July 12, 1932. W. L. KRAHL 1,866,715

ASSEMBLY OF ELEMENTS IN ELECTRON DEVICES

Filed Jan. 25, 1930

Fig. 1.

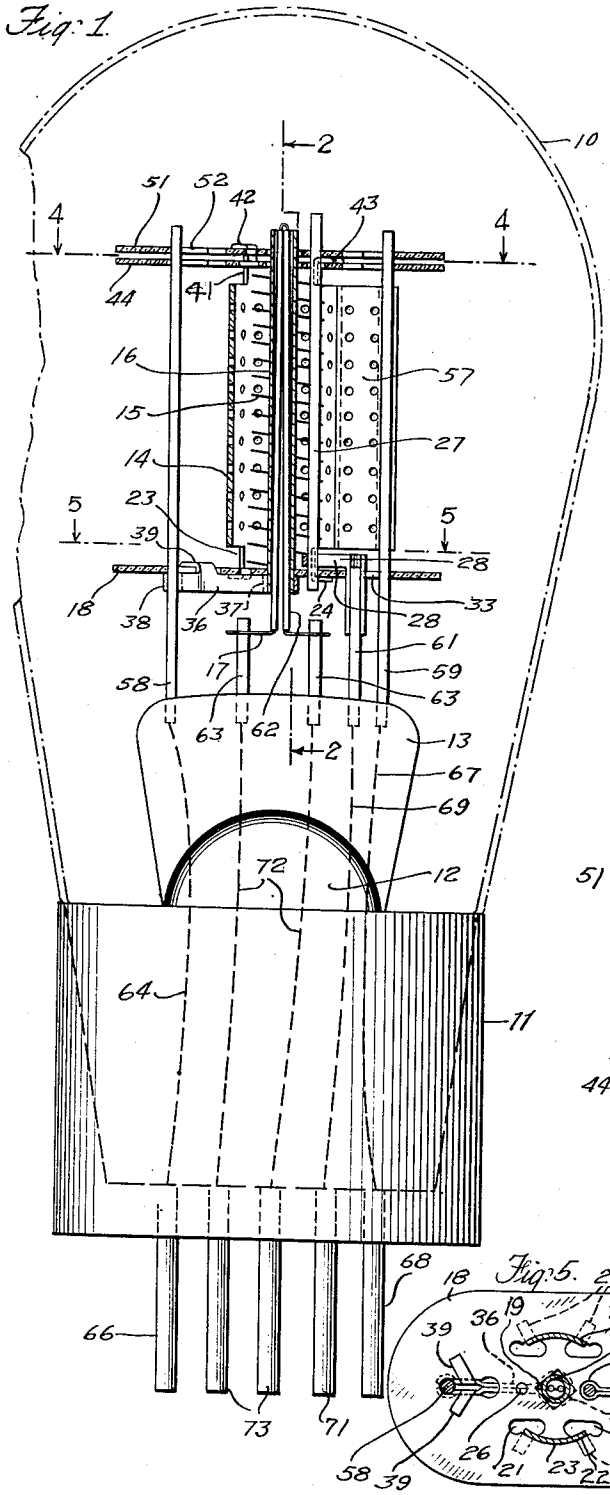


Fig. 2.

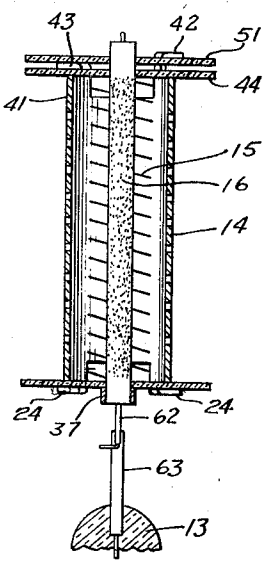
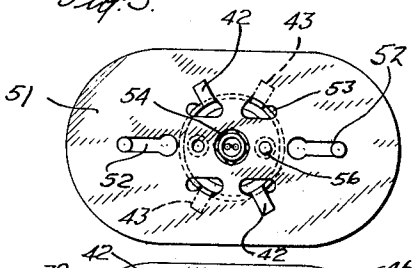


Fig. 3.



