Sept. 21, 1948. A. H. LAIDIG ET AL 2,449,783

APPARATUS FOR COATING THE INSIDE SURFACES OF TUBULAR VITREOUS ENVELOPES

Filed Sept. 30, 1943 3 Sheets-Sheet 1

Fig. 1.

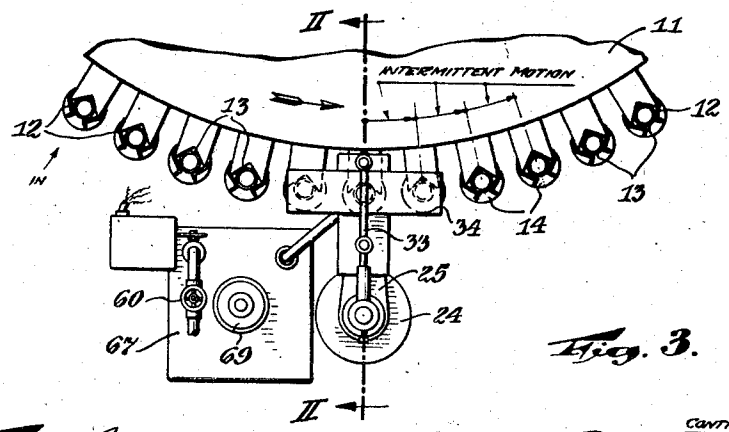


Fig. 3.

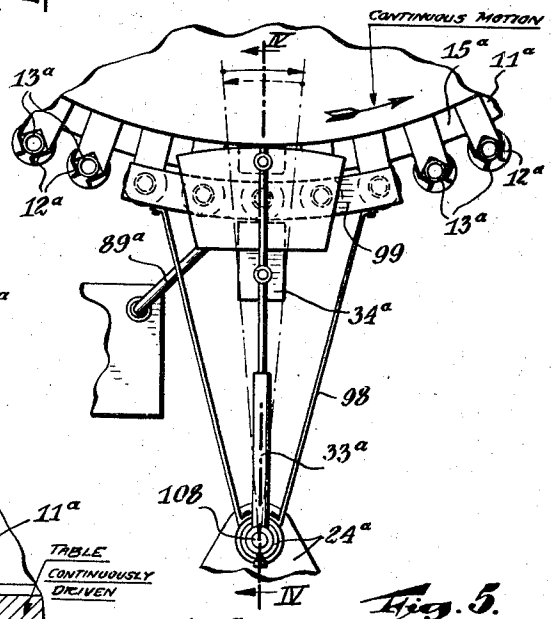


Fig. 4.

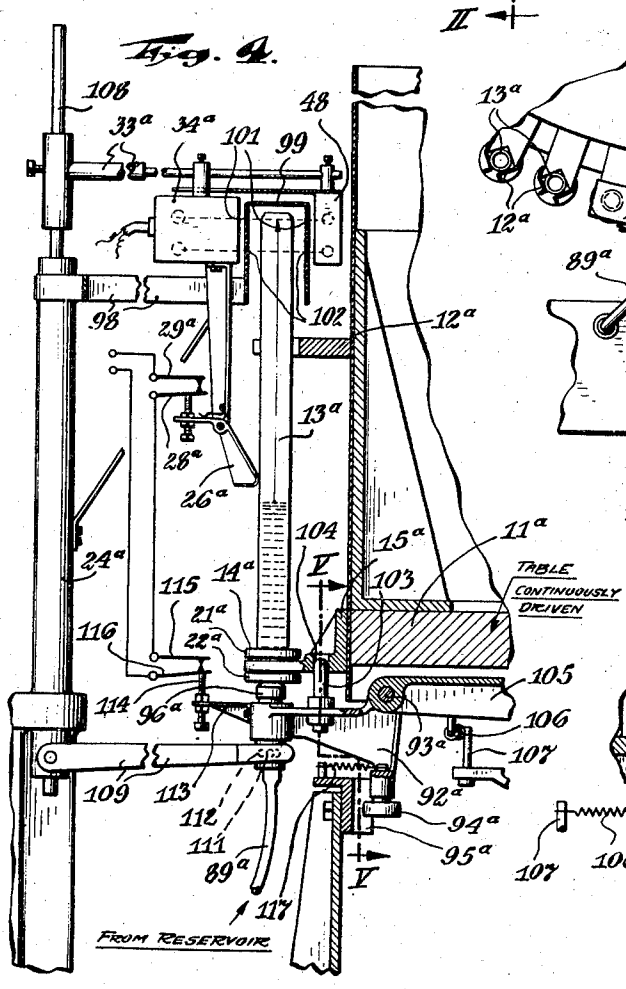
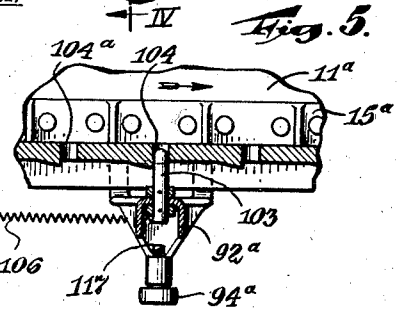


Fig. 5.



