Aug. 23, 1927. 1,640,226

J. S. WHEELER

TIPLESS LAMP AND METHOD OF MAKING SAME

Filed July 2, 1923 3 Sheets-Sheet 1

Fig. 1.

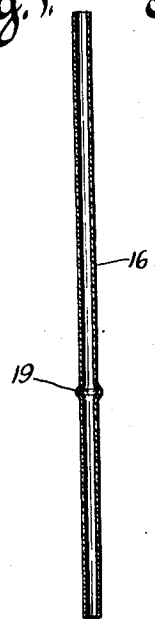


Fig. 2.

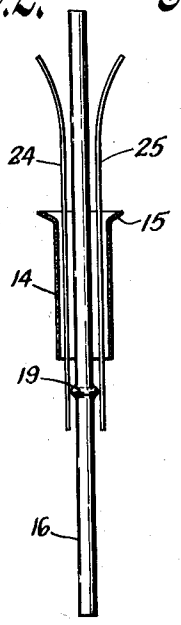


Fig. 3.

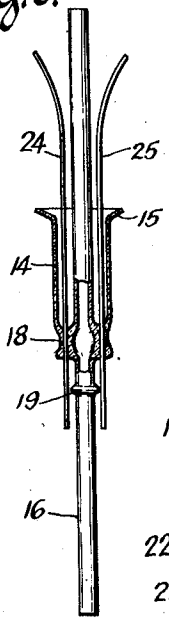


Fig. 4.

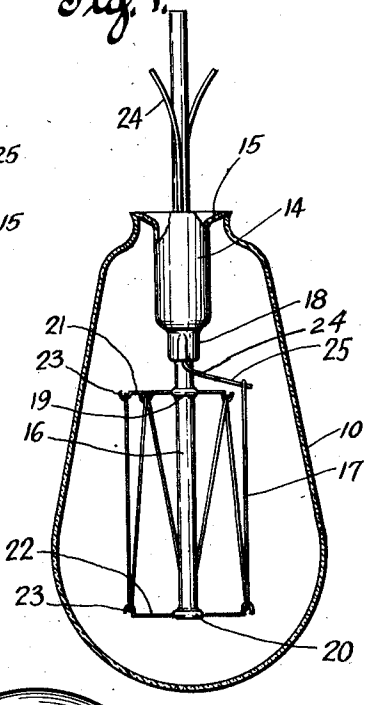


Fig. 5.

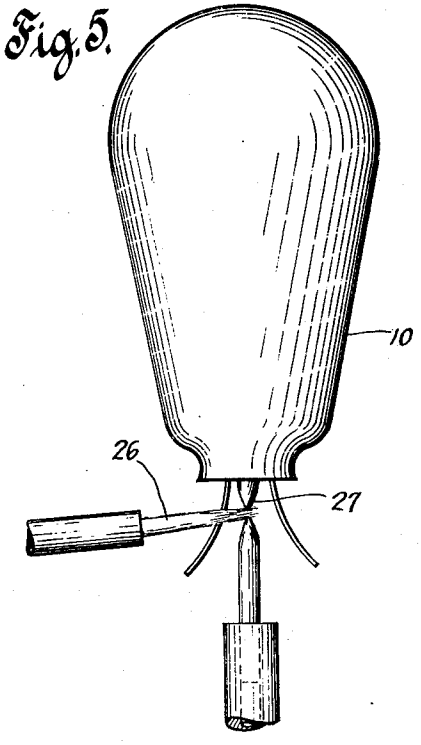
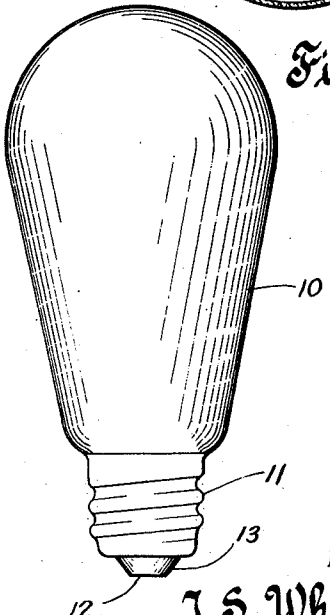


Fig. 6.



INVENTOR

J. S. Wheeler

BY Chester W. Brandt

ATTORNEY

Aug. 23, 1927. 1,640,226

J. S. WHEELER

TIPLESS LAMP AND METHOD OF MAKING SAME

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Fig. 7.