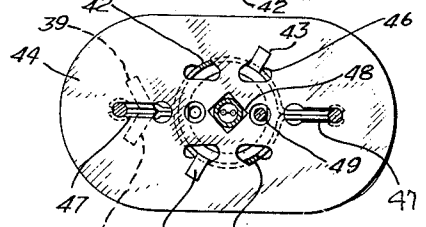


Fig. 4.

Fig. 5.

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UNITED STATES PATENT OFFICE

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ASSEMBLY OF ELEMENTS IN ELECTRON DEVICES

Application filed January 25, 1930. Serial No. 423,504.

This invention relates to electron devices and constitutes an improvement over the construction shown in my application entitled "Vacuum tube assembly", Serial No. 406,243, filed November 11, 1929.

Ordinarily the construction shown in my application above referred to provides an excellent tube but I have found that certain difficulties arise when it is attempted to heat the evacuation of tubes so constructed upon an automatic exhausting machine. In speeding up this action it is necessary to heat the various parts to higher temperatures than are encountered in the ordinary exhausting processes and I have found that this heating results in a disintegration of the nickle cathode which forms a fine coating of metallic nickel upon the surface of the upper insulating member. The presence of this metallic coating on the insulating member tends to provide a leakage path between the grid and the cathode which is detrimental to the proper operation of the tube and the present invention is intended to overcome this difficulty.

It is therefore one of the objects of this invention to provide a means in an electron device assembly to prevent the deleterious results from the deterioration of one of the elements due to overheating during the exhausting process.

Another object of the invention is to provide an assembly of elements for an electron device by means of which the process of exhausting the device may be considerably speeded up.

Another object of the invention is to provide a means in an assembly of elements for an electron device to prevent a leakage path being formed between two of the electrodes across the supporting means therefor.

Another object of the invention is to provide a means to insulatingly support elements in an electron device whereby the leakage path on the insulator between the elements is very much longer than the actual distance between them.

Other objects of the invention and objects relating particularly to the method of manufacturing and assembling the various parts will be apparent as the description of the invention proceeds.

The invention has been illustrated in the accompanying drawing in which:

Fig. 1 is a front sectional elevation of a vacuum tube or electron device embodying the invention;

Fig. 2 is a sectional side elevation of the elements shown in Fig. 1;

Fig. 3 is a plan view of the elements shown in Fig. 1;

Fig. 4 is a sectional plan view taken on the line 4—4 of Fig. 1; and

Fig. 5 is a sectional plan view taken on the line 5—5 of Fig. 1.

Referring now more specifically to the drawing, the invention is shown in connection with an electron device or vacuum tube adapted to be energized by alternating current and having an envelope 10 preferably of glass (shown in dot and dash lines) mounted upon the usual base 11 which supports the contact terminals for the tube. An inturned stem 12 integral with the envelope 10 supports the press 13 for sealing in the connecting wires and mounting the elements of the tube. As described in the application above referred to these elements comprise an anode 14, a grid 15, a cathode 16, and a heating filament 17 for maintaining the operating temperature of the cathode.

These elements are adapted to be assembled together in a unit by means of insulating plates which are positioned at the top and bottom thereof and held in place by the anode itself. The present invention contemplates a novel arrangement of the upper insulator, the lower insulator and parts similar to the construction of the above mentioned application being described first.

An insulating plate 18 preferably formed of mica, isolantite, crolite, or other desirable material is provided at its center with a square opening 19 which is just large enough to accommodate the cylindrical cathode 16 of nickel or other desirable material. The square opening provides means to support the lower end of the cathode at four points to cut down heat or possible leakage across the base of the insulator. On each side of the

opening 19 I provide a pair of slots 21 having a portion on one side as at 22 extending tangentially to a circle whose center is at the center of the square opening 19. The slots are arranged symmetrically with respect to the longitudinal and lateral axis of the insulator so that the insulator may be used with either side up, the slots 21 occurring in the same position whichever way the insulator is turned.

The anode 14 is preferably in the form of a cylinder of nickel or other desirable metal, shown here as perforated to permit heat to radiate from the cathode through the perforations therein, and may be provided at its lower end with extended portions 23 spaced diametrically opposite each other and each provided with a pair of fingers 24 which are adapted to pass through the slots 21 and may be bent back over the edges 22 thus securing the insulator 18 to the anode. The length of the extended portions 23 provides a space between the cylindrical portion of the anode and the insulator.