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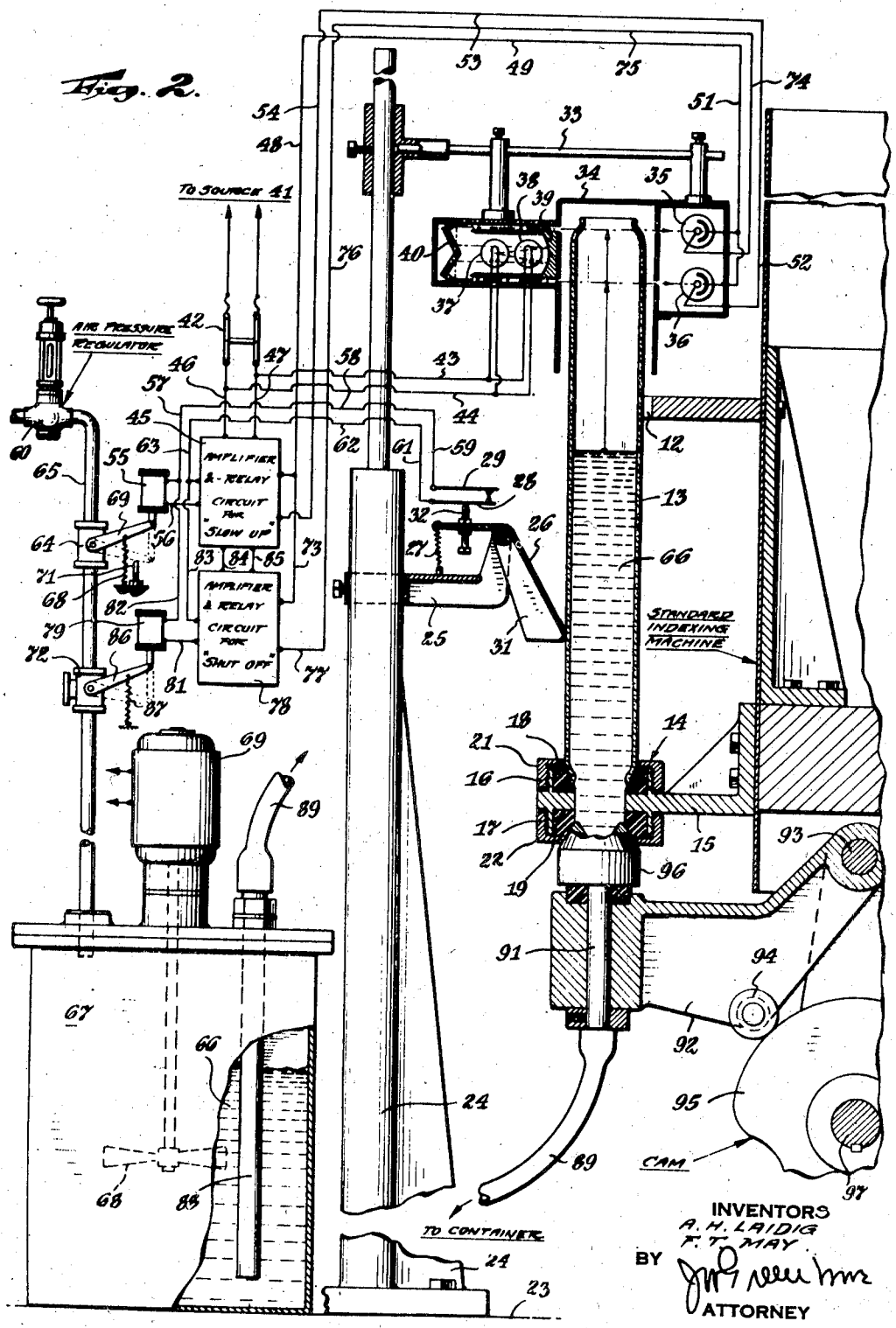
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Fig. 2.



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Fig. 6.

