWEEN THE VOLTAGE AND THE CURRENT. THE HEAVY LINE IS THE VOLTAGE CURVE, THE CURVE AT LEFT IS THE CURRENT CURVE CORRESPONDING TO FIG. 1 AND THE CURVE TO THE RIGHT IS THE CURRENT CURVE CORRESPOND—ING TO FIG. 2.



PHASE DIAGRAM IN A RESISTANCE COUPLED CIRCUIT IN WHICH THE DIRECTIONS OF THE PLATE CURRENT CHANGES ARE SHOWN AT LEFT (FIG. 5). BELOW IS THE VECTOR DIAGRAM FITTING THE CASE. ALTERNATE PLATE CURRENTS ARE IN PHASE. THE SAME CIRCUIT AS IN FIG. 5, EXCEPT THAT A REACTIVE LOAD HAS BEEN SUBSTITUTED FOR A PURE RESISTANCE IN THE LAST TUBE. THE CURRENT VECTOR DIAGRAM IS SHOWN UNDER THE CIRCUIT. THE SECOND CURRENT IS IN OPPOSITE PHASE WITH THE SECOND. THE CURRENT THROUGH THE CHOKE COIL IS NEARLY A QUARTER CYCLE—BEHIND THE FIRST, AND THE SPEAKER CURRENT IS AHEAD OF THE FIRST CURRENT.

between the emf and the current in that circuit.

In a vacuum tube circuit the phase relations are interesting. Suppose that an alternating emf such as is depicted by E in Fig. 1 is impressed on the grid circuit of a tube.

This voltage will change the plate current in that tube, and these changes are in phase with the AC emf impressed on the grid, assuming there are no reactances in the plate circuit. But the effective plate voltage change resulting from the emf impressed on the grid is in opposite phase to the grid voltage. That is, when the grid voltage is maximum the plate voltage is minimum. This results from the fact that when the grid voltage and plate current are greatest the drop in the plate load is also greatest, the net voltage on the plate is the least.

Fig. 5 depicts two stages of a resistance coupled amplifier in which only the tubes and the coupling resistors are given. Suppose that a current I1 flows through the first resistor in the direction indicated by the arrow. This current lowers the grid voltage on the first tube. The current I2 in the second resistor is thus decreased, which is indicated by the arrow pointing downward.

The currents I1 and I2 are thus in opposite phase. Just as I1 and I2 are in opposite phase, I2 and I3 are in opposite phase. It is obvious, then, that I1 and I3 are in the same phase. The vector diagram under the circuit in Fig. 5 shows the

total plate currents in the three tubes, but only signal currents or variations in the plate currents.

The Effect of Reactance

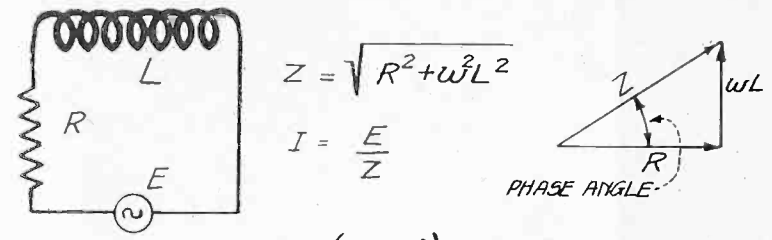
In Fig. 6 is shown a circuit in which the load on the last tube is reactive. The load is made of two branches, a high inductance choke coil and the loud speaker with its stopping condenser.

The currents in the two pure resistances are not affected by the reactances, and I1 and I2 flow as in the previous case. But the currents in the choke and the speaker no longer flow as in I3 in Fig. 5. The current IL through the choke is very small and lags behind the grid voltage, and therefore behind I1. This is indicated in the vector diagram under the circuit in Fig. 6. IL is almost 90 degrees behind I1.

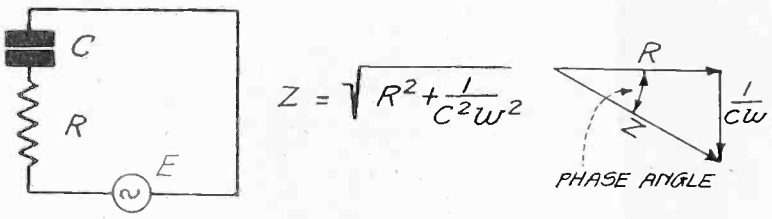
The current through the speaker and the condenser may lead or lag behind the grid voltage depending on the frequency, the inductance of the speaker and the capacity of the condenser. If the frequency is low enough to make the reactance of this branch capacitive the current will lead, and this case has been illustrated in the vector diagram in Fig. 6. The current through the speaker is represented by the longer arrow I3 which points in a direction slightly ahead of I1, and almost 90 degrees ahead of IL.

These directions were determined for a frequency of 100 cycles, a capacity of 2 mfd. in the stopping condenser, a resist-

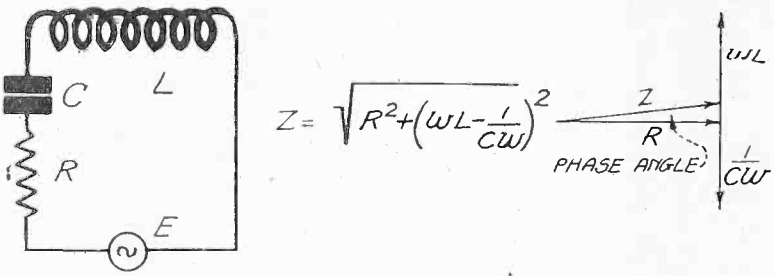
Phases that Shift Like

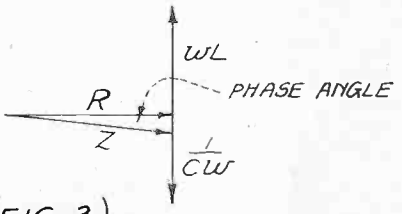


(FIG. 1)



(FIG. 2)





(FIG. 3)

FIG. 1 SHOWS A CIRCUIT CONTAINING INDUCTANCE AND RESISTANCE IN SERIES WITH AN ALTERNATING EMF E.
FIG. 2 IS A CIRCUIT CONTAINING CAPACITY AND RESISTANCE IN SERIES WITH THE EMF E.
FIG. 3 CONTAINS RESISTANCE, INDUCTANCE AND CAPACITY IN SERIES WITH THE EMF E.
THE FORMULAS AT THE RIGHT OF THE CIRCUIT SHOW THE MANNER IN WHICH THE IMPEDENCE IS OBTAINED, AND THE VECTOR DIAGRAMS SHOW THE SAME THING GRAPHICALLY.

By J. E. Anderson

Technical Editor

WHY is it that phase offers such a stumbling block in radio? As soon as the term "phase" is mentioned in an article the layman stamps that article as deep, technical, abstruse.

But phase is no more incomprehensible than time. As a matter of fact, in one sense phase and time are identical. But phase includes the idea of aspect—the aspect of something at a given instant of time. It is in this dual sense of phase that the term is applied to the moon.

It is customary to define phase as the total time that has elapsed after an arbitrary start of a periodically recurrent phenomenon. Thus the phase in the Gregorian calendar is now 1927. The phase of the moon is expressed in quarters of the time of a complete revolution since new moon. In racing, the phase of each contestant is usually expressed in laps. The phase of the day could be expressed in hours since midnight. The phase of the tide is visible on the piles of a pier. The shifting sands leave their mark, too.

Phase is also defined as the total angle that has been described by the periodic phenomenon since the arbitrary start; but this is merely a special case of the previous definition, since time is nearly always measured in some kind of angular unit.

One complete period of the periodic phenomenon, or one complete cycle, such as a year, a lunar month, a day, a lap around a race course, a complete change of an alternating current, is a measure of time or of phase and each cycle contains 360 degrees in angular measure.

It's the Differences

But we are not often concerned with the total phase of a recurrent phenomenon in radio. We are interested in the difference in phase, and in the instantaneous aspect of one or more phenomena. For example, we are greatly interested in the difference in the phases of an emf (voltage) and the current which that emf drives around a given circuit. When alternating currents and voltages are considered the phase of each is counted from that instant when each is zero and is increasing. Each starts at zero, rises to a maximum, falls again to zero, decreases to a minimum, and finally rises to zero, thus completing a full cycle. The absolute values of the current (or voltage) at maximum and minimum are exactly equal, but they are in opposite directions. But the current may not reach a maximum value at the same time as the emf which is driving it through the circuit. The current may lag behind the emf or it may lead it.

When the two are not together there is a difference in phase between them. The extent and the direction of this difference depend on the type of impedance through which the emf has to drive a current.

If the impedance is a pure resistance, the phase difference is zero and the two are always together, that is, they reach corresponding values at the same instant.

When the impedance is a pure inductance the current lags behind the emf by 90 degrees, or a quarter period.

When the impedance is a pure capacitance the current leads the emf by 90 degrees, or by a quarter period. The difference in phase between the voltage and the current is usually spoken of as the phase angle or the phase difference, or even as the phase angle difference or phase difference angle.

When Two Are Together

When inductance and resistance exist together in a circuit the current lags behind the emf by an angle less than 90 degrees, that is, by a time less than a quarter period. The actual lag depends on the ratio of the reactance to the resistance. The reactance is the product of the frequency by the inductance by 6.28. The lower this ratio is, the smaller is the lag of the current behind the voltage. This case is illustrated in Fig. 1. L is the inductance, R the resistance, E the emf or voltage of the generator, and w is the frequency times 6.28. The current is obtained by dividing the emf E by the impedance Z, as shown at the right, and the impedance is obtained as also shown at the right. The impedance is numerically equal to the hypotenuse of the right triangle, of which R and wL are the short sides. The angle subtended between Z and R is the phase angle, or the angle by which the current lags behind the emf.

When the circuit contains resistance and capacity the current leads the emf by an angle less than 90 degrees, or less than a quarter period. The amount of lead depends on the ratio of the reactance to the resistance, just as in the case of the inductive circuit. But in this case the reactance is the reciprocal of the capacity times the frequency times 6.28, and it is negative, whereas the inductive reactance is positive.

