July 5, 1932. J. E. FERGUSON 1,865,436

LAMP COATING

Filed Sept. 26, 1928 5 Sheets-Sheet 1

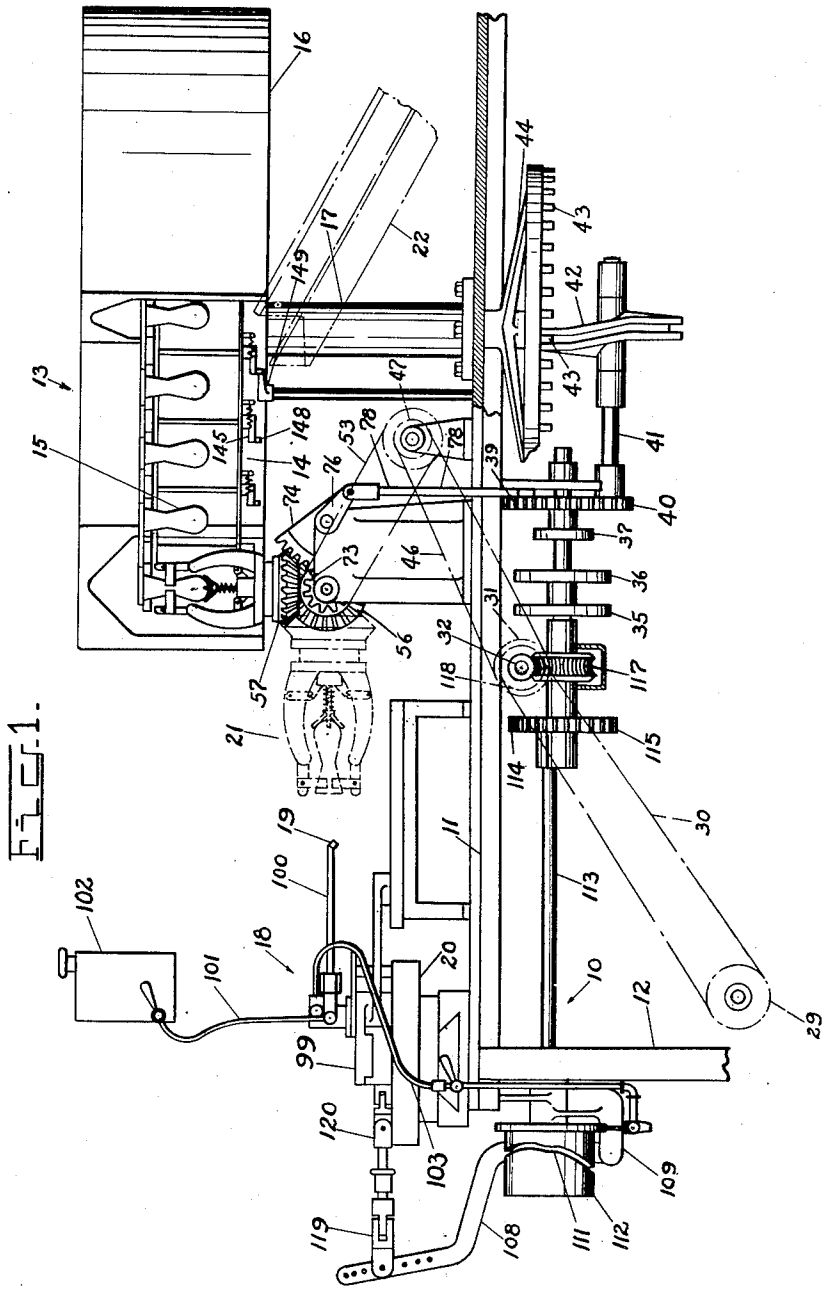


FIG. 1.

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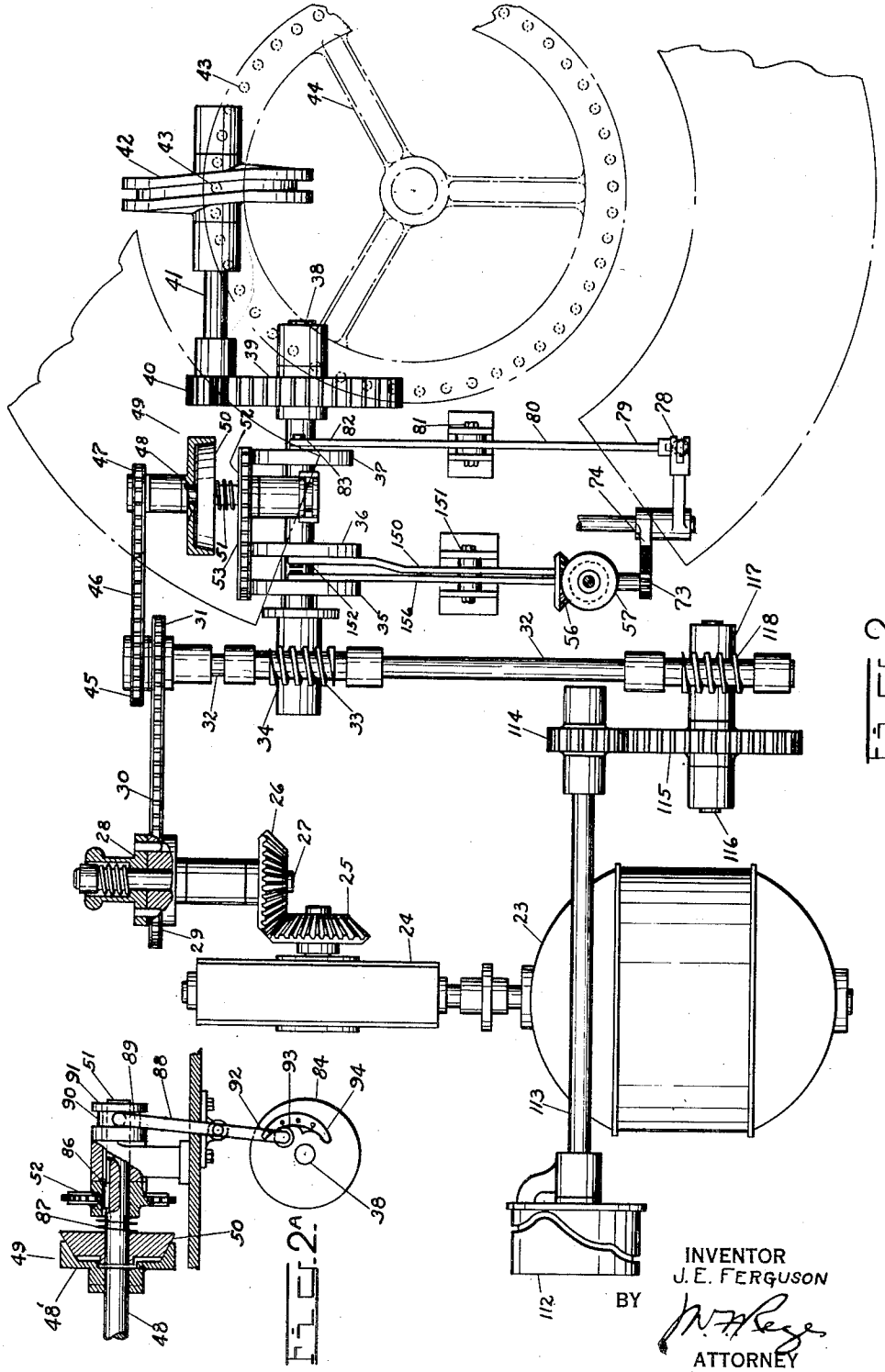


