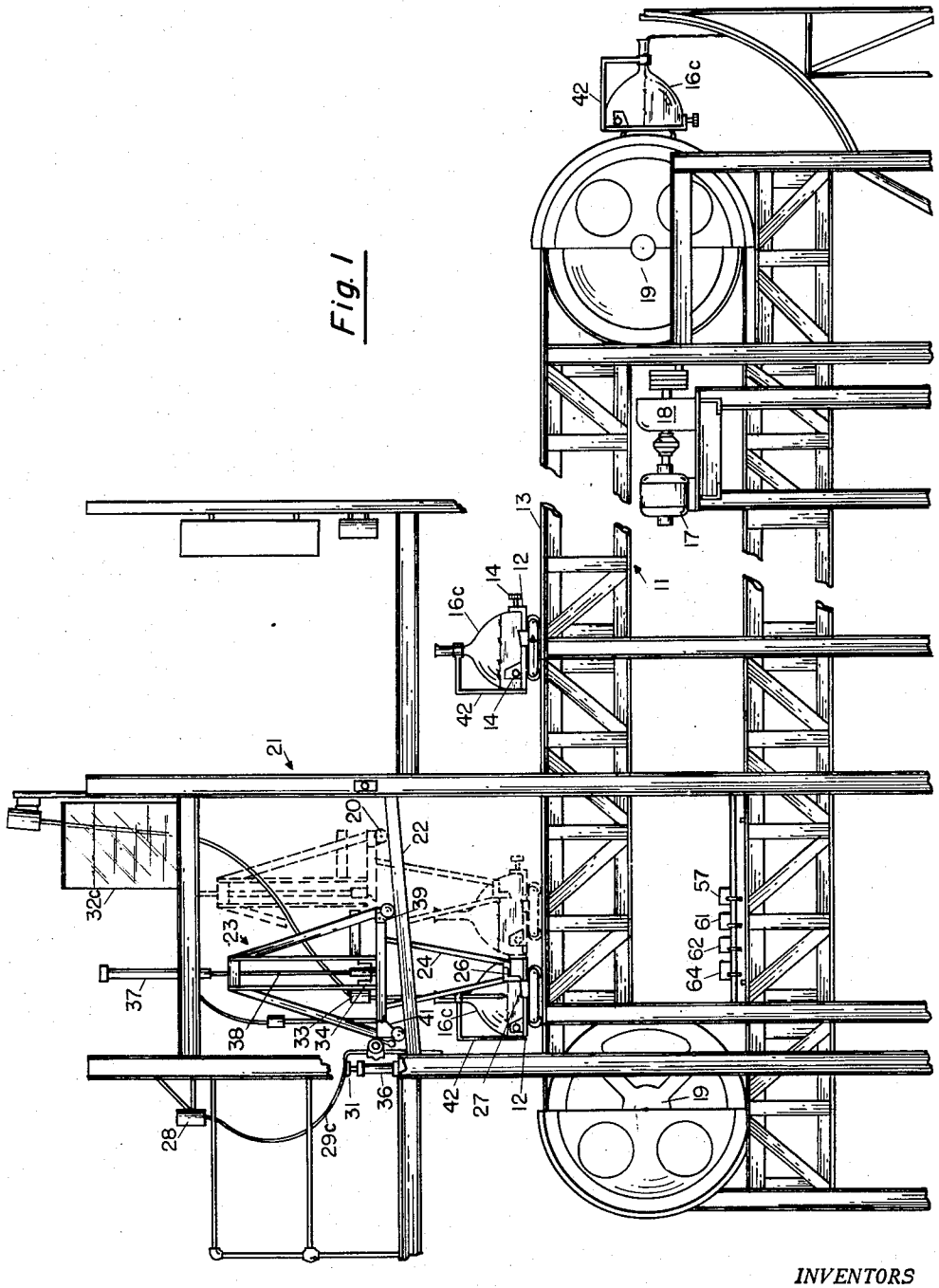
Dec. 1, 1953 J. H. DYNE ET AL 2,660,978

CATHODE-RAY TUBE COATING APPARATUS

Filed July 30, 1951 4 Sheets-Sheet 1

Fig. 1



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CATHODE-RAY TUBE COATING APPARATUS

