

Feb. 19, 1952

R. A. KUEBLER
APPARATUS FOR COATING INTERNAL
SURFACES OF HOLLOW GLASSWARE

2,586,348

Filed March 27, 1948

2 SHEETS—SHEET 1

Fig. 2.

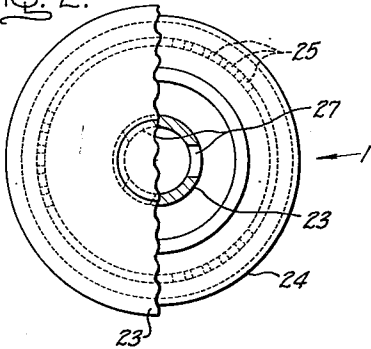


Fig. 3.

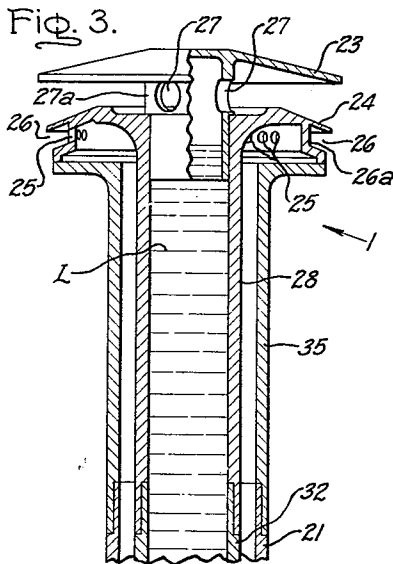
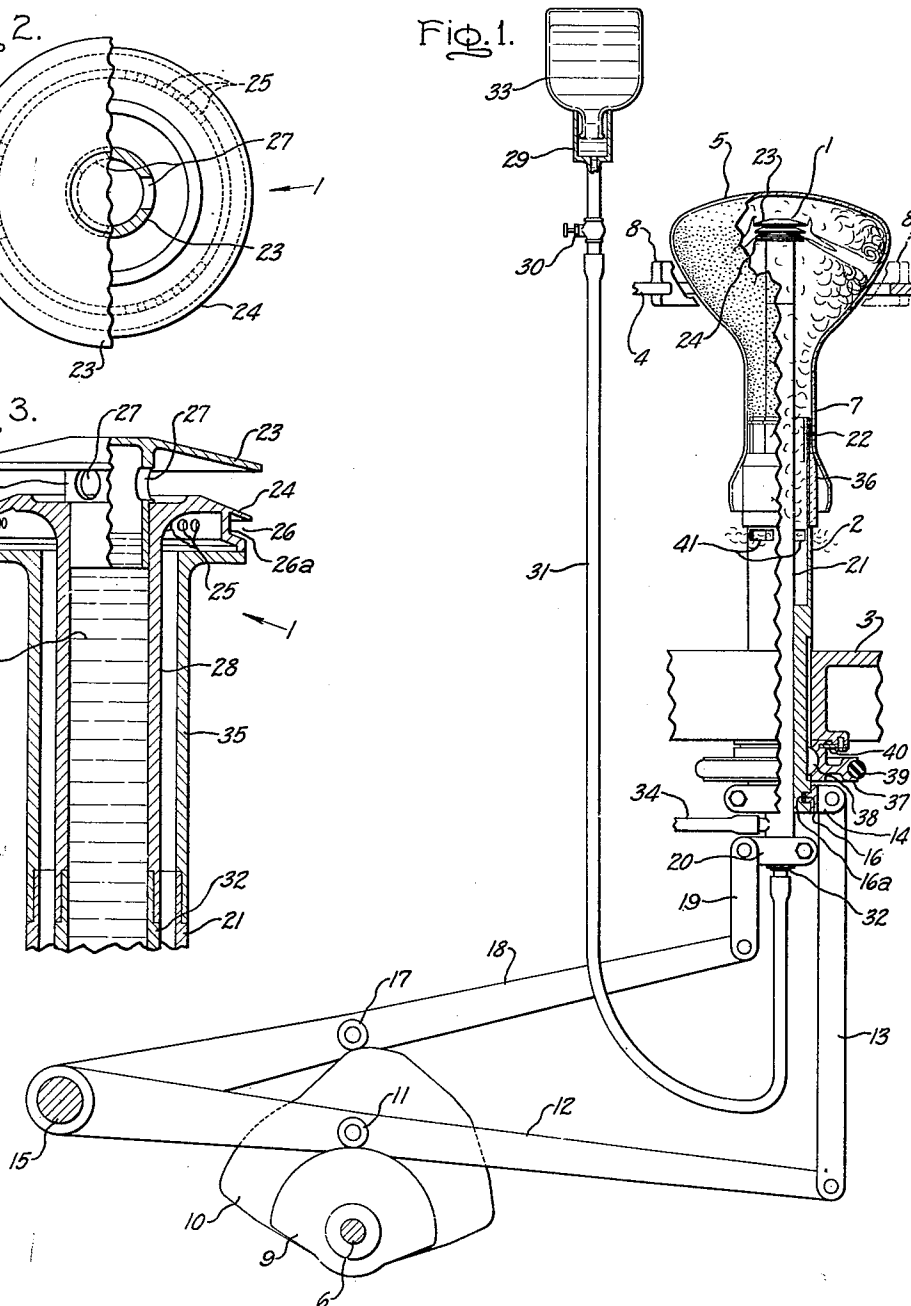