FIG. 2.

FIG. 2A.

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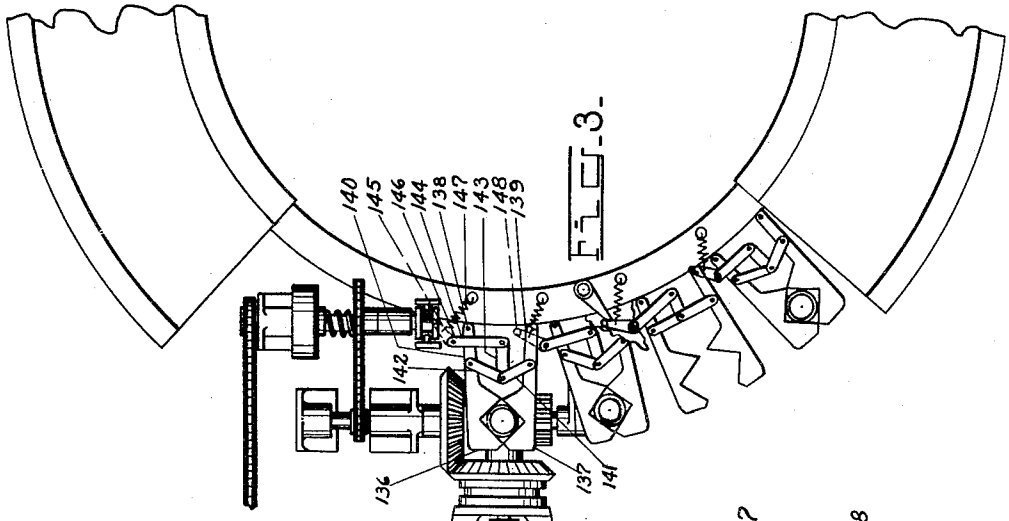


FIG-3.

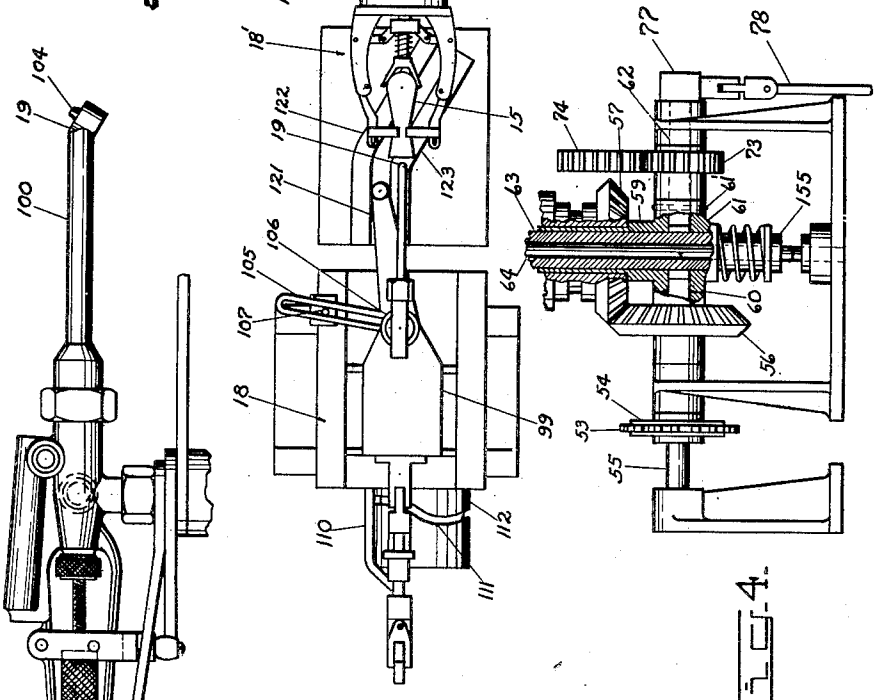


FIG-4.

