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APPARATUS FOR COATING HOLLOW GLASSWARE

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FIG. 1.

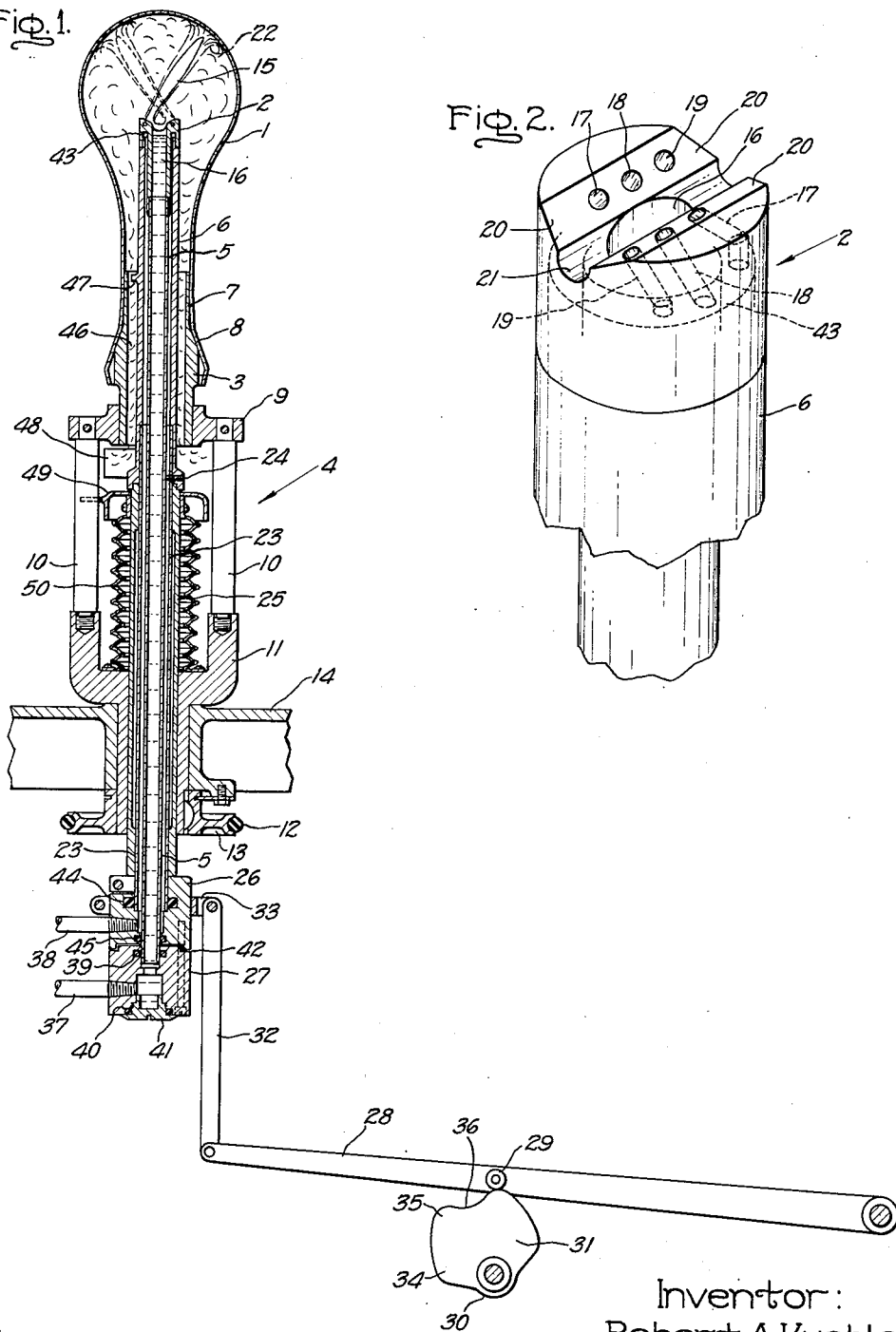
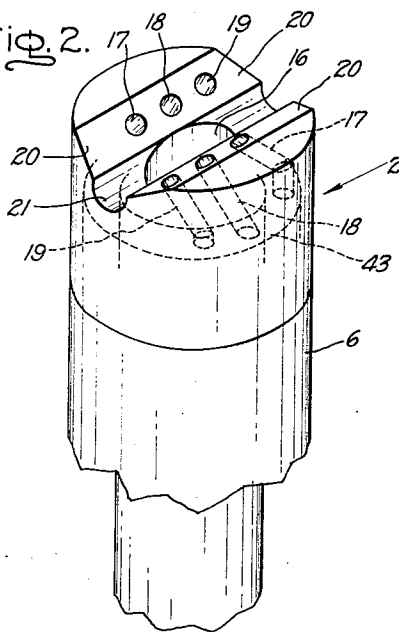


FIG. 2.