In symbols the capacitive reactance is

the Sands and the Tides

—1/wC. As in the previous case, the current through the circuit is obtained by dividing the emf, E, by the impedance.

In this case the impedance is obtained as shown to the right of Fig. 2. The reactance due to the condenser is represented by an arrow drawn at right angles to R but downward. The hypotenuse is the impedance. The angle between R and Z is the phase angle, or the angle by which the current leads the emf producing it.

There is nothing unique about this phenomenon of the effect leading the cause. It occurs whenever a force acts against something springy or resilient. For example, in compressing a spring with a given periodic force the motion is greatest when the force is zero and the motion is zero when the force is maximum. The motion leads the applied force by a quarter of a period.

A Little of Each

Most radio circuits contain both capacity and inductance in addition to resistance. Such a circuit is shown in Fig. 3. The total reactance in this circuit is the difference between the inductive and the capacitive reactances. The impedance, as before, is the square root of the sum of the squares of the resistance and the net reactance. This is indicated at the right of the circuit in Fig. 3. If the inductive reactance predominates over the capacitive, the current in the circuit lags behind the emf. This case is illustrated graphically at the right of Fig. 3 where the arrow for Z is above that for R.

If the capacitive reactance predominates over the inductive the current leads the emf. This is indicated in the vector diagram at the bottom of Fig. 3. The arrow for Z is now below that of R.

In these cases the angle of lag or lead is small because the inductive and the capacitive reactances are nearly equal When they are exactly equal there is no reactance at all in the circuit and the impedance reduces to a pure resistance. The circuit is then said to be in resonance with the emf. When this condition obtains the current is in phase with the emf, that is, they both reach corresponding values at the same instants.

The Curves Of It

The heavy line E in Fig. 4 represents an alternating emf over one and one-quarter cycle. If this voltage be impressed on a circuit such as that shown in Fig. 1 the resulting current wave will be of the form marked I. This curve is always behind the voltage curve, that is, it is always to the left of the emf line.

If the voltage E is impressed on the circuit in Fig. 2 the resulting current would be as shown by the light curve marked I. This is always ahead of the voltage curve.

When there is no reactance in the circuit the current curve coincides with the emf curve, or at least they cross the zero line at the same time and reach maximum and minimum values at the same instants.

Other Cases of Phase Difference

The idea of phase difference is not confined to emf and current but may be applied to two or more emfs having the same frequency, to two or more currents having the same frequency, and by extension to variable phase difference, it can be applied to currents and voltages having different frequencies.

When the phase angle of an impedance

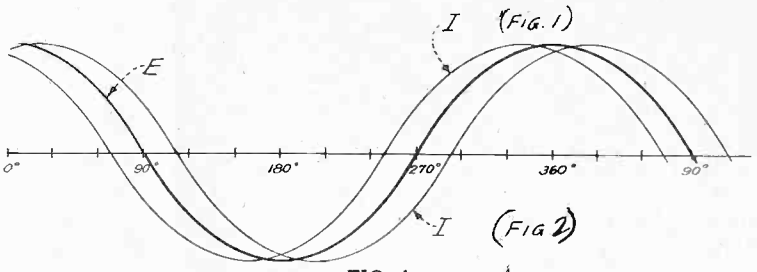
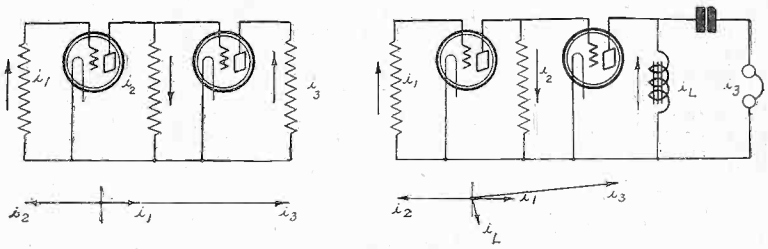


FIG. 4

THIS DIAGRAM SHOWS VOLTAGE AND CURRENT CURVES IN WHICH THERE IS A PHASE DIFFERENCE BETWEEN THE VOLTAGE AND THE CURRENT. THE HEAVY LINE IS THE VOLTAGE CURVE, THE CURVE AT LEFT IS THE CURRENT CURVE CORRESPONDING TO FIG. 1 AND THE CURVE TO THE RIGHT IS THE CURRENT CURVE CORRESPOND-— ING TO FIG. 2.



PHASE DIAGRAM IN A RESISTANCE COUPLED CIRCUIT IN WHICH THE DIRECTIONS OF THE PLATE CURRENT CHANGES ARE SHOWN AT LEFT (FIG. 5). BELOW IS THE VECTOR DIAGRAM FITTING THE CASE. ALTERNATE PLATE CURRENTS ARE IN PHASE. THE SAME CIRCUIT AS IN FIG. 5, EXCEPT THAT A REACTIVE LOAD HAS BEEN SUBSTITUTED FOR A PURE RESISTANCE IN THE LAST TUBE. THE CURRENT VECTOR DIAGRAM IS SHOWN UNDER THE CIRCUIT. THE SECOND CURRENT IS IN OPPOSITE PHASE WITH THE SECOND. THE CURRENT THROUGH THE CHOKE COIL IS NEARLY A QUARTER CYCLE— BEHIND THE FIRST, AND THE SPEAKER CURRENT IS AHEAD OF THE FIRST CURRENT.

between the emf and the current in that circuit.

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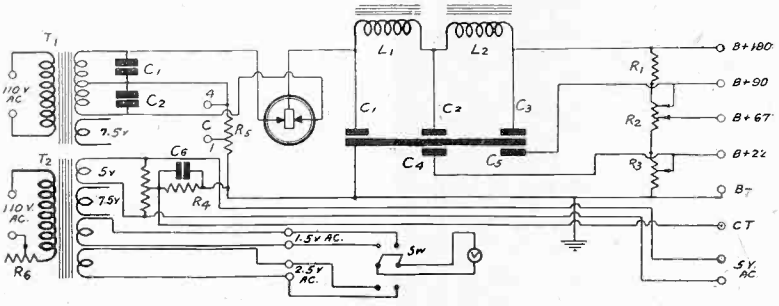
These directions were determined for a frequency of 100 cycles, a capacity of 2 mfd. in the stopping condenser, a resistance of 2,000 ohms and an inductance of 1

A Complete Driver

By Robert



THE CIRCUIT DIAGRAM.

A COMPLETE driver for an AC set is illustrated herewith and consists of a filament transformer and a B supply. The power transformer, used in the B supply, has three windings. One is the primary, which connects to the 110 volts AC main. Two are secondary windings, one of which supplies the high voltage and is tapped at its center, the other winding delivering 7.5 volts and not center tapped. The 7.5 volt winding is to supply the filament current of a power tube that may require that voltage. However, it is not used in the power supply now under discussion.

The filament supply transformer has five windings. The 110 volt primary winding has a 250 ohm rheostat in series with it which is used to control the secondary voltages. There is a 1.5 volt secondary winding which supplies the filaments of the type—26 amplifier tube, and a 2.5 volt coil to deliver the necessary voltage for the—27 type detector tube. Both of these are AC tubes.

To assure correct voltages for these AC tubes an 0-3 AC voltmeter is connected to a control switch in such manner as to connect the meter to either of these windings, thereby allowing for a proper adjustment of the filament voltages. There are two other low voltages on the filament transformer, one of which is 5 volts and supplies the necessary current for two—371 power tubes. The additional 7.5 volt winding is not used.

Uses Q. R. S. Tube

The high AC voltage delivered by the transformer is to be converted to DC and is accomplished by a Q. R. S. tube which will deliver 85 milliamperes of current. The high inductance choke coils are encased in one container and afford an efficient means of filtering the rough DC, leaving the rectified tube. This is done in conjunction with the bank of high capacity condensers which are also encased in one container.

Such features as all the condensers being in one metal container and the two chokes in another assist in making a compact design.

The voltages are divided into required values by a bank of variable and fixed resistances connected across the output. This supplies the necessary B voltage such as 22 to 45 for the detector, 60 to 90 for the RF, 60 to 135 for the first stage of AF and 180 volts for the power tube. There are also various C voltages that may be required by any type of receiver.

The front and sub-panel measure 8x10 inches. Two Benjamin brackets are used to support them and it will be noticed that the choke coil unit and the two transformers are mounted close together at the rear portion of the sub-panel with the double choke unit at the extreme left hand side. The high voltage transformer unit is in the center and to the left of this is the low voltage transformer, just in front of this transformer the condenser block is mounted with the base of this unit so measured that the hole used to support it is in direct line with that of the support bracket.

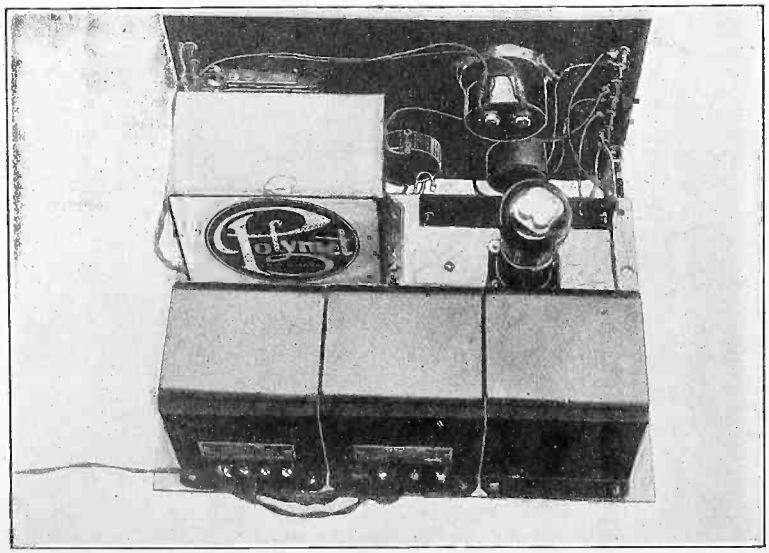
Mounting Advice

To the left of the large condenser block, the rectifier tube socket is mounted, in front of this socket the resistor strip R1 is supported with the aid of two small brackets.