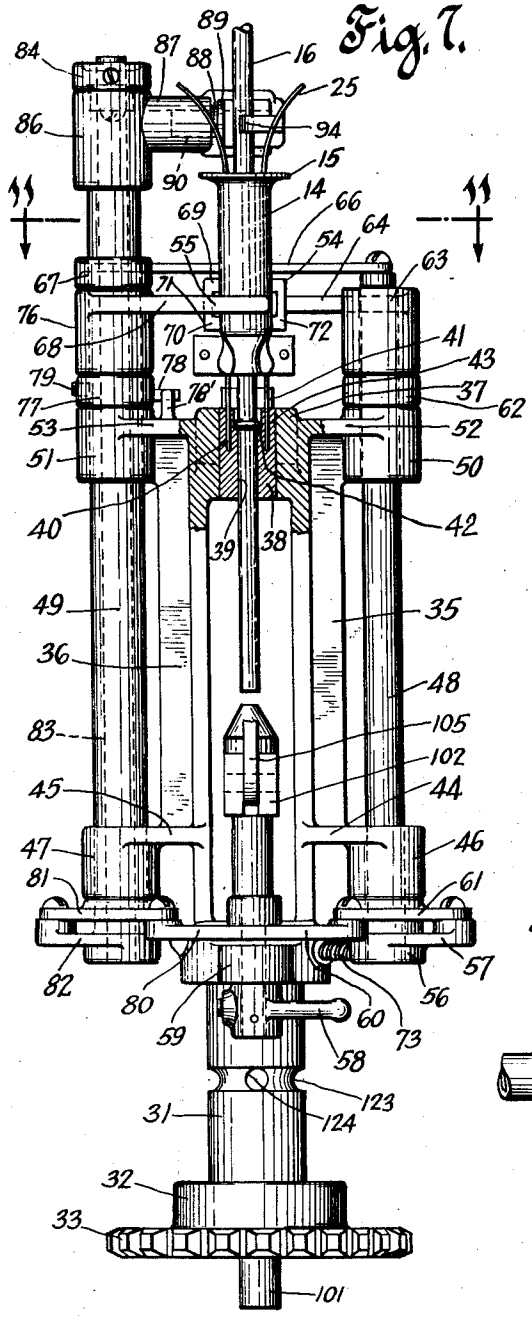
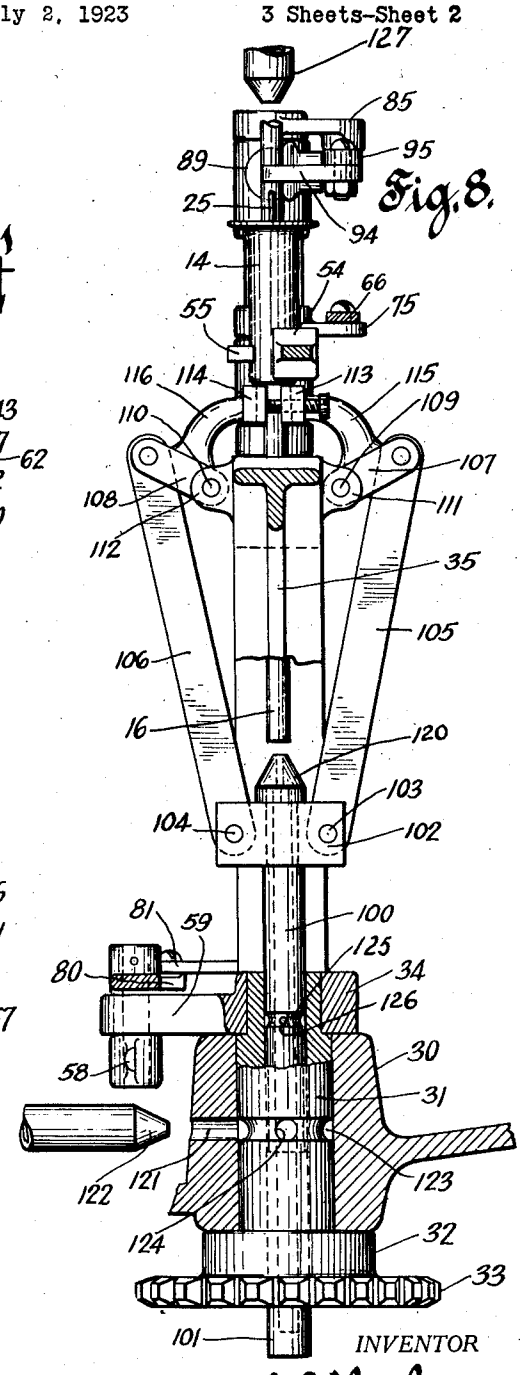


Fig. 8.



