July 2, 1935. D. S. GUSTIN ET AL 2,006,568

METHOD OF SEALING METAL WIRES TO GLASS

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Fig. 1.

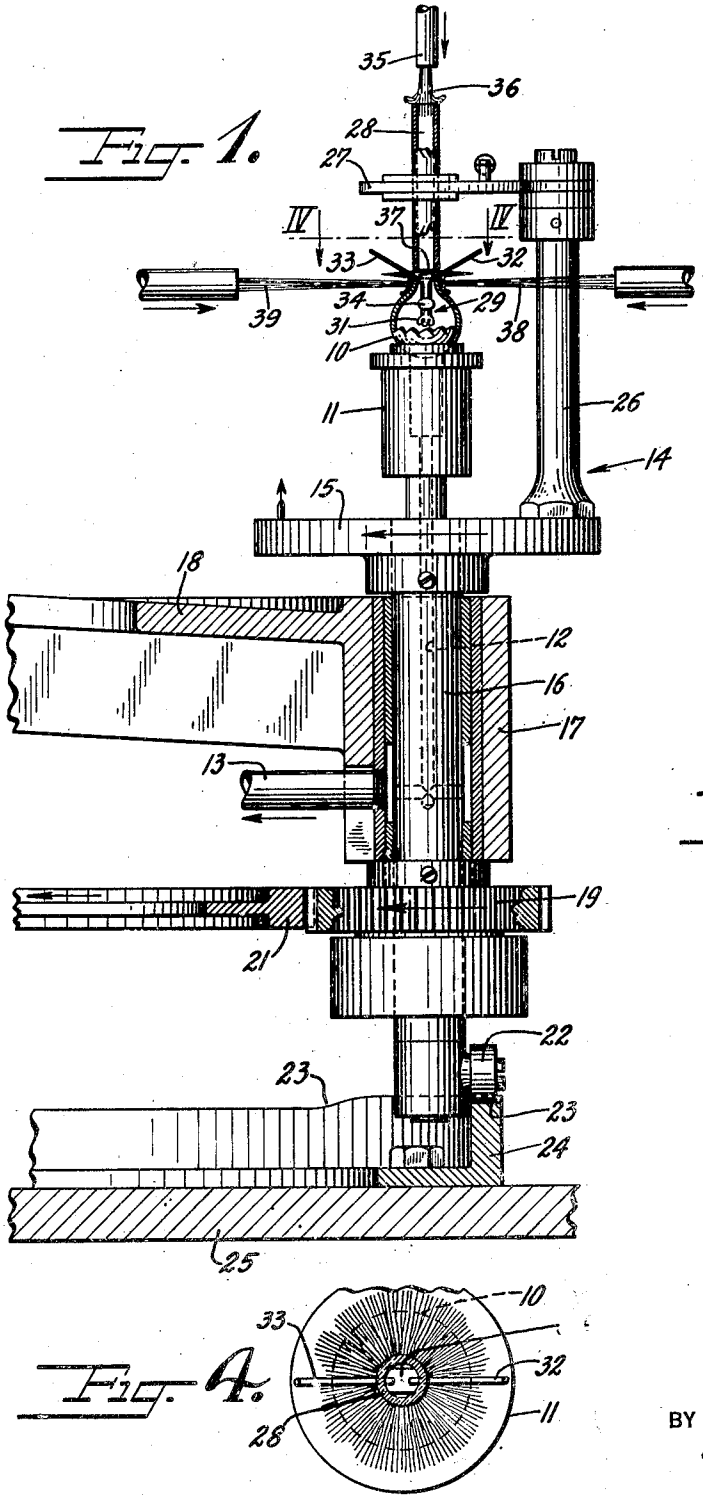


Fig. 2.

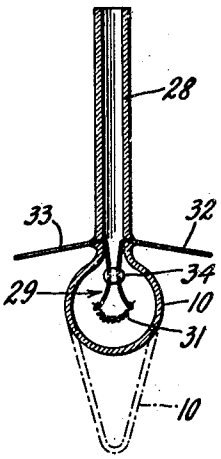


Fig. 3.