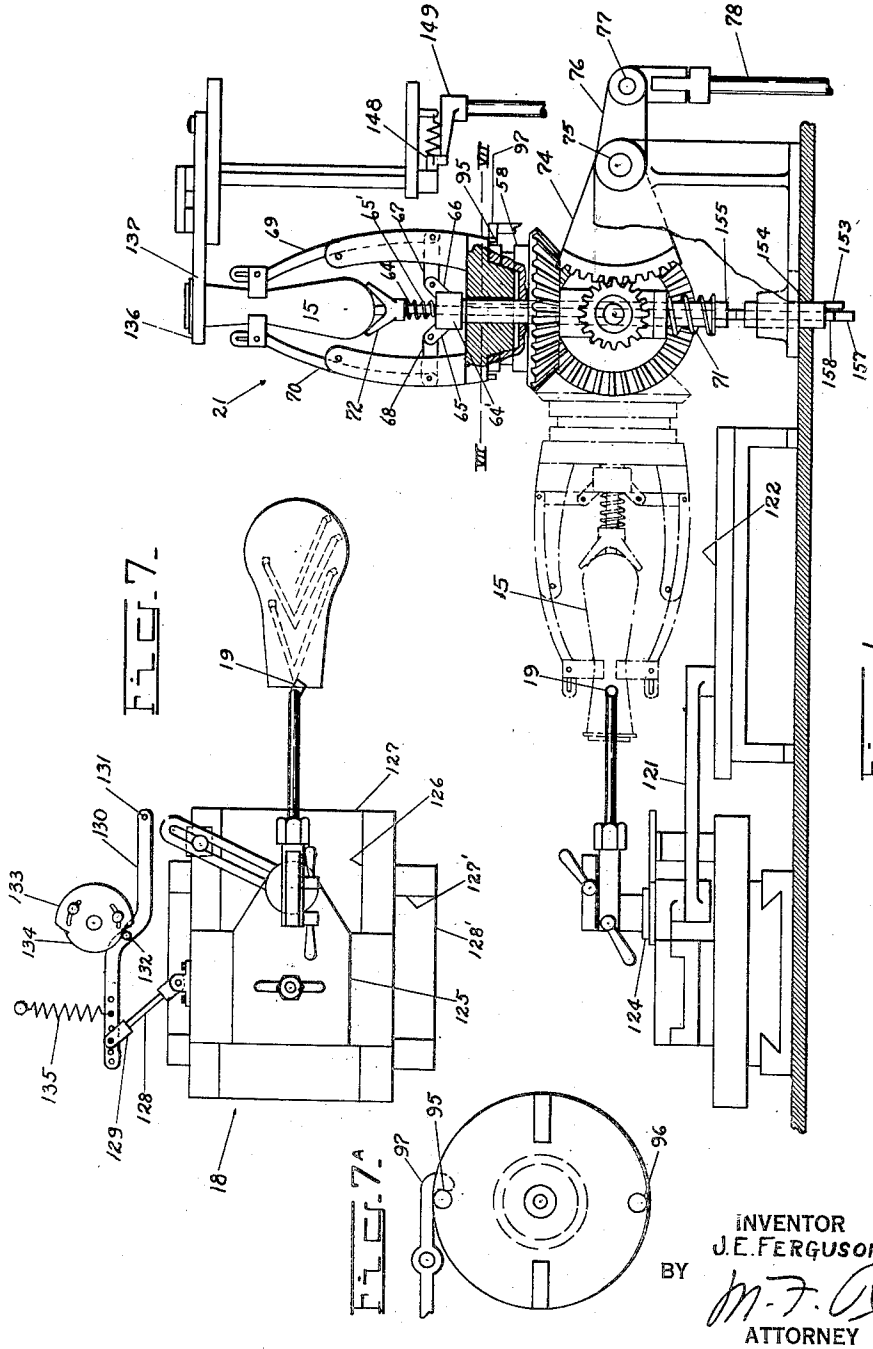
FIG-5.

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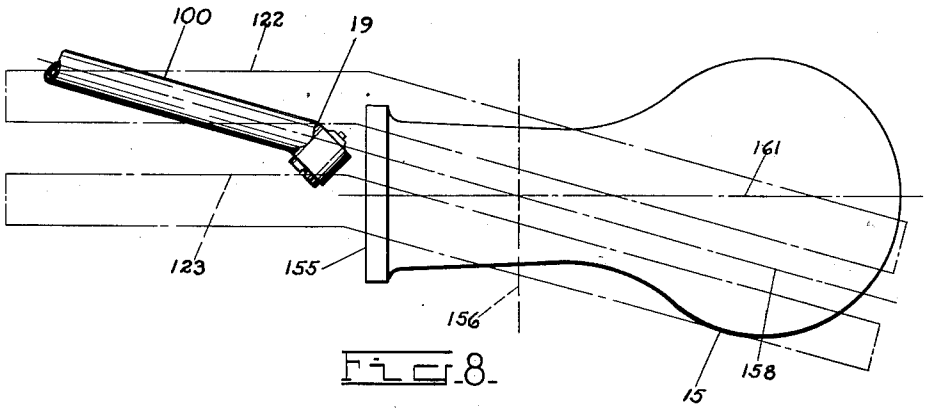


Fig. 8.

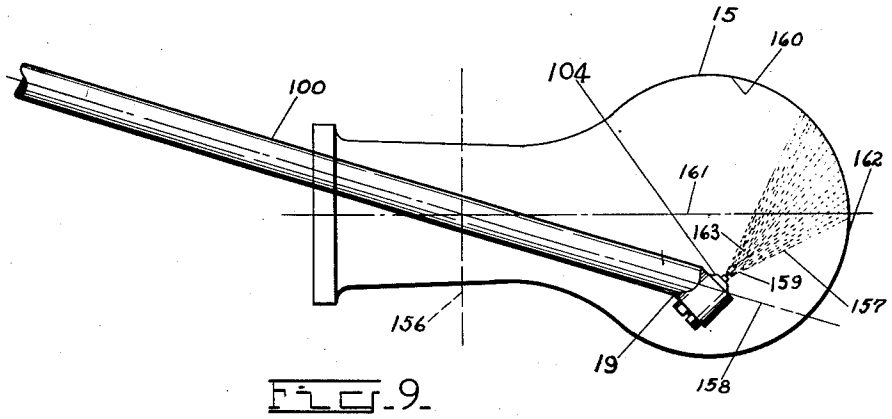


Fig. 9.

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UNITED STATES PATENT OFFICE

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LAMP COATING

Application filed September 26, 1928. Serial No. 306,562.

This invention relates to a machine for coating the interior of a hollow body and relates more particularly to a machine for practicing the method of coating as set forth in copending application, Serial No. 295,091, filed July 24, 1928, and assigned to the same assignee as is the present application.

Although the present invention may be practiced for the coating of the interior of hollow bodies of various forms, the following description together with the accompanying drawings, set forth a practical embodiment of the invention as applied to the coating of the interior of incandescent electric lamp bulbs.

