March 13, 1962 F. J. CAMARATA 3,025,426

PRESS SEAL

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FIG. 1.

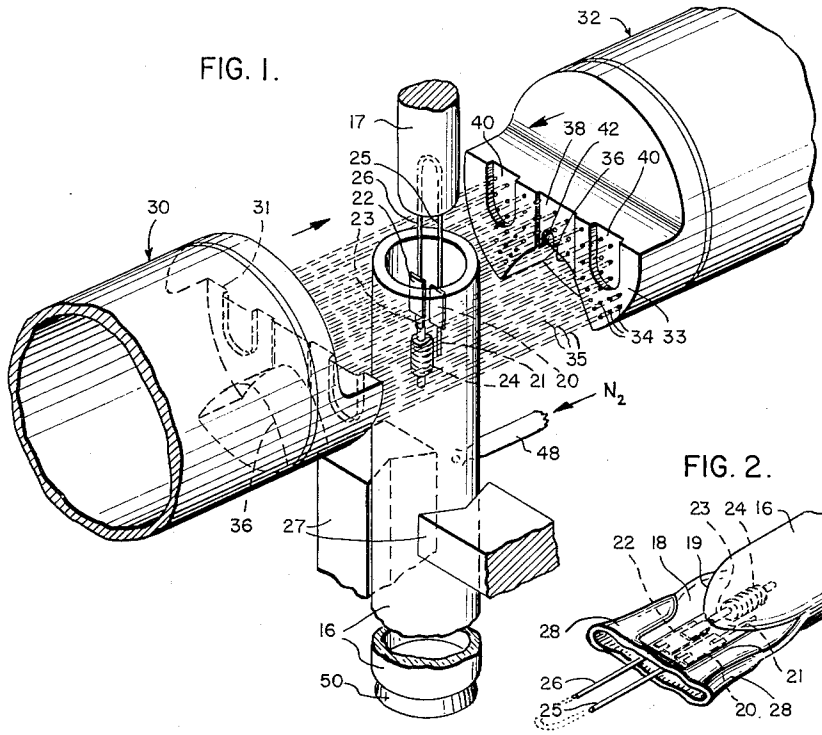


FIG. 2.

FIG. 3.

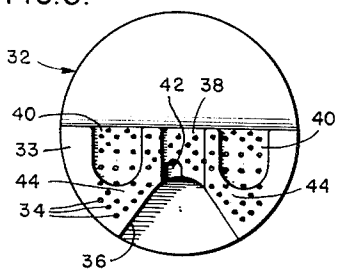


FIG. 4.

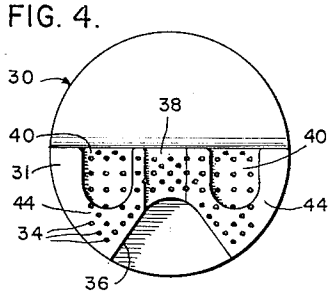


FIG. 5.

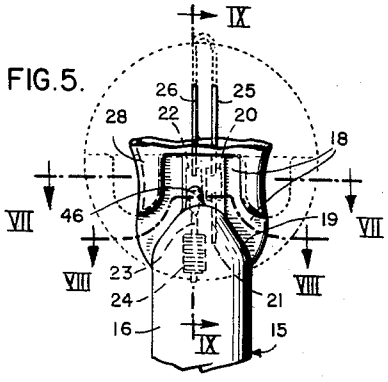
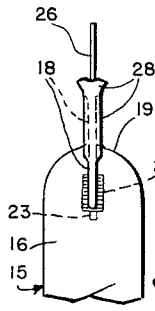


FIG. 6.



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FIG. 7.

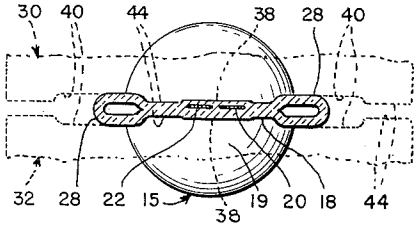


FIG. 8.