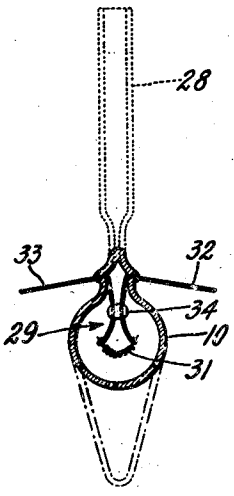


Fig. 4.

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Fig. 7.

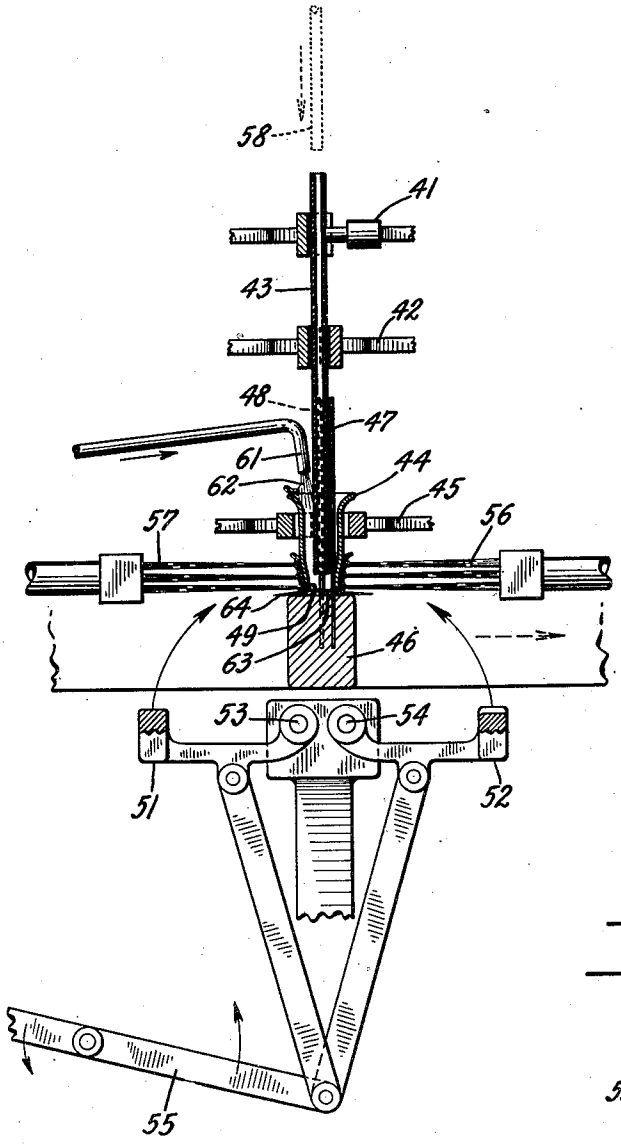


Fig. 5.

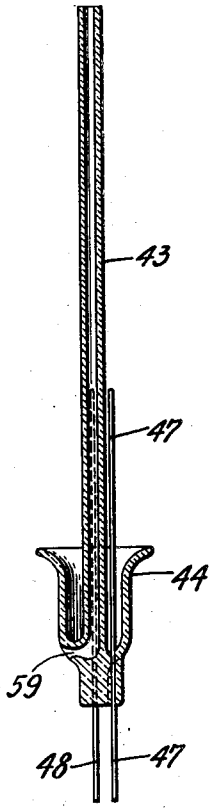
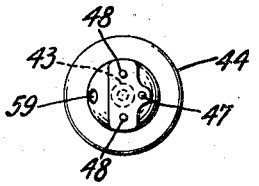


Fig. 6.



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METHOD OF SEALING METAL WIRES TO GLASS

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Application July 1, 1932, Serial No. 620,368

4 Claims. (Cl. 49—78)

This invention relates to the manufacture of incandescent vacuum devices and relates particularly to the manufacture of incandescent lamps wherein leading-in conductors are provided and sealed in a wall of a glass bulb or container.

