

July 29, 1958

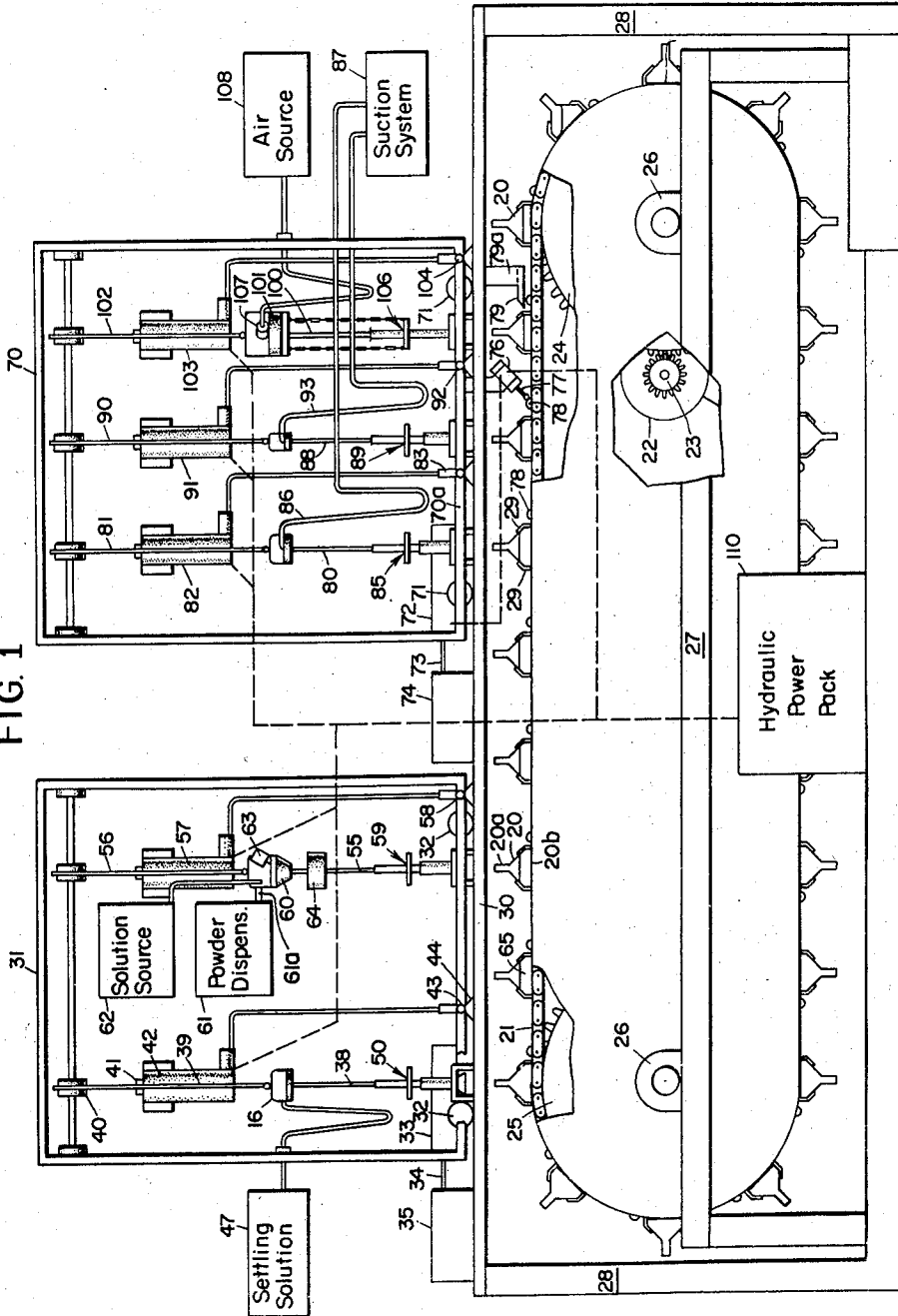
J. S. BAILEY
SCREENING DISPENSER FOR CATHODE-RAY TUBE
MANUFACTURING APPARATUS

2,845,099

Filed Sept. 17, 1956

3 Sheets-Sheet 1

FIG. 1



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3 Sheets-Sheet 2

FIG. 2

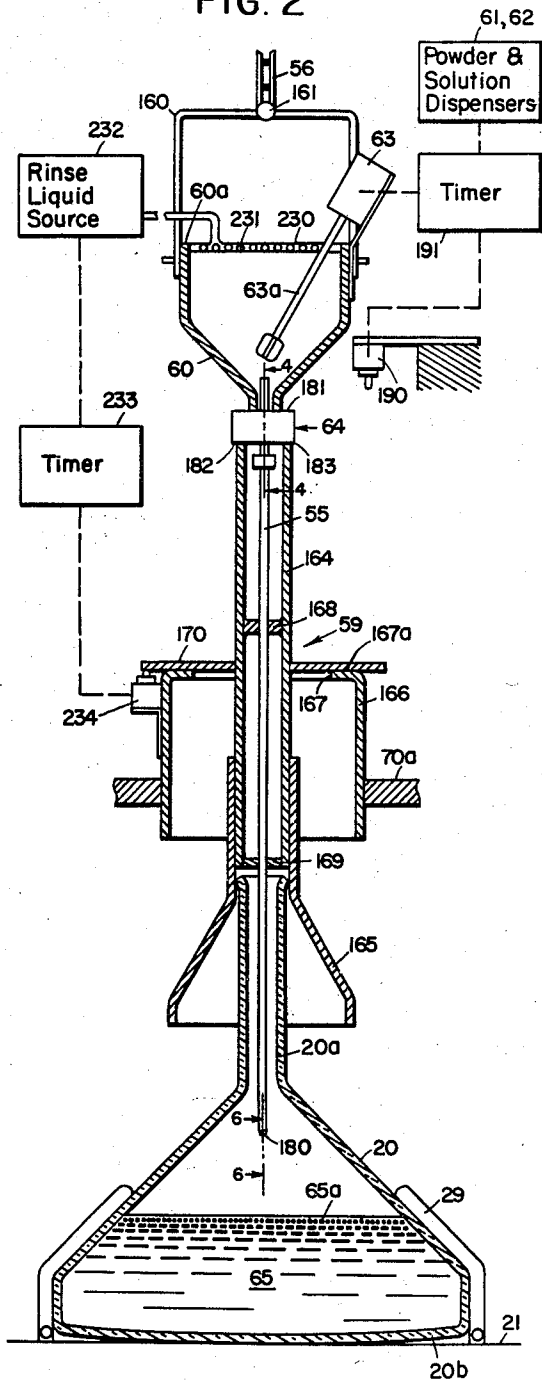
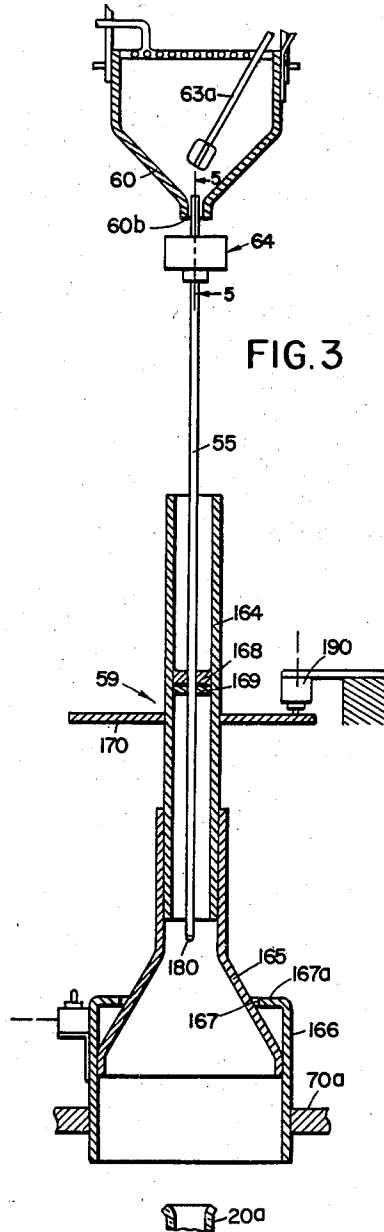


FIG. 3



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3 Sheets-Sheet 3

FIG. 4

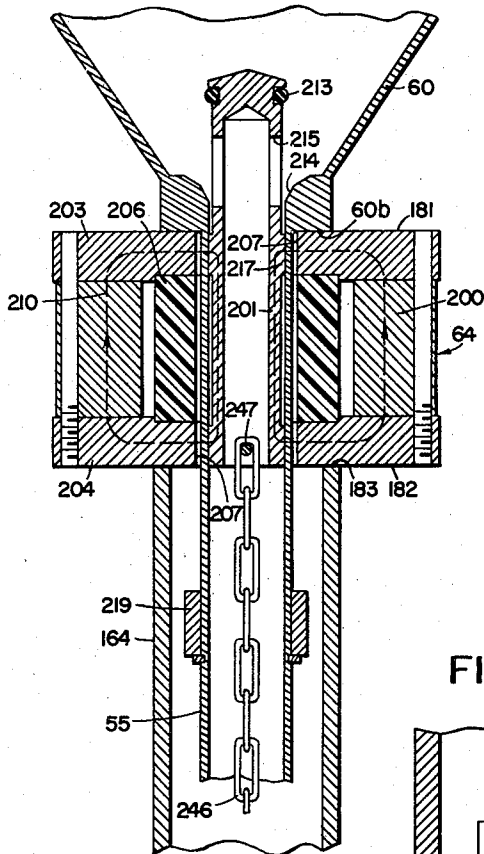


FIG. 5

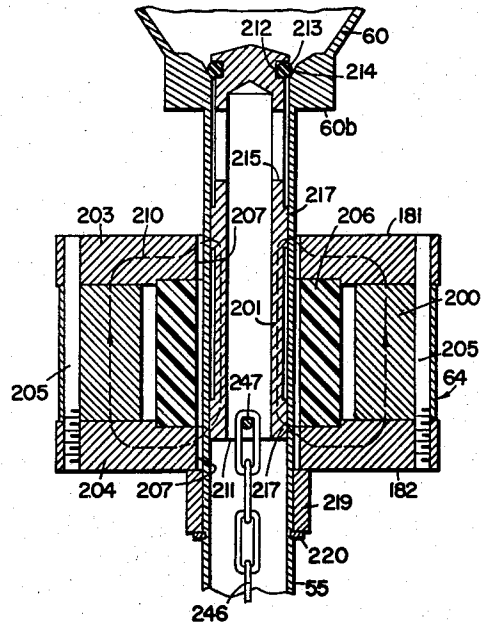


FIG. 6

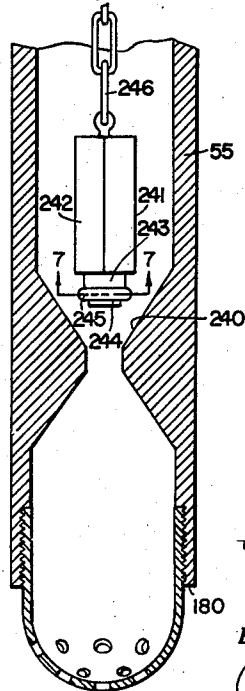


FIG. 7



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2,845,099

SCREENING DISPENSER FOR CATHODE-RAY TUBE MANUFACTURING APPARATUS

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Application September 17, 1956, Serial No. 610,239

8 Claims. (Cl. 141—91)

This invention relates to cathode-ray tube manufacturing apparatus; more particularly it has to do with a dispensing system for use in automatically screening and filming cathode-ray tubes.

