

July 2, 1946.

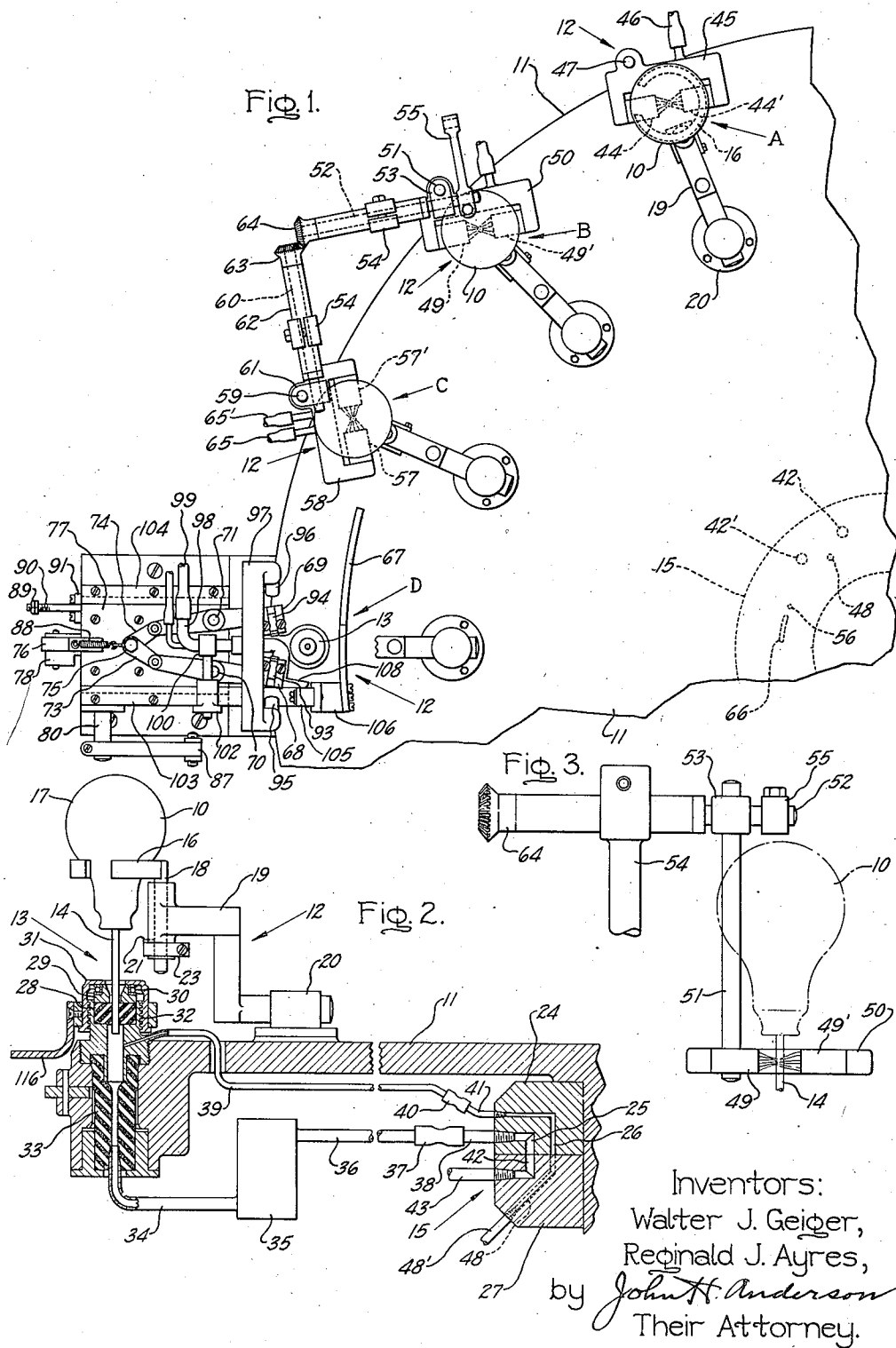
W. J. GEIGER ET AL.