INVENTOR

BY J. S. Wheeler

Chester A. Bartlett

ATTORNEY

Aug. 23, 1927. 1,640,226

J. S. WHEELER

TIPLESS LAMP AND METHOD OF MAKING SAME

Filed July 2, 1923 3 Sheets-Sheet 3

Fig. 9.

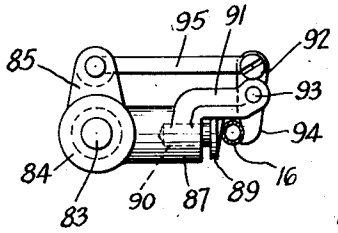


Fig. 11.

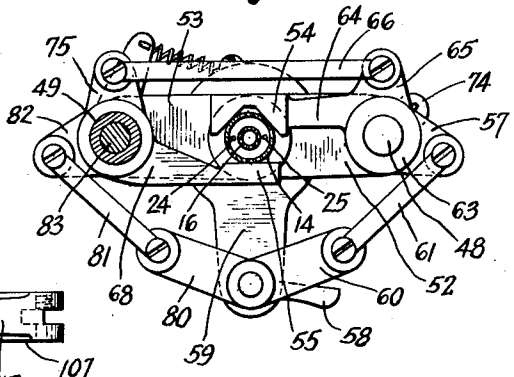


Fig. 10.

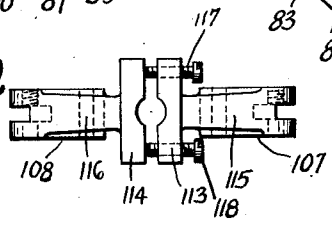


Fig. 12.

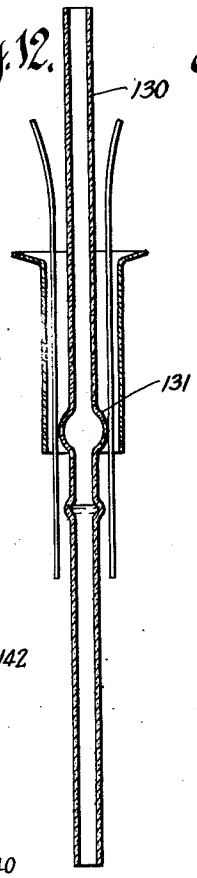


Fig. 13.

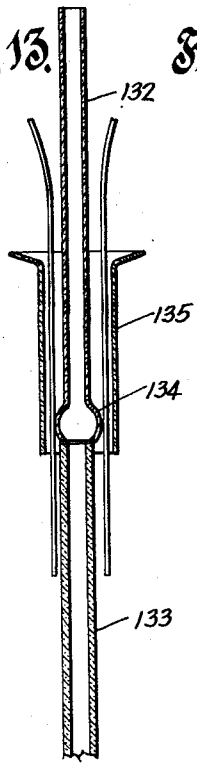


Fig. 14.

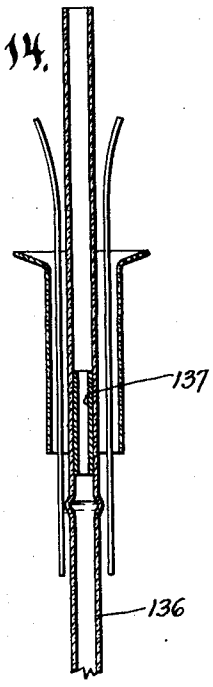
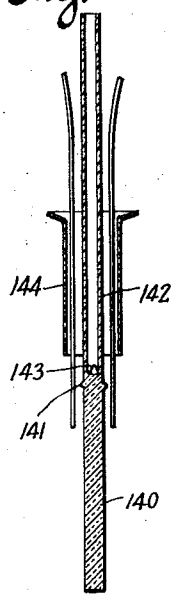


Fig. 15.



INVENTOR

BY J. S. Wheeler

Chester H. Brasell

ATTORNEY

Patented Aug. 23, 1927. 1,640,226

UNITED STATES PATENT OFFICE.

JEROME SCHOFIELD WHEELER, OF GUELPH, ONTARIO, CANADA.

TIPLESS LAMP AND METHOD OF MAKING SAME.

Application filed July 2, 1923. Serial No. 648,909.

The invention relates generally to incandescent lamps and particularly to an improved method of manufacturing lamps of the so-called tipless type.