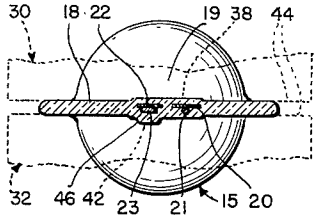


FIG. 9.

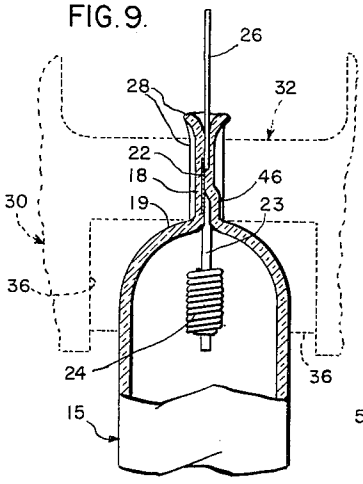


FIG. 10.

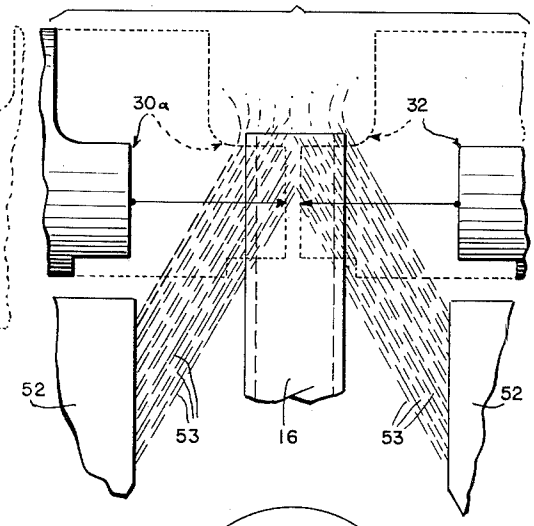


FIG. 11.

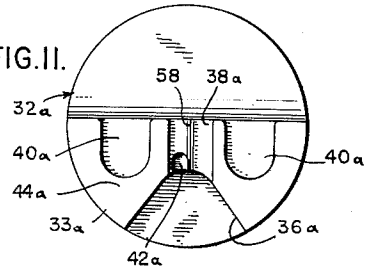


FIG. 12.

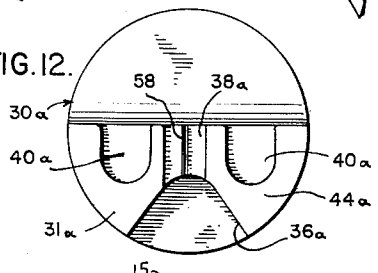


FIG. 13.

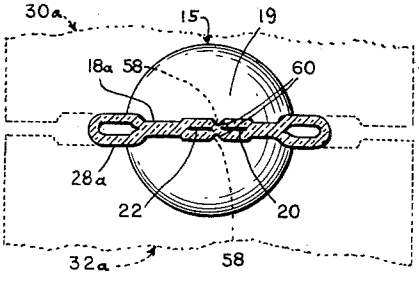
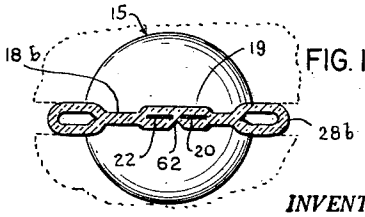


FIG. 14.



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United States Patent Office 3,025,426 Patented Mar. 13, 1962

3,025,426

PRESS SEAL

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Filed Feb. 18, 1960, Ser. No. 9,638
7 Claims. (Cl. 313—184)

This invention relates to sealing and, more particularly, to an improved full press seal for the arc tube of a high-pressure mercury-vapor lamp or the like.