I also provide a pair of holes 26 on the longitudinal axis of the insulator and spaced from the square opening 19 such a distance that they will fall within the circumference of the cylindrical anode. One of these holes is adapted to receive the grid supporting post 27 around which the helical coil 15 is wound and to which each turn of the coil may be welded.

In order to keep the grid post 27 from turning I provide a strap 28 adjacent the upper surface of the insulator 18 and surrounding the grid post 27 as at 29 to which it may be welded. The ends of the strap may be provided with downwardly extended members forming a socket 31 which extends through an opening 32 provided for that purpose in the insulating plate 18. The opening 32 communicates with a slot 33 extending outwardly from the opening and having a rounded end 34 for a purpose to be hereinafter described. A corresponding opening 32 and slot 33 is provided in the opposite end of the insulator spaced the same distance from the center thereof so that which ever way the insulator is used there is always an opening to receive the socket 31 of the strap 28.

The lower end of the cathode 16 may be secured to the lower insulator by means of a strap 36. This strap may be made somewhat similar to the strap 28 already described, in that it surrounds the cathode as at 37 to which it may be welded and the ends of the strap extend outwardly to a point beneath the end of the slot 33 where grooves are formed to provide a socket 38. The strap 36 has tongues 39 which are adapted to pass through the slots 33 and be bent over upon the top of the insulator, thereby holding the strap securely to the insulator and anchoring the cathode thereto.

As described above, the construction is similar to what has been described and illustrated in the above mentioned application and the means of supporting the upper ends of the elements which forms the subject matter of this application will now be described.

The anode 14 is provided at its upper end with a plurality of extended portions 41 which are exactly similar to the extended portions 23 at the lower ends of the anode. These extended portions 41 are also provided each with a pair of lugs 42 and 43 which are exactly similar to the fingers 24 at the lower end of the anode. An insulating plate 44 similar to the insulating plate 18 may be provided to rest upon the upper end of the anode. This plate 44 is provided with a plurality of symmetrically arranged slots 46 exactly similar to the slots 21 in the lower insulating plate 18. These slots are adapted to cooperate with the fingers 42 and 43 on both of the extended portions 41 of the anode, the fingers passing upwardly through the slots. Diametrically opposite fingers 43 are bent down over the top of the insulator while the diametrically opposite fingers 42 are not so bent. The plate 44 is provided with slots 47 on the longitudinal axis of the insulator which are similarly shaped to the slots 33 on the plate 18 and a square hole 48 is provided to receive the upper end of the cathode 16 and support it at spaced points. The insulating plate 44 is also provided with a plurality of holes 49 corresponding to the holes 26 in the plate 18 but slightly larger than these holes so that the grid post 27 may extend up through one of the holes without touching the insulator.

Another insulating plate 51 may be provided similar in shape to the plate 44 and provided with slots 52 similar to the slots 47 and slots 53 similar to the slots 46 in the plate 44. This plate is adapted to fit upon the top of the other plate resting upon the diametrically opposite fingers 43 which were bent down upon the insulator 44. The diametrically opposite fingers 42 are then bent down upon the top of the plate 51 holding it in place but spaced from the insulator 44 a distance equal to the thickness of the fingers 43. This plate has a round hole 54 in the center thereof somewhat larger than the cathode so that the upper end of the cathode may extend through the hole without touching the plate. On either side of this hole 54 I provide a pair of holes 56 which have the same diameter as the holes 26 of the plate 18 and are adapted to receive the upper end of the grid support post 27. Thus the upper end of the grid support post is anchored by the upper plate while the upper end of the cathode is anchored by the plate 44.

The anode 14 may be provided with a flange

57 extending radially outwardly therefrom in alignment with the slot 33 in the plate 18, the slot 47 in the plate 44, and the slot 52 in the plate 51.

In supporting the element structure upon the press 13, I provide relatively long support posts 58 sealed in the opposite ends of the press 13 and spaced apart so as to align with the outer ends of the slots in the insulator plates as indicated. The element unit may be slipped down over the support rods 58 and 59, as indicated, the flange 57 on the anode coming adjacent the support rod 59 to which it may be welded for securing the entire structure in position upon the rods. The socket 38 formed by the ends of the strap 36 may be then welded to the rod 58 so that an electrical connection is made between the rod 58 and the cathode 16 and the unitary structure is also strengthened by this connection.