Now the buffer condensers C1 and C2 are mounted beneath the sub-panel below the power transformers. The long leads furnished with these condensers are long enough to be connected to their respective terminals without the necessity of additional wire. The resistances, R4, R5 and R6, are also mounted below the sub-panel. R6 is used to obtain a center tap from the 5 volt winding, whereas R5 is used to obtain two C voltages 1 and 4½. The resistor R4 is a 5,000 ohm variable unit and is used to deliver a C bias of 40 volts for the —71 power tubes. The various voltages may not all be used but it was the writer's intention to build the unit so it could be used with any type of receiver.

After drilling the sub-panel, support the two transformers and choke unit in the proper position and keep them as close together as possible. This you will notice will relieve the strain on the sub-panel.

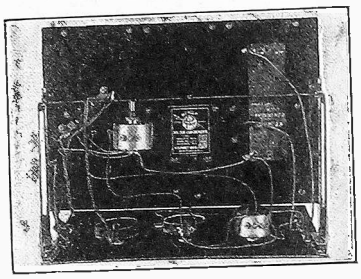
At the left hand side of the front panel the A.C. voltmeter is mounted, just to the right of this is the change over switch, used to determine voltage of the two low A.C. windings. Below the switch the primary rheostat R6 is mounted. To the left of this switch is the center of the panel the four terminal potentiometer R2



THE REAR VIEW.

for an AC Set

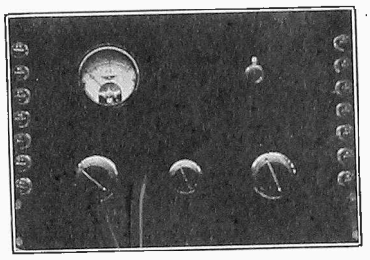
Frank Goodwin



A PEEK UNDER THE SUBPANEL.

All the filament binding posts are mounted to the right hand side of the front panel with the two 5 volt posts at the top, next the 2.5 volt posts and then the two 1.5 volt posts. In wiring these two windings (2.5 V and 1.5 V) to their respective posts it is advisable to use two pieces of Braidite wire for each connection. Then twist both double leads of each winding together. This is advised due to the fact that the current to be carried by these leads is quite high.

The two center posts of the voltmeter switch are connected to the meter and the remaining four, two of each go to their respective windings that connect to the binding post on the front panel.



THE FRONT PANEL.

LIST OF PARTS

T-1—One General Radio transformer, type 365.

T-2—One General Radio transformer, type 440A.

L1 L2—One General Radio filter choke, type 366.

One General Radio Center Tap Resistance, type 439.

C1 to C5—One Polymet bank condenser, type F1000.

C1-2—One Polymet HiVolt buffer condenser.

One Benjamin Cler-A-Tone Socket.

One Set of Benjamin Brackets Type No. 9029.

R2—One Centralab 5,000 ohm fourth terminal variable resistance, type PP5,000.

R3-4—2 Centralab Heavy Duty Potentiometer Type HP-005.

R6—1 Centralab 250 ohm Power Rheostat Type PR250.

R1—One Centralab 3464 ohm tapped resistance type FT3464.

R5—One Centralab 209 ohm Tapped Resistance Type FT209.

One Q.R.S. 85 Mil rectifier tube.

V—One Jewell 0-3 A.C. voltmeter.

SW—One Yaxley voltmeter switch type No. 69.

Two Rolls of Corwico Braidite wire.

Two 8 in x 10 inch Westinghouse Micarta panels.

Thirteen Eby binding posts.

One B Power, one 90 volts, one 45 volts, one C bat., one C power, one CT, one B, four A, two A.

is situated and at the left of this the three terminal potentiometer R3 is mounted.

Connections Explained

The condensers C5 should be connected to the arm of R2, used to obtain the 90 volts, whereas C4 is connected to the arm of R3. This is the detector tap.

The condenser C6, not shown in the photograph, is very effective, it is to be mounted beneath the sub-panel as close to R4 as possible.

In the diagram, the resistance R5 is connected before the common lead of the condenser bank. This is very important and care should be taken not to become confused when wiring.

Simpler Panel Marks, Improvement in Sets

By Joey Ruby

Are you one of the many millions or radio fans who have had a set for several years and are debating whether you should discard it for the latest model? And yet the doubt enters your mind concerning future developments that may again antiquate the present models. You want to throw away the old receiver and yet you aren't sure of the new ones. And what is more, there are about 10,000,000 other set owners in the same predicament.

Just think of it! There are some ten million radio receivers in existence which may be classed as either good, bad or indifferent. Some of these are in service day and night, others are employed only part of the time, as their owners have lost interest in their antiquated performance; while others lie dusty in some attic, closet or cellar. Yet these same sets can be modernized at a very moderate cost by adding some simple accesories.

Sets Are Simpler

"New Sets for Old" and it can be done easily. After all, just what is the difference between the latest set on the market and the one you bought or built a year or two ago? The circuits are practically the same. The main difference lies in the simplicity of operation and appearance. For one the panel has been cleared of the multiplicity of controls, particularly those several rheostat knobs. Your controls now usually consist of a simple tuning device, a filament switch and a volume control.

A simple device, the amperite adapter, makes it possible to modernize any receiver by simplifying the appearance of the panel and reducing the controls to three, namely, the tuning device, filament switch and the volume control. In a single step the problem of filament control has been solved.

The amperite adapter system is simplicity itself, consisting of a simple base with clips to take two standard amperite units which snap into place. This operation requires no tools. The adapter itself connects the amperites in parallel this providing their combined current carrying capacity. This combination is inserted in the A minus lead between the stoppage battery and the set.

Snap Right In

The ends of the wires are gripped by the snap terminals of the adapter then the hand rheostats on the set are turned on full and permanently left in that position. The set is now rejuvenated and ready for automatic filament operation. Moreover, the set owner is now assured the maximum efficiency from his tubes, together with the full life from each tube. Likewise the tone distortion so often rising from the tubes being operated at incorrect filament temperatures is overcome by this automatic means of maintaining tubes at correct operating temperatures for ample electronic emission for the plate circuit requirements.

By properly choosing amperites of the proper ratings for the adapter, according to a given table, it is possible to take care of any receiver from the simple 3 tube set to one of 7 or more tubes.

Pacent Is First One With an A C Pick-up

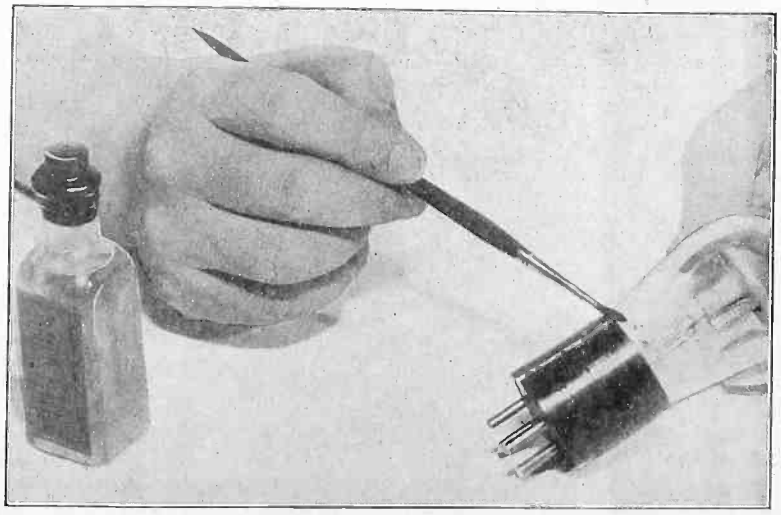
The Pacent Radio Corporation has developed a Phonovox electrical pick-up equipped with an adapter for use on sets using AC tubes.

This AC outfit will have the same list price as the regular Pacent Phonovox, and will be known as Catalog No. 105-AC. J. J. Ryan, treasurer, said:

"We fully believe there is a big opportunity for distributors and dealers to cash in by selling this AC type Phonovox wherever sets incorporating AC tubes have been sold. As we have tested out the performance of our device with the new sets and have found same highly satisfactory, we feel that the operation of the Phonovox with AC sets will help considerably the sale of the Phonovox with all other type sets."

TIN PAN ALLEY TAKE NOTICE!

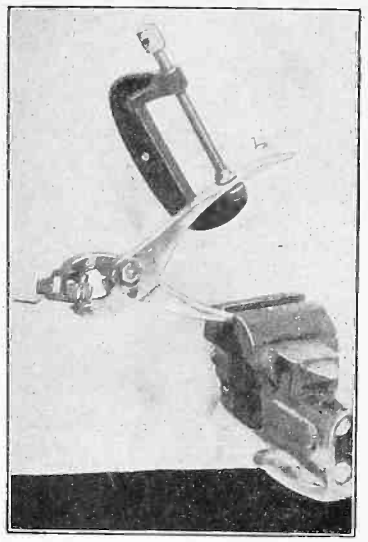
A METAL DISH PAN CAN BE MADE TO TALK BY CONNECTING THE POSITIVE TERMINALS OF THE B BATTERY TO IT AND THEN GRASPING THE LEAD FROM THE POWER TUBE PLATE IN ONE HAND AND TOUCHING THE DISH PAN WITH THE OTHER. IF THE HANDS ARE MOIST A SHOCK MIGHT BE EXPERIENCED



(Photographs by Herbert E. Hayden.)

