June 5, 1951 R. K. BRAUNSDORFF 2,556,059

ELECTRIC INCANDESCENT LAMP AND METHOD OF MANUFACTURING

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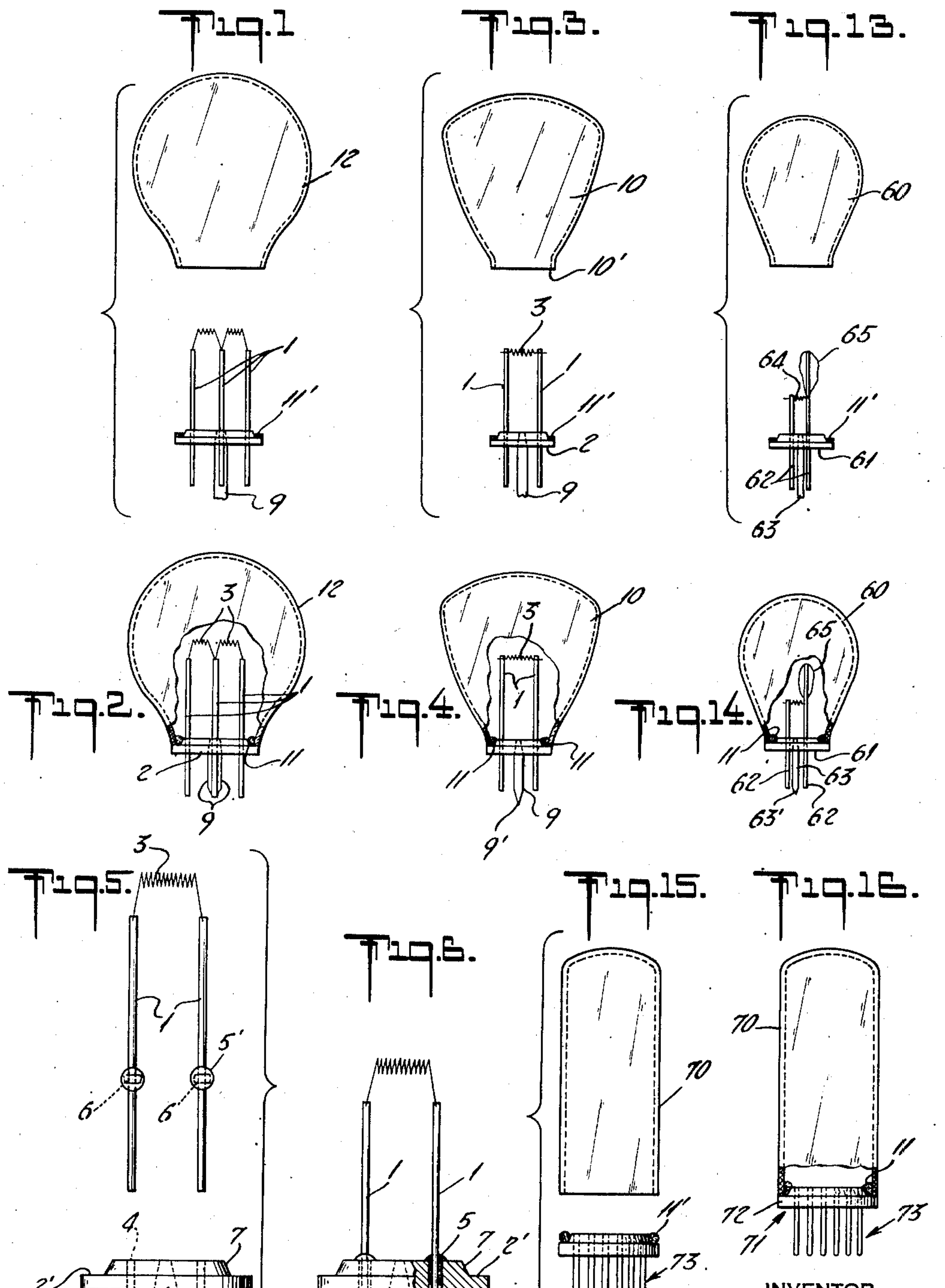

