July 28, 1953 J K. BURTON 2,646,773

APPARATUS FOR FORMING SETTLED COATINGS

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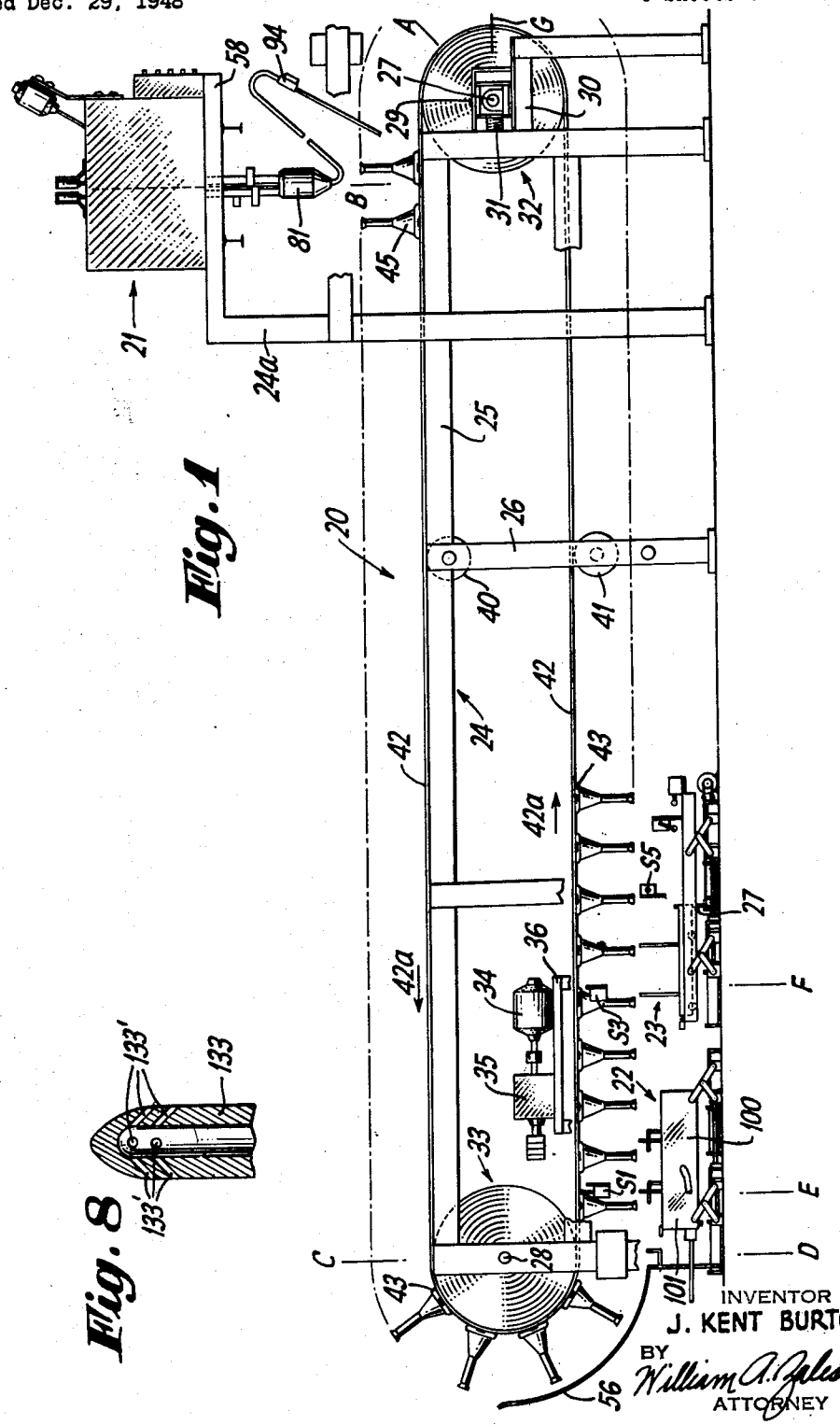


Fig. 1

Fig. 8

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APPARATUS FOR FORMING SETTLED COATINGS

Filed Dec. 29, 1948 5 Sheets-Sheet 2

Fig. 2

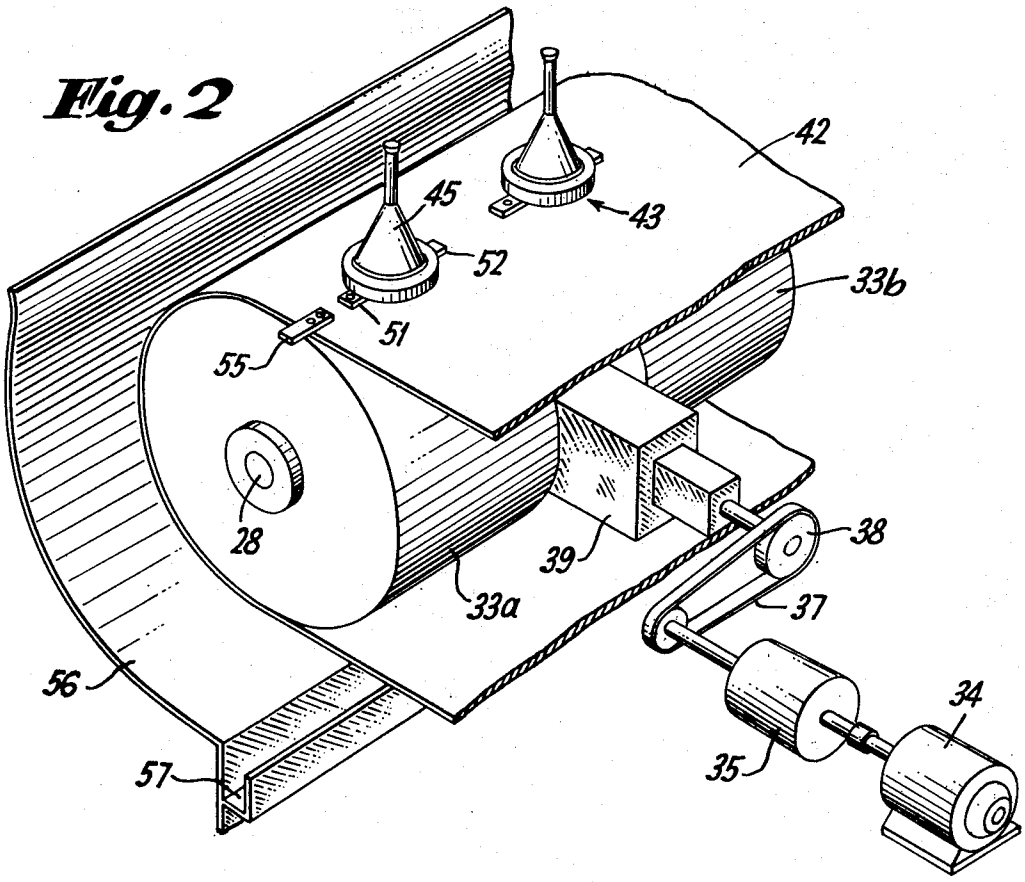
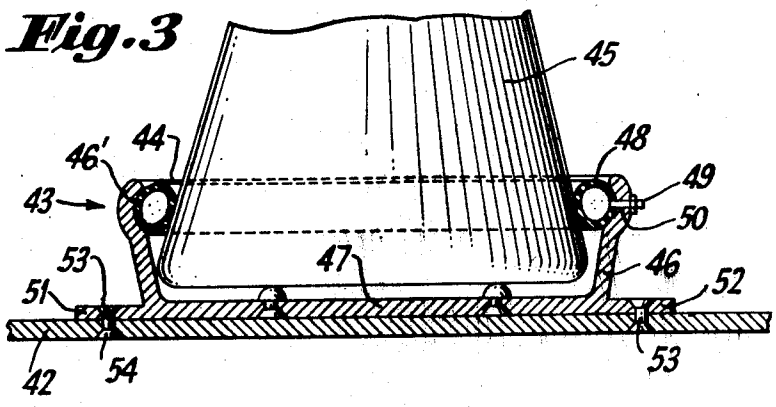