SOMETIMES THE CEMENT HOLDING THE GLASS TUBE TO THE BASE BREAKS, ALLOWING THE TUBE TO TURN IN THE BASE. THIS OFTEN LEADS TO SHORT-CIRCUITING OF THE LEADS AND TO BREAKING THE SEAL WHERE THE LEADS ENTER TE VACUOUS SPACE. TO FASTEN A LOOSE BASE APPLY WOOD ALCOHOL AS SHOWN AND LET DRY. THE CEMENT IS SOLUBLE IN ALCOHOL

WORK HELD FIRM



IF ONE SHOULD HAVE THE HIVES AND POSSESS ONLY ONE ARM, EVEN THOUGH NOT A PAPER-HANGER, OCCUPATION MIGHT BE DIFFICULT WERE IT NOT FOR INGENUITY LIKE THIS. FIGURE IT OUT FOR YOURSELF

Where Chance Cuts No Ice at All

Some intermediate frequency transformers have been designed to work with tubes of standard characteristics and give the maximum voltage step-up of which such tubes and transformers are capable. The matching has been effected by properly choosing the primary and secondary turns, the mutual inductance between the two windings, and the resistance of the secondary circuit. This resistance feature particularly has been brought to the highest peak of efficiency and it accounts more than any other thing for the remarkable results reported for the Magnaformer circuit. There is a metal band around the coil form which has the effect of a short-circuited turn. This stabilizes the circuit and at the same time introduces resistance into the tuned secondary circuit, which resistance is necessary to effect proper matching of the plate impedance of the tube with the impedance of the coil for maximum voltage transfer at the tuned frequency. Hence the band, theoretically a losser, actually is a gainer, as the curve shows. The adjustment of the intermediate transformers to the same frequency has been very carefully done and the adjustment has been made so it stays put after the coil leaves the laboratory.

What makes one Super-Heterodyne superior to others of the type? Is it mere accident that one picks up distant stations with clock-like regularity and certainty while others fail except under the most favorable conditions?

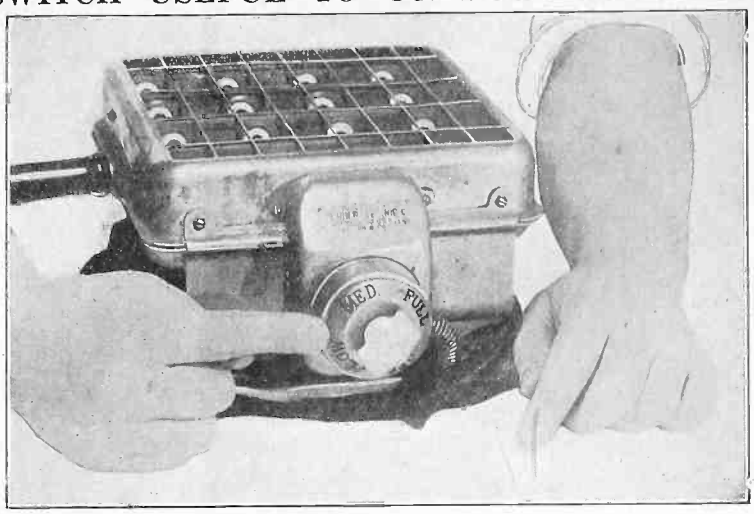
Is it mere chance that the quality of the one should be superb while that of the other is atrocious? Did the fates decide that the selectivity of one should be as incisive as that of the others is obtuse? Is it merely a remarkable coincidence that the sensitivity, the selectivity and the quality are all combined in one in the optimum degree?

Chance, fate and accident have little to do with it. One is superior in all phases because every component part has been designed as dictated by laboratory results.

EASY COLORATION

A METAL SCREW HEAD ON THE PANEL WILL BE MUCH MORE ATTRACTIVE IF IT IS BLUED. HOLD THE HEAD IN THE FLAME OF AN ALCOHOL - BURNING JEWELER'S LAMP, AS IS DONE HERE, UNTIL THE HEAD IS BLUE

SWITCH USEFUL TO COMPARE SPEAKERS



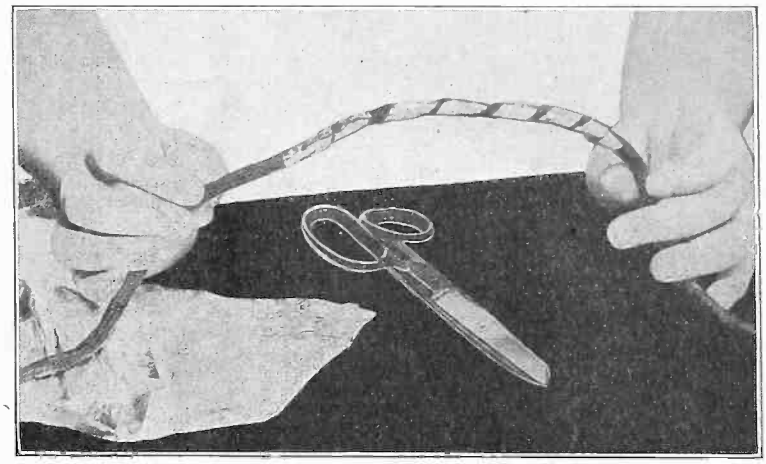
A SWITCH USED ON MANY ELECTRICAL APPLIANCES FOR VARYING THE CURRENT CONSUMED CAN BE USED FOR CONNECTING LOUDSPEAKERS IN SERIES OR PARALLEL. HERE SUCH A SWITCH IS SHOWN MOUNTED ON A WAFFLE IRON. THE SWITCH IS OBTAINABLE INDEPENDENTLY AT HARDWARE STORES

WHAP Moves to New Jersey

WHAP, formerly located in New York City, has moved to Carlstadt, N. J., less then ten miles west of Fort Lee ferry.

The station has a regular schedule on 1,000 watts, according to Franklin Ford, manager of the station which shares time with WMSG and WBNY. The studio will continue to be located at 9 West 96th Street, New York City.

The cost of the new station was estimated at $30,000, not including the cost of the transmitting apparatus proper.



SHIELDING OF LONG LEADS CAN BE ACCOMPLISHED BY WRAPPING AN INSULATED PAIR WITH METAL RIBBON OR STRIPS OF TINFOIL. THE STRIPS SHOULD BE GROUNDED TO BE MOST EFFECTIVE

Daven 6 Years Old; Announces Davohms

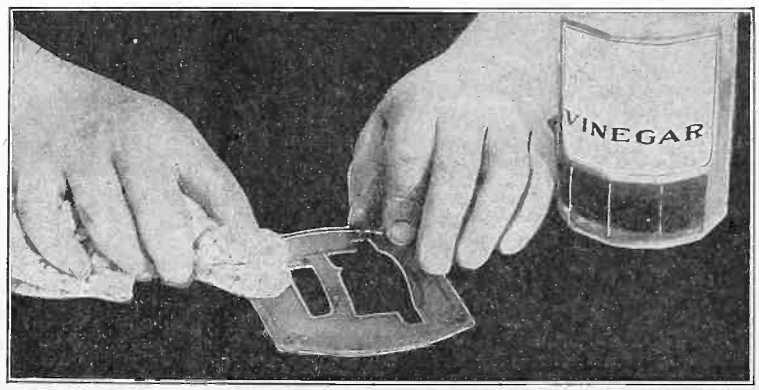
Introduction of a new line of heavy duty wire wound resistors, to be known as Davohms, marked the celebration of the sixth anniversary of the Daven Radio Corporation of Newark, New Jersey.

The Daven Radio Corporation was founded just one year and a few days after the inauguration of the first radio broadcasting station in America, KDKA, and was the pioneer radio company devoted exclusively to the manufacturing of radio resistors.

MacMillan in Arctic Hears WEAF Programs

The programs of WEAF are being heard in the Far North by the Donald MacMillan Arctic Expedition, according to messages received from the operator of station WNP, aboard the expedition schooner, "Bowdoin."

For several months, Arthur Giammatteo, a member of the WEAF staff, has been in communication with WNP from his home, through a 100 watt transmitter 2VI.



IF THE ESCUTCHEON ON YOUR PANEL IS DISCOLORED RUB IT WITH A CLOTH MOIST WITH VINEGAR AND IT WILL BRIGHTEN.

Radio University

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

When writing for information give your Radio University subscription number.

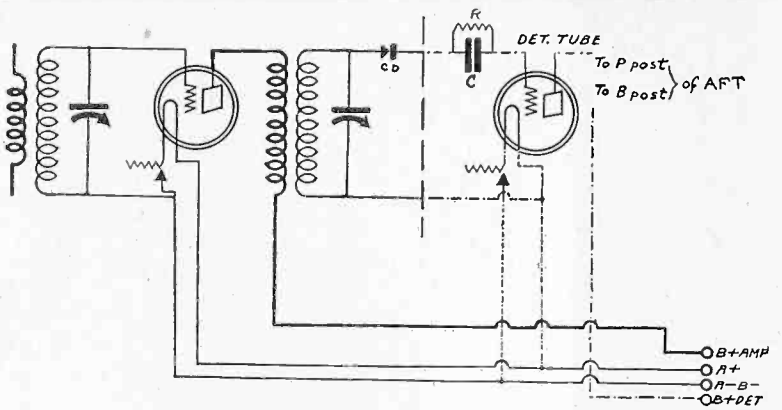


FIG. 583
CIRCUIT SHOWING HOW TO HOOK UP A TUBE DETECTOR IN PLACE OF A CRYSTAL.

UPON LOOKING over the Radio University department of the November 5 issue of RADIO WORLD, I noticed a circuit diagram showing how to hookup a jack, so that it is possible to throw in the antenna or the loop, by simply inserting or taking out a plug attached to the loop leads. I would like to add this extra tube to my set, which is a 4-tube affair, using a regenerative detector and three stages of resistance coupled audio.

(1)—Could I use a radio frequency coil having a 15 turn primary and a 52 turn secondary? These windings are on a 3 inch tubing. No. 22 double cotton covered wire is used.

(2)—What capacity variable condenser should be employed?

(3)—Could a 20 ohm rheostat be used in the filament circuit of the radio frequency amplifier tube?

(4)—I have a loop, which is 2 feet square. It contains 15 turns. Can this be used?—Willis McGraph, Atlantic City, N. J.

(1)—Yes.
(2)—Use a .0005 mfd. type.
(3)—Yes.
(4)—Yes.

