

Oct. 2, 1951

J. H. GREEN

2,569,852

MACHINE FOR APPLYING SPECULAR COATINGS

Filed Nov. 27, 1948

6 Sheets-Sheet 1

Fig. 1.

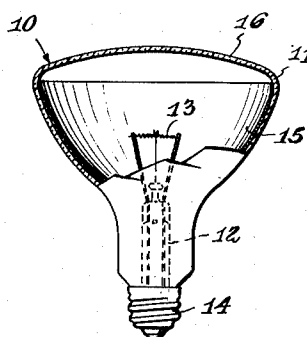


Fig. 6.

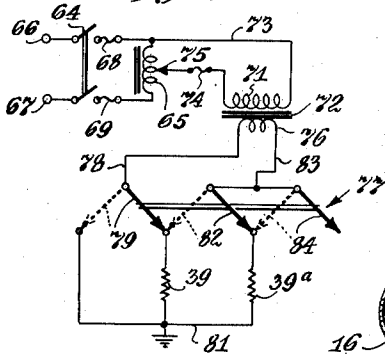


Fig. 2.

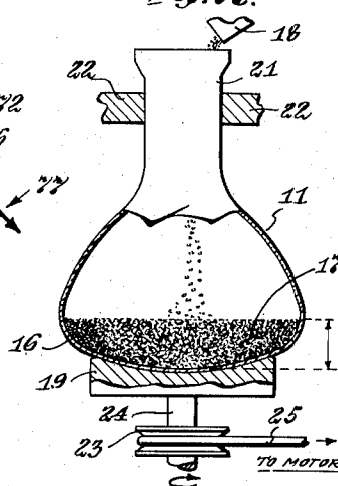


Fig. 3.

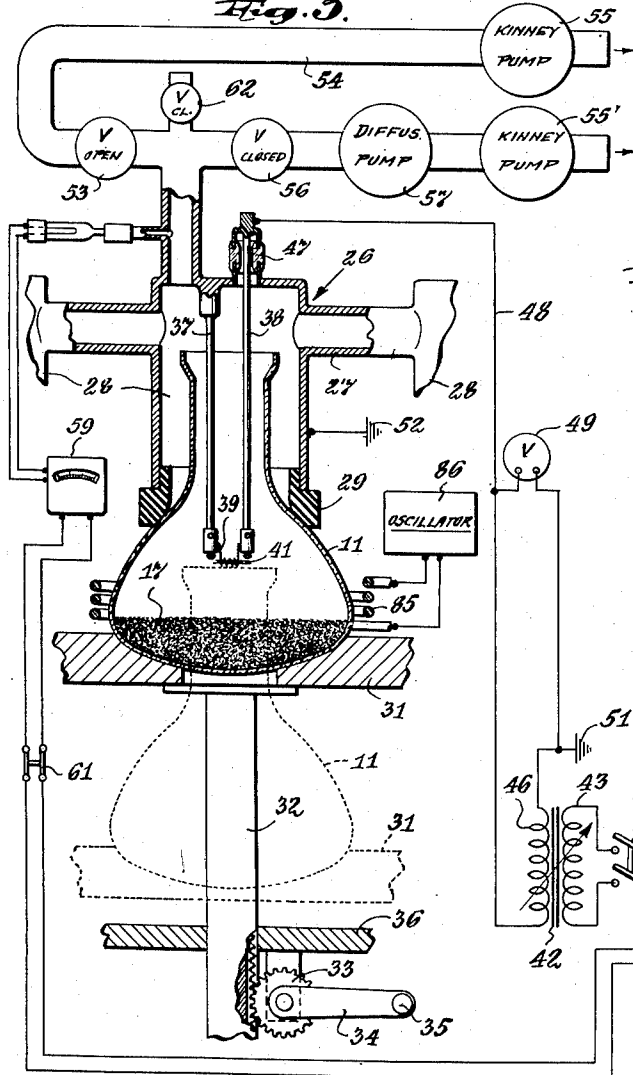


Fig. 4.

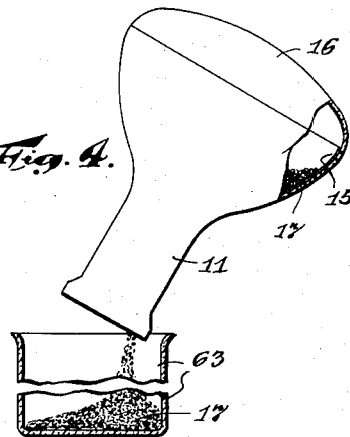
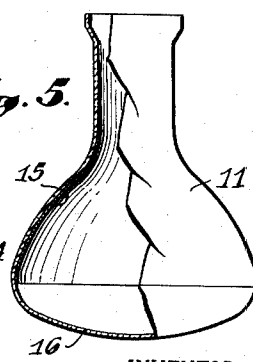


Fig. 5.



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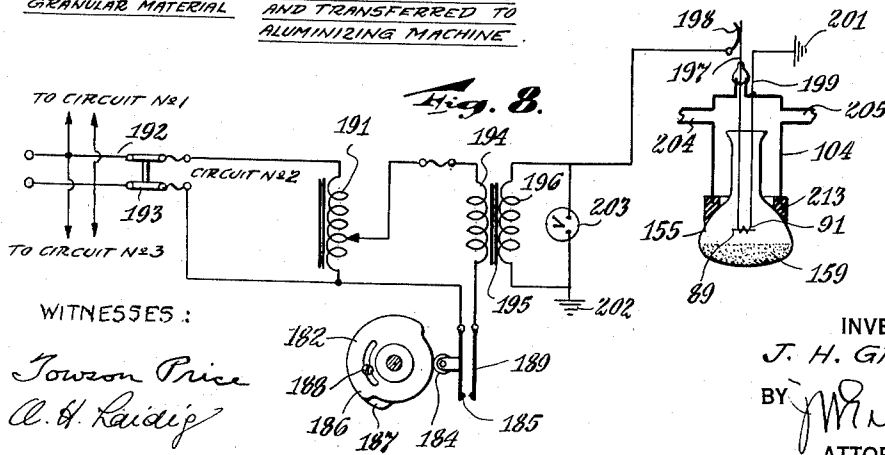
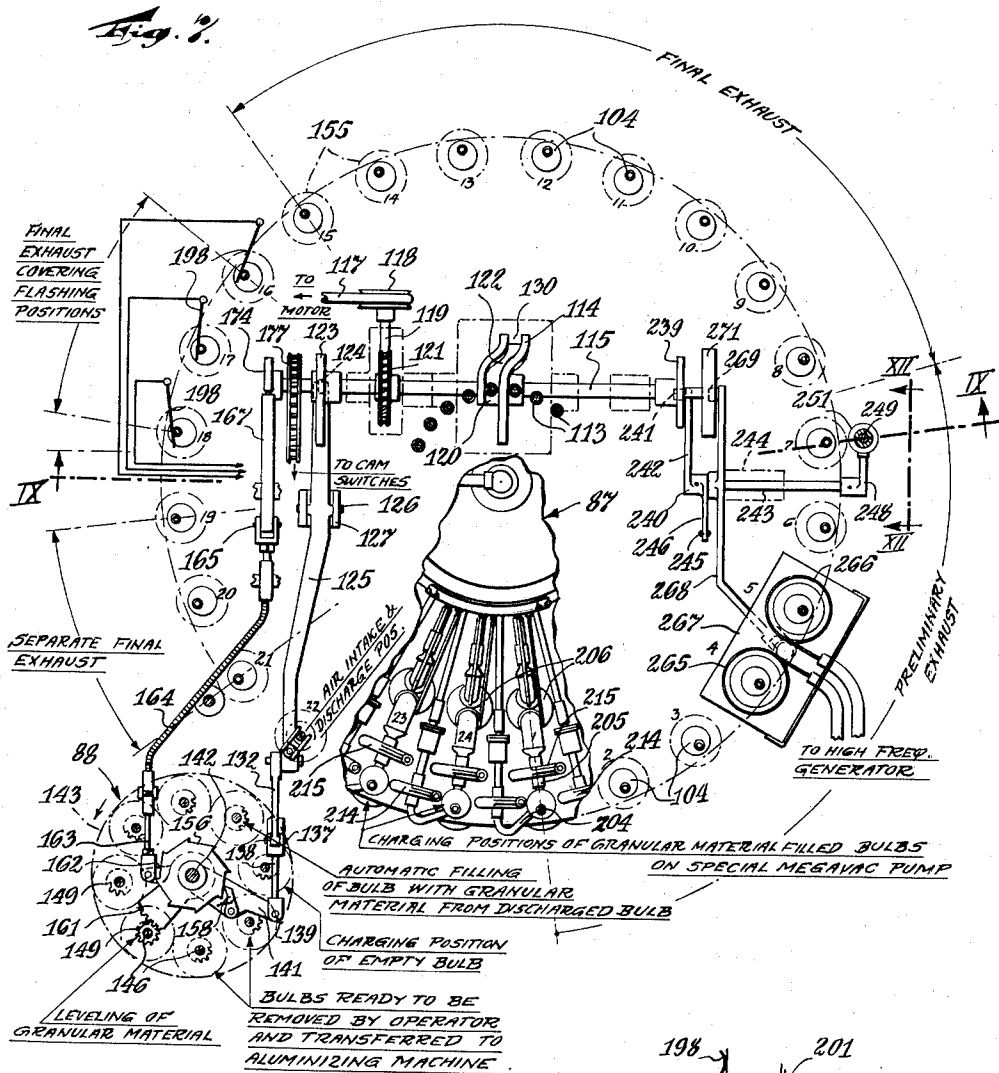
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Fig. 9.

