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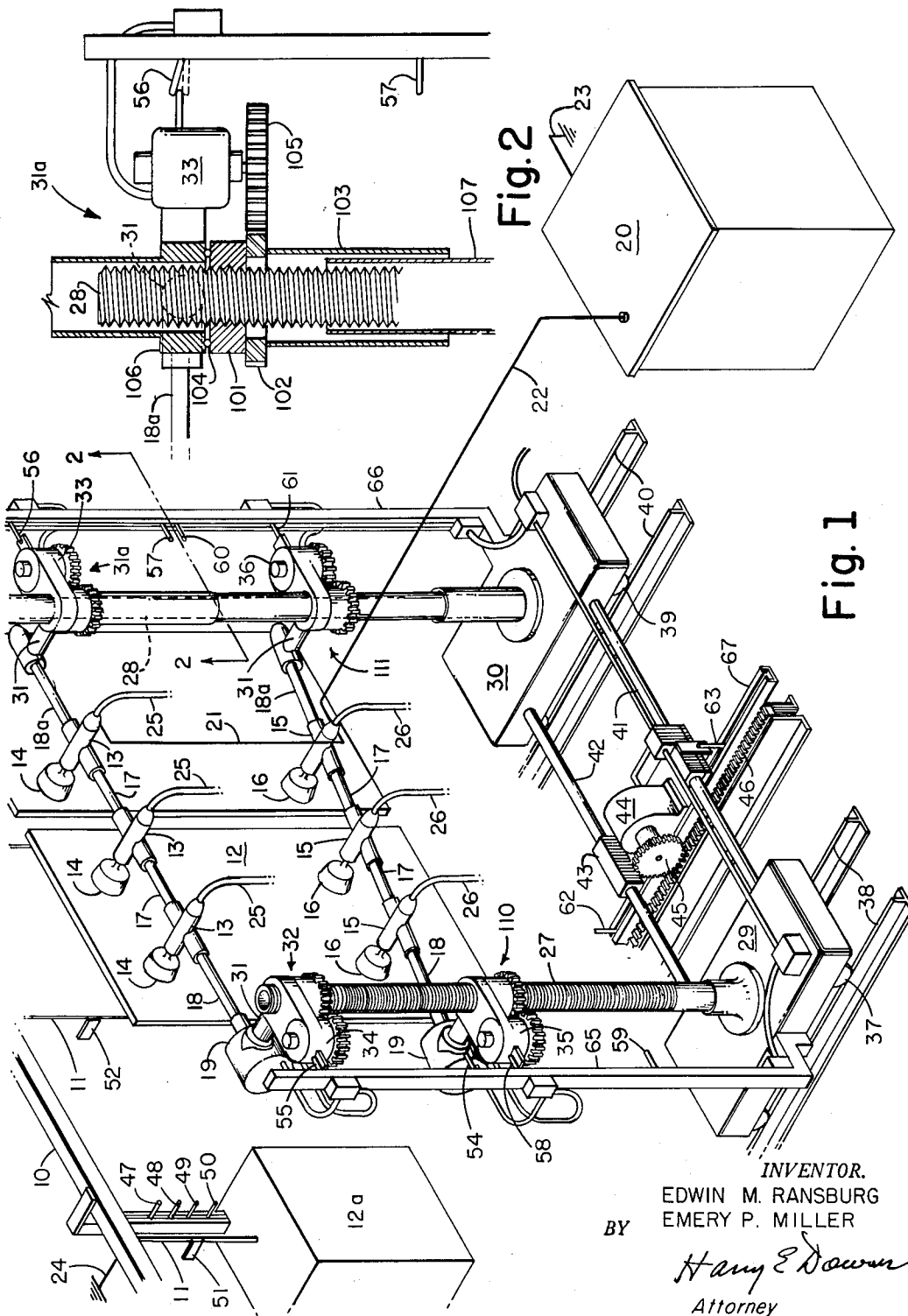
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METHOD AND APPARATUS FOR REPOSITIONING COATING ATOMIZER MEANS