* * *

I HAVE the circuit diagram of a five-tube receiver, consisting of a tuned radio frequency stage, a non-regenerative detector and three stages of resistance coupled audio. I would like to have the following questions regarding this set answered.

(1)—I have two coils with 10 turn primaries, and 45 turn secondaries. Each primary and each secondary is wound on a 3-inch tubing with No. 22 double cotton covered wire. Can they be used with .0005 mfd. variable condensers?

(2)—The filaments of the detector and the RF tubes are controlled by a rheostat. Would a twenty ohm fit the bill?

(3)—Could a No. 4A Amperite be used to control the filaments of the audio tubes, two of which will be —O1A type and one of the 112 type?

(4)—Do you think I could build this set on a baseboard 7 inches wide and 21 inches long?

(5)—If I place the coils 9 inches away from each other, could I do without shields?

(6)—I intend using 157½ volts on the plate of the 112, feeding this to a cone speaker. The diagram does not show any choke coil and condenser or coupling transformer. Would you advise the insertion of one of these?—STANLEY FRANKLIN, Atlantic City, N. J.

(1)—Yes, these coils can be used, provided the RF and detector portion of the set is of the standard type with no special neutralizing or variable features.

(2)—Suggest you use the rheostat in the RF filament leg only, employing a 1A Amperite in the detector filament circuit.

(3, 4 and 5)—Yes.

(6)—Use the choke coil and condenser The choke should have an inductance of 35 henrys or more, while the condenser a capacity of at least 4 mfd.

* * *

PLEASE SHOW how to hookup a tube in place of a crystal detector. I have a 5-tube set using two tuned RF stages, a crystal detector and three resistance coupled audio stages. I wish to use a rheostat in the detector filament circuit and a transformer after the detector, this to be followed by two resistance coupled audio stages.—RALPH KINNERS, Louisville, Ky.

See Fig. 583 for the essential changes in substituting a tube detector for a crystal. The light dashed lines show the necessary additions, all placed to the right of the heavy vertical dashed line. The crystal of course is either short-circuited or removed.

* * *

I HAVE seen many references to plate rectification and am in the dark as to exactly what this term means. Does this mean the application of a small voltage, say about 1½ volts, to the grid of the detector tube, in place of the grid leak and detector in series with the G post of the detector tube socket? Isn't this also referred to as grid bias detection many times?—FRANK WILLSTAR, San Francisco, Calif.

You are correct about the plate rectification, as well as the grid bias detection. They are the same.

* * *

I HAVE a Metro-Super Six receiver. The rheostat has burnt out, and I wish to replace it. What is its ohmage?

(2)—In looking for the rheostat trouble, I accidently broke the fixed condenser leads. They are of the .0005 mfd. type and shunted somewhere in the primary and secondary circuit of the audio transformers. What are their exact location in the set?—FULTON MANN, Chicago, Ill.

(1)—Use a 10 ohm rheostat.

(2)—One is shunted across the primary circuit of the first audio circuit, or between the P and B plus post. Another is connected between the B plus 135 volt post and the minus A, while another is connected between the G and F posts of the second audio transformer.

* * *

IS IT true that the C battery will last as long when used in a set as when standing on the shelf?

(2)—Does the efficiency of a set suffer if plain binding posts are substituted for jacks? — JACK WARRENS, Detroit, Mich.

(1)—Yes.
(2)—No, as long as the contact is solid.

* * *

I AM going to build a 6-tube set with three stages of radio frequency amplification, a non-regenerative detector and two transformer audio stages. I intend using only one tuned RF stage, the other two to be untuned. The filaments of the tubes in the untuned RF stages are to be rheostat controlled, as are the detector and third tuned RF stage filaments. In series with the antenna, a 2,000 ohm variable resistance is to be used. The plate voltage on the first tube is to be controlled with a 10,000 ohm variable resistance. So that I may be certain that I am applying the correct voltage to all of the tubes, I intend using a voltmeter. I also have a 0 to 50 milliameter which I am going to insert, so as to know just what the tubes are drawing. Now, then, will you please give a panel layout for such a set, using a Lignole inlaid panel? ARTHUR MELKIN, Los Angeles, Calif.

The panel layout is shown in Fig. 584. The three rheostats are to be seen at the extreme left and right sides, with another exactly in the center. The antenna control and the plate voltage controls are to be seen underneath the meters. The panel is 7 inches high and 24 inches long.

* * *

THE DESCRIPTION of the Laboratory Super in the November 19, 26 and December 3 issues of RADIO WORLD so impressed me, that I am going to build this receiver. Before going ahead, however, I would like to know:

(1)—I note that no provision is made for an output transformer or choke. Is this correct?—LAURENCE RALPHSTADER, Boston, Mass.

(1)—It is highly desirable that an output transformer such as Silver-Marshall 221 or 222 be used between the receiver and the loudspeaker. This unit has not been included in the set, since the ideal way to build is to leave out the audio stages entirely and use, instead, a power pack such as the Silver-Marshall Unipac—a power amplifier and B supply combined.

The first audio tube may be built into the Unipac, e. g., a CX326 tube, with the first audio transformer in the set itself. In this case, the Unipac would serve beautifully as a phonograph amplifier with a record pick-up connected to the CX326 input tube's grid circuit, or as a two stage amplifier for the radio set with the secondary of the single audio transformer in the set connected to the Unipac in place of the record pick-up by means of a single phone cord.

* * *

ALL THE members of our Radio Club have read the very interesting series of articles on the Winner receiver which appeared in the October 1, 8, 15, 22 and 29 issues of RADIO WORLD. We are going to build it. I have been requested to ask your excellent University department several questions on this set.

(1)—It is noted that the Hammarlund coil and condenser arrangement is just opposite to the regular way. That is, the coil seems to be upside down. In most sets, the variable primary faces the bottom, while here it faces the top. Which is the better, or is it just a matter of taste?

(2)—When connecting up a power device to the set, should the power tube be inserted in the receiver or in the power device?

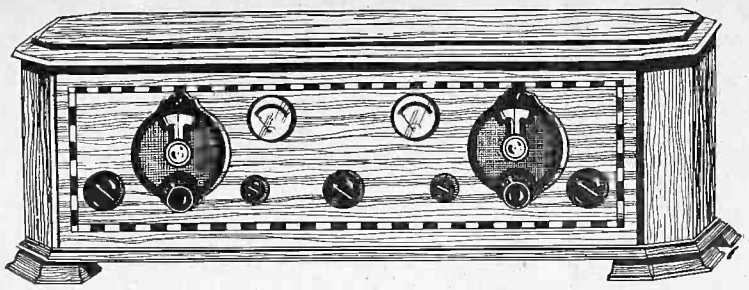


FIG. 584
PANEL LAYOUT REQUESTED BY ARTHUR MELKIN.

(3)—Is it only necessary to take out the ballast resistor in the last filament circuit, so that the AC winding may be attached to the filament posts of the socket, to light the filament of this tube?

(4)—Is a special filament switch necessary here?

(5)—Could a Bakelite be used instead of wood for the baseboard?

(6)—Will the set give good results on an indoor antenna, or is it necessary to use an outdoor antenna? If the indoor antenna is all right, how should it be installed? If not, how long an outdoor antenna should be employed?—WILFRED KENTON, City Island, N. Y.

(1)—Just a matter of taste. Don't change it around, however. You will become confused as to the wiring if you follow the picture diagram shown in the October 29 issue as well as the textual directions. It will also necessitate the switching about of the socket and variable condensers. The results will be the same, though, with either.

(2)—This receiver is wired up for the insertion of the power tube in the set. If, however, you have a power device with the tube included, just connect the secondary terminals F and G of the last audio transformer to their respective posts in the power and amplifier device.

(3)—Yes. Be sure, though, that there is no connection whatsoever from the battery to the filament posts of this tube.

(4)—No, since the shutting off of the power from the eliminator also cuts this supply off, since it all comes from one source.

(5)—It is advisable to use the wooden baseboard, since with Bakelite you will need a special bracket to raise the baseboard. This is to prevent the screws and nuts which will project from scratching up anything the set is placed on.

(6)—The outdoor antenna is suggested. This should be of the average length, or 100 feet, including the leadin. With this antenna you can use the full amount of turns on the primary. If you use a longer antenna, then use one-half the primary. If you have to use the indoor antenna, it should be at least 65 feet long in one stretch, with no bends or turns. By placing the wire around the moulding several times, so that about 100 feet of wire is used, the results will be fairly satisfactory.

* * *

I HAVE a diagram of a 6-tube set showing two tuned radio frequency stages, a non-regenerative detector and two transformer coupled audio stages, two tubes being connected in parallel in the last audio stage. The filaments of the detector and the radio frequency tubes are controlled by a single 6 ohm rheostat.

(1)—Would I get better results if I used a separate rheostat in the first radio frequency filament circuit and the 6 ohm rheostat in the second radio frequency and detector filament circuits?

(2)—Must both tubes in the parallel-audio stage be of the same type?

(3)—If so, how would two 112 tubes work out?

(4)—Could I used a 4A Amperite for the filament control of these two tubes?

(5)—Is the same grid bias used for both these tubes."—IRVING TRAM, Schenectady, N. Y.

(1)—Yes, this would work out very satisfactorily.

(2)—Yes, for best results.

(3)—Fine.

(4)—Yes.

(5)—Yes.

* * *

I AM thinking of building a 2-tube receiver, consisting of a single tuned radio frequency stage which is regenerative, a coil being shunted by a variable condenser in the plate circuit to make the tube oscillate, as well as a regenerative detector, with a variable plate coil. The only means of coupling between the radio frequency and the detector tube is the grid condenser, which has a capacity of .0005 mfd. The filaments of both tubes are each controlled by 10 ohm rheostats. Would it be advisable to build such a set?—HARRIS JULIAN, Kingston, New York.

No, you would find it too difficult to tune.

* * *

SEVERAL MONTHS ago I saw the circuit diagram of a 4-tube receiver, using the condenser feedback system of regeneration in the detector tube. I have redrawn this diagram, as best I could from memory and, so that I may be sure that I am on the right track, I would appreciate having the following queries answered. The set consists of a tuned radio frequency stage, the detector and two transformer audio stages.