It has heretofore been the practice in the manufacture of arc tubes for high intensity light sources, such as high-pressure mercury-vapor (HPMV) lamps for example, to attach constricted end sections to a length of quartz tubing and then collapse them onto the fragile lead-in conductors conventionally employed in such lamps. More recently there has been developed a so-called "full press" seal wherein the entire end segment of the quartz tubing is collapsed and sealed off thereby eliminating the need for the aforesaid constricted end sections and proportionately reducing the manufacturing cost of the arc tube.

While the adoption of such full press seals permitted the quartz tubing to be made directly into arc tubes without preforming the ends or attaching constricted sections thereto, it also increased the total amount of heat and pressure required since the entire end segment of the relatively large diametered tube had to be collapsed and molded. This, in turn, required that the sealing fires and press jaws be precisely adjusted and constantly checked otherwise a prohibitive rate of shrinkage or poor quality seals would result. In addition, and of equal importance, the lateral flow of plastic quartz over the fragile lead-in conductors resulting from compressing such a large volume of quartz frequently placed the conductors under an excessive amount of tension during the sealing-in operation causing them to tear thereby ruining the seal and increasing the rate of shrinkage.

It is accordingly the general object of the present invention to overcome and avoid the foregoing and other problems associated with the manufacture of full press seals.

Another and more specific object is the provision of an improved full press seal that can be conveniently and quickly formed with a minimum amount of heat and pressure and that will materially reduce the detrimental forces imparted to the fragile lead-in conductor during the press-forming operation.

The aforesaid objects, and others which will become apparent as the description proceeds, are achieved in accordance with the invention by tightly compressing only the critical portion of the seal assembly, that is, the portions of the tube end that overlies the lead-in conductor or conductors and that extends laterally therefrom around the bulbous shoulder portion of the tube to the sides of said tube. Thus, only a preselected part rather than the entire end segment of the tube is tightly compressed and hermetically sealed. All of the benefits and advantages of a full press seal are, accordingly, obtained with only a fraction of the compressive force and maintenance heretofore required.

A better understanding of the invention will be obtained by referring to the accompanying drawings wherein:

FIG. 1 is a fragmentary perspective view of a seal assembly comprising an arc tube and a pair of electrode-conductor sub-assemblies held in sealing relationship between a pair of burner-press jaws preparatory to the press-sealing operation in accordance with this invention;

FIG. 2 is a perspective view of the full press seal formed on the end of the arc tube by the apparatus shown in FIG. 1;

FIGS. 3 and 4 are front views of the work faces of the burner-press jaws shown in FIG. 1;

FIGS. 5 and 6 are front and side elevational views, respectively, of the full press seal shown in FIG. 2;

FIG. 7 is a cross-sectional view through the finished press seal along the line VII—VII of FIG. 5, in the direction of the arrows;

FIG. 8 is a cross-sectional view through the finished press seal along the line VIII—VIII of FIG. 5, in the direction of the arrows;

FIG. 9 is a cross-sectional view through the seal along the line IX—IX of FIG. 5, in the direction of the arrows;

FIG. 10 is a side view in elevation of an alternative form of the invention wherein separate press jaws and burners are employed;

FIGS. 11 and 12 are front views of the work faces of an alternative set of press jaws according to the invention; and

FIGS. 13 and 14 are views corresponding to FIG. 7 but show alternative press seal embodiments formed by the alternative set of press jaws shown in FIGS. 11–12 and another type of press jaw, respectively.

While the present invention may be advantageously employed to hermetically seal any vitreous article of relatively large diameter, it is particularly adapted for use in conjunction with the sealing of HPMV lamp arc tubes and accordingly has been so illustrated and will be so described.