2,403,073

METHOD AND APPARATUS FOR GAS FILLING AND TIPPING-OFF ENVELOPES

Filed Sept. 29, 1943

2 Sheets-Sheet 1



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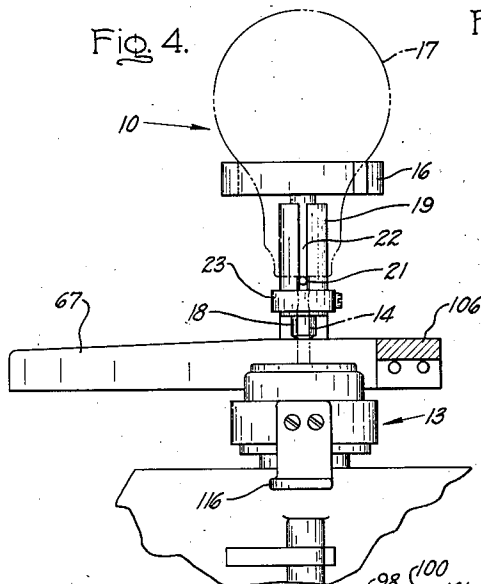
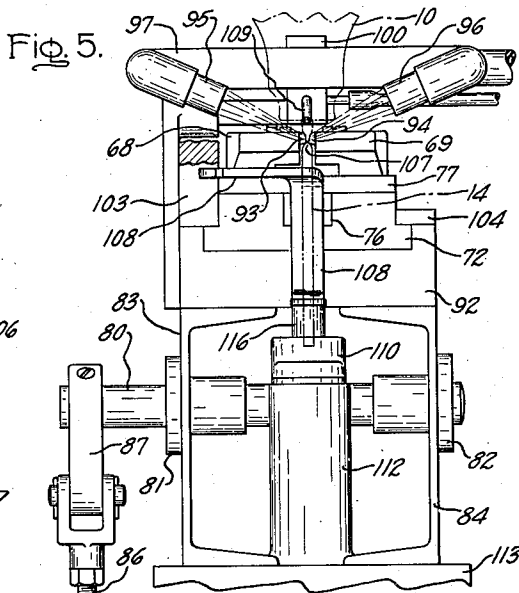
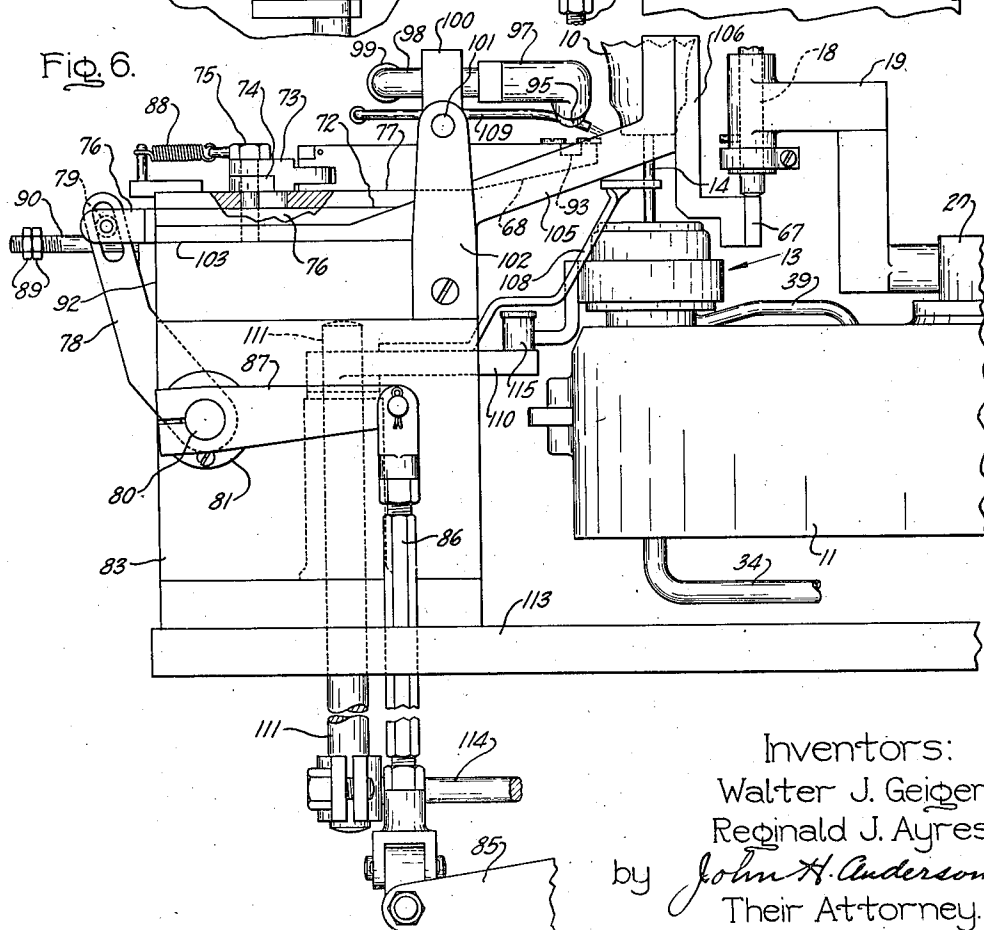
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## UNITED STATES PATENT OFFICE