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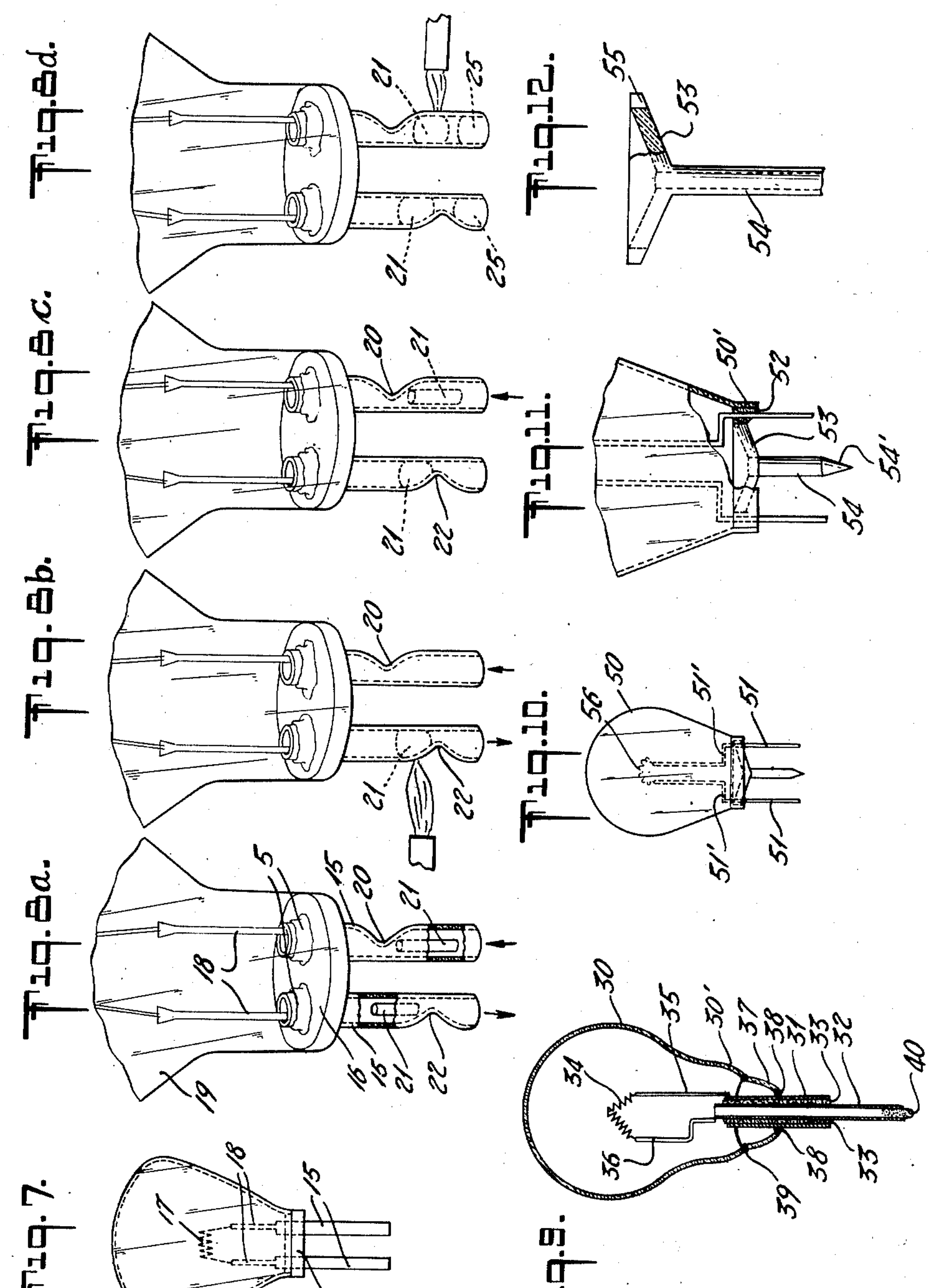

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ELECTRIC INCANDESCENT LAMP AND METHOD OF MANUFACTURING

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5 Claims. (Cl. 176—16)

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This invention relates to electric lamps and particularly to miniature incandescent lamps for automotive purposes, although certain features thereof are of utility in other applications.

An object of the invention is a new and improved lamp construction wherein shorter light center lengths can be obtained.

Another object is a new and improved lamp of the character set forth wherein limitations on the diameter of the leading-in wires are, for all practical purposes, eliminated and a single piece, straight-through leading-in wire construction may be used.

Still another object of the invention is a novel and improved miniature incandescent lamp which is characterized, among other things, by the low cost of manufacture thereof as compared with the cost of manufacturing conventional lamps.

A further object of the invention is a method of manufacturing such miniature lamps which is characterized by the low cost of manufacture and further by the production of lamps of more uniformly good quality with fewer rejects.

Other objects of the invention will hereinafter appear.

For a better understanding of the invention reference may be had to the accompanying drawings, wherein

Fig. 1 is a diagrammatic view of an exploded view of a bulb and a mount therefor embodying the invention;

Fig. 2 is a side view of the completed lamp with parts broken away;

Fig. 3 is an exploded view similar to Fig. 1 of another embodiment;

Fig. 4 is a side view of the completed lamp of the embodiment of Fig. 3;

Fig. 5 is an exploded view of the mount parts of a lamp embodying the invention;

Fig. 6 is a diagrammatic view partly in section of the completed mount of Fig. 5;

Fig. 7 is a side view of another embodiment of the invention;

Figs. 8*a*, 8*b*, 8*c* and 8*d* are enlarged diagrammatic views illustrating certain steps in the manufacture of the embodiment of Fig. 7;

Fig. 9 is a sectional view of another embodiment of the invention;

Fig. 10 is a side view of another embodiment of the invention;

Fig. 11 is an enlarged view of the embodiment of a part of the lamp of Fig. 10;

Fig. 12 is a view partly in section of the button element utilized in the embodiment of Fig. 10;

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Fig. 13 is an exploded view of a miniature photo flash lamp bulb embodying the invention;

Fig. 14 is a diagrammatic side view partly in section of the embodiment of Fig. 13;

Fig. 15 is an exploded view of an envelope and a button mount for a radio tube embodying the invention; and

Fig. 16 is a side view partly in section thereof.