Heretofore the method of manufacture of lamps required as a step in the evacuation of the bulb, the sealing of the aperture in the top of the bulb by which connection to the vacuum pump was made, this resulting in a projecting tip. There are several disadvantages to the presence of such a tip and to the necessity of employing this step in the process of manufacture. In the first place, the process is expensive, involving the attachment of a tube to an aperture in the top of the bulb by a process called "tubulating" and a subsequent fusing operation to remove the tube and close the aperture. Moreover, the projection of the tip makes it subject to contact with other objects, thus resulting in breaking and loss of vacuum. Also the appearance of the lamp with the tip is unsightly, and, particularly, the presence of the tip causes an improper and inefficient light distribution, due to distortive refraction.

Various attempts to build a lamp without the formation of a tip on the bulb have heretofore proven relatively unsuccessful. It has been proposed, for example, to place the evacuation aperture in the neck of the bulb and in the stem within the neck of the bulb, but in both of these methods, increase of breakage, added difficulties in assembling, and increased cost in operation have combined to make these attempts unsuccessful. I succeed in largely avoiding the aforesaid difficulties by utilizing the filament support of the lamp as a conduit, the same extending through the stem of the lamp, and by which the gases within the bulb may be evacuated, thus avoiding entirely the necessity of tubulating to the bulb surface or the employment of an expensive construction of stem.

As is apparent, therefore, from the above exposition, one of the important objects of the invention is to develop a process by which a lamp or any other bulb may be evacuated without the necessity of forming a projecting tip on the surface of the bulb. It is an object also to utilize a process which will not necessitate the formation of an aperture in the bulb surface. Another important object is to devise means of evacuating lamps without the employment of stem supports of expensive and complicated design involving important difficulties in workmanship. An object of particular utility in connection with the manufacture of lamps of this type is the utilization in the process of moulding the stem to the support tube of a current of air to prevent undue contraction or closure of the tube. Additional objects are directed to greatly improving the appearance of the lamp, to supplying the method of assembly and evacuation, and to cheapen and render more efficient the total manufacturing cost.

With these objects in mind, reference is made to certain embodiments of my invention, which may be preferred, fully described hereinbelow and illustrated in the accompanying drawings, wherein

Figure 1 shows a support tube, such as is used in my invention;

Figure 2 shows the support, leading-in wires, and stem in assembled relation prior to the moulding process;

Figure 3 shows the stem moulded on the wires and support;

Figure 4 is a section through the bulb showing the stem in position and filament attached;

Figure 5 is a view of the sealing operation;

Figure 6 shows the completed lamp;

Figure 7 shows apparatus by means of which the moulding operation may be carried on;

Figure 8 is another view of the moulding machine;

Figures 9, 10 and 11 are detail views of the moulding machine; and

Figures 12, 13, 14 and 15 show modifications of the support structure.

Considering the various features of the invention in detail, reference is made to Figures 4 and 6, as illustrating the essential elements of structure. The lamp includes the usual bulb 10, threaded metallic connector 11, and contact plate 12 separated by insulation 13 from the connector 11. Within and at the neck of the bulb, a stem 14 (Fig. 4) is welded, the stem having a flared lower end 15 at the junction of the neck and stem. Inside the stem is the tubular support 16 for the filament 17, the support being fused onto the stem at 18. The support is formed with a lower bead 19 and an upper bead 20 to which are fused the arbors

21 and 22, over the hooked ends 23, whereof the filament 17 is attached. The leading-in wires 24 and 25 are fused into the stem in the usual way, the same connecting the ends of the filament with the coupler 11 and contact 12.

As previously intimated, the usual process of evacuating an electric light bulb involves the formation of an aperture at the top of the bulb and tubulating by welding a tube to the edge of the aperture, said tube forming the conduit to the exhaust pump. When the proper degree of exhaustion has been attained, the tube is removed by fusion, leaving a tip on the upper end of the bulb. In my invention, the method of evacuation is much simplified by the following process.

Employing the tube 16 with the bead 19 formed thereon, (Fig. 1), the tube is inserted with the two lead-in wires 24 and 25 in the stem 14 (Fig. 2) and then by a moulding process accompanied with the application of heat, the glass is fused at the upper end of the stem 14 and sealed onto the support 16 in such a way as to maintain an open connection from within the bulb to the atmosphere. The moulding process seals in the lead-in wires also. (See Fig. 3.)

