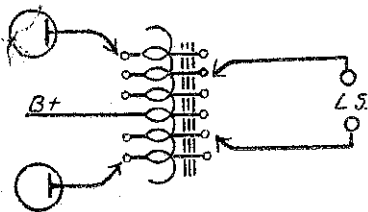


more volume than previously, for the simple reason that the volume can be split up between two valves instead of one.

2. The amount of bias that can be applied between G.B. and earth is double, or more, than for the single valve. The reason is not apparent without the use of valve charts, but it is such that, not only can a greater bias be applied, but also, by applying greater bias, greater signal variation can be applied to each valve, so that really we put on far more than double the voltage (a.c.) to the grid than we could have to one valve.

3. Less plate current. Because a higher grid bias can be used, the plate current is automatically diminished. This makes push-pull amplification admirably suited to receivers which de-



Using a tapped choke instead of a transformer in a push-pull amplifier.

pend entirely on batteries for their supply of current.

4. Because of the compensating action of the two valves, certain forms of distortion will balance out and leave true reproduction of the input voltages.

5. When the amplifier is operated with a.c. on the filament, hum will be, to a large extent, balanced out.

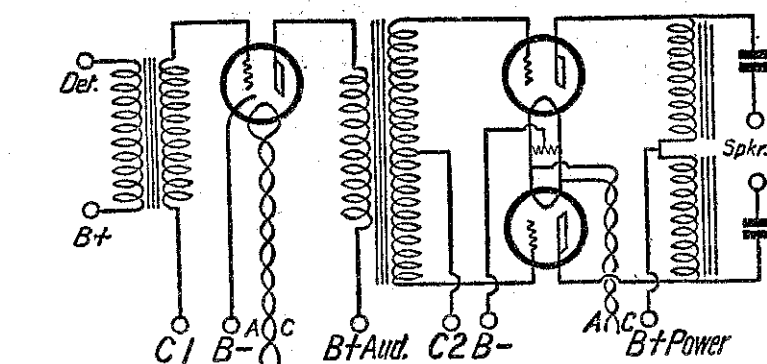
6. The valves must be carefully matched.

7. A push-pull amplifier requires twice the input grid voltage required by a single valve of the same type, if the push-pull arrangement is to show an advantage over a single valve in volume of output.

8. Ordinary transformers may be used instead of the split primary and split secondary type by connecting them as shown in the diagram. Resistances across the secondary of the input transformer should be about 500,000 ohms. The output transformers are two ordinary audio transformers of the same ratio.

9. Remedies for incorrect design may take the form of a .0001 to .00025 mfd. condenser between the grid of the push-pull valve and the centre tap or a 0 to 100,000 ohms resistance across the same position. A tone control, consisting of a .05 condenser, and a 200,000 ohms resistance can be employed in series between the grids of the valve.

10. A tapped output impedance can take the place of the output transformer. In this case, however, match-

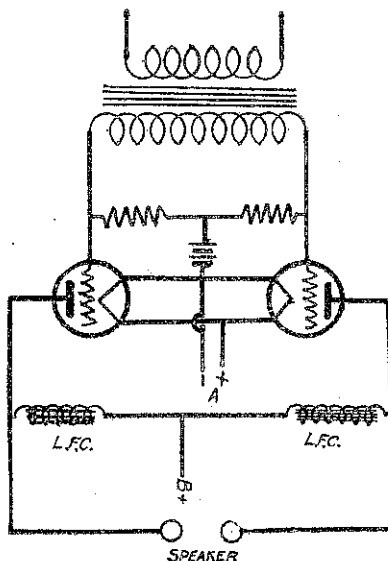


An A.C. Push-pull Amplifier, using an output filter in the place of a transformer.

ing is not possible, and consequently the system should not be employed unless the plate resistance of the valves being used is within the limits of 80 to 125 per cent. of the speaker output impedance in ohms. With low impedance valves and a high impedance speaker there will be opposite relation and an impedance matching output transformer should be used.