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3 Sheets-Sheet 2

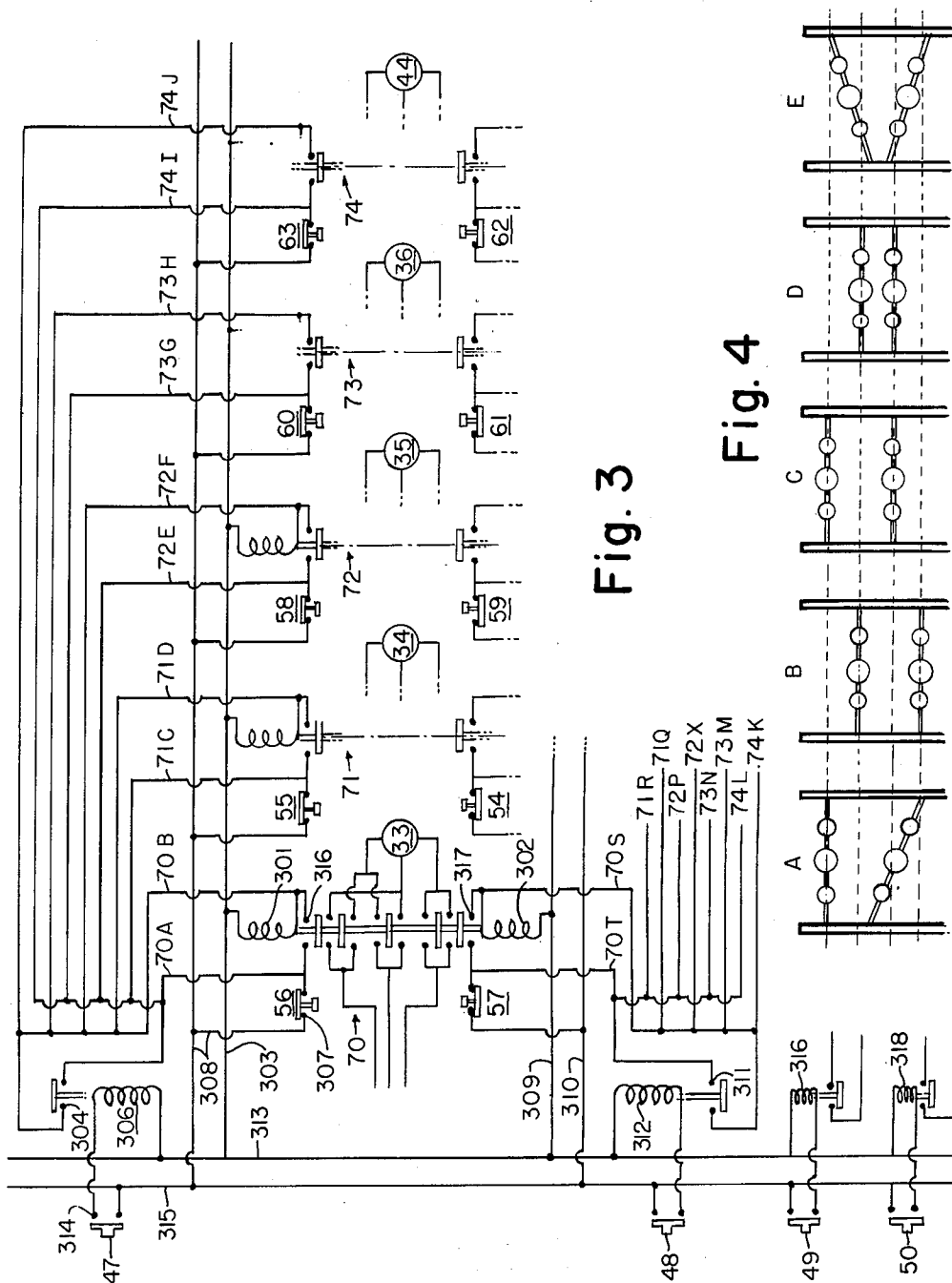
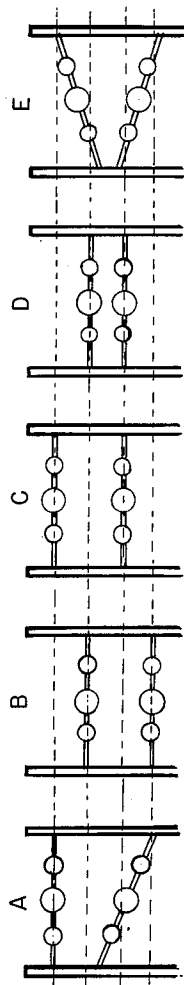