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UNITED STATES PATENT OFFICE

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APPARATUS FOR COATING HOLLOW GLASSWARE

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Application June 29, 1950, Serial No. 171,186

1 Claim. (Cl. 118—48)

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My invention relates to apparatus for depositing particles of a fume of a radiation-modifying material upon the inner surface of hollow glassware. More particularly, my invention relates to apparatus for creating extremely fine particles of radiation-modifying material and for effecting the immediate deposition thereof upon the inner surface of a hollow glass article such as a lamp bulb. The invention has particular utility in the formation of a fume of light-diffusing particles and the deposition of said particles in a uniform coating over the interior surface of a lamp bulb as broadly disclosed and claimed in patent application Serial No. 878, Marvin Pipkin, filed January 7, 1948, now Patent No. 2,545,896 and assigned to the same assignee as this application.

It has been shown heretofore that extremely fine particles of a suitable character to form an almost perfect diffusion material can be created by burning a combustible silicon compound such as ethyl silicate. Such particles can be caused to deposit upon an article directly after formation and are sufficiently adherent to remain fixed to said article during certain uses thereof. The particles can, for instance, be deposited upon the inner surface of an incandescent lamp bulb and will remain in place thereon without further treatment during the operations of making the lamp and during the period of use thereof.

One object of my invention is to provide apparatus for effectively burning a combustible compound capable of producing a product of extremely fine particle size.

Another object of my invention is to provide apparatus for producing, by burning, a fume of particles of extremely small size within hollow glassware without injury thereto and in a manner effecting a desired distribution of the particles over the interior surface of the glassware.

Another object of my invention is to provide a burner and associated apparatus for the effective production and distribution of extremely small particles upon the interior surface of hollow articles, which burner and associated apparatus are adapted to extended periods of operation by remaining as free as possible of deposited particles and by being as completely sealed as possible from said particles. To this end, the burner is constructed so as to throw the particles outward therefrom and so as to be readily brushed free of extraneous particles. The associated apparatus is subject to the collection of a much greater deposit of particles and is provided with means for automatically retaining its effectiveness by cleaning the deposit therefrom.

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And still another object of my invention is to provide a burner for effectively producing a radiation-modifying product within hollow glassware from fluid materials combining under certain conditions a very volatile and explosive mixture which burner is particularly adapted to control the mixing and combustion of said fluid materials and which is particularly adapted to prevent the accidental mixing and possible explosion thereof.

A preferred embodiment of my invention provides apparatus for directing a relatively restricted flow of a gaseous combustible material, having a suitable radiation-modifying product of combustion, and a gaseous combustion-supporting material in a manner to support a continuous burning and to develop a substantially uniform outward spread of fume comprised of particles of the product. The apparatus is also preferably adapted to convert the combustible material from a liquid to a gaseous state by the introduction of heat therein and, by discharging said combustible material at a lower elevation than the combustion-supporting material, preventing the accidental overflow of the liquid combustible material into the portions of the apparatus containing said combustion-supporting material and the development of explosive mixtures in these portions. Apparatus is also provided for holding the hollow glassware and the source of the radiation-modifying material at operative relation and for effecting a suitable relative movement thereof to control the deposition of said material over the surface of the glassware. Apparatus of the above type produces an excess of the radiation-modifying material which is prevented from depositing upon and interfering with the operation of the apparatus by the particular design thereof and by suitable shields and self-cleaning means incorporated therein.

Still other objects and features of my invention will appear from the following detailed description and from the drawing.

In the drawing, Fig. 1 is a vertical section through a burner for developing a source of light-modifying particles, a holder for supporting a glass bulb in operative relation to the burner, and apparatus for effecting the operation of the burner and holder and for effecting relative motion therebetween; and Fig. 2 is a perspective view on a larger scale of the burner with certain internal passages therein indicated in dot-dash lines.

