Feb. 14, 1950

A. GREINER

2,497,545

ELECTRIC LAMP OR SIMILAR DEVICE
AND METHOD OF MANUFACTURE
Filed July 2, 1948

Fig. 1.

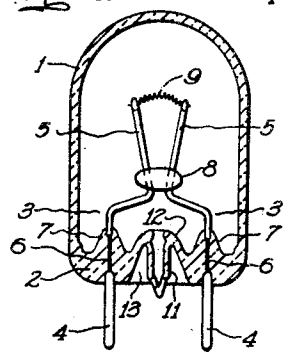


Fig. 2.

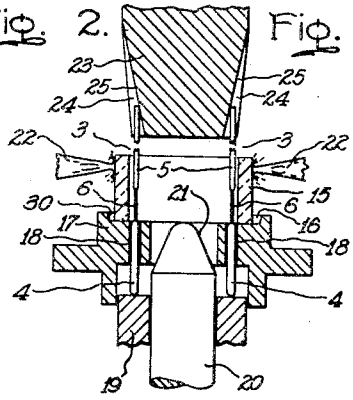


Fig. 3.

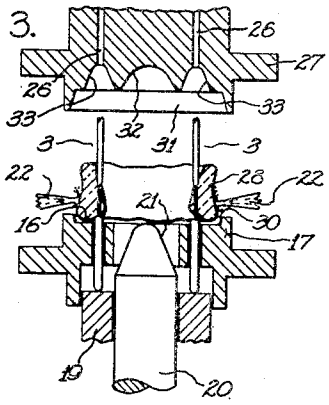


Fig. 4.

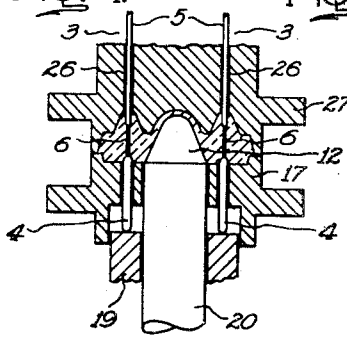


Fig. 5.

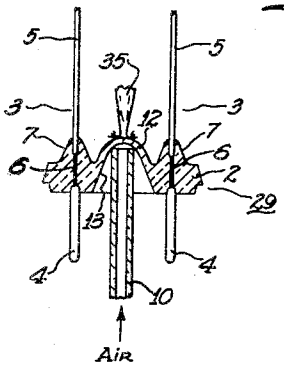


Fig. 6.

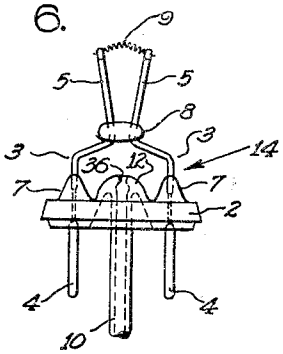


Fig. 7.

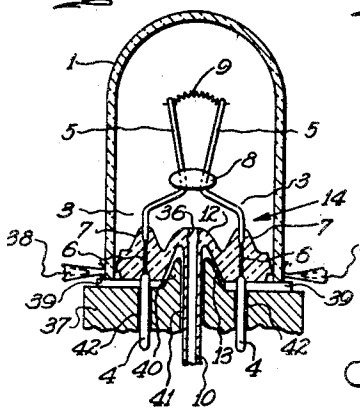
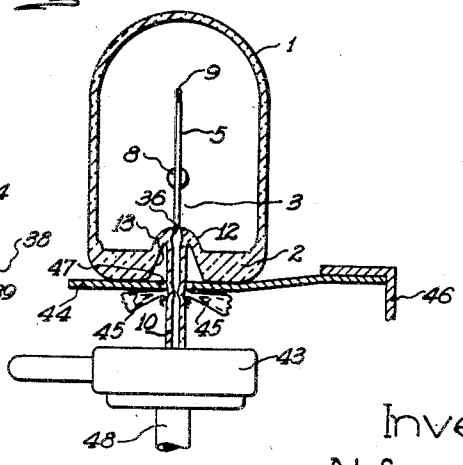


Fig. 8.



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His Attorney.