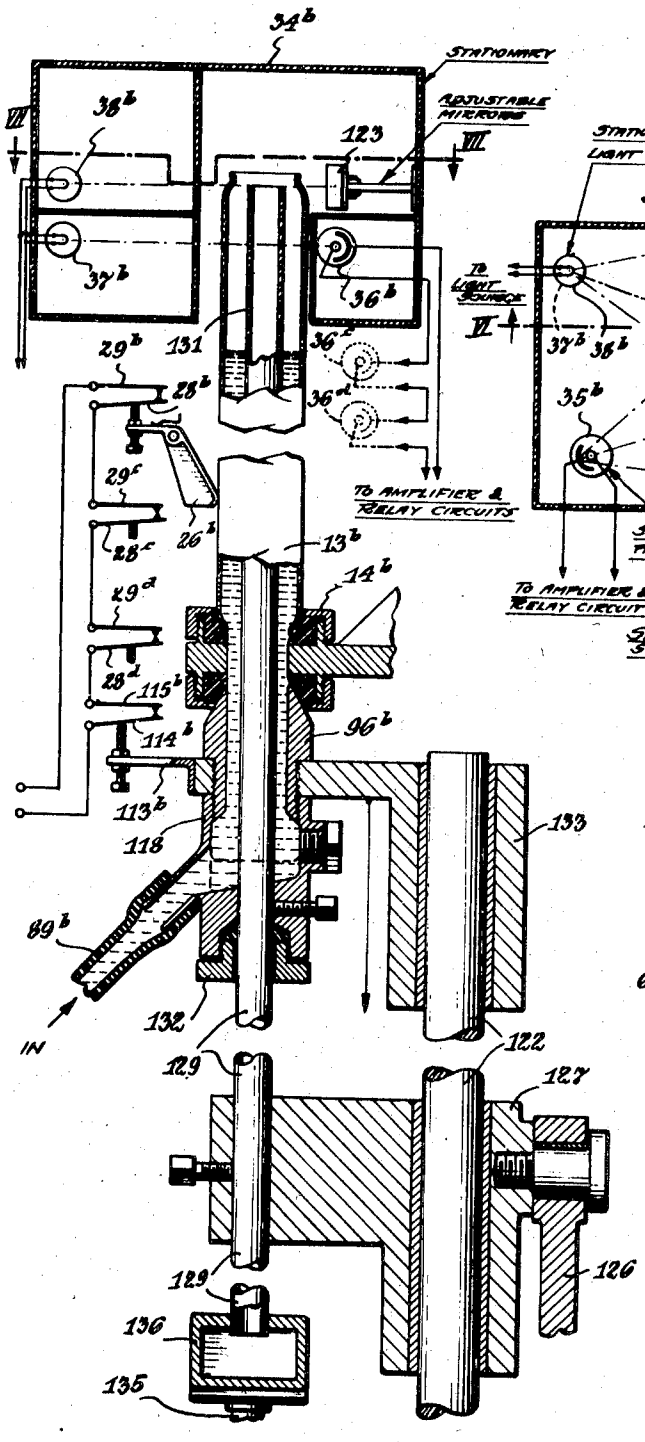


Fig. 7.

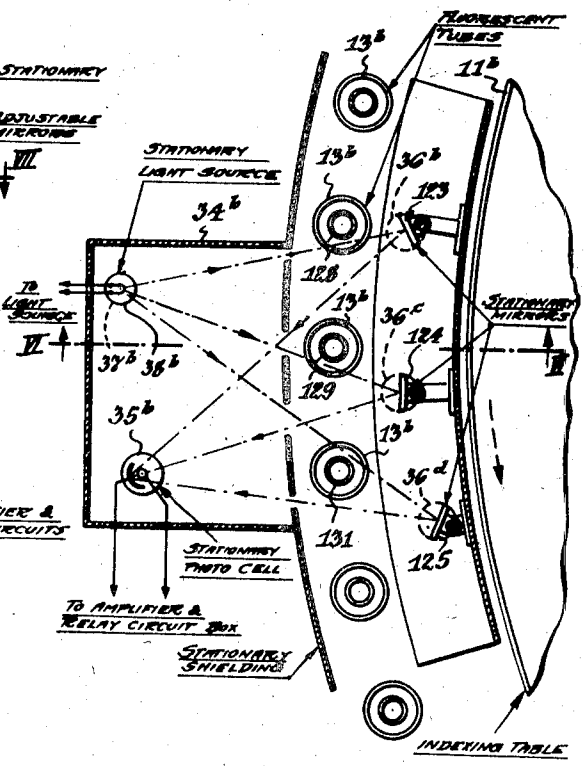
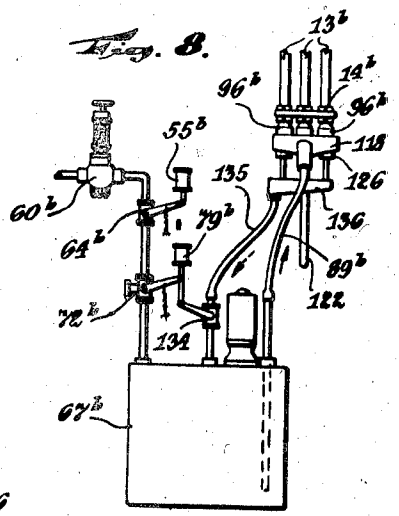


Fig. 8.



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Patented Sept. 21, 1948

2,449,783

UNITED STATES PATENT OFFICE

2,449,783

APPARATUS FOR COATING THE INSIDE SURFACES OF TUBULAR VITREOUS ENVELOPES

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Application September 30, 1943, Serial No. 504,372

9 Claims. (Cl. 91—18)

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This invention relates to coating vitreous envelopes, and, more particularly, the inside surfaces of elongated tubes such as employed for fluorescent lamps and the like.

The principal object of our invention, generally considered, is to automatically coat the inside surfaces of vitreous envelopes uniformly and in an economical and convenient manner, with safety means provided to avoid overflow of the coating material.

Another object of our invention is to provide control means, including such detectors as photocells, for shutting off the supply of coating material at the proper time and causing it to drain out of the envelope being coated.

A further object of our invention is the provision of apparatus for coating the inside surfaces of elongated vitreous envelopes comprising a carrier for a plurality of said envelopes, means for either successively indexing said envelopes or moving them at a predetermined rate of speed, a reservoir of coating material, a flexible connecting tube from said reservoir, means for causing said tube to temporarily connect with one or more of said envelopes, a source of compressed air, means connecting said source to said reservoir, and means for admitting compressed air to said reservoir above the coating material to, at the proper time, force said coating material into one or more of the vitreous envelopes, means being provided to at the proper time shut off and drain the coating material from said envelope, or envelopes, thereby preventing overflow and insuring that the coating thereon will be uniform.

Other objects and advantages of the invention, relating to the particular arrangement and construction of the various parts, will become apparent as the description proceeds.

In the drawings,

Fig. 1 is a fragmentary plan of mechanism embodying our invention.

Fig. 2 is a fragmentary vertical sectional view on the line II—II of Fig. 1, in the direction of the arrows, and on a larger scale.

Fig. 3 is a view corresponding to Fig. 1 but showing another embodiment of our invention.

Fig. 4 is a fragmentary vertical sectional view on the line IV—IV of Fig. 3, in the direction of the arrows, and on a larger scale.

Fig. 5 is a fragmentary vertical sectional view on the line V—V of Fig. 4, in the direction of the arrows.

Fig. 6 is a view corresponding to Fig. 2, but showing a further embodiment of our invention.

Fig. 7 is a horizontal sectional view on the line VII—VII of Fig. 6, in the direction of the arrows.