The apparatus shown in the drawing provides

for the deposition of a light-diffusing material directly on the inner surface of a vitreous bulb 1 for an electric incandescent lamp immediately upon the formation of said light-diffusing material in the flame of the burner 2. This particularly effective manner of producing and depositing a light-diffusing material corresponds generally to that disclosed in the aforesaid United States patent application of Marvin Pipkin and provides for the ready application of a highly efficient light-diffusing material onto the bulb surface in a particularly satisfactory manner. Light-diffusing material applied to a bulb in the prescribed manner is retained by the bulb surface without benefit of a binder.

The bulb 1 rests in an inverted position on the upstanding collar 3 of the holder 4 surrounding the inner and outer support tubes 5 and 6 for the burner 2 and is aligned longitudinally with the vertically extending burner 2. The cycle of operation having to do with bulb 1 is initiated with the burner 2 at a position immediately above the locating flange or shield 7 on the top edge of collar 3. The bulb 1 is properly positioned within the apparatus by the engagement of the flange 7 with the open neck thereof and the seating of the outwardly flared end portion 8 of said neck upon the correspondingly flared portion of the collar 3 and is accordingly aligned and fixed at an elevation determined by the cooperative functions of said flange 7 and said flared portions 8. The relative position of the bulb 1 within the apparatus is determined by the holder 4 which is located upon the platform 9 carried by the support columns 10—10 on the main body 11 of said holder 4.

During the entire cycle of operation, a relative rotative motion occurs between the bulb 1 and the burner 2 in that the holder 4 is rotated through a belt 12 engaging a sheave 13 on the lower end of the main body 11 thereof which extends through and is supported by the bracket 14. A source of energy, not shown, moves the belt 12 at a sufficiently rapid speed to cause a moderate rate of rotation in the bulb 1 whereby a sufficiently rapid relative movement of the bulb surface and the burner 2 occurs to neutralize the effect of any nonuniform distribution of the light-diffusing material about said burner 2. Support for the apparatus is provided in the bracket 14 which can be in the form of a stationary table or a turret which is indexed to carry the burner to bulb-loading and other work stations in turn.

The light-diffusing material deposited upon the interior surface of the bulb 1 is the product of a controlled burning of ethyl silicate vapors in the presence of oxygen and air and first appears in the apparatus in the form of a fume thrown off from the flames 15 over the upper end of said burner 2. Heat absorbed by the burner 2 from the flames 15 causes liquid ethyl silicate located within a relatively large central well 16 to boil off as a vapor which burns over the upper end thereof. However, comparatively little of the ethyl silicate vapors burn close to the outer surface of the burner 2 as a series of three outlets 17, 18, and 19 on diametrically opposite sides of the central well 16 direct streams of oxygen from the end surface of the burner 2 and the majority of the free ethyl silicate vapors is sucked into and directed away from the burner 2 by these streams. The three outlets 17, 18, and 19 of each group extend from oblique end faces 20—20 on the burner 2 at opposite sides of a rela-

tively deep transverse channel 21 thereacross and are accordingly directed across the axis of said burner 2. Each group of outlets 17, 18, and 19 are also offset oppositely from the center of the burner 2 and are inclined oppositely to the faces 20—20 so that the gas streams discharged thereby are directed over different end portions of said burner 2 and pass without interference from each other toward the opposite bulb wall.

In other words, all the passages 17, 18, 19 in a given one of the two groups are inclined in the same general direction with respect to the vertical axis of the tubes 5, 6 and head 2, and each group of passages have their axes inclined toward a vertical plane extending through the said vertical axis and through the axis of the channel 21; the two groups of passages 17, 18, 19 also have their respective axes inclined in opposite directions with respect to a second vertical plane extending through said vertical axis normal to the first-mentioned plane, and the projected axes of respective groups of passages extend across opposite sides of the head 2 without intersecting at any point whereby the two groups project distinct non-intersecting flames which cross over above the said head.