With specific reference to the form of the invention shown in the drawings, in FIG. 2 there is illustrated one end of an arc tube 15 for an HPMV lamp which tube comprises a light-transmitting envelope of highly refractory vitreous material such as a length 16 of quartz tubing of relatively large and substantially uniform diameter, both ends whereof are hermetically closed by a full press seal 18 which constitutes part of a flattened end section. As shown, the press seal 18 is of generally Y-shaped configuration in that it has a riser segment that extends inwardly from the end of the quartz tube 16 centrally and axially thereof to the bulbous arcuate shoulder 19 of the tube where it branches into two arm segments that extend laterally around said shoulder to the sides of the aforesaid flattened end section. The aforesaid riser segment is of such width that it not only overlies and is hermetically united with a pair of thin and extremely fragile lead-in conductors such as metal ribbons 20 and 22 but extends therebeyond and includes the adjoining quartz-to-quartz area of the seal assembly as well. The ribbon conductor 20 is connected at one end to an auxiliary electrode 21 sealed inside the quartz tube 16 and at its other end to an external terminal lead 25. The ribbon conductor 22, in turn, is connected at one end to the flattened end of a support rod 23 that carries a main electrode 24 and at its opposite end to another terminal lead 26. The ends of the aforesaid terminal leads, auxiliary electrode and support rod are embedded and thus anchored in the axially extending riser segment of the Y-shaped seal 18.

By virtue of the configuration of the full press seal 18 there is provided a partly compressed but unsealed and thus raised area 28 of generally U-shaped configuration on the end of the quartz tube 16 (see FIG. 2 and more particularly FIGS. 5–7 and 9). The aforesaid press seal and unsealed raised area together constitute the previously mentioned flattened section at each end of the quartz tube 16 which section is greater in width than the diameter of the tube and lies in the same plane that contains the ribbon conductors 20 and 22. The raised area

28 comprises the flattened but unsealed end and adjoining marginal segments of the tube end so that the press seal 18 is located inwardly therefrom and is partly surrounded thereby, as shown in FIGS. 2 and 5.

Only one end of the quartz tube 16 is provided with two electrodes 21 and 24 as here illustrated, the opposite end having only a main electrode as is customary. In order to facilitate locating the conductor-and-electrode assemblies in proper sealing relationship within the end of the quartz tube 16 the terminal leads 25 and 26 initially are joined together by a loop (as shown by the dotted lines in FIGS. 2 and 5) and thus comprise a unitary U-shaped pin. After the press seal 18 has been completed the aforesaid loop is cut off to provide the desired individual terminal leads 25 and 26.

In FIG. 1 there is illustrated a preferred apparatus for fabricating the improved full press seal 18 of this invention. As there shown, the two conductor-and-electrode assemblies are placed within the end of the quartz tube 16 to provide a seal assembly which is then compressed by a pair of press jaws 30 and 32, after the end of the quartz tube 16 is heated and made plastic. The work faces 31 and 33 of the jaws are specially contoured, as will be hereinafter described, to apply the differential sealing pressure required to form the press seal 18. The main and auxiliary electrodes, together with their respective lead-in and terminal conductor assemblies, are held in proper sealing relation within the end of the quartz tube 16 by means of a jig 17 in which the looped end of the pin connecting the terminal leads 25 and 26 is anchored, the tube in turn being held by a suitable holder 27. As will be understood, the aforesaid jig, tube holder, and press jaws comprise parts of a well-known automatic sealing machine that includes means (not shown) for reciprocally moving the jaws toward each other in a direction perpendicular to the plane containing the ribbon conductors 20 and 22, as indicated by the arrows in FIG. 1.

When the aforementioned seal assembly consisting of the quartz tube 16, the auxiliary electrode 21, the main electrode 24, the support rod 23 and their respective lead-in and terminal conductors is indexed into position between the press jaws 30 and 32 it is centrally located therebetween as shown in FIG. 1. As shown in the latter figure, and more particularly in FIGS. 3 and 4, the work faces 31 and 33 of the aforesaid press jaws are both of generally semicircular configuration and are contoured to match one another except for one difference which will hereinafter be described. In this particular embodiment the jaws 30 and 32 comprise the heads of gas-burners and their work faces are provided with a plurality of fine holes 34 that communicate with the interior of the respective jaws which, in turn, are connected to a suitable gas supply (not shown), such as a mixture of oxygen and illuminating gas or hydrogen for example. Thus, in this instance the jaws are adapted to apply both heat and differential sealing pressure to the end of the quartz tube 16, the heat being applied in the form of flame jets 35 when the work faces of the jaws are not in contact with the quartz.