2,403,073

METHOD AND APPARATUS FOR GAS FILLING  
AND TIPPING-OFF ENVELOPESWalter J. Geiger, Cleveland Heights, and Reginald  
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Our invention relates to a method and apparatus for sealing-off vitreous vessels and more particularly to a method and apparatus for tipping-off the vitreous exhaust tubes of incandescent lamps, discharge tubes and other electrical devices.

An object of our invention is to provide a method and apparatus for tipping-off electrical devices in very high speed exhausting and gas filling apparatus. Such apparatus advances the devices from one work station to another at short intervals so that they remain in operative relation to the tools at any one station a comparatively short interval of time, making it very difficult to successfully heat and close off the exhaust tube with sufficient rapidity at any one station. Usually it became necessary to divide the tipping-off operation between two or more work stations so that the operation is interrupted, but even this method can not be carried to the extent desired, and it limits the speed of operation of the machine. Our present invention, on the other hand, provides for the distribution of the limiting portion of the tipping-off operation over the time interval in which the electrical device is located at two adjacent stations and is being indexed therebetween. The tipping-off operation is speeded up to such an extent by the above operation that it no longer limits the operation of the exhaust machine.

Another object of our invention is to provide a method and apparatus for tipping-off electrical devices having an internal pressure greater than atmospheric pressure. The usual tipping-off apparatus can not be used in the manufacture of such lamps as the high gas pressure within the devices forces a passage through the walls of the exhaust tube, once said tube is heated to fusing temperature. The effect of the internal gas pressure must be overcome and it is preferred that the exhaust tube be squeezed shut mechanically immediately after it is heated to a workable temperature. The use of this type apparatus extends to many electrical devices which do not have super-atmospheric pressures when their manufacture is complete but which are heated considerably above ambient temperature at the time of gas filling and are therefore about or somewhat above atmospheric pressure. Still other indirect advantages are received by use of our invention in that the need for cooling the electrical device during the flushing operation of the exhaust machine to reduce the interior pressure is no longer necessary, a practice which has some indications of being injurious to the

quality of the device, and in that the use of higher than atmospheric pressures in the electrical device permit different filling gases to be used with a consequent increase in efficiency, etc.

Other objects and advantages of our invention will appear from the following detailed description of a species thereof and from the drawings.

In the drawings Fig. 1 is a plan view of a portion of an exhaust machine embodying the apparatus of our invention; Fig. 2 is a side elevation of the lamp and lamp holder in combination with a fragmentary vertical section through the exhaust port, turret and rotary valve opposite the first station of the exhaust machine occupied by said apparatus; Fig. 3 is a side elevation of the burners and burner positioning means at station B; Fig. 4 is a peripheral side elevation of the exhaust port and the lamp holder and holder adjusting cam at the final work station of the exhaust machine; Fig. 5 is an end view of the effective end of the pinching mechanism at said station; and Fig. 6 is a side elevation of the exhaust port and the tipping-off apparatus at said final work station.

