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APPARATUS FOR SEALING-IN ELECTRON TUBES AND THE LIKE

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Fig. 1.

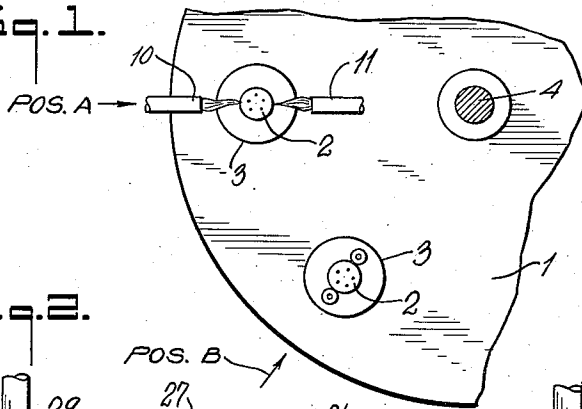


Fig. 2.

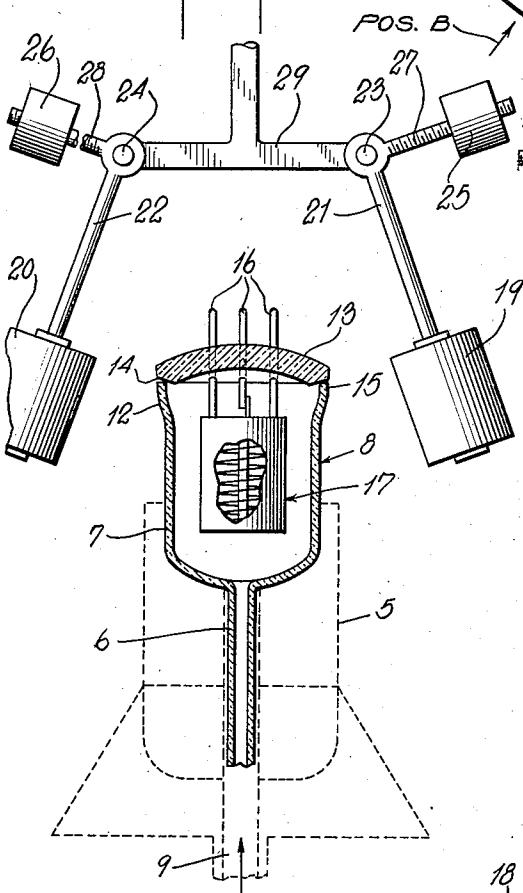


Fig. 3.

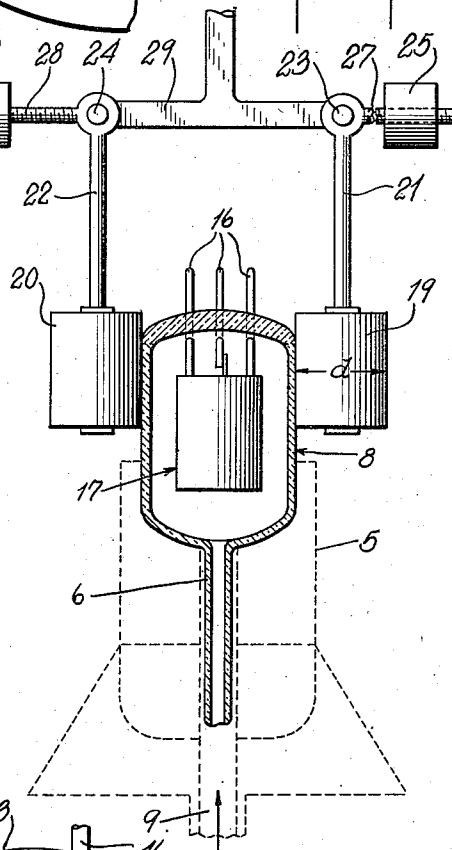


Fig. 4.

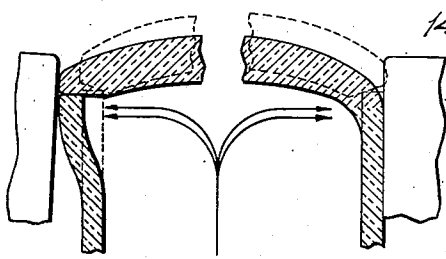
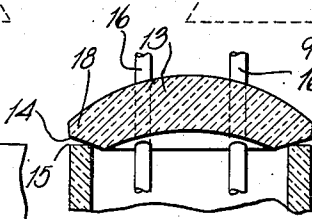


Fig. 5.

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APPARATUS FOR SEALING-IN ELECTRON
TUBES AND THE LIKE

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1 Claim. (Cl. 49—2)

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This invention refers to apparatus for manufacturing electron discharge devices and other vacuum tubes and more particularly to apparatus for sealing a glass header or stem, carrying an electron assembly, into a glass envelope.