Subsequent steps involve the formation of the upper bead 20 on the support tube, the insertion of the arbor supports 21 and 22 in the lower and upper beads 19 and 20, welding joints between the ends of the filament 17 and lead-in wires 24 and 25, hanging the filament on the arbors 21 and 22, inserting the stem including the support, and filament within the bulb and welding the same thereto at the stem flare 15.

When the stem unit is properly positioned and sealed within the bulb 10, there is only one gaseous conduit to the bulb interior, namely, through the hollow support tube 16, and hence evacuation of the bulb may be carried on by connecting the tube to a vacuum pump. When the proper degree of vacuum has been attained by an application of heat, by a flame, for example, (see 26, Fig. 5), at a point of the support tube near the base of the bulb, the glass is fused and on separating the tube, a seal 27 is formed.

The final steps in the building of the lamp involve the soldering of the lead-in wires to the connector 11 and plate 12, respectively, and the moulding of insulating and binding material on the neck of the lamp to hold the contact elements in place.

Any suitable means may be employed for effecting the juncture between the support tube 16 and stem 14, but for the purpose of this invention I have shown in Figures 7 to 11 a specific type of machine which accomplishes the results desired in a sufficient and satisfactory way, the various features of which machine, however, I do not claim in this application as a part of my present invention, the same being described and claimed in my co-pending application Serial No. 48,037, filed August 4, 1925.

Referring to Figures 7 and 8, there is shown a bracket support 30 which is hollowed vertically to serve as a bearing for the stub shaft 31. The lower end of this shaft carries a hub 32 to which is attached a gear 33 for rotating the shaft. The upper end of the shaft 31 above the bracket 30 carries the frame of the moulding apparatus, the whole of which is rotatable by means of the gear 33. There is disclosed a collar 34 fixedly secured to the shaft 31 by any appropriate means having two upright angle bars 35 and 36 oppositely placed and integral therewith, and extending an appreciable distance above said collar. The top of these bars is joined by a second collar 37 enclosing a tubular block 38 adapted to be employed as a combined centering and holding member for the glass tube support 16 and as a holder for the lead-in wires 24 and 25 of a given lamp. The support tube aperture 39 is centrally placed in the block 38 in proper relationship to the two lead-in wire holes 40 and 41, which latter enter part-way into the block 38 and are in parallel relation to the axis of tube aperture 39. The aperture 39 is somewhat enlarged near its upper end forming a shoulder 42 adapted to contact with lower bead 19 of the support tube, thereby holding the tube in proper position for the moulding operation.

Extending from a point adjacent the base of the upright standards 35 and 36 are two arms 44 and 45 terminating in bearings 46 and 47 adapted to receive operating rods 48 49. These rods also have upper bearings 50 and 51 rigid with arms 52 and 53 extending from the top of the standards 35 and 36. The rod 48 is adapted to operate clutch elements 54 and 55 for the stem 14, whereby the same is maintained in proper spaced relationship with the support tube 16. To this end, the rod 48 extends below the bearing 46 and terminates in a cap member 56 to which is integrally attached a lever arm 57. A manually operable lever 58 pivotally attached to the projecting arm 59 extending from the annular collar 34 on the frame, is adapted through the intermediary relationship of connecting bars 60 and 61, clearly illustrated in Figure 11, to cause movement of said lever 57, thereby rotating the clutch rod 48. Above the bearing 50, there is positioned a spacer 62 adapted to separate the member 50 and an annular member 64 to which lever arm 56 of the clutch element 54 is attached. Extending also from the member 63 approximately at right angles to the arm 57 at the base of the rod 48 is a lever arm 65 which is adapted by means of a cross bar 66 and a lever arm 75 connected to the collar 67 to rotate the rod 49, thereby

operating the lever arm 68 with its attached clutch element 55. The clutch element 55 cooperates with the clutch element 54 to bind the stem normally in operative relationship. The lever arm 68 is directly attached to collar 76 and is separated from the bearing member 51 on the rod 49 by means of a collar 77 which serves both as a separating element and as means for adjustment of the rod 49 in central position. This adjustment is secured by means of a projection 78 which is adapted to contact with the stop 78′, the position of stop being determined by the set screw 79.

It is pointed out that the clutch element 54 has two V-shaped jaws 69 and 70 interconnected by transverse bars 71 and 72 and the clutch element 55 has a single jaw having one flat surface adapted to bear on the intervening tube at a point axially in between the bearing points of the jaws 69 and 70 of the clutch element 54.

