June 21, 1927. 1,632,870

A. C. BARTLETT ET AL

THERMIONIC VALVE

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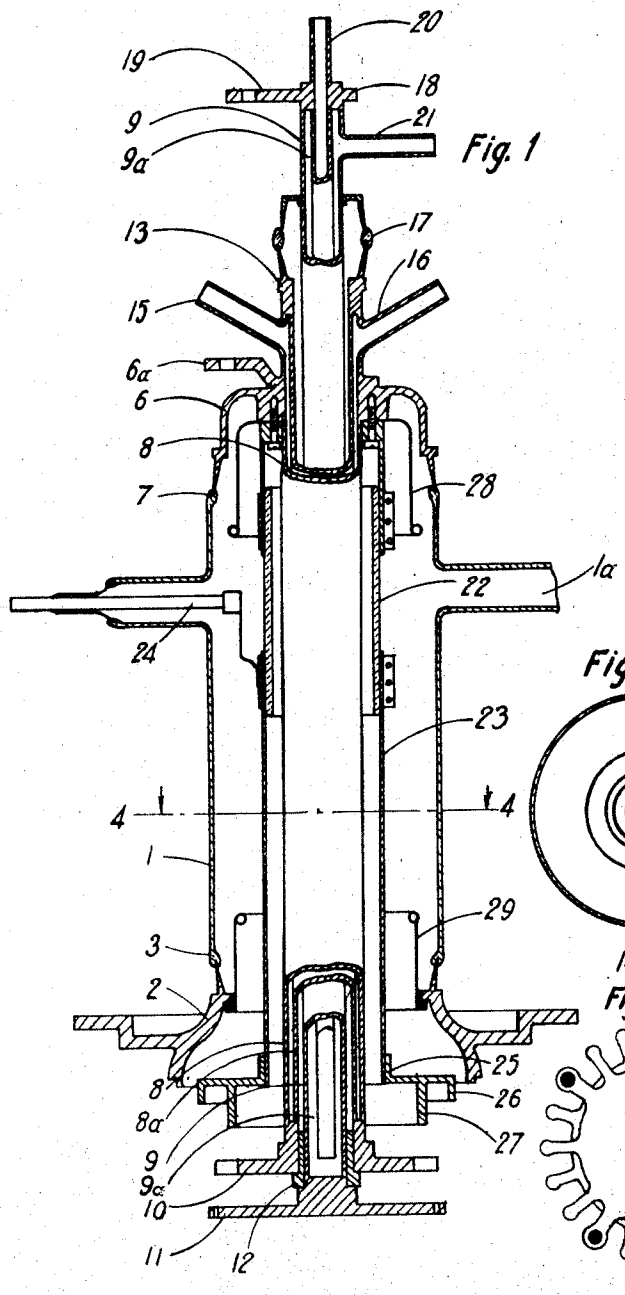

Fig. 1

Fig. 4

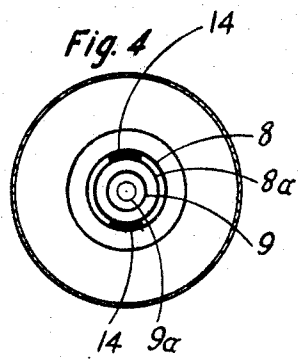

Fig. 5

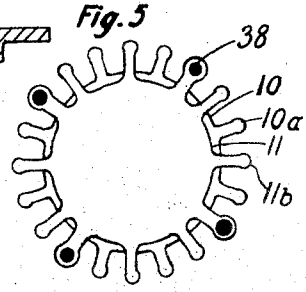

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Fig. 2.