Fig. 3



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APPARATUS FOR FORMING SETTLED COATINGS

Filed Dec. 29, 1948 5 Sheets-Sheet 3

Fig. 5

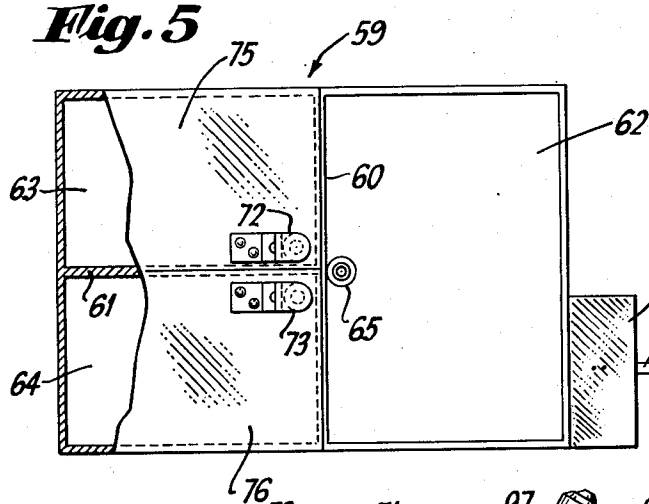


Fig. 11

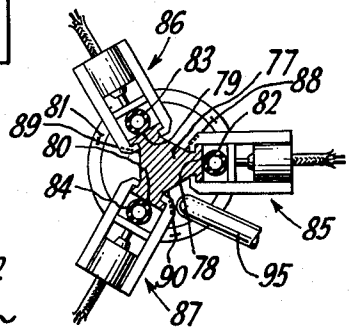
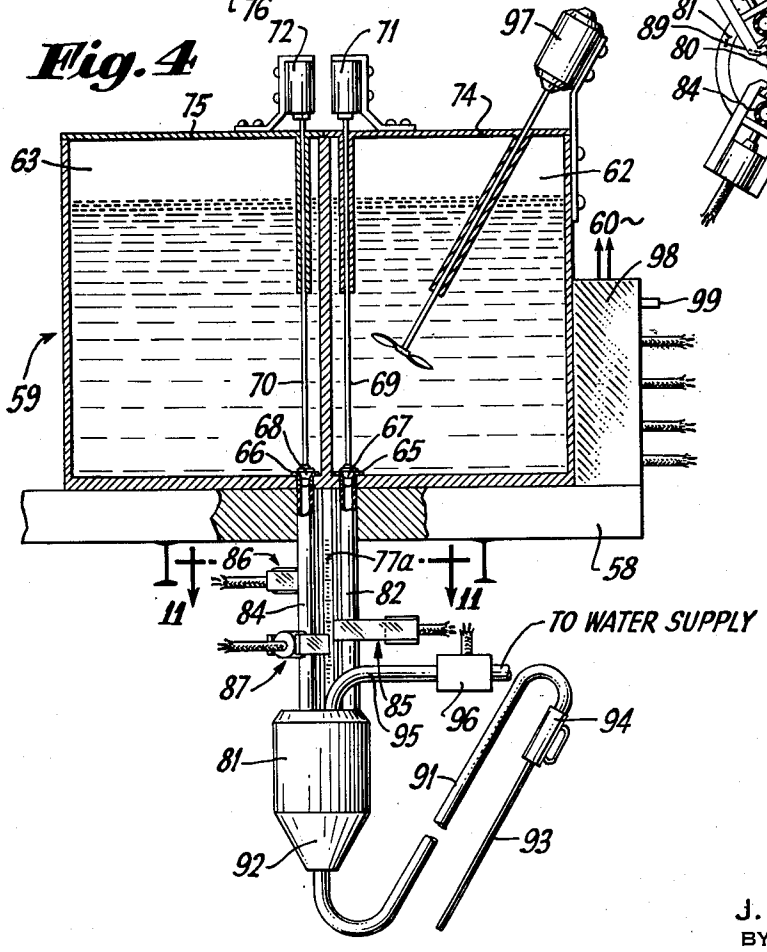