Numerous attempts to mechanize the manufacture of cathode-ray picture tubes have been carried out with varied degrees of success. The conventional methods of applying luminescent screens onto the faceplates of the cathode-ray tube bulbs have undergone considerable change since the advent of widespread commercial television; the continual striving for more economical tube production has resulted in the expenditure of large sums of money and man-power to the end of providing a machine which will carry out the process of applying a luminescent screen in a completely automatic manner and which will accomplish this result efficiently and dependably.

With the advent of aluminized television screens, it became desirable to apply a film of organic material over the back surface of the luminescent screen; it likewise is highly desirable that the film applying process be completely mechanized. It has been appreciated that this filming process should preferably be carried out on the same apparatus that is utilized to apply the luminescent screens, since more efficient and economical operation would result from the attendant reduction of bulb handling.

Various approaches at mechanization have been tried, usually involving the use of a continuously moving conveyor onto which the bulbs are loaded at one end, are carried slowly along beneath associated screening and filming apparatus, and finally are carried around and under the other end of the conveyor to decant excess settling solution out of the screen and filmed bulb. However, it has been found that the shrinkage rates tend to run excessively high; a shrinkage rate is a measure of the percentage of unsatisfactory tubes produced by the screening and filming apparatus. Rejection of the bulbs may be the result of any of various reasons, including uneven distribution of settled phosphor, lack of proper adherence of the phosphor or the application of either too heavy or too light a layer of the phosphor.

Apparatus capable of overcoming the aforementioned difficulties and which permits the automatic continuous production of cathode-ray tubes of very good quality at lower shrinkage rates than possible with prior art techniques is claimed and described in the co-pending application of Jeromie J. O'Callaghan, Serial No. 600,851, filed July 30, 1956, and assigned to the same assignee as the present invention. In that application, there is included a brief description of dispensing apparatus for dispensing a powder-slurry into a settling solution previously introduced into a cathode-ray tube bulb. Such a dispenser must be capable of dispensing accurate quantities of material over long periods of time with a minimum of attention.

It is accordingly a general object of the present invention to provide an improved, simple and efficient dispenser for use with cathode-ray tube screening apparatus.

Another object of the present invention is to provide

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an improved dispenser which is capable of continued operation over long periods of time without clogging even when dispensing highly precipitative fluids.

A further object of the present invention is to provide a dispenser, for use in apparatus of the above character, which is capable of being moved relative to a series of cathode-ray tube bulbs, into which it successively dispenses; without spilling the dispensed medium on the external surfaces of the bulbs or the supporting structure.

In accordance with the present invention, a luminescent-powder-slurry dispenser, for use with cathode-ray tube manufacturing apparatus supporting a bulb containing a pool of settling solution, comprises a hopper for storing a powder-slurry and a conduit coupled to the hopper and movable to project its lower end into the bulb to a position above the surface of the settling solution. Valve means is disposed in the conduit for establishing the flow of the powder slurry from the hopper through the conduit in response to the disposition of the lower conduit end within the bulb. A rinse medium source cooperates with the foregoing apparatus for flushing the hopper and conduit with rinse medium, in timed relation with the opening of the valve means, while the lower conduit end is disposed within the bulb.

In accordance with another aspect of the present invention, wherein the powder slurry dispenser moves relative to a series of horizontally spaced cathode-ray tube bulbs in order to dispense the slurry successively into each of the bulbs, the dispenser comprises a vertically disposed conduit for conveying the powder slurry and movable between lower and upper positions to project and withdraw its lower end into and out of the bulbs. Adjacent the lower end of the conduit is a valve seat against which a valve member disposed in the conduit sealingly closes. Means is provided for opening the valve automatically upon movement of the conduit into its lower position and for closing the valve automatically upon movement of the conduit away from the lower position.

The features of the present invention which are believed to be novel are set forth with particularity in the appended claims. The organization and manner of operation of the invention, together with further objects and advantages thereof, may best be understood by reference to the following description taken in connection with the accompanying drawings, in the several figures of which like reference numerals identify like elements and in which:

Figure 1 is a general view, partially broken away, of cathode-ray tube manufacturing apparatus embodying the present invention;

Figure 2 is a fragmentary cross-sectional view of a powder dispenser which is part of the apparatus shown in Figure 1;

Figure 3 is a view similar to Figure 2 but with the parts in different position;

Figure 4 is a fragmentary cross-sectional view taken along line 4—4 in Figure 2;

Figure 5 is a fragmentary cross-sectional view, similar to Figure 4 but with the parts in different positions, taken along line 5—5 in Figure 3;

Figure 6 is a fragmentary cross-sectional view taken along line 6—6 in Figure 2; and

Figure 7 is a cross-sectional view taken along line 7—7 in Figure 6.

In the overall view of the embodiment shown in Figure 1 for purposes of illustration, a series of cathode-ray tube bulbs 20, supported in an upright position with their neck portions 20a uppermost and their faceplates 20b horizontal, are carried horizontally from left to right by a conveyor 21 moved at a uniform speed by means of a drive motor 22 coupled to conveyor 21 through a gear-unit 23 and a sprocket 24. Sprocket 24, at the right end of the apparatus, and a similar sprocket 25, at

the other end of the apparatus, are journaled in bearings 26 mounted upon a stationary horizontal beam 27. Suitable conventional mechanism may be employed to maintain a constant tension in conveyor 21. Bulbs 20 are secured to conveyor 21 by means of hinged clamps 29.

Carried above conveyor 21 on a stationary track-way 30 supported by uprights 28 is a screening carriage 31 movably supported on track-way 30 by rollers 32; track-way 30 is supported separately from conveyor 21 to minimize the transfer of vibration from one carriage to the conveyor. A piston cylinder 33 is mounted on carriage 31 and encloses a piston having a piston rod 34 affixed at its outer end to a block 35 secured to track-way 30, extension of piston rod 34 being effective to move carriage 31 in the direction of movement of conveyor 21.