Referring to Figs. 1 to 4, inclusive, I have illustrated my invention as embodied in conventional automotive head or projector lamp bulbs. The lamp or bulb of Figs. 1 and 2 is one conventional type and shape and the lamp or bulb of Figs. 3 and 4 is of another conventional type. The lamp of Figs. 1 and 2 is a multiple filament lamp while the lamp of Figs. 3 and 4 is a single filament lamp.

It is conventional practice in making these automotive lamps to form mount stems comprising flares and then to fuse the flares and necks of the bulbs together. Conventional bases are then attached to the neck of the bulb. This practice involves the utilization of fusing temperatures high enough to melt the glass of the bulb neck and the flare and this gives rise to special annealing and other problems. Also in the manufacture of the stems the flares are melted upon the lead wires and special lead wires are required, as for example, of Dumet wire which are limited as to the volume of current that may be employed. By the invention illustrated in Figs. 1 to 6 this conventional practice with its special problems and expensive operations is avoided.

Referring to Figs. 5 and 6 I first form a mount of the simplified character shown in these figures which comprises simple metallic lead wires **1**, a disc **2** of glass and a conventional lighting filament **3**. The disc **2** is provided with apertures or holes **4**, one for each of the metallic wires **1** and these metallic wires **1** are fastened to the disc or button **2** and sealed within the openings **4** by means of a suitable bonding material **5** which melts or fuses at a temperature substantially below the fusing temperature of the glass of the button or disc **2**. The bonding material **5** should also have a coefficient of expansion approaching that of the glass disc **2** but as indicated should melt at a substantially lower temperature so that the bonding material can be fused into the openings **4** about the metallic lead wires **1** without fusing the button or disc **2** at any point thereof and without setting up undue strains therein. In the particular embodiment illustrated the bond **5** is formed by first forming about the leads **1** a mass **5'** of such material at the desired points thereof. This is effected by first mounting on the lead wires 1 cross lengths 6, these cross lengths 6 being fastened to the lead wires 1 at points which are desired to be at or substantially flush with the inner face of the disc or button 2. After these short cross lengths 6 are fastened the bonding material 5' is anchored to the length 6, as by heating sufficiently to anchor it and as diagrammatically shown in Fig. 5 this bonding material forms a bead-like body after it has been thus anchored to the cross wires at this point. With the metallic lead wires 1 thus provided with the beads or globules of bonding material 5' and with the filaments 3 mounted on the ends thereof in any conventional manner these lead-in wires 1 and the button or disc 2 are then assembled with the lower ends of the lead wires 1 passing through the openings 4 of the button, and with the globules or masses 5' of fusing material resting on the upper side of the disc or button at the openings 4. With the parts thus assembled the masses of bonding material 5' are heated to a temperature sufficient to fuse them about the lead wires 1 and in the openings 4 as shown in Fig. 6. Since the fusing temperature of the bonding material is substantially below that of the glass of the button or disc 2 the heating of the disc or button 2 is substantially less than is required to fuse it and the annealing and other probles arising at the higher temperatures are avoided and wires 1 are of sufficient capacity to carry the load without limitation. After the making of the simple mount of Fig. 6 it is then assembled into the bulb and bonded thereto as described below.

The disc or button 2 is formed with an upper flat surface 2' at its periphery for assuming an abutting relation with the end of the neck of a bulb and the upper central part of the disc or button is slightly tapered in an upward direction as indicated at 7 and extends into the inside of the neck of the bulb.

The button or disc is provided also with an aperture 8 which may conveniently be centrally disposed of the button or disc for the reception of an exhaust tube 9. The latter is preferably of glass and is also preferably fastened within the opening 8 by means of a bonding material similar to the bonding material 5, namely one which has a fusing or melting temperature substantially below that of the button or disc 2 and the exhaust tube 9 and also preferably having a coefficient of expansion approximating the coefficient of expansion of the glass.