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Fig. 8 is an elevational view, on a small scale, of part of the apparatus of the form of Figs. 6 and 7.

A purpose of the present invention is to obviate the necessity of having an operator watch the rise of the liquid, of the fluorescent or other mixture, in an envelope being coated, in order to shut off the air pressure as soon as the liquid reaches the upper end of said envelope. Such an operation is dependent solely on the constant alertness and good judgment of the operator, as each envelope must be completely coated during one continuous rise and fall of the liquid in order to achieve the best results.

Referring now to the drawing in detail, like parts being designated by like reference characters, and first considering the embodiment of our invention illustrated in Figs. 1 and 2, there is shown a coating machine comprising a conveyor 11 having a plurality of clips 12 between which are held elongated light-pervious vitreous envelopes or tubes 13, such as those employed in the manufacture of fluorescent lamps, that is, they may be generally cylindrical hollow tubes open at top and bottom. The conveyor 11 rotates and is adapted to periodically index or stop after it has turned a distance equal to the circumferential distance between adjacent tubes, times the number of tubes handled at once, which in the present embodiment is one.

In addition to the clips 12, there are in the present embodiment sockets 14 for holding the tubes 13, comprising supporting brackets 15 with upstanding and depending threaded cylindrical portion 16 and 17 receiving rubber packing members 18 and 19, held in place as by means of hollow nuts 21 and 22. Each nut 21 may be so adjusted that the packing 18 enclosed is just right to hold the lower end of the associated tube 13, making a fluid tight connection therewith.

Associated with the conveyor 11 is a table, bench or other support 23, from which projects a standard or pedestal 24 carrying a bracket 25, on which is pivotally-mounted a bell crank lever 26, one arm 31 of which is normally urged toward the conveyor by a coil spring 27, so as to release the lower contact element 28 from its cooperating element 29 and open a control circuit when there is no tube in place. When, however, the tube 13 is in place, as illustrated in Fig. 2, it engages the inclined arm 31 of said lever 26 and causes the adjustable set screw 32 thereof to push the lower contact element 28 against its associated element

29 to close the control circuit and put the apparatus in condition for operation.

The standard 24 also has another bracket 33 which adjustably carries a housing 34 containing an upper photocell or similar sensitive element 35, a lower photocell or similar sensitive element 36, a light source which, for safety purposes, may comprise two incandescent electric lamps 37 and 38, and means such as mirrors 39 and 40 for directing horizontal beams of light to the photocells 35 and 36. The upper beam is at approximately the end of the indexed tube 13 while the lower beam is enough therebelow to slow the flow of coating fluid sufficiently so that it may be accurately stopped at the upper end of the indexed tube.

A source of power 41 connects through switch 42 and lines 43 and 44 to the lamps 37 and 38. It also connects to amplifier and relay circuit 45, for the "slow up" operation, through lines 46 and 47, said circuit being, in turn, connected through lines 48, 49, 51, 52, 53 and 54 to the photocell 36. Said amplifier and relay circuit 45 is also connected to "slow up" solenoid 55 through lines 56, 57, 58, 59, contacts 29 and 28, lines 61, 62 and 63, which solenoid controls the "slow up" valve 64 to nearly shut off the supply of air at accurately regulated pressure from compressed air source through regulator 60 and pipe 65, when the coating fluid 66 from reservoir 67, to which said pipe is connected, rises to a point where it intercepts the beam of light to the "slow up" photocell 36. The coil spring 68 normally nearly closes valve 64 by moving the handle 69 until it engages an adjustable stop 71 when the power is cut off, as when there is no envelope 13 in engagement with the bell crank lever arm 31, or the coating fluid and coating on the envelope cuts off the flow of light to the photocell 36.

An "air escape" or "shut off" three way valve 72 is provided and disposed between the valve 64 and reservoir 67, so as to admit compressed air to the reservoir 67 when open and exhaust it therefrom when closed. When the coating fluid 66, after being retarded, rises to the upper end of the tube 13 it cuts off the beam of light to the upper photocell 35. Said cell through control lines 73, 48, 49, 51, 74, 75, 76, and 77 to amplifier and relay circuit 78, shuts off solenoid 79, connected to said amplifier and relay circuit through lines 81, 82, 57, 58, 59, contacts 29 and 28, lines 61, 62, 63 and 83. The amplifier and relay circuit 78 receives power from the source 41 through amplifier and relay circuit 45 and connecting lines 84 and 85. The handle 86 of the valve 72 is normally urged into closed position by coil spring 87.

The coating fluid 66 in the reservoir 67 is kept in uniform condition by a stirrer 68, desirably operated by an electric motor 69. It feeds into the indexed envelope 13 through socket 14 from pipe 88 dipping thereinto, flexible tube 89, and pipe 91, carried by angular lever 92 pivoted as indicated at 93 and carrying a roller 94 normally engaged by operating cam 95. The upper end of the pipe 91 carries a plug 96 which fits the rubber gasket 19 of the socket 14 when urged into engagement therewith by the cam 95, so as to temporarily connect with the indexed envelope 13 for coating purposes, as illustrated in Fig. 2.

The operation of the apparatus previously described is as follows: The conveyor 11 is caused to rotate intermittently, successively bringing, in the present embodiment, one tube or envelope 13 into position so that the upper end thereof lies between the source of light, provided by the lamps 37 and 38, and the controlling photocells 35 and 36, the contacts 28 and 29 being engaged as the envelope indexes, so as to energize the control circuits, opening the "air escape" valve 72 and fully opening the "slow up" valve 64.