Carriage 31 includes equipment for first dispensing a measured quantity of a settling solution into one of the bulbs 20 and then for dispensing a measured quantity of a slurry including a luminescent phosphor into the previously injected settling solution. For injecting the settling solution, a conduit 38 is supported for vertical movement by a flexible linkage 39 guided over an idler gear 40 and affixed to the piston rod 41 of a hydraulic actuator 42. Hydraulic actuator 42 is operated only in response to engagement of a conventional cam follower 43, moving from left to right, with a cam 44 supported by track-way 30. On the upper end of conduit 38 is a conventional dispenser 16 for delivering a measured quantity of settling solution from a reservoir indicated at 47 and operated in response to suitable micro-switches (not shown) during the time that conduit 38 is lowered to a preset position within one of bulbs 20. Mounted to telescope over conduit 38 is a neck-finder and guiding means 50 for accurately directing conduit 38 through neck portions 20a upon the down-stroke of conduit 38; a more detailed operational description of guiding means 50 is given below in connection with other figures.

For dispensing the slurry of luminescent powder into the settling solution previously dispensed through conduit 38, there is a conduit 55 suspended from a flexible linkage 56 for vertical movement by means of a hydraulic actuator 57 keyed to operate by action of a cam follower 58 engageable with cams 44 in the same manner as actuator 42. A guiding means 59 is mounted on conduit 55 and is identical with guiding means 50. At the upper end of conduit 55 is an upright, cup-shaped mixing hopper 60, which may be an enlarged portion of the conduit, into which a measured quantity of powder is injected from a dispenser 61, through a chute 61a, together with solution from a reservoir indicated at 62, the solution and powder being thoroughly stirred by a mixer 63 and then, upon action of a magnetic valve operator 64 fixed to open its valve when conduit 55 is projected within a bulb 20, the mixture of slurry is allowed to flow downwardly through conduit 55 into the body of settling solution 65 previously dispensed into bulbs 20.

A second carriage 70 is carried on track-way 30 by means of wheels 71 and supports siphoning and film dispensing equipment. Carriage 70 is similarly driven by means of a hydraulic actuator including a piston cylinder 72 enclosing a piston from which a piston rod 73 extends; piston rod 73 is affixed at its outer end to a block 74 supported by track-way 30. Carriages 31 and 70 are controlled in their movement along track-way 30 by means of a synchronizing system which includes a valve 76 (shown only in connection with carriage 70 for sake of clarity of the drawing, identical valves being employed for controlling the operation of actuators 33 and 72) having an operating member 77 engageable with one of a series of cams 78 affixed on conveyor 21, one cam 78 being provided for each of the bulbs 20; a detailed description of this synchronizing system is included in the above mentioned co-pending O'Callaghan application Serial No. 600,851. Also cooperating with the synchronizing system is a stationary cam 79 carried on a

frame-member 79a and which cooperates with valve 76 to limit movement of carriage 70 and cause reversal in its movement after a complete cycle of operation. A similar cam (not shown) is provided in connection with carriage 31.

In the instant embodiment, carriage 70 supports equipment utilized in the filming portion of the overall process; included on carriage 70 are rough and fine siphon systems for removing a portion of settling solution 65 from bulbs 20, the rough siphon being capable of removing the settling solution at a high-volume flow rate and being operated to lower the solution level only approximately to a particular level desired in connection with the below-described operation of the film dispensing equipment. This rough siphon system comprises a conduit 80 supported from a flexible linkage 81 affixed to a hydraulic actuator 82 and controlled to effect reciprocation of conduit 80, in the same manner as for actuators 42 and 57, by means of a cam follower 83 engageable with cams 44. A guiding means 85 telescopes over conduit 80 in a manner identical with that of guiding means 50 and 59. Conduit 80 is coupled by a flexible hose 86 to a suction system indicated at 87 and described in more detail in the copending O'Callaghan application Serial No. 600,851. Spaced in the direction of conveyor movement beyond conduit 80 is a fine siphon conduit 88 provided with a guiding means 89 and suspended by a flexible element 90 from a hydraulic actuator 91 responsive to a cam follower 92, reciprocation of conduit 88 being initiated in the same manner as that above described with respect to conduit 38. If desired, reciprocation of both conduits 80 and 88 may be controlled by a single common actuator. Conduit 88 is coupled to suction system 87 by a hose 93 and is utilized for drawing off settling solution 65 down to a very accurately preselected level.

Carriage 70 also supports a film dispenser for applying precisely measured amounts of film solution onto the surface of the settling solution remaining in the bulbs 20 after the siphoning steps and arranged to insure the formation of an even film over the settling solution surface. The illustrated embodiment of the film dispenser includes a conduit 100 depending downwardly from a reservoir 101 supported by a flexible element 102 attached to a hydraulic actuator 103 controlled by a cam follower 104 to operate in the same manner as that above described with respect to conduit 38, so as to lower conduit 100 successively into each of bulbs 20 during their movement by conveyor 21. Conduit 100 also includes a guiding means 106 which operates in a manner similar to that of guiding means 50 and the others. The film dispenser includes a valve, described in the copending O'Callaghan application Serial No. 600,851, for controlling the flow of film solution into bulbs 20, which valve is operated by an air cylinder 107 powered by an air source indicated at 108 upon the actuation of suitable microswitches which function in response to the lowering of conduit 100 to project its lower end into one of the bulbs 20.