With the button or disc mount shown in Fig. 6 thus formed it is then assembled into fastening and sealing relation with the bulb 10 shown in Figs. 3 and 4. Before the bulb 10 and the button or disc mount are assembled one of these elements is provided at the sealing line with a suitable bonding material which fuses at a temperature substantially below the fusing temperature of the envelope or bulb 10 and in the particular embodiment shown the disc or button 2 is provided with such a material 11'. This bonding material 11' is positioned on the upper surface 2' of the disc and around the tapering upper part 7 of the disc. The two elements are then assembled with the abutting edge 10' of the neck of the bulb 10 resting upon the material 11' and with the upper tapering part of the disc or button projecting into the neck of the bulb. With the parts thus assembled sufficient heat is applied to the bonding material 11' to fuse the neck of the bulb to the button or disc. This sealing in the particular embodiment shown comprises both a butt seal between the abutting edge 10' of the neck of the bulb 10 and the upper surface 2' of the button or disc 2 and also a seal around the inner edge of the neck of the bulb 10 to the lower part of the taper 7. The bond thus formed is indicated at 11 in Fig. 4. By thus sealing the button or disc mount to the neck of the bulb 10, the highest temperature to which any part of the bulb 10 and the button or disc 2 is subjected is the fusing temperature of the bonding material 11' and since that is substantially below the fusing temperature of the bulb and the disc the annealing and other problems are simplified and the stress and strains are minimized during the sealing-in step.

The embodiment of Figs. 1 and 2 is the same as that of Figs. 3 and 4, the only difference being that a differently shaped bulb or envelope 12 is used and multiple filaments 3 are employed requiring more than two leads 1.

In Figs. 2 and 4 the lamps have been exhausted or filled with the desired gas and the exhaust tubes 9 are sealed off as indicated at 9'.

Instead of forming the mount and assembling the mount in two steps, this may be done in a single step, that is before the lead wires 1 are actually fastened to and sealed to the button 2 the assembly consisting of the button, the leads 1 and the bulb 10 (or 12) are assembled together in the desired sealing relationship and the assembly is then heated to a temperature sufficient to fuse the bonding materials 5' and 11' simultaneously which temperature is below the fusing temperature of the button and the envelope 10. This heating may, for example, be effected by heating the whole assembly in an oven or the heating may be effected in any other suitable manner as, for example, by applying gas burner flames thereto or to the neck and disc. The heating which is sufficient to fuse the bonding material and seal the parts together may be effected in a very short time as, for example, a period of a minute or substantially less than a minute. Thus where in the conventional practice two separate heating operations are required, namely one for making the conventional stem and second the fusing of the stem to the glass bulb, I am able to form the completed bulb with just one heating except for the exhaust and sealing off operation. This latter operation may be effected immediately after the sealing of the leads 1, the buttons 2 and the bulbs together so as to avoid cooling and reheating for the exhaust. However, the sealing and fastening of the exhaust tube 9 to the button 2 may be effected at the same time, namely simultaneously with the fusing of the bonding materials 5' and 11'.

The lead wires 1 as above indicated may be the plain conventional alloy wire used as the support wires in conventional automotive lamp bulbs and no special sealing-in wire as, for example, Dumet is required. The cross wires 6 may be of the same alloy as the lead wires 1 and these wires function to facilitate the anchoring of the bonding material thereto and to prevent the wires 1 from tending to slide relatively to the button 2 during the sealing step. The bonding material 5' and 11' may be of paste form or of solid form. The solid form may be formed into a ring 11 and disposed on the surface 2' of the button 2 or the material in the form of a paste may be applied to 2', and similarly with respect to the bonding material 5'. The glass of the bulbs 10 and 12 may be of the conventional lime or lead glass and similarly the buttons 2 and the exhaust tubing 9 may be of the same glass. Any suitable bonding material may be used for the material 5' and 11' having a fusing temperature substantially below the softening or fusing temperature of soft glass of which the bulbs 10 and 12, the button 2 and the exhaust tube 9 are formed. It must have the quality of forming a firm bond between the elements with a tensile strength sufficient to hold the parts firmly united and other desired characteristics such as freedom from crazing. It also must have a coefficient of expansion in the neighborhood of the coefficient of expansion of the soft glass parts which are to be sealed and bonded together. I have obtained particularly good results by utilizing a low fusing material which may be described generally as of the lead or lead oxide family of such materials available on the market. For example, I have obtained good results with a bonding material containing 50% or more of lead or lead oxide and a suitable flux or fluxes and a suitable filler or fillers to compensate for any irregularity in the expansion of the flux or mass when fused and set between and to the button surfaces of the elements to be sealed and joined. The elasticity of the fillers compensates for any irregularity in the expansion of the flux or mass when fused and set between and to the surfaces. It has a coefficient of expansion in the neighborhood of the coefficient of expansion of lime glass and has a range of expansion coefficient of from 85 to 95 multiplied by 10^{-7}. It melts or fuses at a temperature under or around 500° C. which is substantially below the softening or melting point of lead glass, which is roughly 626° C. and that of lime glass which is roughly 696° C. This bonding and sealing material when fused between the juxtaposed surfaces of the peripheral edges forms a firm union between the soft glass elements to be joined which has been demonstrated by tests to be at least as strong, if not stronger than the glass itself and further the bonding and sealing operation may be effected with little or no rejects or shrinkage. This fused bonding material appears to merge into and in effect form part of the glass of the elements to be joined notwithstanding the fact that the bonding operation is carried on at a temperature well below the fusing temperature of the glass elements to be joined and with the film or layer of bond having tensile strength adequate not only to firmly unite the elements when the lamp is evacuated but also when the lamp is pressurized with gas. It is understood however that my invention is not limited to this particular bonding material since other bonding materials having characteristics of the above described bonding material may be utilized.

