

Pentodes and Tetrodes

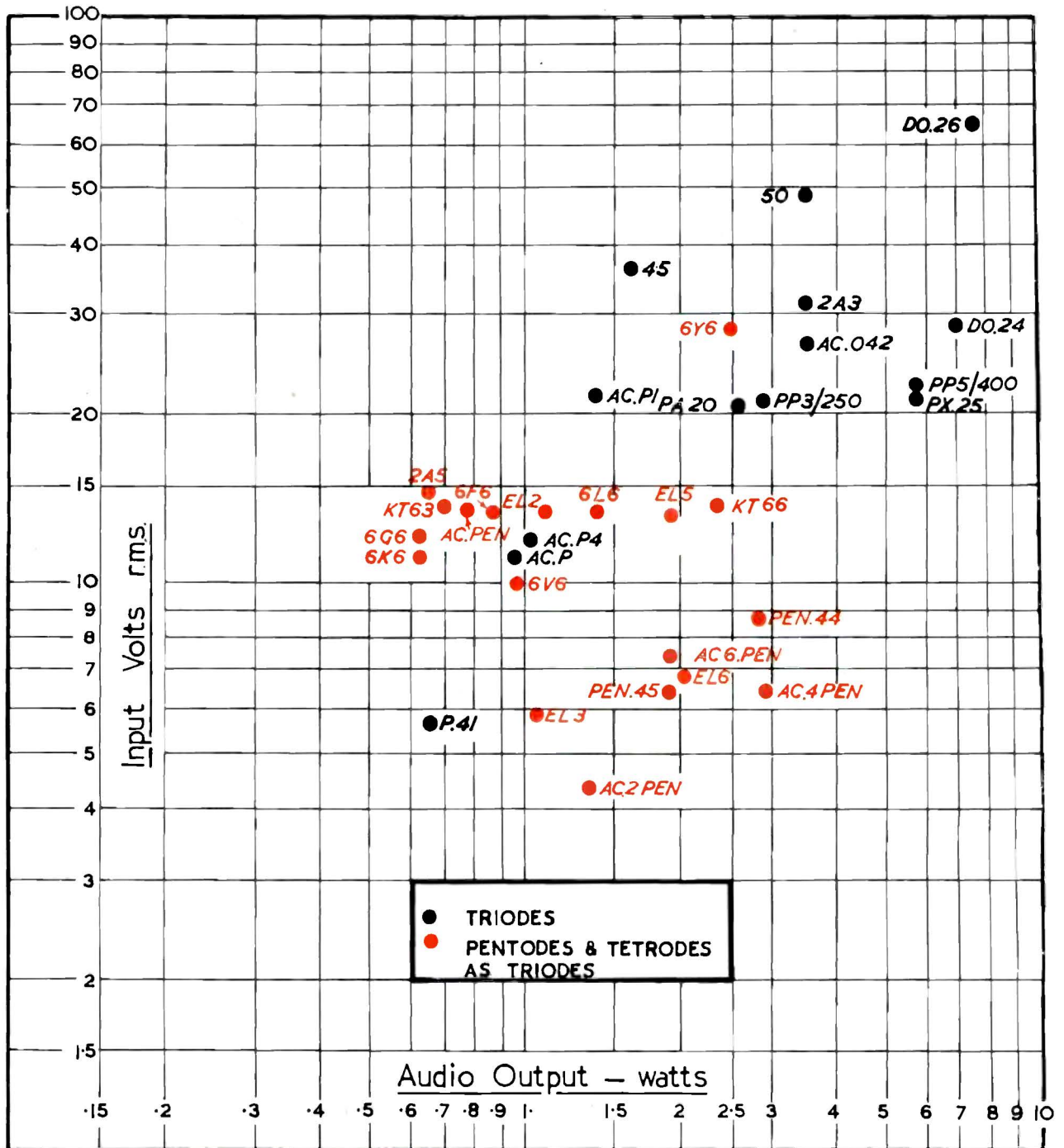


Chart of typical British and American triodes, tetrodes, and pentodes classified according to power output and input voltage swing.