In the manufacture of incandescent lamps, it is necessary to provide leading-in conductors of such character that they may be hermetically sealed through the glass wall of an envelope. The leading-in wires are, therefore, made of a material which will "wet" with the glass and although metallic conductors of various metals have been employed, the most commonly used is a conductor composed of what is termed Dumet wire. Dumet wire is formed with a nickel iron core and an outside surrounding copper sheath. The wire is of such character that it has substantially the same coefficiency of expansion as the glass in which it is used and the copper has the property of wetting and hermetically sealing with the glass. Although Dumet wire has been used over a long period and has given satisfactory results in the manufacture of large volumes of lamps and other devices, it has always been found that a certain amount of shrinkage, due to leaks occurring, attended the use of dumet as well as the use of other leading-in conductors employed under similar conditions. This shrinkage is due to various causes and principally by reason of the oxide which accumulates on the surface of the wire when it is exposed to the atmosphere and when heated during the usual manufacturing operations.

It is impossible from a practical manufacturing standpoint to entirely clean the wire or prevent the formation of oxide thereon during the sealing-in operation and for this reason a certain percentage of lamps manufactured develop what is known as leakers, which permit the entrance of air into the bulb with detrimental results, insofar as the quality and life of the lamp are concerned.

It is an object of the present invention, therefore, to provide a step in the manufacture of vacuum devices wherein portions of the leading-in wires to be sealed in the glass are conditioned to more effectively wet with the glass.

Another object of the invention is to provide a method of sealing a metallic conductor in a glass wall in the presence of a reducing atmosphere.

Another object of the invention is to provide a method of sealing a metallic conductor in a glass body while plastic by enveloping a portion of the conductor to be sealed in a reducing atmosphere and in pressing the glass body around such portion.

Another object of the invention is to provide a method of cleaning the surface of a metallic conductor by surrounding the same with an ignited gas and in compressing the glass body while plastic around the said enveloped portion of said conductor.

Other objects and advantages of the invention will be more clearly understood by reference to the accompanying drawings in which:

Fig. 1 is a side elevational view of a portion of the machine partly in section for performing what is termed a butt-sealing operation in connection with a miniature type of lamp;

Fig. 2 is a cross sectional view of a lamp after the butt-sealing operation has been performed showing the sealed-in lead wires and the extending exhaust tube;

Fig. 3 shows the lamp after the exhaust tube has been tipped off the top and constriction being shown in dotted lines;

Fig. 4 is a view taken on line IV—IV in Fig. 1 and shows, on a larger scale, the ring of flame resulting from the passage of the reducing atmosphere between the exhaust tube and the bulb neck;

Fig. 5 shows another form of stem which may be manufactured in accordance with the present method, the stem being shown in cross section;

Fig. 6 is a view looking upwardly toward the lower end of the stem shown in Fig. 5 and

Fig. 7 is more or less a diagrammatic illustration of a machine for holding the parts of the stem, shown in Fig. 5, in position to have the leading-in wires sealed therein.

The present invention may be used in connection with the sealing-in of wires either through the wall of a bulb as shown in Figs. 1 to 4 or it may be employed in connection with the manufacture of a stem as shown in Figs. 5 to 7. It may also be used in connection with various other types of lamps and in the manufacture of other types of stems. The lamp shown in Figs. 1 to 5 is what is termed a miniature lamp and is manufactured by a so-called butt-sealing operation. In performing this operation a bulb is held with the neck projecting upwardly and a mount is positioned with the lead wires extending laterally from the neck and resting on the edge thereof.

An exhaust tube is then positioned so that its longitudinal axis is in alignment with the longitudinal axis of the bulb and is moved so that the end of the tube abuts the neck of the bulb or

is in close abutting relation thereto with the lead wires interposed. Flames are then directed against the neck of the bulb and the lower end of the exhaust tube to heat them until they become plastic after which they are moved relative to each other until they abut and consolidate, sealing the leading-in wires through the wall thus formed.

This operation is well known in the manufacture of incandescent lamps and is clearly shown and described in Patent Number 1,742,153 issued December 13, 1929. In the present invention, mechanism for accomplishing the above operations may be the same as that shown in the above mentioned patent and sufficient structure is illustrated to give a clear understanding of the invention and the application of the present method as a step in the manufacture of devices of the character to which the invention relates. As shown in Fig. 1, a bulb 10 may be supported in a holder in the form of a vacuum cup 11 which has a vacuum passage 12 connected to a vacuum line 13. The vacuum cup support 11 is mounted on a rotatable head 14 including a plate 15 secured to the upper end of a spindle 16. The spindle is rotatable in a bearing 17 on an arm 18 of a rotatable conveyor. The spindle 16 is provided with a gear wheel 19 in mesh with a continuously driven gear wheel 21. The lower end of the spindle 16 is provided with a roller or cam follower 22 which traverses the surface 23 of a cam 24 mounted on a cable 25. The cam surface 23 is formed to slightly raise and lower the spindle 16 for a purpose to be presently described. The plate 15 is provided with a post 26 the upper end of which is equipped with a pair of gripping jaws 27 to hold an exhaust tube 28 in alignment with the bulb end in the cup 11.