In the embodiments of Figs. 7 and 8 the lead-in wires 15 are in the form of tubes and these tubular conductors are sealed in openings formed in the buttons 16 in a manner similar to the sealing of the lead wires 1 into the button 2 as above described and by the use of a bonding material similar to the bonding material 5, 5' of Figs. 1 to 6. The filament 17 is mounted upon support wires 18 of conventional metal as, for example, nickel alloy, with their lower ends fastened to the inner ends of the tubular conductors 15, as, for example, by welding. The button 16 is bonded to the neck of the bulb 19 by means of a bonding material similar to the bonding material 11' of Figs. 1 to 4 and in a similar manner, this bonding material having a fusing point substantially below the fusing point of the glass of the button 16 and the bulb 19. The hollow conductors or lead wires 15 are utilized for flushing the air out of the bulb 19 and for introducing any desired gas inside the bulb. Figs. 8*a* to 8*d* are enlarged views of the neck portion of the bulb 19 for purposes of illustration. A pinch 20 is formed in the side of one tubular conductor 15 which is to be used as the inlet, this pinch 20 being formed adjacent the button 16. Into the outer end of this tube 15 is placed a sealing and bonding material which may be similar to the bonding material 5' and 11' above described or any other suitable material. In the particular embodiment shown this bonding material 21 is in the form of an elongated body which is inserted in the open end of the tube up against the walls of the pinch 20. A pinch 22 is also formed in the other tubular conductor 15 but before this pinch is formed a body of sealing and bonding material 21 is inserted in the open end of the tube beyond the point where the pinch 22 is to be formed and then the latter is formed, or the material 21 may be inserted into the inner end of the tube 15 after the pinch 22 is formed and before the mount is sealed to the bulb, but in sealing in the mount care must be taken not to fuse the material 21. This latter tubular conductor 15 forms the outlet through which the air and other gaseous material to be removed from the tube is flushed. A flushing gas is then introduced into the inlet tube as, for example, by connecting a rubber tube to the inlet which tube is connected with the source of flushing gas pressure. After the bulb 19 is flushed the sealing material 21 is heated and melted to seal up the outlet tubular conductor at the pinch 22. This heating may be effected by the flame as shown in Fig. 8*b*. The supply of flushing gas is preferably continued while this bonding and sealing material 21 is being fused to close the outer tube at the pinch 22. After the bulb is flushed out in this manner and the outlet tube sealed at the pinch 22, the pressure of the gas can be increased and raised to the desired value inside the bulb. When this is effected, the body or fusing material 21 below the pinch 20 is fused or melted so as to seal the inlet tube (Fig. 8*c*). After the fusing of the sealing material 21, the outer ends of both the inlet and outlet tubular conductors may be filled with lead solder melted thereinto as indicated at 25 in Fig. 8*d*. The heating flame may be of an ordinary gas and air flame for heating and fusing the bonding and sealing bodies 21, and Argon gas may be used as the flushing gas. By forcing the Argon gas through the inlet tubular conductor, the air therein and other gases are forced out through the tubular outlet past the pinch 22 and when the gas is all out the outlet tubular conductor is sealed as described above, whereupon the Argon gas is continued to be supplied until the desired pressure is reached. Some of the Argon gas is likely to be lost in this operation of flushing, and therefore a less expensive gas such as hydrogen may be used as the principal flushing medium. After the air is flushed out of the bulb, the Argon is supplied through the inlet to drive out the hydrogen, or the greater portion of it, whereupon the outlet tube is sealed and the Argon gas continued to be supplied up to the desired pressure.

The tubular lead-in structure illustrated in the embodiment of Figs. 7 and 8 may be used for connection directly to an external circuit, and thus eliminate the conventional lamp base; this would result in a material reduction in the cost of the lamp. This is also true of the embodiment illustrated in Fig. 9, wherein concentric tubular terminals sealed into the glass envelope are employed.

In flushing the lamps having the tubular-type terminals as illustrated in Figs. 7 and 8, it is possible to effect the flushing operation without the need for conventional pumping. By the combination of an adequate flush plus heating of the filament in a controlled flush atmosphere, such as, for example, hydrogen, the envelope could be thoroughly purged of residual gases and filled with an inert gas such as argon, for example. Moreover, with this particular lamp construction it is possible to employ filling pressures up to the bursting strength of the assembled parts, and the lamps could be tipped off with pressures of the order of several atmospheres and even higher. For instance, the plug 21 could be melted within its terminal 15 while the gas pressure is being maintained on the lamp, since the pressures on either side of the plug would be equal, and an effective seal could be made.