Operating as Triodes

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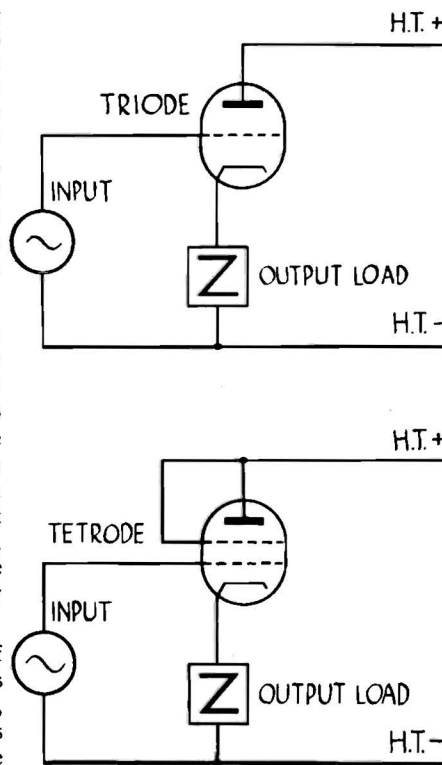
SINCE commercial radio receiver designers have necessarily to and public address equipment provide a maximum audio power output for a minimum D.C. power input (to reduce cost of H.T. supply equipment) and a minimum audio input swing (to reduce cost of early stages), the pentode and its successor the beam tetrode has been almost universally chosen for the output stage.

The result of this concentration on power efficiency has very naturally caused the valve designers to neglect triodes and to devote their skill to the still further improvement of the pentodes and tetrodes. This can be very readily seen by looking through current catalogues and finding that the old original PX4, PP3/250, PX25, PP5/400, etc., are still the "ultimate" in triodes much as they were over ten years ago.

Now among a large number of quality-conscious enthusiasts triodes are still used extensively because, without wishing to go into the details of the age-old controversy, there are advantages if efficiency is not of paramount importance. This large body of discriminating people are, too, realising that the triode has not progressed to any marked extent for years and they have had to resort to methods not altogether orthodox to produce for themselves more efficient triodes. This they have done by linking electrodes in the pentode and tetrode class and thus evolving for themselves "new" valves having higher mutual conductances (and sometimes anode dissipations) than is possible by using the somewhat restricted range of true triodes.

How far they succeed will be shown later, but before doing so, another point will be touched upon that is causing the growing interest in the use of pentodes and tetrodes as triodes.

The "cathode-follower" as applied to the output stage, where the loud speaker transformer appears in the cathode circuit, is beginning to find



favour because of the damping imposed on the speaker. The important thing about this circuit (from the point of view of this article) is that, whether one employs a triode beam tetrode, or pentode, all function effectively as triodes as will be seen by the diagram. Thus it becomes important to know the triode characteristics of tetrodes and pentodes if one is to assess the desirability of adopting "cathode-follower" circuits.

Unfortunately, the maker's catalogues do not give, except in rare cases, the details wanted and the user will have to "work it out" for himself.

This can be done fairly easily by reference to the catalogues. Taking for example the Mazda A.C.4/Pen valve, the details given in the maker's list are:—

- Anode Current 64 m/a at V_a 250.
- Screen „ 13 m/a at V_a 250.

From this it may be seen that the

screen current is one-fifth of the anode current. This relationship can be assumed to remain substantially constant throughout the ranges of potential in which we are interested and enables the "triode" anode current to be derived by addition of screen and anode current. Where the manufacturer gives a family of anode current-control grid voltage curves for identical anode and screen voltages, the procedure of conversion to anode current-anode voltage curves is simplified. Where the anode current-control grid voltage curves are given for varying anode voltages and fixed screen voltages, interpolation methods will have to be adopted. In the case of a true pentode, as distinct from a beam tetrode, the screen, suppressor grid and anode must all be linked together in making an artificial triode.

The adjoining chart has been prepared to indicate the power output to be expected from a representative range of British and American triodes, pentodes and beam tetrodes, the two latter types connected as triodes. To give the chart greater value the input swing necessary to achieve the power output stated can also be read off from a scale. The figures are in general given with due regard to the maker's maximum dissipation requirements, restriction of second harmonic distortion to a maximum of 5 per cent. of the fundamental, and utilisation of optimum load resistance.

The table may be of value to those who are unable to obtain a particularly old type triode by indicating a pentode which, connected as a triode, will give approximately the same power output.

In addition, the sensitivity of any individual valve appearing on the chart may be simply obtained by dividing the power output by the input voltage swing, thus deriving an expression of milliwatts per volt input. British pentodes and beam tetrodes connected as triodes will be found to be considerably ahead of any other types from the point of view of sensitivity.

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