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2,030,186

STEM MAKING APPARATUS

Original Filed Dec. 29, 1933

Fig. 1

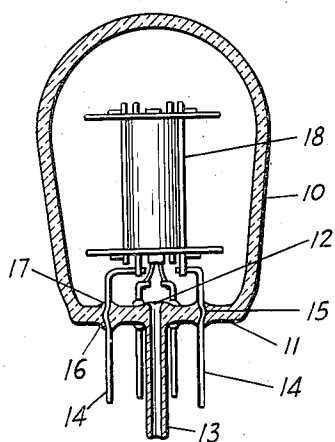


Fig. 2

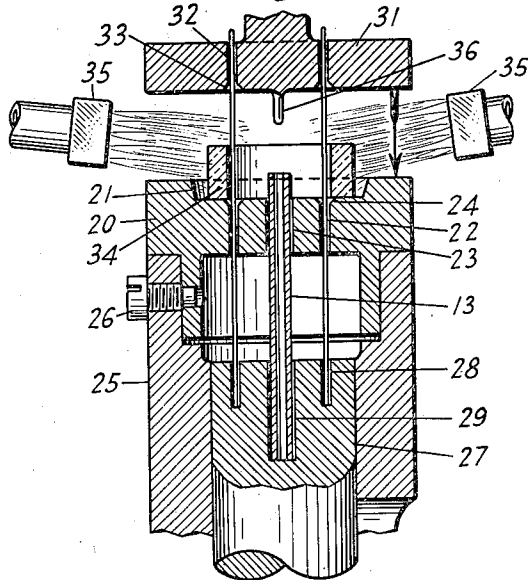


Fig. 3

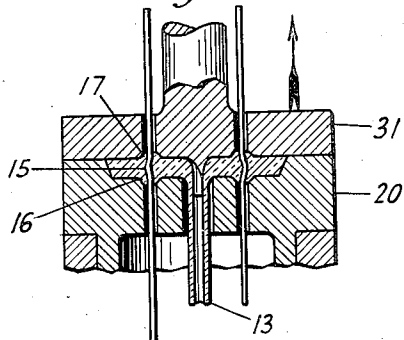


Fig. 4

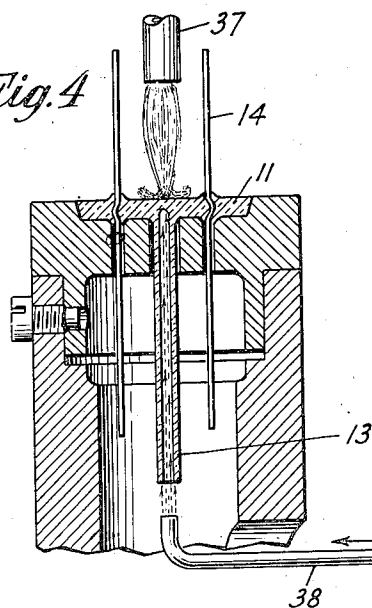
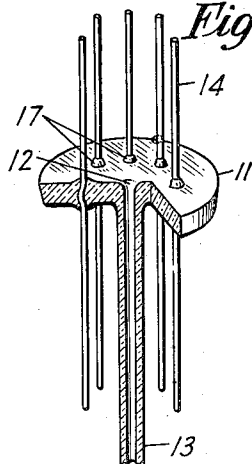


Fig. 5



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STEM MAKING APPARATUS

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Original application December 29, 1933, Serial No. 704,416. Divided and this application October 25, 1934, Serial No. 749,955

8 Claims. (Cl. 49-2)

My invention relates to electrical devices comprising sealed containers, such as electron discharge devices and similar articles, and more particularly to apparatus for making the stem for such devices.

This application is a division of my co-pending application, Serial No. 704,416, filed December 29, 1933, and assigned to the same assignee as the present application.

In electron discharge tubes and similar devices having sealed or evacuated bulbs which enclose electrodes mounted on the conventional reentrant stem or stem press, approximately 30% of the overall length of the tube is due to the stem. The comparatively long leading-in wires extending thru the stem from the stem press inside the bulb to the contact pins on the base are objectionable when the tube is used in high frequency circuits, since the inductance of the leads and the interlead capacity become so nearly comparable in magnitude to the external tuning inductance and capacity as to limit the frequency at which the tube can operate satisfactorily.