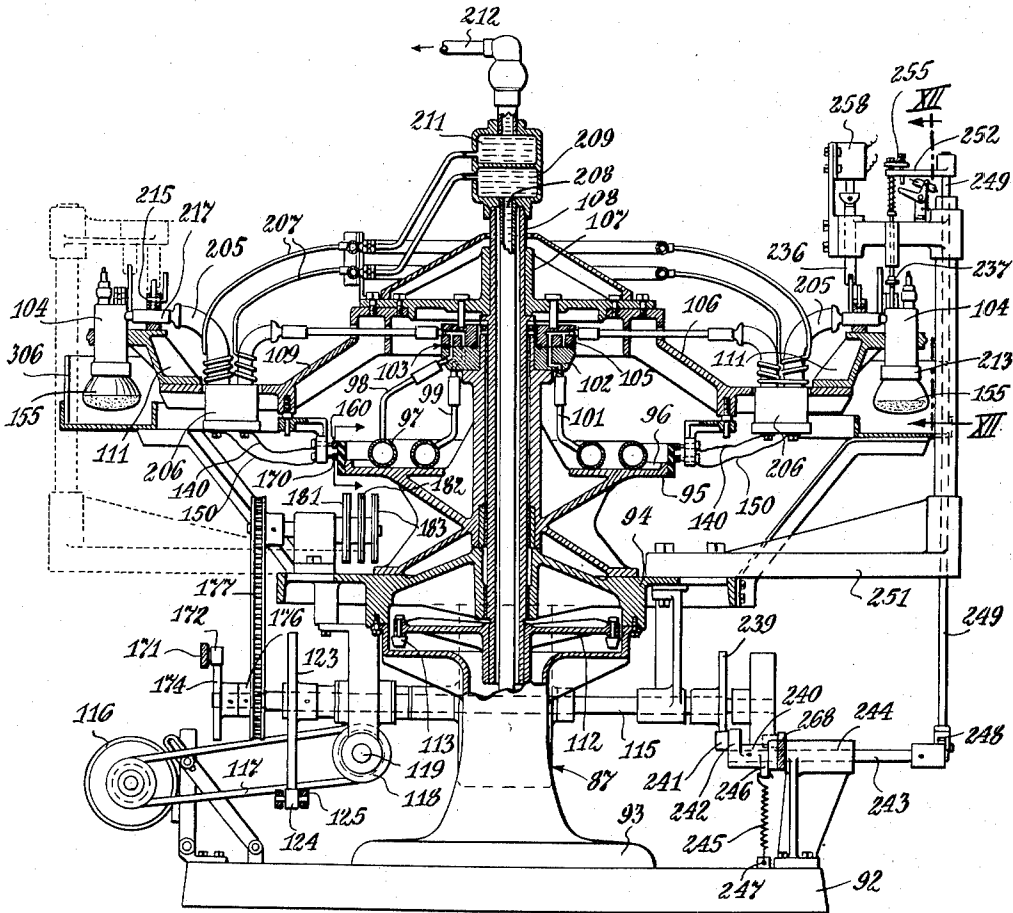


Fig. 11.

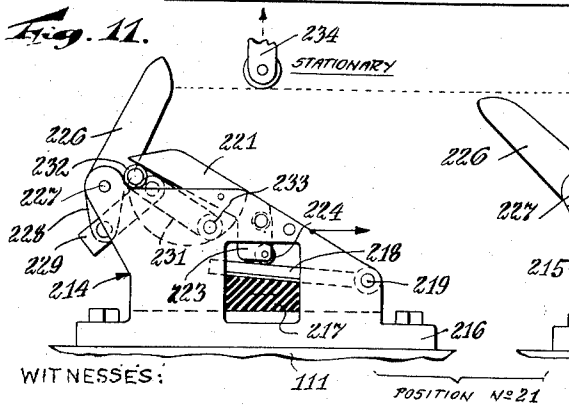
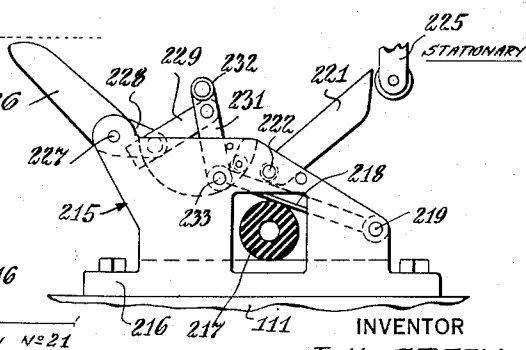


Fig. 10.



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POSITION N° 21

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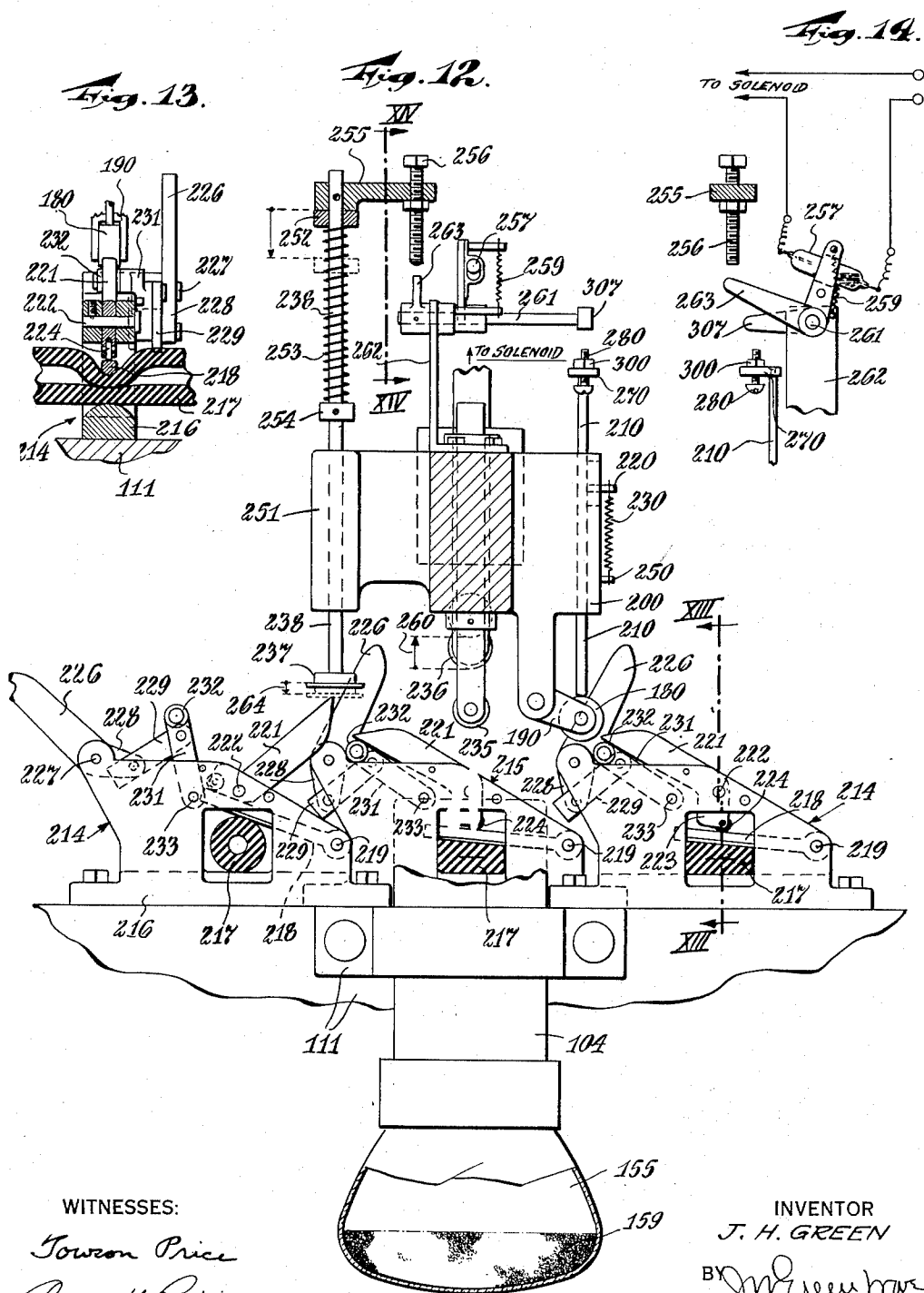
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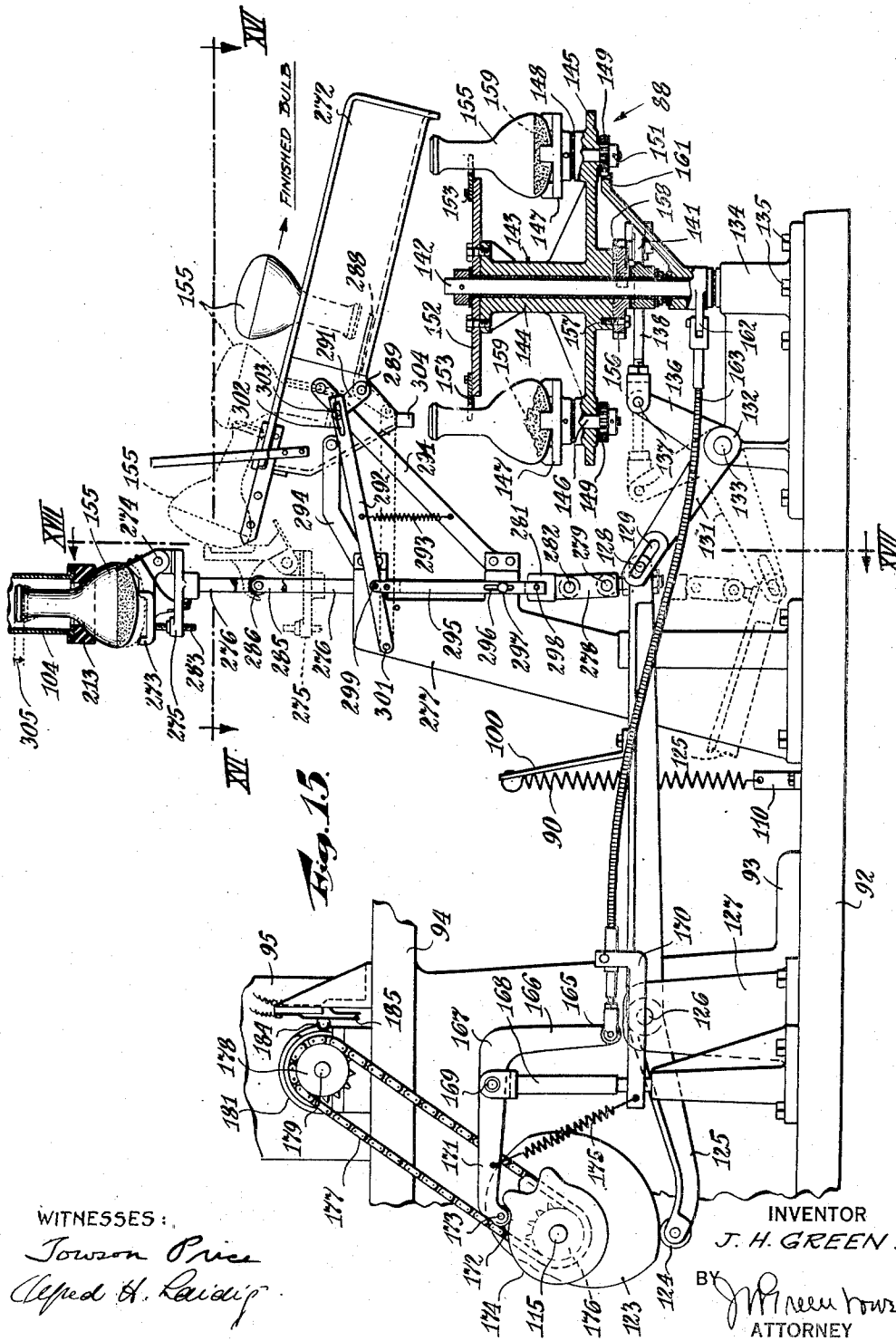
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Fig. 16.