Power for all of the hydraulic actuating devices is provided by a single hydraulic power pack indicated at 110, which may be of conventional construction including a reservoir of hydraulic fluid and a pump for maintaining hydraulic pressure in the system. Hydraulic power pack 110 is coupled to each of hydraulic actuators 42, 57, 82, 91, and 102; in addition, hydraulic power pack 110 is utilized together with valve 76 and the corresponding valve associated with carriage 31 to control the extension of piston rods 73 and 34 for moving carriages 70 and 31, respectively.

Before proceeding further, it is desirable to understand the general operation of the apparatus shown in Figure 1. In operation, bulbs 20 are secured by clamps 29 onto conveyor 21 at the lefthand end of the apparatus. The bulbs are then carried smoothly and evenly from left to right while they undergo the several above mentioned

operations. Initially, a measured amount of settling solution 65 is introduced into each of the bulbs 20 through conduit 38. During the initial filling period, conduit 38 is lowered to project its lower end within the bulb while the bulb continues its uniform movement, the synchronizing system being effective to move conduit 38 from left to right in precise step with the bulb movement. Subsequently, after conduit 38 has been withdrawn, carriage 31 is moved to the left to bring conduit 55 into a position where it is lowered into the bulb 20 previously filled with settling solution 65. Again, carriage 31, and hence conduit 55 is moved along precisely in step with the bulb movement during a period of time when the powder slurry from hopper 60 is flowing through conduit 55 into settling solution 65.

After the powder slurry has been introduced into the bulbs 20, the powder settles through settling solution 65 during the time interval elapsing as conveyor 21 moves the bulbs progressively along toward a position beneath conduit 80 of the rough siphon. By the time conduit 80 is lowered to immerse its lower end into solution 65, a desired amount of phosphor has settled into adhering relation with faceplate 20b. After the rough and fine siphoning steps, respectively by means of conduits 80 and 88, film dispenser conduit 100 is lowered to a position at which its lower end is slightly above the surface of the remaining amount of solution 65, and film solution from reservoir 101 is floated over the settling solution surface. After withdrawal of conduit 100, the remaining settling solution is decanted from bulbs 20 out from under the solidified or partially solidified film layer during travel of the bulb around sprocket 24 at the righthand end of Figure 1. During the decanting, the film layer first affixes itself to the upper inside portions of the bulb near faceplate 20b and then, as the bulb is tipped outwardly, the film layer falls smoothly over the faceplate as the water is poured off out from under the film layer. After decanting of the excess solution, the bulbs are returned along the underside of the conveyor to the loading station, at the left end of Figure 1, from where they are removed.

The general advantages resulting from the moving of the bulbs 20 slowly and evenly along their path of travel are old and well known in the art; more accurate and even settling of the luminescent powder is obtained by preventing agitation or sloshing of solution 65. Hence, frame 28 is of rugged construction and the entire assemblage is constructed of heavy, strong materials and preferably is firmly secured to a suitable foundation. It is desirable to employ suitable conventional apparatus to prevent operation of either the raising and lowering mechanisms or of the powder and solution dispensers 61, 62, in the absence of a bulb in a particular set of the clamps 29.

Figures 2 and 3 show a preferred form of guiding means 59 employed on powder dispenser conduit 55; guiding means 50, 85, 89, and 106 may be of identical construction. The upper portion of hopper 60, from which conduit 55 depends downwardly, is secured to flexible chain 56 by a U-shaped strap 160 pivotally connected to chain 56 by a pin 161 and secured to cup-shaped hopper 60 at its rim 60a. Slidable on conduit 55, in telescoping relation therewith, is a sleeve 164 affixed at its lower end to an inverted funnel-shaped member 165. In Figure 3, the flared portion of member 165 is encased within a box 166 mounted upon the floor 70a of carriage 70; a hole 167 is cut into the top portion 167a of box 166 through which the apparatus may be raised and lowered. The side portions of box 166 project downwardly toward bulbs 20, the box being open on its underside and the lower edges thereof being spaced above neck portion 20a by a distance sufficient to permit lateral movement of member 165 when the latter is lowered to dispose the rim of its flared portion below box 166 (Figure 2). Guiding means 59 is carried on conduit 55 by inwardly projecting lugs 168 rigid with

sleeve 164 and, as shown in Figure 3, resting on the upper surface of a collar 169 affixed on conduit 55. Downward movement of guiding means 59 is limited by engagement of a collar 170 rigid with sleeve 164 which, upon lowering of conduit 55 abuts against box surface 167a.

The operation of guiding means 59 is best understood by a comparison of Figures 2 and 3 which show guiding means 59 in its lowered and raised positions, respectively. In Figure 3, chain 56 is pulled upwardly whereupon guiding means 59 is disposed in its upper position with its lugs 168 resting on collar 169. When chain 56 is extended downwardly, by operation of actuator 57 in Figure 1, guiding means 59 is carried downwardly by conduit 55 until collar 170 lands on box surface 167a; conduit 55 then continues its downward movement on into bulb 20. The flared portion of member 165 defines a downwardly and outwardly tapering cam surface which, as the entire assembly is lowered toward bulb 20 engages with the upper end of neck portion 20a and guides the entire assembly into a centered position over bulb 20 so that, as conduit 55 continues its downward movement on into the bulb, its lower end 180 is disposed to enter neck portion 20a. If, upon lowering of guiding means 59 toward bulb 20, the latter is not centered beneath conduit 55, guiding means 59 is free to move laterally in any direction as soon as the outer rim of the flared portion clears the lower edge of box 166; thus, accurate centering and alignment of conduit 55 with neck portion 20a is insured.

For dispensing the powder slurry into settling solution 65, it is preferred to space the lower end 180 of conduit 55 accurately above the settling solution surface 65a. This is accomplished in the present instance by accurately adjusting the distance that conduit 55 projects below hopper 60, taking into account the height of valve operator 64, to correspond with the previously determined spacing of top surface 167a above conveyor 21, against which faceplate 20b is disposed. As the entire assemblage is lowered, collar 170 first lands on top surface 167a and then the bottom surface 60b of hopper 60 abuts against top surface 181 of valve operator 64, the bottom surface 182 of the latter having come into abutting engagement with the upper end 183 of sleeve 164. This accordingly limits downward movement of lower end 180 to a position accurately spaced above surface 65a.

