meter after impressing equal and opposite potentials on the grid, said method being characterised in that the voltages applied are related to the meter scale on the basis that, when the meter scale is based on milliamp readings, the R.M.S. value of the alternating voltage applied to the anode is equal substantially to 1.4 times the rated D.C. voltage for the test whilst the equal and opposite grid potentials differ by an amount equal substantially to twice the difference of the normally accepted D.C. grid voltages so that the meter reading indicates a proportion of the actual published mutual conductance figures.

Now such a method is very simple and enables simple and inexpensive apparatus to be provided for efficiently testing the mutual conductance of a valve. It will be appreciated, however, that it is an empirical method and gives only an indication of the mutual conductance of the valve at zero grid volts and the rated anode volts and, whilst at the date of our said prior Patent such a test was generally recognised as the standard test for the "goodness" of a valve, it has since been appreciated that in many cases such a test does not give a sufficiently accurate indication of the value under working conditions. Also, it is often required to know other things about a valve, for example its anode current at a given grid voltage, and so on. Such readings were not correctly given in the old method. It is, therefore, the chief object of the present invention to provide a method of and apparatus for testing thermionic valves which, whilst retaining all the advantages pointed out in our said prior Patent of applying A.C. voltages, as distinct from D.C. voltages, to the electrodes of the valves, will give readings from which any desired parameter of the valve under test may be produced.

Following the principle of our abovementioned prior Patent, it is reasonable to assume that, with sinusoidal alternating voltage on the anode and a counterphase sinusoidal grid voltage of suitable magnitude, the required state of affairs would be produced, thus enabling Ia/Vg curves to be drawn.

There is, however, a serious drawback to this arrangement, particularly occurring during the half cycle in which the anode is being operated on by the negative half cycle of the applied anode volts. At this time, the anode is not drawing current, but the grid has applied thereto a positive half cycle of grid volts which may be of considerable magnitude. The grid thus being positive with respect to the cathode will draw considerable current, which can, due to the comparatively low impedance in the grid circuit, reach injurious proportions. Further, it tends to alter the effective phase of the negative grid half cycle with the result that anode voltage/grid current curves and other relevant characteristics are erroneously extended towards cut-off.

At first sight an immediate solution of this difficulty would appear to be the use of negative D.C. voltage on the grid, still with sinusoidal voltage on the anode. Since the current drawn by the grid when negative is for all practical purposes nil, this would be a fairly simple matter to include in the instrument, without complication, as regulation troubles would not be introduced, and the grid voltage could be pre-calibrated for all valves in the same way as could a sinusoidal A.C. voltage.

Reference to Figures 1 and 2 of the accompanying drawings will show, however, that this arrangement cannot give a true interpretation of the valve characteristics. Consider the general form of a Triode Valve characteristic which can be considered to follow the form:—

$$Ia = \frac{K(Va + \mu Vg)}{Ra}$$

where K is a constant dependant upon the physical proportions of the valve. Let Figure 1 represent a set of Ia/Va characteristics of such a valve which, for the sake of simplicity, have been idealised by making them parallel straight lines, neglecting the curvature at cut-off.

Let us assume that the valve is biased at minus 3 negative grid volts, and subjected to a sinusoidal alternating anode voltage having a peak value of 140 volts (RMS 100 volts), then Figure 2 will represent the excursion of anode current over the first half cycle of anode voltage. It will be seen that, due to the steady negative bias, anode current will not start to flow during the initial stages of the anode and voltage cycle until the instantaneous value of anode voltage exceeds that for which the $Vg = -3$ characteristic cuts-off (i.e. the amplification factor × the value of the negative bias). The actual anode current over the half cycle in question is thus represented by the shaded portion of the curve ABCDE. Relating this to the applied anode and grid voltages, and with the following notation, we have:—

Let $\hat{e}$ be the peak value of the sinusoidal anode voltage

Eg be the value of the negative D.C.