Fig. 1.



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2 SHEETS—SHEET 2

FIG. 4.

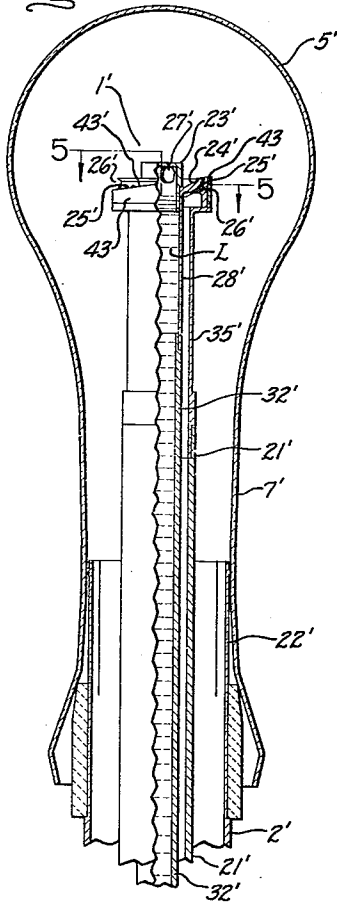


FIG. 5.

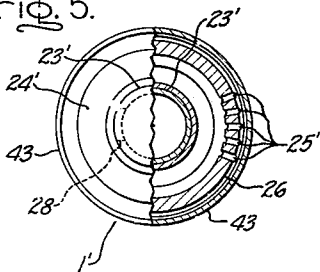
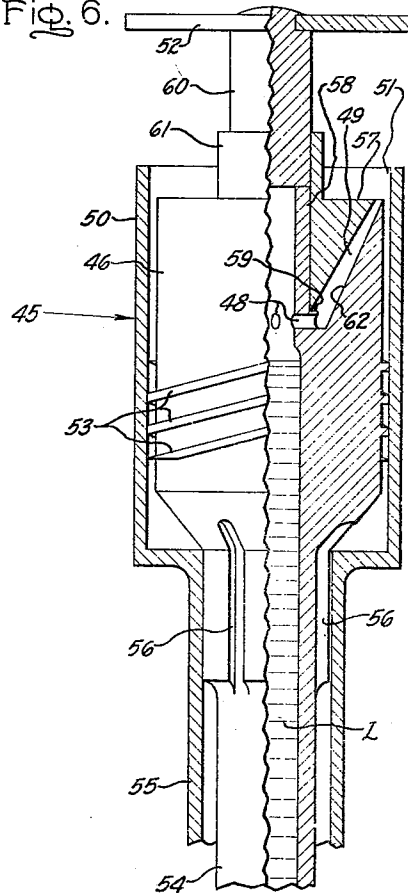


FIG. 6.



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UNITED STATES PATENT OFFICE

2,586,348

APPARATUS FOR COATING INTERNAL SURFACES OF HOLLOW GLASSWARE

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Application March 27, 1948, Serial No. 17,494

6 Claims. (Cl. 118—48)

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My invention relates to a method and apparatus for coating the inner surface of hollow glassware for illuminating and irradiating purposes. More particularly my invention relates to a method and apparatus for causing the generation of a fume or smoke of light-diffusing or irradiation-modifying particles and for causing the desired deposition of said particles over the inner surface of hollow glassware. My invention has most particularly to do with the deposition of a fume-produced diffusing coating upon the inner surfaces of the neck and bulbous portions of the envelopes of incandescent lamps.