Incandescent electric lamp bulbs usually comprise either a light diffusing, translucent, vitreous material or a clear glass bulb having a coating of a light diffusing character thereon. In certain cases a light diffusing material was employed consisting of a so-called opalescent opal glass, this glass being produced by adding cryolite to a batch of glass during manufacture. The use of a translucent or opalescent material, however, added expense to the manufacture and it has been found that certain reactions take place in the glass, liberating gases which are detrimental to the life of the filament. For the purpose of producing a bulb similar to the opalescent glass, lamp bulbs have been coated upon their exterior surface by the application of a translucent material. This outside coating, although providing a satisfactory light diffusing material, did not attain the desired opalescent effect, which may be defined as a light diffusing medium inclosed in a glossy or highly polished surface such as the normal exterior surface of a lamp bulb.

By practicing the method as set forth in the above mentioned copending application, it is possible to coat the interior surface of the bulb with a light diffusing material, thus providing a bulb which will diffuse light and by reason of the smooth exterior surface will give a pleasing opalescent effect. It is important, however, when applying the coating to the interior surface of the bulb to deposit the coating material evenly over the entire surface so as to provide a coating of uniform density, free from flaws or defects so as to give a light diffusing medium of pleasing appearance which will eliminate the glare of the filament within the bulb with a minimum amount of loss of light through absorption.

It will be appreciated that when applying light diffusing material to a transparent surface it is essential to deposit the material in such a way that the coating is of uniform density, since by reason of the transmission of light the least irregularity or defect is visible and destroys the appearance of the article. A coating applied to the interior surface of a lamp bulb must, therefore, be deposited so as to avoid the above disadvantages.

Inasmuch as the coating includes colored pigments, it has been found that unless the coating is applied in a manner as hereinafter set forth the required depth of color is lost and light and dark spots occur. Furthermore, it will be understood that although the coating material may be applied in a layer of such depth as to bring out the color value, the thickness of the coating must be limited by reason of the light which it absorbs and it is consequently necessary to provide a coating of minimum thickness and at the same time attain uniformity of density and the required color value.

It is an object of the present invention, therefore, to provide a machine for automatically depositing a uniform light diffusing coating upon the interior surface of a hollow body.

Another object of the invention is to provide mechanism for supporting a hollow body in combination with a coating discharging element arranged for relative movement to effect an evenly distributed deposit of coating material over the interior surface of a hollow body.

Other objects and advantages of the invention will be more fully understood from the following description, together with the accompanying drawings, in which

Fig. 1 is a side elevational view of a machine embodying the present invention;

Fig. 2 is a skeleton plan view showing the

various operating elements connected with a source of power;

Fig. 2*a* is a detail view partly in section showing mechanism for automatically actuating a bulb carrier;

Fig. 3 is a fragmentary view showing a conveyor with a spray mechanism disposed in operative relation thereto;

Fig. 4 is an enlarged detail view partly in section, showing mechanism for removing a bulb from the conveyor and for rotating the bulb;

Fig. 5 is an enlarged side elevational view of a spray gun;

Fig. 6 is an enlarged side elevational view of a poriton of the mechanism shown in Fig. 1 for removing a bulb from the conveyor and holding the same in position for a spraying operation;

Fig. 7 is a plan view of spray gun mechanism and means to produce a movement of the spray gun in conformation with the shape of the bulb wall.

Fig. 7*a* is a view taken substantially on line VII—VII in Fig. 6 and shows the bulb holder head retained by a latch member;

Fig. 8 is a diagrammatic view of a bulb with the spray gun in position for insertion therein; and,

Fig. 9 is a view similar to Fig. 8 but shows the spray gun within the bulb for the discharge spray material.

Although the present mechanism may be employed to deposit a coating of spray material upon the interior wall of hollow vessels of different shapes, it is shown and described herein for the purpose of coating the inner surface of an incandescent electric lamp bulb.

A practical embodiment of the invention may comprise a suitable supporting framework 10 having a table or top portion 11 supported on legs 12. The table supports two cooperating mechanisms. One mechanism, indicated by the numeral 13, consists of a conveyor 14 for supporting a plurality of lamp bulbs 15, the conveyor being disposed so as to move the bulbs through an oven 16 of any suitable type as, for example, the oven may be heated by fluid burners or by electric heating coils (not shown). The conveyor is mounted on a vertical shaft 17 and is driven by mechanism to be hereinafter more fully described. The second mechanism, above referred to, consists of a spray device 18 comprising a spray nozzle 19 mounted on a slide plate 20 for movement to and from the conveyor. The said spray device will be hereinafter more fully described.

Intermediate the spray device and the conveyor is disposed mechanism, indicated by the numeral 18′, which operates to remove a bulb from the conveyor and to hold it in position to receive the nozzle 19. This mechanism consists of a rockable bulb carrier 21.

With the mechanisms in mind, it may be briefly stated that the apparatus operates to carry bulbs through the oven 16 whereby each bulb is given a preheat treatment and moved to position to be received by the rockable carrier 21, which removes the bulb from the conveyor and holds it in a substantially horizontal position whereupon the nozzle 19 is actuated and the said nozzle enters the bulb after which the spray operation is effected and the interior of the bulb coated. The rockable bulb carrier then returns the bulb to the conveyor which indexes until it brings the bulb to the discharge position, at which time it is removed from the conveyor and may travel along a guide or chute 22 to a suitable receptable and a new bulb is positioned in the conveyor in place of the one removed.

The mechanism for transmitting motion for performing the various operations will be more clearly understood by reference to Fig. 2 wherein a source of power in the form of a motor 23 is shown provided with a standard reduction gear box 24 connected to a beveled gear 25. The beveled gear 25 is disposed in mesh with a beveled gear 26 mounted on a shaft 27. The said shaft is provided with a slip clutch 28 which connects the shaft with a sprocket wheel 29 over which a chain 30 is led.

The chain 30 engages a sprocket wheel 31 on a counter-shaft 32, the said counter-shaft being provided with a worm wheel 33 in mesh with a worm 34, which latter is disposed on a shaft 38 having cams 35, 36 and 37 secured thereto. The said shaft is provided with a spur gear 39 disposed in mesh with a gear 40 mounted on a shaft 41 having secured thereto a peripherally grooved cam 42 adapted to engage with pins 43 extending from a spider 44 which constitutes the supporting frame of the conveyor 13, whereby a rotary motion of the cam 42 will cause an intermittent rotary motion of the conveyor.