At the same time, turning of the cam 95, as by means of its power operated shaft 97, brings the plug 96 into engagement with the gasket 19 to allow the coating fluid 66 to be forced through the flexible tube 89 from the reservoir 67, by means of the compressed air through pipe 65, up into the tube 13 for coating the interior thereof. It is, of course, understood that the stirrer 68 is during the operation working to keep the coating fluid in proper condition.

The coating fluid proceeds up the envelope until it intercepts the light beam to the lower photocell 36, causing de-energization of the solenoid 55 and partial closing of the "slow up" valve 64, as allowed by the setting of the stop 71, whereupon it proceeds at a slower rate, until it intercepts the light beam to the upper photocell 35, causing de-energization of the solenoid 79 and closing of the "air escape" valve 72, cutting off the air supply, releasing the air above the fluid 66 in reservoir 67, and allowing said fluid in the indexed envelope 13 to flow back into the reservoir through the flexible tube 89. The coating adhering to the envelope prevents the beams of light from reenergizing the control circuits until said envelope has moved on and the next one indexed. After this coating-fluid return has occurred, continued operation of the cam 95 will cause the plug 96 to drop away from the socket gasket 19, allowing the coated envelope to move on with the conveyor 11, the control circuits being kept deenergized by opening of the contacts 28 and 29 until the next tube is indexed. The socket gasket 19 of the next tube 13, as indexed, is engaged by plug 96, and the process repeated.

Referring now to the embodiment of our invention illustrated in Figures 3, 4 and 5, there is shown a coating machine comprising a conveyor 11a having a plurality of clips 12a, between which are held elongated vitreous envelopes or tubes 13a, such as those employed in the manufacture of fluorescent lamps, as in the first embodiment. The conveyor 11a rotates but does not index. The present embodiment is, therefore, to provide for coating the inside surfaces of such envelopes while they are rotating with the conveyor instead of while stationary.

The lower end of each tube 13a fits its socket 14a, which may correspond with the sockets 14 of the preceding embodiment and be held in a supporting bracket 15a with upstanding and depending threaded cylindrical portions receiving rubber packing members, and held in place by means of hollow nuts 21a and 22a, as in the first embodiment. Its nut 21a may be so adjusted that a fluid-tight connection between the socket and associated envelope 13a is effected.

Associated with the conveyor 11a is a support, not shown, from which projects a standard or pedestal 24a carrying a fixed bracket 98 which serves to support a shield 99 to enclose the upper portion of the envelope 13a being treated. The standard 24a has a movable bracket 33a which adjustably carries housing members 34a and 48 containing, respectively, a source of light and photocells corresponding with the cells 35 and 36 of the preceding embodiment. The shield 99 is provided with upper slits 101 and lower slits 102 for, respectively, transmitting an upper horizontal beam of light to the upper photocell and

a lower horizontal beam of light to the lower photocell. The photocells, lamps providing the source of light, and appropriate amplifier and relay circuits, connected for controlling "slow up" and "shut off" valves in the compressed air line to the reservoir of coating fluid, are provided as in the preceding embodiment.

The coating fluid is kept stirred and fed to the adjacent envelope, by means of its connecting socket 14ª, through a pipe dipping thereinto, flexible tube 89ª and pipe carried by the angular lever 92ª, pivoted as indicated at 93ª, and carrying roller 94ª normally engaged by operating cam 95ª. The upper end of the lever-carried pipe has a plug 96ª which normally fits the lower rubber gasket of the adjacent socket 14ª, when urged into engagement therewith by the spring 117, upon release by the cam 95ª, so as to temporarily connect with an envelope 13ª for coating purposes.

Registry of the plug 96ª and associated gasket is insured by a stud 103 on lever 92ª engaging indexing aperture 104 in bracket 15ª, so that the lever 92ª and its supporting element 105, move about a vertical pivot (not shown) which is coaxial with the conveyor 11ª. Thus, the lever 92ª and its plug 96ª are carried along in engagement with the socket 14ª, until released by action with the cam 95ª, such movement being against the force of the return spring 106, acting between the member 105 and a stationary portion 107 of the machine.

In order to cause the beams, from the source of light to the photocells, to follow the moving tube 13ª during the coating process, the bracket 33ª is adjustably fixed to a rod 108, movable about a vertical axis in the standard 24ª, and pivotally carrying a lever 109, at its lower end, and connected to the lever 92ª as by means of pin 111 movable in slot 112. To deenergize the control circuits from the photocells when the plug 96ª is not in engagement with the socket 14ª, as well as when no envelope 13ª is in position, in addition to a bell crank lever 26ª corresponding with the lever 26 of the preceding embodiment and causing contact between elements 28ª and 29ª in the control circuits only when an envelope 13ª is in place, we provide a bracket 113 on the lever 92ª, carrying an adjustable set screw 114 which causes engagement between the contacts 115 and 116 only when the plug 96ª is in engagement with the socket 14ª, thereby permitting energization of the control circuits only when there is no danger of loss of coating fluid on account of a disconnection between the flexible tube 89ª and an envelope 13ª.

The operation of the apparatus previously described is as follows: The conveyor 11ª is caused to rotate continuously, bringing one tube at a time into position so that the upper end thereof lies between the source of light and the controlling photocells, the contacts 28ª and 29ª being engaged as the envelope reaches its position. The cam roller 94ª is urged into engagement with the stationary cam 95ª by spring 117, so that the lever 92ª and plug 96ª are carried along with the envelope 13ª being coated, by engagement of the stud 103 in an aperture 104.