According to the invention of Marvin Pipkin, as disclosed in the pending patent application Serial No. 878, filed January 7, 1948 which is now Patent No. 2,545,896 of March 20, 1951 which is assigned to the assignee of the present invention, a fume or smoke of very fine particles is a preferred source of coating material for irradiation-modifying purposes. The fineness and character of the particles comprised of such a fume or smoke are such as to cause them to adhere to glassware in a very satisfactory manner when deposited directly out of the fume and are such that they can readily be deposited on glassware in a coating of apparent uniform density. For instance, the burning of a combustible silicon compound such as ethyl silicate in a lamp bulb in the presence of air and oxygen produces a fume of very fine silica particles which are deposited on the inner surface of the bulb to form a thin adherent coating of very high diffusion characteristics and inappreciable light-absorbing properties. The fume-produced coating can also be applied to the inner surface of inside frosted incandescent lamp bulbs to give maximum diffusion.

One object of my invention is to provide a method and apparatus for producing a fume of very fine light-diffusing or irradiation-modifying particles within hollow glassware and causing said particles to be deposited on the inner surface of said glassware. The fume is produced by the flame from a burner inserted into the glassware and is the product resulting from the burning of a combustible silicon compound in the presence of oxygen supplied in a minor proportion by the air within said glassware and in a major proportion by a discharge from the burner.

Another object of my invention is to provide a method and apparatus for producing a fume of very fine particles within hollow glassware of varying configuration and for varying the quan-

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tity of fume produced in various portions of the glassware in conformity to the configuration thereof to effect the desired density of deposition of the fume particles in said portions. The control of the deposition of the fume particles is largely dependent on the circulation of the fume across the inner surface of the glassware and the period of dwell of the fume-producing burner in the various portions of said glassware.

Another object of my invention is to provide a method and apparatus for directing a fume of very fine particles against the surface of glassware in a manner causing said fume to effectively impinge upon or wipe said surface. Such a manner of operation permits very satisfactory controls to be established over the density of the deposition of the fume particles and gives maximum economy, high efficiency and high speed of manufacture. The fume is produced within the flame from a burner introduced into the hollow interior of the glassware, which flame results from the burning of a combustible fume-producing gas discharged by said burner and which extends in a lateral direction from said burner because of the pull or suction of a stream of a second gas discharged with some force contiguously thereto. Almost all of the fume appears in the stream of gas and is discharged in the direction of and with the force of said stream so that a selective distribution of fume about the burner results. A relative movement between the burner and the glassware permits the desired distribution of fume particles over the surface of said glassware. The directional properties of the burner are desirable to provide a ready control over the distribution of the fume particles over the glassware and permit uniform, very light and graduated depositions thereof over various portions of said glassware.

Still another object of my invention is to provide a burner for the propagation of a fume-producing flame, which burner generates within itself the gas burned in the flame from a liquid supply and which affects said generation by absorbing heat from the flame and transferring it to said liquid. The self-generating burner is also of such proportions as to be capable of proper operation within the relatively confining open neck and the adjacent comparatively large bulbous portion of a glass lamp bulb or other glassware and accordingly must not cause such non-uniform heating of the bulb or glassware that cracking occurs, and must cause the desired deposition of fume particles over relatively great variations in area. The burner must also assist

in controlling the burning so that a fume of particles of the desired size and character is produced and a sufficiently large quantity of fume is produced to allow the rapid and economical coating of glassware without creating explosive conditions in said glassware.

Still another object of my invention is to provide a burner for the propagation of a fume-producing flame, which burner is so constructed that a minimum of fume particles deposit thereon, and which is readily cleaned of deposit. Still further objects and advantages of my invention will appear from the following description of species thereof and from the drawing.

In the drawing, Fig. 1 is a side elevation of a burner and associated apparatus for the propagation of a fume of fine light-diffusing particles and for causing said fume particles to deposit in a selected manner over the inner surface of a lamp bulb, the apparatus being shown midway through a cycle of operation and partially broken away in the planes of a quarter section; Figs. 2 and 3 are sectional plan and side views, on an enlarged scale, of the burner disclosed in Fig. 1; Fig. 4 is a side elevation, from which a quarter section is taken, of a common form of lamp bulb, a burner and directly associated apparatus for causing fume particles to deposit on the inner surface of said bulb; Fig. 5 is a sectional plan view of the burner disclosed in Fig. 4 as taken from the plane indicated by the line 5-5 in Fig. 4 and in the direction indicated; and Fig. 6 is a sectional view, on an enlarged scale, of a modified burner.

The specific form of my invention appearing in Figs. 1, 2 and 3 starts its cycle of operation with the burner 1 and the bulb holder 2 in a lowered position with their upper ends only slightly above the top surface of the support bracket 3, at which position sufficient clearance is provided below the conveyor 4 to allow lateral movement of said conveyor 4 to advance the lamp bulb 5 to the position shown. The conveyor 4 can take the form of a turret or any other well-known form of carrier; however, it is preferred that it be driven from the drive shaft 6, which also provides the means of timing and effecting all operations of the coating apparatus, in order to function in proper synchronism therewith. If less automatic operation is adequate or desired, the conveyor or holder 4 may remain in the position shown at all times and the lamp bulbs 5 may be inserted and removed therefrom manually at the proper intervals.

