

Advantage of High Amplification Factor.

WITH three element valves, the energy supplied to the loudspeaker depends upon the plate voltage, and, in general, the higher this voltage, the greater the valve output.

It must be realised that the D.C. voltage on the anode of a power-valve is not equal to the battery or power-pack voltage, nor does it remain constant during operation, as there is invariably a "load" in the anode circuit of the power-valve.

When, therefore, under the influence of grid voltage variation, the anode current increases, the voltage generated across this "load" increases (voltage equals current multiplied by resistance) and it is of such phase relationship that it acts against the supply voltage, and the actual anode voltage is decreased.

Conversely, if the anode current decreases (control grid made more negative), the voltage drop across the load decreases, thereby increasing the effective anode voltage, and counteracting the decrease in anode current.

It will immediately be clear that this must have a very unfavourable effect upon the speaker energy supplied by the power valve, and that if this influence of the varying anode voltage on the anode current could be eliminated a much larger useful output would be obtained.

The Third Grid.

SO far the operation of the penthode is comparatively simple—there is, however, an important and unfavourable effect known as secondary emission, which must be taken care of, or the high quality of reproduction would be ruined.

This secondary emission is caused by the high velocity with which the electrons pass through the grids, and strike the anode.

There the greater part of their kinetic energy is converted into heat, but due to collision with the metal anode, other electrons (called secondary electrons) are "knocked off."

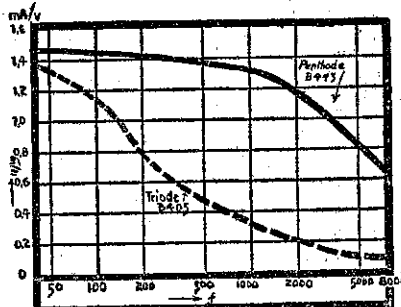
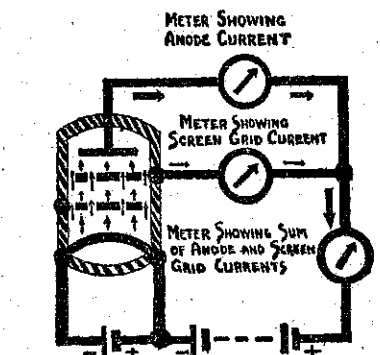
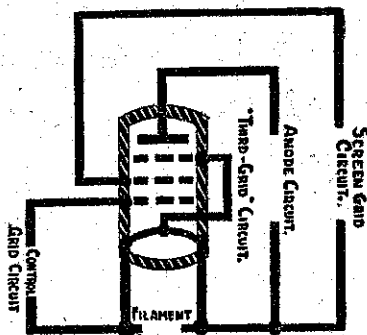
This secondary emission—which occurs also in normal valves—would not be troublesome were it not for the fact that at certain instants the screen grid is at higher potential than the anode, and as such times a stream of secondary electrons would flow from anode to screen grid, completely upsetting the normal operation.

In normal valves the grid is always at a potential so much lower than the anode that this does not occur.

In the penthode this secondary emission current is eliminated by inserting yet another grid (the third) between the screen grid and the anode. This third grid naturally is connected to the point of the lowest potential in the valve, i.e., the filament, and it thus screens the screen grid from the anode. Due to the fact that the triode difficulty of wastefully opposing voltages has thus been eliminated, it is seen that the penthode supplies a larger quantity of energy than a triode operating under similar conditions. This, however, is by no means its only advantage, for, in addition to increasing the quantity of energy, it equally improves the quality of reproduction, as will be evident from the following explanation.

High Internal Resistance.

THE sound volume produced by the loudspeaker is dependent upon the



Upper—Showing the five different circuits of the penthode valve. Middle—Some of the electrons are claimed by the Screen-grid, but the majority get through the meshes to the anode. Lower—Showing the advantage of the penthode. The steepness of the characteristic curve remains for various frequencies much more constant than that of the ordinary valve.

intensity of the alternating speech currents circulating through its coil.

The value of these circulating currents is determined by Ohm's Law (which states that current is proportional to voltage divided by resistance) applied to the anode circuit of the power valve.