Filed July 30, 1951 4 Sheets-Sheet 2

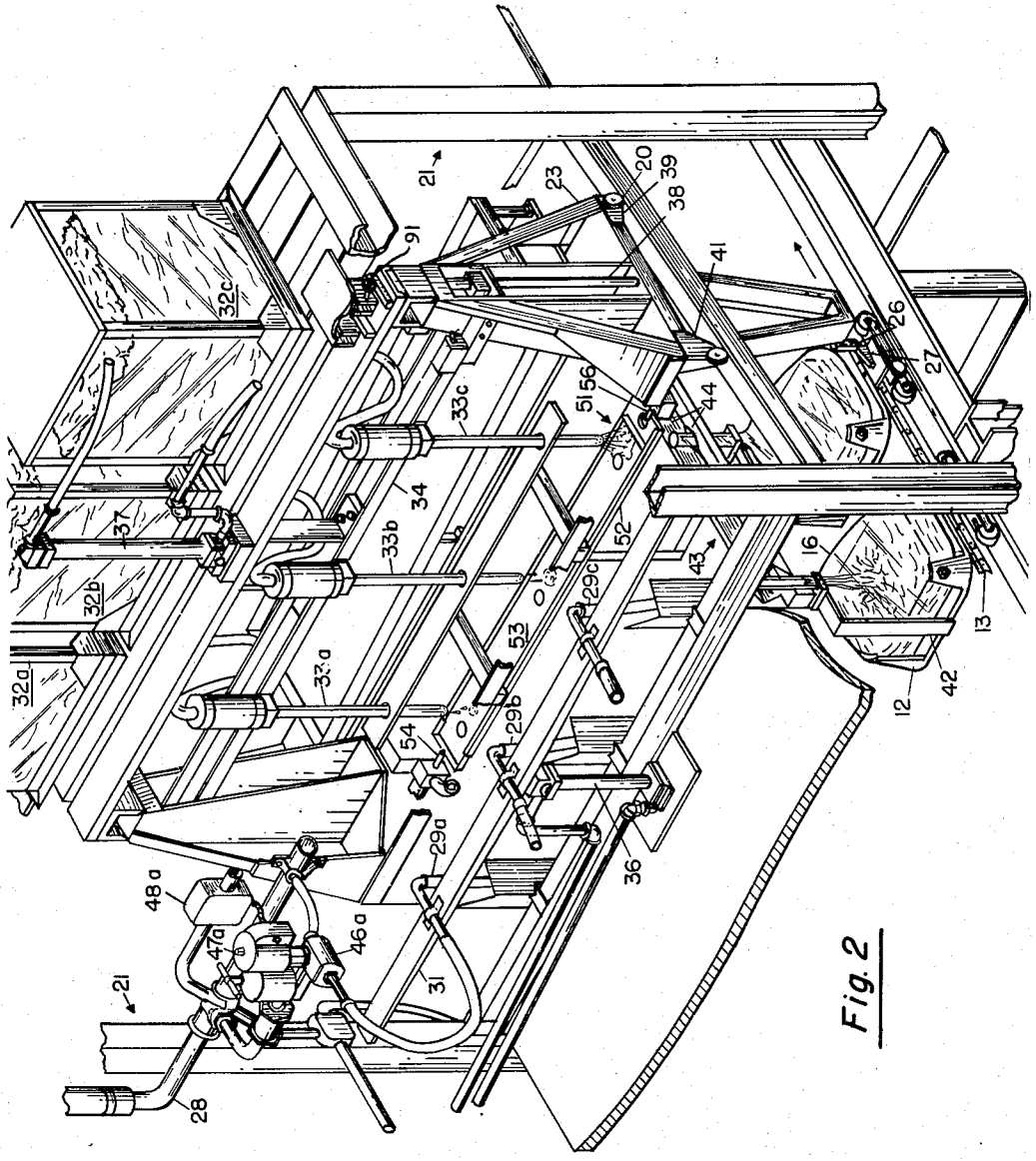


Fig. 2

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CATHODE-RAY TUBE COATING APPARATUS