Normally, the clutch elements are forced toward each other by means of a coil spring 73, one end of which is attached to the base collar 34 of the mechanism and the other end to a projection 74 adjacent the rear side of the lever 57. When, however, the operating member 58 is pushed rearwardly by an attendant, the bar 60, rotating to the left (see Fig. 11), pulls over the lever arm 57 toward the front of the mechanism, as viewed in Figure 7, thereby rotating the rod 48 in such a manner as to force rearwardly the clutch member 54. At the same time, the integral lever 65, rotating with the rod 48 pulls over the lever 75, causing a simultaneous opening of the corresponding jaw member 55, this simultaneous movement of the jaws releasing the stem or permitting insertion of the stem thereinbetween.

The mechanism, by means of which the support rod of the lamp is centered and held from movement, will now be described.

Referring particularly to Figures 7 and 11, the bar 60 is shown as extending in a diverging integral member 80 so that operation of the lever arm 58 causes a forward movement of the arm 80 to the same extent as the arm or bar 60 moves rearwardly. The end of the lever arm 80 is connected by means of a bar 81 to a lever arm 82, rigidly attached to the base of a rod 83, extending upwardly within the rod 49, as indicated in dotted outline in Figure 7.

At the top of the rod 83 is attached an annular member 84, from which a lever arm 85 extends radially. Directly beneath the member 84 and resting upon the top of the hollow rod 49 is a sleeve 86, adapted to have limited rotation about the rod 83. There is attached to this sleeve, a radially extending arm 87, the outer end of which is hollowed to receive a pin 88, having a flattened head 89 and adapted to move inwardly against the expansion force of the coil spring 90. To the outer end of the arm 87, is also attached a bracket 91 upon which a clutch member 92 is pivoted as at 93, the operative clutching portion 94 being adapted to hold the support tube 16. A rod 95 connects the arm 85 with the end of the clutch 92.

The operation of this device is as follows: Rotation of the center rod 83, as brought about by manipulation of the lever 58, causes first an opening of the clutch jaw 94 until the clutch arm is moved to such an extent that tension is applied to the pivot point 93 when the whole member, including the arm 87, is bodily rotated about the shaft 83 away from juxtaposition with the glass tube. This operation is requisite to permit axial insertion of the stem with its flared end.

Consideration may now be made of the mould utilized in forming the juncture of the stem and filament support tube together with the operating mechanism for the same.

There is positioned within the hollow stub shaft 31 an axially movable rod 100, the base 101 of which extends below the gear 33 where it is adapted to contact with a cam (not shown) and thereby receive reciprocating movement in the shaft 31.

The upper portion of the rod 100 extends above the end of the holding shaft 31 between the standards 35 and 36 and carries adjacent its upper end a cross head 102 extending transversely relative to the plane of the standards 35 and 36. The ends of the cross head 102 are bifurcated and carry pivot pins 103 and 104 to which are pivotally connected connecting rods 105 and 106. The rods 105 and 106 are adapted to operate the lever arms 107 and 108 which latter are pivotally attached at 109 and 110 to the lugs 111 and 112, integral with the collar 37. The cooperating mould jaws or dies 113 and 114 are fitted at the ends of projections 115 and 116 extending outwardly from the lever arms 107 and 108.

The operation of the moulding mechanism, as above intimated, results from reciprocation of the rod 100, such movement causing a pivotal movement of the levers 107 and 108 through the connecting rods 105 and 106, thereby causing movement of the jaws 113 and 114 toward or from each other, as determined by the movement of rod 100. It is observed that adjustment of the mould jaws or dies is secured by means of the screws 117 and 118 and that there is formed inwardly curved adjacent surfaces on the mould jaws adapted to prevent undue compression of the tubular structure positioned thereinbetween during the moulding operation.

Attention is directed to the means by which an outward pressure is exerted in the support tube during the moulding process. The rod 100 is hollow and terminates at its

upper end in a nozzle formation 120 directly beneath the open end of the support tube 16 suspended in position for the molding operation.

There is a conduit 121 formed in the wall of the frame 30 adjacent the termination of a nozzle 122 from a pipe line by means of which air or other gas under pressure is delivered. Adjacent the inner end of the conduit 121 is an annular groove 123 cut in the shaft 31 and in this groove are sunk a series of spaced holes 124 penetrating to the rod 100, which at this point is shaped with a diminished diameter, extending upwardly to a second groove 125 having a series of spaced holes 126 leading to the center of the rod. By this means air may be introduced to the rod interior at any point of movement of the same.

A second air nozzle 127 is positioned at the upper end of the support tube so that air may be admitted either above, below, or simultaneously at both ends of the support tube.