Fig. 4

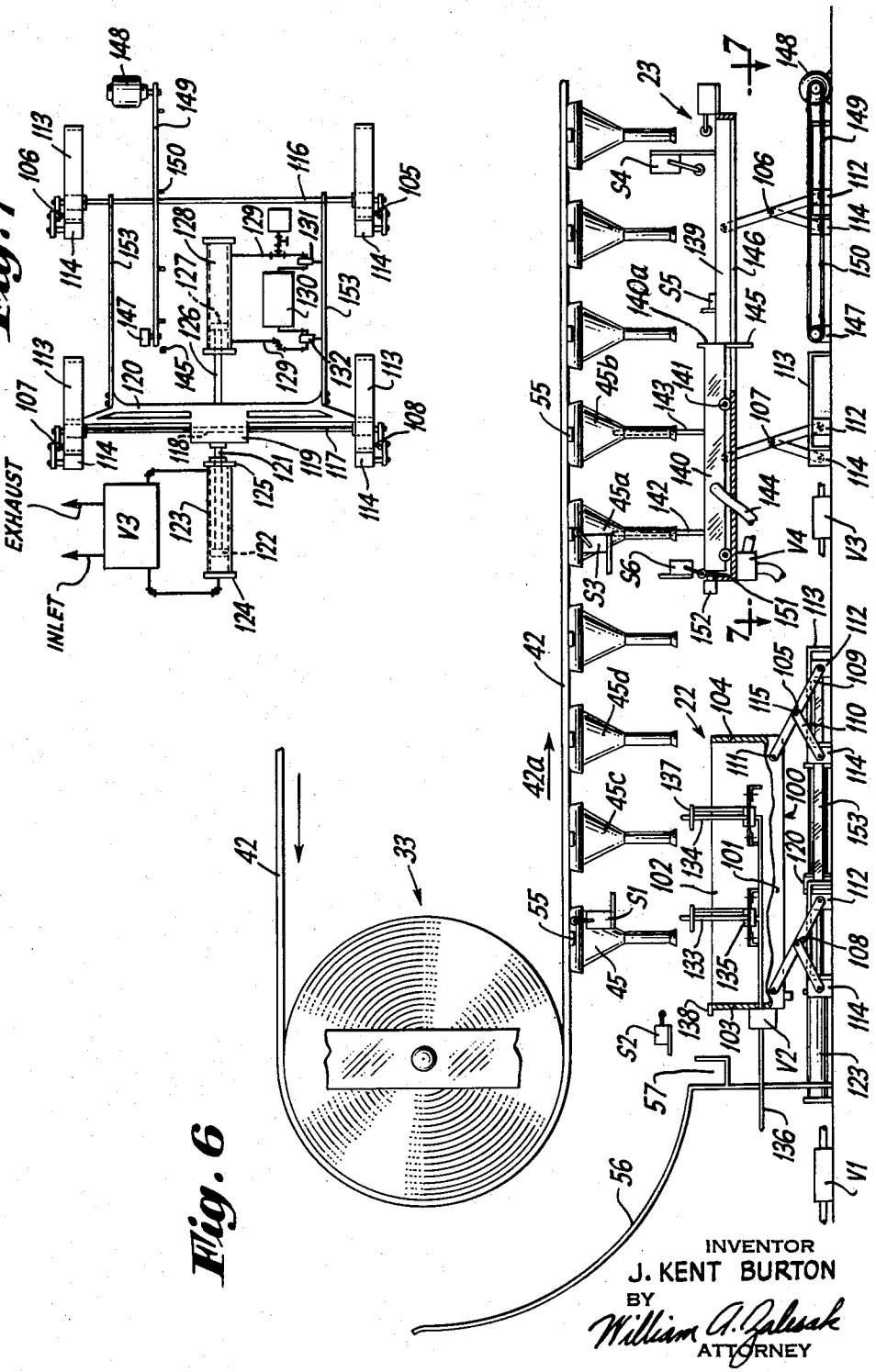


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July 28, 1953 J K. BURTON 2,646,773

APPARATUS FOR FORMING SETTLED COATINGS

Filed Dec. 29, 1948 5 Sheets-Sheet 4



July 28, 1953 J K. BURTON 2,646,773

APPARATUS FOR FORMING SETTLED COATINGS

Filed Dec. 29, 1948 5 Sheets-Sheet 5

Fig. 9

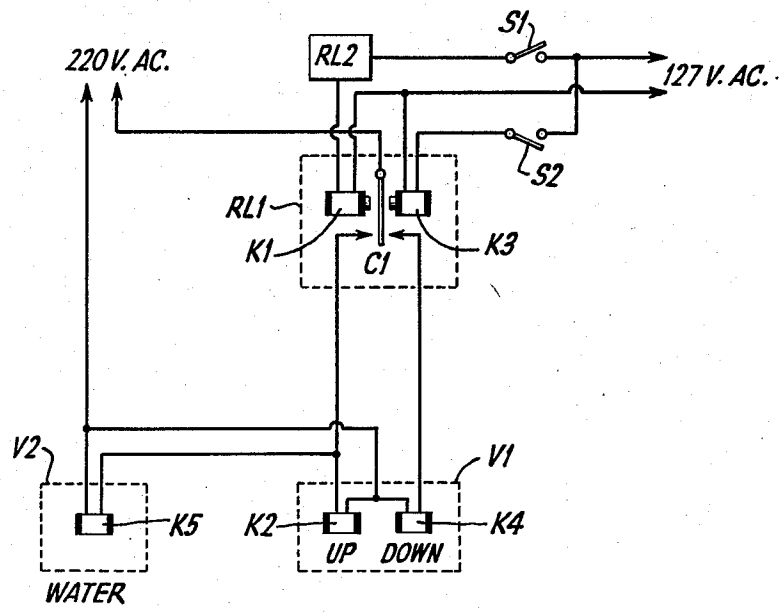
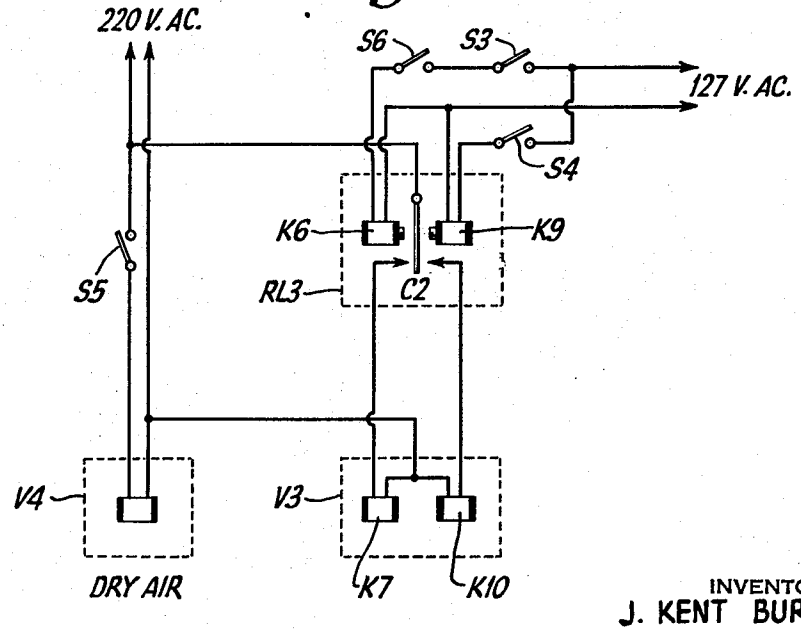


Fig. 10



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2,646,773

APPARATUS FOR FORMING SETTLED COATINGS

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Application December 29, 1948, Serial No. 67,964

11 Claims. (Cl. 118—58)

1

This invention relates to the formation of coatings and more particularly to an apparatus for facilitating the production of such coatings which are applied in the form of a mechanical mixture or suspension and then allowed to settle out upon the surface to be coated.