The manner of directing the flames 15 across the end of the burner 2 gives a swirling motion thereto and keeps the higher temperature zone close in around the burner 2 so as to allow the use thereof within the relatively confining neck portion of the bulb 1 without causing said neck to be heated to an extent that it cracks or is injured. The outlets 17 in opposite halves of the burner 2 are at somewhat greater inclination to the burner faces 20—20 than the other outlets 18 and 19 to cause the outer fringe of the gas discharge therefrom to pass each other without interference and together with said outlets 18 and 19 discharge sufficient oxygen to cause separate streams 22 of concentrated fume to develop beyond the flames 15. These streams 22 of fume wipe the neck of the bulb 1 when the burner 2 is located adjacent the top of the locating flange 7 and are the source of the majority of the light-diffusing material deposited upon said neck portion.

The burner 2 is, at all times during the operation of the apparatus, at an elevation determined by the vertical position of the support means comprised of the outer tube 6 and a further extent thereof in the tub 23 which passes down through the main body 11 of the holder 4 to operating means located below the support bracket 14. Overlapping portions of the outer support tube 6 and the tube 23 are fastened together by a screw 24 which also holds the inner support tube 5 in place through engagement with a depression in the side wall thereof. The burner support means includes a sleeve 25 around the tube 23 and is retained by the operating means through engagement with the oxygen connection block 26 which is clamped to the lower end of said tube 23. A second connection block 27 fastened to the bottom surface of connection block 26 provides the means of supplying ethyl silicate to the bottom end of the inner support tube 5.

The cycle of operation is initiated with the burner 2 located directly above the top edge of the locating flange 7 as, at that time, the lever 28 of the operating means is then at a lowered position in which the roller 29 thereon rides on the low portion 30 of the cam 31 and holds the oxygen connection block 26, to which it is attached by link 32 and the split collar 33, and the burner

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assembly at a correspondingly lower position. The burner 2 is not allowed to remain at this position after the start of the cycle because of the relatively restricted bulb area to be coated with the light-diffusing material and is gradually raised to the position shown by rotation of other higher portions 34 and 35 of the cam 31 into position below the roller 29. The rate of movement is to a considerable extent determined by the bulb area to be covered by the light-diffusing material at any particular moment; however, said rate must also be less when the burner 2 passes into the upper portion of the bulb as the concentrated streams 22 of the fume do not then wipe the surface thereof and relatively more time must be allowed for said material to deposit from the slower moving fume. The considerably greater area of the upper portion of the bulb 1 increases the amount of light-diffusion material required in the upper portion of the movement of the burner 2 and said burner 2 is caused to oscillate up and down through a short stroke by the advance of a hollow 36 in the cam 31 into engagement with the roller 29 to provide said additional material. The fume within the bulb 1 takes both a vertical curling motion and a spiralling motion because of the form of the bulb 1 and the particular direction of the oxygen discharge from the burner 2. Accordingly, all portions of said fume repeatedly wipe or "paint" the inner surface of said bulb 1 and produce thereon as uniform a coating of light-diffusing material as possible. The end of the cycle of operation is reached following a gradual lowering movement of the burner 2 during which the concentrated fume streams 22 again impinge upon the bulb neck and deposit a second application of light-diffusing material directly thereto.

The rates of burning of the ethyl silicate and flow of oxygen are both preferably controlled through adjustments of the sources of supply which are coupled to the connection blocks 27 and 28, respectively, by the pipes 37 and 38, respectively. The flow of ethyl silicate, for instance, is restricted to an amount required to produce the specific coating requirements of the bulb 1 and accordingly is such as to allow that amount of ethyl silicate to rise to the hot top of the burner 2. The ethyl silicate flows from the end of the pipe 37 to a chamber in the center of the connection block 27 and from there passes directly up the hollow center of the inner support tube 5 to the well in the center burner 2. Leakage of the ethyl silicate, which under certain conditions is explosive, is prevented by the packing rings 39 and 40 which are located between the connection block 27 and the support tube 5 on one hand and between said connection block 27 and the clean-out plug 41 on the other hand. However, should some leakage occur between the connection blocks 28 and 27, it will be dissipated in the open air since vent grooves 42 between the abutted faces thereof allow it to escape.