The operations of the species of our invention shown in the drawings are largely restricted to the four stations A, B, C and D of that portion of the exhaust machine shown and are brought about during the course of the movements of the electrical device, an incandescent lamp 10 in this instance, through said stations, the results of regular counterclockwise indexing rotative movements of the turret 11. The lamp 10 (Figs. 1 and 2) is held in one of a plurality of heads 12 adjacent the periphery of the turret 11 and is connected in the usual manner through the exhaust port 13, which makes a hermetic seal with exhaust tube 14 of the lamp 10, to the rotary valve 15 which controls the exhaust, flush and gas filling operations of the exhaust machine. The lamp 10 is also supported in the species of our invention shown by a holder 16 in the form of a split ring which engages the bulb 17 thereof and which is attached to a post 18 slidable vertically within the bracket 19. A circular clamping block 20 attached to the turret 11 opposite each head 12 is the means of supporting the bracket 19 which provides an arm of circular cross section in an opening through the clamping block 20. A pin 21 extending from the side of the post 18 into a vertical slot 22 (Fig. 4) in the end of the bracket 19 prevents the holder 16 from swinging laterally out of position over the exhaust port 13 whereas a collar 23 clamped to a portion of the bracket 19 functions as a rest for

the pin 21 and thereby establishes the vertical position of the holder 16 and the lamp 10.

The operations of the exhaust machine are such that the lamp 10 advanced to station A has still to be subjected to several of the operations in the exhausting and gas filling process. These operations are brought about in the usual manner by the indexing motions of the turret 11 which motion causes a corresponding rotative movement of the upper half 24 of the rotary valve 15 and thereby changes the positions of the exhaust passage 25 and the gas filling passage 26 connected to each exhaust port 13 with respect to the exhausting and gas filling outlets in the stationary lower half 27 of said rotary valve 15. As shown in Fig. 2, the exhaust port 13 provides the ring 28 of rubber which is compressed by the downward pressure of the guide ring 29, ball bearing 30 and screw cap 31 so that it engages tightly the full periphery of the exhaust tube 14, and which also engages the inner walls of the opening in the body 32 of the port 13 sealing it. The body 32 of the exhaust port 13 is, in turn, connected through the section of rubber hose 33, the pipe 34, trap 35, pipe 36, rubber hose 37 and pipe nipple 38 to the exhaust passage 25 in the movable upper half 24 of the rotary valve 15 and through a pipe 39, rubber hose 40 and pipe nipple 41 to the gas filling passage 26 in said upper half 24 of the rotary valve 15.

The lamp 10 at station A is subjected to an exhaust operation, the result of the presence of the exhaust passage 25 in the upper half 24 of the rotary valve 15 over the passage 42 (Figs. 1 and 2) in the lower half 27 of said rotary valve 15 which passage 42 is connected through pipe 43 to a source of vacuum (not shown). The gas filling passage 26 within the upper half 24 of the rotary valve 15 which is permanently connected to the head 10 is inoperative during the above interval as it lies over a solid portion of the lower half 27 of the rotary valve 15 and is blocked off thereby. Station A is also occupied by the opposed burners 44 and 44' which are moved to operative relation (as shown) to the exhaust head 12 after the indexing movement of the turret 11. The burners 44 and 44' are mounted on opposite sides of the manifold 45 which is connected to the combustible gas mixture through a rubber hose 46 and which is caused to move said burners 44—44' into operative relation to the particular portion of the exhaust tube 14 that is to be tipped off by means (not shown) attached to the rod 47. Such preheating burners 44 and 44' have been used in other tipping-off apparatus and are therefore not shown in detail. The interval of operation at station A exhausts the lamp 10 and is followed by a sideward movement of the burners 44 and 44', which carries them from operative relation thereto, and by the index of the turret 11.

In the course of the indexing movement of the head 12 from station A to station B, the next in order, the exhaust passage 25 in the upper half 24 of the rotary valve 15 passes over a solid portion of the lower half 27 of said valve 15 and is blocked off, and the gas filling passage 26 passes momentarily over a passage 48 (Figs. 1 and 2) which is connected through pipe 48' to a source of gas. In this interval sufficient gas flows through the gas filling passage 26 and the exhaust port 13 to the lamp 10 to act as a flushing agent.

When finally located at station B, the lamp 10 is connected through the exhaust port 13, the exhaust passage 25 to a passage 42' (Fig. 1) in

the lower half 27 of the rotary valve 15, which passage 42' is connected to a source of vacuum and exhausts the lamp 10 to the degree desired. The flushing gas admitted to the lamp 10 in the course of its movement to this station and any contamination the gas picks up while in the lamp 10 are removed in this way.