All operations of the coating process occur at the work station shown and are initiated, after the lamp bulb 5 is located at said station, by the upward movement of the holder 2 and the burner 1. These movements are brought about by the rotation of the drive shaft 6 and the cams 9 and 10, the former of which raises the holder 2 until it engages the inner surface of the bulb neck 7 and, through said engagement, lifts the bulb 5 from the rests 8 of the conveyor 4, and the latter of which raises the burner 1 into the bulb 5 through its neck 7. At the presently described moment the high side of the cam 9 is brought into position below the roller 11 on the lever 12 thereby causing said lever 12, which is connected to the lower end of the holder 2 by means of link 13 and collar 14, to turn about the stationary shaft 15 to thereby raise said holder 2. The collar 14 is a split member in which the holder 2 can turn freely and can only influence the vertical position of the holder since the only positive

lock therebetween is the engagement of the internal ridge 16 on collar 14 with the annular groove 16a in the holder 2. The rotation of a rise portion of the cam 10 below the roller 17 on the lever 18 moves said lever 18 about the stationary shaft 15 so that the link 19 and collar 20, which connect it to the metal burner support tube 21, are moved upward and effect a corresponding movement in the support tube 21 and burner 1.

At the time the burner 1 and shield 22 are introduced into the neck 7 of the bulb 5, the upper end portion of the burner is located just above the top of the tubular metal shield 22 which is in effect the upper end of the holder 2, and a flame burns about a discharge opening completely around said end portion. The flame results from the combustion of gaseous ethyl silicate discharged laterally from between the metal shield or cap 23 (Figs. 1, 2 and 3) and the flanged metal head 24 of the burner 1 and is drawn into a contiguous stream of gas discharged laterally or radially from the openings 25 in the base of the peripheral groove 26 about the burner head 24. The base of said groove 26 is formed by a depending annular flange or ring portion 26a of the head 24. Only a minor portion of the flame remains out of the stream of gas as the pressure of discharge of the gaseous ethyl silicate is relatively low since it is free to pass through the large openings 27 in the tubular stem portion 27a of the shield 23 as soon as it is generated from the liquid form L present in the stem 28 of the burner 1.

Control over the amount of the combustible ethyl silicate gas discharged by the burner 1 is afforded through the control of the liquid ethyl silicate introduced into the burner 1, which liquid is drained by the force of gravity from a constant level reservoir 29 through the valve 30 and the flexible hose 31 to the lower end of the support tube 32 on which the stem 28 of the burner 1 is mounted. The control valve 30 is adjusted to allow the required quantity of liquid ethyl silicate to flow into the stem 28 of the burner 1 to produce the desired flame thereabout and has no reference to the ability of the burner 1 to generate gas therefrom. The liquid level in stem 28 should not be permitted to fall too low since that would cause the vapors to burn inside the cap portion 27a and thereby fill up the holes 27. For all normal requirements of the burner 1, sufficient heat is contained therein to vaporize the liquid ethyl silicate as fast as it is introduced into said burner 1, although the level of the liquid ethyl silicate in the burner 1 rises as greater amounts thereof are fed thereto. To retain the proper degree of heat in the burner, the stem 28 may be made of metal having relatively poor heat conductivity; a suitable material is a stainless steel containing about 18 per cent chromium, 8 per cent nickel and the remainder iron. The sleeve 35 and cap 23 may be made of the same material, or the said cap may be made of brass. An inverted bottle 33 with its open neck in the reservoir 29 provides the automatic means of replenishing the liquid drained therefrom.

The stream of gas discharged from the openings 25 in the burner 1 is at such a pressure that the major part of the gaseous ethyl silicate is drawn into it and produces a flame taking the same direction as the stream. It is preferred that the gas in said stream be oxygen so as to facilitate the formation of fume particles of the desired character from the flame

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and accordingly a source thereof (not shown) is connected to the rubber hose 34 leading to the outer support tube 21 which is connected by means of the sleeve 35 of the burner 1 to the openings 25 therein. An adjustable constant-pressure source of oxygen is preferred.