The structural arrangement of the mechanical elements is such that when the bulb is positioned in the cup the exhaust tube is held by the jaws 27, the longitudinal axis of the exhaust tube coincides with the longitudinal axis of the bulb so that the lower edge of the exhaust tube and the edge of the bulb neck will register when moved to abutting relation. When the bulb 10 is in position and before the exhaust tube is applied, a mount 29 is positioned in the bulb. This mount consists of a filament 31 and lead wires 32 and 33 held by a glass bead 34. The lead wires of the mount are bent outwardly as shown so that the filament is held in position in the bulb by resting the lead wires on the edge of the bulb neck. The lead wires are not, however, bent at right angles so that they contact with the flat edge of the bulb wall, and are thus almost entirely exposed to the action of a reducing atmosphere as provided in accordance with the present invention.

For the purpose of improving the manufacturing process, the present invention provides means in the form of a nozzle 35 for directing a stream of a reducing gas 36 into the exhaust tube 28. It has been found, although various reducing gases may be employed such as a mixture of hydrogen and nitrogen or the like, that good results are obtained by employing a gas of relatively low cost such as the ordinary illuminating gas. In practicing the present method, the gas passes down the exhaust tube which is held with its lower end in relatively close spaced relation to the neck of the bulb leaving an annular opening 37 through which the gas is forced and from which it issues in the form of a reducing zone which becomes ignited by fires 38 and 39 which are directed against the bulb neck and the end of the tube to render them plastic for consolidation.

When the glass parts are in a proper state of plasticity, the cam 24 operates to slightly raise the bulb 10, pressing the plastic portions of glass together and thus consolidating the bulb and exhaust tube and consequently sealing the lead wires at the united portions. This operation is performed in the presence of the reducing atmosphere or while the portions of the lead wires to be sealed are enveloped in the ignited reducing fluid. By performing the reducing operation substantially simultaneously with the fusing operation, the portions of the lead wires to be sealed are entirely free of any foreign material and by reason of the enveloping reducing atmosphere no oxides can form leaving the copper surface in its best condition for wetting and thus hermetically sealing with the glass. It will be understood that the present method wherein the portions of the wires to be sealed are enveloped in the ignited gas that the surrounding gas actually prevents the formation of the oxides which would ordinarily form.

In the operation of sealing lead wires in a press or in the wall of a bulb the portions of the wires to be sealed are unavoidably heated by the fires which are employed to heat and soften the glass. Thus in the absence of the present method an oxide is formed on the surface of the heated portions of the wire with the result that since the oxide is interposed between the surface of the wire and the glass the necessary intimate contact to make an air-tight seal is unattainable. When the present method is employed the reducing gas, which, by means of the glass heating fires is ignited, envelops the portions of the wires to be sealed in a gas flame which prevents the formation of oxide and leaves the surface clean and effective to make a hermetic seal and thus removes loss due to leakage.

The burning gas, which flows from the inside of the tubular body outwardly across the portions of the wire to be sealed, serves to heat the wires, preparing them for the sealing operation. The ignited reducing gas flame also aids in heating the glass in conjunction with the glass fusing flames.

The foregoing description relates to the manufacture of a butt-sealed lamp including the step of cleaning the lead wires and the same method is applicable to the manufacture of a stem shown in Figs. 5 to 7. As shown in Fig. 7, two pairs of jaws 41 and 42 are provided to hold an exhaust tube 43. A flare tube 44 may be held by a pair of jaws 45. The several pairs of jaws are so arranged that the exhaust tube 43 may be held in concentric relation and extend within the flare tube 44. A lead wire support block 46 may be provided having suitable apertures to receive lead wires 47 and 48 in position within the flare tube and with ends extending below the neck 49 thereof. A pair of press forming jaws 51 and 52 are provided pivoted at 53 and 54 and operated by means of a lever 55 from a source of power not shown. These jaws serve to compress the flare tube and exhaust tube after portions thereof have been rendered plastic by means of suitable fires 56 and 57. Mechanism for performing this operation as well as the operation of blowing air down through the exhaust tube by means of a nozzle 58, indicated in dotted lines in Fig. 7, is well known in the lamp art. The purpose of the nozzle 58 is to force air into the exhaust tube after the same has been consolidated with the flare tube in a plastic mass and while the mass is still plas-