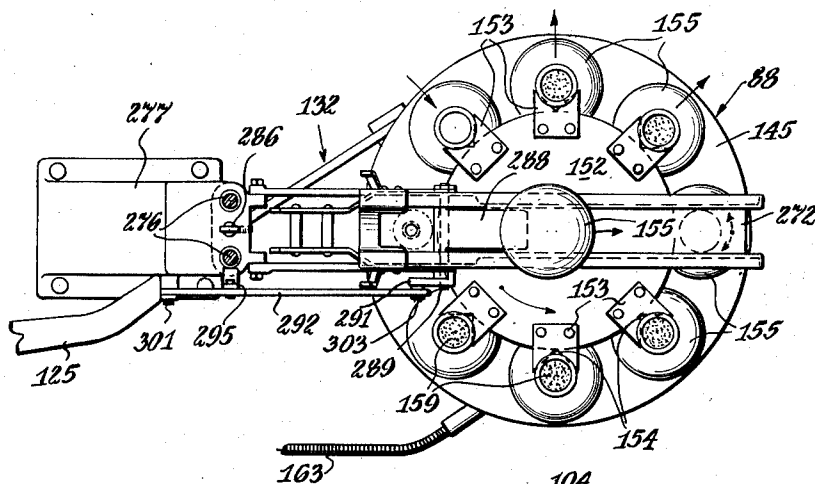


Fig. 17.

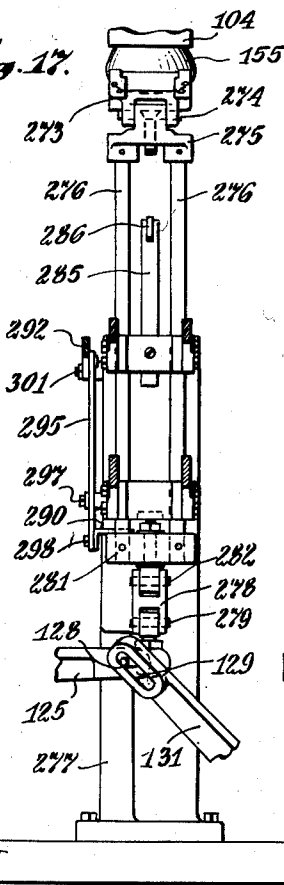
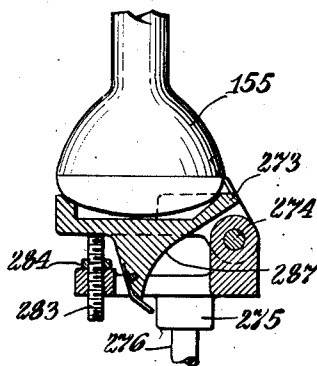


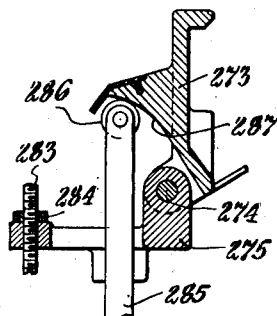
Fig. 18.



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Fig. 19.



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UNITED STATES PATENT OFFICE

2,569,852

MACHINE FOR APPLYING SPECULAR COATINGS

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Application November 27, 1948, Serial No. 62,343

11 Claims. (Cl. 91—12.2)

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This application is a continuation-in-part of my copending application Serial No. 671,545, filed May 22, 1946, now abandoned, and entitled "Method and Apparatus for Applying Specular Coatings."

This invention relates to coating the interior surfaces of transparent vitreous envelopes with specular material, such as aluminum.

The principal object of my invention, generally considered, is to manufacture bulbs for heat, spot, flood, and sun lamps, and other devices in which radiant energy is to be reflected therefrom in a certain direction, by applying a specular coating of a metal, such as aluminum, for example, over a portion only of such bulbs, the remainder being kept clear to allow the radiant energy to freely emerge therefrom.

Another object of my invention is to coat bulbs for radiant energy devices with reflecting material, while portions thereof are covered with a suitable masking material to leave a translucent or transparent window in each bulb to thereby allow for the transmission of radiant energy in a desired direction.

A further object of my invention is to provide a machine for automatically adjusting the masking material in the bulb, evacuating, flashing the specular material on the unmasked portion of the bulb, and unloading the coated bulb from the machine.

Other objects and advantages of the invention will become apparent as the description proceeds. In the drawing:

Figure 1 is an elevational view, partly in axial section, of a lamp of a type manufactured in accordance with my invention.

Figure 2 is a side elevational view, partly in section, of a bulb used to make a lamp of a type similar to that illustrated in Figure 1 during the process of rotation to distribute masking material being fed thereto, as desired, over the end to be kept clear of a reflecting coating.

Figure 3 is an elevational view, partly in vertical section, of apparatus for evacuating a lamp bulb and flashing a reflecting coating thereon.

Figure 4 shows the masking material being poured out of a bulb after it has been removed from the exhaust machine.

Figure 5 is an elevational view, partly in axial section, of a bulb coated in accordance with my invention.

Figure 6 is a schematic representation of a flashing circuit.

Figure 7 is a fragmentary plan of an automatic machine for aluminizing bulbs.

Figure 8 is a wiring diagram showing how the

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specular material may be vaporized onto a bulb, in accordance with my invention.

Figure 9 is a vertical sectional view on the line IX—IX of Figure 7, in the direction of the arrows.

Figure 10 is an elevational view of a double-acting pinch valve for controlling the exhausting of bulbs in accordance with my invention, said valve being shown in open position, and a valve actuator on the machine being shown ready to move said valve to closed position, at position 21 on the machine.

Figure 11 is an elevational view of a similar valve illustrated in closed position, and a valve actuator of the machine being shown associated therewith in a position about to open said valve, also at position 21.

Figure 12 is an elevational view of three of the valves for controlling the exhausting of bulbs, in accordance with my invention, on the lines XII—XII of Figs. 7 and 9, in the direction of the arrows, associated apparatus being illustrated whereby the final exhaust is not applied if the preliminary exhaust valve has been manually or otherwise closed prior to a prospective change over from preliminary to final exhaust.

Figure 13 is a fragmentary sectional view on the line XIII—XIII of Figure 12, in the direction of the arrows.

Figure 14 is a fragmentary elevational view, with a part in section on the line XIV—XIV of Figure 12, in the direction of the arrows.

Figure 15 is an elevational view of a portion of the apparatus, showing how the masking material is applied to the bulbs, how it is distributed, and how the coated bulbs are finally removed from the machine.

Figure 16 is a fragmentary plan, with parts in section on the line XVI—XVI of Figure 15.

Figure 17 is an elevational view, with parts in section on the line XVII—XVII of Figure 15, in the direction of the arrows.