With this structure, as well as with the structures previously described, short light-center lengths are readily attainable, and this is particularly so where the leading-in wires form the terminals to connect the lamp directly to an external circuit without the necessity for a conventional base. Moreover, this structure greatly facilitates the positioning of filaments in what are generally termed "pre-focused" lamps, and in which the filament must occupy a predetermined position with respect to the base or some other guiding feature on the bulb, so that when it is mounted in the apparatus, the filament will be in a predetermined position with respect to the optical system with which it is to cooperate. Moreover, by means of the greatly decreased light center lengths available with the structure as illustrated in Figs. 7 and 8, as well as with other embodiments of the invention illustrated in the drawings, far greater latitude is permissible in the design of associated optical devices than would be permissible with conventional lamp structures with which I am familiar.

In the embodiment of Fig. 9 I have shown a conventional type of bulb 30 with the filament mount comprising concentric tubular lead-in conductors, these concentric conductors comprising an outer hollow or tubular conductor 31 and an inner tubular conductor 32. These two tubular conductors 31 and 32 may be insulated from each other in any suitable manner but preferably they are insulated from each other and fastened firmly together by means of an insulating and bonding material 33 of the character of the bonding material 5′, 11′ and 21 above described. This bond 33 is fused or melted in situ in a manner to surround the inner tube 32 and to bond the latter to the outer tubular conductor 31 in substantially concentric relation therewith. A conventional filament 34 is mounted on filament support wires 35 and 36, the support wire 35 being fastened to the outer tubular conductor 31 as by welding and the support wire 36 being fastened similarly to the upper end of the inner tubular conductor 32, the latter projecting slightly beyond the inner end of the outer tubular conductor 31 to facilitate the welding of the support wire 36 thereto. The filament mount thus formed is fastened to and sealed to a flare or cup-like device 37, the latter preferably being of glass and this may be of the same glass composition as that of the bulb 30. The flare 37 is provided with an opening through which the mount support comprising the tubular conductors 31 and 32 is inserted and the two parts are fastened and sealed together along the periphery of the opening of the flare 37, as shown at 38, the latter preferably being a bond material of the character of the bond material 5′, 11′ and 21, above described. The flaring periphery of the flare 37 is also fastened and sealed into the neck of the bulb neck 30′ of the bulb 30 by means of the bonding material 39 which is similar to the bonding material 38. Both the seals 38 and 39 may be formed simultaneously or the seal at 38 may be first formed and the seal at 39 formed thereafter. The inner tubular lead-in conductor 32 is utilized for exhausting the lamp and for introducing a suitable gas if desired. At the completion of the exhaust the tubular conductor 32 is closed off in any suitable manner and I have indicated it as closed off by a sealing material 40 which may be of the character of the bond and seals 38 and 39. The tubular conductors 31 and 32 may be of a conventional alloy known in the trade as No. 4 alloy. The seals 33, 38 and 39 may be formed simultaneously so as to avoid reheating in steps if they are formed at different times.

Firm and secure bonds and seals are thus obtained between the tubular lead-in conductors 31 and 32, between the tubular conductor 31 and the flare 37 and between the flare and the neck 30′ of the bulb 30 and moreover without heating either the flare 37 or the bulb 30 to the fusing or melting point. The low working temperatures simplify the bonding and sealing operation as well as annealing operations and the mount structure is considerably simplified. This provides a complete single circuit lamp with only one protruding connector which then itself is insulated to provide the circuit connections. The lamp of this embodiment is particularly adapted for use with a special type jet connector.

In the embodiment of Figs. 10, 11 and 12 I have illustrated a bulb 50 of a conventional type and shape and having the lead-in wires 51 fastened and sealed in position by being embodied in the bond and seal 52 formed between the button closure 53 and the neck 50′ of the bulb 50. The button closure 53 is formed by flaring the exhaust tube 54 at one end. This flare 53 is provided with V notches 55 on its periphery for the accommodation of the lead-in conductors 51 and the bonding material 52 utilized in bonding and sealing the flare 53 to the neck 50′ at the same time bonds and seals the conductors 51 in these V notches. This bonding material 52 is of the character of the bonding materials 5′, 11′ and 21 above described. In the particular embodiment shown the lead-in conductors 51 are offset at 51′ to accommodate them to the sealing position between the periphery of the flare 53 and the neck 50′ of the bulb and at the same time to be in a position to support the filament 56 in the desired manner. All parts are jigged in the final position and oven-heated to effect the seals. The exhaust is effected through the exhaust tube 54 and the latter is sealed off in any conventional manner at 54′. This provides a simple and inexpensive construction for low cost lamps such as photoflash or other surfaces where a special connector may be provided.