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UNITED STATES PATENT OFFICE

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ELECTRIC LAMP OR SIMILAR DEVICE AND METHOD OF MANUFACTURE

Alfred Greiner, Cleveland Heights, Ohio, assignor to General Electric Company, a corporation of New York

Application July 2, 1948, Serial No. 36,616

9 Claims. (Cl. 176—16)

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My invention relates to sealed containers of the type provided with a tipped-off exhaust tubulation, and to a method of manufacture thereof. The invention is of particular utility in the manufacture of various types of electrical devices such as electric incandescent lamps, flash lamps, radio tubes and other discharge devices, for instance.

In the manufacture of various types of electric lamps and similar devices employing a sealed envelope which is evacuated and in some instances filled with a gas of suitable character, it is customary to provide a glass tubulation or exhaust tube on the envelope through which the latter is evacuated and filled with gas, if any, after which the exhaust tube is tipped-off to form an exhaust tip sealing-off the envelope. Such exhaust tubes are generally attached either to the top of the envelope or to the base end thereof, the latter arrangement being preferable, however, because of the lesser likelihood of accidental breakage of the exhaust tip.

Where the exhaust tip is provided on the base end of the envelope, it is especially desirable to have the exhaust tip project as short a distance as possible from the envelope so as not to be broken during insertion of the device into a socket. However, where the base end of the envelope is composed of a header or combination base and stem assembly in the form of a relatively thick glass sealing disc or button having lead-in conductors sealed therethrough, a short exhaust tip on such a thick glass sealing disc is very difficult to produce because of the strong tendency of the glass to develop cracks when the seal-off is made close to the thick cross-section of glass comprising the sealing disc. These cracks are caused by localized strains in the glass which develop when heat is localized in a small area or region, as is the case in the tipping-off of the exhaust tube. While the formation of such localized strains may be avoided by tipping off the exhaust tube at a temperature well above the strain point of the particular glass compositions of which the exhaust tube and sealing disc are made, or by annealing the lamp after it has been sealed off, such operations nevertheless constitute complicating manufacturing factors and also add to the cost of fabrication of the lamp or other device.

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It is an object of my invention, therefore, to provide a sealed tubulated hollow article having a relatively thick glass base or end wall of novel construction and provided with a relatively short exhaust tip projecting therefrom.

Another object of my invention is to provide an electric lamp or similar device having a combination base and stem assembly of novel character.

Still another object of my invention is to provide an improved tubulated glass stem for an electric lamp or similar device and comprising a relatively thick glass disc having a glass tubulation projecting therefrom which can be tipped off extremely short without danger of the glass cracking.

A further object of my invention is to provide an improved method of manufacturing a sealed hollow article having a thick glass end wall or sealing disc provided with a relatively short exhaust tip.

Further objects and advantages of my invention will appear from the following description of a species thereof and from the accompanying drawing in which:

Fig. 1 is an elevation on an enlarged scale of an electric incandescent lamp provided with a combination base and stem assembly according to the invention; Figs. 2 to 8 are views illustrating successive steps in the manufacture of the lamp shown in Fig. 1 according to the invention, Fig. 2 showing the component parts of the stem in position for the molding of the stem in a forming mold; Fig. 3 illustrates the heating and softening of the glass stem-forming collar which is subsequently pressed into shape in the forming mold; Fig. 4 illustrates the pressing of the softened glass collar into shape in the forming mold; Fig. 5 illustrates the attaching of the exhaust tube to the pressed glass body of the stem; Fig. 6 is an elevation of the completed base and stem assembly according to the invention; Fig. 7 illustrates the sealing of the combination base and stem assembly into the envelope of the lamp; and Fig. 8 illustrates the exhausting of the lamp and the tipping off of the exhaust tube thereof in accordance with the invention.