Station B is also occupied by a second pair of preheating burners 49 and 49' (Figs. 1 and 3) which are moved to operative relation to the exhaust tube 14 of the lamp 10 for an interval and which heat said tube 14 still further. The burners 49—49' are mounted on opposite ends of the manifold 50 which is suspended on the rod 51 fastened to the horizontal shaft 52 by the clamp 53 and is swung from a position outside the path of movement of the lamp 10 and head 12 by a rotative movement of the shaft 52 within the stationary supporting bracket 54. The above positioning motion of the burners 49 and 49' is brought about by a portion (not shown) of the exhaust machine so that it occurs in proper timing with the indexing movements thereof and engages the arm 55 on the end of the shaft 52.

The directly succeeding operations of the apparatus occur after the lamp 10 and head 12 are indexed into station C, and consist in the entrance of a portion of the final gas filling into said lamp 10 and the final heating step in the treatment of the exhaust tube 14 thereof. The indexing movement terminates the previous exhaust operation by carrying the exhaust passage 25 in the upper half 24 of the rotary valve 15 from communication with the passage 42' in the lower half 27 thereof, and advances the gas filling passage 26 to a position over the passage 56 which is connected to a source (not shown) of filling gas at the desired pressure. According to our invention, the gas must be introduced into the lamp 10 at any pressure which does not greatly exceed atmospheric (for example, 20 mm. above atmospheric pressure) or very near to atmospheric pressure, while located at this station, so that it does not have sufficient pressure to force an escape opening through the exhaust tube 14 which becomes plastic in the course of the heating cycle thereat. The exhaust tube heating operation is performed by flames from the burners 57—57' which correspond to burners 49—49' at station B and are mounted in opposed relation on the opposite ends of the manifold 58 which is suspended on the rod 59 attached to the horizontal shaft 60 by the clamp 61. The burners 57—57' are moved to and from operative relation to the exhaust tube 14 in proper timing with the indexing movements of the turret 11 by the partial rotation of the shaft 60 within the stationary bearing 62, which shaft 60 is coupled to the corresponding shaft 52 controlling the burners 49—49' by the bevel gears 63 and 64. In this particular instance the manifold 58 is divided midway in its length so that each of the burners 57 and 57' can be supplied separately through the rubber hoses 65 and 65' from the sources (not shown) of the combustible gases and therefore more accurately controlled. The fires from burners 57—57' preferably have much greater heating effect on the exhaust tube 14 than the previous sets of burners and heat said tube 14 to a degree which permits it to be stretched and mechanically pinched shut and sealed in the succeeding operations of the apparatus. The head 12 is indexed immediately after the burners 57—57' are swung from operative relation to the exhaust tube 14 so that there is virtually no

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interruption in the heating operation thereof and the following operations of the apparatus.

The indexing movement that now occurs advances the head 12 to station D and coincides with a movement of the upper half 24 of the rotary valve 15 which carries the gas filling passage 26 therein from communication with the passage 56 in the lower half 27 thereof and, then for an interval, into communication with the arcuate groove 66 in said lower half 27. The effect of this operation is to connect the lamp 10 to a second gas source directly before it is brought into operative relation to the apparatus at station D so that the final adjustment of the gas pressure within the lamp 10 is made only an instant before the exhaust tube 14 is closed off. This method of operation permits the lamp 10 to be filled to greater than atmospheric pressure as in the particular case described, but need not be limited to such pressures. The arcuate groove 66 is connected to a gas source (not shown) and during its interval of communication with the gas filling passage 26 increases the gas pressure within the lamp 10 to the desired pressure (for instance to 1100 mm. of mercury).

During the indexing movement to station D, the lower end of the post of the holder for the lamp 10 is carried into engagement with the top edge of the cam 67 and is moved up by the gradually increased height (Fig. 4) thereof so that the heated portion of the exhaust tube 14 is caused to be stretched. This operation tends to draw the walls of the exhaust tube 14 together somewhat in most instances so as to form a constriction therein, and in combination with the cooling effect of the incoming gas on the interior walls of the exhaust tube 14 at the same interval, prevents said exhaust tube 14 from being distorted by the high interior gas pressure for the extremely short interval before pinch tipping.