tic, the air serves to form a lateral passage 59, as shown in Fig. 5, for exhaust purposes. This operation is performed subsequent to the operation of actually compressing and uniting the flare tube 44 and exhaust tube 43.

For the purpose of practicing the present method during the consolidation of the component parts of the stem, a nozzle 61 is provided to discharge a fluid 62 into the flare tube and around the portions of the lead wires to be sealed in the glass. The flare tube 44 is held above the support 46 to provide an annular opening 63 for the passage of the reducing fluid which issues in the form of a surrounding ring 64. This issuing fluid is ignited thus completely excluding the entrance of any air to portions of lead wires to be sealed and obviously the filling of fluid within the flare tube will prevent the entrance of air from the opposite side of the exhaust tube. While the lead wires are thus enveloped in a reducing atmosphere, the jaws 51 and 52 are actuated and the plastic glass is compressed about the lead wires in the presence of the reducing atmosphere thus sealing the wires and making it possible to obtain a seal under ideal conditions.

It has been found that when practicing the present method, a great saving is accomplished in that leaks are avoided and the defective seals which were prevalent heretofore are eliminated. Various materials have been used for lead-in wires and one of the greatest difficulties has been to provide a metallic conductor which would be dependable in wetting with the glass but although good wetting materials have been obtained and the results have been satisfactory up to a certain point, the difficulty always remained of having a certain percentage of defects by reason of the impracticability of obtaining wire with the surface free from oxide or other foreign substances which operate to destroy the effective wetting property of the material used. By reason of the present invention the portions of the leading-in conductors to be sealed in the glass are so treated that their wetting properties are improved and consequently, when employing the present method, the cost of manufacture is reduced by reason of low shrinkage.

Although a preferred embodiment of the invention is shown and described herein, it is to be understood that modifications may be made therein without departing from the spirit and scope of the appended claims.

What is claimed is:

1. The method of butt-sealing which comprises supporting a bulb, disposing lead wires with portions extending from the bulb neck, positioning an exhaust tube with one end adjacent to portions of said wires, directing a flow of a reducing gas down said exhaust tube and around said portions of said wires, heating to render plastic the bulb neck and the end of said tube and in moving the bulb and exhaust tube to compress the plastic portions about the wires.

2. The method of making an incandescent electric lamp of the butt-seal type which comprises positioning a lamp bulb with the neck portion extending upwardly, disposing a lamp mount within said bulb with the lead wires, projecting at an angle to the neck wall and resting on the edge of said neck, positioning an exhaust tube with its longitudinal axis coincident with the longitudinal axis of said bulb and with its lower end in spaced relation to said bulb neck to provide an annular outlet, directing a reducing fluid into the upper end of said tube for discharge from said outlet, heating adjacent portions of said tube and bulb neck, and in compressing the heated portions about said wires.

3. The method of butt-sealing which comprises supporting a bulb, disposing lead wires with portions extending from the bulb neck, positioning an exhaust tube with one end adjacent to portions of said wires, directing a flow of a reducing gas down said exhaust tube and around said portions of said wires, heating to render plastic the bulb neck and the end of said tube and in changing the relative positions of the bulb and exhaust tube to compress the plastic portions about the wires.

4. The method of hermetically sealing an electrical conductor oxidizable in air in a fused wall in a tubular glass part which comprises surrounding a conductor with one end of said tubular part, directing a flow of reducing gas through the other end of said tubular part so as to flow out the end surrounding said conductor, diverting the flow of said gas to cause it to be discharged substantially transversely across the edge of said end surrounding said conductor to envelope the portion of said conductor surrounded by said glass part end in said reducing gas to the exclusion of air, heating the end of said part surrounding said conductor until plactic and compressing said plastic portion about said conductor.

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