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STEM FOR ELECTRON DISCHARGE DEVICES

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FIG. 1

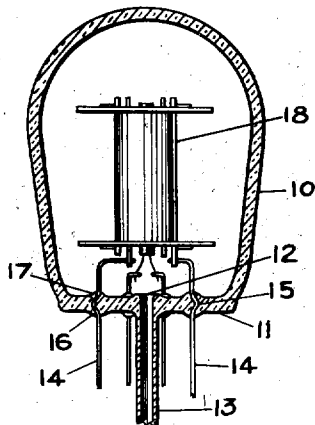


FIG. 2

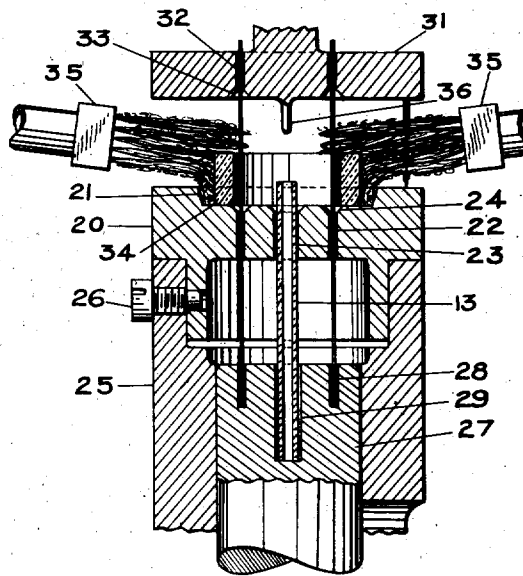


FIG. 3

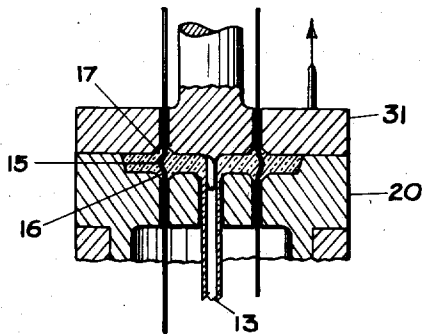


FIG. 4

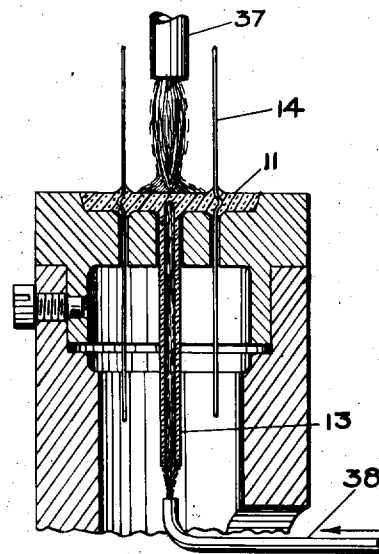
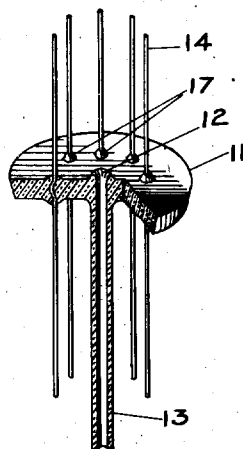


FIG. 5



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STEM FOR ELECTRON DISCHARGE
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8 Claims. (Cl. 49-78)

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

In electron discharge tubes and similar devices having sealed or evacuated bulbs which enclose electrodes mounted on the conventional reentrant stem or stem tube, approximately 30% of the overall length of the tube is due to the stem. The comparatively long leading-in wires extending through 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 for electron discharge devices and similar articles an improved stem which can be made commercially even in very small sizes and has much less interlead capacity and inductance of the leads than stems of the conventional type.

Another object of my invention is to provide a novel and simple method and apparatus for making my improved stem.

