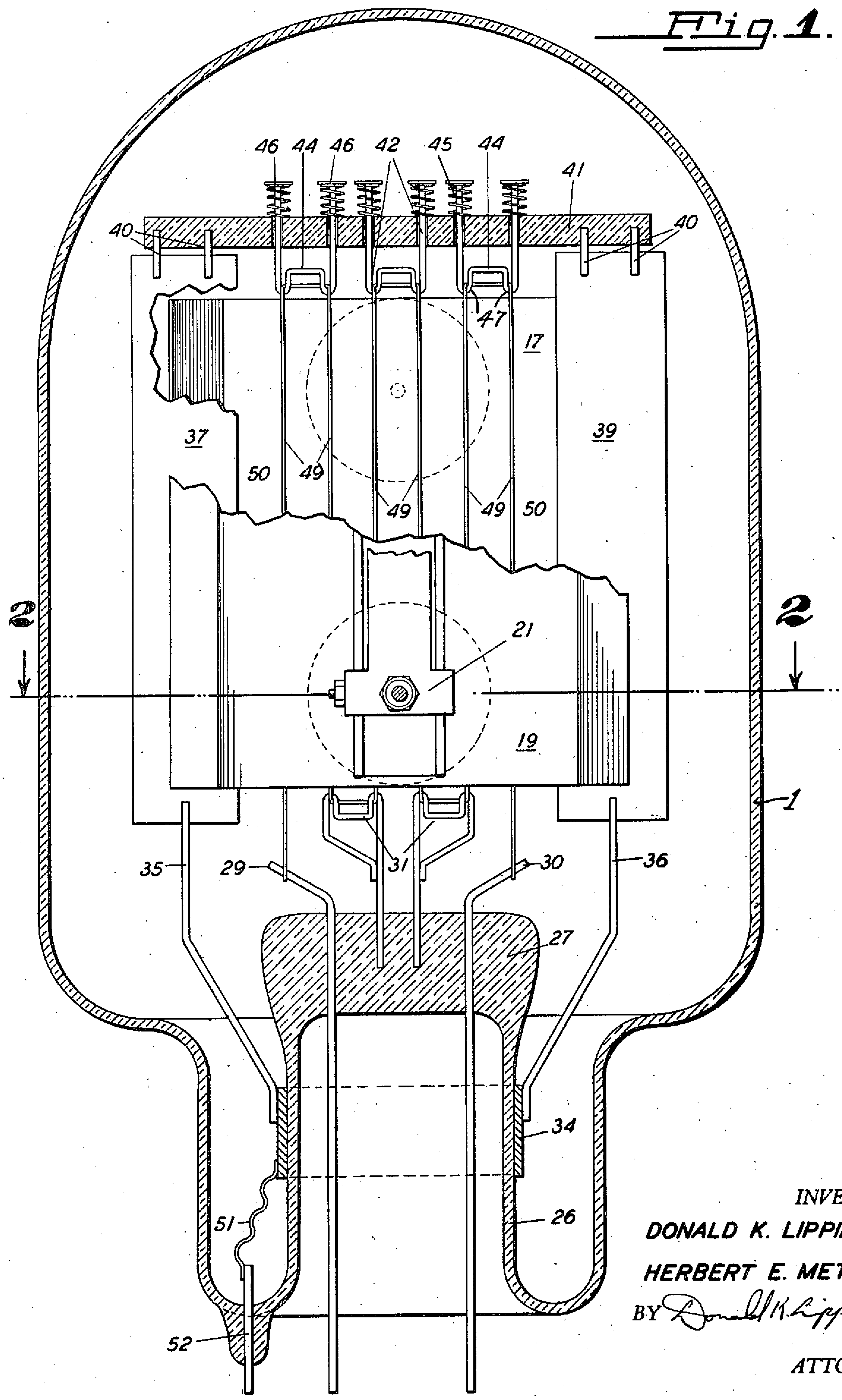
Nov. 26, 1935. D. K. LIPPINCOTT ET AL 2,022,212

LOW CAPACITY THERMIONIC TUBE

Filed July 29, 1932 3 Sheets-Sheet 1

Fig. 1.