Efforts have been made to lessen the inductance and capacity of the leads by shortening the conventional stem and increasing the separation of the leads, but these efforts have been unsuccessful in practice, as the difficulties of making a conventional type stem increase so rapidly as the stem decreases in size that it is not commercially feasible to make very short stems of the conventional type.

An object of my invention is to provide a novel and simple apparatus for commercially making an improved stem for electron discharge devices and similar articles, and which can be made even in very small sizes and has much less interlead capacity and inductance of the leads than stems of the conventional type.

The novel features which I believe to be characteristic of my invention are set forth more particularly in the appended claims, but the invention itself will best be understood by reference to the following description taken in connection with the drawing in which—

Figure 1 is a vertical cross section of an electron discharge device having a stem made in accordance with my invention;

Figure 2 is a cross sectional view of the apparatus made in accordance with my invention at one stage of the process of forming a stem for the electron discharge device shown in Figure 1; Figure 3 shows the apparatus at another stage of making a stem for the electron discharge device shown in Figure 1;

Figure 4 shows an optional method of providing a stem made in accordance with my invention with an exhaust opening;

Figure 5 is a perspective view, partly in section, of a complete stem made in accordance with my invention.

The envelope 10 of the electron discharge device shown in Figure 1 has a stem which is made in accordance with my invention. This stem has a flat disc press 11 with a central exhaust hole 12 communicating with a perpendicular exhaust tube 13 hermetically sealed to the press 11 and sealed off after exhaust. Leading-in wires 14, each having a bowed portion 15 embedded in the press 11, have pips 16 and 17 around the leading-in wires on either side of the press to increase the length of the seal between the glass and leading-in wires. The leading-in wires may be such as are commonly used for radio tubes and lamps, or may be of a chrome iron alloy proportioned to have a coefficient of thermal expansion such that the wires make a hermetical seal with the stem glass. An electrode assembly 18 of the conventional type is supported by and connected to the leading-in wires within the envelope 10.

My improved stem with the flat press 11 is of minimum length, but has sufficient length of leading-in wires embedded in the press to make a good hermetical seal.

The leading-in wires are not much longer than the thickness of the press, hence their inductance is a minimum and the wide spacing of the leading-in wires in the press not only makes the interlead capacity very small, but renders negligible the losses due to glass electrolysis.

One form of apparatus made in accordance with my invention and suitable for making my stem having the flat disc press 11 is shown in Figures 2 and 3. This apparatus is essentially a press mold for molding the glass into shape and at the same time hermetically sealing the leading-in wires into the molded glass. This particular apparatus comprises a plate 20 having on its upper side a flared circular pocket or depression 21 forming a press mold in which the press 11 is molded. To position the leading-in wires during the molding of the press a number of holes 22 slightly larger than the leading-in wires extend from the bottom of the pocket 21, thru the plate 20, and are arranged in a circle concentric with and somewhat smaller than the pocket. The exhaust tube 13 is positioned with its upper end in the pocket by means of a central hole 23 in which it fits loosely. The upper ends of the holes 22 and 23 are countersunk to provide in the bottom

of the pocket conical recesses or countersinks 24 which form the pips 16 around the leading-in wires and a fillet around the exhaust tube, thus strengthening the stem. The press mold or plate 20 is supported by a tubular pedestal 25 and held in place by a set screw 26.

The ends of the leading-in wires and of the exhaust tube which project below the plate are properly positioned during the molding of the press by a plunger 27 movable in the bore of the pedestal 25 and having in its upper end countersunk pockets 28 for the end of the leading-in wires and a similar pocket 29 for the end of the exhaust tube.

With the leading-in wires and the exhaust tube held in position in the press mold 21, the glass of the press 11 is molded into shape by a press block 31, which is movable vertically and in alignment with the mold 21. This press block has holes 32 corresponding to and in registry with the holes 22 in the mold 21, to receive the upper ends of the leading-in wires. The lead wires could be threaded thru the holes 32 of block 31 into the holes 22 and pockets 28 prior to molding the glass into a press. The holes 32 are countersunk at the lower ends to form conical recesses or countersinks 33 which form the pips 17 around the leading-in wires when the press is formed.