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 provid-

ing a stem made in accordance with my invention with an exhaust opening;

Figure 5 is a perspective view, partly in section, of a completed 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 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, through 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 counter-

sinks 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 ends 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 holes 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 through 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 through 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 through 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 through 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 through an opening in the pedestal, the plunger 27 being retracted at this time to permit insertion of nozzle 37. As the glass in the center of the press softens the air in the exhaust tube blows an exhaust hole 12 through 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 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. The method of making stems for electron discharge and other evacuated devices which consists in assembling an exhaust tube with its end within a tubular glass member and extending leading-in wires between and longitudinally of said exhaust tube and tubular glass member, heating the tubular member until it becomes

plastic and flows around said leading-in wire and the exhaust tube, forming the heated mass into a rough disc perpendicular to the exhaust tube, reheating said rough disc to relieve strains and render said disc plastic, compressing said reheated mass into a finished disc-like press perpendicular to said leading-in wires and the exhaust tube, and forming an opening through said press communicating with the exhaust tube while the press around the end of said exhaust tube is plastic.

2. The method of making stems for electron discharge and other evacuated devices which consists in assembling an exhaust tube with its end within a tubular glass member and extending leading-in wires between and longitudinally of said exhaust tube and tubular member, heating said tubular glass member until it becomes plastic and flows around said leading-in wires and said exhaust tube, and compressing said plastic material into a flat press perpendicular to said exhaust tube and leading-in wires to seal said wires and exhaust tube in said press.

3. The method of making stems for an electron discharge and other evacuated devices which consists in assembling an exhaust tube with its end within a tubular glass member and extending leading-in wires between and longitudinally of said exhaust tube and tubular member, heating the tubular member until it becomes plastic and flows around said leading-in wires and said exhaust tube, compressing said plastic material into a disc-like press perpendicular to said exhaust tube and leading-in wires to seal said wires and exhaust tube in said press, and forming an opening through said press communicating with said exhaust tube while the press around the end of said exhaust tube is plastic.

4. The method of making stems for electron discharge and other evacuated devices which consists in assembling an exhaust tube with its end within a tubular glass member and extending leading-in wires between and longitudinally of said exhaust tube and tubular member, heating the tubular glass member until it becomes plastic and flows around said leading-in wires and said exhaust tube, and compressing the plastic material into a disc-like press perpendicular to said exhaust tube and leading-in wires to seal said wires and exhaust tube in said press while maintaining a mandrel in the end of said exhaust tube to provide an opening through the press communicating with said exhaust tube.

5. A method of making stems for electron discharge and other evacuated devices which consists in assembling an exhaust tube with its end within a tubular glass member and extending leading-in wires between and longitudinally of said exhaust tube and tubular member, heating

the tubular member until it becomes plastic and flows around said leading-in wires of said exhaust tube, forming the plastic mass into a rough disc perpendicular to said exhaust tube, reheating said rough disc to relieve strains and render said disc plastic, and compressing said reheated disc to provide a finished disc perpendicularly to said exhaust tube and leading-in wires and to seal said wires and exhaust tube in said press, while maintaining a mandrel within the end of said exhaust tube to provide an opening through said press communicating with said exhaust tube.

6. The method of making glass stems for electrical devices comprising sealed containers which consists in positioning an exhaust tube with its end within a tubular glass member, heating said tubular glass member and the end of said exhaust tube to form a fused mass, forming said fused mass into a flat press perpendicular to said tube, and introducing fluid under pressure into said exhaust tube and simultaneously heating said press locally at the end of said exhaust tube until a hole is blown from said exhaust tube through said press.

7. The method of making stems for electron discharge and other evacuated devices which consists in assembling the exhaust tube with its end within a tubular glass member and extending leading-in wires between and longitudinally of said exhaust tube and tubular member, heating the tubular glass member until it becomes plastic and flows around said leading-in wires and said exhaust tube, compressing said plastic material into a disc-like press perpendicular to said exhaust tube and leading-in wires to seal said wires and exhaust tube in said press, and applying fluid pressure through said exhaust tube while heating the press around the exhaust tube to provide an opening through said press communicating with said exhaust tube.

8. The method of making stems for an electron discharge and other evacuated devices which consists in assembling an exhaust tube with its end within a tubular glass member and extending leading-in wires between and longitudinally of said exhaust tube and tubular member, heating the tubular member until it becomes plastic and flows around said leading-in wires and said exhaust tube, forming the heated mass into a rough disc perpendicular to said exhaust tube, reheating said formed mass to relieve strains, compressing said reheated mass into a finished disc perpendicular to said exhaust tube and leading-in wires to seal said wires and exhaust tube in said press, and applying fluid pressure through said exhaust tube while applying heat to the press to provide an opening through said press communicating with said exhaust tube.

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