Figure 18 is a fragmentary view of a finished bulb as it is discharged from the machine, and a detailed sectional view of a device for receiving such a bulb, shown supported thereon, said device being shown in bulb-receiving position.

Figure 19 is a detailed sectional view, corresponding to Figure 18 but showing the device after the bulb holder thereof has been tipped to discharge the bulb from the machine.

In the previous manufacture of reflecting bulbs, for devices such as infra-red lamps and sun-lamps, it has been the practice to flash specular material, such as aluminum, on the inner surface of the bulb and then dissolve a portion of said

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coating, so as to form a translucent or transparent window for the radiant energy to be distributed therefrom.

The purpose of my invention is to apply such a coating to the portion of each bulb as desired, leaving the remainder uncovered for the transmission of radiant energy, and thereby avoid the necessity for dissolving a portion of the coating after application.

Form of Figures 1 to 5, inclusive

Referring to the drawing in detail, like parts being designated by like reference characters, and first considering the embodiment of my invention illustrated in Figures 1 to 5, inclusive, there is shown in Figure 1, a lamp 10 comprising an envelope or bulb 11 closed by a press 12 carrying an energy translating filament or other device 13, and having a base 14 which may be screw-threaded. The base-adjacent portion of the bulb is shown covered with a reflecting coating 15 on the inside thereof, which coating may be of aluminum or other specular material, preferably metal, flashed or vaporized thereon in a manner which will now be explained. The portion 16 of the bulb opposite the base is either clear or frosted, as desired.

In practicing the process, I first take an open necked glass bulb or envelope 11, such as shown in Figure 1, or modified, if desired, as shown in Figure 2, and invert it as compared with its position in Figure 1. A measured quantity 17 of masking material, such as Alundum powder, fine glass granules, or other heavy, fine, preferably non-metallic powder, or granular material is then poured therein, as from a receptacle 18 or other bulb. The powder 17, which is desirably, although not necessarily what is called "Barium Crown Glass Beads," preferably .014" in diameter, and between the limits of .014" and .017", as manufactured by Potter Bros. of Long Island, may be distributed in any desired manner, preferably while being poured, by having the bulb 11 on a support 19 and, while the neck 21 is held by means 22 upright but unrestrained against rotation, the support 19 is rotated or oscillated by any desired means, such as a pulley 23 on a shaft 24 therefrom. The pulley is operated, as by a belt 25 from a motor, not shown, so that the powder 17 is evenly distributed on the bottom, as desired, by centrifugal force to a predetermined cutoff line.

Referring now to Figure 3 there is shown evacuating apparatus 26 which may consist of a manifold 27, only a fragmentary portion of which is shown, each portion comprising a head or chamber 28 opening downwardly and carrying means for making an airtight connection with a bulb, such as a soft rubber mouthpiece 29. The mouthpiece is closed by elevating a masking-material-containing bulb 11, from the dotted position to the full-line position, as by means of a platform or support 31 from which rack bar 32 depends. The rack bar is engaged by pinion 33 which may be operated manually by crank 34 and handle 35, and passes through a table or other support 36. Other means of elevating bulb 11 may be substituted if desired, such as air, motor or hydraulic cylinders.

Each chamber 28 also desirably has electrodes 37 and 38, between which may be mounted a container coil 39 of refractory metal wire such as tungsten, molybdenum, or similar material. In said coil is a desired quantity of specular material to be flashed on the bulb 11, such as one or more pieces 41 of aluminum sheet or wire. A de-

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sirable material is crimped aluminum ribbon, preferably that designated by the assignee as #3. As an alternative, the coil 39 may be replaced by a pot or container for the specular material, in turn enclosed in a high frequency induction coil for creating the desired heating effect. The filament may be heated to flash the specular material onto the uncovered inner surface of the bulb, as by means of a variable transformer 42. The primary winding 43 is energized from the source of power 44 through switch 45, and the secondary winding 46 is connected to one of the electrodes, such as 38, by means of conductor 48. Said electrode 38 is electrically separated from the manifold 27 by insulating or glass cylinder 47. A voltmeter 49 is desirably used to show the applied potential. The other side of the line may be grounded at 51, and the electrode 37 electrically connected to the manifold 27, grounded as indicated at 52.

Operation, referring to Figure 3

The manifold 27 and connected bulbs 11 are evacuated, first roughly through valve 53 connected by pipe 54 to vacuum pump, such as one of the Kinney type designated 55. Desirably during the time gas is being removed from bulb 11 by Kinney pump 55, the radio-frequency coil 85 is energized from an oscillator 86 for the purpose of ionizing said gas, thereby bombarding the inner surface of the envelope to get rid of moisture and occluded gases. At a predetermined period in this evacuation when the ionization has been reduced to a minimum, valve 53 is closed and valve 56 opened to finally evacuate the manifold and bulbs 11, as by means of an oil diffusion pump 57, which may be one of the type designated VMF20 and manufactured by Distillation Products, Inc., 570 Lexington Ave., New York city 22, N. Y., and Kinney pump 55'. When a pressure of about 1 micron is reached, as shown by a micron or Pirani gauge 59 connected through a switch 61 to the source of power 44, the switch 45 may be closed, while the transformer is adjusted to cause the coil 39 to first heat and slightly melt the aluminum, or other material 41 held therein, onto the supporting wire 39 in the envelope 11.

The purpose of first slightly melting the aluminum, or other material to be applied to the bulb, is to avoid an explosive flash which might damage the bulb and/or cause the coating material to be deposited non-uniformly thereon. After this coating material has been melted slightly, and before it has had a chance to run off the supporting wire, it is allowed to solidify on said wire. Then the transformer is adjusted to a higher voltage, the switch 45 is again closed, at this time vaporizing the aluminum or other coating material from the wire 39 to which it has adhered. The vaporization is thereby effected quickly but uniformly upon the uncovered surface of the envelope or bulb. It is essential that flashing of the coating material be of long enough duration to remove all of it from the heating coil.

Although only one envelope is illustrated, it will be understood that the evacuation of any convenient number of envelopes may be simultaneously effected and all of said envelopes coated simultaneously, or at about the same time, by flashing aluminum or other material thereon. In coating a series of envelopes, for example six, it is desirable to first apply approximately 1/2 voltage to the filaments in the envelopes, as by con-

necting adjacent pairs in series so that the aluminum, or other coating material, is first melted in the first pair, then in the second pair, and finally in the third pair, while the material in the preceding pair, or pairs, is allowed to cool. The voltage is then increased, as by changing the connections to similarly successively flash the pairs of filaments in the bulbs in parallel instead of series, thereby vaporizing the coating material upon the bulbs of the first pair, then upon the bulbs of the second pair, and finally upon the bulbs of the third pair.

After the coating operation has been effected, the apparatus is allowed to cool and the valve 62 opened to break the vacuum. The envelope 11 and the other envelopes on the manifold 27 are then removed, and the Alundum or other material poured out, as illustrated in Figure 4, into another envelope, or if the masking material is to be tested, as is done at infrequent intervals, into a receptacle 63.

Embodiment of Figure 6

Referring now to the embodiment of my invention illustrated by the wiring diagram of Figure 6, there is shown a switch 64 connecting an adjustable auto-transformer 65 with a source of power which may be 110 volt, 60 cycle A. C., represented by terminals 66 and 67, through fuses 68 and 69 or other circuit-breaking means. The auto-transformer is connected to the primary winding 71 of transformer 72, through line 73 connected to one pole of the auto-transformer 65 and through fused line 74 connected to the adjusting terminal 75 of said auto transformer 65.

The secondary winding 76 of said transformer 72 is connected to change-over switch 77 which is for the purpose of changing the connection to the filaments 39 and 39^a. These filaments are only diagrammatically illustrated, but are supposed to be mounted in bulbs and carry aluminum or other specular material like the filament 39 in Figure 3. The filament 39, although shown as a single filament, may represent two or more filaments in parallel, each filament being mounted in its separate envelope, like the filament 39 in Figure 3, and a similar comment applies to the filament 39^a, although the operation is desirably as shown in Figure 3.

In using the apparatus illustrated in Figure 6, the switch 64 is first closed when the switch 77 is in a position as shown in full lines. The auto-transformer contact 75 is adjusted to give the desired voltage in the secondary winding 76 when the circuit is closed through the filaments 39 and 39^a. These filaments are first energized with the switch 77 in the position shown in full lines, so that the current flows from said secondary winding 76 through line 78, switch element 79, filament 39, line 81, filament 39^a, switch element 82, and back to secondary winding 76 through line 83. This, of course, means that the filaments are first energized at half voltage or in series, so that the aluminum or coating material is merely melted.

If the pair of filaments, 39 and 39^a, represents only one unit of a series, as previously described broadly, then the next pair of filaments may be energized in the same manner through a similar arrangement, while the filaments 39 and 39^a are allowed to cool. Finally, after all of said filaments have been so treated, or if there are no other filaments in the series after a pre-determined short-time interval allowing the coating material to cool, the switch 77 is moved from the

full to the dotted line position, causing an energization of the filaments 39 and 39^a in parallel through line 78, switch element 79 in dotted position, to grounded line portion 81, where the current divides, half of it going through each of the filaments 39 and 39^a, through switch element 82 in dotted position, and switch element 84 in dotted position, whereupon the current reunites and passes back through line 83 to secondary winding 76.

This second energization of the filament at full voltage vaporizes the aluminum or other coating material thereon and effects the desired coating of the enclosing bulbs. This vaporization in the bulbs carrying the filaments 39 and 39^a, if merely a unit of a series may be followed by vaporization of the coating material carried by the filaments in successive pairs of bulbs, as was done in connection with the initial treatment of such filaments.