The counter-shaft 32 is provided with an additional sprocket wheel 45 over which a chain 46 is led, the chain passing over a sprocket wheel 47 mounted on a stub shaft 48. The shaft 48 constitutes part of a friction clutch 49, the internal cone 48′ of which is secured to the shaft 48. The opposite portion of the clutch 49 includes a shaft 51 carrying cone 50 and upon which is mounted a sprocket wheel 52 having a chain 53 which connects the said sprocket wheel 52 with a sprocket wheel 54 mounted on a shaft 55 (see Fig. 4). The clutch 49 will be hereinafter more fully described.

The shaft 55 is provided with a beveled gear 56 which actuates the rockable bulb carrier 21. This rockable bulb carrier is formed with a hub 58 (see Figs. 4 and 6) secured to a cruciform member 59, an arm 60 of which is rotatable on an end of shaft 55 and arm 61 of the said member being secured by pin 61′ to shaft 62. Within the member 59 is a

sleeve 63 and within the sleeve is disposed a push rod 64. The sleeve 63 is provided with a collar 64′ having lugs 65 and 66 which in turn are connected by links 68 and 67 to clamping jaws 70 and 69 respectively. The sleeve is held in its normal position to maintain the jaws closed by means of a helical spring 65′. An upward movement of the sleeve causes an opening of the jaws. Intermediate the jaws 69 and 70 is provided a tripod centering member 72 mounted at an upper end of the push rod 64. A spring 65′ disposed between the tripod member and the upper end of the sleeve 63 urges the said member upwardly so that when a bulb is secured between the jaws 69 and 70, the tripod member will engage the spherical portion of the bulb and hold the same with its longitudinal axis coincident with the longitudinal axis of the rockable carrier.

For the purpose of moving the rockable carrier, the shaft 62 is provided with a pinion 73 in mesh with a segment 74 mounted on a shaft 75 in a suitable bearing. The segment is provided with an arm 76 pivotally connected at 77 with actuating rod 78. The rod 78 (see Fig. 2) is connected with an end 79 of a lever 80 fulcrumed at 81. The opposite end 82 of the lever 80 is provided with an offset portion 83 engaged with cam 37 mounted on shaft 38 so that a rotation of the cam 37 causes an oscillation of the segment 74 resulting in an oscillatory movement of the carrier 21. When the carrier 21 has moved from a vertical to a horizontal position the beveled gear 56 is actuated to cause a rotation of the carrier. This actuation of the beveled gear 56 is produced by means of a cam 84 (see Fig. 2*a*) which engages the lower end of a lever member 88.

As will be noted, the friction clutch 49 includes the cone member 50 secured to shaft 51 upon which the sprocket wheel 52 is mounted. A feather 86 is provided so that the sprocket 52 may rotate with the shaft 51 and at the same time the shaft may be moved longitudinally. A helical spring 87 is provided between the sprocket wheel 52 and the cone 50 to normally engage the clutch and thereby impart rotary motion to the bulb carrier.

As heretofore described, the bulb carrier is oscillated by the segment 74 and when the said carrier is in a vertical position to receive a bulb from the conveyor, the rotary motion of the carrier is terminated. This is effected by means of the lever 88 shown in Fig. 2*a* having a forked end 89 engageable with an annular slot 90 in a collar 91 on the shaft 51. The other end 92 of the lever 88 is provided with a roller 93 which is engaged by a raised portion 94 of a cam 84. Thus when the cam 84 is rotated with the shaft 38 the lever 88 operates to disengage the cone 50 of the friction clutch 49 at the time when the carrier is in its vertical position.

The raised portion 94 of the cam, merely disengages the clutch 49 momentarily but the carrier 21 is provided with a pair of oppositely disposed pins 95 and 96 (see Figs. 7*a*) one of which engages with a latch member 97. The construction of the carrier head 21 is such that the beveled gear 57 thereof may continue to rotate while the jaws of the head remain locked by means of the latch member 97. To accomplish the above the head is formed in two parts. (See Fig. 6.) The lower part to which the beveled gear 57 is attached, is provided with a conical friction surface engageable with a tapered recess 98 in the hub 58 upon which the jaws 69 and 70 are mounted. Normally, the jaw carrying portion and the beveled gear portion of the carrier are held in frictional relation by means of the spring 71 which also operates to maintain the jaws closed.

From the above it will be evident that when the carrier assumes its vertical position the temporary release of the clutch 49 permits the latch member 97 to lock the jaws from rotation so that the friction clutch of the head will slip, permitting the beveled gears 56 and 57 to rotate without rotating the jaws of the carrier. Immediately upon an actuation of the segment 74, however, in reverse direction, the carrier is removed from engagement with the latch member 97 and the head begins to rotate and continues to rotate while in its horizontal position, at which time the spray mechanism is actuated to coat the interior of the body held in the jaws.

The spray mechanism 18, as clearly shown in Figs. 1 and 3, comprises the slide plate 20 upon which is mounted a cross head 99 for carrying the spray nozzle 19. The spray nozzle may be of any suitable type (see Fig. 5) having a tubular portion 100 through which the finely powdered spray material is caused to flow. The spray material may enter the tubular portion 100 through a flexible tube 101 which tube may be connected to a container 102 containing a spray material. The container is usually elevated above the spray gun so that the spray material flows by gravity into the spray gun.

The discharge of spray substantially in the form of a fan or cone is produced in the usual manner by the discharge of air which enters a conduit 103 and is directed across a tip 104 of a nozzle 19 by means of a suitable outlet orifice. This discharge of air passing across the nozzle tip results in the usual ejector effect to atomize and eject finely divided material flowing through the tubular passage 100. Means are provided for terminating the flow of coating material except when the nozzle is in a predetermined position within the bulb. Such means may comprise a slotted arm 105 of an air valve 106

extending into the slot of the said arm and attached to the stationary portion of the machine is a pin 107 so that upon a movement of the spray gun to and from a positioned bulb, the arm 105 will be actuated to open or close the valve 106.