One example of such coatings is the luminescent screen on the face or end of a cathode ray tube envelope which heretofore have been applied by means of a process and apparatus costly in both time and space. In accordance with the methods with which I am familiar such luminescent coatings or screens have been formed by introducing a mixture of the ingredients in water into the bulb or envelope of a cathode ray tube and then placing the dosed envelope in a position where it could stand undisturbed while the particles forming the screen or coating settle out upon the face of the envelope. The formation of such screens or coatings must be carried out under critically controlled conditions and in particular must be free of vibration and mechanical shock to insure that the formation is of uniform density. Heretofore such a method was carried out on a so-called "tilt table." A cathode ray tube envelope was first charged or dosed with a mixture of the ingredients and then placed on a tilt-table where the particles forming the luminescent screen or coating settled out. After settling of the coating the table was gradually tilted to pour off the remaining liquid. After decanting, the envelope was successively carried to neck wash and drying apparatus where these operations were carried out. The above described method and apparatus required that the envelope be manually handled numerous times and required considerable floor space. It is apparent from the foregoing that the formation of such screens were time consuming and exceedingly costly. Nor was the tilt-table type of apparatus or the foregoing method adaptable to supply a constantly increasing demand or to mass production.

A serious obstacle to the introduction of machinery of the automatic or continuously operating variety lies in vibrations or mechanical socks usually associated therewith since vibrations transmitted to the envelope during the settling of the screen thereon or during decanting of the excess liquid therefrom adversely affected the uniformity of the coating.

Thus, a principal object of my invention is to provide an apparatus to facilitate the application of screens or coatings formed by the settling out of particles from mechanical solution onto the

2

surface to be coated thereby and which is suitable for mass production.

Another object of my invention is to provide such an apparatus for carrying out the same wherein containers, having surfaces to which suspended particles are to be applied, are moved continuously and at a constant speed through various dispensing, settling, decanting, washing and drying positions.

Yet another object is the provision of an apparatus designed to remove the excess liquid at the proper time without any change in acceleration being imparted to the object being coated.

A further object is the provision of such apparatus which after affecting the removal of the liquid from which the granular coating forming particles had settled, presents the coated objects successively to rinsing and drying apparatus to complete the formation of the coating without in any way changing the speed at which the coated objects travel.

Still another object is the provision of such apparatus substantially free of vibration, acceleration and deceleration and their attendant adverse affect upon the coating.

Yet another object of my invention, is the provision of clamping means into which the objects to be coated may be inserted, centered and clamped without danger of breakage or deformation of the object and from which the object may be readily removed on completion of a cycle.

Still other objects will appear as the nature of my invention is more fully understood from the following description taken in conjunction with the accompanying drawings wherein like parts are identified by identical numerals in the several views.

My invention accordingly consists in the provision of a novel apparatus for the formation of coatings by the settling of particles out of solution upon the surface to be coated and of apparatus to carry out the same. It is to be understood that while I have shown but one embodiment in the drawings, this showing is by way of exemplification only, the invention being susceptible of various modifications and changes in construction, arrangements and operation which would be within the spirit of the invention.

In the accompanying drawings, wherein is shown, by way of illustration, one of the embodiments which the present invention may take:

Figure 1 is a side elevational view of an apparatus constructed in accordance with my invention;

Figure 2 is a fragmentary perspective view

on an enlarged scale of the left end of the conveyor shown in Figure 1;

Figure 3 is a fragmentary sectional view also on an enlarged scale showing a holder for a cathode ray tube envelope;

Figure 4 is a vertical sectional view on an enlarged scale of the dispenser shown in Figure 1;

Figure 5 is a plan view of the dispenser shown in Figure 4 with a portion of the cover, the agitator and one solenoid removed;

Figure 6 is a side elevational view partially in section and on an enlarged scale of the wash and dry apparatus shown in Figure 1 with the conveyor schematically shown;

Figure 7 is a sectional view on the line 7—7 of Figure 6 in the direction indicated with the elevating mechanism in plan view and the air and hydraulic lines shown schematically;

Figure 8 is a fragmentary vertical sectional view of one of the wash spouts;

Figure 9 is a schematic wiring diagram of the wash and rinse apparatus;

Figure 10 is a schematic wiring diagram of the drying apparatus; and

Figure 11 is a sectional view through the line 11—11 of Figure 4.

As pointed out, hereinabove, it was believed that in order to secure the formation of a uniform coating where the coating forming particles were applied to the surface to be coated in the form of a suspension from which the particles settled onto the surface and thereby coating the same, that the article or surface thereof being coated had to be immobilized or motionless during the time the settling was taking place. Thus, the apparatus heretofore used for applying such coatings, insofar as I am familiar therewith, have always provided for the articles being coated to remain stationary upon a motionless table or support from the time the particles in suspension were applied and until the particles had settled out upon said surface thereby forming the coating. I have discovered that contrary to this general belief it is not necessary for objects or surfaces receiving such coatings to be at rest but in accordance with my invention such objects are in motion throughout my process. In order to exemplify and describe my process and apparatus for carrying out the same I have done so in connection with the application of luminescent screens to the face of cathode ray tube envelopes and have shown one means for applying such screens to cathode ray tube envelopes of the type commonly used in television receivers. It is to be understood that my method is not limited to the application of luminescent screens but is equally applicable to the settling of coatings which are not luminescent.

In carrying out my process, an object to receive a coating such as a cathode ray tube envelope is set in motion along a predetermined path. Once tinuously along said path until it arrives at the the envelope is thus set in motion it travels conterminus thereof at which time it is removed with a coating formed thereon as hereinafter more fully pointed out. By imparting a constant speed to the envelope and by maintaining said speed substantially free of any acceleration or deceleration from the time a dose or charge of suspended particles is delivered to the envelope and throughout the complete cycle of my process until the coating has been fully formed, I obtain more uniform and more perfect screens than were obtainable in the past.

According to my process, an object after having been set in motion as described above is charged with a dose of particles in suspension and continues to travel at a constant velocity toward the position where excess liquid is removed. As the object travels through this position excess liquid is removed and it continues to travel successively through other positions where various additional operations are carried out. The speed of travel and the distance between the position where the object is charged and the excess liquid is removed are such that the suspended particles have substantially all settled out upon the surface to be coated or a coating of the desired density has settled. After the excess liquid has been removed, the object continues to travel through such additional positions as are necessary to complete the setting of the coating. In the setting of a luminescent screen on the face of a cathode ray tube envelope, such additional positions may include rinse, wash and dry positions as more fully described below.

It is apparent from the foregoing that in keeping with my process manual handling of the object being coated is completely eliminated together with the attendant imperfections and breakage. Approximately one-third the floor space is required to produce a given quantity of coated objects while the labor required is substantially less than one-third that heretofore required.

Referring now to the drawings in detail one arrangement for carrying out my process may include a carrier means in the form of an endless belt conveyor indicated as at **20** (Fig. 1), a dispenser **21**, a rinse and wash position **22**, and a dry position **23**. An object placed on the conveyor **20** at A is dosed with a charge of coating forming ingredients in suspension at B which settle out as the object continues in movement from B to C. As the object passes between C and D excess liquid is poured off followed by rinsing and drying between D and E, and E and F respectively. At the end of the cycle, the object with a completed coating may then be removed which may be conveniently effected adjacent the loading position as at G. By the term cycle I desire to be understood as meaning the entire program from the time an object is placed on the conveyor and started on its path until it has finally passed through all of the various positions and areas and is terminated by removal of the object.

