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SPIN-COATING MACHINE
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1 Claim

ABSTRACT OF THE DISCLOSURE

An improved device for applying coating solutions to spectacle lenses. The device includes an adjustable lens holder rotatably mounted in a sealed, glass-walled compartment, a coating applicator, and means for introduc- ing filtered, dehumidified air under pressure into the compartment. A vacuum chamber connected to a vacuum de-
vice is positioned around said lens holder. When in operation, a controlled air flow is maintained around the vicin-
ity of the spinning lens, as a result of the pressure differ-
cential created between the positive pressure within the compartment and the vacuum in the area of the spinning

lens. By use of this invention, the problem of speckling or

mottling is eliminated. The sealed chamber includes
glove means sealingly secured to openings in the chamber

wall and permitting operator-manipulation within the cham-

ber. At least one oven is incorporated into the struc-
ture defining the compartment and includes plural door

means whereby entry into the oven can be from both

within said without the compartment.

Field of the invention

Apparatus for spin-coating lenses and filters, including a controlled air flow in the area of the spinning lens.

Description of the prior art

Lenses and filters have in the past been spin-coated by

depositing on the center of the article to be coated a pre-
determined amount of the coating material and spinning the lens or filter to produce a thin film, as is shown in British patent specification 571,238. Prior art devices pre-

sent problems in uniformly coating certain elongated lens

shapes especially when the concave side of a lens is being

coated. Many of today's lenses, especially those used in

women's spectacles, are designed with a short axis and a long axis. As a result, the liquid coating material ap-
plied to the surface and spun off at the short axis is

picked up along the surface of the long axis as the lens

rotates, causing speckling or mottling of the surface along

the long axis. By providing a pressure differential in ac-

cordance with this invention, a controlled air flow in the

area of the spinning lens is produced so that material

spun off is drawn clear of the surface to be coated and the

problem of speckling or mottling is eliminated.

Summary

A spin-coating machine including a sealed compart-

ment and means for introducing filtered, dehumidified,

heated air under a positive pressure into said compart-
mnt and a vacuum cavity producing a pressure differen-
tial in the area of the spinning lens for controlled with-
drawal and flow of said air around the spinning lens.

It is an object of this invention to provide an im-

proved device for spin-coating lenses by providing an

environment free of dust and water vapor.

It is a further object of this invention to provide an

improved device wherein the problem of speckling or

mottling of the coated lens is eliminated by a controlled

air flow around the spinning lens.

Brief description of the drawing

FIG. 1 is a perspective view of an embodiment of the invention.
FIG. 2 is a sectional view taken along line 2—2 of FIG. 1 with the operator removed.
FIG. 3 is an enlarged cross-sectional view of the vacuum chamber of the invention.
FIG. 4 is an exploded perspective cross-sectional view of the vacuum chamber as shown in FIG. 3.
FIG. 5 is a top view in diagrammatic form showing the flow of coating material.
FIG. 6 is a diagrammatic view similar to FIG. 5 but showing the lens in a position one-quarter of a revolu-
tion from the position shown in FIG. 5.
FIG. 7 is a side view of a spinning lens showing diagrammatically the controlled air flow that results from the invention.

The spin-coating machine of this invention consists of a booth generally indicated by the numeral 10, com-
prising a sealed compartment 12 supported by bench 14.
Compartment 12 is built up from floor 18, side walls 20, 22, rear wall 24, top cover 25 and front wall 27. Front wall 27 facing operator 26 is provided with two vertical
glass panels 28 and 30. Separating glass panels 28 and 30 is a vertical metal sheet 32 having formed therein
two openings 34 and 36, which are fitted with gauntlets 38 and 39. These may be made of parachute nylon or other light impervious sheet fabric material. Said gaun-
lets are tightened to operator 26 at the wrists and pro-

vide a means whereby operator 26 can extend both hands

into the interior of compartment 12 while maintaining

said compartment in a sealed condition. Directly above
metal sheet 32 carrying gauntlets 38 and 39 is located
movable glass cover 40, which slopes backward at an
angle of about 45° and is hingedly joined by hinge 41
to top 25 of compartment 12. A sealing material such as
foam rubber is applied about the periphery of cover
40 to provide a tight seal between cover 40 and the ad-

nacent edges of the frame in which it sits. Integral-

ly joined to glass panel 28 and top 25 is glass side panel
43 and joined in the same manner to glass panel 30 is
glass side panel 45. Located on each side of said gaun-