In the conventional method of sealing-in incandescent lamps, radio tubes and the like, automatic machinery is used comprising an intermittently rotating table on which is disposed on a circle, a plurality of holder heads mounted on spindles for receiving the glass stems or headers. In a loading position, an operator inserts the headers into the holder heads, the electrode mount pointing upwards, and slips the glass bulb downwardly over the electrode mount. Usually the stem is provided with an exhaust tubulation, which fits into an axial hole in the spindle head. If desired, means may be provided to supply an inert gas through bores in the spindles into the exhaust tubulation in order to prevent oxidation of the mount elements when the glass of the envelope and the header is heated for sealing-in.

When the bulb or envelope is downwardly telescoped over the mount, it is usually held in position by special bulb supporting arms attached to and spinning with the spindle, or it may rest with the rim of its open end in abutting relation against the periphery of the header, and be taken up before sealing by grippers into chucks which rotate and spin synchronously vertically above the header-holding spindles.

One disadvantage of this method of sealing-in tubes, with the open rim of the envelope or bulb facing downward, is that the gravitational forces acting on the softened glass at the lower open end of the envelope tend to pull this soft plastic glass downward, with the result that the lower part of the wall of the envelope becomes thinner, while the excess glass flowing downward increases the thickness of the header.

It is, therefore, an object of the invention to provide means for employing the gravitational forces, acting on the softening glass rim of a glass envelope during sealing-in, for the purpose of increasing the wall thickness of the glass envelope in that region.

Another object of the invention is, to provide means for employing the gravitational forces, acting on the softening glass rim of a glass header during sealing-in, for obtaining a gradually decreasing glass thickness from the header which is relatively thick, to the bulb glass wall which is relatively thinner.

In some types of tubes, in particular in small

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tubes as used e. g., in hearing aid amplifiers, the header is too small to provide enough space for attaching an exhaust tubulation of sufficiently large diameter for insuring the desired pumping speed during exhaust of the tube. The exhaust tubulation in these tubes is, therefore, usually attached to the closed end of the envelope, opposite to the header end. If it is desired to introduce an inert gas through the tubulation during sealing-in with the conventional position of the glass bulb above the header during sealing-in, special means must be provided for supplying the gas from above into the tubulation and for preventing the glass bulb from tumbling e. g., through a pipe system provided in the overhead chucks, or in any feasible manner. This complicates the mechanical construction of the sealing-in machine.

It is, therefore, a principal object of the invention to devise an apparatus for sealing-in vacuum discharge tubes in which only one of the two parts to be sealed together is directly supported by external means.

It is another object of the invention to provide means for sealing in a vacuum tube assembly, in which the header-mount assembly is supported directly by the glass envelope into which it is to be sealed.

According to a further object of the invention, means are provided for supporting a tubulated glass envelope from below, with the open end of the envelope pointing upward and with the exhaust tubulation downward.

A still further feature of the invention refers to the application of a pair of working rollers in a fixed shaping position above an intermittently rotating seal-in table.

Another object of the invention is to provide means for forming a perfectly smooth butt seal by the combined application of gas pressure into a glass envelope from below, the weight of the header and mount, and of a pair of shaping rollers.

According to a still further object of the invention, means are provided to prevent excessive heating of tube mount during sealing-in.

The invention will now be described in connection with the drawing, in which:

Fig. 1 is a top-plan view of a sector of the intermittently rotating table showing two consecutive positions.

Fig. 2 is a side view of the tube being sealed-in, just as it is entering the shaping position.

Fig. 3 is a side view of a tube in the shaping position, at the end of the shaping operation.

Fig. 4 is a magnified view of the header and butt prior to sealing.

Fig. 5 is a magnified view explaining successive stages in the sealing.