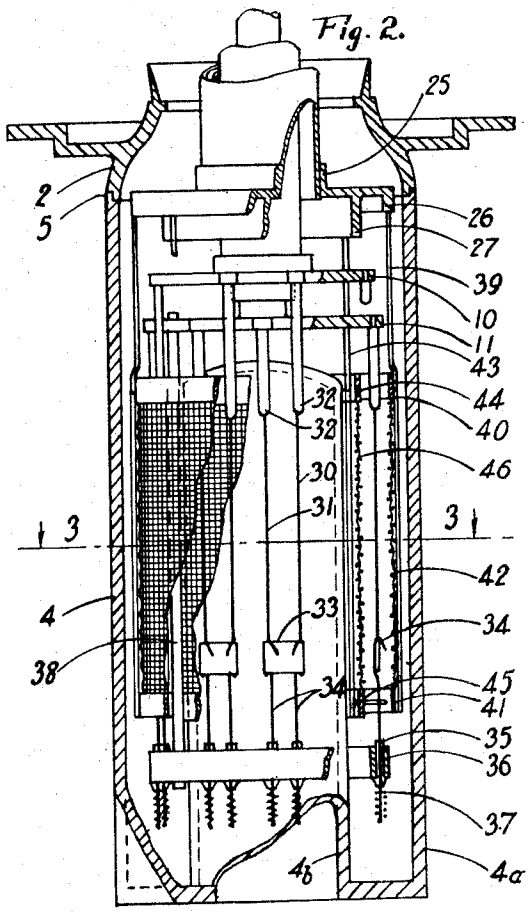
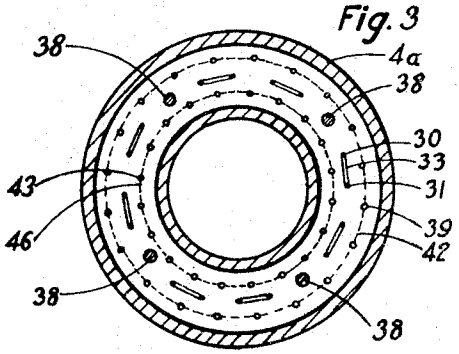


Fig. 3



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UNITED STATES PATENT OFFICE.

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THERMIONIC VALVE.

Application filed November 17, 1926, Serial No. 148,936, and in Great Britain June 9, 1925.

This invention relates to thermionic valves, of the kind in which the metal anode forms part of the envelope, and has for its object to provide a compact and mechanically stable electrode system.

According to this invention, a thermionic valve, of the kind in which the metal anode forms part of the envelope, is so constructed that the metal anode is arranged to give an internal vacuous space of annular form in which space may be arranged the cathode, in the case of a rectifier, together with the control electrode, in the case of a three electrode system, the cathode consisting of a number of filaments arranged cylindrically. If the diameter of the grid filament system be greater than that of the glass end of the envelope, the metal anode may be made in two parts one of which is first joined to the glass tube, the other part of the anode being placed over the grid filament system; the two parts of the anode are then joined by a metal to metal joint.

The accompanying drawings illustrate, by way of example, a three electrode valve constructed in accordance with the invention. For convenience in illustrating the details of construction, the valve is shown divided into two parts, Figure 1 being one half and Figure 2 being the other half with some parts of Figure 1 repeated in order that the complete arrangement may be understood more readily. Figure 1 is a part sectional view of one end of the envelope, leading-in conductors for the cathode and grid-electrode, metal to glass joints, and the cooling system. Figure 2 is a part sectional view of the annular anode, the filament system, the grid electrode system and details, certain parts being omitted for clearness. Figure 3 is a sectional plan view taken along the line 3—3, Figure 2, showing the annular anode, the looped filaments of the cylindrical cathode system and the double cylindrical grid-electrode system. Figure 4 is a sectional view taken along the line 4—4, Figure 1, to show the passages in the cooling system for the filament leads, whilst Figure 5 is a plan diagram of the arrangement of the terminals of the adjacent looped filaments which are electrically in parallel.

As shown, the envelope of the valve consists of a glass part 1, connected with a flanged metal part 2, by a metal to glass joint 3, and a main metal portion 4 annular in form, the parts 2 and 4 together constituting the anode of the valve. The arrangement is such that after the filament system and grid electrode system have been assembled in relation to the glass part 1 with the metal part 2 attached, the annular metal part 4 may be placed in position enclosing the filament-grid system and then joined to the metal part 2 by a metal to metal joint 5. The valve is then exhausted and sealed off at the glass part 1. In order to repair the grid or filament system the annular part 4 of the metal envelope may be removed, by opening the metal to metal joint 5 between the parts 2 and 4, and replaced after the repair has been effected. In this way it is unnecessary to disturb the metal to glass joint 3. The details of the construction are as follows. As shown in Figure 1 a metal cap 6 is attached to the glass part 1 by a metal to glass joint 7. Through the cap 6 pass two conductors formed as concentric tubes 8 and 9 separated from each other and serving as current leads for the filament. The inner ends of the tubes 8 and 9 terminate in two discs or flanged members 10 and 11 separated by an insulator 12.

The tube 8 is provided with an inner concentric tube 8^a attached at one end to a boss 13 and at the other to the member 10; and the space between the tubes 8 and 8^a is divided into two parts by longitudinally arranged strips 14 (see Figure 4). Inlet and outlet tubes 15 and 16 are provided so that when the valve is in use cooling fluid may circulate through the space between the tubes 8 and 8^a to prevent overheating of the flanged member 10 attached to the tube 8. At its upper end the tube 8 is electrically insulated from the tube 9 by means of a glass ring insulator 17 to which the boss 13 is joined by a lip as shown, and at its lower end by the insulator 12.