When conduit 55 and hopper 60 are raised to an upper position, collar 170 comes into engagement with a stationary microswitch 190 which actuates suitable timer apparatus 191 for effecting the flow of liquid from solution source 62 and luminescent powder from powder dispenser 61. Upon introduction of the liquid and powder into hopper 60 from the powder and solution dispensers, timer 191 effects energization of mixer 63 to rotate its stirring element 63a, thereby thoroughly mixing the powder and solution, to form the powder slurry. As will be described presently, conduit 55 is then lowered to project lower end 180 within bulb 20 whereupon valve means open to permit the powder slurry to drain through conduit 55 and into settling solution 65.

From the foregoing it will be seen that the valve means must be closed while the dispensing apparatus is in its upper position in order to retain the powder and liquid in hopper 160 while being stirred by mixer 63. In addition, the valve means also comprises the main flow-control means for initiating and terminating the actual dispensing of the powder slurry into the bulb; it is therefore necessary that the valve open only when conduit 55 is in its lower, dispensing position. To this end, and as shown in Figures 4 and 5, valve operator 64 comprises a permanent magnet 200 slidably mounted on conduit 55 and which cooperates with a ferromagnetic valve stem 201 disposed within conduit 55 and movable by magnetic attraction with movement of magnet 200 to effect valve operation.

Magnet 200 is cylindrical in shape and encircles con-

duit 55 below hopper 60; the cylindrical magnet is sandwiched between a pair of annular pole pieces 203, 204 by screws 205. A cylindrical plastic spacer 206 separates the inner portions of pole pieces 203, 204, magnet 200 encircling the spacer 206. The inner surfaces 207 of pole pieces 203 and 204 thus form pole faces snugly encircling conduit 55; the latter, or at least the portion immediately below hopper 60, is of non-magnetic material, whereupon a flux path indicated at 210 is established between valve stem 201 and magnet 200.

Valve stem 201 is a hollow tube open at its bottom end 211 and grooved around its upper end surface 212 to accept a rubber O-ring 213; O-ring 213 cooperates with a valve seat 214 defined in the bottom portion of hopper 60. Openings 215 are cut through the side-walls of valve stem 201 just below O-ring 213. A pair of outwardly facing lugs 217 on valve stem 201 slide snugly within conduit 55 and are spaced apart by a distance approximately equal to the spacing between pole faces 207. Completing the valve assembly is a collar 219 affixed on conduit 55 below magnet 64 by a C-ring 220. Collar 219 is spaced below hopper 60 by a distance such that, when the external magnet assembly is resting on collar 219, valve stem 201 is pulled downwardly to sealingly engage O-ring 213 and valve seat 214, as shown in Figure 5. Preferably, the spacing of collar 219 below hopper 60 is slightly more than that necessary to permit the magnet just to close the valve so that a positive attracting force exists when the valve is closed thereby tightly sealing the latter; this is indicated in Figure 5 wherein it will be noted that flex path 210 curves slightly upward in its passage through conduit 55.

The operation of the valve will best be understood by a comparison of Figures 4 and 5 taken in combination with Figures 2 and 3, respectively. In Figures 3 and 5, hopper 60 and conduit 55 are raised to the upper position at which the powder and solution is dispensed into the hopper. In this position, magnet 200 and its assembly rest on collar 219; valve stem 201 is therefore pulled downwardly to form a tight seal between O-ring 213 and valve seat 214. Thus, the flow of powder slurry from hopper 60 into conduit 55 is prevented. Upon the subsequent lowering of hopper 60 and conduit 55 to project lower end 180 into bulb 20, it will be recalled that collar 170 first lands on top surface 167a while conduit 55 continues downward movement into bulb 20. As soon as collar 170 lands on surface 167a, upper end 183 of sleeve 164 forms a stationary abutment directly in the path of bottom surface 182 of pole piece 204. Accordingly, as conduit 55 nears the end of its downward movement, end surface 183 engages with bottom surface 182, thus limiting downward movement of the magnet assembly. However, conduit 55 continues its downward movement to its lower position, the downward movement of the latter being limited when hopper bottom surface 60b engages magnet assembly top surface 181. Therefore, after engagement between surfaces 182 and 183, the magnet slides upwardly relative to conduit 55; this upward movement of the magnet, relative to the conduit, by magnetic attraction also moves valve stem 201 upwardly relative to the conduit disengaging O-ring 213 from valve seat 214 and moving openings 215 above valve seat 214. Thus, downward movement of conduit 55 into its dispensing position automatically effects opening of the valve whereupon the powder slurry in hopper 60 is permitted to flow into openings 215, through valve stem 201 and finally through the remainder of conduit 55 into bulb 20. It should be noted that the provisions of openings 215, which permit fluid flow inside valve stem 201, permit the latter to be of a diameter only slightly smaller than that of the conduit and thus to be in close magnetic coupling relation with the external magnet assembly; likewise, lugs 217 which are spaced in mating relation with pole pieces 207 permit the attainment of efficient magnetic action.