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Filed July 29, 1932 3 Sheets-Sheet 2

Fig. 2.

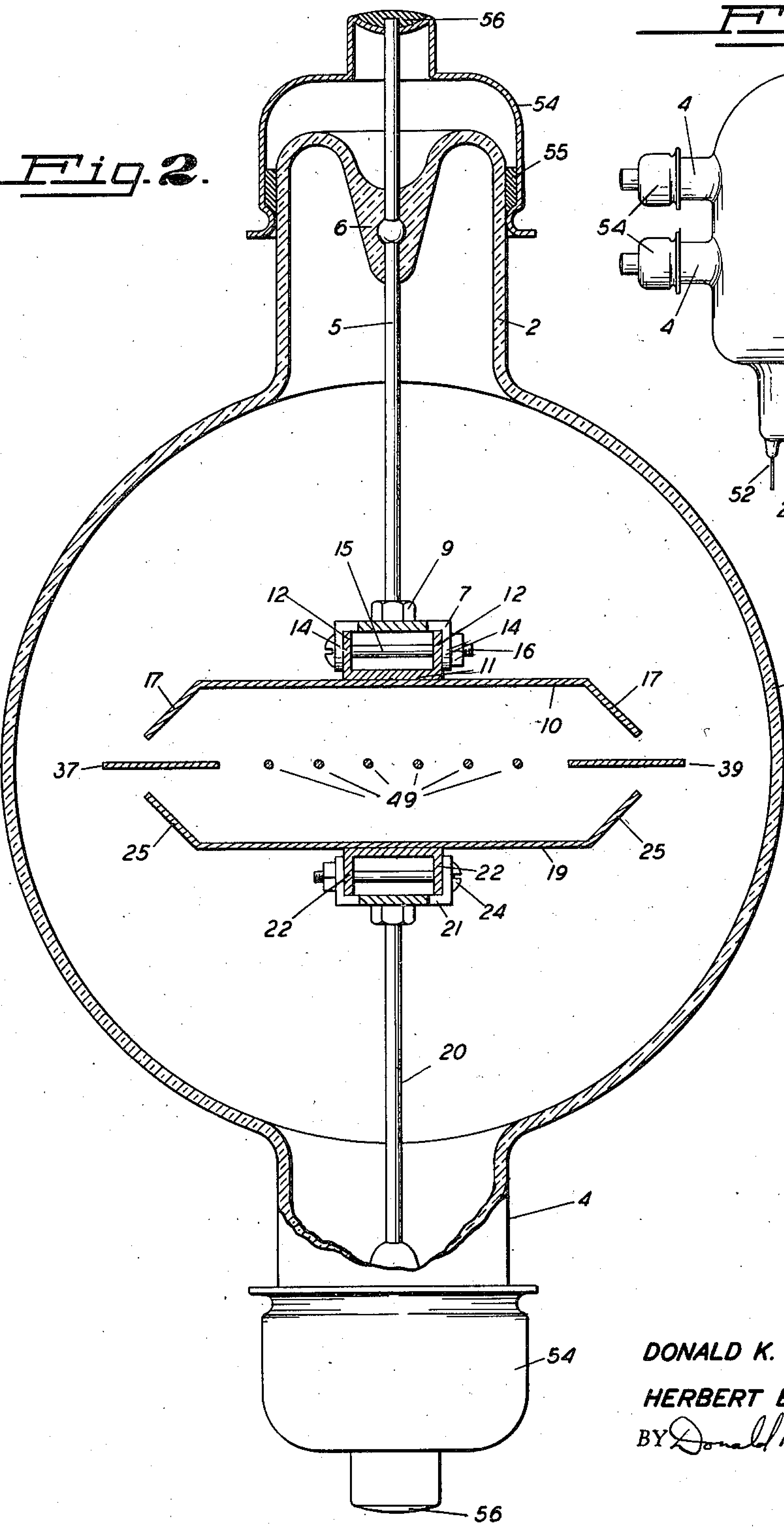

Fig. 3.

