

An Amplifier for Quality and Volume.

Details of "Push-Pull"

By "Pentode"

IT is not so very long ago that the wireless enthusiast built a receiver with the only available components, the best in those days, and set and listened in awe to the barely recognisable speech and music issuing from throaty horn loudspeakers. Given the same components, it is doubtful if we could do much better to-day, except that the greatly improved transmission might assist to some extent. Dealing purely with the amplification of received signals, practically no difference exists between the circuits used in the very latest products and those used some years ago.

Power Valves.

ONE development which has greatly assisted radio to take its place in the home as a source of music rather than just a hobby, is the use of power valves with their associated high plate voltages. It has been very truly said that, using but one valve in the last audio stage, real music cannot be obtained with less plate voltage than some two or three hundred. The inconvenience of supplying this voltage and the danger associated with it militates very strongly against its use, however, and we are forced to look for some alternative means of obtaining the required power output. By "power output" it does not necessarily mean volume. Taking the range of audible musical frequencies from thirty to ten thousand cycles per second, very much more power is required to produce notes of, say, sixty cycles, than a note of, say, a frequency of two thousand, with the same intensity.

To obtain faithful reproduction of either music or speech, none of the lower frequencies must be suppressed, as they certainly would be if there was insufficient power available to operate the speaker at the low frequencies under discussion. Certain types of

speakers tend to accentuate the low notes and try by this means to add what the amplifier will not give. The best procedure by far is to utilise an

amplifier that will faithfully amplify the low notes and not to rely for the bass notes on the booming and drumming effect produced by these speakers.

Push-Pull Amplification.

RETURNING to the design of the amplifier suitable for the amateur's construction and use, it has previously been mentioned that the dangers involved do not warrant the use of high-plate voltages. There is another alternative circuit which can be used to give exactly the same effect as the other system using high-plate potentials. This is known as the push-pull method of amplification. Using two valves in push-pull, the voltage input which can be accommodated (and it is the ability to handle the input rather than give the output that denotes a "power valve") may in fact be as much as between three and four times what each valve would accommodate singly.

In the first place, the input is divided equally between the two valves, and in the second place, each valve can, if a very great output is desired, be so biased to the extreme bottom of the characteristic curve that it becomes quite safe to use larger maximum plate voltages than those specified by the maker of the valves in question. However, this is a technical point which need not trouble the constructor.

Although ninety volts will operate the amplifier about to be described, it is advisable to go up to 135 or 180 if possible.

The results obtainable will be equal to if not better than those obtained by using a single valve in the last stage and two or three hundred volts on the plate. Some suggestion regarding suitable valves and correct grid bias potential will be given later. The inevitable circuit diagram is given in figure 1. A small fixed condenser is inserted across the input terminals. In the transformer used by the writer (Ferranti) this condenser is incorporated in the shell of the transformer and is omitted in the construction. This condenser helps to by-pass high frequency currents from the detector as, if these currents pass into the audio side, grave distortion is liable to be set up, very often evident in the form of a high pitched whistle.

The Transformer.

A much longer article than this would be needed to explain the theory of push-pull amplification, but on referring to the diagram it will be seen that the primary of the second transformer is used in the normal fashion. The secondary is divided into two equal halves, the two ends joining to the grids of two separate valves, while the centre tap is connected to C. battery negative. An output transformer is necessary. The primary in this case is centre tapped which joins to B bat-

tery plus, while the two ends are connected to the plates of the two valves. The secondary connects directly to the speaker terminals and thus it will be seen that the speaker is isolated completely from the B battery. No direct current will be flowing through the windings and therefore it is immaterial which way the speaker leads are connected.

Constructional Details.

BELOW is given a list of the parts to be used. Because these components are mentioned, it does not necessarily mean that they are the only ones suitable. Practically all present-day manufacturers of reputable components that can be relied upon, but one word of warning would not be amiss. It is not good policy to buy cheap material. There is a saying, "Why spoil the boat for a hap'th of tar."