As shown, each of the semicircular work faces 31 and 33 have a centrally located concave cavity or groove 36 that extends radially inward from the arcuate edge of the jaw and merges with a much shallower medial groove or depression 38 that extends from the apex of the groove 36 diametrically across to the straight edge of the respective work faces. As shown more particularly in FIGS. 3 and 4, the medial depressions 38 are located slightly off center with respect to their respective work faces and the grooves 36 to enable the rod 23 and main electrode 24 to be centered as closely as possible within the quartz tube 16 without positioning the auxiliary electrode 21 too close to the inner surface of the arcuate bulbous shoulder 19.

Each of the work faces 31 and 33 are also provided with a pair of elongated marginal depressions 40 that are disposed laterally of the medial depressions 38 and extend parallel thereto from the straight edges of the work faces. The marginal depressions 40, as shown in FIG. 1, are deeper than the medial depressions 38 but much shallower than the concave grooves 36.

The work faces 31 and 33 are identical in every respect except that the one which faces the end of the support rod 23 adjoined to the ribbon conductor 22 (as here shown it is the work face 33 of the jaw 32) is provided with an auxiliary depression 42 that extends inwardly from approximately the apex of the concave groove 36 proximate and parallel to the more centrally located edge of the medial depression 38. The aforesaid auxiliary depression is dimensioned and located to overlie the flattened end of the support rod 23 that is connected to the ribbon conductor 22 and thus provide a relief cavity therefor.

As shown in FIGS. 1, and 7 and 8, the medial depressions 38 are disposed and dimensioned to overlie and provide relief cavities for the ribbon conductors 20 and 22 whereas the deeper marginal depressions 40 are disposed and dimensioned to overlie the corresponding marginal or quartz-to-quartz portions of the seal assembly. The length of the medial depressions 38 is such that the outermost end segment of the tube 16 is not contacted thereby and is thus flattened but not compressed or sealed during the press-forming operation. By virtue of the configuration and location of the aforesaid grooves and depressions there is provided in each work face a pair of generally U-shaped lands 44 which, together with the planar recessed surfaces of the medial depressions 38, define the areas of greatest compression and mold the plastic quartz to form the generally Y-shaped press seal 18.

The press-forming operation is accomplished by heating the end of the quartz tube 16 until it becomes plastic and then advancing the burner-press jaws 30 and 32 toward each other a predetermined distance to partially flatten the tube end. The jaws are then returned to their original open position to allow the flame jets 35 to reheat the quartz and when this has been accomplished the jaws are again advanced until the motion thereof is stopped by the pressed quartz.

As shown in FIGS. 7 and 8, when the jaws close the medial depressions 38 form a shallow pocket for the ribbon conductors 20 and 22 thereby not only taking the pressing shock off the ribbons but minimizing the lateral flow of molten quartz in this region during the pressing operation—both of which serve to prevent tearing of the ribbons. The press seal 18 is accordingly slightly thicker in this region by an amount at least equal to and preferably slightly in excess of the maximum ribbon thickness. The marginal depressions 40, on the other hand, form relatively deep cavities for the corresponding portions of the tube 16 which are thus merely flattened and left unsealed as shown in FIG. 7. This latter feature drastically reduces the amount of pressure required to form the seal insofar as the aforesaid marginal portions of the tube, due to the tube curvature, are not heated to as high a temperature as the central portion of the tube and are thus not as plastic and harder to compress.

It should also be noted that while each of the lands 44 are of generally U-shaped configuration only the centrally located portions thereof actually contact the end of the quartz tube 16 and are used in molding the seal, as shown in FIGS. 7 and 8. Thus, the effective or operative areas of the aforesaid lands together with the recessed planar surfaces of the medial depressions 38 form a pressing surface that is actually of Y-shaped configuration.