Means for moving the spray mechanism 18 and consequently the nozzle 19 into and out from a bulb 15 may comprise a lever arm 108 pivoted at 109 and provided with a projection 110 disposed in a slot 111 of a barrel cam 112. The barrel cam is attached to a shaft 113 (see Fig. 2) having secured thereto a pinion 114 in mesh with a gear wheel 115 mounted on a stub shaft 116.

The shaft 116 is provided with a worm wheel 117 engaged with a worm 118 secured to shaft 32. A transmission of motion is therefore imparted to the barrel cam 112 through the chain drive 30 and beveled gears 25 and 26 which are actuated by the motor 23. The arm 108 (see Figs. 1 and 3) is provided with an adjustable link pivotally attached at 120 to cross head 99 mounted on slide plate 20. An oscillation of the arm 108 upon a rotary motion of the cam 112 will cause a movement of the head and consequently produce a reciprocable movement of the spray nozzle 19.

It has been found that the mere injection of the nozzle into the body for the discharge of spray material is not satisfactory in producing the desired uniform layer of material. In order to properly coat a bulb it is desirable to move the nozzle into the bulb at an angle to the longitudinal axis of the latter. This is accomplished in the present construction by providing the cross head 99 with a guide finger 121 movable between angularly disposed tracks 122 and 123. These tracks are arranged to lie beneath the bulb when the same is held in position for spraying. It will be evident that by reason of the guide finger when the cross head is moved toward the bulb, to insert the nozzle 19 therein, the formation of the track will cause the nozzle to take a predetermined path during its movement within the bulb.

It will be readily understood that in order to permit a movement of the nozzle and its associated parts in the desired angular direction as produced by reason of the tracks 122 and 123 that the said nozzle and the parts thereof must have a pivotal relation with the cross head 99 and the spray mechanism is therefore pivoted at 124 so that as the cross head 99 moves to and from the bulb, the spray nozzle 19 may readily enter the bulb and move in the path produced by reason of the tracks or guides 122 and 123.

Instead of providing the tracks 122 and 123, the spray mechanism may be somewhat modified as shown in Fig. 7 and the spray mechanism 18 may be mounted on a head 125 movable to and from the bulb in a suitable groove 126 in a plate. The slide plate 127 is slidable laterally in a groove 127′ in a bottom plate 128′. The slide plate 127 may be provided with a link 128 connected at 129 with a lever arm 130. The lever arm may be pivoted at 131 and provided with a pin 132 engageable with a face 133 of a cam 134. The free end of the lever may be provided with a spring 135 for maintaining the pin 132 in contact with the cam. In this structure the head 125 may be given the same movement to and from the bulb as pointed out in the above described mechanism. In addition to the reciprocable movement of the spray gun a lateral movement is produced by means of the cam 134, while the slide plate 127 is moved in a direction substantially transverse to the movement of the head 125. Thus the nozzle 19 of the spray gun may be made to travel through any desired path as, for example, through a path at an equal distance from the surface of the bulb. The various positions of the nozzle during the actuation of the spray mechanism are shown in dotted lines within the bulb in Fig. 7. It is to be understood that the contour or effective surface of the cam 134 may be varied, thus varying what may be termed the lateral movement of the nozzle during its travel into and out from the bulb, whereby it may be moved through any desired path. If desirable it may be disposed in closed relation to the wall of the bulb at one point and spaced a considerable distance from the wall of the bulb at another point, or as above mentioned, the path of the nozzle may be substantially that of the contour of the bulb so that the nozzle is always an equal distance from the bulb at all points during its travel.

From the foregoing it will be evident that a bulb placed in the conveyor 13 may pass through oven 16 for a heating operation and eventually be indexed to position for removal from the conveyor for a spraying operation. After the spraying operation the bulb is returned to its holder on the conveyor. The conveyor may be equipped with a plurality of bulb holders of any suitable type. In the present construction each bulb holder comprises a pair of jaws 136 and 137 pivoted at 138 and 139 on the conveyor. Intermediate to and connected to arms 140 and 141 is disposed a toggle member 142 having a pull rod 143 connected to its center pin. The pull rod 143 is connected by a link 144 having an extension 145 in the form of a lever arm, the said lever arm being pivoted at 146. The lever arm is held by a spring 147 so as to normally maintain the jaws closed. For the purpose of opening the jaws, the lever arm is provided with a depending projection 148 (see Fig. 1) and a contact member 149 is arranged adjacent to the path of movement of the conveyor to engage with the projection 148 so as to actuate

the lever 145 and open the jaws with each stage of movement of the conveyor. It will be noted that a contact arm 149 is provided at the position where the bulb carrier is actuated to remove a bulb from a holder and also at another position adjacent to the entrance to the oven whereby a bulb is discharged from the holder for passage down the chute 22. This point is also the loading position and as soon as the bulb is removed from the conveyor the operator inserts another bulb in the holder for passage through the oven and subsequent disposition for removal by the bulb carrier for a spraying operation.

The foregoing description in addition to being specific to the various parts, is descriptive of the various operations and it will therefore be understood that in operation, the bulb holders on the conveyor are filled with bulbs until the first bulb has passed through the oven and reached a position opposite to the rockable bulb carrier. When so positioned, the segment 74 operates and assuming the bulb carrier to be in a horizontal position, it will be oscillated to a vertical position at which time the projection 94 on the cam 84 will temporarily terminate the rotation of the carrier jaws and one of the pins on the carrier will be engaged by the latch member holding the carrier from further rotation. When the carrier is held nonrotatable in its vertical position the jaws 69 and 70 are so positioned that when open a bulb may be moved therebetween. When in this position, means are actuated to move the sleeve 63 upwardly to open the jaws 69 and 70. The said means comprises a lever 150 fulcrummed on a trunnion 151 (see Figs. 2 and 6). One end 152 of the lever 150 engages with cam 36 mounted on shaft 38. The opposite end 153 of the said lever engages with a slidable bushing 154 which in turn makes contact with an end 155 of the sleeve 63, thus causing the jaws 69 and 70 to open. By reason of the pins 96 and 97 the carrier 21 will be positioned with its jaws opened ready to receive a bulb disposed in one of the holders on the conveyor and when the jaws are thus opened the conveyor indexes and positions the bulb between the jaws 69 and 70 in the holder at which time a further movement of the cam 36 causes the jaws to close and cam 35 actuates to move a lever 156 fulcrumed on the trunnion 151 so that an end 157 of the lever 156 engages a plunger 158 to engage the push rod 64 raising the tripod member 72 to firmly engage the bulb between the jaws 69 and 70.