Conveyor **20**, as most clearly shown in Figures 1, 2 and 3 has a main supporting frame indicated generally as at **24** having suitably interconnected horizontal and vertical members **25**, **26** as required to support the desired load with little or no vibration. Suitable additional bracing may be supplied. When using this apparatus for settling luminescent screens, I make frame **24** substantially heavier and sturdier than would ordinarily be utilized to accommodate a maximum load in order to insure that little or no vibration can be transmitted through the frame and thereby affect the quality of the screens produced in view of the sensitivity of the screen forming suspension to vibration during settling and decanting. Supported by the frame and at each end thereof is a rotatably mounted shaft **27**, **28**. Shaft **27** is mounted at each of its ends in bushings **29** (only one of which is shown in Figure 1) adjustably movable on supports **30** by means of a pair of adjusting screws and springs. An idler drum or roller **32** is mounted on and rotates with shaft **27**. A drive roller **33** is mount-

ed on shaft 28 and rotates therewith. A motor 34 and gear box 35 are mounted on a separate support 36 and are connected to conveyor 20 only through belt 37 which may be of rubber or other suitable material. A separate platform and flexible interconnection are provided to reduce to a minimum the transmission of vibration from motor 34 and gear box 35 to conveyor 20. Belts 37 may be connected to either end of shaft 28 or to the center thereof by a suitable pulley 38 and driving worm 39 as shown in Figure 2. In the latter instance roller 33 has two sections 33*a* and 33*b*.

Additional idler rollers 40, 41 for the upper and lower courses may be provided as required by the nature of the load.

An endless belt 42 extends around idlers 32 and 33 and is tensioned by roller 32 by means of spring 31. Evenly distributed over the surface of belt 42 and connected thereto are holders 43. An array of holders 43 extending longitudinally along the belt is referred to hereinafter as "lines" while an array extending transversely across the belt is referred to as a "row." It is immaterial how many holders are arranged in a row or how many lines of holders are present except insofar as the design is affected. Thus, in Figure 2, a row containing two holders is shown indicating that there are two continuous lines of holders extending along the surface of belt 42.

As most clearly shown in Figure 3, each holder 43 includes a body portion or receiver 44 which is substantially cup-shaped to receive a cathode ray tube envelope 45 and has an annular upstanding wall 46 which may be integral with base 47 as shown. Wall 46 is provided with an annular recess 46'. Adjacent its upper open end and in which is located an endless inflatable tube 48 having an air valve and stem 49 which passes through a hole 50 in recess 47. Receiver 44 is provided with a pair of ears or straps 51, 52 which are fastened to belt 42 by means of rivets 53 or the like, with the inner ends 54 thereof countersunk below the surface of the belt.

Also connected to belt 42 and extending beyond the edge thereof are trips 55 positioned in alinement with the center line of each row of holders. As will be pointed out in greater detail, trips 55 actuate certain phases of the cycle on closing specified switches.

As shown in Figure 1, dispenser 21 is located over and adjacent one end of conveyor 20. In alinement with the other end of conveyor 20 is a splash shield 56 having a trough 57 disposed to receive liquid collected by shield 56 and conduct the same to a collecting container or waste receptacle not shown.

From the foregoing it is apparent that an object such as tube envelope 45 inserted in a holder 43 while the same is passing through position A will be carried through position B under dispenser 21. Similarly, all holders in a given row pass through position A simultaneously and then through position B. All envelopes 45 as they pass through station B are charged with a dose of coating ingredients from dispenser 21 as will now be described. So much of the construction of the dispenser will be pointed out and described here as to enable one skilled in the art to fully understand the present invention and carry out the same. A vertical and upwardly extending portion 24*a* of main frame 24 supports platform 58 which supports dispenser 21 over conveyor 20 and above position B. Referring now to Figures 4, 5 and 11, a tank 59 is subdivided by walls 60 and 61 into suitably proportioned sections or sub tanks 62, 63, 64 and is conveniently arranged on platform 58 as shown. As appears in Figure 5, sections 62 and 63 are provided with openings through the base or lower portions thereof having respectively valve seats 65, 66, valves 67, 68, valve stems 69, 70 and valve actuating solenoids 71, 72. It is to be understood that tank section 64 is similarly provided with corresponding valve seat, valve and valve stem though these elements do not appear in Figure 5. As apparent in Figure 4, the solenoid corresponding to tank section 64 is indicated at 73. Furthermore, tank sections 62, 63 and 64 are each provided with a cover 74, 75, 76 respectively upon which the corresponding solenoids 71, 72, 73 and valve assemblies are mounted as clearly shown.

Depending from platform 58 and centered with respect to the openings in tank sections 62, 63, 64 is a rail 77 provided with vertical tracks or slideways 78, 79, 80. Connected to the lower end of rail 77 and depending therefrom is a funnel 81. Leading from each of said openings in the tank sections are tubes 82, 83, 84 which lead into funnel 81. Tubes 82, 83, 84 are preferably made of resilient indeformable rubber or the like and are each encircled by a solenoid actuated clamp or shut-off 85, 86, 87 which are in turn slidable on corresponding tracks 78, 79, 80 respectively. Each of the solenoid actuated shut-offs 85, 86, 87 are provided with an adjustable locking thumb screw 88, 89, 90 respectively which permit selective positioning of each shut-off with respect to its tube, the purpose of which will be pointed out hereinbelow. Suitable scales may be provided as at 77*a* to facilitate positioning of the shut-offs. A flexible tube 91 is connected to a spout 92 at the lower end of funnel 81 and is provided with a nozzle 93 and a drip shut-off valve 94. Also leading into funnel 81 is a water conduit 95 provided with a solenoid valve 96 and which is connected to a source of water supply as indicated.

Tank 59 is provided with three sections to accommodate different chemical ingredients which may be used in the settling of luminescent screens on cathode ray tube envelopes. When required, an agitator 97 may be conveniently mounted on the wall of tank 59 for any or all of sections 62, 63, 64.

The various solenoids described above are all connected to a source of electrical power through a control box 98 provided with a program switch 99. The circuits of the control box 98 are so arranged and interconnected that when switch 99 is closed shut-offs 85, 86, 87, which are normally closed while switch 99 is open, remain closed while the valves in tank sections 62, 63, 64 open allowing tubes 82, 83, 84 to be filled with ingredients from their respective tanks between the shut-offs and the valves. The valves than close and shut-offs 85, 86, 87 open permitting the ingredients to discharge from tubes 82, 83, 84 through funnel 8, tube 91 and nozzle 93 into the object to be coated such as an envelope 45. The shut-offs are then closed by the timer circuit in box 98 and on completion of the dispensing cycle switch 99 is automatically reset in readiness for another cycle. Valve 96 is also connected into control box 98 and is automatically actuated to open and close twice during each dispensing cycle, each time discharging a measured quantity of water through funnel 81. Valve 96 opens and closes once before the shut-offs open and once after the shut-offs are closed.