The object of the air currents is to prevent overheating of the tubes when the seal is being formed and also, primarily, to exert an expansive force within the tube during the moulding operation in opposition to the compression of the jaws or dies 113, 114, thereby preventing a fusing or collapsing together of the plastic material heated by the flame and thus ensuring a continuous passage through the tube subsequent to the moulding operation. Moreover the opposing pressures of the exterior dies and the interior gas cause a flow of the hot viscous glass of the tube and stem axially thereof, which action not only produces a perfect seal, but also thins the annular walls of said seal to a point approximating that of the glass of the stem or tube alone. An important result of this action is the production of an annular seal, the walls of which are of approximately the same thickness as the adjacent walls of glass which are united by it so that unequal expansion and contraction in and around the seal are prevented. Also the walls into which the lamp lead wires are sealed being relatively thin, they will heat and cool more nearly in unison with the lead wires and thereby preserve the seal.

The various structural elements of the moulding mechanism have been described in detail. The operation will now be considered. In forming the stem-support-unit, the tube is inserted in the block 39 until the bead 19 rests on the ledge 43. The lead-in wires 24 and 25 are then placed in position on the holes 40 and 41, and the stem slipped over the support tube and wires with the flared end 15 uppermost. While so positioned, the lever 58 is compressed, thus opening the spring closed jaws 54 and 55 and swinging the arm 87 to one side.

When properly positioned, the lever 58 is released and the stem is clutched by the cooperating jaws 54 and 55 and the support tube clutched by the members 89 and 94. Heat, by means of a gas flame, is then applied to the lower end of the stem and the tube adjacent while simultaneously the whole unit is rotated by means of the gear 33. During this initial rotation, the rod 100 is lowered, the cam being inoperative, and the mould jaws extended. As soon as the required heat is attained, the cam or operating means is applied to the rod 100 thus raising the mould arms and forcing the mould jaws onto the heated semi-plastic tubes, compressing them to the formation of the mould and at the same time sealing the tubes together and the wires within the stem.

During this operation, air is supplied either at the top or bottom or at both ends of the support tube, thus preventing a complete closure in the tube passage-way. The unit is then allowed to cool and is then ready for welding into the neck of the bulb.

Further modifications of the invention are illustrated in Figures 12, 13 and 14. In Figure 12, I have indicated the appropriate method to be employed when the support rod is of such thickness that during the heating operation prior to the moulding process, the tube does not become sufficiently heated. It is desirable that both stem and tube be heated to approximately the same temperature, in order to obtain a perfect seal during the moulding process, and, to accomplish this end, as indicated in Figure 12, the support tube 130 is heated and blown prior to the moulding operation sufficiently to thin the walls of the tube, as at 131, so that when heated prior to moulding, both the inner tube and the stem arrive at approximately the same temperature. Thick walled support tubes are essential in the larger type of lamps, particularly, the gas filled, high wattage lamps, and, consequently, this method of utilizing the heavy support tube required in this type of lamp is valuable.

Figure 13 illustrates a method of utilizing a heavier support tube than is possible in the construction shown in Figure 12, wherein the support tube is formed of a single glass unit of uniform dimensions.

In Figure 13 the support tube proper is of such a thickness that it can be blown or thinned with difficulty and at the same time be maintained within the walls of the stem tube. In order to overcome, therefore, the difficulty attendant on the moulding operation due to the diminution of the heat absorption at the moulding point by the support tube, I utilize two separate tubes, an evacuating tube 132 and a support tube proper 133, the evacuating tube being thinned by expansion adjacent the moulding point at 134 so that there will be no de-

ficiency due to insufficient heating during the moulding process. In this operation, not only is the evacuating tube 132 moulded and sealed into the stem 135, but also the support tube 133 is fused into position and into contact with the evacuating tube and the stem, the whole forming one moulded unit.

In Figure 14 there is utilized, in conjunction with the single support tube 136, alternative means for preventing the collapse of a wall of the tube when placed in the moulding press. This means consists in the utilization of a short metallic tube 137 placed within the support tube 136 at the moulding point, thus supplying an element resisting compression of the glass structure and consequently maintaining an open passageway through the support tube, subsequent to the moulding operation.