This causes engagement to be made between the contact elements 115 and 116, thereby permitting energization of the control circuits. During this movement of the envelope 13ª with the connected lever 92ª and associated parts, the source of light and control photocells follow the

upper end portion of said envelope, because of the lever, rod, and bracket connection previously described.

The energization of the control circuit opens the valves, corresponding with the valves 84 and 72 of the preceding embodiment, allowing coating fluid to proceed up the envelope 13ª until it intercepts the light beam to the lower photocell, slowing down the action as in the first embodiment, until the light beam of the upper photocell is intercepted, whereupon the air escape valve is closed, cutting the air supply, releasing the air above the fluid in the reservoir, and allowing said fluid in the envelope to flow back into the reservoir through the flexible tube 89ª.

The machine is so adjusted that about this time, or shortly thereafter, the roller 94ª reaches the high part of the cam 95ª, causing a withdrawal of the stud 103 from the aperture 104, a deenergization of the circuits by the disengagement of the contacts 116 and 115, and the snapping back of the stud 103 from the aperture 104 to engagement with the succeeding aperture 104ª, under the action of return spring 106, and a repetition of the coating process on the next envelope.

Referring now to the embodiment of our invention illustrated in Figures 6, 7 and 8, we illustrate portions of a machine which is adapted for indexing and treatment of a plurality of envelopes 13ᵇ, held in sockets 14ᵇ and supplied with coating fluid from a manifold 118 through flexible tube 89ᵇ. The construction and operation is otherwise nearly identical with that of the first embodiment, except that when coating more than one envelope at a time, provision is desirably made for the possibility that the coating fluid will rise to the top of one of the envelopes before it rises to the top of another. It is, therefore, desirable to provide means inside of the envelopes which takes care of the overflow of the first envelope, or envelopes, to be completely coated, and permits the fluid to rise in the remaining or last envelope, whereby all in the set are coated prior to termination of the operation.

In order to accomplish this result in the simultaneous coating of, for example, three envelopes 13ᵇ, we provide a stationary light source 37ᵇ and flow-retarding photocells 36ᵇ, 36ᶜ and 36ᵈ, one for each of said set of envelopes to be simultaneously coated, said light source and cells being so arranged with respect to the indexed position of the envelopes 13ᵇ that they all three receive horizontal beams of light from the source 37ᵇ through corresponding slits in the housing 34ᵇ and side or peripheral, rather than central portions, of the envelopes, thereby avoiding light interference due to coating on the inner tubes 128, 129 and 131. The cells are in series with one another for a reason which will become apparent from the description to follow.

With regard to the means for stopping the flow of coating fluid when it has reached the top of the last envelope undergoing treatment, we provide a lamp 38ᵇ which directs horizontal beams of light to stationary mirrors 123, 124 and 125 which, after receiving beams of light from the source through corresponding slits in the housing 34ᵇ and side portions of the envelopes being coated, reflects all to a single stationary photocell 35ᵇ, the amplifier and relay circuit controlled by said cell being such that it is energized to keep the coating fluid flowing to the envelopes until said fluid rises to the top of the last envelope, or that most slowly receiving the

fluid, after overflowing into the remainder of the inner tubes 128, 129 and 131.

In order to prevent a coating operation when one or more of the envelopes in a set is not in place, the safety arrangement for the circuits controlling the valves 64b and 72b, indicated by the contacts 28b, 29b and the controlling bell crank lever 26b, is duplicated for the rest of the envelopes in a set, as indicated by the reference characters 28c, 29c, 28d and 29d.

In the present embodiment plugs 96b are moved into engagement with sockets 14b of indexed envelopes 13b, upon initiation of the coating operation by means of a vertical reciprocating rod 122 operated by suitable means, such as a connecting rod 126 pivoted to a bracket 127 thereon, which bracket also adjustably carries tubes 128, 129 and 131 which pass through glands 132 in, and adjustably connect with, the manifold 118 which in turn carries the plugs 96b, and on through the envelopes 13b being treated, so as to not only provide an inner overflow pipe for each envelope under treatment, but also allow for quicker filling and emptying due to the corresponding decrease in the amount of coating fluid needed to fill an envelope.

In addition to the foregoing, we may also provide the previously-described safety arrangement, indicated by the reference characters 113b, 114b and 115b, corresponding with the similarly numbered parts of the preceding embodiment, so that the control circuits are de-energized except when plugs 96b carried by bracket 133, also attached to rod 122, are in engagement with sockets 14b.

The solenoid 79b controlling the shut-off valve 72b also desirably controls a valve 134 in the return connection 135 from an overflow manifold 136 to the coating fluid reservoir 67b, so that said valve 134 is closed when the valve 72b is opened, and vice versa. Except as specifically described, the embodiment of Figs. 6, 7 and 8 may correspond with that of Figs. 3, 4 and 5.

The operation of the apparatus of Figs. 6, 7 and 8 is desirably as follows: The conveyor 11b is caused to rotate intermittently successively bringing, in the present embodiment, three tubes or envelopes 13b into indexed position so that the upper ends thereof lie horizontally between the source of light 37b and the cells 36b, 36c and 36d, while the mirrors 123, 124 and 125 similarly receive horizontal beams of light from the source 38b, after passing through said envelopes, and reflect said light to the photocell 35b, as most clearly shown in Fig. 7. The contacts 28b and 29b, 28c and 29c, 28d and 29d engage as the envelopes index.

The connecting rod 126 moves up the tubes 128, 129 and 131 into the indexed envelopes 13b and the plugs 96b into engagement with the sockets 14b, causing engagement between the contact elements 114b and 115b, thereby permitting energization of the control circuits.