Next to be considered is the apparatus for set-

ting the coating which may include neck wash and rinse and drying of the screen which is most clearly shown in Figures 6 and 7. Referring now to these figures in detail it is apparent that tube envelopes 45 are carried inverted through the wash and rinse position 22 as well as dry position 23. A substantially rectangular platform 100 has upstanding front and rear walls 101, 102 and end walls 103, 104 forming a rectangular tank open at the top. As will be pointed out hereinafter platform 100 is vertically reciprocating in operation and therefore the tank walls are of such height that they do not interfere with the operation of belt 42 or the passage of envelopes 45 even when in their top most position. Platform 100 is supported adjacent each of its corners by four identical and parallel linkages or link systems 105, 106, 107 and 108 each of which comprises a long link 109 and a short link 110, one-half the length of link 109. Each link 109 is pivotally connected as at 111 to platform 100 adjacent each corner thereof while the opposite ends thereof are each pivotally connected to a block 112 free to slide horizontally in a frame 113. The lower or left-hand ends of links 110, looking in the direction of Figure 6 are pivotally connected to fixed blocks or lugs 114 and at their opposite ends are pivotally connected to the center of the corresponding long links 109 as indicated at 115. The sliding block 112 of linkages 105 and 106 are operatively interconnected by means of a rod or tie bar 116 while the slide blocks of linkages 107 and 108 are connected by rod or tie bars 117. Tie bar 117 extends through a transverse bore 118 in a bridge 119 connected to or integral with a yoke 120. One end of yoke 120 is in face to face engagement with the sliding block of linkage 107 while the other end thereof is in engagement with the sliding block of linkage 108. On one side, bridge 119 is connected to piston rod 121 and piston 122 which is free to reciprocate in cylinder 123. Both ends 124, 125 of cylinder 123 are connected to a constant source of air pressure and an exhaust pipe through a solenoid operated valve V1 which in turn is connected to switches S1 and S2 hereinafter more fully described. For one operative position of valve V1, end 124 of cylinder 123 is connected to the source of air pressure while the other end 125 is connected to exhaust. In the other position of valve V1, end 124 is connected to exhaust while end 125 is connected to air pressure. To permit fine adjustment of the rate of rise and descent of platform 100, yoke 120 is connected to piston rod 126 of piston 127 free to reciprocate in cylinder 128. As is schematically indicated in Figure 7, the ends of cylinder 128 are connected through a conduit 129 having an accumulator 130 in the line and a pair of valves 131, 132. Cylinder 128, conduit 129 and accumulator 130 are filled with a suitable hydraulic fluid and the rate at which piston 127 may reciprocate is controlled by the hydraulic fluid, the passage of which from one side of the piston to the other is regulated by valves 131 and 132. As is clear from Figure 7, tie bar 116 is also connected to yoke 120 by means of a pair of bars 153.

On platform 100 are two rows of spouts 133 and 134. It is to be understood that there are as many spouts in each row as there are envelopes 45 in each row of the same. Also, the spouts are so disposed that they match the envelopes in the rows that are in alinement therewith. Each spout is mounted on a flexible rubber holder 135 in order to reduce the possibility of an envelope being broken should one be struck by a spout. The spouts are connected to a source of washing solution by means of flexible tubing 136 and through a solenoid valve V2 which is also actuated by switch S1. As is most clearly shown in Figure 8 spouts 133 and 134 have at their upper ends downwardly directed passages 133'. Concentric with the spouts and adjacent the upper ends thereof are rings 137 which have inwardly directed perforations and which are also connected to the source of wash solution through valve V2 and serve to wash the outer surface of the envelope necks as the spouts wash the insides of the necks.

Switch S1 is located on frame 24 in such position that it is actuated by each trip 55 in passing to bring platform 100 up and carry row of spouts 133 up into its row of envelopes while spouts 134 are carried up into the preceding row of envelopes; thus each row of envelopes is washed twice, once by spouts 133 and once by spouts 134. Switch S2 is positioned on one of the horizontal frame members 25 so that it is actuated by a trip 138 mounted on platform 100 as the platform travels up to return the same.

Positioned beyond wash and rinse platform 100 in the direction of travel of the lower course of belt 42 and to the right of platform 100 as shown in Figure 6, is an air-dry platform 139 which is supported on a system of four paralleled linkages identical in all respects with those shown and described in connection with wash platform 100. Furthermore, the linkages of platform 139 are actuated by compressed air and controlled by a hydraulic system also identical in all respects with that shown and described in connection with wash platform 100. Thus, platform 139 is supported by 4 linkages 105, 106, 107, 108; the corresponding pairs of which are interconnected by tie bars 116 and 117. As in the case of wash platform 100, tie bar 117 is operatively connected to another yoke 120 which in turn is actuated by compressed air and controlled by a hydraulic system. Since as stated these various parts are identical with those already described in detail in connection with the elevating mechanism of platform 100 and since a detailed description thereof at this point would be merely repetitious, the same is omitted. Movably mounted on platform 139 and free to travel in the direction of belt 42 is a dry rack 140 mounted on wheels 141 and which carries rows of air spouts 142 and 143. As in the case of spouts 133 and 134, the number of spouts in each row 142 and 143 is the same as the number of envelopes in each row across belt 42. Furthermore, the spouts are positioned so as to match the envelopes in the rows which overlie them. The air spouts may be suitably interconnected adjacent their lower ends by a system of conduits which is in turn connected to a source of compressed air by means of flexible tubing 144 through a valve V4. Depending from the right hand or leading edge of air rack 140 is a pin 145 which extends down through an elongated longitudinal slot 146 in platform 139. As stated, air rack 140 is movable on platform 139 from right to left. Positioned below platform 139 and substantially in alinement with edge 140a of air rack 140 when air rack 140 is in its extreme left hand position is a pulley 147. A motor and pulley 148 is disposed below platform 139 and to the right of the right hand edge thereof. Pulleys 147 and 148 carry an endless belt 149 stretched taut between them. A plurality of spaced pins 150 are mounted on belt 149 and project horizon-

tally therefrom. Pulleys 147 and 148 are so disposed with respect to slot 146 that pin 145 extending down through slot 146 is located to be engaged by any one of the pins 150 on belt 149 when platform 139 is in its lowered position. The direction of travel for belt 149 is the same as that described for belt 42. Its upper course travels to the left while its lower course travels to the right looking in the direction of Figure 6.