When the head 12 and lamp 10 finally reach station D, the jaws 68 and 69 (Figs. 1, 5 and 6) which are pivoted on the studs 70 and 71 extending from the top surface of the slide 72 are moved into operative relation to the still plastic exhaust tube 14 and are closed thereon as shown in Fig. 5. This operation pinches the exhaust tube 14 so that the walls thereof are brought together to seal off said lamp 10, and correspond to similar pinching operations performed by our very similar apparatus disclosed in U. S. Patent No. 2,295,034.

The jaws 68 and 69 of our present apparatus are connected by the links 73 and 74 to a pin 75 extending upward from an actuator slide 76 below the plate 77 in ways in the slide 72 and are operated through the movements of the arm 78 which engages the roller 79 in the end of the actuator slide 76. The arm 78, in turn, is fastened to a shaft 80 supported by the bearings 81 and 82 held by the channel pieces 83 and 84 of the base of the apparatus and is operated from the central cam actuated means generally associated with lamp making machines through the lever 85 (only partially shown), the push rod 86 and the arm 87.

The positioning movements of the jaws 68 and 69 occur during the first movements of the actuator slide 76 as the tension of the spring 88 which extends between means attached to the pin 75 and other means attached to the plate 77 over the slide 72 causes said actuator slide 76 and slide 72 to retain their relative position until the nuts 89 on the stud 90 extending from the end of slide 72 engages the yoke 91. At such times the slide

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72 is at its maximum forward position in the ways of the block 92 of the base of the apparatus since the yoke 91 is attached to said block 92 and the further movement of the actuator slide 76 results in an independent movement of the pin 75 and the links 73 and 74 which closes the jaws 68 and 69.

The jaws 68 and 69 engage the heated portion of the exhaust tube 14 through dies 93 and 94 which they carry and are effective in working the walls of the exhaust tube 14 together because said dies 93 and 94 are at a sufficiently elevated temperature to prevent heat loss from said tube 14 during their interval of contact therewith. The heat retained by the dies 93 and 94 is introduced therein by the flames from the burners 95 and 96 which are mounted on the manifold 97 extending from the pipe 98 and which are arranged so as to be directed against the dies 93 and 94 before said dies 93 and 94 are brought into operative relation to the exhaust tube 14. The pipe 98 and flexible hose 99 provide the combustible gas used by the burners 95 and 96 which are held in place by the clamping block 100 engaging pipe 98, the shaft 101 and the bracket 102 attached to block 92. Gibs 103 and 104 at opposite sides of the block 92 to keep the slide 72 in place in its ways therein and an extending portion 105 of gib 103 engages the bracket 106 supporting the cam 67.

As in the pinching apparatus in our patent hereinbefore referred to, the pinching dies 93 and 94 squeeze an appreciable portion of the exhaust tube 14 together, which portion fuses into a solid, homogeneous and permanent seal, and are provided with ridges which squeeze an adjacent portion 107 of said exhaust tube 14 to a very thin section.

Although the lamp 10 is now completely sealed, it is not removed from the apparatus until after the opening movement of jaws 68 and 69, which is produced by the return movement of the actuator slide 76 and preferably after the exhaust tube 14 is separated. This latter operation is performed by a sharp blow against the exhaust tube 14 by the mallet 108 and occurs after a jet of air controlled by a cam actuated plunger valve (not shown) from pipe 109 has cooled said exhaust tube 14 sufficiently to cause the excessively pinch portion 107 to break. The mallet 108 is fastened to an arm 110 attached to shaft 111 extending vertically through the support bracket 112 held by the frame 113 of the exhaust machine and is caused to strike the exhaust tube 14 at the correct instant by cam actuated means (not shown), a portion of the exhaust machine, turning said shaft 111 through the arm 114 on its lower end. The lamp 10 which is still retained by the holder is removed either manually or mechanically before the head 12 is indexed from station D.

The arm 110 can also be used to release the lower end of the exhaust tube 14 from the grip of the exhaust port 13 by providing it with a roller 115 which swings against and turns the arm 110 so that the cap 31 is unscrewed. The end of the exhaust tube 14 can then be removed manually or mechanically from the port 13 as desired. All exhausting and gas filling connections to the port 13 are closed off at this time as the exhaust passage 25 in the upper half 24 of the rotary valve 15 is over a solid portion of the lower half 27 thereof and the gas filling passage 26 has been removed from communication with the passage 66 connected to the gas source to a

position over a solid portion of the lower half 21 of said valve 15.