Typical powder slurries utilized in cathode-ray tube screening are highly precipitative in nature; in addition, they usually comprise a silicate which adheres firmly to glass and other surfaces. This highly precipitative nature of the powder slurry results in the clogging of valve parts and the building up of coatings on the inner dispenser surfaces exposed to the powder slurry and on the stirring portions of the mixer. In the present apparatus, such fouling of the dispensing apparatus is effectively prevented by means for flushing the hopper and conduit with a rinse medium. In prior art screening apparatus, the customary approach has been to first dispense the settling solution into the bulbs and subsequently to dispense the powder slurry into the settling solution. Thereafter, the settling solution suspension is left strictly alone until the powder has settled onto the faceplate. The present apparatus departs completely from conventional teachings by actually flushing hopper 60 and conduit 55 into settling solution 65 immediately after dispensing of the powder slurry. To this end, a ring-shaped pipe 230 is secured horizontally around the inner circumference of hopper 60, at rim 60a. A plurality of similarly oriented downwardly and inwardly displaced tangential orifices 231 are spaced around the circumference. Pipe 230 is coupled to a rinse liquid source 232 which supplies rinse liquid to the pipe under the control of a timer 233 actuated by a microswitch 234 affixed on box 166 and engageable with collar 170 upon lowering of guiding means 59. Timer 233 is effective to cause flow of the rinse liquid into pipe 230 after conduit 55 has reached its lower position whereupon valve 64 is opened permitting the powder slurry to drain into bulb 20; the rinse liquid is discharged through orifices 231 in a series of small jets each directed circumferentially around the inner surface of hopper 60 thereby causing the rinse liquid to swirl around the hopper and down through the then open valve 64 into bulb 20. By so washing down the dispensing apparatus after each dispensing cycle, the build-up of precipitation from the powder slurry is completely prevented thereby enabling continued operation of the powder dispenser over long periods of time.

It will be recalled from the description of Figure 1 that after each dispensing operation, carriage 31, and hence the powder dispensing apparatus, is moved relative to bulbs 20 so as to align the powder dispenser with the next successive bulb. As mentioned above, the powder slurry is highly precipitative and, if permitted to drip onto the external surfaces of the bulbs or onto conveyor 21, adheres thereto giving rise to increased cleaning and maintenance cost as to the conveyor and with the result that the finished bulbs acquire unsightly blemishes on their outer surfaces. In order to prevent dripping of the powder slurry from lower end 180 of the conduit 55 as the latter is moved from one bulb to the next, the present apparatus includes a valve disposed adjacent lower end 180 which opens only when conduit 55 is disposed in its lower position and which closes upon movement of the conduit away from the lower position so that any powder slurry remaining on the inner walls of the conduit is retained therein. To this end, as shown in Figure 6, conduit 55 is of reduced cross-section immediately adjacent lower end 180; the upper surfaces of the portion of reduced cross-section taper downwardly and inwardly to define a valve seat 240. Cooperating with valve seat 240 is a valve member 241 having a body portion 242 of triangular cross-section (Figure 7) from the lower end of which projects a shank 243 necked down at its lower end 244 to receive a resilient O-ring 245. Valve member 241 is secured at its upper end to a chain 246 suspended from the bottom of valve stem 201 by a pin 247 (Figure 5).

Thus, valve member 241 is actuated in common with valve stem 201, both in response to movement of magnet 200 relative to conduit 55 upon raising and lowering of the latter. When conduit 55 is moved to its lower position whereupon magnet 200 is moved upwardly relative

to conduit 55 as described previously with respect of Figure 4, valve member 241 is pulled upwardly relative to conduit 55 by chain 246 to the position shown in Figure 6 whereupon the powder slurry and the rinse liquid are permitted to flow out of lower end 180. When conduit 55 subsequently is raised whereupon magnet 200 and, hence, valve stem 201 move downwardly relative to conduit 55, valve member 241 likewise moves relatively downward to sealingly close O-ring 245 against valve seat 240. The very small length of conduit 55 remaining below valve seat 240 is immediately drained of any powder slurry or rinse solution remaining therein so that, after conduit 55 completes its upward movement and then is moved laterally by carriage 31, there is no dripping from lower end 180 onto the external bulb surfaces or the conveyor.

In a commercial embodiment of the disclosed apparatus which has been operated steadily for several months while producing screened and filmed cathode-ray tubes at a commercially profitable and competitive shrinkage rate, the following typical parameters are employed. Bulbs 20 are spaced approximately 20 inches apart on conveyor 21 which is moving uniformly at a speed of approximately 1¼ feet per minute. In the first step of the process, a conventional 21 inch cathode-ray tube bulb is filled with about 22.5 liters of a deionized water-electrolyte settling solution dispensed through conduit 38. In the next step of the process, the powder slurry dispensed through conduit 55, which is of non-magnetic stainless steel, is a mixture of 7.7 grams of commercial grade fluorescent powder and 215 milliliters of potassium silicate in 500 milliliters of deionized water; the rinse medium from source 232 is deionized water. Rough siphon conduit 80 is spaced from powder dispensing conduit 55 by a distance such that the powder is permitted to settle for approximately 14 minutes. The rough siphon then takes the settling solution level down to about 2¼ inches above conveyor 21 after which fine siphon conduit 88 removes the settling solution down to a precise level above conveyor 21 whereupon the depth of the remaining solution is about two inches. Film dispensing conduit 100 is subsequently lowered to dispose its lower end slightly above the settling solution surface whereupon a few small drops, representing a fraction of one milliliter, of nitrocellulose lacquer, the film solution, is applied onto the settling solution surface. Reservoir 101 is approximately one inch in height and six inches in diameter, while conduit 100 is approximately 50 inches long. It must be emphasized that close attention in detail is required to produce satisfactory screening and filming.

It will thus be seen that the powder dispensing apparatus of the present invention is capable of continued operation over long periods of time without close attention. It will be appreciated that the dispenser of the present invention operates automatically in response to movement of the dispenser to its dispensing position. In addition, the main dispenser valve operates automatically with no external connection of source of power. These improved results are obtained by a dispenser which is very simple to construct and which is efficient in operation.

Certain features of the apparatus described in the present application are described and claimed in a concurrently filed copending application of Jerome J. O'Callaghan, entitled Cathode-Ray Tube Manufacturing Apparatus, and assigned to the same assignee as the present application.