As the total A.C. resistance in this anode circuit is composed of the internal resistance (impedance) of the valve, and the impedance of the loudspeaker, it will be understood that if one of these is variable as a function of the frequency (of the a.c. passing through it) the intensity of the speech currents will obey the changes in circuit impedance.

This is the case with loudspeaker impedance, which is low at low note frequencies, and may reach very high values at the highest audio frequencies.

If, therefore, the valve impedance is comparatively low, the varying loudspeaker impedance will cause large

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An Ejector for any Circuit

Some Amendments

A SLIGHT error occurred in the text of the original description of this very efficient wave trap and, although it was apparent to those who were conversant with circuits, it probably gave trouble to others. The corrected description should read:—

"On a good cardboard former which made from 2½ in. to 2½ in. in diameter and about 3 in. long, fix with glue, matchsticks without their heads. These should be from ½ in. to ¾ in. apart. Over this wind on closely and tightly about forty feet of 22 DCC. copper wire. This amounts to roughly 50 turns. Leave some 6 in. slack at each end after anchoring the ends to the holes in the former as shown. These ends will ultimately connect with the moving condenser marked "S" in the diagram. This is the secondary coil. Over the centre of the coil fix a band of tissue paper about an inch broad, and over this wind ten turns of 18 DCC. wire in the same direction as the secondary was wound. Anchor these turns as shown in the diagram and leave about 6 in. slack at the end. This is the primary coil marked "P" in the diagram. One end connects with the aerial and the other with the terminal of the set. The condenser should be fastened to a formica panel, the coils being placed in an oblique position to it when completed. Efficient soldering must be

variations in the total circuit impedance, so that at the higher note frequencies the current intensity is much weaker than in the middle or lower register.

This high note loss may seriously impair the quality of the reproduction, particularly as many transmitters and many receivers have already a marked tendency to suppress the higher note frequencies.

For real quality reproduction it is essential to faithfully reproduce the note frequencies from 3000 per second upwards, as the intelligibility of speech and the "colour" of music is so largely dependent upon their presence.

If we make the impedance of the valve very high compared with the loudspeaker at medium frequencies, the varying loudspeaker impedance will be a smaller fraction of the total impedance and thus exercise a relatively small effect upon the alternating current flowing through the circuit.

This is achieved in the penthode, where the internal impedance is of the order of 50,000 ohms.

(To be concluded next week.)

effected wherever possible, even to the set terminal if the ejector is to be a permanent connection.

In tuning, use both dials until signals are at the loudest. The interfering signal can be then trapped out; or again, trap out the interfering signals and tune in those desired with the dial on the set. A little practice may be necessary as this apparatus, if well made, is somewhat critical in using. By running X through a crystal detector, thence through phones and on to connection Y, or, better still, con-

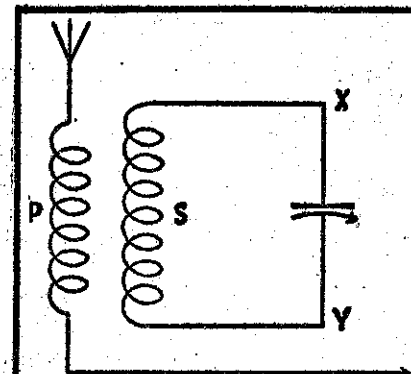


FIG. 1. To Aerial Terminal of Set

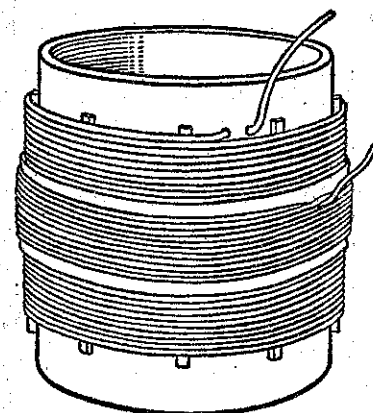


FIG. 2.

necting X and Y to a double point switch and wiring them as just said, reception can be had by either valve or crystal receiver at will. In this case the arrow point goes to earth. The trap will also smooth out rough signals, reduce static, and it also has improved both tonal and tuning qualities often enough. It does not diminish volume and the writer knows quite well it will solve many of the complaints from listeners that appear from time to time. This circuit does not assist short-wave reception.

For crystal work connect arrow point to earth.

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