As the conveyor indexes, the contact element 149 engages the depending projection 148 on the holder, opening the same to release the bulb. It will be noted that the holders on the conveyor support the bulbs by gripping the same adjacent to the mouth or neck, whereas the bulb carrier secures the narrow portion of the neck of the bulb and the spherical portion to centralize the bulb. After the bulb is secured in the carrier the segment 74 is given an opposite oscillatory movement and the carrier is positioned in a horizontal position as shown in Figs. 3 and 6. At this time the barrel cam 112 rotates to cause a movement of the spray mechanism to bring the nozzle thereof into the bulb. When the nozzle has reached a predetermined position within the bulb the arm 105 is moved to cause a discharge of spray material which continues during a movement of the nozzle into the bulb while the same is rotated by reason of the beveled gears 56 and 57. As the barrel cam continues to rotate the spray nozzle is removed from the bulb and when the said nozzle reaches its initial discharge position, the discharge of spray material is terminated and the nozzle removed from the bulb after which the segment 74 operates and the carrier returns the bulb to the open jaws of the holder which close as the conveyor moves and the jaws of the carrier open, which jaws remain open until the conveyor indexes and positions another bulb between the said jaws 69 and 70 of the carrier after which the above described operation is repeated.

The operation of the present machine has been described but it is believed that a more complete understanding of the function of the apparatus in carrying out the method will be had by reference to Figs. 8 and 9 which diagrammatically illustrate bulbs or blanks about to be sprayed.

At the spraying station, the nozzle 19 is moved into and out from the bulb to deposit a layer of spray material on the interior surface of the bulb, which operation is clearly shown in the said Figs. 8 and 9. As will be noted, the nozzle 19 travels through a path at an angle to the longitudinal axis of the bulb. It is obvious, however, that the nozzle 19 may be moved through a predetermined path and the bulb may be held at an angle, in which case, the spray nozzle 19 might, for example, be moved horizontally. The result of this operation, would, however, be the same as moving the nozzle as above set forth.

The spraying of the interior surface of a hollow body such as a lamp bulb is a difficult and exacting operation. With the present apparatus the nozzle 19 is moved into the neck 155 until adjacent to a point as indicated by the dotted line 156 at which time the spray gun is operated to project a fan or conical shaped discharge 157 of finely divided material. Thus the spray is produced within the article and the spray gun nozzle is moved along the path indicated by the dotted line 158 which path has been chosen so as to keep the concentrated portion 159 of the spray as far from the surface wall 160 receiving the

spray as is possible it being understood that the distance of the nozzle from the said wall is limited by the dimensions of the bulb.

The importance of heating the bulb prior to spraying will be appreciated for the reason that the spray must not run when it is applied to the bulb, but must be in such condition as to readily adhere to the surface and cover the same. When coating the outside surface of a bulb, the distance between the bulb and the spray nozzle may be relatively long, thus the particles may be comparatively dry before reaching the bulb. The combination of the sprayed material and its application within and to a wall of a heated bulb is an important step in the method of coating as carried out by the present apparatus.

As the gun moves into the bulb, the bulb is rotated at relatively high speed, thus causing an impingement or deposit of the spray material over the interior surface of the bulb. Inasmuch as the bulb is rotated about its axis indicated by the dotted line 161, the upper end or top 162 of the bulb will be in the dead center of rotation and rotate at relatively low speed as compared with the adjacent wall of the bulb.

As the spray gun moves into the bulb, the enlarged portion of the bulb will receive a certain amount of spray material owing to the length of time to which the wall of the bulb is subjected to the discharge of spray. It has been found that in order to obtain a uniform layer of sprayed material upon the inside surface of the bulb, the comparatively dense portion 163 which may be termed the main body thereof, should be moved so that this main body of spray does not reach the top portion 162 of the bulb. In accordance with the above described mechanism the spray gun is, therefore, moved until the main body of the spray is discharged adjacent to a point on the dead center of rotation of the bulb so that the free or roving particles of spray which are projected from the main body will be deposited upon the upper wall of the bulb to produce a layer which, by reason of the relatively long time period, the upper wall is exposed to the roving particles of spray, will produce a layer of material upon the upper wall equal in density and thickness to the deposit upon the adjacent wall or the remainder of the interior surface of the bulb.

In producing a sprayed lamp bulb, the thickness of the coating may be determined by the character of the material used or by the duration of the spraying period as, for example, the number of reciprocable movements or passes of the spray nozzle within the bulb may be varied. If a light coating is to be obtained, it may only be necessary to move the spray nozzle into and out from the bulb, or if a heavier coating is desired, the spray nozzle may be moved back and forth several times within the bulb.

It will be noted that mechanism is provided for causing the bodily manipulation of a discharge of spray within the body to be sprayed. This makes it possible to properly cover the wall of the object, such as a lamp bulb which has a surface of undulatory form in longitudinal cross-section.

As illustrated in the drawings, the nozzle is shown as movable into and out from the bulb in such manner that the spray nozzle is held as far from the surface to be sprayed as practical. In practicing the present method, it has also been found that good results are obtained by moving the nozzle into the bulb through a path in accordance with the contour of the surface to be coated as above described and for which a modified form of spray mechanism is shown in Fig. 7. By this manner of manipulating the nozzle, the outlet or discharge orifice of the nozzle may be maintained a uniform distance from the bulb.

As hereinbefore mentioned, it has been found that the degree of the density of the coating may be controlled by the number of movements or passes of the nozzle into and out from the bulb and that the rate of speed of rotation of the bulb may be varied so that the surface to be coated will be exposed to the spray for a longer or shorter period.

In the coating of lamp bulbs it has been found that satisfactory results are obtained by heating the bulb prior to the application of the coating material. In the apparatus shown and described herein the oven used for heating the bulb attains a temperature of about 350° C. Although it has been found practical and satisfactory to heat the bulbs and spray the same and then remove them it will be understood that if desirable, the bulbs may be passed through another baking oven after the spraying operation.