Referring to the drawings, the invention is there shown as applied to an electric incandescent lamp comprising a glass envelope or bulb 1

having a relatively thick disc-shaped glass base or end wall portion 2 through which are sealed a plurality (two in the particular case shown) of pin-type lead-in or current conductors 3. The said conductors 3 each comprise an outer pin portion 4 and an inner wire lead portion 5 butt-welded to opposite ends of and joined by a central or seal portion 6 completely embedded in the glass base 2 and having an expansion coefficient matching that of the glass base 2. At the region where each conductor 3 is sealed through the glass base 2, the latter is locally thickened, as by means of upstanding bosses 7 provided thereon, to permit embedding of the contact pins 4 in the glass to a depth sufficient to rigidly support the said pins therefrom. In the particular case shown, the conductors 3 are spaced apart a distance, measured center to center, of approximately ⅜ inch or thereabouts, and are disposed symmetrically on opposite sides of the center of the disc-shaped glass base 2. The inner lead portions 5 of the conductors 3 are tied together by an insulating bead 8 of glass or other suitable insulating material, although the said bead may be omitted, if desired. An electric energy translation device 9, such as a coiled wire filament of tungsten or other suitable refractory metal, is disposed within the envelope 1 and is connected across the inner leads 5. The glass base or sealing disc 2 is provided with a glass exhaust tube 10 (Figs. 6–8) which is attached to the disc at the central region thereof and communicates with the interior of the envelope 1. During the manufacture of the lamp the envelope 1 is exhausted and, if desired, filled with a suitable gas through the exhaust tube 10, after which the latter is tipped off, in accordance with the invention at a point very close to the glass base 2, to thereby form a short exhaust tube tip 11 (Fig. 1) hermetically sealing the envelope.

As is well known in the art, exhaust tubes such as are used to evacuate electric incandescent lamps, radio tubes, and similar devices, are customarily made of relatively thin-walled glass tubing. Thus, in the particular case shown, the exhaust tube 10 has a wall thickness of approximately 1/64 inch. Where such thin-walled exhaust tubes are joined directly to a relatively thick-sectioned glass body (such as the glass base 2) which is many times thicker than the wall thickness of the exhaust tube, it is very difficult to tip off the exhaust tube close to the glass body without cracking the glass, due to the development of localized strains in the glass resulting from the localized heating thereof during the tipping off operation.

In accordance with the invention, the glass base 2 is provided with a relatively thin-walled central dome section or indented wall portion 12 to the crown of which the exhaust tube 10 is attached. Such thin-walled dome section 12 thus provides an extended heat-conduction path of relatively thin-sectioned glass between the point of tip off of the exhaust tube and the relatively thick section of glass forming the glass base proper. This extended heat-conduction path of relatively thin-sectioned glass permits the tipping off of the exhaust tube relatively close to the glass base (e. g., within ⅛ inch or so of the crown of the dome 12) without causing any cracking of the glass, since it prevents the glass strains set up in the glass during the tipping off operation from localizing in a small area, which condition generally is the cause of fractures.

For the purpose of the invention, the wall of the dome section 12 should be materially thinner than that of the main body of the glass base 2, preferably less than about half the thickness of the glass base 2 and more nearly comparable to the wall thickness of the exhaust tube 10. Thus, in the particular case illustrated wherein the main body of the glass base 2 is around 7/64 inch thick, the dome section 12 may have a wall thickness of the order of 3/64 inch or thereabouts which is intermediate the wall thickness of the glass base proper and the exhaust tube and more nearly approaches the 1/64 inch wall thickness of the exhaust tube 10. The dome section 12 thus forms a thin transitional web of glass which is graded down in thickness from that of the envelope wall proper to a thickness of the order of that of the exhaust tube wall.

In addition to providing an extended thin transitional web of glass joining the thin wall of the exhaust tube 10 with the relatively thick wall of the glass base 2, the dome section 12 also provides a recess or hollow 13 in the outer side of the glass base 2 which enables the tipping off of the exhaust tube substantially flush with the outer side of the glass base so that the remaining short exhaust tube tip 11 will be practically completely accommodated within the said recess and thus protected from accidental breakage.

In manufacturing the lamp according to the invention, a combination base and mount assembly 14 (as shown in Fig. 6) is first formed as a separate unit which is then sealed to the glass envelope or bulb 1. The said assembly 14 may be formed in the manner indicated in Figs. 2–6. As there shown, a glass collar 15 is rested within the cavity 16 of a vertically stationary mold 17 which is provided with apertures 18 for receiving the pin portions 4 of the lead-in conductors 3 and supporting the latter in upright, properly spaced relation within the mold cavity, as indicated in Fig. 2. The lower ends of the lead-in conductors 3 rest on the upper end of a vertically reciprocable sleeve 19 to thereby support the conductors in proper vertical position within the mold with the upper ends of their pin portions 4 approximately flush with the bottom of the mold cavity 16. The mold 17 is provided further with a vertically reciprocable center forming pin 20 having a dome-shaped upper end 21, the said pin being vertically movable from a normally lowered or retracted position wherein its upper end 21 is located below the mold cavity 16 (as shown in Figs. 2 and 3), into an elevated position wherein its upper end 21 is located within the mold cavity, as shown in Fig. 4.