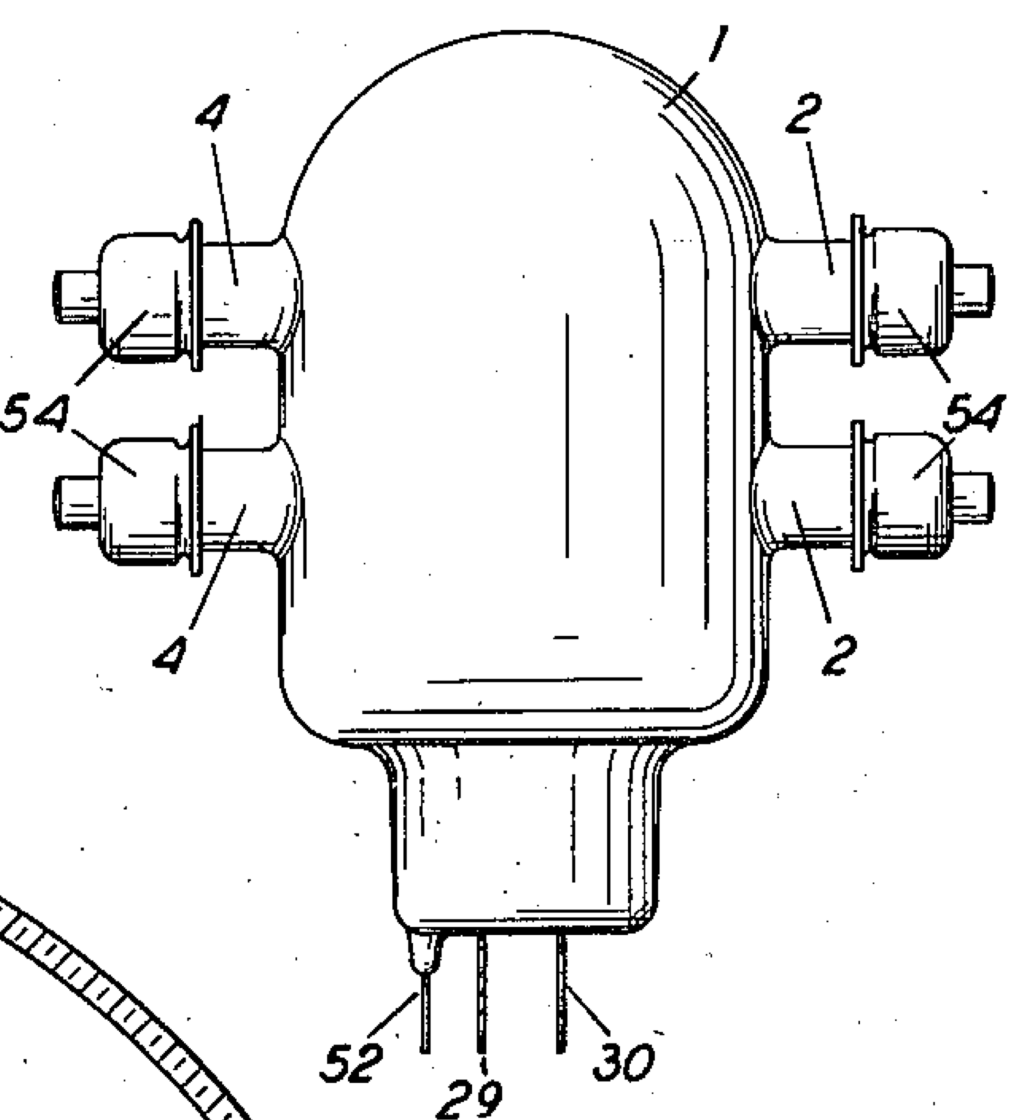

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Fig. 4.