This energization effects opening of the valves 64b and 72b, which admit compressed air, controlled by pressure regulator 60b, to cause coating fluid to proceed up the envelopes 13b until it intercepts one of the horizontal light beams from the source 37b to one of the cells 35b, 35c and 35d, deenergizing the solenoid 55b and slowing down the action, as in the first embodiment. Finally overflow has taken place in two of the envelopes 13b into two of the tubes 128, 129 and 131, and the fluid rises in the slowest envelope and completely cuts off the light to the photocell 35b,

thereby deenergizing the solenoid 79b, closing the valve 72b to cut the air supply and release the air above the fluid in the reservoir, and opening the drain valve 134, allowing said fluid in the envelopes to flow back into the reservoir through the flexible tubes 89b and 135.

The machine is adjusted so that about this time, or shortly thereafter, the connecting rod 126 causes a withdrawal of the plugs 96b and inner tubes 128, 129 and 131, respectively, from the sockets 14b and envelopes 13b, to allow said envelopes to pass on and another set index for a repetition of the process.

From the foregoing it will be seen that we have provided apparatus for alternatively coating envelopes, such as those adapted for use in the manufacture of fluorescent lamps, whereby said envelopes are either indexed and individually coated, coated in continuous movement, or a plurality thereof are coated at one time, with or without the provision of two control valves and/or an internal overflow pipe, and with or without an individual light source and one or two photocells for each envelope.

Our invention provides the following advantages over present practice:

1. The control of the coating operation is positive.

2. The control is independent of the supply air pressure and speed of coating.

3. The envelope being coated can be kept completely open at its upper end for speedy air escape, thereby obviating any clogging in an air outlet.

4. Labor is saved by providing automatic operation.

5. Provision is made for adjustment for different lengths of envelope and the parts are easily replaceable.

6. Failure is guarded against by the construction of the apparatus.

7. The coated envelopes may go directly to a continuous circulating dryer.

8. One or more envelopes may be simultaneously coated either upon indexing or while moving.

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

We claim:

1. Apparatus for coating the inside surface of a light-pervious vitreous envelope comprising means to hold the envelope vertically, means for automatically feeding coating fluid thereto through its lower end, means for directing a beam of light through its upper end portion, means for automatically terminating the flow of said fluid when it intercepts said light beam, and means for then automatically withdrawing said fluid.

2. Apparatus for coating the inside surfaces of light-pervious vitreous envelopes comprising means to hold the envelopes vertically, means for sequentially indexing said envelopes, means for automatically feeding coating fluid to each envelope through its lower end while indexed, means for directing a beam of light through the upper end portion of the indexed envelope, means for automatically terminating the flow of said fluid when it intercepts said light beam, and means for then automatically withdrawing said fluid.

3. Apparatus for coating the inside surfaces of light-pervious vitreous envelopes comprising means to hold the envelopes vertically, means

for feeding coating fluid simultaneously to a plurality thereof through their lower ends, means for directing a beam of light through the upper end portion of each of the envelopes, means for automatically terminating the flow of said fluid when it intercepts at least one of said light beams, and means for then automatically withdrawing said fluid.

4. Apparatus for coating the inside surfaces of light-pervious vitreous envelopes comprising means to hold the envelopes vertically, means for automatically feeding coating fluid thereto through the lower end of each, means for directing a beam of light through a portion of said envelope adjacent but not at its upper end, and another through its upper end portion, means for automatically slowing down the flow of said fluid when it intercepts said first light beam, means for automatically terminating the flow of said fluid as it intercepts the other light beam, and means for then automatically withdrawing said fluid.

5. A machine for coating the inside surfaces of light-pervious vitreous envelopes comprising a carrier with a socket for holding vertically each of a plurality of said envelopes, means for successively indexing the envelopes in said machine, a reservoir of coating fluid, a flexible tube extending from the coating fluid in said reservoir, means causing said tube to connect with the socket of the indexed envelope, a pipe connecting a source of compressed air to said reservoir above the coating fluid therein, a normally-closed valve in said pipe for admitting or shutting off said compressed air and releasing the air trapped between it and said reservoir, a standard mounted adjacent the periphery of said carrier, a photocell carried by said standard, so that it is at the level of the upper end of the indexed envelope, a source of light also carried by said standard for directing a beam horizontally on said photocell through the upper end portion of the indexed envelope, said photocell being connected to control the valve, and a switch in the valve control circuit closed only when an envelope is indexed, whereby upon indexing an envelope, said valve is opened and coating fluid forced by air pressure through the flexible tube and up into said envelope until it intercepts the light passing to the photocell, whereupon the compressed air valve is closed, the air trapped in said reservoir allowed to escape, and the coating fluid drained back into the reservoir.

6. A machine for coating the inside surfaces of light-pervious vitreous envelopes comprising a carrier with a socket for holding vertically each of a plurality of said envelopes, means for successively indexing the envelopes in said machine, a reservoir of coating fluid, a flexible tube extending from the coating fluid in said reservoir, means causing said tube to connect with the socket of the indexed envelope, a pipe connecting a source of compressed air to said reservoir above the coating fluid therein, a normally-closed slow-up valve in said pipe for admitting or partially shutting off said compressed air, a normally-closed shut-off valve in said pipe, nearer said reservoir, for admitting or completely shutting off said compressed air and releasing the air trapped between it and said reservoir, a standard mounted adjacent the periphery of said carrier, a pair of photocells carried by said standard, so that one is at the level of the upper end of the indexed envelope and the other is slightly therebelow, a source of light also carried by said standard for directing a beam horizontally on each of said photocells through the upper end portions of the indexed envelope, said lower photocell being connected to control the first-mentioned valve and the upper photocell being connected to control the second-mentioned valve, and a switch in the valve control circuits closed only when an envelope is indexed, whereby upon indexing an envelope, said valves are opened and coating fluid forced by air pressure through the flexible tube and up into said envelope until it intercepts the light passing to the lower photocell, whereupon the compressed air slow-up valve is closed, and the flow of coating fluid into said envelope slowed until said fluid intercepts the light to the upper photocell, whereupon the shut-off valve is closed, the supply of compressed air cut off, the air trapped in said reservoir allowed to escape, and the coating fluid drained back into the reservoir.