In Fig. 1, 1 is a sector of the usual turntable, on which are arranged in a circle the holding heads 2 on spindles 3, the table being intermittently rotated around vertical shaft 4, which is mounted in bearings on, and driven by an indexing drive with respect to a stationary rack (not shown). The indexing motion is so controlled, that the holding heads and spindles come to a stop in certain working positions, where they remain stationary for a fixed interval. Two of these positions are indicated in the figure, and marked as positions (A) and (B). The spindles 3 with heads 2 include a receptacle 5 for the exhaust tubulation 6 and the lower part 7 of cylindrical glass bulb 8, each spindle being provided with a bore 9 through which a neutral gas e. g., nitrogen is supplied as indicated by the vertical arrows in Figs. 2 and 3. In position (A) of Fig. 1, a pair of torches 10 and 11 is provided for bringing the upper portion 12 of bulb 8 and the periphery of header 13 to softening temperature. The header 13 is of much thicker glass than the bulb and is dome-shaped with a flat but slightly inclined peripheral edge 14 on its lower face where it initially seats against the rim 15 of the bulb. Header 13 has the usual lead-in wires 16 presealed therethrough, and any well-known form of electrode assembly 17 is attached to and supported by wires 16. The weight of mount 17 tends to exert downwardly directed forces on the rim 18 of the softening header, and presses downwardly and outwardly on the open upper rim 15 of the glass bulb with enough pressure to overcome the respective surface tensions of the two glass parts, thus effecting a mutual wetting and puddling to begin the sealing operation. The gas is now trapped between 15 and 18 and its pressure through the tubulation is high enough to expand the sealing portion of the softened header and the portion 12 of the bulb, radially outward, so as to impart to it a bulging shape similar to that indicated in Figs. 2 and 3. When the viscosity of the glass has been sufficiently lowered by the heat applied in position (A), the head 2 and spindle 3 are indexed into position (B), where a pair of graphite rollers 19 and 20 are located. These rollers may be suspended by levers 21, 22, from hinges 23 and 24, attached to stationary rod 25. Rollers 19 and 20, may be separated by the indexing motion of table 1 so as to provide a clear path for the bulb 8 and header 13 between the rollers as shown in Fig. 2. As soon as the table 1 is at rest again after completion of the indexing motion, the rollers 19 and 20 close (Fig. 3) and their weight works the hot glass from the outside, whereby a perfectly smooth transition between the cylindrical part of the bulb and the header is obtained. By properly locating the hinges 23 and 24, and by proper choice of the diameter of the rollers 19 and 20, the "straightness" of the seal as shown in Fig. 3 between the cylindrical bulb and the header can easily be insured, and the proper amount of radially inward and upward pressure exerted by the rollers on the soft glass seal and can easily be adjusted, e. g., by counterweights 25 and 26, adjustably attached to horizontal rods 27 and 28, which form bell-cranks with arms 21 and 22. It will be observed that the hinges or pivots 23 and 24 are located considerably above the soft-

ened sealed portion and are located outside the boundary of the bulb 8. Consequently, as the rollers 19 and 20 swing inwardly towards the bulb, they describe a circular arc directed upwardly towards the header 13. Furthermore, the rollers 19 and 20 are considerably longer than the length of the softened area so that their inward movement is limited by their respective engagements with the unsoftened portion of the bulb 8. By virtue of the low center of gravity of rollers 19 and 20 and their contact with the cooler and solid part of bulb 8, extensive reduction in bulb diameter is avoided.

In order to avoid sliding down or sagging of the header inside the softening wall of bulb 8, as a result of the deformation of the header in response to the sealing torches applied in position (A), and in response to the weight of the tube mount 17, the header is, in accordance with the invention, made slightly dome-shaped or saucer-shaped, with the convex side pointing upward as shown in Figs. 2 and 3. It is clear therefore, that the periphery of the header will exert a downward pressure on the upper margin of the glass bulb as the header tends to flatten out. This results in a tapered thickening of the bulb rim at the sealing region and in a smoothly tapered final seal as shown in Fig. 3.

This feature is very important. If a flat disc-shaped header is used in this method of sealing-in, the shape of the originally flat header deforms and collapses into a downwardly convex curved surface in response to the weight of the mount when the header softens.

Accordingly, a flat header has a tendency to slip down into the envelope, which frustrates the formation of the desired uniformly tapered seal, due to formation of forces pulling the periphery of the header radially inward. Such forces not only decrease the downward pressure of the periphery of the header on the softening bulb rim, but represent a pulling away of the header periphery from the seal with the rim of the envelope.

With the foregoing described method of sealing-in, a minimum of heat is transmitted to the interior part of the mount and it is not necessary to support mechanically the header and mount from opposite ends.

It will be understood that if the gravitational forces acting on the header are insufficient to effect the proper "working" of the softened glass, it may be supplemented by pushing down on the header. Thus if the header is of the type which carries the exhaust tubulation, this tubulation may at the sealing-in position be subjected to a downward pressure.

Various changes and modifications can be made without departing from the spirit and scope of the invention.

What is claimed is:

Apparatus for sealing-in a relatively thick glass header to a thinner-walled glass bulb which apparatus is of the type comprising a turntable indexable to a series of successive positions at which operations are to be performed, a plurality of rotatable heads carried by said turntable, each head having means to receive and support a bulb with its mouth uppermost and with the header resting on the lip of the mouth, means effective in one position of said turntable for heating the contacting regions of the bulb and header to softening temperature and for admitting gas under pressure to the interior of the bulb to cause the softened regions to bulge outwardly, the fea-

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ture of novelty which includes means effective in another position of said turntable to press the bulged region mechanically inwardly comprising a pair of weighted rollers which are pivotally supported on pivot points located above and beyond the boundary of the said bulb, each roller having a length which is substantially greater than the length of the said softened regions whereby the inward movement of said rollers is limited by their engagement respectively with the unsoftened wall of the bulb.

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