Some variation occurs in the spread of the flames about the burner 1 as the combustible fume-producing ethyl silicate gas is discharged somewhat more generously opposite the three openings 27 in the burner 1 and the stream of combustion-supporting oxygen gas is discharged from three groups of openings 25 midway between openings 27 (Fig. 2). These variations in the flame, and any other that may occur because of slight deposits of fume particles thereon, do not result in uneven distribution of fume particles over the bulb 5 because the bulb is constantly being rotated by the holder 2. The rotation of the bulb 5 is also desirable to cause the full periphery thereof to be uniformly heated by the flame so as to avoid cracking said bulb, and is effected through its engagement with the refractory collar 36 on the holder 2. The said collar 36 fits snugly in the neck 7 of the bulb 5 and may be made of a mixture of asbestos and Portland cement. The relatively light engagement of the shield 22 with the bulb neck 7 assists in keeping the bulb 5 in alignment with the holder 2 during the rotative movement which is imparted to said holder 2 from the pulley 37 by means of the key 38 therebetween. The pulley 37 is driven from a source (not shown) of constant rotation by means of the belt 39 and is retained in the position shown, so as not to be affected by the vertical motions of the holder 2, by the key 40 which is fastened to the support bracket 3 and which enters a peripheral groove in said pulley 37. The key 38 slides in a longitudinal keyway in the holder 2 during the vertical movement thereof.

The deposit of fume particles on the bulb 5 is restricted, at a given instant, largely to the area of the bulb 5 contacted by and adjacent to the stream of gas emitted by the burner 1, as nearly all of the fume is produced in the stream of gas and to a great extent deposits on said bulb 5 during its wiping engagement therewith. The stream of gas emitted by the burner 1 becomes in effect a stream of fume which, after engagement with the walls of the bulb 5, rolls both up and down along said walls bringing all of the fume particles therein into engagement with the said walls. The undeposited fume of the gas stream combines with the very small amount of fume given off by the portion of the flame outside said stream and circulates throughout the bulb 5 until it is finally exhausted to the atmosphere, together with other products of combustion, through the open upper end of the holder 2 and the lateral openings 41 therein. The portion of the flame outside of the gas stream burns slowly in a flickering manner and has the dual function of contributing heat to the burner 1 and of piloting the flame within the gas stream.

The rate of production of fume by the burner 1 is so high that the upward movement thereof need not be interrupted after it first enters the open neck 7 of the bulb 5 and is caused to continue, although at somewhat less speed. When the burner 1 is raised to the position where the stream of fume therefrom passes beyond the narrow neck 7 of the bulb 5 and into the wider flaring

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portion of said bulb 5, its rate of movement is reduced proportionately to the greater area over which the fume particles are deposited so that a substantially uniform coating of fume particles deposits on the various parts of the bulb.

These various rates of upward movement are effected by differences in the changes in shape of the various portions of the cam 10 which are engaged by the roller 17, and are followed by a short inactive period in the movement of the burner 1 when the stream of fume therefrom reaches the upper limit over which the fume particles are to be deposited on the bulb 5 in the present instance. The bulb 5 is to have a substantially uniform coating of fume particles over the neck and side walls thereof, with a very light coating on the top end or face thereof. Therefore, the burner 1 is again caused to move down after a time interval at the upper limit of its motion during which a coating is built of equal density to that deposited over the other portions of the bulb 5 during the upward movement of the burner 1 and the subsequent return downward movement thereof. The shape of cam 10 is such that the downward movement of the burner 1 is more rapid than the upward movement because the bulb 5 was heated during the upward movement of the burner 1 and now cannot be subjected to the same degree of heat without softening or melting.

When the burner 1 has been lowered to a position where the gas stream just passes the top of the shield 22, a corresponding downward movement occurs in both burner 1 and holder 2 which first lowers the bulb 5 onto the rests 8 of the conveyor 4 and then carries the burner and holder completely out of the neck 7 of the bulb 5. The conveyor 4 then indexes so as to carry the coated bulb 5 out of the work station and bring another uncoated bulb in its place.

The upper end of the bulb 5, which receives a coating of very light density, is in the present instance coated by particles from the extraneous fume within the bulb 5 and gradually increases in density around the edge to the full density of the side coating on said bulb 5 due to the additional deposit of fume particles from the fume stream at this point. The shield 23 over the top of the burner 1 is to a certain extent responsible for the extremely light density of the coating on the end of the bulb 5 in that it prevents the combustible fume-producing gas from burning over the upper end thereof; however, almost any degree of density can be obtained by varying exposure of the fume thereto. In the present instance the reduction in exposure to the fume is effected by giving the burner 1 directional properties which permit more ready control of the distribution of the fume, by shielding (shields 22 and 23) the fume from portions of the bulb 5, and by varying the length of time to which various portions of the bulb 5 are exposed to the fume. To produce a deposit of uniform density over glassware of varying configuration it is preferable that the burner produce fume at a uniform rate and the rate of movement of the burner be inversely proportional to the area covered by the stream of fume therefrom. In every instance, however, it is preferred that that portion of the glassware to be coated be lifted from engagement with any supporting means or held in some manner whereby said means cannot have a cooling effect thereon and accordingly disturb the disposition of fume or heating of said glassware.