The air cylinder 123 of the elevating mechanism of platform 139 is connected to a source of compressed air and an exhaust through a solenoid actuated valve V3. Valve V3 is connected to a source of electrical current through switches S3, S4, and S6. Switch S3 is disposed on main frame 24 so as to be actuated by each trip 55 in passing. Switch S4 is mounted adjacent the right hand end of platform 139 and is actuated by air rack 140 as the same approaches its extreme right hand position. Positioned adjacent the left hand end of platform 139 is switch S6 which is closed by air rack 140 only when it is in its extreme left hand position. As will be hereinafter more fully explained, switch S6 is connected in series with S3 and acts as a safety to prevent raising of platform 139 except when the air rack has returned to its left hand position.

Flexible air tube 144 is connected to its source of compressed air through solenoid actuated valve V4 which is opened when a switch S5 is closed. Switch S5 is so disposed on one of the vertical frame members 26 so as to be closed by platform 139 when the platform reaches its raised position.

Air rack 140 carries centrally positioned on its left hand end looking in the direction of Figure 6 a tongue 151 which is engaged by a latch 152 disposed in alinement therewith on the left end of platform 139 and which serves to releasably clamp tongue 151 and retain air rack 140 in its left hand position when it is returned thereto by belt 149.

In operation motor 34 is connected to a source of electrical power and constantly drives belt 42 in the direction indicated. Objects to be coated such as cathode ray tube envelopes 45 are inserted into rows of holders 43 when they are approximately in position A. The inflatable tubes 48 of this row of holders are inflated through air valves 49 by any suitable means (not shown) thereby centering and clamping envelopes 45 in position in their holders. As belt 42 continues in its travel, envelopes 45 are carried through position B where they are dosed with a measured charge of coating ingredients from dispenser 21. During the continued travel of belt 42 from position B to position C the particles which were suspended in solution settle upon the faces of envelopes 45 and coat the same. The length of belt 42 between positions B and C and the rate of travel of same are such that the time required for the settling of the particles out of solution is provided. If the settling time required is one hour, a distance between shafts 27 and 28 may be so selected that the rate of travel of belt 42 will be four inches per minute. The rate of travel of the belt may be varied somewhat but the maximum speed available is limited in order to afford ample time for the wash and rinse spouts to enter and leave envelopes 45 without coming in contact therewith. As the envelopes progress beyond position C they are gradually tilted and the excess liquid is finally poured off into splash shield 56 and trough 57. When the envelopes pass through position D all of the excess liquid has been poured out and as they start to pass through position E, trip 55 engages and closes switch S1 in passing. Referring now to Figure 9, switch S1 is connected to a relay RL1 through a time delay relay or circuit breaker RL2. When switch S1 is closed, coil K1 of relay RL1 is energized which in turn actuates contact C1 to close the circuit between coil K2 of valve V1 and a source of electrical power. This sets valve V1 so that compressed air is supplied to the end 125 of cylinder 123 while end 124 is connected to exhaust. This drives piston 122 to the left. Piston 122 is connected through its piston rod 121, bridge 119 and yoke 120 to both tie bars 116 and 117. Thus the motion of piston 122 is transmitted through the four linkages to platform 100 and elevates the same. In view of the relatively short time between the start of the upward travel of platform 100 and the start of its downward travel, time delay relay RL2 is inserted in the circuit between switch S1 and relay RL1. Therefore, coil K1 is only momentarily energized and then the circuit is broken by the action of time delay relay RL2 even though switch S1 may still be closed. Relay RL1 is of the self-latching type and remains in the position set by the energizing of coil K1 even though coil K1 has been deenergized. Thus, relay RL1 is ready to reverse valve V1 even though switch S1 may still be closed. As shown in Figure 9, valve V2 is connected to be energized when contact C1 completes the circuit to coil K2 of valve V1. As platform 100 reaches its top most position it closes switch S2 which permits coil K3 to be energized shifting contact C1 so as to open the circuit of coil K2 and close the circuit of coil K4; reversing valve V1 and the direction of travel of piston 122 thereby lowering platform 100. It is to be noted that when the circuit of coil K2 is opened, the solenoid K5 of valve V2 is also deenergized. As soon as platform 100 starts its downward travel switch S2 opens while self-latching relay RL1 remains as set by coil K3.

The operation of the dry position is similar to that just explained for the wash and rinse. Referring to Figure 10, switch S3 is closed as one of the trips 55 passes the same. Since air rack 140 is in its extreme left hand position switch S6 is also closed and the circuit is now closed between coil K6 of self-latching relay RL2 and a source of electrical current. When coil K6 is energized contact C2 is shifted to complete the circuit between coil K7 of valve V3 and the source of electrical power. Energizing coil K7 shifts valve V3 in the same manner that valve V1 was shifted by coil K2. Since platform 139 has an elevating mechanism similar in every respect to that described to that of platform 100, platform 139 is elevated and rows of spouts 142 and 143 enter the necks of envelopes 45 as shown in Figure 6. When platform 139 reaches its upper most position it closes switch S5 which in turn closes the circuit between a coil of valve V4 thereby opening the same and permitting air to flow through tube 144, spouts 142, 143 and into envelopes 45*a* and 45*b* in which the spouts are positioned. Since air rack 140 is free to move to the right it travels along with envelopes 45*a* and 45*b* and belt 42. As air rack 140 arrives at its extreme right hand position, switch S4 is closed by the rack causing coil K9 to be energized and resetting contact C2. Now coil K10 of valve V3 is energized thereby shifting the valve and reversing the elevating mechanism of platform

139 causing the same to be lowered. As soon as platform 139 starts downward, switch S5 is opened, deenergizing coil K8 and closing valve V4, thus shutting off the flow of air through tube 144. When platform 139 reaches its downward position, pin 145 depending from rack 140 is engaged by one of the pins 150 on belt 149. Since belt 149 is constantly rotating in a counterclockwise direction as viewed in Figure 6, rack 140 is carried back to the left to its starting position. It should be noted that during the entire time that air rack 140 is out of its starting position, switch S6 has remained open. Thus even though successive trips 55 might close switch S3 nothing happens because switch S6 was open. However, now that air rack 140 has returned to its starting position, switch S6 is closed and the next trip 55 to trigger switch S3 will start the drying cycle once again. It is clear that as the number of rows of envelopes that are simultaneously dried is increased the drying period is increased and the longer most platform 139 be in order to allow for the necessarily increased travel of air rack 140. Referring back to Figure 6, it is seen that spouts 142 and 143 are respectively in engagement with envelope rows 45*a* and 45*b*. When rows 45*a* and 45*b* have been dried and air rack 140 has returned once again to its starting position, spouts 142 and 143 are prepared to be carried up into the envelopes in rows 45*c* and 45*d* respectively, since they are now moving through the positions formerly occupied by rows 45*a* and 45*b*.

