From D.C. to A.C. Operation

Complete Details of the Change Over

(By "PENTODE")

NO ONE can fail to notice the increasing tendency towards the total A.C. mains' operation, not only in the public favour but also by the percentage of these types of receivers produced by manufacturers during the last six months. One can purchase battery-operated sets at a ridiculously cheap figure, the same machines but a few months ago, being well in the fore. However, in many localities, especially where the electric power is not installed, receivers depending upon battery power are necessary and so it can never be stated that battery sets will get out of date.

There are quite a number of listeners, who, having battery sets, would sooner be in the possession of an A.C. receiver but do not feel like disposing of their instrument and buying one of the latest products. They feel, and rightly so, that they cannot demand a fair price for their old sets as practically 75 per cent. of the money they paid would be lost in the deal.

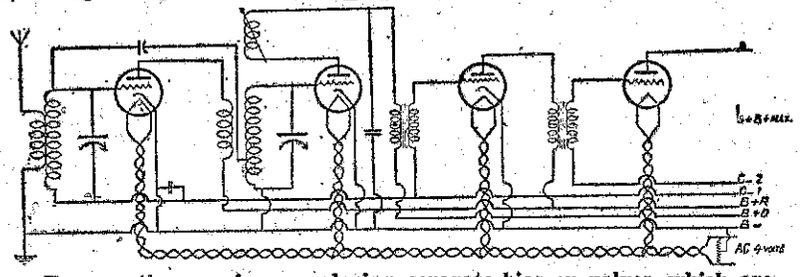
Then, why not convert it into an A.C.-operated set oneself? To those experimenters who have thought of doing so the following article will prove interesting and helpful. Also, to those who have not thought of changing over or who consider that A.C.-operated receivers are in any way inferior to those using batteries, the following comparisons show that the favourable points are all on the side of the sets using mains' power.

Consider first of all the battery problem. It is well known that really true reproduction cannot be obtained unless high anode voltages are used. At least 135 volts are necessary for the operation of even the smallest of power valves. This means the price of three standard or heavy duty B batteries straight away. But this is not all. The big rub comes when, after a few months' use they want renewing. But before this dreaded time comes, the batteries have been getting lower and lower and for half the time they are in use the actual voltage is below normal and the set is not giving out its maximum power. This is a big point in favour of A.C.-operated sets, in which the B voltage is constant and always to such a voltage that the power valves are being fed to deliver their best. On the question of actual upkeep, it is interesting to note that electricity used for power work is but 2d. per unit, whereas an equivalent amount of electricity if purchased in the form of the standard 45-volt block works out at about £10 per unit. Count this as several points in favour of A.C. mains!

Consider the valves themselves. Those designed to operate from A.C. as a means of liberating a controllable electron stream can be made far more efficient, both mechanically and from an electrical point of view. Better characteristics are available. Microphonic valves are a thing practically unheard of when using the heater type of valve.

Receivers can be built as one unit without a host of batteries and wires, which, however tidy cannot be called an ornament. One of the great drawbacks in the past has been an interfering hum, but with a carefully designed receiver and power unit no hum should be audible more than a few inches from the speaker. So that, taken all round, A.C. sets greatly outweigh in every detail their brother battery receivers.

Now let us compare the different types of valves that can use raw alternating current on their filament. First comes that known as the 226 type. This is a three electrode valve which has a thick filament whose temperature does not vary greatly with changes in the operating voltage. A pressure of 1.5 volts is necessary and from 1 to 1.5 ampres is consumed, depending upon the make of valve. In use these valves are connected up as any direct current valve; except that the grid return is connected to either a centre tapping on the transformer or the centre tap of a potentiometer connected directly across the filament terminals. As in all receivers using A.C. valves, the filament leads have to be of heavy gauge wire to carry the current and the filament wires in all cases are twisted to reduce their fields.



Regenerative receiver employing separate bias on valves, which are supplied by a four-volt winding.

Next comes the heater type of valve. Instead of the filament itself being heated to liberate electrons, the filament in the 227, or heater type of valve, is made use of to heat an independent cathode, which is generally in the form of a tube surrounding the filament and coated with thorium oxide. This cathode then takes the place of the filament in the more well-known triode. In order to keep the filament proper at earth potential the cathode is usually connected to the centre tap of the filament transformer or potentiometer.