While a particular embodiment of the present invention has been shown and described, it will be obvious to those skilled in the art that changes and modifications may be made without departing from the invention in its broader aspects. Accordingly, the aim in the appended claims is to cover all such changes and modifications as fall within the true spirit and scope of the invention.

I claim:

1. A luminescent-powder-slurry dispenser for use with

cathode-ray tube manufacturing apparatus upon which a bulb containing a pool of settling solution is supported with its neck portion uppermost comprising: a hopper for storing said powder slurry; a conduit depending downwardly from said hopper and movable to project its lower end into said bulb to a position above the surface of said settling solution; valve means for establishing the flow of said powder slurry from said hopper through said conduit; means for opening said valve means in response to disposition of said lower end within said bulb; a source of rinse medium; and means coupled to said rinse medium source for flushing said hopper and conduit with said rinse medium, in timed relation with the opening of said valve means, while said lower end is disposed within said bulb.

2. A luminescent-powder-slurry dispenser for use with cathode-ray tube manufacturing apparatus upon which a bulb containing a pool of settling solution is supported with its neck portion uppermost comprising: a hopper for storing said powder slurry; a conduit depending downwardly from said hopper and movable to project its lower end into said bulb to a position above the surface of said settling solution; valve means for establishing the flow of said powder slurry from said hopper through said conduit; means for opening said valve means in response to disposition of said lower end within said bulb; a source of rinse medium; and means, including a ring-shaped pipe disposed horizontally around the inner circumference of said hopper and having a plurality of similarly oriented downwardly and inwardly displaced tangential orifices spaced around said circumference, coupled to said rinse medium source for flushing said hopper and conduit with said rinse medium, in timed relation with the opening of said valve means, while said lower end is disposed within said bulb.

3. A luminescent-material dispenser for use with cathode-ray tube manufacturing apparatus upon which a bulb is supported with its neck portion uppermost comprising: a hopper for storing said material; a conduit coupled to said hopper and movable to project its lower end into said bulb; valve means for establishing the flow of said material from said hopper through said conduit in response to disposition of said lower end within said bulb; a rinse medium source; means, including a ring-shaped pipe disposed horizontally around the inner circumference of said hopper and having a plurality of downwardly and inwardly displaced tangential orifices spaced around said circumference, coupled to said rinse medium source for directing said rinse medium in a swirling path over the inner surfaces of said hopper; and means for effecting flow of said medium into said pipe in timed relation with the disposition of said lower end within said bulb.

4. A luminescent powder-slurry dispenser for use with cathode-ray tube manufacturing apparatus upon which a bulb is supported with its neck portion uppermost comprising: an upright cup-shaped hopper for storing said powder slurry; a conduit depending downwardly from said hopper and movable to project its lower end into said bulb; valve means for establishing the flow of said powder slurry from said hopper through said conduit; a ring-shaped pipe disposed around the inner circumference of the rim of said hopper and having a plurality of similarly oriented downwardly and inwardly displaced tangential orifices spaced around said circumference; a source of rinse medium coupled to said pipe; and means for effecting flow of said rinse medium into said pipe in timed relation with opening of said valve means.

5. In a cathode-ray tube manufacturing apparatus wherein a powder-slurry dispenser moves relative to a series of horizontally spaced cathode-ray tube bulbs in order to dispense said powder slurry successively into each of said bulbs, said dispenser comprising: a hopper for storing said powder slurry; a vertically disposed conduit coupled to said hopper for conveying said powder slurry; first valve means for establishing the flow of said powder slurry from said hopper into said conduit; means for moving

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said conduit between a lower position and an upper position to project and withdraw the lower end thereof into and out of said bulbs; second valve means disposed in said conduit adjacent said lower end thereof; common actuator means for opening said valve means in response to disposition of said lower end within said bulb; a source of rinse medium; and means coupled to said rinse medium source for flushing said hopper, conduit and valve means with said rinse medium, in timed relation with the opening of said valve means, while said lower end is disposed within said bulb.

6. In a cathode-ray tube manufacturing apparatus wherein a powder-slurry dispenser moves relative to a series of horizontally spaced cathode-ray tube bulbs in order to dispense said powder slurry successively into each of said bulbs, said dispenser comprising: a vertically disposed conduit for conveying said powder slurry; means for moving said conduit between a lower position and an upper position to project and withdraw the lower end thereof into and out of said bulbs; means in said conduit adjacent said lower end defining a valve seat; a valve member disposed in said conduit for sealingly closing with said valve seat; means for effecting opening of said valve member and seat automatically upon movement of said conduit into said lower position and for effecting closure of said valve member and seat automatically upon movement of said conduit away from said lower position; and means, including a source of flushing medium, for flushing said conduit while in said lower position.

7. A material dispenser for use with cathode-ray tube manufacturing apparatus upon which a bulb is supported

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with its neck portion uppermost comprising: a hopper for storing said material; a conduit coupled to said hopper and movable to project its lower end into said bulb; first valve means for establishing the flow of said material from said hopper into said conduit; second valve means disposed within said conduit adjacent said lower end; common actuator means for opening said first and second valve means in response to disposition of said lower end within said bulb and for closing said first and second valve means upon withdrawal of said conduit from said bulb; and means, including a source of flushing medium, for flushing said hopper and conduit while said lower end is in said bulb.

8. A luminescent-powder-slurry dispenser for use with cathode-ray tube manufacturing apparatus upon which a bulb containing a pool of settling solution is supported with its neck portion uppermost comprising: a hopper for storing said powder slurry; a movable conduit depending downwardly from said hopper and in one position having its lower end adjacent the surface of said settling solution; valve means for establishing the flow of slurry from said hopper through said conduit; means for opening said valve means in response to disposition of said lower end within said bulb; a source of rinse medium; and means coupled to said source for flushing said hopper and conduit, in timed relation with the opening of said valve means, while said lower end is disposed within said bulb.

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