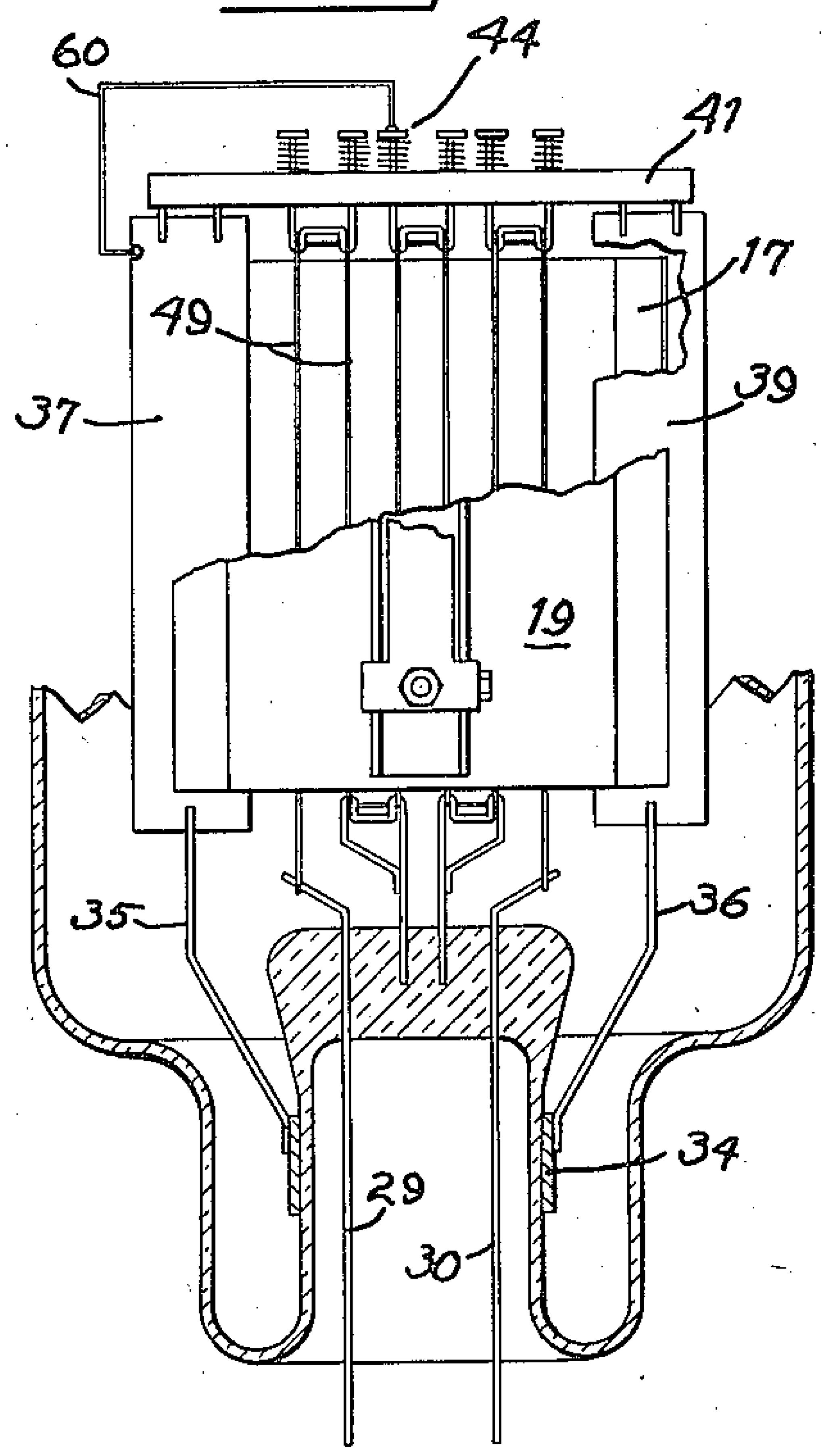


Fig. 6.