As shown in FIGS. 8 and 9, when the jaws are closed the auxiliary depression 42 in the work face 33 of the jaw 32 overlies and forms a pocket for the end of the support rod 23 connected to the ribbon conductor 22. As a result there is provided a reinforcing knot or knob

46 of quartz in this critical area that serves to inhibit the formation of cracks in the finished seal as it cools.

As is illustrated in FIG. 1, in order to prevent excessive oxidation of the ribbon conductors **20** and **22** during the preheating and press-forming operations, nitrogen or other suitable inert gas is passed through the quartz tube **16** through a tubulation **48** thereon, the other end of the tube being closed off by a stopper **50** as shown.

As shown in FIG. 10, separate burners **52** may be employed, if desired, to heat the quartz which burners are adapted to angularly direct their flame jets **53** onto the end of the quartz tube **16** from a location out of the line of movement of the press jaws **30***a* and **32***a*. In this case the work faces of the aforesaid jaws would only be used for compressing and not heating the quartz and thus would not have gas openings therein, as illustrated in FIGS. 11 and 12. As there shown, the work faces **31***a* and **33***a* are identical in every respect to those of the combination burner-and-press jaws **30** and **32** described above except that they are devoid of the aforesaid gas openings. In addition, it will be noted that the medial depressions **38***a* are partitioned by centrally located and axially extending rib-like projections **58**. The projections **58** are not as high as the lands **44***a* but are of sufficient height to produce and define a region of increased compression in the quartz between the ribbon conductors **20** and **22** when the jaws **30***a* and **32***a* are advanced into sealing position, as shown in FIG. 13. This, in turn, generates lateral oppositely-directed forces in this region during the pressing operation that forces the ribbons apart and maintains a predetermined spacing therebetween sufficient to prevent them from shorting out and causing an internal arc that would ruin the arc tube. The resulting indentation of the quartz in this area, of course, forms two aligned grooves **60** (FIG. 13) that extend axially of the riser segment of the press seal **18***a*.

As shown in FIG. 14, only a single rib or projection may be provided in one of the jaws to provide a press seal **18***b* having a riser segment with only one groove **62** therein. This is sufficient to produce the desired lateral pressure in the inter-ribbon area and effect the resultant automatic separation of the ribbons without any possibility whatever of dangerously weakening the seal.

Experience has shown that the reduction in the criticality of the sealing operation achieved by tightly compressing and closing only the preselected and necessary portions of the end of the quartz tube required to seal-in the ribbons and seal-off the tube in accordance with this invention has decreased the percent shrinkage due to torn ribbons, leaky seals, etc. by about 80% compared to the previous practice of compressing and sealing the entire end segment of the tube.

It will be apparent from the foregoing that the objects of the invention have been attained by providing an improved full-press seal wherein only a preselected part rather than the entire end of the quartz tube is compressed and sealed off, thereby not only reducing the total amount of pressure required and rendering the press-forming operation less critical but providing a tighter and more durable seal with less shrinkage.

While several press seal embodiments have been described in detail, it is to be understood that various modifications and refinements therein may be made without departing from the spirit and scope of the invention.

I claim:

1. A vitreous tube having a flattened section at one end that comprises a sealed portion and an unsealed portion, said sealed portion comprising a press seal that extends across and hermetically closes off said tube and constitutes the inward terminus of said flattened end section, and said unsealed portion comprising a raised area that merges with said press seal and extends a substantial distance along both sides of said flattened end section from said press seal to the end of said tube.

2. A vitreous tube having a flattened section at one end that comprises a sealed portion and an unsealed portion, said sealed portion comprising a press seal that extends across and hermetically closes off said tube and constitutes the inward terminus of said flattened end section, and said unsealed portion comprising a raised area of generally U-shaped configuration that merges with and partly surrounds said press seal and constitutes the tip and adjoining marginal segments of said flattened end section.