(1)—The secondaries of both the antenna and detector coils are tapped in the center. The tap from the antenna coil is brought to the minus A, while the other tap lead is brought to the plus A. The regeneration condenser is connected between the plate and the end of the secondary winding of the detector coupling coil. Are all these points all right?

(2)—I do not remember seeing any radio frequency choke in the set, and I would like, therefore, to insert one, but am at a loss on exactly how to go ahead. I have a 65 millihenry choke and wonder if this could be used.—GERALD HONFRAM, Salt Lake City, Utah.

(1)—Yes. Be sure that the end of the secondary winding of the antenna coil is brought to the rotary plate section of the variable condenser, which has its stator connected to the beginning of the winding and to the grid post on the socket. This also applies to the detector coil secondary winding, except that the beginning of the secondary winding is brought to the grid condenser and leak.

(2)—You can use the choke you have. Simply break the lead going from the rotary plate post of the regenerative condenser, this being connected to the plate post of the detector tube socket, to the P post on the audio transformer. Then insert the RF choke here. You will note that it is in series with the plate and the P post. Now, procure a .0005 mfd. fixed condenser and connect it from the P post of the detector tube socket to the minus A.

* * *

A DIAGRAM of a 4-tube set with a regenerative detector, a non-regenerative detector and two transformer stages was recently given to me. I have nearly all the parts to build the set. I think that the missing parts can be left out. In series with the B plus lead of the first audio tube, an audio choke and condenser is inserted. Cannot the choke be left out? The condenser is connected between the minus A and plus B.

(2)—The filaments of both audio tubes are controlled by a single ballast. Could I use a separate ballast in the filament circuit of each tube? An -01A tube is to be used in the first audio stage and a 171 in the last stage.

(3)—A pilot light is shunted across the plus A and minus A lead. Can't this be left out?

(4)—Separate voltages for the radio frequency, detector, first audio and second audio tubes are indicated. Is it possible to use a common voltage for the radio frequency and first audio tubes?

MILTON FELDMAN, N. Y. City.

(1)—Yes, you can omit the choke.

(2)—Yes.

(3)—Yes.

(4)—Use individual voltages. Do not connect the radio frequency and first audio plate leads together.

* * *

A loud howl in the loudspeaker is usually caused by the continuous vibration of an audio tube or the detector. It is set in vibration by jars, which may come from the loudspeaker. The cure is to put a heavy load, such as a lead cap, on the vibrating tube, to replace the tube with a good one, to place the receiver and the speaker on something soft, and to move the loudspeaker.

A THOUGHT FOR THE WEEK

A FELLOW in Tuckahoe, N. Y., discarded his set because it wouldn't work, only to discover a few evenings later that his three-year old daughter had liberally sprinkled a package of needles all over the poor set's insides.

SIXTH YEAR

RADIO WORLD

The First and Only National Radio Weekly

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

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

NOT ALWAYS THE SET'S FAULT

Sea squalls are quite prevalent these days. These result in the transmission of SOS calls, which in turn cause the cessation of all broadcasting. Many stations shut off on receipt of this distress call, without any preliminary announcement. Do not, therefore, condemn your receiver, if you suddenly cease to hear signals, until you have fully investigated the cause.

WFBM ON 1,000 WATTS

The Indianapolis Power and Light Company station, WFBM, has been granted permission to increase its power to 1,000 watts. This station operates on 275.1 meters (1,090 kilocycles).

Diplomacy Is Over; Good Riddance Next

Washington.

The following announcement was made by the Federal Radio Commission:

"Individual members of the Commission have, from the very first, realized that elimination of some 300 broadcasters was eventually the only real solution of the present overcrowding of the air channels. This number is approximately the total of those who came on the air during the breakdown of the law of 1926.

"But the Commission recognized also that important constitutional questions are involved in such license denials and transfers, and that in some cases court action could be expected. To have undertaken denying licenses at the outset might have tied up the Commission by injunction and court orders, preventing it from making any progress in attacking the big problems it faced back in April and May. It, therefore, proceeded to make the best of a bad situation, and carried out both local and national reallocation of existing stations, denying licenses to none.

Improvement Made

"But now with local stations separated at fifty-kilocycle intervals, with all stations on even ten-kilocycle separation; with wave-jumpers and power-jumpers put back into their proper places as dictated by merit; with the Canadian channels all clear and with a band of some thirty-five non-heterodyning or cleared channels to be in operation by January, the Commission finds itself in a wholly different situation.

"Local and national reception will within sixty days have been put in the best condition possible with the present number of stations on the air. Further improvement will have to come by elimination of stations not rendering service correspondending to the interference they cause.

Can't Interfere Now

"Court injunctions in such cases cannot now interfere with the clearing that has been accomplished in the long wave portion of the spectrum. From this time on the Commission, therefore, can devote itself to clearing up the remainder of the broadcasting band by transfers and denials of licenses.

"Incidentally, it is known that members of Congress and others interested in radio matters would like to see adjudicated by the courts the rights of the radio supervisory authority under the 1927 law to deny licenses in order that definite knowledge of the status of the 1927 law can be laid before Congress in planning future radio legislation at the next session."

Developments are awaited.

Station List to Remain Unchanged Until Feb. 1

Washington.

No more changes in the condition of operation of radio broadcasting stations in the United States will be made by the Federal Radio Commission before February 1, according to a statement issued by the Commission. Full trial of present arrangements will thus be made. The statement:

"No further changes in the frequencies or powers of broadcasting stations will be made prior to February 1, 1928, in order to permit stations to obtain full trial of their present assignments.

"On January 15, 1928, the Commission will announce a number of station transfers to become effective February 1, 1928, for the purpose of improving reception conditions in the broadcasting band. No changes from the assignments as announced January 15, will be made except as the result of public hearings.

"Broadcasting affected by such transfers who desire public hearings will, by making application, have opportunity to be heard either prior to February 1, or, if time does not permit, immediately after that date.

"A supplementary list of transfers of Pacific Coast stations to improve conditions of local and national reception, will be announced February 15, 1928, to become effective March 1, 1928."

[*The complete list of stations, with frequencies and wavelengths, and place to write in dial settings, was published in the December 17 issue. It was the first official call book and log of the new allocations.*]

Small Stations to Unite Soon, Baker Prophesies

The next step that will be taken to aid in clearing the air from heterodyne squeals and overlapping will be consolidation of smaller stations, so that groups may employ a single transmitter and wavelength, divide time on the air, and share maintenance costs, said L. S. Baker, executive secretary of the National Association of Broadcasters.

"Many stations still are using only a small part of their broadcasting time, nevertheless occupying a radio channel," continued Mr. Baker.

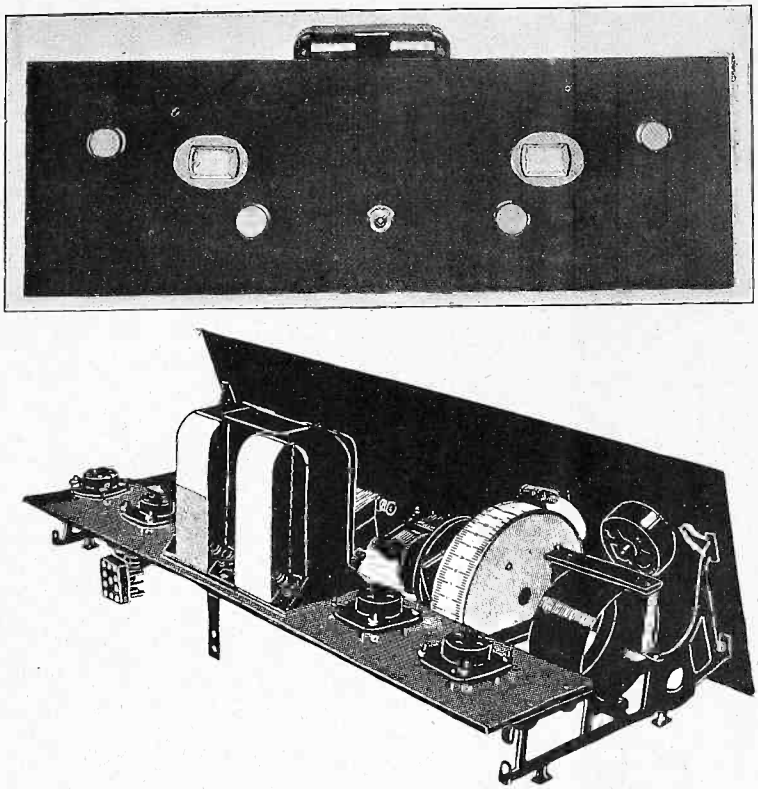
"There is a growing tendency to consolidate and thus reduce the expenses of maintenance. For many stations the expense of maintaining an individual transmitter is too great.

"We have just received a report from our field representative who has completed a survey of the broadcasting situation in New York, Pennsylvania and Ohio. It indicates that six stations in these States may consolidate to the extent that they will employ only one transmitter. This process is now being considered by many stations, according to general indications.

"Beginning next week, the field representatives of the association will tour Illinois, Indiana and the Middle West States and proceed to the Pacific Coast.

The AC-300 Receiver

By the Laboratory Staff



THE NEAT PANEL LAYOUT IS SEEN AT TOP. A REAR VIEW IS AT BOTTOM.

[*Part I was published last week. Part II, the conclusion, follows.*]

IN the original description of the AC 300 the RF pick-up was derived from the lighting circuit, that is, the house wiring was used as the antenna.

This connection is undoubtedly the most convenient in any radio set, but it is not always the best.

Since the antenna is directly connected to the house wiring, there is more chance of picking up stray noises of electrical origin then when the pick-up system is entirely dissociated from the house wiring.

Those who can install an open circuit antenna, even if it has to be an indoor one, should do so. It will yield rich dividends in quality and satisfaction.