Filed July 30, 1951 4 Sheets-Sheet 3

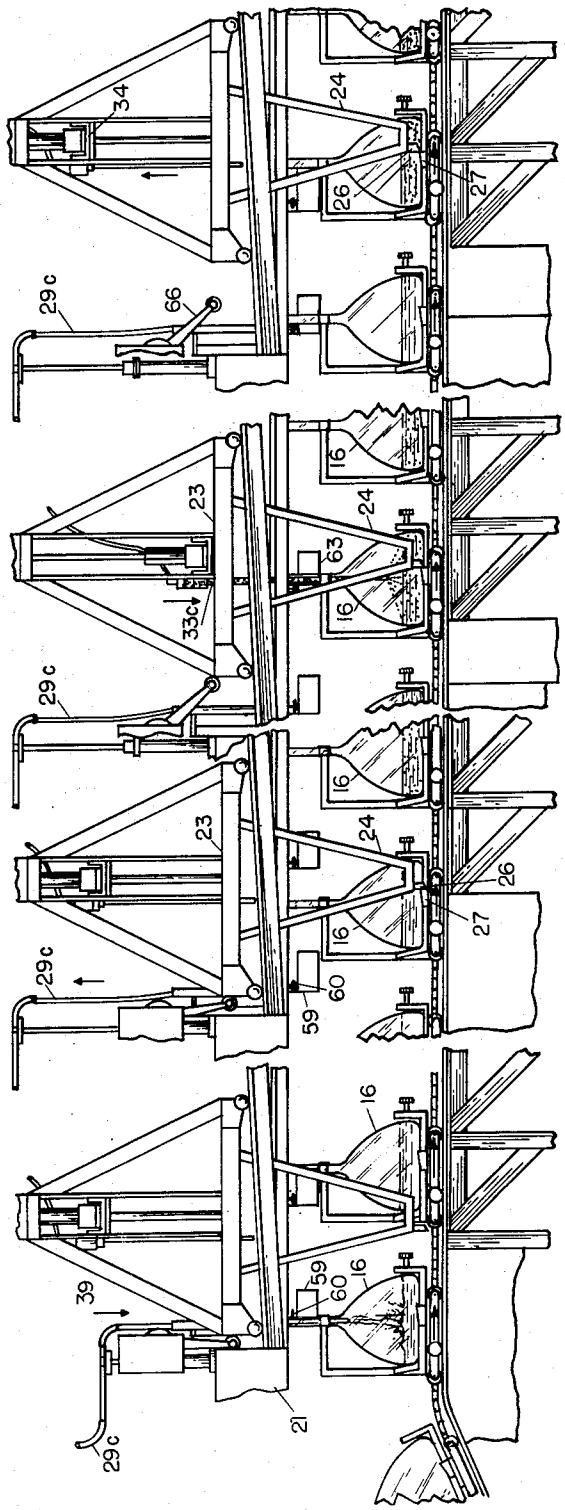


Fig. 9

Fig. 7

Fig. 5

Fig. 3

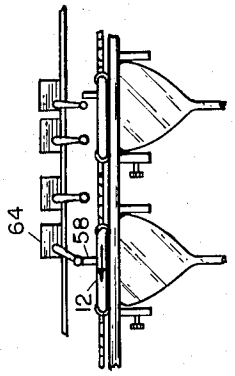


Fig. 10

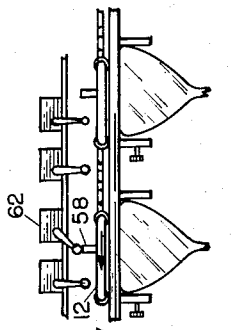


Fig. 8

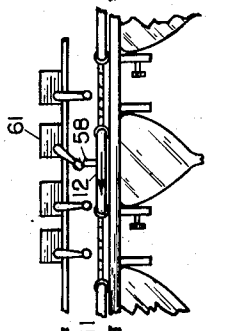


Fig. 6

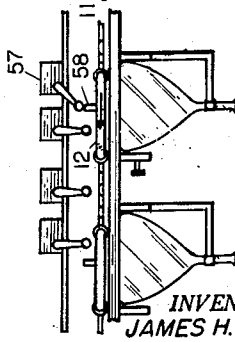


Fig. 4

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CATHODE-RAY TUBE COATING APPARATUS