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

1. The method of gas-filling and sealing a bulb having a vitreous exhaust tube extending therefrom, which comprises exhausting the bulb through said tube, heating a portion of the tube to a plastic condition, introducing into the bulb a gas filling at a pressure less than the desired ultimate pressure, stretching and constricting the plastic portion of the tube and simultaneously introducing more gas into the bulb to provide the desired ultimate pressure, and then quickly pinching the plastic portion of the tube to close it off. 15

2. The method of gas-filling and sealing a bulb having a vitreous exhaust tube extending therefrom, which comprises exhausting the bulb through said tube, heating a portion of the tube to a plastic condition, stretching and constricting the plastic portion of the tube and simultaneously introducing into the bulb a gas filling at a pressure substantially in excess of atmospheric pressure, and then quickly pinching the plastic portion of the tube to close it off. 20

3. The method of gas-filling and sealing a bulb having a vitreous exhaust tube extending therefrom, which comprises exhausting the bulb through said tube, heating a portion of the tube to a plastic condition, introducing into the bulb a gas filling at a pressure not substantially exceeding atmospheric pressure, stretching and constricting the plastic portion of the tube while introducing more gas into the bulb to increase the pressure substantially in excess of atmospheric pressure, and then quickly pinching the plastic portion of the exhaust tube to close it off. 30

4. The method of gas-filling and sealing a bulb having a vitreous exhaust tube extending therefrom, which comprises exhausting the bulb through said tube, heating a portion of the tube to a plastic condition, introducing into the bulb a gas filling at a pressure slightly in excess of atmospheric pressure but insufficient to rupture the plastic portion of the said tube, stretching and constricting the plastic portion of the tube while introducing more gas into the bulb to increase the pressure substantially in excess of atmospheric pressure, and then quickly pinching the plastic portion of the exhaust tube to close it off. 40

5. Apparatus for exhausting a bulb having a vitreous exhaust tube extending therefrom, filling the bulb with gas at a pressure substantially in excess of atmospheric pressure, and tipping-off the exhaust tube, said apparatus comprising a bulb holder for supporting the bulb, means for gripping the end of the exhaust tube, means for evacuating the bulb through said exhaust tube, means for filling the bulb through said tube with gas at approximately atmospheric pressure, means for heating a portion of said exhaust tube to a plastic state, means for effecting a relative axial separating movement between the bulb holder and the exhaust tube gripping means to stretch and constrict the plastic portion of the exhaust tube, means for introducing more gas into the bulb to raise the pressure therein substantially above atmospheric simultaneously with the stretching of the exhaust tube, and means for immediately thereafter pinching shut the stretched and plastic portion of the exhaust tube. 50

6. Apparatus for tipping-off a vitreous exhaust 75

tube extending from a bulb comprising, in combination, an exhaust port adapted to grip and make a gas tight seal with the end of the exhaust tube, a carrier arranged to support the exhaust port and index it to a plurality of stations in turn, means located at one of said stations for heating a portion of the exhaust tube to a plastic state, means for effecting relative movement between the bulb and the exhaust port to stretch and constrict the plastic portion of the exhaust tube during the course of the succeeding indexing movement, valve means on said carrier connected to the exhaust port and arranged to introduce a gas filling at the desired pressure into the bulb through the exhaust tube during the said indexing movement thereof and simultaneously with the stretching of the exhaust tube, and clamping means at the succeeding station constructed and arranged to mechanically pinch the heated and stretched portion of the exhaust tube to seal it immediately upon indexing of the exhaust port into said station.