With the glass collar 15 and lead-in conductors 3 properly positioned and supported in the mold 17, the glass collar is suitably heated and fused, as by means of gas fires 22, to cause the glass to flow down and around the lead-in conductors 3. During the fusion of the glass collar 15, the lead-in conductors 3 are maintained in properly spaced parallel relation with one another, against displacement by the softened flowing mass of glass, by means of an upper spacer member 23 provided with conductor-receiving grooves 24 having downwardly converging spacing surfaces 25 which engage the upper ends of the lead-in conductors 3. The spacer member 23 is rotated in unison with the mold 17, about the vertical center axis of the latter, during the heating operation. In heating the glass collar 15, the gas fires 22 are initially directed at the upper regions of the glass collar (as shown in Fig. 2) until it begins to soften at such region, whereupon the

gas fires 22 are shifted downwardly so as to be directed at the lower regions of the glass collar, as shown in Fig. 3. This particular manner of heating the glass collar 15 causes an inward bowing of the latter as it softens and fuses down, thus keeping the upper regions of the glass collar spaced away from the lead-in conductors 3 so as not to leave a thin layer or film of glass on the upper or inner lead portions 5 of the conductors such as would cause them to stick in the conductor-receiving apertures 26 in the forming plunger or force 27 (Fig. 3) during the subsequent molding operation. As soon as the glass at the lower region of the collar 15 becomes softened and flows against and sticks to the lead-in conductors 3, the sleeve 19 is raised a slight distance, e. g., 1/32 inch or thereabouts. As shown in Fig. 3, this upward movement of the sleeve 19 pushes up on the lead-in conductors 3 and lifts the softened glass mass 28 off the bottom of the mold cavity 16, thus allowing the heat from the gas fires 22 to get under the glass mass 28 and heat the underside thereof, such operation being essential to the molding of the glass button or disc 2 of the stem 29 (Fig. 5) without cracking thereof.

The heating of the glass collar 15 is continued until the glass melts down into the mold cavity 16 and just begins to shrink and separate from the side wall 30 of the mold cavity, at which time the distribution of the softened glass 28 across the mold cavity corresponds most nearly to the final distribution of glass in the finished glass button 2 of the stem 29, i. e., with the greater portion of the softened glass mass 28 distributed around the outer regions of the mold cavity 16 and only a small amount of the glass located at the central region of the mold cavity where the thin-walled dome section 12 of the glass button 2 is to be formed. When such stage in the heating of the glass is reached, the spacer member 23 is withdrawn out of the way and the forming plunger or force 27 immediately moved into position above the mold 17 and lowered and the center forming pin 20 simultaneously raised, to close the mold for a short instant and press the softened glass 28 into shape, as shown in Fig. 4. The forming plunger or force 27 is adapted to rotate in unison with the mold 17 and is provided with a mold cavity 31 (Fig. 3) corresponding to and aligned with the cavity 16 in the mold 17 and having a central disc-shaped recess 32 which corresponds to the dome-shaped upper end 21 of the forming pin 20 and cooperates therewith to shape the central dome section 12 of the finished stem 29. The cavity 31 in the plunger 27 is also provided with wells or recesses 33 at the lower ends of the conductor-receiving apertures 26, which serve to shape the glass bosses 7 around each of the conductors 3 in the finished stem 29. Upon completion of the stem-molding operation, the plunger 27 is raised and the center pin 20 lowered, whereupon the sleeve 19 is raised an additional amount to push the conductors 3 upward and eject the molded stem 29 from the mold cavity 16.