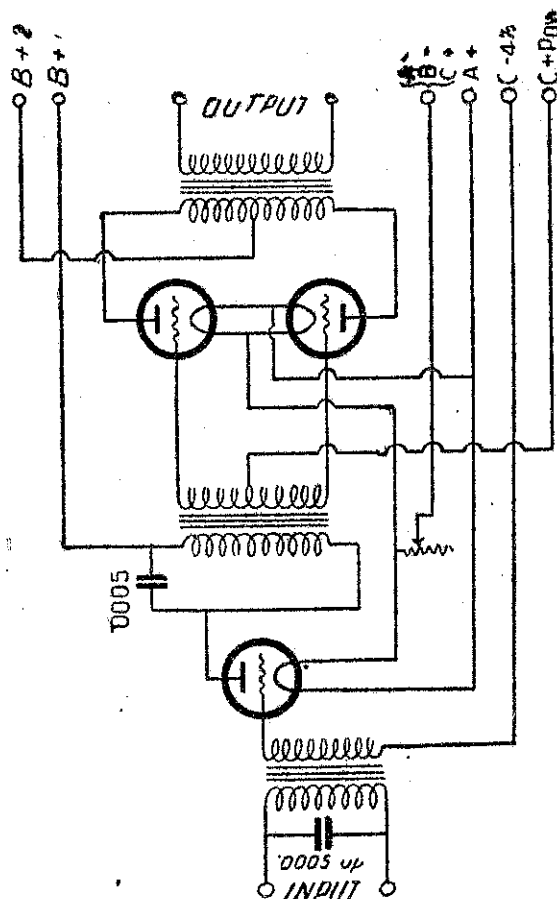
If the constructor decides on making a good amplifier, why spoil it by using even one transformer that happens to be a bit cheaper than one made by a firm of repute. The present case may be likened to a pipe through which a stream of water is passing. One obstruction anywhere along the tube will influence and retard the even flow of water from the outlet.

The baseboard, 15in. x 6in. x 5-8in. can be planed and stained any dark colour. No cabinet or front panel is used in this set, but a box in the form of a lid could easily be constructed to protect the whole from dust. Parts required:—

- 1 transformer (Ferranti) AF4 or AF3.
- 1 Push-Pull Transformer AF4C or AF3C (Ferranti).
- 1 Output Push-Pull Transformer OP6C or OP3C (Ferranti).
- 3 valve sockets.
- 1 Ingranic porcelain rheostat, 6 ohms.
- Terminal strip, 6in. x 1½in.
- 6 terminals.
- Baseboard 15in x 6in. x 5-8in.
- Busbar, sundry screws, etc.

The layout is quite symmetrical. On the left of the baseboard is screwed the first transformer AF4 or AF3, with the input (marked primary) terminals on the left. In the centre of the board the second AF3C or AF4C is screwed into place with the three terminals towards the right of the board. On the extreme right the output transformer is fastened with the speaker or output terminals at the opposite end to the input terminals on the left of the board.

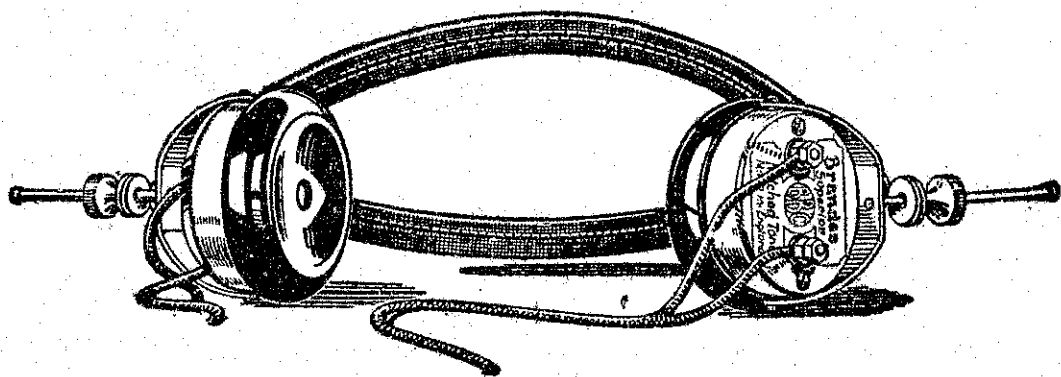
At the back between the first and second transformer, a valve socket is screwed with the grid and plate terminals or soldering lugs at the back as shown. In front of this is the rheostat. The Ingranic rheostat used can be adapted to baseboard mounting and the dial fastened by the grub screw so that it can be operated from the top. Between the second and third transformers are fixed the two remaining sockets with the grid and plate terminals at the back as before. Six terminals are arranged equidistant along the top edge of the ebonite strip, so that when this is screwed into place on the back of the board in the centre, the termin-



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