7. A machine for coating the inside surfaces of light-pervious vitreous envelopes comprising a carrier with a socket for holding vertically each of a plurality of said envelopes, means for rotating said carrier to move said envelopes in a circular path, a reservoir of coating fluid, a flexible tube extending from the coating fluid in said reservoir, means causing said tube to sequentially connect with one socket at a time of said envelopes, a pipe connecting a source of compressed air to said reservoir above the coating fluid, a normally closed valve in said pipe for admitting or shutting off said compressed air and releasing the air trapped between it and said reservoir, a standard mounted adjacent the periphery of said carrier, a photocell carried by said standard so that it is at about the level of the upper end of the adjacent envelope, a source of light also carried by said standard for directing a beam horizontally on said photocell through the upper end portion of said envelope, said photocell being connected to control the valve, a switch in the valve control circuit closed only when an envelope is in position to be coated, means causing said source of light and photocell to follow the tube being coated until the operation is terminated, means then causing said flexible tube to connect with the socket of the next envelope and the photocell and light source to retrace for following said next envelope during its coating operation, whereby upon making a connection with an envelope said valve is opened and coating fluid forced by air pressure through the flexible tube and up into said envelope until it intercepts the light beam passing to the photocell, whereupon the compressed air valve is closed, the flow of coating fluid into the envelope terminated, the air trapped in said reservoir allowed to escape, and the coating fluid drained back into said reservoir.

8. A machine for coating the inside surfaces of light-pervious vitreous envelopes comprising a carrier with a socket for holding vertically each of a plurality of said envelopes, means for successively indexing simultaneously a plurality of envelopes in said machine, a reservoir of coating fluid, a flexible tube extending from the coating fluid in said reservoir, a manifold connected to said tube, means causing said manifold to connect with the socket of the indexed envelopes, a pipe connecting a source of compressed air to said reservoir above the coating fluid therein, a normally closed valve in said pipe for admitting or shutting off the compressed air and releasing the air trapped between it and said reservoir, a stand-

ard mounted adjacent the periphery of said carrier, a photocell carried by said standard, a source of light also carried by said standard and directing beams horizontally through the upper end portions of all of the indexed envelopes, mirrors for directing all of said beams on said photocell, switches in the valve control circuits closed only when the envelopes are indexed, a pipe mounted so as to lie inside of each of said envelopes and provide for draining any overflow therefrom, a manifold connection from said pipes back to said reservoir through a drain valve, and connections from said photocell to control said air and drain valves, whereby upon indexing said envelopes said compressed air valve is opened, the drain valve closed, and coating fluid forced by air pressure through the flexible tube and up into said envelopes until it intercepts all of the light beams passing to the photocell, whereupon the compressed air valve is closed and the drain valve opened, so that the air trapped in the reservoir is allowed to escape, any coating fluid which overflows is allowed to return thereto, and the coating fluid initially supplied to said envelopes is drained back into the reservoir.

9. A machine for coating the inside surfaces of light-pervious vitreous envelopes comprising a carrier with a socket for holding vertically each of a plurality of said envelopes, means for successively indexing a plurality of said envelopes simultaneously in said machine, a reservoir of coating fluid, a flexible tube extending from the coating fluid in said reservoir, a manifold connected to said tube, means causing said manifold to connect with the sockets of the indexed envelopes, a pipe connecting a source of compressed air to said reservoir above the coating fluid therein, a normally-closed slow-up valve in said pipe for admitting or shutting off said compressed air, a normally-closed shut-off valve in said pipe, nearer said reservoir, for admitting or completely shutting-off said compressed air and releasing the air trapped between it and said reservoir, a pair of light sources supported so that one is at the level of the upper end of the indexed envelopes and the other is slightly therebelow, a photocell for each of said envelopes, supported at the level of the lower source of light, a mirror for each of said envelopes supported at the level of the upper source of light, and another photocell supported at the level of the mirror for receiving light passing through all of said envelopes from said upper source of light, said lower photocells being connected in series to control the first-mentioned valve, and the upper photocell being connected to control the second-mentioned valve, switches in the valve-control circuit closed only when the envelopes are indexed, pipes to provide for draining any overflow therefrom, a manifold connection from said pipes back to said reservoir through a drain valve interconnected with said shut-off valve, and means for causing said pipes to pass into and out of said envelopes to be coated as the manifold connection for coating is made or broken, whereby upon indexing said envelopes said valves are opened and coating fluid forced by air pressure through the flexible tube and up into said envelopes until it intercepts the light passing to one of the lower photocells, whereupon the compressed air slow-up valve is released to close and the coating fluid into said vitreous envelopes slowed down until said fluid completely intercepts the light to the upper photocell, whereupon the shut-off valve is closed, the drain valve opened, cutting off supply of compressed air, allowing the air trapped in said reservoir to escape and any coating fluid which overflows to return to, and the fluid initially supplied to said envelopes to drain back into, the reservoir.

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