In the embodiment of Fig. 14 I have illustrated a photoflash lamp comprising a bulb 60 and a button mount 61. The latter is similar to the button mount 2 described above with respect to Figs. 1 to 6 and is bonded and sealed to the neck of the bulb 60 by means of a bonding material 11' identical with that described with respect to Figs. 1 to 6. This bonding material 11' when fused forms the bond 11 of Fig. 14.

The lead-in conductors 62 are sealed into the button 61 in the manner similar to the sealing of the lead-in conductors 1 to the button 2 of Figs. 1 to 6, namely, by the use of a bonding material similar to the bonding material 5' and 11'. An exhaust tube 63 similar to the exhaust tube 9 of Figs. 1 to 6 is bonded and sealed to the button 61 and in the manner described above with respect to exhaust tube 9. The conductors 62 carry an igniting filament 64 for igniting the magnesium or aluminum foil 65 contained in the bulb 6. The ignition means and the magnesium or aluminum foil are of any conventional structure and as in conventional practice oxygen is contained in the bulb 60 to accelerate the lighting flare. Fig. 13 is an exploded view of the bulb 60 and the mount before the mount and the bulb are bonded and sealed together, the bonding material 11' being positioned about the button 61 either in the paste or solid form.

In the embodiment of Figs. 15 and 16 I have illustrated a radio tube having an envelope 70 and a button mount 71, the interior structure of the radio tube being omitted for convenience in illustration. The mount 71 comprises a button 72 similar to the button 2 of Figs. 1 to 6. The open end of the tube 70 is butt sealed and bonded to the button 72 in a manner similar to the sealing and bonding of the button 2 to the neck of the bulb 12 above described and by the use of a bonding material 11' similar to the bonding material 11' of Figs. 1 to 6. The mount 71 also comprises a multiplicity of terminal connectors 73 which are conventional. These terminal connectors may be sealed into the button during the button molding process, or they may be secured in the button in substantially the same manner as shown and described in connection with Figs. 5 and 6.

With the new and improved lamp construction as previously described, applicant is able to form incandescent lamps having much shorter light-center lengths, which feature is of great importance in certain applications, and especially in applications wherein the filament is to be disposed at a particular point with respect to a reflector.

Another important and outstanding advantage of this invention resides in the particular leading-in wire structure. With conventional methods of sealing in the leading-in wires in incandescent lamps with which I am familiar, the diameter of the wire is limited, since too large a wire will crack the press supporting the wires and filament, and this wire limitation limits the amount of power that can be delivered to the filament. With applicant's construction, however, there is, for all practical purposes, no limitation whatever on the wire size, and relatively large wire diameters may be employed without any possibility of cracking or otherwise damaging the button part of the lamp even in the presence of the wide temperature range encountered during normal use of lamps of this type.

Furthermore, the use of the button seal and leading-in wire construction in accordance with

this invention enables the use of a straight single section of leading-in wire, which materially reduces the cost of manufacturing the lamp as compared with the three-piece leading-in wires used in conventional lamp constructions with which I am familiar.

For the sealing material denoted by the numeral 11' in the drawings, as for instance in Fig. 1, and the sealing material denoted by 5 and 5' in Figs. 5 and 6, for instance, I have had particularly good results by utilizing a low fusing material which can be described generally as being of the lead or lead oxide family of such materials available on the market. Although it is understood that other bonding materials having the same characteristics may be used, as for example the bonding material previously described, they should preferably have a temperature coefficient of expansion around or fairly close to glass, namely a coefficient of expansion of 90 to 94×10^{-7}. The bonding material previously described has a softening point below 450° C. (around 415° C. to 420° C.) and it melts or fuses at a temperature around 500° C. Its fluidity becomes quite marked at temperatures above 500° C. This marked fluidity of the bonding material is such that when a portion thereof in the pulverized or granular form is positioned on a glass slide and heated to the fusing and melting temperature, it tends to flow into a thin layer and when heated to above 500° C., as for example to 575° C., say for fifteen minutes, it flows very thin and spreads itself in a very thin flat layer on the slide. I believe this tendency of the fused bonding material to spread into a thin layer or film at around or above 500° C. is important in the forming of the seal and strong rigid joint, although I have obtained fairly good results with bonding materials whose fluidity at the fusing and melting temperature is substantially less than that of the specific bonding material described above.

Any suitable glass may be used for the bulb and button parts, such for example as lead glass which softens at around 626° C., and lime glass which softens at around 696° C., and by softening is meant softening to a point where the glass becomes slightly flexible or distortable from its shape, or begins to become flexible or distortable. I have had particularly good results by using bulb and button parts made of lime glass.