Figure 15 illustrates a modification of my process in which the support tube proper is replaced by solid glass as in the ordinary support rod of the tungsten lamps now being marketed. The solid part 140 of the support, however, terminates immediately below the lower bead 141 (when the stem is held in the position shown in Fig. 15) and to the flattened lower surface thereof is attached by an appropriate welding process a hollow tube 142, the welded end thereof having a transverse V-shaped formation 143 so that in the process of welding the two elements together, an opening remains on opposite sides of the hollow tube giving entry into the interior thereof. By this construction, an evacuating means, attached to the lower end of the tube 142, may, after the same has been sealed into the stem 144 and the stem sealed in the bulb, withdraw gases from within the bulb until a proper degree of pressure is attained. In the process of welding the two elements of the support together it may be desirable to utilize a metallic pin to form the transverse notch, the pin being later withdrawn after the heating process; or the notch may be made in the glass by inserting a tool at the heated juncture when the glass is hot; in other words, the opening to the bulb interior is not by a blowing process, but rather by a forming process.

It is pointed out that the general process employed in the various modifications illustrated and described is similar in that in all cases a support tube having a hollowed interior is sealed into a stem, so that an opening through the tube exists at both sides of the sealing or attaching point of the two members, whereby as in the case of an incandescent lamp, for example, the gaseous contents of the bulb of the lamp may be evacuated by connection to pumping mechanism. It is further pointed out that in the various modifications in all cases, the use of gas or fluid pressure of some type is utilized to prevent the collapse of the support tube during the moulding process, this pressure being applied simultaneously with the moulding operation and, consequently, preventing the closure of the channel through the tube. It is of importance to note also that the conformation of the stem and tube is of the simplest, with no pronounced curvatures, such as would produce undue strain on the glass subsequent to the heating and moulding operation, the process consisting merely in a heating and stamping operation performed on two adjacent parallelly extending tubes. Another common point of similarity exists in the analogous method of sealing the vacuum within the bulb which consists in extending the support tube through the base of a stem and fusing the same adjacent the said base after the evacuating process has been completed. The major features of the invention, therefore, are the utilization of a sealing process brought about by the application of heat and mould applied between two parallelly extended hollow tubes, while at the same time exerting an outward pressure, either by gaseous or mechanical means for preventing the closure of the passage-way therethrough; subsequently sealing the moulded tubes with attached illuminating elements, as metallic filaments, within the chamber to be evacuated of gases, evacuating the chamber and fusing the support tube adjacent the base of the same, all of these characteristics of the invention having a close interrelation in the building up of an effective and novel means and process of lamp construction.

Attention is directed to the fact that in the case of lamps filled with an inert gas such as nitrogen, the tube 16 serves as an inlet conduit for the gas as well as an outlet conduit for the atmospheric gases exhausted. In the manufacture of this type of lamp the air is first exhausted and then the nitrogen forced in until the pressure within the bulb is slightly below atmospheric. The tube 16 is then sealed as in Figure 5, the slight difference in pressure causing the molten glass to collapse and seal properly.

While I have shown certain applications of my invention in various preferred modifications of the process, it is, of course, understood that the invention is not limited to the specific details set forth but it is intended to cover all such variations as come within the scope of the claims hereto appended.

Having thus described my invention, what I desire to secure by United States Letters Patent and claim is:

1. The herein described method of sealing a glass stem for an incandescent lamp to a combined filament support and evacua-

tion tube which comprises the following steps: placing in said stem a glass tube having a projecting portion extending beyond the stem in one direction to form part of a filament support, and a portion projecting in the other direction to form an exhaust connection, heating the end of said stem and the adjacent portion of said tube to molding temperature, and forcing the softened glass of the stem inward and the softened glass of the tube outward until the two unite in a single integral ring of glass to form an airtight joint between said stem and tube.

2. As a new article of manufacture a product of the herein described process being an incandescent electric lamp having an inwardly extending tubular stem, and a glass filament support extending throughout nearly the entire length of the lamp interior and having a tubular portion united by a pinched seal to the inner end of said stem and also extending through said stem, together with lead wires extending through said seal and through the annular space between said tubular portion and said stem.

3. An article such as defined in claim 2 in which the combined tube and stem walls forming the seal have a thickness considerably less than the sum of their respective thicknesses at points outside of the seal.

4. An article such as defined in claim 2 in which the combined tube and stem walls forming the seal have a thickness considerably less than the sum of their respective thicknesses at points outside of the seal and have an internal contour which is substantially globular.

5. An article such as defined in claim 2 in which the filament support located within the lamp is formed of thicker glass than that comprising the tubular portion projecting beyond said seal.

6. An article such as defined in claim 2 in which the filament support located within the lamp comprises a solid glass rod but has a perforation through the tubular portion and opening into the lamp interior through which the lamp may be exhausted.

In testimony whereof, I affix my signature.

JEROME SCHOFIELD WHEELER.