The glass for the press 11 is supplied to the mold in the form of a glass ring or collar 34 which is set in the mold to encircle the leading-in wires, as shown in Figure 2. This glass collar is heated, preferably by rather soft flames from burners 35 set to direct their flames onto the glass collar and to some extent into the mold 21. As the glass collar softens it tends to shrink around the leading-in wires 14 and the end of the exhaust tube 13, and eventually forms a plastic mass which is held in the pocket 21 and in which the leading-in wires and the upper end of the exhaust tube are embedded. When the glass of the collar 34 becomes sufficiently plastic to flow easily, the press block 31 is moved downwardly until the plastic glass is pressed into the pocket 21 and forms a rough disc in which the leading-in wires and tubular exhaust member are embedded. The press block is then retracted or raised into substantially the position shown in Figure 2, and the newly formed disc in the pocket 21 is again heated to soften it and eliminate stresses in the glass. While the glass is soft, the press block again descends and presses the glass in the pocket 21 into its final form. During this final shaping of the glass the portions of the leading-in wires embedded in the glass become bowed, as indicated at 15, probably by pressure due to radial flow of the glass as it is formed into the flat press, and the pips 16 and 17 are formed as the glass is pressed into the countersinks 24 and 33.

It is necessary to have an exhaust opening 12 in the press as shown in Figure 1. While it is possible to provide the exhaust opening thru the press by properly positioning the exhaust tube and carefully directing the flames to avoid softening the end of the exhaust tube so that it stays open during the press forming operation, I prefer to use more positive methods of providing the exhaust opening thru the press. In the form of apparatus shown in Figures 2 and 3 the opening 12 is made by a mandrel or pin 36 approximately the size of the bore of the exhaust tube and extending downwardly from the press block 31 in registry with the exhaust tube 13. As the press block is moved to pressing position to form

the press the mandrel 36 enters the end of the exhaust tube and maintains the opening 12 thru the press during the press forming operation as shown in Figure 3.

If preferred the mandrel 36 on block 31 may be omitted. In this case the exhaust opening will probably be closed as shown in Figure 4 when the final press is made. To provide the exhaust opening the press block 31 is lifted and moved out of the way, and an exhaust hole thru the flat press to the exhaust tube 13 is opened by heating the center of the press with a sharp pointed flame from the burner 37, as shown in Figure 4, and introducing air under pressure into the exhaust tube 13 by a nozzle 38 inserted into the pedestal 25 thru an opening in the pedestal, the plunger 27 being retracted at this time to permit insertion of nozzle 38. As the glass in the center of the press softens the air in the exhaust tube blows an exhaust hole 12 thru the press. The finished stem regardless of the method of providing the exhaust opening is shown in Figure 5. This stem may then be given a final annealing in an oven.

The leading-in wires of the finished stem are formed or bent to shape for mounting of the electrode assembly 18 on the stem. The exhaust tube may conveniently be used as a handle to hold the stem during the assembly of the tube. The neck of the envelope or bulb 10 is hermetically sealed to the edge of the press 11, the sealed container thus produced exhausted, and the exhaust tube 13 tipped off as close to the press 11 as convenient. The tipping off of the exhaust tube may be done on the conventional machines. The finished tube may then be based in the conventional manner.

The electron discharge device which I have described may be made commercially on a stem machine of the turret type provided with the stem forming apparatus shown in Figures 2, 3 and 4. The stem is easily and quickly made and, an electron discharge device made with my improved stem is of minimum overall length, is mechanically strong, and has desirable characteristics, particularly for use at high frequencies. This type of stem, because of the disc press, is well adapted for use with tubes in which the envelope or bulb is of metal and forms the anode of the tube, since my stem permits a quick and reliable seal to be made between the edge of the press and the usual cylindrical metal envelope.

While it is convenient to mount the die on the pedestal 25 as shown in Figure 2, I can reverse the positions of the die and the press block and have the press block mounted on the pedestal. In this case the stem press will be provided with an oppositely directed flare which may be useful in some cases. This is possible because the plastic glass will tend to shrink around the leading-in wires and exhaust tube.

While I have indicated the preferred embodiments of my invention of which I am now aware and have also indicated only one specific application for which my invention may be employed, it will be apparent that my invention is by no means limited to the exact forms illustrated or the use indicated, but that many variations may be made in the particular structure used and the purpose for which it is employed without departing from the scope of my invention as set forth in the appended claims.