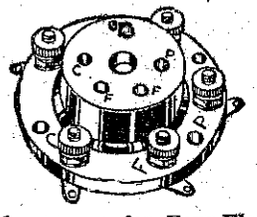
The filament voltage for the heater type of valve varies with different makes. The American standard is at 2½ volts, while the European standard appears to be fixed at 4 volts applied to the heater filament, and transformers are available for either type of valve.

The final stage of a multivalve receiver usually employs any of the well-known power valves with raw alternating current used on the filament similar to the 226 type. No appreciable hum is introduced by this method.

It is safe to prophesy that in the near future A.C. sets will be designed to use valves throughout of one filament voltage. Already the new power valve type, 245, is available, which uses a 2.5 volts filament, and this can be used in sets in which the heater type valve using the same voltages is used in previous stages. Similarly in European method, the four-volt heater valve can be used in conjunction with the 4-volt power valves already available, and the same filament winding on the transformer is used for any and all stages. It will be appreciated when it is stated that it is fatal to make the mistake of plugging a 226 type valve in the last socket of an A.C. receiver, where a filament voltage of 6 is provided.

In cases where the constructors think of converting their sets, the use of either the 2.5-volt or 4-volt type of valve is strongly advisable, not only from the point of expense, but also from the ease in converting.

The discussion until the present has been from the point of view of A.C. filament supply. There are other batteries—namely, the "B" and "C," that have to be considered and eliminated before a set can be said to be A.C. operated. As there are so many different types of "B" and "C" eliminator units on the market, a method which at once suggests itself would be to use one of these in conjunction with a filament heating transformer. An article dealing with the construction and application of a "B" and "C" eliminator would be too long here, so it will be assumed that the listener intends installing the "B" and "C" unit and adapting his set for the use of A.C. valves, using the same filament voltage throughout.



A Valve Socket for Four-Element Valves.

It has been stated that transformers are available for either type of heater valve and it must be first decided upon as to which valves are to be used. If the listener so desires a filament heating transformer can be constructed. Valuable information on this subject will be found in the "Radio Listeners' Guide." Care must be taken to have heavy enough secondary wire to carry the high current necessary. As an example a four-valve receiver using four 227 type of valves has a current consumption of 4 x 1.75 amperes equals 7 amperes, and the secondary would have to be wound with 12 s.w.g. wire. Using the four-volt series of valves which consume .9 amps. each, the total current would be less and a secondary winding of 16 s.w.g. would suffice. However the construction of transformers is outside the scope of this article, and the writer simply suggests that a tranformer of correct secondary capabilities is desirable, leaving the type or make to the reader's choice.

CONSIDER the wiring diagram for a minute. This is the theoretical circuit of a Browning Drake whose filaments operate from A.C. using the indirectly heated filaments. One or two outstanding points will be noted. In the first place the radio frequency valve has been given a negative grid bias. This is advisable, not only from a point of view of "B" consumption, but also for the sake of selectivity. A bypass condenser of .5 or 1 mfd. capacity bypasses all high frequency, making the receiver more stable in operation. When using indirectly heated valves the valve of the grid leak resistance, although not critical, can be of a lower resistance than usual. A valve of 1 megohm is quite suitable. In each case the cathode of the valve has been connected to earth and the potentiometer shown on the right is advisable as a hum control.

Only one circuit is given, but other circuits such as the neutrodyne, etc., can be arranged along similar lines. The last audio valve it will be noted employs an ordinary three-electrode valve. In the case of the 227 type of valve taking 2.5 volts filament voltage, either a similar 227 indirectly heated or one of the new 245 types of power valves can be used. If the four-volt series are decided upon it is not difficult to procure a four-volt power or super-power valve.

A FEW hints as to the actual conversion from the existing batteries to A.C. operation would perhaps be advisable. Most of the standard A.C. valves employ special five-pin bases and existing sockets will have to be changed for these except the last audio stage, which still retains the standard U.X. type. A diagram of the different connections on the five-pin base is given, and when wiring it will be found advisable to employ twisted heavy flex for the filament leads. The cathodes in all cases are connected together and treated as the A— wire in the old D.C. set.

When using A.C. valves the old method of using filament rheostats for volume control is unsuitable. No filament resistance should be used and as a suggestion the position of the rheostat can be taken by a potentiometer or volume control, which in

(Continued on Page 45.)