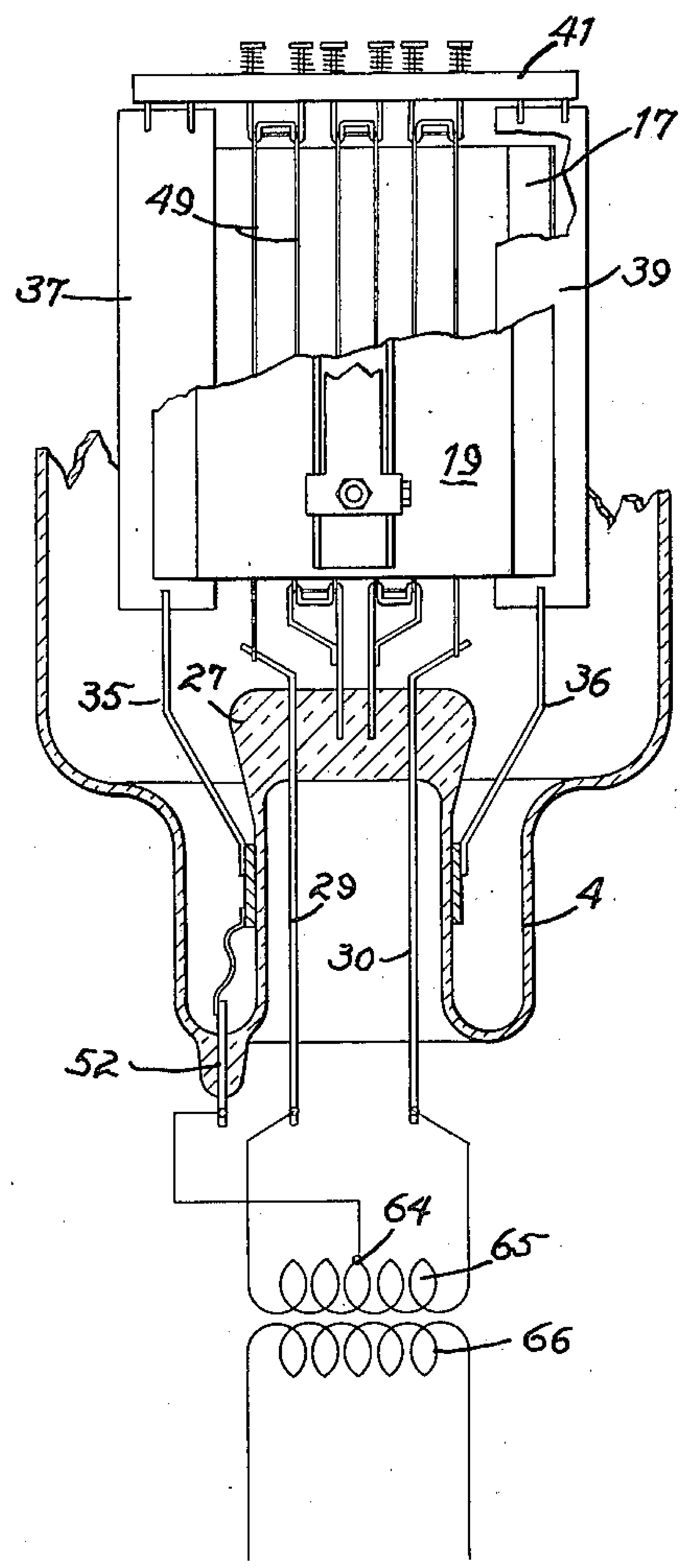