The stem 29 thus formed is next provided with a glass tubulation or exhaust tube 10 which is attached to the crown of the dome section 12 within the recess 13 formed thereby. The said exhaust tube 10 may be attached to the stem in the manner shown in Fig. 5 by holding an end of the glass tube 10 against the underside of the crown of the dome section 12 and heating the latter on the upper side thereof opposite the glass tube, as by means of a gas fire 35 directed there-

against, until the glass softens and fuses to the end of the glass tube, whereupon a puff of air is directed into the open end of the glass tube 10 (as indicated by the arrow in Fig. 5) to blow an opening 36 through the wall of the dome section 12. The inner leads 5 of the stem 29 are then formed or bent into the desired final shape, an insulating bead 8 of glass or other insulating material (if such a bead is desirable) fused around the inner leads 5 to tie and hold them together in spaced relation, and an electric energy translation element or filament 9 such as a coiled wire of tungsten or other refractory metal connected across the inner end portions of the inner leads 5, to thereby complete the combination base and mount assembly 14 as shown in Fig. 6.

The mount assembly 14 thus formed is then sealed to the open end of the glass envelope 1. This may be performed in the manner indicated in Fig. 7 by holding the mount 14 and envelope 1 in sealing relation on a mount support pin 37 and rotating them through gas sealing fires 38 directed against the lower end of the envelope to fuse the said envelope end to the periphery of the glass disc 2 of the mount. As shown, the glass disc 2 of the mount 14 rests on the upper end of the mount pin 37, and the envelope 1 is held in a suitable holder (not shown) with its open end surrounding the glass disc 2 of the mount and likewise resting on the mount pin 37. The said mount pin 37 is provided with a plurality (preferably three) of radially extending ridges 39 on its upper end on which the mount 14 and the envelope 1 rest to thus uniformly position the end of each envelope in exactly the same sealing relation to the glass sealing disc 2 of each mount. The mount pin 37 is also provided with a central upstanding frusto-conical boss 40 which is adapted to enter the central recess 13 in the glass disc 2 of the mount so as to shield the exhaust tube 10 from the heat of the sealing fires 38. To enable the seating of the glass disc 2 of the mount on the ridges 39 of the mount pin 37, apertures or passageways 41 and 42 are provided in the mount pin for respectively accommodating therein the projecting exhaust tube 10 and contact pins 4 of the mount.

After the mount 14 has been sealed into the envelope 1, the lamp is then ready for exhaustion thereof through the exhaust tube 10 and the tipping off of the latter substantially flush with the outer side of the glass base or disc 2 to complete the manufacture of the lamp. For this purpose, the exhaust tube 10 is inserted and gripped in a compression rubber chuck 43 (Fig. 8) with the base end of the lamp pressed against and slightly deflecting the unsupported end of a flat spring baffle plate 44 which covers the base end of the lamp so as to shield it from the gas tipping-off fires 45. The said baffle plate 44 may be made of a 1/32 inch thick strip of stainless steel secured at one end to a bracket 46 and provided with an aperture 47 for the passage therethrough of the exhaust tube 10. The compression chuck 43 may be of the type such as is customarily employed in the art for lamp-exhausting purposes, and it connects the exhaust tube 10 in an air-tight manner to a conduit 48 connected to a vacuum pump (not shown). When the required degree of vacuum has been attained within the lamp envelope 1 and the gas filling, if any, introduced thereinto, the tipping off fires 45 are directed against the exhaust tube 10 at a point immediately outward of the baffle plate 44 to fuse and tip off the exhaust tube. As the glass of the

exhaust tube begins to soften, the force of the deflected spring baffle plate 44 acting against the base end of the lamp operates to stretch and attenuate the exhaust tube at the softened region thereof and thus aids in the tipping off or closing of the exhaust tube.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. A sealed hollow article having a relatively thick glass end wall, and a glass tubulation fused to the said end wall and communicating with the interior of the article, said tubulation having a wall thickness materially less than that of said end wall and being tipped-off closely adjacent its junction with the said end wall, and the region of the said end wall bordering and extending a substantial distance away from its junction with the tubulation being of materially reduced wall thickness.

2. A sealed hollow article having a relatively thick glass end wall provided with an indentation in its outer surface, and a glass tubulation fused to the said end wall within the indentation therein and communicating with the interior of the article, said tubulation having a wall thickness materially less than that of said end wall and being tipped-off closely adjacent its junction with the said end wall so as to be substantially confined within the said indentation, and the region of the said end wall bordering and extending a substantial distance away from its junction with the tubulation being of materially reduced wall thickness.