The tube 9 is also provided with an inner concentric tube 9^a which is attached to a boss 18 having a terminal lug 19, and the tube 9^a terminates in an open end close to the flanged end piece 11. Inlet and outlet tubes 20, 21 are provided as shown, so that when the valve is in use, cooling fluid may be circulated through the tube 9^a and the space between it and the tube 9 to prevent over-heating of the flanged member 11.

Attached to the cap 6 is a tubular insulator 22, on which a conductor 23 is clamped. The conductor 23 consists of a metal tube with which is connected a lead-in conductor 24 and collar 25 with two annular flanges 26, 27, for the grid electrode as hereinafter described. Shields 28 and 29 serve to protect the metal to glass joints 7 and 3 respectively.

The multiple looped filament system which forms the cathode of the valve will now be described in detail. The filament system is constituted by a number of parallel tungsten filaments arranged in pairs to form a substantially cylindrical cage. In Figure 3 eight pairs are shown. The two flanged members 10 and 11 (previously referred to in connection with Figure 1 and shown also in Figure 2) are formed with horizontally disposed radial lugs 10^a and 11^b and the members 10 and 11 are assembled so that when viewed in plan the lugs 10^a and 11^b are staggered as shown in Figure 5. Straight filaments 30 and 31 of tungsten wire are connected by short rods 32 respectively with each of the lugs 10^a and 11^b and the filaments 30, 31 of each adjacent pair are connected together by a bridge piece 33 forming in effect a loop, the whole filament system thus forming a series of loops. A front view of one complete loop is shown in Figure 2, which also shows a side view of one loop. Each bridge piece 33 is gripped by a pair of hooks 34 arranged in insulators 35 mounted in a metal ring 36, springs 37 being provided to keep the filaments taut when they are heated. The ring 36 is attached rigidly to the flanged member 11 by four rods 38 only one of which is shown in Figure 2. When the valve is in use the path of the current for the cathode filament system may be from the terminal lug 6^a on the cap 6, through the tube 8 to the flanged collar 10, the lugs 10^a, filaments 30 and 31, back to the lugs 11^b on the flanged member 11, through the tube 9 to the other terminal lug 19, or vice versa. Figure 3 shows the relative positions of the filaments in a system of eight loops. The grid-electrode system which includes two cylindrical cages arranged concentrically one inside and the other outside the filament system will now be described in detail.

The whole of the grid is supported from the collar 25 with two annular flanges 26, 27 which have been described previously with reference to Figure 1, and which is also shown in Figure 2. Spaced around, and attached to, the flanges 26 are rods 39 supporting a ring 40 in the position shown in Figure 2, the rods being extended so as to support a second ring 41 at their opposite ends. A cylindrical grid of wire mesh 42 extends between the rings 40 and 41 and is electrically connected therewith. The arrangement of the rods 39 and wire mesh 42 are shown in Figure 3. The other half of the grid electrode is similar to that just described. Rods 43 attached to the other flange 27 (which is concentric with the flange 26) support a ring 44 and are extended to support a second ring 45 and a cylindrical grid of wire mesh 46 extends between the rings 44 and 45 and is electrically connected therewith. The arrangement of the rods 43 and wire mesh 46 are shown in Figure 3.

The main portion 4 of the anode which forms part of the envelope of the valve, as described previously, is substantially annular in form and consists of an outer cylindrical part 4^a, with a re-entrant cylindrical part 4^b Fig. 3 closed at the inner end as clearly indicated in Figure 2, the latter serving as the plate anode in cooperative relation with the inner cylindrical grid 46.

The annular portion 4 of the anode is attached as described previously after the other parts of the valve have been assembled. The envelope is then exhausted through an exhaust tube 1^a, the valve being given that heating and pumping treatment to remove gas which is now usual in the manufacture of high vacuum valves; finally, the exhaust tube 1^a is sealed off.

We claim:—

1. A thermionic valve having an envelope consisting in part of a metal anode, said anode being formed with a re-entrant portion producing an annular internal vacuous space.

2. A thermionic valve as claimed in claim 1, wherein the cathode and grid electrodes are mounted within the annular space of the anode.

3. A thermionic valve as claimed in claim 1, wherein the cathode comprising a plurality of filament loops connected electrically in parallel is mounted cylindrically within said annular anode space, and two concentric cylindrical grids connected together electrically are mounted one on either side of said filament system.

Dated the twenty-seventh day of October, 1926.

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