Any suitable coating material may be employed but it has been found that the present apparatus satisfactorily coats bulbs when the coating material contains sodium silicate, a filler such as kaolin and a pigment with a suitable amount of water mixed in a ball mill until a homogeneous mixture is obtained. A mixture of this character which has been found suitable for the present purpose is set forth in Patent 1,581,766.

The present apparatus operates to coat the interior surface of bulbs in an effective and efficient manner so as to produce a layer of uniform density and thickness. By reason of the present invention lamps may be coated at a high rate of speed as is required in connection with other lamp making operations. Furthermore, by coating the interior surface of the bulb a considerable saving of material is effected since whereas the outside coating of bulbs resulted in a waste of about 70% of the coating, the coating of the interior surface is performed with substantially no waste.

Although a preferred embodiment of the

invention is shown and described herein it is to be understood that modifications may be made therein without departing from the spirit and scope of the invention as set forth in the appended claims.

What is claimed is:

1. An apparatus for coating lamp bulbs comprising a conveyor for supporting a plurality of lamp bulbs, spraying means, means for moving said conveyor to position a bulb adjacent to said spraying means, means for terminating the movement of said conveyor, means for transferring a bulb from said conveyor for a spraying operation and means for actuating said spraying means.

2. An apparatus for coating lamp bulbs comprising a conveyor for supporting a plurality of lamp bulbs, spraying means, means for moving said conveyor to position a bulb adjacent to said spraying means, means for terminating the movement of said conveyor, means for transferring a bulb from said conveyor for a spraying operation, means for actuating said spraying means and means for returning said sprayed bulb to said conveyor.

3. An apparatus for coating lamp bulbs comprising a conveyor for supporting a plurality of lamp bulbs, spraying means, means for moving said conveyor to position a bulb adjacent to said spraying means, means for terminating the movement of said conveyor, means for transferring a bulb from said conveyor for a spraying operation, means for actuating said spraying means, means for returning said sprayed bulb to said conveyor and means for discharging said sprayed bulb from said conveyor.

4. An apparatus for coating lamp bulbs comprising a conveyor for supporting a plurality of bulbs, a heat zone, means for actuating said conveyor to move said bulbs through said heat zone, bulb spraying means, means for terminating the movement of said conveyor to position a heated bulb adjacent to said bulb spraying means, means for removing a bulb from said conveyor for a spraying operation and means for returning said bulb to said conveyor.

5. An apparatus for coating lamp bulbs comprising a conveyor for supporting a plurality of bulbs, a heat zone, means for actuating said conveyor to move said bulbs through said heat zone, bulb spraying means, means for terminating the movement of said conveyor to position a heated bulb adjacent to said bulb spraying means, means for removing a bulb from said conveyor for a spraying operation, means for returning said bulb to said conveyor and means for discharging said bulb from said conveyor.

6. An apparatus for coating the interior surfaces of lamp bulbs comprising a carrier for supporting a plurality of bulbs, means for actuating said carrier to move said bulbs through a given path, a spray nozzle adjacent to the path of movement of said bulbs, means for removing a bulb from said carrier when adjacent to said spray nozzle, means for causing said nozzle to move into said bulb, and means for automatically actuating said spray gun to project coating material when said nozzle reaches a predetermined position within said bulb.

7. An apparatus for coating the interior surfaces of lamp bulbs comprising a carrier for supporting a plurality of bulbs, means for actuating said carrier to move said bulbs through a given path, a spray nozzle adjacent to the path of movement of said bulbs, means for removing a bulb from said carrier when adjacent to said spray nozzle, means for causing said nozzle to move into said bulb, means for automatically actuating said spray gun to project coating material when said nozzle reaches a predetermined position within said bulb, and means for causing a relative movement between said bulb and gun during the actuation of said gun.

8. An apparatus for coating lamp bulbs comprising a carrier for a plurality of bulbs, a spray nozzle, means for moving said spray nozzle to position a bulb adjacent said carrier, means for removing a bulb from the carrier, means for rotating the removed bulb, means for moving said spray nozzle into said bulb and means for actuating said nozzle to coat the interior surface of said bulb.

9. An apparatus for coating lamp bulbs comprising a carrier for a plurality of bulbs, a spray nozzle, means for moving said carrier to position a bulb adjacent said nozzle, means for removing a bulb from the carrier, means for rotating the removed bulb, means for moving said spray nozzle into said bulb, means for actuating said nozzle to coat the interior surface of said bulb and means for returning said bulb to said carrier.

10. An apparatus for coating lamp bulbs comprising a carrier for a plurality of bulbs, a spray nozzle, means for moving said carrier to position a bulb adjacent said nozzle, means for removing a bulb from the carrier, means for rotating the removed bulb, means for moving said spray nozzle into said bulb, means for actuating said nozzle to coat the interior surface of said bulb, means for returning said bulb to said carrier and means for discharging said bulb from said carrier.

11. An apparatus for coating the interior surface of hollow bodies comprising a carrier for supporting a plurality of bodies, a spray gun having a nozzle, means for removing a body from said carrier, means for rotating said removed body, means for moving said spray gun relative to said rotating body, means for automatically actuating said gun to discharge coating material upon a movement of the nozzle of said gun

to a predetermined position within said bulb to coat the surface thereof and means for returning said bulb to said carrier.

12. An apparatus for coating lamp bulbs comprising a carrier for a plurality of bulbs, a spray nozzle, means for moving said carrier to position a bulb adjacent to said spray nozzle, means for removing a bulb from the carrier, means for rotating the removed bulb and means for actuating said spray nozzle to coat said bulb.

13. An apparatus for coating lamp bulbs comprising a carrier for a plurality of bulbs, a spray nozzle, means for moving said carrier to position a bulb adjacent to said spray nozzle, means for removing a bulb from the carrier, means for rotating the removed bulb, means for actuating said spray nozzle to spray said removed bulb and means for moving said spray nozzle within said bulb during the spraying operation.

In testimony whereof, I have hereunto subscribed my name this 21st day of September, 1928.

JOHN E. FERGUSON.