tlets, so placed to be conveniently reached by said opera-
tor, are ovens 44 and 46. Constructed of monolithic

insulating refractory blocks, and heated by wire-wound
heating units. In a typical embodiment said heating units

are so positioned on the top and bottom of the oven as

to provide for a uniform distribution of heat. Hingedly

located on the front and back of said oven is framed
door 48 also insulated with a monolithic refractory ma-

terial. In a typical embodiment, both ovens protrude

through rear wall 24 as is shown in FIG. 2. Lenses placed

in an oven after being spin-coated, through the front
door, can be removed by the operator from the rear
door without entering into compartment 12 through

either cover 40 or gauntlets 38. Formed in floor 18 in-

termediate between said gauntlets is aperture 50. Located
directly beneath said aperture and symmetrically oriented

with respect thereto is spin pan 52 having the general

shape of a cylinder.

Spin pan 52 is supported by brace 49 and sealed to

the underside of floor 18 of compartment 12 by gasket
51. Located beneath spin pan 52 is electric motor 54
having a rotatable shaft 56 extending through aperture

57 formed in the center of said spin pan. Fixedly at-

tached to shaft 56 as by set screw 61, is chuck 58, de-

signed to receive lens holder 59 such as that described

in U.S. Patent No. 3,356,902, assigned to the assignee

of the instant application.

An electrical speed control device for said rotating
haunt, not shown, is located on a rear wall of said compartment within said operator's reach, and is capable of providing various speeds of rotation of motor 54 within the range of 100 to 4,000 revolutions per minute, as elected by the operator. Secured to floor 18 is mounting lage 60. Positioned in said flange is standard 62 having pivotally joined thereto arm 64 which has attached herein clamp 66. Said clamp provides means for securely holding coating solution applicator 68 at the desired elevation and orientation over the lens chuck. Said applicator is generally comprised of tank 70 fitted with filter 71. Tank 70 is fused to stockpole unit 72, which itself is fused to stem 73 having formed therein a suitably sized orifice 75. A pressure, not shown, is connected by means of air line 74 to tank 70 by means of rubber stopper 79. Proper pressure is applied to the liquid in said tank by means of an adjustable manually operated pressure reducing valve, now shown. When said stockpole is turned on, liquid coating materials are metered by pressure applied to said tank through said air line.

Secured to top 25 is housing 76 which houses a standard 300m dehumidification unit mounted above a dust filter, not shown. Mounted adjacent to housing 76 is slower 77 operated by motor 82. Said blower pulls air through the dust filter and the dehumidifier. The dust-free, dehumidified air is thus blown through an aperture, not shown, in top 25 onto heating coils 78 mounted on sable 80. A thermostat, not shown, is provided to control the temperature of the heated air within said compartment. This mechanism supplies dehumidified, dust-filtered, heated air under a moderate degree of pressure into the compartment.

Located beneath said compartment is a suction device, such as a vacuum cleaner indicated by the numeral 82, having a hose 84 which is connected to a T-joint 87. Formed in said hose beneath said T-joint is suction by-pass vent 86 over which is irrationally fixed rotatable vent cover 88. Attached to T-joint 87 are two suction hoses 90 which are attached to elbows 92. The base of said spin pan has formed therein ducts 94 over which is received elbow 92. So designed to be received by said ducts 94 is a vacuum chamber, generally indicated by the numeral 95. Said chamber includes a bottom circular plate 96 having an outer flanged rim 101, a central aperture 97 and two ducts 99 which extend in an opposite direction from said rim and are coupled to ducts 94 in said spin pan. Vacuum chamber 95 has an upper disc-like plate 98 having formed therein a central aperture 100 corresponding to aperture 97 on lower plate 96 and having an outer flanged rim 102 which is telescoped on rim 101 on lower plate 96. The vacuum chamber, when connected to the vacuum device as described above, causes a high velocity air flow from the inside of the closed booth over the surface of the spinning lens. The air flow has a large radial component of motion for a purpose which will be described.

A slight positive pressure is maintained within the booth by adjusting the influx of air from blower 77 with relation to the exhaust of air caused by vacuum device 82.