If other glassware of different shape and pro-

portions, such as the common form of lamp bulb 5' shown in Fig. 4, is to be coated uniformly over the entire interior surface thereof, a modified burner 1' is preferably used. The fume particles are to be deposited over the end and the sides of the bulb 5' so that the ability of burner 1' to direct a stream of fume both laterally and longitudinally thereof is preferable.

The combustible fume-producing material is introduced into the burner 1' in liquid form L through the bottom of the support tube 32' and is vaporized into a gas by the heat within the stem 28' to finally be discharged out the openings 27' of the shield or cap 23'. The (oxygen) gas stream establishes the direction of spread of the fume-producing flame and, accordingly, the stream of gas enters the sleeve 35' of the burner 1' from the support tube 21' and is discharged from the burner 1' through the openings 25' (Figs. 4 and 5) located in the base of the peripheral groove 26' in the stem head 24'. The assembly of parts making up the burner 1' is completed by a deflector 43 consisting of a deflector 43 consisting of a sheet metal ring having an oblique upper end 43'. The said deflector 43 is the means of redirecting the gas stream from the openings 25' so that it passes directly from the openings 25' in a lateral direction at one (low) side of the deflector (which is below the openings) and is redirected and takes a more upward direction further around said burner 1' until a vertically upward direction is taken at the opposite (high) side of the deflector which is above the openings 25'.

The above-described modified burner 1' is preferably used in combination with apparatus like that shown in Fig. 1 and effects the coating of the lamp bulb 5' while said bulb is supported and rotated by a holder 2' corresponding to the holder 2 of the Fig. 1 apparatus. At the start of the cycle of operation the burner 1' is located just above the top edge of the shield 22' and is moved upward toward the top end of the bulb 5' at a variable rate of speed to a great extent dependent on the area swept by the stream of fume emitted thereby. In the present instance, there is more extraneous fume in the bulb 5' than in the Fig. 1 apparatus since the flame and, consequently, the fume directed upward in the gas stream from the burner 1', is initially a relatively long distance from the top of said bulb 5' and since a larger proportion of flame burns freely over the top of said burner 1' and outside of the gas stream. This extraneous fume is responsible for a larger amount of the fume particles deposited on the bulb 5' than in the prior instance; however, the desired uniformity of coating is obtained if the burner 1' is moved upward and then downward in said bulb 5' during the cycle of operation in much the same manner as in the prior instance. A short dwell occurs in the movement of the burner 1' at the upper limit thereof; otherwise, it is uninterrupted. The burner 1' is also characterized by relatively thin walls of the stem 28' and the sleeve 35' in order to reduce the heat loss therefrom to a minimum.

The modified coating burner 45 shown in Fig. 6 is adapted to project an upwardly and outwardly directed stream of fume from the end thereof, a stream which is particularly desirable in coating long tubular glassware but which is likewise useful in coating a lamp bulb like that shown in Fig. 4. The combustible fume-producing liquid L is vaporized into a gas in the

head 46 of the burner 45 and flows through a plurality of lateral openings 48 to an inverted frusto-conical or outwardly flaring annular distribution chamber 49 vented at the edge of the burner head 46. The (oxygen) gas stream developing the directional properties of the burner 45 is discharged from the opening between the upper edge of the burner head 46 and the surrounding outer shell 50 of said burner 45 and passes upward and outward between the upper edge 51 of the shell 50 and the shield or deflector 52 mounted thereabove. The flame is flared outwardly and has a swirling motion caused by the circulation of the stream of gas about the screw-shaped (helical) partition 53 between the burner head 46 and the shell 50. Both flame conditions assist in causing the fume produced thereby to wipe or scrub the surface of the glassware. The sources of the combustible liquid and the gas are connected to the support tubes 54 and 55, respectively, of the burner 45, the liquid flowing upward through the open interior of the tube 54 and the burner head 46, and the gas flowing through the space between tubes 54 and 55, and the grooves 56 in said head 46.