3. A quartz tube of relatively large and substantially uniform diameter having a flattened section at one end that is wider than the diameter of said tube and consists of an unsealed portion and a sealed portion disposed inwardly from said unsealed portion, said sealed portion comprising a generally Y-shaped press seal the riser segment whereof extends axially toward the proximate end of said tube and the arm segments whereof extend laterally to the sides of said flattened end section and thereby span and hermetically close off said tube, and said unsealed portion comprising a raised area of generally U-shaped configuration that merges with and partly surrounds said press seal and constitutes the end and adjoining marginal segments of said flattened end section.

4. A quartz tube of relatively large and substantially uniform diameter having a flattened section at one end that is wider than the diameter of said tube and consists of an unsealed portion and a sealed portion disposed inwardly from said unsealed portion, said sealed portion comprising a generally Y-shaped press seal the riser segment whereof is centrally disposed and extends axially toward the proximate end of said tube and the arm segments whereof extend laterally to the sides of said flattened end section and thereby span and hermetically close off said tube, a metal conductor hermetically embedded in and extending through the riser segment of said press seal into said tube, said unsealed portion comprising a raised area of generally U-shaped configuration that merges with and partly surrounds said press seal and constitutes the end and adjoining marginal segments of said flattened end section.

5. A quartz tube of relatively large and substantially uniform diameter having a flattened section at one end that is wider than the diameter of said tube and consists of an unsealed portion and a sealed portion disposed inwardly from said unsealed portion, said sealed portion comprising a generally Y-shaped press seal the riser segment whereof is centrally disposed and extends axially toward the proximate end of said tube whereas the arm segments of said press seal extend laterally to the sides of said flattened end section and thereby span and hermetically close off said tube, a lead-in conductor extending through said press seal into said tube and including a thin metal section that is embedded in and hermetically united with the riser segment of said Y-shaped press seal and is joined at its inward end to the end of a metal rod that is anchored in said riser segment and projects therefrom into said tube, the face of said press seal contiguous with the sealed-in end of said metal rod being provided with an embossment that overlies the end of said rod and reinforces the press seal thereat, said unsealed portion comprising a raised area of generally U-shaped configuration that merges with said press seal and constitutes the end and adjoining marginal segments of said flattened end section.

6. An arc tube for a high-pressure mercury-vapor lamp comprising a quartz tube of relatively large and substantially uniform diameter having a press seal at each end and a pair of spaced lead-in conductors extending through one of said press seals and connected to a pair of electrodes within said tube, each of said press seals being of generally Y-shaped configuration with their riser segments centrally disposed and extending axially toward the adjacent end of said tube and their arm segments extending laterally to the sides of said tube and thereby spanning and hermetically closing off said tube at points

remote from the ends thereof, the marginal and end segments of said tube adjoining each of said press seals being flattened but unsealed and constituting raised areas of partial compression, each of the lead-in conductors in said one press seal having intermediate metal foil sections that are embedded in and hermetically united with the riser segment thereof, at least one face of said one press seal having a groove in the riser segment thereof that overlies and is substantially coextensive with the space between the aforesaid metal foil sections.

7. A vitreous tube that is hermetically closed at a preselected point along its axis by a press seal which includes a sealed portion and an unsealed portion, said sealed portion comprising a tightly compressed region of generally Y-shaped configuration the arm segments whereof extend across and hermetically close off said tube, and

said unsealed portion comprising a partly collapsed flattened region that is thicker than and merges with said sealed portion and extends for a substantial distance along both sides of the riser segment of said Y-shaped sealed portion.

References Cited in the file of this patent

UNITED STATES PATENTS

2,664,517	Wiener	Dec. 29, 1953
2,675,496	Unglert et al.	Apr. 13, 1954
2,816,398	Pearson	Dec. 17, 1957
2,848,641	Peterson	Aug. 19, 1958
2,857,712	Yoder et al.	Oct. 28, 1958
2,876,377	Retzer et al.	Mar. 3, 1959
2,884,743	Hunter	May 5, 1959