The open circuit type of antenna can readily be connected to the AC 300. It is only necessary to cut the lead from condenser C0 to S1 and connect the condenser to the antenna instead. The condenser is no longer absolutely necessary but it does no harm and it may serve sometime as a short-circuit preventer.

As will be observed from the original drawing the volume controls are either in or after the detector. Now it is highly desirable to have a volume control ahead of the detector, so as to prevent blocking of the detector grid and to prevent overloading of the detector.

One of the best ways, and almost the only way in an AC heated receiver, to control the volume is to insert a variable resistor in the antenna lead. One of 2,000 to 10,000 ohms maximum resistance may well be used.

When such a control is used the potentiometer P1 should be set for maximum volume and the tickler should be set either for minimum regeneration or for a slight amount of damping. Then the volume should be controlled as far as possible with the variable resistor in the antenna lead. For most cases this should prove enough, but there may be exceptional conditions where a much wider volume control is desired, and again there may be conditions where the selectivity is insufficient if some damping is allowed to exist in the detector circuit.

If the selectivity is not great enough the solution is to increase the tickling to the required degree. This increases the volume, and it may be that it will be too great for proper control with the antenna series resistance. Then P1 should be used as an auxiliary.

If volume is too great and selectivity is not too low, the output may be decreased by all three methods. It should be noted that the less the regeneration and the lower the selectivity the better will the quality be.

One of the notable features of the AC 300 is the ease of tuning the circuit. Two Remler condensers, known for their ease of movements, are used. Simplicity is still further enhanced by the use of two Remler drum dials for operating tuning condensers. The drums have a large diameter on which a long scale divided into 200 divisions is placed. A small knob fitted with a small worm pinion engages with a gear on the periphery on the drum. Thus the condenser can be turned with utmost ease. But this micrometer action does not signify that it takes a long time to go from one station to another. No, the condensers can be turned with surprising rapidity.

2,000,000 LISTENERS IN GERMANY BERLIN

Approximately 2,000,000 receiving set licenses have been issued by the Reich. Two marks per month is the price which the fans must pay for the privilege of listening in.

Important Points on the Victoreen Power Supply

(*Concluded from page* 8)

bass drum comes through with a powerful kick, just as any bass drum does in real life, anywhere. You need but tap a bass drum amid the concerted strains of a hundred stringed pieces, and the percussion comes right home to the ear, forcefully and with a penchant for lingering. Not so in many radio sets, unless there is power—real power—behind that final audio stage. The bass drum is there but not heard as such.

Then take the bull fiddle or bass viol. These you likely miss. You hear something. It suggests their presence. Or what you hear may convince you that these instruments are not in the orchestra to which you are listening. Use good audio and the Victoreen Power Supply and you KNOW what instruments are in the orchestra. It is almost true that you can count the number of pieces.

If a biasing resistor, eg., Tobe Veritas 2,500 ohms, is used for the final audio grid, i.e., the Power Supply with audio stage is used as diagrammed last week, as an addition to a regular receiver, then it is not necessary to by-pass the biasing resistor. The frequency characteristics are not materially changed by omission. The higher frequencies are slighted trivially. But the amplification is low. It is about one, instead of 7½ or 8. That is as it should be, if your set, duly provided with audio, is to have the present Supply hitched onto it. But if you are to work out of one audio stage only (or two of resistance coupling) into the Supply's audio transformer, then use the bypass condenser. It should be 1 mfd. or more, and need meet only ordinary voltage requirements.

If any biasing is accomplished in any resistance coupled audio stage, due to a resistor voltage drop, this biasing resistor MUST be bypassed by at least 4 mfd., otherwise low notes suffer intolerably.

Hence, with a transformer stage, you may bypass, but with a resistance stage you must.

As for the output filter condenser, if it is of the 350 volt type it is preferable to connect the speaker return not to minus B but to plus B. In that way only the voltage drop in the output choke coil is the strain on the condenser (disregarding the AC). Otherwise 1,000 volt test condensers are needed. Tobe condensers are used throughout and are standard for the Victoreen device.

Resistance is Measured With Single Voltmeter

A voltmeter can be used for obtaining the values of resistances and for adjusting variable resistors to the correct values for grid bias provided that the internal resistance of the meter is known.

The resistance of a resistor can often be determined with a voltmeter alone provided that the resistance of the meter is known.

Suppose the meter has a resistance of 50 ohms per volt and that it has a scale of zero to 100 volts. The total resistance of that meter is therefore 5,000 ohms. If this meter is connected across a 45 volt dry cell battery in good condition the reading on the meter will be 45 volts.

Now suppose that a resistor of unknown resistance be inserted in series with the battery and the voltmeter. The reading on the meter will now be less than 45 volts. Suppose it is found to be 20 volts. What is the resistance of the resistor put in series? It is 6,250 ohms.

It is obtained in this manner:

Divide the first reading, that is, 45 volts, by the second reading, or 20 volts. The result is 2.25. Subtract one from this, leaving 1.25. Multiply this number by the total resistance of the resistor put in series with the meter and the battery.

Read Voltage Carefully

Let us take another example. A certain resistor supposed to be 50,000 ohms was put in series with the voltmeter and the 45 volt battery. The apparent voltage was 4. Dividing 45 by 4 and subtracting 1 gives 10.25. When this is multiplied by 5,000 the result is 51,250 ohms. The greatest source of error in this lies in the low voltmeter reading. Hence in applying the method it is necessary to read this very carefully.

The accuracy is greatest when the resistance to be measured is equal to the resistance of the meter. Hence if the meter has two or more scales the most suitable scale should be used and the voltage employed should be adjusted so that the reading is as large as possible. For example, suppose that the meter has a scale reading from zero to 10 volts as well as the zero to 100. The total resistance of the zero to 10 adjustment of the voltmeter is 500 ohms.

Instance of Computation

Suppose then we wish to know the resistance of a resistor which is supposed to be 400 ohms.

The battery voltage is adjusted to 9½ volts by employing fresh dry cells of adequate number. The 400 ohm resistor is connected in series with the meter and the battery, and the second reading is 5.3 volts. The ratio of the two readings, less one, is .792. This multiplied by 500 gives a resistance of 396 ohms, which is close enough to the rated value.

The Formula

Now suppose that we have a variable resistor of 1,000 ohms and we want to adjust it to a value of 852 ohms for a grid bias resistor. How can the meter be used for that purpose? To solve this problem it is best to use the above formula in algebraic form.

It is X=R(D1/D2—1), where X is the unknown resistance, R the resistance of the meter and D1 and D2 are the first and second readings of the meter. But the present problem X is not unknown but is equal to 852 ohms. But D2 is the unknown. We use the 0-10 scale on the meter which makes R equal to 500 ohms and we use the 9½ volt battery so that D1 is equal to 9½. Solving the formula we get D2 equals RD1 (X+R), or D2 equals 3½. The variable resistor is inserted in series and varied until the reading is 3½ and the resistance then is close to the required value of 842 ohms.

Since a voltmeter is only a sensitive milliameter with a high series resistance built into it, it is obvious that an ordinary milliameter with a known external resistance can be used in the same manner as the voltmeter for measuring another resistance. A source of suitable voltage is necessary, but it is not necessary what the voltage is.

How It's Done

The current which the voltage drives through the known resistance is first read on the milliameter. Then the unknown resistance is connected in series also and the reading on the milliameter is again taken. The above formula can then be used for determining the value of the unknown resistance. X is the unknown, D1 the first reading, D2 the second and R is the known resistance.

As an example let us assume that we have a known resistance of 5,000 ohms and that a certain battery can drive 5 milliamperes through that resistance and the meter. When the unknown resistance is added to the series the current is 2 milliamperes. What is the value of the unknown resistance? The ratio of the two readings is 2½, which when diminished by 1 leaves 1½. Multiplying this by 5,000 gives a value of 7,500 ohms for the unknown resistance. It is assumed that the voltage of the battery does not change when the unknown resistance is added, an assumption which is valid if the battery used is fresh or fully charged.

Both Come in Handy

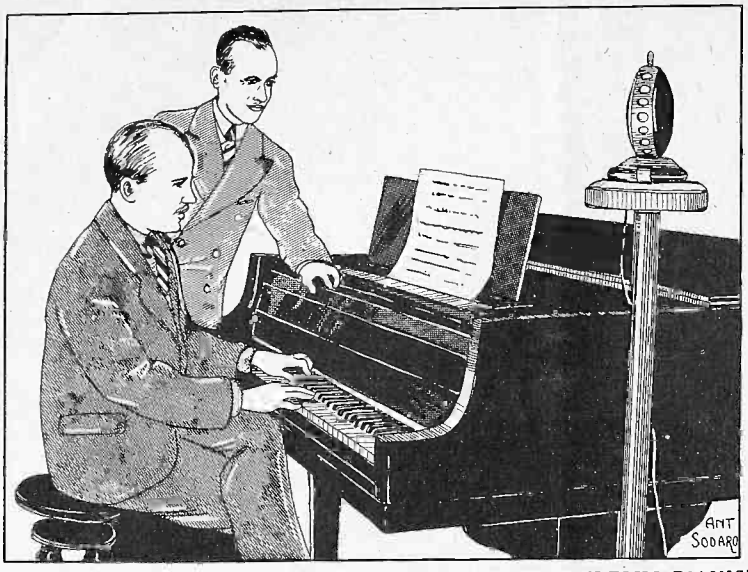
If a voltmeter is available as well as an ammeter or milliammeter any resistance can be measured by the use of Ohm's law. But both instruments are not always handy and then the single meter method is useful.

Electrad Announces Type V for AC Tubes

The growing extensive use of alternating current tubes has prompted Electrad, Inc., 173-175 Varick Street, New York, prominent parts and accessories manufacturer, to produce a resistance designed to increase the efficiency of AC tube operation. It is known as the Electrad type V Center Tap Resistance, and is used across the filaments of AC tubes, the center tap providing the exact electrical center for grid return leads.

There are eight types, ranging from 10 to 200 ohms, and with working voltages from 3.5 to 17.