Filed July 30, 1951 4 Sheets-Sheet 4

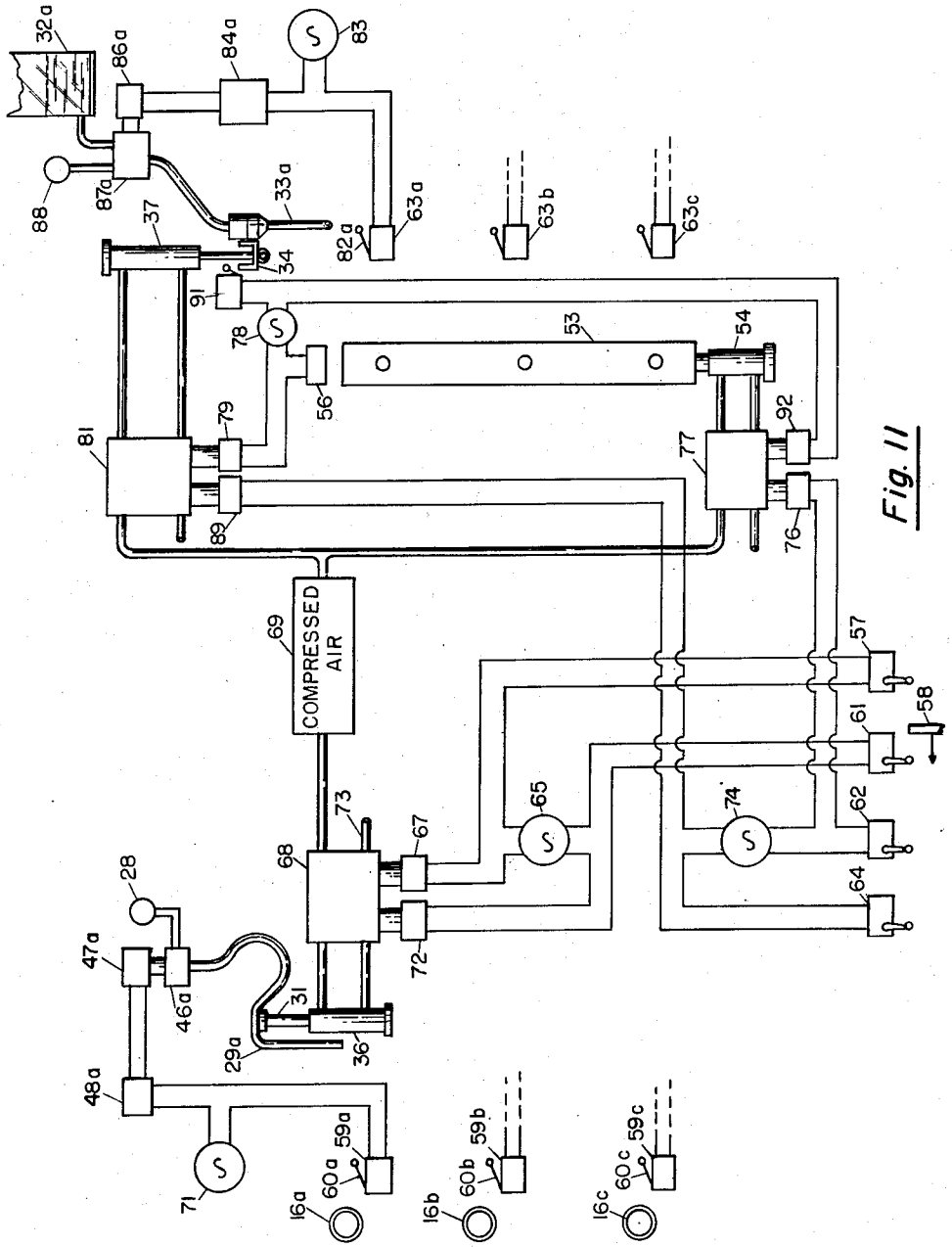


Fig. 11

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UNITED STATES PATENT OFFICE

2,660,978

CATHODE-RAY TUBE COATING APPARATUS

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Application July 30, 1951, Serial No. 239,346

5 Claims. (Cl. 118—2)

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This invention relates to apparatus for making cathode ray tubes and more particularly to apparatus for applying fluorescent screens to such tubes.

When cathode ray tubes are mass produced on conveyors, some means must be provided to load the screen-forming solutions into the tube blanks. Some of these solutions may be poured indiscriminately into the blanks but other solutions must be evenly dispersed within the blanks and, because of this, it has been found desirable to provide a rigid tubular member having a suitable dispersing nozzle that may be lowered into the tube blank. In order to do this, means must be provided to simultaneously move the tubular member with the tube blank as the blank is moved by the conveyor and great care must be taken not to introduce vibration into the conveyor which would result in forming imperfect fluorescent screens. Furthermore, the means for carrying the tubular member must return automatically to substantially the same starting location after the proper amount of liquid has been dispensed.

It is one object of the invention to provide improved apparatus for producing cathode ray tubes.

Other objects are to provide improved apparatus for applying the fluorescent screen to cathode ray tubes and to provide apparatus which may be easily and accurately controlled with variations in the screen material, size of the cathode ray tube blank or such other factors as are likely to be changed in the normal course of production within a short space of time. Other objects will be apparent after studying the following specification and drawings in which:

Figure 1 is a side-elevation view illustrating apparatus incorporating the present invention;

Figure 2 is a fragmentary perspective view of the apparatus illustrated in Figure 1;

Figures 3 through 10 are fragmentary views of the apparatus illustrating the timing sequence of the operations involved in the normal use of the apparatus and

Figure 11 is a diagrammatic illustration of the control system of the present invention.

This invention comprises dispensing apparatus operating simultaneously with a conveyor to form the fluorescent screens in cathode ray tubes in mass production. The dispensing apparatus, which is located adjacent one end of the conveyor and is preferably supported by a separate framework to allow operators to reach the dispensing apparatus without introducing vibration into the conveyor itself, is adapted to introduce

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predetermined amounts of a plurality of chemical solutions into each cathode ray tube blank on the conveyor to form a fluorescent screen therein, as described in United States patent application Serial No. 100,543 to Albert Steadman, filed June 21, 1949, and assigned to the assignee of the present invention. In accordance with the disclosure of that application, a solution of barium acetate is first introduced into the tube blanks and thereafter a second solution comprising a mixture of potassium silicate and the fluorescent screen material is added. In introducing these solutions into the cathode ray tube envelope in accordance with the present invention, a hose from a manifold in communication with a reservoir, conducts a metered amount of the barium acetate solution into the continuously moving tube blanks and thereafter a predetermined amount of the second solution is evenly distributed into the first solution by a thistle tube which is in communication with a second reservoir containing the mixture of potassium silicate and fluorescent material. To accomplish an even distribution of the second solution, it is dispensed through a thistle tube which is lowered into the neck of the tube blank after the removal of the flexible hose. The thistle tube is supported by a carriage movable on rails which form part of a framework preferably structurally independent of the conveyor heretofore mentioned. The power to move the carriage is supplied by the conveyor through cogs attached to the tube supports on the conveyor which intercept arms on the carriage. Automatic release of the carriage and return to the starting position following the introduction of the second solution into the tube blank is accomplished by inclining the carriage supporting rails so that the carriage is raised simultaneously with its forward movement until the arms clear the cogs, thus allowing the carriage to coast to rest at the starting position. Raising and lowering of the flexible hose lines and thistle tubes out of and into the necks of the cathode ray tube blanks is accomplished by elevator mechanisms controlled by electrical switches which time the operations and which are interlocked to allow the solutions to flow only if a cathode ray tube is in position to receive them.