From the foregoing disclosure it will be seen that I have devised an improved method and apparatus for aluminizing bulbs, and particularly those of the R-40 Sunlamp type. Although only a portion of the manifold is illustrated, it will be understood that it may involve six heads. Two or more of such manifolds may, if desired, be used on a single table or other support. The valves 53 and 56 may be of the hand operated on-off type, and the valve 62 is a simple air-release valve. Under the inverted heads, the platform 31 raises and lowers for loading and unloading the bulbs. Although the drawing shows means for merely heating the coil 39 by the resistance thereof, it will be understood that high-frequency or radio-frequency power may be substituted for mere alternating or direct current, so that the metal used as a coating material may be inductively heated.

By my invention I have accomplished various results, as compared with the prior method of coating the entire bulb and then dissolving a portion thereof of the reflecting surface. One is the improvement in quality in connection with Sunlamp manufacture insuring at least a 50% increase in ultraviolet output. A further improvement is that, when using radio-frequency as the ionizing means, the pumping time per load is reduced from 5 minutes to 3 minutes, or only 60% of the normal pumping time is required. A further gain is an improvement in the hardness and adherence of the specular coating, and the improvement in its appearance by having a saw-toothed edge, the fineness of which depends on the size of the grains of masking material, rather than one which is unwavering. By using Alundum, a fine grain emery, or similar granular substance as the masking agent, four operations which existed in the previous manufacturing procedure have been eliminated, that is (1) the water wash ahead of the dissolving operation, (2) the dissolving of the metal coating on the bulb ends, (3) the after wash to neutralize the dissolving acids used, and (4) a baking operation to dry the bulbs.

Embodiment of Figures 7 to 19

Referring now to the embodiment of my invention illustrated in Figures 7 to 19, inclusive, there is shown a rotary conveyor 87 so constructed that it automatically aluminizes and then discharges finished bulbs. An associated rotary bulb-preparing machine or turret 88 is employed to load and level the masking material in each bulb to be aluminized. The machine 88 is driven from

the same source of power as that which drives the conveyor 87. It distributes the masking material so as to insure that the deposit of the aluminum is cut off or stopped at a desired plane. From this machine 88, the bulbs are transferred manually by the first operator, one at a time to the conveyor 87 which carries out the entire aluminizing operation, and finally at a point of near tangency between the circle of movement of bulbs on the conveyor and the circle of movement of bulbs on the turret, empties the masking material into another bulb, which is then prepared for in a similar manner for aluminizing. The only other manual operations are those of placing the aluminum, or other specular material 89, in the flashing filament 91, which is desirably a coil of tungsten, prior to placing the loaded bulb on the machine, and packing the aluminized bulbs, as they are discharged from the machine and inspected, in a suitable receptacle. Before describing the operation of the machine in detail, I will first describe the various parts thereof and the manner in which they operate.

The conveyor

The conveyor 87 comprises a base 92 on which is mounted a pedestal 93. Secured to said pedestal 93 is a generally circular platform member 94 serving as a support for various parts of the machine which will subsequently be described. On this platform member rests a generally annular supporting device 95, providing an annular tray 96, in which rest the manifolds 97, from which exhaust lines or pipes 98, 99, and 101 extend to the lower member 102 of valve 103 for connecting the various exhaust lines to the various heads 104 of the machine in sequence. On this lower valve member 102 rests the upper member 105 of the valve 103, which moves with the rotary portion or spider 106 of the conveyor 87. The spider 106 comprises a central portion 107, secured to an upright hollow drive shaft 108, and a main or body portion 109 to which a plurality of brackets 111, in this instance twenty-four, are secured. Each bracket carries a device or head 104 for air-tight evacuating connection to, and deposition of coating material on, a bulb being processed.

The shaft 108 carries at its lower end a gear 112 formed by a series of pivotally-mounted frustoconical rollers 113, successively engaged by the drive wheel 114 on shaft 115, which is driven from motor 116, through belt 117 over pulley 118 mounted on shaft 119 which carries worm (not shown) meshing with worm wheel 121 secured on shaft 115. The drive wheel 114 is so formed that, as it turns, the gear 112 is kept stationary for the greater part of its revolution, but moves a step, that is, from one indexed position to the next, as an engaged roller 113 passes along the axially-curved trough portion 122 which joins the axially-offset trough portions 120 and 130, as shown in Figure 7, whereby each head 104 of the machine is indexed in one position for a certain length of time and then promptly moved to its next indexed position.

Bulb-preparing turret

The bulb-preparing machine or turret 88 is driven step by step, so that it indexes like the conveyor 87, by means of a cam 123 on the shaft 115, which cam engages a roller 124 on a lever 125 secured by a pivot at 126 to a bracket 127 upstanding from the base 92 of the machine. The roller 124 is kept in engagement with the cam 123 by a coil

spring 90 acting between a bracket 100 on the other end of said lever and a bracket 110 on the base 92. Said other end of the lever 125 carries a pin 128 received in a slot 129 of the arm 131 of a bell-crank lever 132, connected by pivot pin 133 to base member 134 of bulb-preparing machine 88, which is in turn secured to base 92 as by bolts 135. The other arm 136 of bell crank lever 132 is connected through a pivot pin 137, rod 138, and pin 139, to lever 141, pivoted about the main upright shaft 142 of bulb-preparing machine 88.

The shaft 142 carries a spider 143, comprising a column portion 144 through which the shaft 142 extends, and about which the spider rotates, and an annular platform portion carrying adjacent its periphery a series of rotatable shafts 146, on the top of each of which is mounted a bulb supporting member 147. Between the bulb-supporting members and the platform portion 145 are anti-friction means 148, such as rollers or ball bearings. The lower end of each shaft 146 carries a pinion 149 secured thereto, as by means of a pin 151. Mounted on the upper end of the column 144, is a disc 152 carrying a series of plates 153, each of which is notched as indicated at 154, so that when a bulb 155 rests on a bulb-supporting member 147, its neck may be disposed in the notch of the member 153 immediately thereabove, to insure that it is in a desired vertical position.

Step-by-step indexing motion of the spider 143 is effected by a ratchet 156 secured to the bottom thereof, as by means of bolts 157, and engaged by a pawl 158 carried by the lever 141, whereby movement of the lever back and forth effects indexing of the spider from one position to the next, in this instance, through $\frac{1}{8}$ of a revolution, as the spider is formed to support eight bulbs. As will be understood, the ratchet 156 has the same number of teeth as the spider has bulb-supporting portions.

In order to effect a twirling movement of each bulb, after being loaded with masking material 159, sufficiently fast so that said masking material is distributed to a uniform cut-off plane, the pinions 149 are sequentially engaged by a gear segment 161, pivoted about the shaft 142, and oscillated. This is effected by having an arm 162 on the segment 161, connected by a flexible cable 163, passing through a guide to a pivot pin 165 in arm 166 of bell crank lever 167 pivoted to standard 168 extending from the base 92, by connecting pin 169. The other arm 171 of said lever 167 carries a roller 172 pivoted at 173 and held in engagement with a cam 174 by means of coil spring 175 acting between the arm 171 and bracket 170 on standard 168. By virtue of the shape of the cam 174, as each pinion 149 comes into engagement with the gear segment 161 as the spider 143 is indexed, the corresponding bulb support 147 is rotated back and forth twice about the axis of the bulb neck, thereby distributing the measured quantity of masking material 159 to a uniform cut-off level, as illustrated.

Flash-timing mechanism

The shaft 115 also carries a gear 176, over which passes a chain 177 meshing with a corresponding gear 178 on a shaft 179 carrying a series of timing cams 181, 182, and 183, respectively engaged by rollers 184 of timing switch elements 185. These cams 181, 182, and 183, only the second one of which is shown in detail in Figure 8, are adjustable as there indicated by each being formed of two relatively-rotatable

cam segments 186 and 187, held in adjustable relationship by bolt 188, so that the proportion of each revolution that the actuated switch member 185 is held against the cooperating switch member 189, may be regulated so that the filament 91 is energized for a desired length of time for flashing the enclosed specular material 89 therefrom.

A typical flashing circuit, representing circuit #2 at position 17, is illustrated in Figure 8, comprising an adjustable auto-transformer 191 energized from a power circuit 192, through switch 193, and in turn energizing the primary winding 194 of transformer 195, the secondary winding 196 of said transformer being connected to one of the leads 197 of a head 104, as said head is indexed at one of the positions 16, 17, or 18 as shown in Figure 7, as by means of a flexible slip-contact member 198, the other lead 199 being grounded as indicated at 201. The other terminal of the secondary winding is grounded as indicated at 202, and a voltmeter 203 is disposed across the secondary-winding terminals so as to indicate the voltage adjustment.

Although I have shown three flashing positions, it is ordinarily unnecessary to use more than two, the third position being a standby and disconnected. The auto-transformer 191 is so adjusted that voltage at the first flashing position, numbered 16, is just sufficient to soften or barely melt the aluminum 89, whereby it closely rests in consolidated condition on the flashing coil 91, ready to be vaporized at the next position, or that designated 17. It has been found in practice that about 4 or 5 volts may be applied to effect this softening or melting of the aluminum, while about 10 to 10.5 volts is needed for the flashing operation at position 17.