Fig. 3

Fig. 4



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3 Sheets-Sheet 3

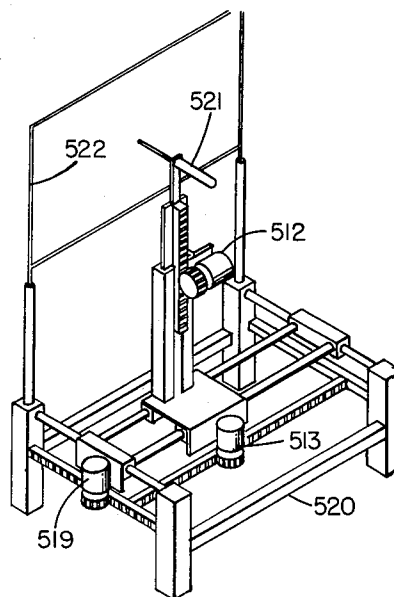


Fig. 6

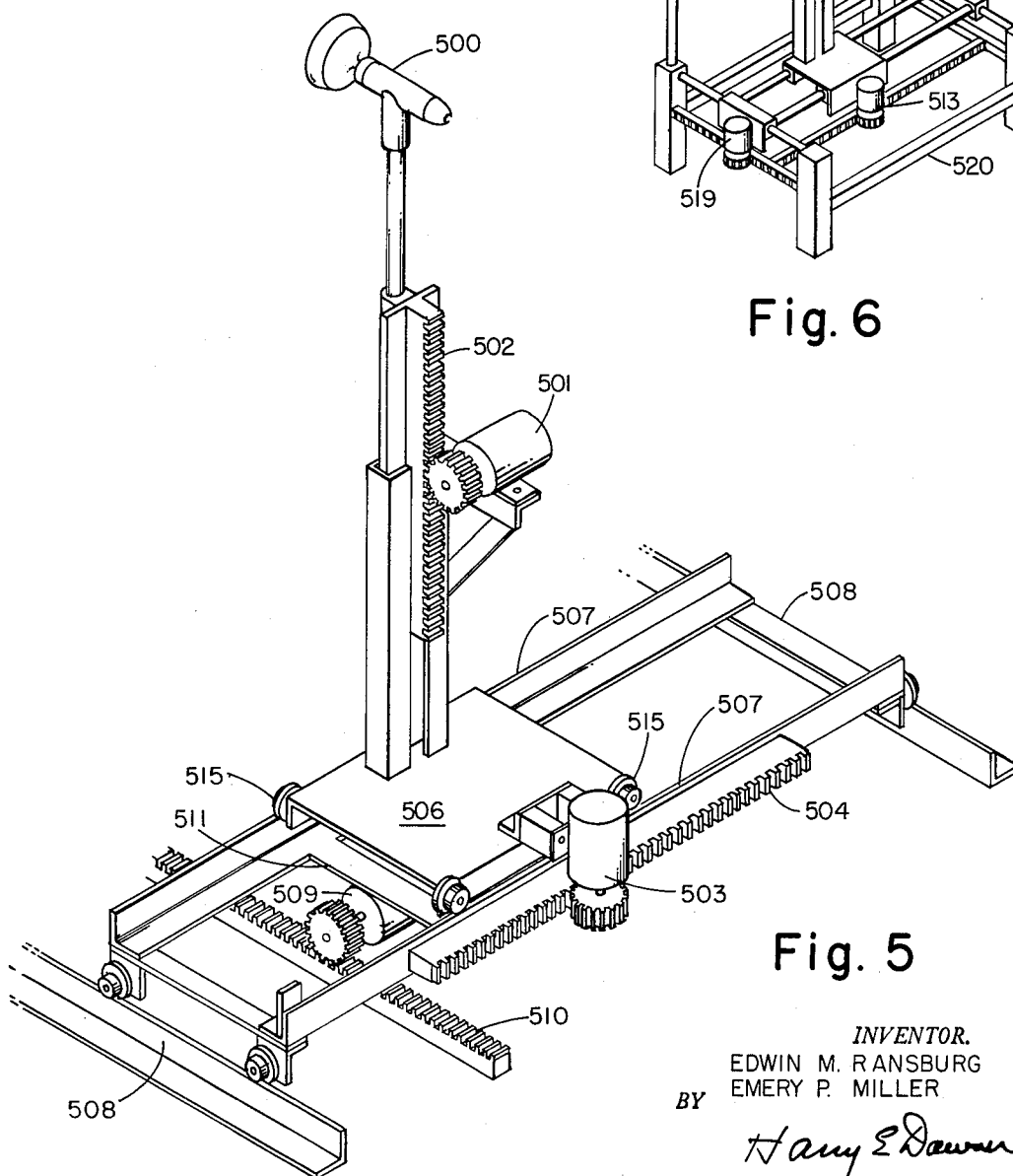


Fig. 5

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METHOD AND APPARATUS FOR REPOSITIONING COATING ATOMIZER MEANS

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Application March 19, 1952, Serial No. 277,384

26 Claims. (Cl. 117—93)

This invention relates generally to methods and apparatus for coating of articles and it more particularly relates to a method and apparatus for automatically positioning atomizing units in predetermined positions relative to an article to be coated as required by the surface characteristics, configuration or other controlling peculiarity of an individual article.