7. Apparatus for tipping-off a vitreous exhaust tube extending from a bulb comprising, in combination, an exhaust port adapted to grip and make a gas tight seal with the end of the exhaust tube, a carrier arranged to support the exhaust port and index it to a plurality of stations in turn, means located at one of said stations for heating a portion of the exhaust tube to a plastic state, means for effecting a relative movement between the bulb and the exhaust port to stretch and constrict the plastic portion of the exhaust tube during the course of the succeeding indexing movement, valve means on said carrier connected to the exhaust port and arranged to introduce a gas filling at approximately atmospheric pressure into the bulb through the exhaust tube at said one station and to introduce more gas at a pressure substantially in excess of atmospheric pressure during the said succeeding indexing movement and simultaneously with the stretching of said exhaust tube, and clamping means at the succeeding station constructed and arranged to mechanically pinch the heated and stretched portion of the exhaust tube to seal it immediately upon indexing of the exhaust port into the said succeeding station. 45

8. Apparatus for tipping-off a vitreous exhaust tube extending from a bulb comprising, in combination, a head having a movable holder for supporting the bulb and having an exhaust port in alignment therewith adapted to grip and make a gas tight seal with the end of the exhaust tube, said holder being mounted for movement relative to and in alignment with said exhaust port, a carrier arranged to support the head and index it to a plurality of stations in turn, means located at one of said stations for heating a portion of the exhaust tube to a plastic state, stationary actuating means located in the path of movement of the head and arranged to move the holder in a direction away from the exhaust port during the course of the succeeding indexing movement to move the bulb and thereby cause the plastic portion of the exhaust tube to be stretched and constricted, valve means on said carrier connected to the exhaust port and arranged to introduce a gas filling at approximately atmospheric pressure into the bulb through the exhaust tube at said one station and to introduce more gas at a pressure substantially in excess of atmospheric pressure during the said succeeding indexing movement and simultaneously with the stretching of said exhaust tube, 75

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and clamping means at the succeeding station constructed and arranged to mechanically pinch the heated and stretched portion of the exhaust tube to close it off immediately upon indexing of the head into the said succeeding station.

9. Apparatus for tipping-off a vitreous exhaust tube extending from a bulb comprising, in combination, a head having a vertically movable holder for supporting the bulb, a vertically arranged post carrying said holder and mounted for vertically upward movement in said head, and an exhaust port located below said holder in alignment therewith and adapted to grip and make a gas tight seal with the end of the exhaust tube, a carrier arranged to support the head and index it to a plurality of stations in turn, means located at one of said stations for heating a portion of the exhaust tube to a plastic state, a stationary cam located along the path of movement of the head during the succeeding indexing movement and arranged to engage the said post to cause it and the holder and the bulb to be moved upward away from the exhaust port to thereby stretch and constrict the plastic portion of the exhaust tube, valve means on said carrier connected to the exhaust port and arranged to introduce a gas filling at approximately atmospheric pressure into the bulb through the exhaust tube at said one station and to introduce more gas at a pressure substantially in excess of atmospheric pressure during the said succeeding indexing movement, and clamping means at the succeeding stations constructed and arranged to mechanically pinch the heated and stretched portion of the exhaust tube to seal it immediately upon indexing of the head into the said succeeding station.

10. A machine of the class described comprising a rotatable turret adapted to be intermit-

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tently indexed, a plurality of exhaust ports spaced around the periphery of said turret and carried thereby through a plurality of stations, each of said exhaust ports being adapted to grip and make air-tight connection with the end of a glass exhaust tube extending downwardly from a bulb, bulb holders above and in register with each exhaust port and adapted to engage a bulb, said bulb holders being supported from said turret for movement upward, valve means carried by said turret and adapted to connect said exhaust ports alternatively with a source of vacuum and sources of gas supply, a heater at a gas-filling station occupied by the exhaust ports for heating a portion of the exhaust tube carried by a port at said station to a temperature of plasticity, the valve means being arranged to connect said exhaust port at said gas-filling station with a source of gas supply to fill the bulb with gas at a pressure approximating atmospheric, pinching jaws at a succeeding pinching station adapted to pinch and close the said heated portion of the said exhaust tube, said valve means being arranged to connect the exhaust port with a source of gas supply to increase the gas filling in the bulb to a pressure above atmospheric during the indexing motion of the turret which carries the exhaust port from the said gas-filling station to the said pinching station, and stationary means in the path of movement of the bulb holders for causing the bulb holder associated with said exhaust port to move upward during the said indexing motion of the turret to carry the bulb upward and thereby stretch and constrict the heated portion of the exhaust tube simultaneously with the increase of the gas pressure in the bulb.

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