The temperature coefficient of expansion of lead glass at 0° C.–310° C. is around 90×10^{-7}, and that of lime glass is around 92×10^{-7}. While the coefficient of expansion of the above-described bonding material is somewhat different from that of lead and lime glasses, and while the coefficient of expansion of these materials may vary with the temperature, I have found that after heating up to 500° C. or above and during cooling the assembly down to room temperature, the bond is free from any tendency to craze and crack and that a durable firm bond and a secure seal are obtained between the glass elements. The elasticity of the bond material above described compensates for irregularities in expansion within the material itself and for slight differences in coefficients of expansion between the glass of the bulb and button parts, and this characteristic of the bonding material is believed to be responsible at least in part for the freedom from craze and cracks in the joint formed between the glass elements. These and other characteristics of the bond contribute to its tensile strength and to the quality of forming a substantially integral bond between the abutting surfaces of the bulb and button parts.

The bonding and sealing material when thus fused between the juxtaposed and abutting surfaces of the peripheral edges forms a firm union between the soft glass elements, which has been demonstrated by tests to be at least as strong, if not stronger, than the glass itself. This fused bonding material appears to merge into and in effect form an integral part of the glass of the elements, though the bonding operation is carried on at a temperature well below the softening temperature of the glass, and with the film or layer of bond having tensile strength adequate not only to firmly unit the elements when the lamp is evacuated but also when the lamp is pressurized with gas. With the preferred bonding material, the layer approaches molecular depth at the pressure points with a variation in thickness of the layer to compensate for the irregularities in the abutting surfaces and also forms a firm and secure bond between the leading in means and the button material.

These important features, together with the important features and advantages previously set forth, greatly facilitate the manufacturing of incandescent lamps and enable the production of lamps at a materially reduced cost. Moreover, it is possible with this invention to eliminate the conventional base, as well as to produce lamps having very short light-center lengths and which can be accurately controlled in the manufacture of the lamp. Furthermore, with the tubular terminal construction which I have illustrated, conventional pumping methods can be eliminated, and the envelope can be thoroughly purged of residual gas in a much shorter time than with conventional pumping processes with which I am familiar, and the envelope can be filled and sealed at much higher envelope pressures.

What is claimed is:

1. A miniature incandescent lamp comprising a glass bulb having an opening therein, a glass button part sealed in said opening, a filament in said lamp, and support wires connected with said filament and extending through said button part and hermetically sealed thereto, and transverse members secured to each support wire at predetermined distances from the filament to facilitate positioning of the filament relative to the button part when said support wires are sealed in said button part.

2. In a miniature incandescent lamp having a glass bulb part having a neck-like opening therein and an electric filament in said bulb, means for supporting and aligning said filament in said bulb comprising a button part having means on the edge thereof for cooperating with the opening in said bulb to facilitate alignment of the button part relative to the bulb, and filament support wires extending through said button having transverse members fastened thereto at predetermined distances from the filament to facilitate alignment of the filament relative to the button part when the support wires are sealed therein by bringing said transverse members into contact with the surface of the button part before effecting the seal.

3. A miniature incandescent lamp comprising a glass bulb part having a neck-like opening therein, a filament in said lamp, and leading-in wires for supporting said filament on their inner ends and extending outwardly through said opening, and means for closing said opening comprising a glass tube having an outwardly flared portion on one end thereof with said flanged portion closely fitting said opening and having notches in the edge thereof through which the leading-in wires pass, and means for sealing said flange and support wires to said bulb comprising a low temperature adhesive having a melting point below the softening point of the flange and bulb parts, said glass tube providing a tipping off means for said bulb.

4. The method of making an incandescent lamp mount comprising forming a button part of insulating material with at least two openings therein for the reception of leading in wires to support a filament within the lamp, fastening a short metallic member to each leading in wire in transverse relationship thereto and at a predetermined distance from one end thereof, forming a bead of sealing material about the metallic member on each leading in wire, inserting the leading in wires through the openings in the button part, heating the beads of sealing material while exerting a slight longitudinal pressure on the leading in wires whereupon the sealing material will fill the openings to seal the wires therein with the transverse members resting lightly against one surface of the button part to accurately fix the distance of said one end of the leading in wires relative to the button part and then securing a filament to said one end of the leading in wires.

5. The method of making an incandescent lamp mount comprising forming a button part of insulating material with at least two openings therein for the reception of leading in wires to support a filament within the lamp, fastening a short metallic member to each leading in wire in transverse relationship thereto and at a predetermined distance from one end thereof, inserting the leading in wires through the openings in the button part with the transverse members in meeting engagement with one surface thereof and sealing the leading in wires in said openings.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,606,276	Vello	Nov. 9, 1926
1,967,852	Wright	July 24, 1934
2,006,818	Zimber	July 2, 1935
2,199,866	Alterthum et al.	May 7, 1940
2,200,954	Glassberg	May 14, 1940
2,212,556	Baier	Aug. 27, 1940
2,248,644	Reger	July 8, 1941
2,268,666	Lopp	Jan. 6, 1942
2,269,840	Anderson	Jan. 13, 1942
2,362,171	Swanson	Nov. 7, 1944
2,464,990	Plagge	Mar. 22, 1949
2,482,119	Mickley	Sept. 20, 1949