Evacuating system

The evacuating means, desirably a plurality of pumps such as those of the Kinney type, are connected to the exhaust manifolds 97 in any desired manner, and from there the vacuum system is lead to the outer exhaust pipes 204 and the inner exhaust pipes 205, both of which connect with the exhausting heads 104. In the present machine, there are in general two types of vacuum pipes, that is, those which form the preliminary evacuating system, and those which form the final evacuating system. The preliminary evacuating means is connected to the inner of the exhaust manifolds 97, and from there controlled by the inner passages of the valve members 102 and 105, through the outer exhaust pipes 204, which connect with the outer portions of the heads 104.

The final evacuating means is connected to the outer of the exhaust manifolds and from there controlled by the outer passages in the valve members 102 and 105, through the inner exhaust pipes 205, in series with supplemental evacuating means, which in the present embodiment comprises oil diffusion pumps 206 which may be of the type VMF 20 previously referred to. These pumps as illustrated, receive electric power through conductors 140 and 150, connecting through flexible contacts with slip rings 160 and 170, mounted on an insulating portion of the tray 96 and connected to a suitable source. A cooling system through which water circulates is provided for each pump 206 from supply pipe 208 to manifold 209, from whence it passes through pipe 207 to manifold 211, from whence it passes out through pipe 212.

A consideration of Figure 7 will show that the

loaded bulbs 155, as received from the bulb-preparing machine 88, are fed to the conveyor 87 at a position such as that designated 23 or that designated 24, where the exhausting begins. A desirable way to start the preliminary exhaust is by means of a so-called "megavac" pump or house rough vacuum system, with plug constrictions in the connecting pipes so as to avoid initially destroying the vacuum in the system to too great an extent. A Kinney pump or pumps may, however, serve for preliminary evacuating, and such pump or pumps may be employed to, through the inner passages in the valve members 102 and 105, draw the air from the heads 104 to which the bulbs 155 are connected as shown in detail in Figure 8. A soft rubber facing 213 is used at each head to seal its engagement with the associated bulb.

This preliminary exhaust connection continues through position 7, as shown in Figure 7, whereupon at position 8 each bulb is successively switched on to final exhaust through the outer passages of the valve 103, making use of the diffusion pumps 206 and the inner exhaust pipes 205.

Pinch valves

The pipes 204 and 205 are respectively controlled by port closers in the form of pinch valves 214 and 215, making two valves per head 104, as shown in detail in Figures 10, 11, and 12. These valves may be identical, but the valves 214 for controlling the preliminary exhaust, shown in detail in Figure 11 and at the extreme right and left of Figure 12, are positioned on a circle of greater radius than the valves 215 for controlling the final exhaust, shown in detail in Figure 10 and as the middle valve of Figure 12, so that they are operated by different stops or roller cams on the machine. A consideration of these figures will show that each valve comprises a body casting 216, through which a flexible rubber vacuum hose 217 passes. The closing of the hose 217 is effected by a valve plate 218 pivoted at 219, and controlled by a closing lever 221, pivoted at 222, and having a short angular extension 223 carrying a roller 224 which engages the top surface of the plate 218. As the lever 221 is moved from the position shown in Figure 10 to that shown in Figure 11, as by a cam or stop 225 at position 21 on the machine, the plate 218 is moved down to compress the rubber hose 217, thereby closing the aperture therethrough and holding it in a compressed position.

The opening lever 226 of each valve is pivoted to the body casting 216 as at 227, and has a short extension 228 pivoted to a connecting rod 229, the other end of which is in turn pivoted to an intermediate portion of a prying member 231 carrying a roller 232, and connected with the body casting 216 by a pivot member 233. When the opening lever 226 is moved to the left, that is, from the position of Figure 11 to that of Figure 10, as by engagement of a stationary member or roller cam 234 therewith at position 21 during rotation of the conveyor 87, the prying member 231 is rotated clockwise, and its roller 232 pushes upon the closing lever 221 until the latter is snapped open by the resiliency of the rubber hose 217 acting upward on the plate 218.

From the foregoing disclosure, it will be seen that, as shown particularly in Figure 12, the change over from the preliminary exhaust to final exhaust between positions 7 and 8, is effected by a stationary stop or roller cam 235 closing an outer valve 214, and a stationary stop

or roller cam 236, almost simultaneously but immediately thereafter opening the corresponding inner valve 215.

In order to take care of a situation where a head may not have a connected bulb 155, or where a connected bulb may have become broken due to the evacuating operation or for any reason, or where the operator for this or any other reason may have manually closed a valve 214, or provision is made for automatically closing such a valve upon the development of a leak, thereby preventing the pumping of a bulb, if in the corresponding head, or because a preliminary valve 214 was closed in order to prevent waste of power due to the absence or breakage of a bulb in said head, I provide means for automatically insuring that the final vacuum connection is not made. These means involve a "feeler" member 237 on reciprocating rod 238, moved by a cam 239 on shaft 115 (Figs. 7, 9 and 12). The cam 239 engages a roller 241 on an arm 242 of a crank 240 carried by a shaft 243, rotatable in a bracket 244 mounted on the base 92. The roller 241 is held in engagement with said cam 239 by a coil spring 245 acting between an arm 246 of said crank and a bracket 247 on the base 92.

This cam 239 thus causes the shaft 243 to oscillate and, through a crank 248 thereon, move a connected rod 249 with its arm 252 up and down in a bracket 251 carried by the platform member 94. The arm 252 slides on rod 238 against the action of light coil spring 253 thereon held between said arm 252 and a stop collar 254 on said rod. The coil spring 253 tends to push the collar 254 and connected rod 238 down, so that the arm 255 mounted adjacent the top of the rod 238, and carrying an adjustable set screw 256, is caused to engage the top of the arm 252 as shown in Figure 12.

A mercury switch 257 in circuit with a solenoid 258, controlling the roller cam 236, and biased slightly toward open position by a light coil spring 259, is connected by a pivot 261 to a bracket 262 supported by the bracket 251, and provided with an arm 263 underlying the set screw 256. If on reciprocation of the rod 237 the "feeler" 238 "finds" the closing lever 221 closed, rather than in the normal open position represented in Figure 12, it will move down a relatively great distance, rather than the small distance indicated by the arrow 264, and cause the set screw 256 to engage the arm 263, and effect closure of the mercury switch 257, energization of the solenoid 258, and consequent raising thereby of the roller cam 236, through the distance represented by the arrow 260. This prevents engagement of said cam 236 with the opening lever 226 of the corresponding valve 215 to the final vacuum system.

Thus, if one of the valves 214 has been closed for any reason prior to reaching position 7, the "feeler" 237 will move downwardly a greater distance than that represented by the arrow 264, or one sufficient to effect closure of the mercury switch 257, thereby raising the cam 236 to its upper position in order to avoid opening the corresponding valve 215. This means that the mercury switch 257 has been moved counterclockwise, as represented in Figure 14, to closed position. Because the spring 259 is very light, the switch would tend to stay in that position, thereby preventing desired opening of subsequent valves 215 and initiation of the final exhaust, even though the next valve 214 is in open or normal position.

In order to avoid such an undesirable situation, I provide a roller cam 180 disposed a slight distance counterclockwise beyond, but on the same circumference as the cam 235. This cam 180 is pivoted to a lever 190, in turn pivoted to a bracket 200 and adapted to roll over the upper face of each lever 221, in the closed position represented in Figure 12. Engaging the top of this cam is a rod 210 reciprocating in the bracket 200 and carrying an arm 270 near its upper end. The rod 210 also carries an outstanding post 226 connected by a coil spring 230 to a corresponding post 250 on the bracket, whereby said rod is urged downwardly into engagement with the roller 180.

The arm 270 carries a set screw 280 locked in adjusted position by a nut 300. The mercury switch device 257 carries an arm 307 normally overlying the set screw 280, as shown diagrammatically in Figure 14, so that if the mercury switch 257 is closed as the roller 180 is engaged by the lever 221, the rod 210 as it is pushed upwardly causes the set screw 280 to engage the arm 307 and, assisted by the coil spring 259, trips the mercury switch back to normally-open position as in Figure 14.

The high frequency control

At positions 4 and 5, or at such positions where the pumps have reduced the pressure in the bulbs being evacuated to between 25 and 75 microns of mercury, I may provide high-frequency coils 265 and 266 carried in an enclosure 267 which is moved up to surround the bulbs 155 to be aluminized as they are indexed, and moved down out of the way to clear the bulbs while they are being moved from one position to the next. The moving means for this control comprises a lever 268 pivoted about the shaft 243 and its outer end moving the high frequency coils up and down, while its inner end carries a roller 269 engaging a cam 271 mounted on shaft 115, whereby the movement of the lever is synchronized with the indexing of the heads 104. The coil-moving means desirably includes a switch for energizing the coils 265 and 266 only when they surround indexed bulbs. The frequency of the energizing power is desirably between 175 kilocycles and 30 megacycles.

Unloading of bulbs

Figures 15 to 19, inclusive, show details of the apparatus which acts to receive each bulb 155, as the vacuum thereto is broken after the aluminizing is complete, and discharge it into a chute 272, from which it is removed by the operator preparatory to being used, as for making a lamp. This apparatus involves a bulb holder 273, connected by a pivot pin 274 to a terminal casting 275, carried by a pair of rods 276 which reciprocate in bracket 277 mounted on base 92. Reciprocation is effected by a connection with the end of the lever 125, through link 278 and connecting pivot 279, to a crosshead 281 to which the lower ends of the rods 276 are secured, by means of pivot pin 282.