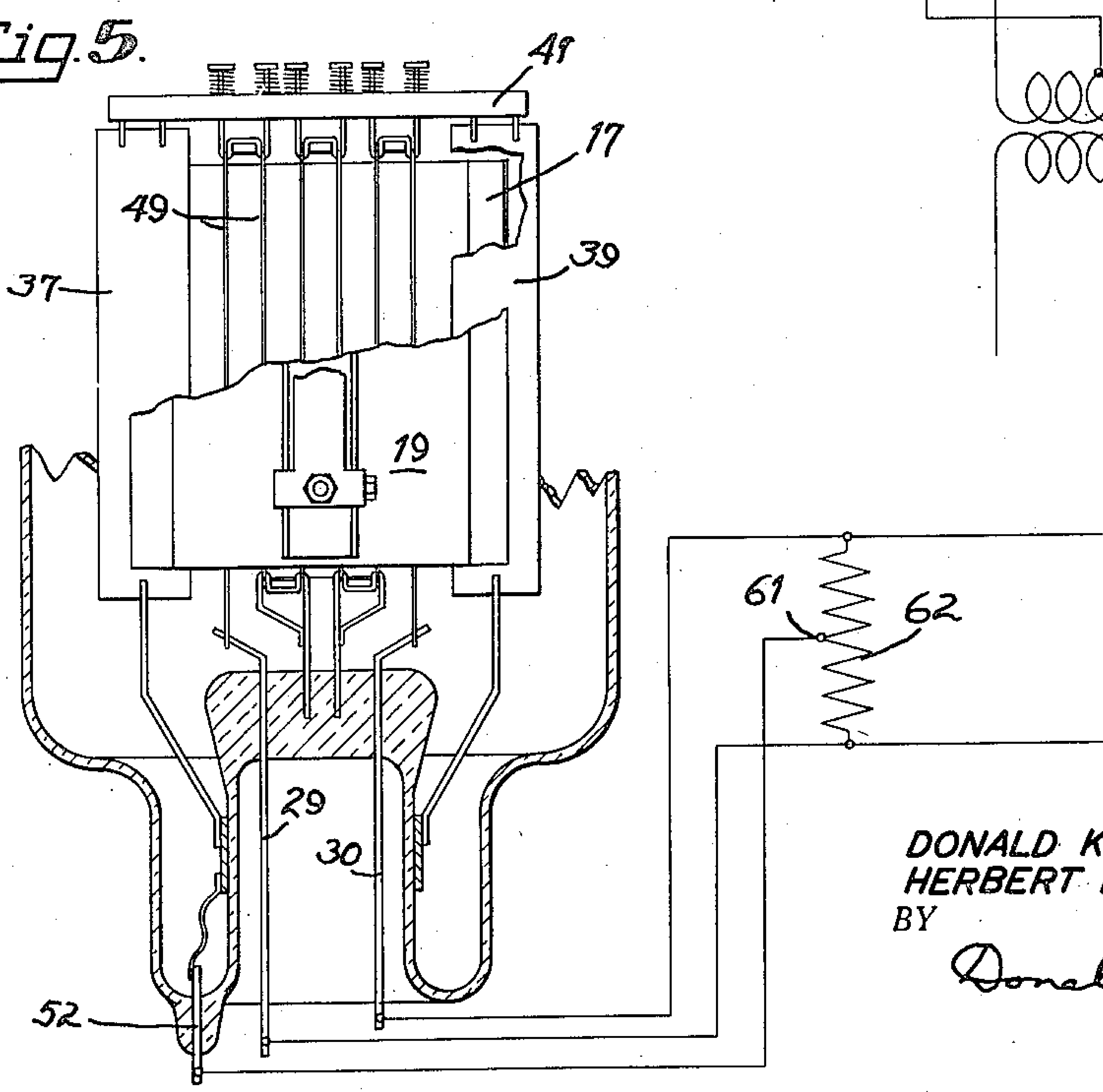