Referring now to the drawings and particularly to Figure 1, there is illustrated a continuous conveyor 11 having a plurality of spaced cathode ray tube holders 12 preferably equally spaced along the longitudinal dimension of and attached to the endless belt 13. It is customary to mount these holders three abreast at relatively

closely-spaced positions along the longitudinal dimension of the conveyor belt, but more or less than that number may be used depending upon the desired production capacity. Thumb screws 14 or other suitable clamping devices securely clasp cathode ray tube blanks 16a, 16b and 16c in the holders which are attached to the belt 13. The thumb screws 14 are adjustable to the various sizes and types of cathode ray tubes which are in current use. The belt 13 is driven by a motor 17 connected to the input shaft of a speed reduction transmission 18, the output shaft of which in turn is connected to one of the belt-driving wheels 19 through suitable damping means, not shown. The belt 13 is supported for continuous movement on the wheels 19 which are rotatably mounted at opposite ends of the conveyor assembly.

The dispensing apparatus comprises a support structure 21 including a pair of rails 22 positioned on the support to be inclined upwardly relatively to the supporting surface of the conveyor belt, along the direction of its movement, as shown. While the support structure 21 is shown as being independent of the conveyor belt assembly to avoid transmission of vibration from the dispensing apparatus to the conveyor belt assembly, it will be obvious that it may form an integral part of the conveyor belt assembly. A carriage 23 provided with rollers 26 engaging the rails 22 reciprocates on the rails in substantially the direction of movement of the conveyor belt. A pair of generally V-shaped arms 24 are disposed on opposite sides of the carriage 23 and engage the inner sides of the rails 22 to prevent the carriage from slipping from the rails. The arms are provided at their lower ends with hardened catches 26 which engage with similarly hardened cogs 27 secured on the holders 12 when the carriage is at its initial or normal position of movement on the rails.

Referring now to Figures 1 and 2, there is secured at the top of the structure 21, a manifold 28 and three spaced hose lines 29a, 29b and 29c for dispensing a barium acetate solution. The hose lines are supported by and raised and lowered into and out of the necks of the tubes 16 by a frame 31, see particularly Figure 2. The second solution comprising a mixture of potassium silicate and fluorescent material is stored in three vessels 32a, 32b and 32c mounted at the top of the structure 21 and is dispensed through the thistle tubes 33a, 33b and 33c which are secured in spaced relation on the carriage 23. The thistle tubes 33 are raised and lowered by a frame 34.

Referring now more particularly to Figure 2, there is illustrated in detail the dispensing apparatus including the elevator mechanisms for raising and lowering the frames 31 and 34. In the present embodiment, air cylinders 36 and 37 slideably supporting pistons connected respectively to the frames 31 and 34 raise and lower the frames. Movement of the frame 34 is guided in the carriage 23 by a pair of bearing rods 38 vertically supported at opposite sides of the carriage. The base of the carriage 23 is maintained substantially level and in parallel relation with the conveyor belt by supporting legs 39 and 41 of unequal length in order that the thistle tubes may drop perpendicularly into the necks of the tubes 16.

In Figure 2, the tube 16 is shown receiving a charge of barium acetate solution by means of the hose line 29c inserted in the neck which is located on the holder 12 by the clamp 42 secured

thereto so that the line 29 will drop into the neck without striking the rim. As the conveyor moves the tube holder 12 in the direction shown by the arrow, the neck of the cathode ray tube blanks enters an inverted trough 43 comprising a pair of perpendicularly disposed adjacent flaps 44 which prevent excess liquid from running down the outside of the trough and into the conveyor mechanism.

Attached to the support 21 is a metering apparatus for dispensing the barium acetate through the hose lines 29a, 29b and 29c. The metering apparatus comprises the manifold 28 and a plurality of solenoid operated valves 46a, 46b and 46c of which only one 46a is shown in the drawing. A solenoid 47a for operating the valve 46a is located directly above the valve itself and is controlled by an electric current from a timer 48a in response to signals from microswitches which are not shown in this figure. In this connection, it will be understood that each of the valves 46b and 46c is controlled by a solenoid and timer similar to the solenoid and timer 47a and 48a respectively. A continuous and even pressure is maintained in the manifold 28 and the metering of the proper amount of barium acetate solution therethrough is accomplished by timing the open period of the valves 46a, 46b and 46c rather than by allowing the fixed amount of solution to accumulate in a separate reservoir. This results in easier changeover from one size of cathode ray tube blank requiring a certain amount of barium acetate to another size tube blank requiring a different amount since the amount can then be determined by the setting of the timers 48a, 48b and 48c rather than by changing to a reservoir of a different size which would entail disconnecting a number of hose lines. However, using a separate reservoir to meter the barium acetate results in a somewhat more accurate control of the volume thereof supplied to each tube blank and the separate reservoir may thereby be used as an alternative to the timer controlled process, particularly where precise measurement of the volume of liquid is required.