In order to adjust the normal position of the bulb holder 273, a set screw 283 is provided extending from the casting 275 to the bottom face of the holder 273, and locked in adjusted position by nut 284. Tilting of the bulb holder 273, to the unloading dotted-line position represented in Figure 15, is effected by a post 285 carried by the bracket 277 and upstanding between the reciprocating rods 276, so that as said rods descend

carrying the holder 273 therewith, the roller 286 mounted on the top of the rod 285 engages the cam surface 287 on the bulb holder 273, and tilts the latter to upset and discharge the bulb 155 carried thereon into the chute 272.

A gate 288 in said chute is provided to automatically stop each bulb 155 as it is received, and release it prior to reception of the next bulb. This gate is pivoted to the chute 272 as indicated at 289, and has an arm 291 extending in a diagonal generally-opposite direction therefrom and actuated, as the rods 276 move up and down, by connected lever 292 urged downwardly by coil spring 293 acting thereon from an intermediate portion of one of the supporting rods 294 extending from the bracket 277 to the chute 272. Movement is transmitted to the lever 292 to periodically close the gate 288 by connecting rod 295 provided with a slot 296 receiving a pin 297 outstanding from the bracket 277, and with an angle clip 298 secured to its lower end, as by a rivet 299, and actuated by engagement of the crosshead 281 therewith during part of the movement of the latter. The upper end of the connecting rod 295 is connected by pivot pin 299 to an intermediate portion of the lever 292. The lever has one end connected to the bracket 277 by a pivot pin 301, and its other end provided with a slot 302 receiving a pin 303 outstanding from the arm 291 of the gate 288. It will thus be seen that during the upper portion of the up and down movement of the rods 276, the gate is synchronously opened and closed.

The chute 272 is disposed over the bulb-preparing machine or turret 88 and provided in its bottom with a funnel 304 so that as each bulb is overturned and placed in the chute, the masking material therein is discharged therefrom into a bulb in said turret, thereby reusing the masking material.

Operation, referring to Figures 7 to 19

The bulbs 155 prior to placing on the aluminizing machine are thoroughly cleansed, as by washing first in a 5% hydrofluoric acid solution, then in cold water, and then given a rinse with hot "deionized" or neutral water. After this they are passed through a heated tunnel in order to thoroughly dry them, which tunnel may be heated by infra red lamps, or indirect gas heat, applied to the top and sides of the bulb.

In the present embodiment, the conveyor machine 87 has 24 heads and thus the same number of indexing positions, numbered 1 to 24. It is desirably set for index every 8 seconds. Because of the connection of the bulb-preparing machine or turret 88 thereto, a bulb on this turret is also moved from one position to the next every 8 seconds. The coating operation should be started with a supply of washed and dried bulbs, each containing a measured quantity of the masking material. At least 24 bulbs so provided and a number of extras should be on hand before starting. The bulb-preparing turret 88 should be loaded with a bulb in each position, and after each bulb is twirled to properly distribute the masking material, it is by hand moved to the coating machine 87. We will now follow the operation of a bulb from when it is first loaded on the machine to its discharge therefrom.

Two operators are employed, number 1 to insert the specular material, such as aluminum foil 89, in the refractory metal heating coil 91 and the prepared bulb in the head, and number 2 to prepare the bulbs for the turret 88 and receive the aluminized bulbs. After placing the foil 89 and

removing a bulb from the preparing turret 88, after the masking material has been properly distributed therein, it is placed in a head 104, at position 23 or 24 of the machine, the assembly of such a bulb in a head being shown diagrammatically in Figure 8. The suction at the loading position holds the bulb 155 in place. The anti-leakage soft rubber mouthpiece or connector 213 serves to insure against leakage between the bulb and head, and the vacuum connection is made by having the corresponding preliminary pinch valve 214 open. The bulb travels step by step to position 4, while being preliminarily exhausted.

At position 4, if the radio- or high-frequency treatment is being employed, it is surrounded by the high-frequency coil 265 energized so as to ionize the gas therein and facilitate evacuation. This high-frequency treatment also has other desirable effects, as described in connection with the first embodiment. The treatment may be repeated at position 5. After the bulb arrives at position 7, a change over from the preliminary evacuation to a final evacuation at position 8 is effected. That is, the corresponding outer valve 214 is closed, while the corresponding inner valve 215 is opened, by the roller cams 235 and 236, respectively. Because of the machine operating counter-clockwise, and the inner valve for each head being thus somewhat in advance of the outer valve for said head, and inasmuch as the cams 235 and 236 are on the same radius at position 7, the opening lever 226 of the valve 215 is engaged before the closing lever 221 of the valve 214. As shown in Figure 12, said levers are, when the valve 215 is closed and the valve 214 open, on approximately the same radius, so that because of the difference in the throw of the lever 221 as compared with that of the lever 226, there is a connection to the final vacuum system effected almost simultaneously with, but a very small interval of time after, a closing of the preliminary evacuating line.

The bulb then passes through positions 8 to 15, inclusive, and finally reaches position 16, where the enclosed filament 91 is given a moderate electrical energization so that the aluminum foil, or other specular material 89 therein, is barely melted without appreciable vaporization or other losses therefrom. At the next position 17, a higher electrical energization is given to the coil 91, or one to vaporize the aluminum or other specular material therefrom, thereby completing the coating operation. Position 18 is a standby flashing position which is ordinarily used for cooling. Positions 19, 20, and 21 are also employed for cooling. Between position 21 and position 22, the final vacuum valve 215 is closed by the cam 225 and the preliminary vacuum valve 214 opened by the cam 234, as represented in Figures 10 and 11, to by virtue of the construction of the valve 103 at this point, break the vacuum; allowing air to come into the bulb through the pipe 204.

The breaking of the vacuum in the bulb allows it to drop the distance represented by the arrow 305 in Figure 15, onto the bulb holder 273, which shortly thereafter descends to the dotted position illustrated in Figure 15. This action overturns the bulb 155 onto the chute 272, where it is momentarily stopped by the gate 288, while the masking material therein is discharged through funnel 304 into a bulb 155 immediately therebelow, to thereby fill it with the desired quantity of masking material. By virtue of this operation, it is unnecessary to have a great quantity of bulbs filled with masking material, or

any great amount of masking material for the purpose. It is, however, desirable to periodically clean the masking material by sieving to remove contaminations due to the operation of the machine. Prior to the next bulb reaching the unloading position, the gate 288 is lowered allowing the bulb under consideration to slide down the chute 272 to be received by an operator.

In order to insure the desired results, the machine should be kept reasonably clean of masking material, dirt, and oil, at all times. The guards 306 which are desirably employed around the path of the bulb to protect the operators, and which may be formed of cellulose acetate or other similar transparent material, are desirably removed periodically and cleaned. The bearing surfaces and cams should also be kept reasonably clean and lubricated. The pumps, of course, should be kept in good condition and the degree of vacuum during operation may be indicated by a Pirani gage (not shown). The rubber mouthpieces 213 of the heads 104 may be cleaned by means of a clean lintless cloth soaked in acetone, and then wiped dry with a clean lintless cloth.

Although preferred embodiments of my invention have been disclosed, it will be understood that modifications may be made within the spirit and scope of the appended claims.

I claim:

1. Apparatus for coating predetermined portions of the inner surfaces of open-necked glass bulbs, comprising means for holding said bulbs with their open necks upward and containing granular masking material in the bottoms thereof, means comprising anti-leakage mouthpieces connectable with bulbs through their open necks and supported refractory means which then depend through said necks for holding and heating said coating material, for connecting said open necks to exhausting means for producing a vacuum in said bulbs, and at the same time positioning said holding and heating means in said bulb while surrounding material with which the bulbs are to be coated, means for energizing said refractory means to flash the material on said bulbs, and means for then breaking the vacuum to allow for removal of said bulbs from the machine.

2. Apparatus for coating predetermined portions of the inner surfaces of open-necked glass bulbs, comprising means for holding said bulbs, means comprising a chamber opening downwardly and terminating in a soft rubber mouthpiece and electrodes depending in said chamber through said mouthpiece and supporting means for holding and heating said coating material, for connecting said open necks to exhausting means for producing a vacuum in said bulbs, and at the same time positioning said holding and heating means in said bulbs and surrounding material with which the bulbs are to be coated, means for energizing said electrodes to flash the material on said bulbs, and means for then breaking the vacuum to allow for removal of said bulbs from the machine.

3. Apparatus for coating with specular material predetermined portions of the inner surface of open-necked glass bulbs, comprising a chamber opening downwardly and terminating in a soft rubber mouthpiece, electrodes depending in said chamber through said mouthpiece and supporting means for holding and heating said coating material, a vertically movable support for a bulb, means for operating said support to cause

it to raise or lower a bulb from said chamber, so that its neck enters said chamber and the electrodes enter said neck when raised, whereby the soft rubber mouthpiece engages said bulb below said neck to effect a vacuum-tight seal, means for exhausting said chamber in order to remove the air from said bulb, means for energizing said heating means to flash the coating material onto said supported bulb, and means for breaking the vacuum to said chamber to release the bulb.

4. Apparatus for coating predetermined portions only of the inner surfaces of open-necked bulbs, comprising a rotary conveyor, means for rotating said conveyor step by step and indexing it between each step of its rotation, a plurality of exhaust heads on said conveyor, each comprising a chamber opening downwardly, terminating in an anti-leakage mouthpiece engageable with a bulb around its neck, and formed with leads to support a coil for holding bulb-coating material, a vacuum valve associated with said conveyor, vacuum lines from said valve to said heads, one line to each head being for preliminary exhaust and the other for final exhaust, means in the final exhaust line between said valve and each head for improving the vacuum effected, means at one position on said conveyor for automatically switching over from the preliminary to the final vacuum system, means at another position for subjecting a coil in a head to energization to barely melt bulb-coating material enclosed therein, means at the next succeeding position to flash said coating material from said coil onto the bulb, and a bulb holder at a succeeding position for after cooling and breaking the vacuum, receiving said bulb, a discharge chute.