Also mounted in the press 13 is a support rod 61 which is positioned in alignment with the socket 31 attached to the strap 28 and extends upwardly within the socket to which it may be welded, thus forming a connection between the support 61 and the grid support 27 and aiding in maintaining the element unit in position.

Any type of filamentary heater for the cathode may be used but I have shown a hairpin filament 17 upon each leg of which is mounted an insulator sleeve 62 which insulates the filament from itself and from the walls of the cathode. This filament and insulator forms the subject matter of another application filed by me entitled "Means of supporting filaments in thermionic tubes", Serial No. 402,557, filed October 26, 1929. If desired, a coated hairpin filament may also be used. The ends of the filament 17 are bent outwardly and welded to two supports 63 which are sealed in the press 13.

The support rod 58 may be connected by means of a wire 64 to the cathode terminal 66 at the base of the tube which forms the cathode connection. The other support rod 59 may be connected by means of a wire 67 to the anode terminal 68 at the base of the tube forming the anode connection. In like manner, a wire 69 may connect the grid post 61 with the grid terminal 71 at the base of the tube. Also the filament support rods 63 may be connected by means of two wires 72 to the filament terminals 73 at the base. The terminals 66, 68, 71, and 73 have been shown apparently in a straight line, but it is understood that they may be arranged in any desired manner as in a circle corresponding to the terminal spacing of the standard five terminal socket.

When the temperature of the cathode is raised during the exhausting process, heat is probably conducted away from the lower end thereof by the strap 36 which connects the cathode with the support rod 58, while the novel arrangement of insulators at the top prevents the bad effects of the overheating at this end.

It will be seen from the above description that I have provided a means for supporting the elements of the electron device so as to prevent leakage between adjacent elements.

Many modifications may be made in the invention without departing from the spirit thereof, and I do not desire therefore, to limit the invention to what has been shown and described except as such limitations occur in the appended claims.

What I claim is:

1. In an electron device a tubular electrode, a second tubular electrode within said first electrode, a third tubular electrode within said second electrode, an insulating plate rigidly supported upon one end of said first electrode, said plate having an opening to permit a portion of said second electrode to pass therethrough without touching said plate and a second opening adapted to cooperate with a portion of said third electrode to maintain said third electrode in position with respect to said first electrode, a second insulating plate mounted upon said first electrode in close proximity to said first insulating plate but spaced therefrom, said second insulating plate having an opening cooperating with a portion of said second electrode whereby said second electrode is supported in spaced relation from said first electrode, and an opening to permit said third electrode to extend through it without touching said plate.

2. In an electron device a tubular anode, a tubular grid within said anode, a tubular cathode within said grid, an insulating plate attached to one end of said anode, said insulating plate having openings to receive portions of said grid and cathode whereby said grid and cathode are spaced at that end from said anode, a second insulating plate attached to the other end of said anode, said plate having an opening to receive a portion of said cathode whereby said cathode is spaced from said anode, and said plate also having an opening through which a portion of said grid may extend without touching said plate, a third insulating plate attached to said anode adjacent said second plate but spaced therefrom, said plate having an opening to receive a portion of said grid whereby said grid is spaced between said anode and said cathode, and said plate having another opening to permit the end of said cathode to extend therethrough without touching.

3. In an electron device a tubular anode a plurality of fingers on each end of said anode, an insulating plate secured across one end of said anode and held in position by said fingers, an insulating plate secured across the opposite end of said anode and secured in position by a portion of said fingers, each of said insulating plates having an opening to

receive one end of said cathode and to support said cathode in spaced relation to said anode, a grid, said first insulating plate having an opening to receive a portion of said grid whereby said grid is supported from said anode and cathode, said second plate having an opening through which a portion of said grid may pass without touching, a third insulating plate mounted upon said anode adjacent said second insulating plate and held in position by the remaining of said fingers, said third insulating plate having an opening to receive a portion of said grid whereby said grid is positioned between said cathode and anode and having an opening through which a portion of said cathode may protrude without touching said plate.

4. In an electron device, the combination of an anode, grid and cathode, and an insulator for maintaining the electrodes in spaced relation, one of said electrodes passing through the insulator, said insulator having an opening the perimeter of which differs in shape from the circumferential shape of the electrode passing therethrough whereby contact between the insulator and said electrode is effected at a limited number of points.

In testimony whereof, I affix my signature.

WALTER LOUIS KRAHL.