Supported on the carriage 23 beneath the thistle tubes is a drip trough 51 comprising a bottom member 52 having holes, not shown, aligned with the necks of the tube blanks and a top piece 53 having similar holes. Upon closure of a limiting switch, not shown, air actuated device 54 pushes the top piece 53 to the right so that the holes therein are aligned with the holes on the bottom piece and the necks of the tube blanks. When the two pieces are so aligned, a switch 56 is closed which allows the air cylinder 37 to lower the frame 34 so that the ends of the thistle tubes 33 pass through the aligned holes and into the necks of the tube blanks. The purpose of providing two relatively slideable members 52 and 53 is to cut off the drippage from the thistle tubes 33 as shown.

Referring now to Figures 3 through 10, there is illustrated the sequence of operation of the air actuated devices 36 and 37. As one of the tube blanks comes into position under the barium acetate dispensing member 29c in Figure 3, a microswitch 57 shown in Figures 1 and 4 as being supported on the conveyor belt assembly above the returning belt, is closed by movement of a bar 58 secured on the underside of the holders 12. It is possible to use any part of the conveyor as a timer because the entire mechanism operates as a unit and each of the longitudinally

spaced holders 12 is equally spaced from adjacent holders. Where the tube holders are not equally spaced, it would be obvious that it will be necessary to support the microswitch 57 on the conveyor assembly so that it will be actuated as the row of tube blanks moves into position under the dispensing members 29a, 29b and 29c. A plurality of microswitches 59 are attached at laterally spaced points on support 21, each microswitch being positioned so that the arm 60 thereof is actuated by contact with the necks of each of the laterally spaced tube blanks 16.

In Figure 5, the tube 16 has moved to the right and has received its full charge of barium acetate solution through the hose 29 which has moved upwardly as indicated by the arrow in response to a signal from the microswitch 61 shown in Figure 6. It will also be noted that the catch 26 has made contact with the cog 27 initiating the above-mentioned movement of the carriage 23.

In Figure 7, the frame 34 has lowered in response to a signal from microswitch 62, in Figure 8, and the second solution of potassium silicate and fluorescent material is being disseminated through the dispersing nozzle on the end of the thistle tube 33c. Another group of laterally spaced microswitches 63 supported by the frame 21 is operated by the necks of tube blanks in a manner similar to that described in connection with microswitches 59. While the microswitches 59 and 63 act on the timers to start the flow of the solutions through the hose lines 29a, 29b and 29c and thistle tubes 33a, 33b and 33c respectively, they also act as interlocking switches to prevent the flow of these solutions in the event that the operator has failed to place a tube blank in any particular holder.

In Figure 9, the frame 34 has moved up again as indicated by the directional arrow and the carriage 23 has risen almost enough to allow the catch 26 to clear the cog 27. Raising of the frame 34 is accomplished by the air cylinder 37, shown in Figure 2, in response to a signal from the microswitch 65, shown in Figure 10. A shock absorber 66 is attached to the frame 21 to index the initial or starting position of the carriage 23 and to dissipate the momentum or shock of impact of the carriage 23 when it returns to its initial position.

After the thistle tubes have been raised as shown in Figure 9, the cathode ray tube blanks 16 travel up to the far end of the conveyor 11, are tilted to decant the excess liquid as shown in Figure 1, and return on the underside of the conveyor to the starting position at the left hand end thereof where they are removed by the operator and fresh blanks are put in place. The entire operation can be accomplished by a single operator in place of the three or four who would normally be necessary if the screen-forming materials were hand loaded into the tube blanks as has been the custom heretofore.

In the diagrammatic representation in Figure 11, the interconnections between parts of the dispensing apparatus which are operated electrically and those which are operated by air pressure are diagrammatically shown to the exclusion of the conveyor 11 and the carriage 23 of Figures 1 and 2. Figure 11 may be considered as supplementary to Figures 3 through 10 in illustrating the operation of the dispensing apparatus.

The operation of the circuit in Figure 11 starts with the actuation of microswitch 57 by the bar 58. Microswitch 57 connects electrical power from the source 65 to a solenoid 67 controlling the operation of the four-way air valve 68 which connects a source 69 of compressed air selectively to either side of the piston, now shown, in the air cylinder 36. Energizing the solenoid 67 operates the valve 68 to apply compressed air to the side of the piston which causes lowering of the frame 31 thereby dropping the hose lines 29a, 29b and 29c into the necks of the tube blanks. Since the operation is the same for each of the three laterally spaced columns of tube blanks, reference will be limited to the apparatus associated with the column of tube blanks identified by the subscript "a" throughout the description of Figure 11 in order to simplify the description. After the hose line 29a descends into the neck of the tube 16a, movement of the conveyor 11, which is not shown in this figure, causes the neck of the tube 16a to press on the arm 60a thereby actuating the microswitch 59a which connects electrical power from the source 71 to the timer 43a and from there to the solenoid 47a which opens the valve 46a. As has been heretofore mentioned, it will be understood that similar timers and solenoids will be associated repectively with dispensing members 29b and 29c as described in connection with dispensing member 29a. While the power source 71 is illustrated as being independent of the power source 65, it will be understood that electrical power for the system may be supplied from a common source. Opening valve 46a allows barium acetate solution to flow from the manifold 28 to the tube 16a through the hose line 29a. At the end of a predetermined length of time when the required amount of barium acetate has passed into the tube 16a, the timer 43a shuts off the electrical power to the solenoid 47a which, in turn, closes the valve 46a.