5. Apparatus for coating predetermined portions of the inner surfaces of open-necked glass bulbs, comprising a turret on which a plurality of said bulbs holding granular masking material may be disposed with their open necks upward, a rotatable support on said turret underlying each bulb, means for indexing said turret to move each bulb from one position to another, means in one position for twirling the underlying support so as to distribute said masking material in said bulb to a predetermined level, a rotary conveyor portion of a coating machine adjacent said turret, means for rotating said conveyor portion step by step and indexing it between each step of its rotation, a plurality of exhaust heads on said conveyor, each comprising a chamber opening downwardly, terminating in an anti-leakage mouthpiece engageable with a bulb around its neck, and formed with leads to support a coil for holding bulb-coating material, a vacuum valve associated with said conveyor, vacuum lines from said valve to said heads, one line to each head being for preliminary exhaust and the other for final exhaust, means in the final exhaust line between said valve and each head for improving the vacuum effected, means adjacent said conveyor for at a given indexed position, subjecting each bulb in its head to high-frequency treatment, means at another position for automatically switching over from the preliminary to the final vacuum system, means at still another position for subjecting a coil in a head to energization to barely melt bulb-coating material enclosed therein, means at the next succeeding position to flash said coating material from said coil onto the portion of the bulb not covered by said masking material, means at a succeeding position for, after cooling, breaking the vacuum

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to said bulb, allowing it to drop onto a holder, lowering said holder, and tipping said bulb onto a discharge chute, where it first pours the contained masking material into an empty bulb held on said turret.

6. Apparatus for coating with specular metal predetermined portions of the inner surface of open-necked glass bulbs, comprising a chamber opening downwardly and terminating in a soft rubber mouthpiece, leads depending in said chamber through said mouthpiece and supporting a coil of tungsten for holding and heating a small quantity of said metal, a vertically movable support for a bulb, means for lowering said bulb from said chamber, or raising said bulb to said chamber so that its neck enters said chamber and the leads enter said neck, whereby the soft rubber mouthpiece engages said bulb below said neck to effect a vacuum-tight seal, means for exhausting said chamber and bulb, and means for energizing said coil to flash the metal onto said supported bulb.

7. Apparatus for coating predetermined portions of the inner surfaces of open-necked bulbs, comprising a rotary conveyor, means for rotating said conveyor step by step and indexing it between each step of its rotation, a plurality of exhaust heads on said conveyor, each comprising a chamber opening downwardly, terminating in an anti-leakage mouthpiece engageable with a bulb around its neck, and formed with leads to support a coil for holding bulb-coating material, a pinch valve associated with said conveyor, said valve comprising a body casting, a flexible rubber vacuum hose passing therethrough, a valve plate pivoted to said body casting, a closing lever pivoted to said body casting and having a short angular extension carrying a roller which engages the top surface of said valve plate so as to compress the rubber hose and close the aperture therethrough, an opening lever pivoted to the body casting and having a short extension, a prying member carrying a roller and pivoted to the body member, and a connecting rod with one end pivoted to an intermediate portion of said prying member and the other end pivoted to the end of said opening lever extension, said prying member carrying a roller engaged by the closing member when closed, whereby when said prying member is rotated, its roller pushes up on the closing lever until the latter is snapped open by the resiliency of the rubber hose acting upward on the valve plate, vacuum lines from said valve to said heads, one line to each head being for preliminary exhaust and the other for final exhaust, means in the final exhaust line between said valve and each head for improving the vacuum effected, means at one position on said conveyor for automatically switching over from the preliminary to the final vacuum system, means at another position for subjecting a coil in a head to energization to barely melt bulb-coating material enclosed therein, means at the next succeeding position to flash said coating material from said coil onto the bulb, a bulb holder at a succeeding position for after cooling and breaking the vacuum, receiving said bulb, a discharge chute, and means for lowering said holder and tipping said bulb onto said chute.

8. Apparatus for coating predetermined portions of the inner surfaces of open-necked glass bulbs, comprising a turret on which a plurality of said bulbs holding granular masking material may be disposed with their open necks upward, a rotatable support on said turret underlying each

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bulb, means for indexing said turret to move each bulb from one position to another, means in one position for twirling the underlying support so as to distribute said masking material in said bulb to a predetermined level, a rotary conveyor portion of a coating machine adjacent said turret, means for rotating said conveyor portion step by step and indexing it between each step of its rotation, a plurality of exhaust heads on said conveyor, each comprising a chamber opening downwardly, terminating in an anti-leakage mouthpiece engageable with a bulb around its neck, and formed with leads to support a coil for holding bulb-coating material, a vacuum valve associated with said conveyor, vacuum lines from said valve to said heads, one line to each head being for preliminary exhaust and the other for final exhaust, means in the final exhaust line between said valve and each head for improving the vacuum effected, means adjacent said conveyor for at a given indexed position, subjecting each bulb in its head to high-frequency treatment, means at another position for automatically switching over from the preliminary to the final vacuum system, means at still another position for subjecting a coil in a head to energization to barely melt bulb-coating material enclosed therein, means at the next succeeding position to flash said coating material from said coil onto the portion of the bulb not covered by said masking material, and means at a succeeding position for, after cooling, breaking the vacuum to said bulb, allowing it to drop onto the holder of unloading mechanism comprising a pair of vertically reciprocable rods, a terminal casting connecting the upper ends of said rods, said holder being pivotally carried by said terminal casting, means for reciprocating said rods in synchronism with the indexing of said coating apparatus, and means for tilting said bulb holder as the rods move downwardly, comprising a stationary portion disposed between said rods and engaging a lower portion of said bulb holder, a chute disposed adjacent said unloading mechanism and onto which each bulb is periodically upset and fed thereon, and a gate pivoted to a lower portion of said chute so as to stop each bulb as it first passes to said chute, and then release it move down said chute prior to the reception of the next bulb.

9. Apparatus for coating predetermined portions of the inner surfaces of open-necked glass bulbs, comprising a rotary conveyor, means for rotating said conveyor step by step and indexing it between each step of its rotation, a plurality of exhaust heads on said conveyor, each comprising a chamber opening downwardly, terminating in an anti-leakage mouthpiece engageable with a bulb around its neck, and formed with leads to support a coil for holding bulb-coating material, a vacuum valve associated with said conveyor, vacuum lines from said valve to said heads, one line to each head being for preliminary exhaust and the other for final exhaust, means in the final exhaust line between said valve and each head for improving the vacuum effected, means adjacent said conveyor for at a given indexed position, subjecting each bulb in its head to high-frequency treatment, means at another position for automatically switching over from the preliminary to the final vacuum system, means at still another position for subjecting a coil in a head to energization to barely melt bulb-coating material enclosed therein, means at the next succeeding position to flash said coating

material from said coil onto the bulb, means at a succeeding position for, after cooling, breaking the vacuum to said bulb, allowing it to drop onto a holder, lowering said holder, and tipping said bulb onto a discharge chute.

10. Apparatus for coating predetermined portions of the inner surfaces of open-necked glass bulbs, comprising means for preparing such bulbs for coating said predetermined portions thereof, said means comprising a rotatable turret on which a plurality of said bulbs may be disposed in a circle about the turret axis of rotation with their open necks upward, an individually rotatable support on said turret underlying each bulb, a rotary conveyor portion of a coating machine with devices adapted for evacuation and deposition of coating material on said bulbs, disposed in a circle about the conveyor axis of rotation for receiving a plurality of said bulbs holding granular masking material so spaced from said turret axis that, at a point of near tangency between said circles, a bulb on the conveyor portion may be upended to transfer contained masking material therefrom to an adjacent bulb on said turret, means for simultaneously rotating said conveyor portion and said turret step by step from one position to the next, and means at one position on said turret for twirling a rotatable bulb support sufficiently fast to distribute granular material in the supported bulb to a predetermined level, preparatory for transfer to an adjacent evacuating and coating device of said rotary conveyor.

11. Apparatus for coating predetermined portions of the inner surfaces of open-necked glass bulbs, comprising a rotatable turret on which a plurality of said bulbs may be disposed in a circle about the turret axis of rotations with their open necks upward, an individually rotatable support on said turret underlying each bulb, a rotary conveyor portion of a coating machine with heads disposed in a circle about the conveyor axis of rotation for receiving a plurality of said bulbs holding granular masking material so spaced

from said turret axis that, at a point of near tangency between said circles, a bulb on the conveyor portion may be upended to transfer contained masking material therefrom to an adjacent bulb on said turret, means for simultaneously rotating said conveyor portion and said turret step by step from one position to the next, means at one position on said turret for twirling a rotatable bulb support sufficiently fast to distribute such granular masking material in the supported bulb to a predetermined level, means for then holding said bulbs with their open necks upward and containing the distributed masking material in the bottoms thereof for transfer to an adjacent head of said rotary conveyor, whereby they are successively connected to exhausting means for producing a vacuum therein, means on said heads for, when said bulbs are connected thereto, positioning heating means therein surrounding material with which the bulbs are to be coated, means for energizing said heating means to flash the coating material on said bulbs, means for then breaking the vacuum to remove said bulbs from the machine, and means for then upending said bulbs one by one to transfer the granular masking material therefrom to an empty bulb on said turret.

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