3. An electric device comprising a sealed envelope having a relatively thick glass end wall provided with an indentation in its outer surface, an electric energy translation device in said envelope, lead-in conductors sealed through said end wall on opposite sides of the indentation therein and connected to said translation device, and a glass tubulation fused to the said end wall within the indentation therein and communicating with the interior of the envelope, said tubulation having a wall thickness materially less than that of said end wall and being tipped-off closely adjacent its junction with the said end wall so as to be substantially confined within the said indentation, and the region of the said end wall bordering and extending a substantial distance away from its junction with the tubulation being of materially reduced wall thickness.

4. An electric device comprising a sealed envelope having a relatively thick glass end wall provided with a dome-shaped indented wall portion, an electric energy translation device in said envelope, lead-in conductors sealed through said end wall on opposite sides of the indented wall portion and connected to said translation device, and a glass tubulation fused to the said end wall within the recess formed by the said indented portion of the end wall and communicating with the interior of the envelope, said tubulation having a wall thickness materially less than that of said end wall and being tipped-off closely adjacent its junction with the said end wall so as to be substantially confined within the said recess, and the said indented portion of the end wall being of materially reduced thickness intermediate the wall thickness of the tubulation and the remainder of the end wall.

5. In the manufacture of an electric device comprising a sealed envelope having a relatively thick glass end wall provided with a glass exhaust tube projecting therefrom and having a wall thickness materially less than that of said end wall, the steps of shaping the said end wall with a circular region of materially reduced wall thickness and of substantial larger diameter than said exhaust tube, fusing an end of said exhaust tube to the said circular region of the end wall and providing an opening therethrough communicating with the interior of the exhaust tube, and fusing and tipping-off said exhaust tube closely adjacent its junction with the said end wall.

6. In the manufacture of an electric device comprising a sealed envelope having a relatively thick glass end wall provided with a glass exhaust tube projecting therefrom and having a wall thickness materially less than that of said end wall, the steps of shaping the said end wall with a dome-shaped indented wall portion of materially reduced wall thickness and of substantial larger diameter than said exhaust tube, fusing an end of said exhaust tube to the top of the dome indentation in said end wall and providing an opening therethrough communicating with the interior of the exhaust tube, and fusing and tipping-off said exhaust tube closely adjacent its junction with the said end wall to confine the exhaust tip substantially within the recess formed by the indented portion of said end wall.

7. An electric device comprising a sealed envelope having a relatively thick glass end wall, an electric energy translation device in said envelope, lead-in conductors sealed through said end wall and connected to said translation device, and a glass tubulation fused to the said end wall and communicating with the interior of said envelope, said tubulation having a wall thickness materially less than that of said end wall and being tipped-off closely adjacent its junction with the said end wall, and the region of the said end wall bordering and extending a substantial distance away from its junction with the tubulation being graded in thickness from a thickness of the order of that of the tubulation wall to the approximate thickness of the end wall proper.

8. An electric device comprising a sealed envelope having a relatively thick glass end wall, an electric energy translation device in said envelope, a glass tubulation fused to the said end wall and communicating with the interior of the envelope, and lead-in conductors sealed through said end walls on opposite sides of said tubulation, said tubulation having a wall thickness materially less than that of said end wall and being tipped-off closely adjacent its junction with the said end wall, said end wall being locally thickened at said lead-in conductors to provide added support therefor and the region of said end wall bordering its junction with the tubulation and extending to said locally thickened end wall portions being graded in thickness from the approximate thickness of the end wall at the inward side of said locally thickened wall portions to a thickness at the tubulation of the order of that of the tubulation wall.

9. An electric device comprising a sealed envelope having a relatively thick glass end wall provided with a substantially flat annular exterior base surface and a central indentation, an electric translation device in said envelope, a glass tubulation fused to said end wall within the indentation therein and communicating with the interior of the envelope, and lead-in conductors sealed through said end walls on opposite sides of said tubulation, said tubulation having a wall

thickness materially less than that of said end wall and being tipped-off closely adjacent its junction with the said end wall, said end wall being formed with inward bosses at said lead-in conductors to provide added support therefor and the region of said end wall bordering its junction with the tubulation being graded in thickness from the approximate thickness of the end wall at the inward side of said bosses to a thickness at the tubulation of the order of that of the tubulation wall.

ALFRED GREINER.

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