In prior art spin-coating devices, serious problems resulted when attempts were made to uniformly coat elongated lens shapes, which are currently employed in a majority of woman's spectacles. The problem is especially acute when coating the concave side of the elongated lens. As is shown diagrammatically in FIGS. 5 and 6, the liquid coating material which is applied to the center of the spinning lens can result in an uneven coating. As the lens is spinning the coating material deposited on the center of the lens is spread out radially until spun off by centrifugal force at the edge of the lens. In FIG. 5 the letters x are intended to represent droplets of coating material flung off the short axis of the spinning lens. When a lens spins at 3600 revolutions per minute, a complete revolution is made in 1/960 of a second, and the thin liquid coating centrifugally thrown from the center of the lens to its periphery at short axis s is picked up by long axis l as it passes through the air 1/960 of a second later. In FIGS. 5 and 6 the arrow lettered D indicates the direction of rotation of the spinning lens. This results in speckling or mottling of the surface along the long axis, represented by the letter x. In FIG. 6. By use of the instant invention, the problem of speckling the surface along the long axis has been overcome. By providing a positive pressure within the booth and suction concentric to the spinning lens, two important results are obtained. First, the dry, filtered, dehumidified air under positive pressure within the compartment, reinforces this introduction of dust and water vapor within the booth which would, if present, present high quality coatings, and, second, the controllable pressure differential results in a controlled air flow which carries away droplets of the coating material spun off the surface along the short axis as is shown diagrammatically in FIG. 7 before speckling or mottling of the surface along the long axis can result. In FIGS. 3 and 7 the arrows labelled F indicate the direction of the controlled air flow resulting from the pressure differential. When in operation, the pressure differential is controlled by means of vent 86, previously described, over which is irrationally fixed rotatable vent cover 88. While I am, at present, uncertain as to the reason the radial air flow entirely eliminates the redepositing of liquid droplets along the long axis of the lens, exhaustive tests have shown that in fact no such droplets are re-deposited. Although it is not my intention to be restricted to a particular theory, it is believed that the flow of air over the surface of the lens tends to lift the droplets just enough that they clear the long axis and are then carried off by the force of the flowing air before the droplet can redeposit on the spinning lens. The pressure differential is adjusted to produce an air flow over the spinning lens having a velocity fast enough to carry away droplets flung off at the surface along the short axis before being picked up at the surface along the long axis.

Operation

Lenses to be coated are placed within the compartment through cover 40. Coating material is placed within tank 70 by access through the same cover 40. With a supply of uncoated lenses within said compartment and with said tank filled with a coating material, the cover is closed. Further access into said compartment is accomplished by the operator inserting his hands through gauntlets 38 and 39. A lens to be coated is placed on the holder, washed by squirting a lens cleaning solution from a squeeze bottle, and rotated at 3600 revolutions per minute until dry. Coating applicator 68 is then positioned over the center of the lens, the stockpole is then turned one-half a turn, and a predetermined amount of coating material is deposited on the lens by a regulated pattern applied along air line 74 as previously described. The lens is then spun at 3600 revolutions per minute until evenly coating and partially dried, removed and placed on a rack, which is not shown, and the rack, when filled, is placed within one of said ovens, which has been preheated, and baked. The oven is then cooled and the coated lenses are removed by an operator from the rear of the oven. The speed at which a lens is spun, baking time, drying temperature, cooling time and cooling temperature are factors which are dependent on the nature of the coating solution used and are not part of the present invention.

I claim:
1. A spin-coating machine comprising:
   (a) a generally sealed compartment;
   (b) an adjustable lens holder mounted on a motor driven vertically disposed shaft and adapted to secure a horizontally arranged lens;
(c) nozzle means located in an upper portion of the chamber, in general alignment with said shaft whereby coating fluid may be dispensed centrally upon the upper face of said lens;

(d) means providing a flow of filtered, dehumidified and heated air into said compartment and directed generally centrally upon said coated surface;

(e) means to effect a vacuum in said chamber and comprising a conduit system having an intake which includes a pair of horizontally arranged concentric ring-plate elements disposed respectively above and below said secured lens and the internal diameters of which approximate the diameter of said lens, whereby said air flow is drawn peripherally from said lens;

(f) at least one oven means incorporated into the structure defining said chamber and including door means on both inner and outer oven walls whereby said oven may be entered from both within and external of said chamber;

(g) glove means sealingly secured to openings in a wall of said chamber whereby an operator may manipulate both the structure and lens within said chamber without breaking the chamber seal.

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U.S. Cl. X.R.