Accompanying this article are several diagrams of push-pull amplifiers.

THE A.C. set follows the general lines laid down in the earlier articles in this series, only, instead of employing valves with a directly heated filament, a slightly different arrange-



A P-P Coupling, using an ordinary interval transformer and L.F. chokes.

ment is employed, whereby the electron emitting body is indirectly heated because of its proximity to a wire which is heated by a.c. voltage. Very few valves indeed can have their

heaters come in direct contact with the mains and, in order to reduce the mains voltage to a suitable value, a step-down transformer must be employed.

With the plate circuit, however, we cannot employ pulsating current (alternating current is pulsating), and we must take steps to rectify and smooth the A.C. current from the mains.

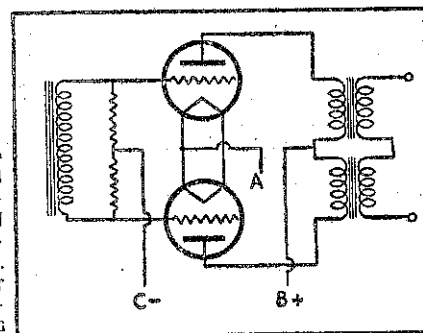
For a moment we shall look at a typical power pack and see what happens. Between all A.C. radio apparatus and the mains themselves there must be employed a transformer. It is against the regulations to use anything else. This transformer will alter the A.C. mains voltage to whatever we require. If we are designing an ordinary set we shall want something like 180 to 250 volts smoothed, for the plate supply, therefore the secondary of the power transformer must be able to supply this. Grid bias must be added to the plate voltage and allowed for in winding or designing the transformer high voltage secondary coil. Furthermore, certain losses will be occasioned by the chokes and the rectifier, although in modern rectifying valves the loss in voltage is very small.

The secondary is then wound to supply, say, 60 to 100 volts extra, as the case may be. The voltage developed across this secondary will be in proportion to the number of turns wound on and the amount of current available will depend upon several factors, not the least of which is the diameter of the wire used in the secondary winding. This voltage is a.c., and as such is useless for plate supply. It must then be changed to direct current. This is brought about by rectification, a sys-

tem by which the reverse pulsations are cut out, leaving the current to flow in one direction only. The current is still rising and falling in voltage, but is not reversing, as ordinary pulsating current does. In order to rectify the current a special valve is generally employed in what is known as a full-wave circuit.

The connections for this are as shown. The ends of the high-voltage secondary go to the plate of the full-wave rectifier and the centre tap of the filament winding of the rectifier supplies the high-tension positive. The centre tap of the secondary winding is the negative. Now between this + and - we have a d.c. voltage of a slightly lower voltage than that developed by the secondary. If we were to use this in the set hum would be present to a marked degree. We must have some means of smoothing or ironing out these pulsations. This is done by a combination of chokes and condensers. A choke we have described, and usually two of these are employed with condensers on either side of them, the other side of the condensers connecting with earth and high-voltage secondary centre tap. At the end of this filter we have smooth current of a voltage equal to that delivered by the secondary, less that dropped in the rectifier and the chokes.

This high voltage may be applicable to one valve, but we require a variation in the voltages supplied throughout the set, so resistances must be used. You will remember that when current passes through a resistance, the voltage is dropped according to the value of the resistance, and by using suitable resistances in the circuit we can drop the voltage to whatever is required. Thus we can turn



A P-P Coupling, employing ordinary transformers.

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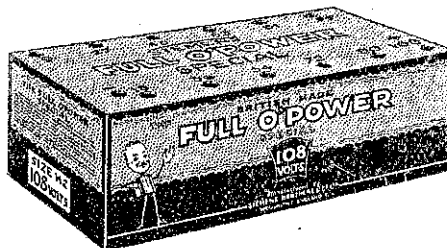
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