THEIR MINDS ON MUSIC AND BUSINESS



STAFF MEMBERS OF WBAL, BALTIMORE, ARE GUSTAV KLEMM, PIANIST-COMPOSER AND JOHN WILBOURN, TENOR. MR. KLEMM IS WBAL'S PROGRAM SUPERVISOR AND MR. WILBOURN ASSISTANT STUDIO MANAGER.

$400,000,000 Sales Is One Expert's Estimate

In an address before members of the Radio Manufacturers' Association in the Hotel Commodore in New York City, C. J. Roberts, president of the National Association of Music Merchants, said that during 1927 nearly $400,000,000 worth of radio apparatus was sold through retail stores. He also stated that 40 per cent. of the sales were made through retail music stores.

"Radio is doing more to re-establish American home life than any other force with which I am acquainted," continued Mr. Roberts. "With the piano, it constitutes the backbone of the musical life of the family."

BARSOOK ISSUES CATALOGUE

The Barsook Co., 55 West Jackson Boulevard, Chicago, has just issued a unique circular listing various parts. Among some of the better known manufacturers the Barsook Co. represents in the mid-West are United Scientific Lab., Inc., American Braiding Co., Thomas-Andrews Corporation, and the Alden Mfg. Co.

$1,000-a-Minute Cost of Dodge Bros. Program

Four corners of the United States—New York, New Orleans, Chicago and Hollywood—will be linked up in one huge chain on January 4, for the broadcasting of a Dodge program.

Will Rogers, who will act as master of ceremonies from Hollywood, will introduce Al Jolson, who will be in New Orleans; Fred Stone, in Chicago, and Paul Whiteman and his orchestra, in New York.

The cost of this sponsored program will be more than $1,000 a minute. The telephonic and mechanical facilities are costing about $35,000. The fees of the four artists run to more than $25,000, while the station's time amounts to $7,600.

Thirty-three stations, which include the combined Red and Pacific Coast networks of the N. B. C., with WEAF the key station, will be used in the tie up. More than 12,000 miles of wire will be employed. The linkup will require three transcontinental circuits. One will be used by broadcasting stations, while the second will send the artists' entertainment to New York. The third will be kept for emergency use.

THE LONG AND SHORT OF IT

Only eliminators operated off the AC line can be connected in series to obtain the multiple-voltage benefit. It cannot be done on DC. A short circuit results.

Radio World's CLASSIFIED ADS *for Quick Action*

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

TROCARFOR-IV-RADIOSET 10-550, designed and tested at the tropics. Agents wanted. Antonio Fornieri, San José, Costa Rica.

WANTED: MEN TO WORK with National Radio Service Organization. No selling scheme. Co-operative Radio Doctors, Dept. W., 131 Essex Street, Salem, Mass.

BETTER THAN ANY FIXED LEAK is the Bretwood Variable Grid Leak. It allows adjustment of grid voltage to maximum sensitivity for reception of far-distant signals, with distortion. The Improved 1928 Model De Luxe Bretwood Grid Leak with Bretwood Bullet Condenser attached, $2.25. The Guaranty Radio Goods Co., 145 West 45th Street, New York City.

EVERY FRIDAY evening, beginning at 5:40 P. M., a ten-minute talk on radio topics is delivered by Herman Bernard, managing editor of *Radio World*, from WGBS, the Gimbel Bros. station, New York. Listen in.

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

IF YOU have DC, be sure to get copy of the Nov. 19 issue of RADIO WORLD. Send 15c for this issue or begin your subscription with it. RADIO WORLD, 145 W. 45th St., N. Y. C.

THE WINNER, a superb 4-tube receiver, was full described in the October 1, 8, 15, 22 and 29 issues of RADIO WORLD. Send 75c for the complete series or begin your subscription with any of the issues. RADIO WORLD, 145 West 45th Street, New York City.

EDISON "A" BATTERIES—Three-cell, 20-ampere-hour; in neat metal cases. Price, $3.50 each; ten or more, $3.00 each. Cash with order. Department "B," 25 East South Street, Indianapolis, Indiana.

$100 A MONTH IN YOUR HOME, folding and mailing circulars; we furnish everything; particulars and samples. 25c. Hedges Mailing Service, Box 422, Edna, Kansas.

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

HERMAN BERNARD, managing editor of *Radio World*, discusses radio topics of popular interest every Friday at 5:40 P. M. from WGBS, 348.6 meters, the Gimbel Bros. station in New York City. Listen in.

Why Phases Are Fickle In Variety of Circuits

(*Concluded from page 11*)

henry in the speaker. The resistance of the choke was assumed to be 5,000 ohms and the inductance 100 henrys.

Had the frequency chosen in this case been slightly higher the stopping condenser and the speaker would have been in resonance with the voltage and the current through the speaker would have coincided with I1. For still higher frequencies the current through the speaker would have lagged behind the first current.

A Mental Picture

It is easy to form a mental picture of the currents when they are in exactly the same phase or in directly opposite phase. When they are in phase they reach maximum values at the same time, or minimum values at the same time. This applies not only to the signal current but it applies to the total fluctuating current in the plate circuits. When two currents are in opposite phase one reaches a maximum value at the instant the other reaches a minimum value.

But when the difference in phase between two currents is not zero or 180 degrees it is a little more difficult to form a mental picture. But one might look at the rise and fall of one current, say I1, and then keep an eye on another, say I3, and see how that behaves in comparison. It will be found that I3 reaches a maximum, or a minimum, at an instant before the corresponding value of I1, that is, it leads by a short time. That refers to the 100 cycle frequency and lower.

If IL is watched in comparison with I1 it will be found, that it reaches maxima and minima about a quarter cycle behind the corresponding values of I1. It lags behind it.

Importance of Phase Relations

These phase relations between the various currents in the plate circuits of an amplifier are of no importance as long as the currents never flow through the same impedance in any part of the circuit. When they flow through the same impedance, for example, the impedance of the plate voltage source, they become of first importance. The good behavior or incorrigibilitiy of a receiver depends directly on the relative directions of the currents.

LITERATURE WANTED

Albert C. Knack, 302 S. Russell Ave., Geneseo, Ill.
Belmont Gilbert, 212 Argo Ave., San Antonio, Tex.
Arthur Smith, 5464 Hillcrest Dr., Los Angeles, Calif.
J. L. Olton, East Greenwich, R. I.
William T. Leiferst, 2233 South Third St., Philadelphia, Pa.
L. E. Rowe, Box 603, Watertown, S. D.
William Engh, Plains, Mont.
G. Vandekamp, 2611 Kettner Blvd., San Diego, Calif.
Home Radio Service, 120 Myers Ave., Akron, O.
N. P. Granes, 158 Chamberlain Ave., Bridgeport, Conn.

Crosstalk by KDKA Complaint by WABC

Listeners from different localities through the Eastern and Central parts of the country have reported to WABC that the use of the new waves, effective December 1, has resulted in interference on 970 kilocycles, the frequency of WABC.

"The trouble is not a heterodyne between the stations," explained Alfred H. Grebe, president of the A. H. Grebe Company, "but it is reported to be an overlapping or blanketing of WABC, in certain localities, due to the power used by KDKA and WHT."

KDKA, located in East Pittsburgh, operates on 950 kilocycles, while WHT, of Chicago, operates on 980 kilocycles.

"Trained observers, traveling from city to city, have reported definitely that crosstalk often exists between our station and the stations mentioned," continued Mr. Grebe.

"Among the cities in which observations were taken are Rochester, Albany, Pittsburgh, Cincinnati, Washington, Detroit, Norfolk and Atlanta.

"Contrary to the supposition that if 'cross talk' exists it should be found between stations that are nearest each other on the wave bands, the greatest difficulty has been found to exist between WABC and KDKA, which are operating twenty kilocycles apart, and the lesser trouble is between WABC and WHT, which are separated only ten kilocycles. Therefore it seems that the power utilized by the stations and the relative condition of the atmosphere are the direct causes of this trouble."

GABRIEL APPOINTED

Charles H. Gabriel, Jr., former newspaper man, magazine contributor and musician, has been appointed Assistant Program Director of the Pacific Coast network of the National Broadcasting Company.

WATCH GROUND ON DC JOB

When connecting up a direct current A and B eliminator, be sure to disconnect the ground wire from your set. The ground to the set should be made through a fixed condenser of .006 mfd. or larger capacity.

ANTENNA BROADENS TUNING

The antenna should not be coupled too closely to the secondary via the primary winding, since the effect of antenna resistance is introduced into the tuned circuit, thus broadening the tuning.

GROUNDED CORE HELPS

Even though audio transformers are encased in a metal case, it is wise to ground the cores or the shield, to prevent any possible stray coupling.

AVERAGE BATTERY SERVICE

Using a medium sized B battery, at the rate of two hours a day, and drawing from it 20 milliamperes, you should obtain 7½ months of service.

Call Book and Log

THE FIRST OFFICIAL CALL BOOK AND LOG of the stations in the United States and its possessions, with the new frequencies and wavelengths as of December 15, appeared in the December 17 issue of Radio World. The stations are arranged inversely as to their frequency frequencies and directly as to their wavelengths, and with special provisions for logging. You can write in your dial settings in blank spaces provided for this purpose. Send 15c for this issue or begin your subscription with it. Radio World, 15 West 45th St., N. Y. City.—Advt.

STEWART'S RETAIL RADIO PALACE

Stewart's, at 66 Cortlandt Street, running through the block to Greenwich Street, recently threw open its doors. The store is beautifully furnished with the most modern fixtures and every convenience for customers. A novel feature is Radioville, a row of quaint little houses wherein customers may receive individual demonstrations on sets and speakers. Every type of standard radio part is carried in stock, also every leading make of set, battery-operated, electrified or all-electric, all the newest speakers, eliminators and tubes for every radio use.

All these are tested in the store's well-equipped laboratory before being placed on sale and carry Stewart's guarantee as well as the maker's.—J. H. C.

COMPLETE DETAILS on the Laboratory-Super appeared in the Nov. 19, 26 and Dec. 3 issues of RADIO WORLD. Send 45c for these issues.