Shortly thereafter, the bar 58 actuates the microswitch 61 which connects the source of power 65 to energize the solenoid 72. Solenoid 72 operates the valve 63 in such a manner as to apply compressed air from the source 69 to the lower side of the piston in the air cylinder 36 and, at the same time, to connect the upper side of the piston, i. e. the side to which compressed air was applied by operation of the solenoid 67, to the atmosphere by means of the exhaust 73. This operation raises the piston in the cylinder 36 thereby raising the frame 31 and lifting the hose line 29a clear of the tube 16a.

Continued movement of the conveyor 11 causes the bar 58 to actuate the microswitch 62 which connects electrical power from the source 74 to energize the solenoid 76 which controls the operation of another four-way valve 77 similar to valve 68. Operation of the valve 77 by the solenoid 76 supplies compressed air from the source 69 to the cylinder 54 in such a way as to push the plate 53 against the microswitch 56 as was described in connection with Figure 2. When the microswitch 56 is operated by the plate 53, electrical power is connected from the source 78 to a solenoid 79 which is one of two solenoids operating a third four-way valve 81. This valve is similar in operation to the four-way valve 68, and the solenoid 79 operates it in such a way as to supply compressed air from the source 69 to the cylinder 37 to force the frame 34 down, thereby carrying the thistle tube 33a into the neck of the tube 16a.

Very shortly after the thistle tube 33a descends into the neck of the tube 16a, the continued motion of the conveyor 11 shown in Figure 1 causes

the tube 16a to actuate the microswitch 63a by means of the lever 82a. Actuation of this microswitch connects a source of power 83 to a timer 84a which controls the power applied to a solenoid 86a. In this connection, it will be understood that similar timers and solenoids are associated with thistle tubes 33b and 33c for the control of the dispensing of solutions therethrough. The solenoid 86a controls a three-way valve 87a which may be opened to admit passage of the solution containing the fluorescent screen material and the potassium silicate mixture from the reservoir 32a to the thistle tube 33a or distilled flushing water from a manifold 88 to the thistle tube 33a or it may be closed entirely. The operation of the timer 84a is therefore somewhat more complex than the operation of the timer 43a in that it is necessary to control the operation of the solenoid 86a to three positions. The sequence of operation starts with the opening of the valve 87a to admit the above-mentioned second solution from the reservoir 32a to the thistle tube 33a and thence to the cathode ray tube blank 16a. At the end of a predetermined length of time, the solenoid 86a switches the valve 87a from the reservoir 32a to the distilled water manifold 36 to flush out the last few drops of the fluorescent material mixture in the thistle tube 33a. After sufficient flushing water has been admitted, the solenoid 86a switches the valve 87a to the cutoff position.

During the flushing operation, the bar 53 moves into position to actuate the microswitch 64 which connects electrical power from the source 74 to the solenoid 89. This solenoid operates the four-way valve 81 to raise the piston in the air cylinder 37 in the same manner as the valve 68 operates on the air cylinder 36 herein above described. As the frame 34 moves upwardly, it actuates the microswitch 91 which applies power from the source 78 to the solenoid 92. This solenoid acts on the four-way valve 77 which controls the return of the tray 53 by means of the air cylinder 54. Since this tray cannot be returned until the thistle tubes 33a have been lifted clear of it, there is no danger of the tray's clipping off the end of the thistle tubes.

One complete cycle of operation of the dispensing apparatus has been described. It will, of course, be obvious to those skilled in the art that modifications may be made in the operation. For instance, the hose lines 29a may be placed on the carriage 23 in Figure 1 and raised and lowered simultaneously with the thistle tubes 33 by a single air cylinder 37, thus eliminating the need for air cylinder 36 and also eliminating the need for the flexible lines 29 which may be replaced by tubes similar to the thistle tubes 33 except that they need not have dispersing nozzles on the ends thereof.

The operation of the machine as a unit is initiated by applying power to the motor 17 which in turn drives the conveyor belt 13. As the conveyor belt with its holders 12 carrying the processed tube blanks 16 move along their return path to the left-hand end of the machine as viewed in Figure 1, an operator stationed at that end releases the processed tube blanks and substitutes unprocessed blanks for processing. As the blanks on the holders move with the belt toward the right-hand end of the machine, barium acetate is introduced into the blanks through the hose lines in the manner hereinbefore described. Thereafter, as the blanks on the holders continue to move toward the right-hand end of the machine the catches 26 supported on arms 24 engage the cogs 27 secured on the holders 12. With continued movement of the belt thereafter, the carriage 23 moves with the belt, holders, and tubes along the inclined rails 22. During this simultaneous movement of the tubes and carriage, the potassium silicate solution with fluorescent material dispersed therethrough is introduced into the tubes through the thistle tubes 33 in the manner hereinbefore described. As the carriage 23 approaches the right-hand end of the inclined rails 22, the catches become disengaged from the cogs 27 permitting the carriage 23 to move by the force of gravity back along the inclined rails to its starting position where the sequence of operations is repeated for the next following row of tubes. After the tubes have received the different solutions, they continue to move with the conveyor toward the right-hand end of the machine where they are tilted as the belt follows the contour of the supporting wheel 19. As the tilting of the tubes is increased by continued movement of the belt, the liquid is slowly decanted from the tubes without disturbing the settled film of fluorescent material. Thereafter the tubes return toward the left-hand end of the machine where they are removed by the operator.