Obviously, different operative conditions occur when the apparatus is initially placed in operation at the start of a day since the burner 2 is not then at the elevated temperature it maintains during normal operation. Accordingly, the controls must be adjusted so that less ethyl silicate passes to the burner 2 during the warming-up period to prevent liquid ethyl silicate from flowing out the top of the burner 2. Should the liquid ethyl silicate be fed to the burner 2 at such a rate that it flows out the end of the well 16, no damage can result as it will drain away from well

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16 through the channel 21 and will not mix with the oxygen.

It is imperative that the outlets 17, 18, and 19 be at a higher elevation than the well 16 to prevent liquid ethyl silicate from flowing in and mixing with the oxygen therein as such a mixture is violently explosive. The oxygen introduced into the apparatus through the pipe 38 enters a chamber in the connection block 28 about the inner support tube 5 and flows upward through the lower end of the tube 23 and thence through the outer support tube 6 to a ring-shaped opening 43 in the burner 2, the lower terminus for the outlets 17, 18, and 19. Although the rate of flow of the oxygen is less critical than that of the ethyl silicate, it must be controlled so that a desired character of silica is formed and so that the extent of the flames 15 and the fume streams 22 will not injure the bulb 1 and still coat it properly. A deficiency of oxygen is to be avoided since it produces a dense black and streaked coating and permits a considerable deposit of silica to quickly collect on the burner 2 preventing its satisfactory operation. Some deposit does collect upon the burner 2 in normal usage, and it is desirable for said burner 2 to be cleaned with a wire brush at intervals. The design of the burner 2 is such as to collect a minimum amount of fume and such as to be readily cleaned by a brush. Leakage of oxygen from the connection block 28 is prevented by the packing ring 44 between it and the tube 23 and by the packing ring 45 between it and the inner support ring 5.

During the normal operation of the apparatus when a bulb 1 is in place over the burner 2, a comparatively slow circulation of air and fume occurs from the bulb 1 through the vent 46 provided between the support collar 3 for said bulb 1 and the outer support tube 6. This passage of the fume through the vent 46 causes a certain amount of the silica to deposit upon the surfaces of the collar 3 where it could possibly block the free circulation of gases from the bulb 1 if allowed to build up to any extent. However, scraper 47 at one point on the support tube 6 extends into the vent 46 and sweeps the deposit from the full length of the collar 3 in the course of the rotative motion of said collar 3 and the vertical motion of the support tube 6 in each cycle of operation. The excess silica dislodged from the vent 46 and the fume passing there-through is thrown clear of the apparatus by the air currents established by the vane 48 on the lower end of the support tube 6. The relative rotation of the collar 3 and the other parts of the holder 4 also creates a mild suction within the vent 46 which assists in withdrawing the fume therethrough and scrapes the deposit of silica that finally collects on the parts within the adjacent area after extended operating periods. A shield 49 and the seal provided by the bellows 50, which rotates with the holder 4 and the sleeve 25, prevent the silica from depositing upon the outer surface of said sleeve 25 and accordingly interfering with the slipping of the said sleeve 25 in the main body 13 of the holder 4 during the vertical movements thereof.

Although a preferred embodiment of my invention is disclosed, it will be understood that the invention, as defined by the claim, can be widely modified within the spirit and scope thereof and is not limited to specific construction and arrangement of parts shown.

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

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In apparatus for coating the interior surfaces of hollow bodies, a liquid fuel burner comprising vertically arranged concentric inner and outer tubes, a burner head mounted on the upper ends of said tubes and having an axial vertical aperture therethrough aligned with the bore of said inner tube and also having an annular portion connected at its periphery to said outer tube, said head having a channel extending diametrically across the upper face thereof through said aperture, a group of outlet passages in said annular portion of the head at each side of said channel, said passages communicating at one end with the annular space between said tubes and terminating in orifices at the top of said head above the bottom of said channel, all the passages in a given group being inclined in the same general direction with respect to the vertical axis of said tubes and head, each group of passages having their axes inclined toward a vertical plane extending through said vertical axis and through the axis of said channel, the two groups of passages also having their respective axes inclined in opposite directions with respect to a second vertical plane extending through said vertical axis normal to the first-mentioned

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plane and the projected axes of respective groups of passages extending across opposite sides of said head without intersecting at any point whereby the two groups project distinct non-intersecting flames which cross over above said head, means to supply liquid fuel through said inner tube to the aperture in said head, and means to supply a combustion-supporting gas through the annular space between said tubes to said passages.

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