After envelopes 45 have been passed through the drying position and have been dried they continue traveling with belt 42 until they arrive substantially in position G. As the holders carrying these envelopes 45 are passing through position G, air valves 49 in rubber tubes 48 are opened and tubes 48 are deflated. Envelopes 45 may now be readily removed from these holders and as the holders continue in motion through position A they are ready to receive a new cathode ray tube envelope.

It is to be understood that although I have described my method of coating the surface of an object with particles settled out of solution in connection with the coating of the faces of cathode ray tube envelopes with a luminescent screen, In do not wish to be limited thereto since my method is equally applicable to coatings having other characteristics but which are also applied in the same manner. Furthermore, my method may be also carried out by means of other apparatus than that shown and described herein above. Although I have shown and described an endless belt type apparatus having upper and lower courses, a continuously operating turret turn-table may be utilized in place of the belt and the various operations of dispensing, settling, removal of excess liquid, washing and rinsing may be carried out in sequence in positions located around the turret.

Thus, while I have set forth one embodiment of my invention and described it in detail with respect to said embodiment, I do not wish to be limited to the exact construction set forth but desire to claim all modifications thereof that come within the scope of the appended claims.

What I claim is:

1. An apparatus for applying coatings to surfaces of objects, comprising a plurality of holders for retaining said objects, means for moving said holders continuously along a predetermined path at a substantailly constant speed, means movable with said holders and disposed above said path for discharging a measured dose of coating forming ingredients into each of said objects while they are in motion and as they pass thereunder, and movable means for drying the coatings and objects positioned along said path and actuated by each object while in motion as they pass a predetermined point along said path.

2. In an apparatus for applying coatings to surfaces of objects by the settling of coating forming particles out of solution onto said surfaces, means for carrying a plurality of said objects in spaced relation along a predetermined path, means for continuously moving said first mentioned means at a substantially constant speed, movable means for discharging a measured dose of coating forming ingredients having particles in suspension to be settled into each of said objects while they are in motion, means for washing said moving objects, said last named means being movable with said objects and disposed adjacent said path and actuated by said means as each of said objects passes a predetermined point along said path, and movable means for drying the moving objects and coatings disposed adjacent said path beyond the washing means, and actuated by said first mentioned means as said objects pass another predetermined point along said path and beyond said first mentioned point.

3. In an apparatus for applying coatings to surfaces of objects by the settling of coating forming particles out of solution onto said surfaces, means for carrying a plurality of said objects in spaced relation along a predetermined path, means for moving said first mentioned means at a substantially constant speed, setting means movable with said objects and disposed adjacent said path and normally removed from said objects, and means actuated by said first mentioned means for moving said setting means toward and away from the same when said objects pass predetermined points along said path and as they continue in motion.

4. In an apparatus for applying coatings to surfaces of objects by the settling of coating forming particles out of solution onto said surfaces, means for carrying a plurality of said objects in spaced relation, means for moving said first mentioned means along a predetermined path and at a substantially constant speed, setting means movable with said objects and disposed adjacent said path and normally removed from said objects, and means responsive to said carrier means for moving said setting means into and then out of said objects as said objects continue in motion and pass predetermined points along said path.

5. In an apparatus for applying coatings to surfaces of objects by the settling of coating forming particles out of solution onto said surfaces, means for carrying a plurality of said objects in spaced relation, means for moving said first mentioned means along a predetermined path and at a substantially constant speed, means movable with said objects for washing said objects disposed adjacent said path and normally removed from said objects, means responsive to said carrier means for moving said means for washing into and then out of said objects as said objects continue in motion and pass a predetermined point along said path, movable means for drying the moving objects and coating disposed adjacent said path beyond said means for washing and normally removed from said ob-

jects, and means responsive to said first mentioned means for moving the drying means into and then out of said moving objects as said objects pass other predetermined points along said path beyond said first mentioned point.

6. In an apparatus for applying coatings to surfaces of objects by settling coating forming particles out of solution onto said surfaces, an endless belt, a plurality of holders on said belt and for carrying said objects in spaced relation thereon, means for rotating said belt at a substantially constant speed, said endless belt having a substantially horizontal upper and lower course, setting means movable with said objects and disposed adjacent and below said lower course and intermediate the ends thereof, said setting means being normally removed from said objects, means for moving said setting means into and out of each of said moving objects, and means supported by said belt for actuating said means for moving said setting means as said objects pass predetermined points along said lower course.

7. In an apparatus for applying coatings to surfaces of objects by the settling of coating forming particles out of solution onto said surfaces, means for carrying said objects in spaced relation, means for moving said first mentioned means at a substantially constant speed, means for removing said solution after the particles have settled, as said objects continue at said substantially constant speed, means movable with said objects for drying the coating formed by said settled particles, and means supported by said first mentioned means for actuating the drying means.

8. In an apparatus for applying coatings to surfaces of objects by the settling of coating forming particles out of solution onto said surfaces, means for carrying a plurality of said objects in spaced relation, means for moving said first mentioned means along a predetermined path and at a substantially constant speed, said last referred to means including means for inverting said objects located along said path and after said particles have settled while said objects continue at said speed, means movable with said objects for drying said moving objects and said coatings disposed adjacent said path, and means supported by said first mentioned means for actuating said means for drying.

9. In an apparatus for applying coatings to surfaces of objects by the settling of coating forming particles out of solution onto said surfaces, means for carrying a plurality of said objects in spaced relation, means for moving said first mentioned means along a predetermined path and at a substantially constant speed, said last referred to means including means for tilting said objects located along said path and after said particles have settled while said objects continue at said speed, means movable with said objects for drying said moving objects and said coatings disposed adjacent said path and means supported by said first mentioned means for actuating said means for drying.

10. Apparatus for applying a relatively smooth coating to an interior surface of a hollow article, comprising means for dosing said article with a suspension containing coating forming ingredients adapted to settle out of said suspension when the same is substantially free from agitation, means for transporting said article in a predetermined direction in a given path at a relatively low velocity and with substantial freedom from vibration, for causing said ingredients to settle from said suspension to form a relatively smooth coating on said surface, means movable with said article for rinsing a portion of said article, and means movable with said article for drying the interior of said article, said dosing means, rinsing means and drying means being supported adjacent said path and spaced from each other in said predetermined direction.

11. In an apparatus for applying a coating to an inner surface of a hollow article by settling coating forming particles out of suspension onto said surface, the improvement comprising a substantially vibration-free support for said article, means for moving said support at a relatively low and constant velocity to prevent formation of ripples on a surface of said suspension, whereby a relatively smooth coating is formed by the settlement of said particles from the suspension, means adjacent said support for further processing said article after the liquid of said suspension remaining after the settling of said particles therefrom is decanted, said means including a rigid member adapted to extend into said article and a movable support for said member to follow said member and article during movement of said article at said velocity, whereby different ones of a plurality of said articles may be simultaneously processed to settle said ingredients out of said suspension and to further process said articles, for increased efficiency of said apparatus.

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