In normal operation some particles of fume deposit on the burner 45 and must be brushed therefrom on occasion, while at other times a more thorough cleaning of said burner 45 is required. The normal passage of the gas stream up between the tubes 54 and 55, through the grooves 56 and between the burner head 46 and the shell 50 keeps these portions of the burner 45 clean. Those portions of the burner 45 holding both the liquid and gaseous combustible material are, on the other hand, subject to blocking by particles deposited from the fume and are constructed so as to be readily removable for cleaning. The shield 52 and the cap 57 can be lifted from the burner 45, thereby giving access to the full length of the interior of the burner head 46 and the support tube 54, the openings 48 and the distribution chamber 49. Replacing the shield 52 and the cap 57 merely consists in first lowering the cap 57 over the tubular projection 58 within the well 62 in the top of the burner head 46 to the extent allowed by the shoulder 59 and then inserting the post 60 extending from the shield 52 into the opening provided by the tubular projection 61 on the cap 57 to the extent allowed by the projection 58.

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

1. Apparatus for coating the inner surface of a lamp bulb with particles of a fume comprising a vertically reciprocable burner having means for discharging a combustible fume-producing gas and having contiguous means for directing a stream of combustion-supporting gas closely adjacent the flame of the burning fume-producing gas whereby to draw a major portion of the said flame into said stream of combustion-supporting gas, a conveyor having support rest means to support the lamp bulb in upright rested position thereon with its open neck and down, said conveyor being movable to advance said support rest means to a position directly over said burner to vertically align the bulb therewith, a bulb holder mounted in substantially vertical alignment with said burner, support means mounting said bulb holder for rotation about its vertical axis and for vertical reciprocation independently of said burner, means for rotating

said holder, actuating means operatively connected to said burner and holder to first raise them concomitantly in their normal elevational position relative to each other to elevate said holder into engagement with the neck of the bulb and lift it to a predetermined position off said support rest means and to then elevate said burner relative to said holder a further amount to introduce the burner into the bulb on said holder and cause the fume therefrom to deposit a coating of fume particles onto the interior surface of said bulb, said actuating means being further operative to thereafter lower the burner relative to said holder to its normal elevational position relative thereto and then concomitantly lower both said burner and holder to their initial lowered position to lower the bulb onto said support rest means and disengage the holder from the bulb and withdraw said burner completely from the interior of said bulb, and operating means connected to said actuating means and said conveyor to operate them in proper time relation with each other.

2. Apparatus for coating the inner surface of hollow glass articles of the open neck end type with light-diffusing particles of a fume comprising a vertically extending holder engageable at its upper end with the interior surface of the article neck to support the article upright with its neck end down, a burner comprising a cylindrical stem portion extending vertically through said holder and provided with a burner head at its upper end, said burner stem having separate passageways therethrough respectively connected at their lower ends to a source of a vaporizable liquid fume-producing fuel and a source of combustion-supporting gas, and said burner head having a heat-retaining capacity proportioned to vaporize the liquid fuel at a point interiorly of the burner head during the normal operation of the burner and having a discharge outlet for discharging the vaporized fuel at relatively low velocity from the burner head and openings for discharging a stream of said combustion-supporting gas contiguous to the discharged fuel vapor whereby to mix therewith to effect the combustion thereof into a short flame extending laterally out from the burner head and draw a major portion of the burning fuel vapor into said stream of combustion-supporting gas to cause the resulting stream of fume to impinge on the inner surface of the article, and actuating means connected to the lower end of said burner stem for vertically moving the burner head through the interior of the article to distribute the fume particles over the desired portion of the inner surface of the article.

3. Apparatus for coating the inner surface of hollow glass articles of the open neck end type with light-diffusing particles of a fume comprising a vertically extending holder engageable at its upper end with the interior surface of the article neck to support the article upright with its neck end down, support means mounting said holder for rotational movement about its vertical axis, a burner comprising a cylindrical stem portion extending vertically through said holder and provided with a burner head at its upper end, said burner stem having separate passageways therethrough respectively connected at their lower ends to a source of a vaporizable liquid fume-producing fuel and a source of combustion-supporting gas, and said burner head having a heat-retaining capacity proportioned to vaporize the liquid fuel at a point interiorly of

the burner head during the normal operation of the burner and having discharge openings for discharging the vaporized fuel at relatively low velocity from the burner head about substantially the full periphery thereof and other openings for discharging a stream of said combustion-supporting gas about substantially the full periphery of the burner head and contiguous to the discharged fuel vapor whereby to mix therewith to effect the combustion thereof into a short flame extending laterally out from the burner head and draw a major portion of the burning fuel vapor into said stream of combustion-supporting gas to cause the resulting stream of fume to impinge on the inner surface of the article, means connected to said holder for rotating it about its axis, and actuating means connected to the lower end of said burner stem for vertically moving the burner head through the interior of the article to distribute the fume particles over the desired portion of the inner surface of the article.