What I claim as new is—

1. A stem forming machine including means for receiving a tubular glass member and an ex-

haust tube having its end extending within said tubular member, means for heating said tubular member to cause said tubular member to become plastic and flow around said exhaust tube, a member relatively movable with respect to and cooperating with said receiving means to compress the plastic material into a flat press perpendicular to the end of said exhaust tube.

2. A stem forming machine including a plate for supporting one end of a tubular glass member and having an aperture for positioning an exhaust tube with its end projecting into said tubular glass member, means for heating said tubular glass member to fuse said tubular member into a plastic mass embedding the projecting end of the exhaust tube in said aperture, a press member relatively movable with respect to and cooperating with said plate to compress the plastic mass into a flat press perpendicular to said exhaust tube, and means for making thru said press an opening communicating with said exhaust tube.

3. A stem forming apparatus including a die plate having a flat bottom depression for receiving a tubular member and formed to receive an exhaust tube and leading-in wires within the tubular member, means for heating said tubular member to cause said tubular member to become plastic and flow around said leading-in wires and said exhaust tube, a press block having apertures thru which the leading-in wires extend, said die plate and block being relatively movable to compress the heated material into a flat press perpendicular to said exhaust tube and to seal said leading-in wires in the press.

4. A stem forming machine including a die plate having a flat bottomed pocket with flared sides for receiving a tubular member, and apertures extending from said depression thru said plate to receive an exhaust tube and leading-in wires around said exhaust tube within said tubular member, means for heating said tubular member to cause said tubular member to become plastic and flow around said leading-in wires and said exhaust tube, a press block having apertures thru which the leading-in wires extend, said die plate and press block being relatively movable to compress the plastic material into a flat press perpendicular to said exhaust tube and to seal said leading-in wires in said press, and a mandrel on said press block registering with the opening in said exhaust tube to provide an exhaust opening thru said press when said die plate and press block are moved to press forming position.

5. A stem forming apparatus including a die plate having a circular flat bottomed pocket for receiving a tubular glass member, apertures extending from said depression thru said plate for receiving an exhaust tube and leading-in wires within said tubular member, a movable member cooperating with said die plate for positioning the end of said exhaust tube within said tubular member and the leading-in wires to extend thru said tubular member, devices for heating said tubular

member to cause said tubular member to become plastic and flow around said leading-in wire and exhaust tube, a press block movable with respect to and cooperating with said die plate to compress the heated material into a flat disc press perpendicular to the end of said exhaust tube and to seal in the leading-in wires, and a mandrel on said press block in registry with the opening in said exhaust tube and cooperating with said exhaust tube for providing an exhaust opening thru said press when said press block and die plate are moved to press forming position.

6. A stem forming machine including means for receiving a tubular member and an exhaust tube having its end extending within said tubular member, means for heating said tubular member to cause said tubular member to become plastic and flow around said exhaust tube, means for compressing said heated material into a flat press perpendicular to and closing the end of said exhaust tube, other means for locally heating said press at the end of said exhaust tube, and means for applying fluid pressure to said press while said press is being heated to provide an opening thru said press communicating with said exhaust tube.

7. A stem forming machine including a die plate having a flat bottomed pocket with flared sides for receiving a tubular member and apertures extending from said depression thru said plate to receive an exhaust tube and leading-in wires around said exhaust tube within said tubular member, means for heating said tubular member to cause said tubular member to become plastic and flow around said leading-in wires and said exhaust tube, a press block having apertures thru which the leading-in wires extend, said die plate and press block being relatively movable to compress the plastic material into a flat press perpendicular to and closing said exhaust tube and to seal said leading-in wires in said press, other means for locally heating said press at the end of said exhaust tube, a device for applying fluid pressure thru said exhaust tube while applying heat to said press to provide an opening thru said press communicating with said exhaust tube.

8. A stem forming machine including means for receiving a tubular glass member and an exhaust tube having its ends extending within said tubular member, means for heating said tubular member to cause said tubular member to become plastic and flow around said exhaust tube, a member relatively movable with respect to and cooperating with said receiving means to compress the molten mass into a flat press perpendicular to and closing the end of said exhaust tube, means for locally heating said press at the end of said exhaust tube, and means for applying fluid pressure thru the exhaust tube while applying heat to said press to provide an opening thru said press communicating with said exhaust tube.

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