Fig. 5.



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2,022,212

LOW CAPACITY THERMIONIC TUBE

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Application July 29, 1932, Serial No. 626,158

4 Claims. (Cl. 250—27.5)

Our invention relates to thermionic tubes and more particularly to that type of tube in which a cathode is interposed between an anode and a control electrode, and in which the cathode acts as a shield between anode and control electrode to reduce the effective anode-control electrode capacity.

Among the objects of our invention are: To provide a thermionic tube having a minimum anode-control-electrode capacity; to provide a thermionic tube having a shield interposed between an anode and a control electrode, a portion of the shield being capable of emitting electrons; to provide a thermionic tube of minimum inter-electrode capacity suitable for use as a generator and amplifier of high frequency alternating currents without the necessity of neutralizing the inter-electrode capacities; and to provide a thermionic tube having a minimum inter-electrode capacity of simple and inexpensive manufacture.

Other objects of our invention will be apparent or will be specifically pointed out in the description forming a part of this specification, but we do not limit ourselves to the embodiment of our invention herein described, as various forms may be adopted within the scope of the claims.

Referring to the drawings:

Figure 1 illustrates a longitudinal section of the tube of our invention showing the disposition of electrodes.

Figure 2 is a cross sectional view taken in the plane indicated by the line 2—2 in Figure 1.

Figure 3 is a view showing the external appearance of the device.

Figures 4, 5 and 6 are diagrams showing how the emitting portion of the shield may be connected to the non-emitting portions.

In thermionic tubes having a cathode interposed between an anode and a control electrode, the cathode is usually formed from filamentary wires, and, when in operation, the cathode acts as a shield between anode and control electrode thus reducing the effective capacity between them. This action allows the tube to be used as a high frequency oscillator or amplifier. If, however, this shielding action is carried too far, the cathode filaments will become too long and too closely spaced for proper and easy assembly, and portions will be inefficiently located with reference to the other electrode.

Our invention broadly considered, comprises a thermionic tube having an anode and a control electrode, separated by an interposed shield, one portion of which is capable of emitting electrons and reticulated to allow a proper electrostatic control of the emitted electrons by the control electrode. The non-emitting and emitting portions are preferably located in the same plane and connected together to form a complete electrostatic shield except in the emitting area where only partial shielding takes place to allow control.

Referring directly to the figures, which show a preferred embodiment of our invention, an envelope 1 of heat resistant glass, is provided with two anode stems 2 and two control-electrode stems 4 on opposite sides of the envelope side walls.

An anode support 5 is fused to the anode stem by a seal 6, and projects inwardly to connect to a yoke 7 held firmly to the support by a lock-nut 9. An anode 10 has welded to its longitudinal axis, a stiffening rib 11 having out-turned rib flanges 12 formed on it. These flanges are fastened to the yoke arms 14 by a bolt 15 and a nut 16.

The two stems on the same side are identical and both support the single anode, the yokes fastening to the stiffening rib near the upper and lower borders of the anode. Edge flanges 17 prevent warping of the anode edges.

A control electrode 19 is positioned opposite the anode, and is of identically the same size and shape as the anode, and is supported in exactly the same way as the anode, from the control-electrode stems 4, by means of supports 20, yokes 21 fastened to control rib flanges 22 by bolts 24. Control electrode edge flanges 25 are for stiffening purposes, as in the anode. I prefer to make all the above electrode and supports of refractory metal such as tungsten or tantalum.

The lower end of the envelope is provided with a reentrant stem 26 having a press 27 fused around cathode leads 29 and 30 and dummy hooks 31.

Applied tightly around the stem is a band 34 carrying shield supports 35 and 36 welded to lateral shields 37 and 39. These shields extend both above and below the other electrodes and also extend beyond their lateral borders.

Bridge supports 40 are welded to their upper edges and are inserted into a filament bridge 41 connecting the two shields. This bridge is bored out to receive legs 42 of three double filament hooks 44. Each of the legs is passed through the holes, has a filament spring 45 fastened to it by the welds 46, and is then ready to receive the cathode filament.