In accordance with one type of conventional practice there is provided apparatus for coating manufactured articles which comprises a conveyor in combination with stationary coating apparatus. In this type of apparatus there is no functional cooperation between the coating equipment and the articles on the conveyor, and therefore articles having different shapes cannot be satisfactorily coated without reorganizing and rearranging the apparatus.

Another conventional coating system comprises a conveyor, a coating apparatus and control apparatus adapted to actuate the coating apparatus in response to the presence of an article on the conveyor, and to disable the coating apparatus when no article is presented for a coating operation. In this system there is also no control of the coating apparatus position which correlates the coating process with the shape of the article. Hence the coating apparatus must be preadjusted in order to deposit a satisfactory coating on the particular type of article which is being coated.

Another conventional coating system includes a conveyor and coating apparatus adapted to be reciprocated with respect to the article for improving the dissemination of the coating material. However, the motion of the coating apparatus is not correlated in any way with the size or shape of the article to be coated, and hence this equipment must be pre-set in accordance with the characteristics of the particular article being coated.

In manufacturing enterprises where various articles of different sizes and shapes are manufactured, it is desirable to apply coatings of enamel, paints or other substances by means of a single coating apparatus. If the articles are placed on a conveyor and if they are of uniform size and shape the atomizing heads may be pre-adjusted with respect to the article surface being coated whereby each article that passes the coating apparatus receives a uniform coating of material. On the other hand if articles of differing sizes and shapes are placed on the conveyor it is necessary that the atomizing heads be moved automatically with respect to the surfaces of the articles to predetermined positions such that each different article may receive a uniform coating. Accordingly, it is desirable to provide an apparatus which will sense the nature of a particular article on the conveyor and pre-adjust the atomizers of the coating apparatus into the appropriate positions to satisfactorily coat that particular article. Where the coating apparatus comprises electrostatic atomizing heads the spray pattern obtained therefrom as well as the degree of atomization of the coating material is dependent on the position of the heads with respect to the article surface being coated.

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In this case particularly it is desirable that the position of the atomizers be correlated with the shape and nature of the article on the conveyor if uniform coatings are to be obtained.

Accordingly the principal object of this invention is to provide a novel coating apparatus for applying coating material to articles of different sizes and shapes.

Another object of this invention is to provide a method and apparatus for remotely controlling coating apparatus in such fashion that a uniform coating may be applied to articles of different sizes and shapes.

Another object of this invention is to provide a coating apparatus adapted to cooperate with a conveyor for coating articles of various sizes and shapes.

Another object of this invention is to provide, in a coating apparatus adapted to cooperate with a conveyor, an automatic control apparatus for moving the coating apparatus in response to the sizes and shapes of the articles presented for coating by the conveyor.

A further object of this invention is to provide an electrostatic coating apparatus in which the position of the atomizers is correlated with the shape and nature of the articles on the conveyor.

Still another object of this invention is to provide, in an electrostatic coating apparatus comprising a conveyor and a plurality of atomizing heads, an automatic control apparatus responsive to the size and shape of an article for moving the atomizing heads toward or away from the articles and for changing the angle of alignment of the atomizing heads with respect to the path of travel of the articles being coated.

A still further object of this invention is to provide, in an electrostatic coating apparatus comprising a conveyor and groups of atomizing heads, an automatic control apparatus responsive to the size and shape of an article presented for coating for moving the groups of atomizing heads toward or away from the article and for changing the angle of alignment of the groups of atomizing heads with respect to the path of travel on the articles being coated.

A still further object of this invention is to provide, in an electrostatic coating apparatus comprising groups of atomizing heads adapted to cooperate with a conveyor, automatic control apparatus adapted to move each group of atomizing heads to a predetermined position both with respect to distance and with respect to alignment of the heads with the path movement of articles of various sizes and shapes.

In accordance with this invention there is provided an article coating system comprising an atomizing unit, an adjustable support for the atomizing unit whereby the spray pattern may be altered to effect uniform coating of articles of different sizes and shapes, and electromotive means for controlling the adjustable support.

Further in accordance with this invention, there is provided a remote control system for a plural position, automatically adjustable, electrostatic coating apparatus comprising a plurality of adjusting motors, a circuit for driving the motors in either direction, and control circuits for actuating the drive circuit and adjusting the coating apparatus for coating articles of different sizes and shapes.

Also, in accordance with this invention there is provided an article coating system comprising a conveyor, an adjustable supporting mechanism for supporting a plurality of atomizing heads, motors cooperating with said adjustable mechanism for changing the position of said atomizing heads and electrical control means cooperating with said conveyor and said supporting mechanism for driving said motors and positioning said atomizing heads in predetermined positions in response to the particular size and shape of articles to be coated on said conveyor.