4. Apparatus for coating the inner surface of hollow glass articles of the open neck end type with light-diffusing particles of a fume comprising a vertically extending holder engageable at its upper end with the interior surface of the article neck to support the article upright with its neck end down, support means mounting said holder for rotational movement about its vertical axis, a burner comprising a cylindrical stem portion extending vertically through said holder and provided with a burner head at its upper end, said burner stem having separate passageways therethrough respectively connected at their lower ends to a source of a vaporizable liquid fume-producing fuel and a source of combustion-supporting gas, and said burner head having a heat-retaining capacity proportioned to vaporize the liquid fuel at a point interiorly of the burner head during the normal operation of the burner and having an outlet for discharging the vaporized fuel at relatively low velocity laterally from the burner head and having a shield thereover for preventing the fuel vapor from burning over the upper end of the burner and for restricting the endwise distribution of fume therefrom, said burner head further having means defining a chamber having an outlet contiguous to the fuel outlet for discharging a stream of the combustion-supporting gas laterally from the burner head and contiguous to the discharged fuel vapor whereby to mix therewith to effect the combustion thereof into a short flame extending laterally out from the burner head and draw a major portion of the burner fuel vapor into said stream of combustion-supporting gas to cause the resulting stream of fume to impinge on the inner surface of the article, means connected to said holder for rotating it about its axis, and actuating means connected to the lower end of said burner stem for vertically moving the burner head through the interior of the article to distribute the fume particles over the desired portion of the inner surface of the article.

5. Apparatus for coating the inner surface of hollow glass articles of the open neck end type with light-diffusing particles of a fume comprising a vertically extending tubular holder engageable at its upper end with the interior surface of the article neck to support the article upright with its neck end down, support means mounting said holder for rotational movement about its vertical axis, a burner comprising a

cylindrical stem portion extending vertically through said holder and provided with a burner head at its upper end, said holder having an internal bearing supporting the burner for vertical reciprocation and providing for rotational movement of the holder about its axis relative to said burner, said burner head having openings for discharging a combustible fume-producing gas therefrom and having other openings for discharging a stream of combustion-supporting gas contiguous to the discharged fume-producing gas whereby a major portion of the flame of the burning fume-producing gas is drawn into said stream and the resulting fume caused to impinge on the inner surface of the article, a source of a vaporizable liquid fume-producing fuel and a source of combustion-supporting gas connected to the lower end of said burner stem in communication with separate passageways extending therethrough and respectively connected at their upper ends to the said openings in the burner head, means connected to said holder for rotating it about its axis, and actuating means connected to the lower end of said burner stem for vertically moving the burner head through the interior of the article to distribute the fume particles over the desired portion of the inner surface of the article.

6. Apparatus for coating the inner surface of hollow glass articles of the open neck end type with light-diffusing particles of a fume comprising a vertically extending tubular holder engageable at its upper end with the interior surface of the article neck to support the article upright with its neck end down, support means mounting said holder for rotational movement about its vertical axis, a burner comprising a cylindrical stem portion extending vertically through said holder and provided with a burner head at its upper end, said holder having an internal bearing supporting the burner for vertical reciprocation and providing for rotational movement of the holder about its axis relative to said burner, said burner head having openings for discharging a combustible fume-producing gas therefrom and having other openings for

discharging a stream of combustion-supporting gas contiguous to the discharged fume-producing gas whereby a major portion of the flame of the burning fume-producing gas is drawn into said stream and the resulting fume caused to impinge on the inner surface of the article, a source of a vaporizable liquid fume-producing fuel and a source of combustion-supporting gas connected to the lower end of said burner stem in communication with separate passageways extending therethrough and respectively connected at their upper ends to the said openings in the burner head, means connected to said holder for rotating it about its axis, and actuating means connected to the lower end of said burner stem for moving the burner head upwardly through the interior of the article and then retracting it downwardly out of the article to effect the desired distribution of the fume particles over the inner surface thereof, said actuating means being arranged to retract said burner downwardly at a substantially greater rate of movement than it advances the burner upwardly into the article whereby to avoid overheating of the latter.

ROBERT A. KUEBLER.

REFERENCES CITED

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

UNITED STATES PATENTS

Number	Name	Date
743,940	Sherwood	Nov. 4, 1903
1,594,202	Jalbert	July 27, 1926
1,642,418	Kovanda et al.	Sept. 13, 1927
1,865,436	Ferguson	July 5, 1932
1,871,367	Hageman et al.	Aug. 9, 1932
1,968,992	Conkling	Aug. 7, 1934
2,046,360	Bahlke et al.	July 7, 1936
2,046,592	Tracy	July 7, 1936
2,175,310	Pontius	Oct. 10, 1939
2,272,342	Hyde	Feb. 10, 1942
2,329,632	Marsden	Sept. 14, 1943
2,442,976	Heany	June 8, 1948