This filament is welded to the cathode lead 29, passed up and around one filament hook, down around the double loop 47 of the dummy hook

31, up again to the next filament hook, and so on until it finally returns downwardly to be welded to the other cathode support 30. Thus there are formed a number of coplanar filament wires 49 parallel, and equally spaced apart, all of them being located in the plane of the shields 37 and 39.

It is also desirable to make the spaces 50, between the end filament wire and the shield, the same as the spaces between the wires.

It is obvious that these parallel filament wires can be connected in parallel instead of series as described. The entire cathode is formed of electron-emitting wire, such as oxide coated platinum, or solid or thoriated tungsten.

Connection is made to the shields through the band 34 by means of a flexible link 51 leading to the outside by connection to a shield lead 52 sealed through the envelope.

While we have shown the shield lead in Figures 1 and 3 brought out separately from the cathode wires, we may also connect it to the cathode inside the tube, as shown in Figure 4, where the shield 37 is connected to the filament hook 44 supporting the center of the filament by a lead 60. The shield lead 52 may also be connected to a center tap 61 on a resistor 62 bridging the cathode leads 29 and 30 exterior to the tube, as shown in Figure 5, or to the center 64 of a primary 65 of a transformer 66 supplying the cathode with heating current, as shown in Figure 6. In all cases we prefer to operate the shields at the same average potential as the cathode.

After the elements have been assembled as described, the tube is evacuated, sealed off the pumps, and provided with connection caps 54 applied to the side stems and held in place by cement 55. A weld 56 insures electrical connection to the electrode supports.

In assembly we prefer to space the filament wires 49 as close together as possible and still have electrostatic control of the emission by the control electrode. The cathode wires themselves then act as a partial shield between the anode and control electrode, but as the area covered by the filament wires is not as large as the entire surface of the opposing electrodes, the side shields complete the shielding.

Referring to Figure 2 it will be seen that the side shield 39 shields the flange 17 from flange 25, and side shield 37 does the same for flanges 17 and 25 on the other side of the electrodes.

By thus providing additional shields located in the plane of the filament, shielding portions of the anode and control electrode, not shielded directly by the wires of the cathode, we have been able to lower the control electrode-anode capacity without suffering loss of control or the use of excessive filament wire inefficiently located.

Tubes built according to the principles outlined above are efficient amplifiers and oscillators at extreme high frequencies, without the necessity for neutralizing circuits or like devices for destroying the effect of a high inter-electrode capacity. Such circuits introduce losses which are not present in the tube of our invention.

We claim:

1. A thermionic tube consisting of an envelope, a pair of electrically separate opposed electrodes therein of substantially equal area and extent, and an electrostatic shield of greater area and extent than said electrodes positioned between said electrodes, the major portion of said shield between said electrodes being filamentary conductors adapted to emit electrons when heated.

2. A thermionic tube consisting of an envelope, a pair of electrically separate opposed electrodes therein of substantially equal area and extent, and an electrostatic shield of greater area and extent than said electrodes positioned between said electrodes, the major portion of said shield between said electrodes being parallel filamentary conductors adapted to emit electrons when heated.

3. A thermionic tube consisting of an envelope, a pair of electrically separate opposed electrodes therein of substantially equal area and extent, and an electrostatic shield of greater area and extent than said electrodes positioned between said electrodes, the major portion of said shield between said electrodes being filamentary conductors adapted to emit electrons when heated, the remainder of the shield being a conductor in sheet form.

4. A thermionic tube consisting of an envelope, a pair of electrically separate opposed electrodes therein of substantially equal area and extent, each having a pair of adjacent edges, a plurality of parallel filamentary conductors adapted to emit electrons when heated positioned between said electrodes apart from said edges and in a plane passing between said edges, and a solid planar conductor in said plane, said conductor passing between said edges without contact therewith.

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