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

1. In combination, a conveyor for supporting and moving a plurality of spaced receptacles thereon, a support for said conveyor, a carriage, means attached to said support for movably mounting said carriage, said means including rails inclined to the horizontal plane of said support to permit the weight of said carriage to return it to the lower position of said rails, means for interconnecting said carriage and said conveyor to move said carriage through a pre-determined distance with said conveyor and thereafter release said carriage, and dispensing means mounted on said carriage movable with said receptacles for introducing fluorescent screen-forming materials into said receptacles.

2. In combination, a conveyor, a plurality of spaced supports mounted on said conveyor, said supports being adapted to receive cathode ray tube blanks, a carriage positioned adjacent said conveyor and movable in directions parallel with the direction of movement of said conveyor, cogs secured to said supports, a catch secured to said carriage, said cogs and catch being interconnectable to provide simultaneous movement of said conveyor and carriage, supporting means for said carriage, said supporting means being inclined to the surface of said conveyor to provide a predetermined amount of simultaneous movement of said carriage and said conveyor and thereafter disengage said cogs and catch and return said carriage to its initial position, indexing means for determining the starting position of said carriage, and dispensing means mounted on said supporting means for said carriage and having liquid conducting means movable with said carriage for introducing predetermined amounts of fluorescent screen-forming solutions into said blanks.

3. In apparatus for forming fluorescent screens on cathode ray tubes, a continuous conveyor, a support for said conveyor, a plurality of spaced cathode ray tube blank holders mounted on said conveyor, cogs attached to said holders, a carriage, a support for said carriage, said support including a pair of rails inclined to said conveyor and on which said carriage moves, arms

depending from said carriage between said rails to guide the movement of said carriage on said rails, a catch attached to one of said arms, said catch and said cogs being interconnected in one position of said carriage on said rails to transmit the motion of said conveyor to said carriage and move said carriage through a predetermined distance where said catch and cogs disengage and said carriage returns by force of gravity to its initial position, shock absorbing means attached to the carriage support for determining said initial position of said carriage and absorbing the momentum of said carriage as it returns to said position, and dispensing means secured to said support for said carriage and having means movable with said conveyor and including separately controlled dispensing members for adding a plurality of fluorescent screen-forming solutions to said tubes at predetermined intervals during the simultaneous movement of said conveyor and carriage.

4. In combination, a continuously moving conveyor, a support therefor, cathode ray tube blanks mounted in holders attached to said conveyor and moving therewith, and dispensing apparatus for supplying fluorescent screen-forming solutions to said blanks, said dispensing apparatus comprising a first source of a first solution and a flexible hose connected to said first source to convey a predetermined amount of said first solution to each of said tube blanks in succession, said first source being mounted on said support, a first elevator attached to said support and to said hose to lower said hose into said tube blanks in succession and subsequently raise said hose again, a second source of a second solution, rigid tubing connected to said second source, a carriage to transport said tubing over said conveyor and parallel to the motion thereof, cogs attached to said conveyor and catches attached to said carriage to transmit motive power from said conveyor to said carriage, a second elevator mechanism to lower said tubing into said blanks in succession following the removal of said hose therefrom in order to bring the end of said tubing into proper spaced relation to disperse a predetermined amount of said second solution over the surface of said first solution, inclined rails forming part of said dispensing apparatus and supporting said carriage, said rails being inclined upward in the direction of motion of said conveyor and the slope of the inclination being sufficient to raise said arms above said cogs to free said carriage to coast back to the starting point.

5. In apparatus for forming fluorescent screens on cathode ray tubes, a continuous conveyor, a plurality of spaced cathode ray tube blank holders mounted on said conveyor, means for driving said conveyor, cogs secured to said holders, a carriage, a support for said carriage, said support including a pair of rails inclined to the surface of said conveyor and on which said carriage moves, a pair of spaced arms extending downwardly from said carriage and between said rails for guiding the movement of said carriage on said rails, catches attached to said arms and inter-engageable with said cogs in one position of said carriage on said rails to transmit motion from said conveyor to said carriage and move said carriage through a predetermined distance on said rails where the upward inclined movement of said carriage with respect to said conveyor disengages said catches and cogs and said carriage returns by force of gravity to its starting position, shock absorbing means attached to the carriage support for indexing the initial position of said carriage on said rails and absorbing the momentum of said carriage as it returns to said position, first dispensing means mounted adjacent said conveyor and automatically movable into and out of said tubes at predetermined time intervals for dispensing a predetermined amount of one fluorescent screen-forming solution therein, and second dispensing means mounted on said carriage and subsequently automatically movable into and out of said tubes to disperse in said first-mentioned solution a predetermined amount of a second fluorescent screen-forming solution.

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CORNELIUS M. BAKER.

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