In accordance with another feature of this invention there is provided an electrostatic coating apparatus adapted to coat articles of different sizes and shapes as they are presented for coating on a conveyor comprising a frame, a multiple-head atomizing unit adjustably mounted on said frame, means for moving said frame toward and away from a conveyor and a means for moving said multiple head atomizing unit to vary the alignment of said unit with respect to the path of movement of articles on said conveyor.

For a better understanding of the invention, together with other and further objects thereof, reference is made to the following description, taken in connection with the accompanying drawings, and its scope will be pointed out in the appended claims.

Fig. 1 of the drawings is an isometric view illustrating a portion of a monorail conveyor and an automatically adjustable multiple head atomizing unit adapted to cooperate with the conveyor.

Fig. 2 is an enlarged detail view, partially in cross-section taken on line 2—2 of Fig. 1.

Fig. 3 is a circuit diagram illustrating the control circuit adapted to cooperate with the apparatus illustrated in Fig. 1.

Fig. 4 is a group of diagrams illustrating various operational positions of the multiple head atomizing units shown in Fig. 1, each diagram exemplifying an operational position correlated to an article of a particular size and shape.

Fig. 5 is an isometric view illustrating an electrostatic atomizing head adapted to be controlled by servo-motors.

Fig. 6 is an isometric view of a control apparatus adapted to control the mechanism shown in Fig. 5.

Referring to the drawings, Fig. 1 illustrates a conveyor in the form of a monorail 10 having supports 11 extending downwardly therefrom for supporting typical articles 12 and 12a which are in position to be coated.

For coating these articles there may be provided two triple head atomizing units, the upper one of which comprises the heads 14 and the lower one of which comprises the heads 16. The structure of these atomizing units forms no part of this invention. The specific heads shown are adapted to run electrostatically and mechanically to transform a coating material into a spray of fine, charged particles. The structure of one such unit is completely disclosed and claimed in the co-pending application of James W. Juvinall, Serial No. 271,625, filed February 14, 1952.

Atomizing heads 14, 16 include support housings 13 and 15 respectively which are adapted to house rotatable shafts on which the belled ends of the heads may rotate. The housings in turn may be mounted on or connected together by means of electrically conducting tubes 17 which in turn are supported at each end by insulating tubular members 18 and 18a. Tubular members 17 and 18 house a rotatable shaft (not shown) which connects rotating gears within the housing 15 with a motor 19 which is adapted to spin the bells of the atomizing heads 14 and 16. This shaft may include insulating portions at its ends whereby the atomizing heads 14 and 16 are electrically insulated from the supporting apparatus. The atomizing heads 14 and 16 can thus be raised to a high potential with respect to ground by means of a suitable high voltage supply 20 connected through conductors 21 and 22. The other side of the high voltage supply may be grounded as at 23 and the conveyor may be grounded as at 24 whereby there exists a high potential electrostatic field between the heads 14, 16 and the articles on the conveyor. For supplying coating material to the heads 14 and 16 there may be provided a source (not shown) connected to hoses 25 and 26.

By virtue of the rotation of heads 14 and 16 by motor 19 coating material flows around the internal surface of the heads, moving to the front edge of the heads where

it is removed in the form of finely atomized particles and precipitated on the surface of the articles being coated.

For supporting the multiple head atomizing units there are provided two upright threaded columns 27 and 28 mounted on base elements or trucks 29 and 30. The atomizing units or assemblies may be pivotally attached to columns 27 and 28 by swivel elements 31 whereby each end of the unit may be elevated or lowered with respect to the other end thereof. In order to provide for such pivotal movement the insulating element 18a may telescope into swivel 31 and move with respect thereto. The uppermost atomizing unit may be moved into various positions on columns 27 and 28 by means of a motor and screw assembly 31a mounted on column 28 and a second motor and screw assembly 32 mounted on column 27. These assemblies cooperate with the threads on the columns to move the atomizing units with respect thereto.

Assembly 31a (see Fig. 2) includes a motor 33 which is adapted to drive a nut 101, threaded on the threads of column 28, through a gear 102 fixed to the nut and a gear 105 mounted on the shaft of motor 33 and meshing with gear 102. Nut 101 and bearings 104 rotatably support a collar 106 to which motor 33 may be attached. It should be noted that the swivel element 31 may be mounted on collar 106. Whenever motor 33 is energized it will be clear that the nut 101 rotates on the threads of column 28 thereby moving the collar 106 upwardly or downwardly depending upon the direction of rotation of the motor 33.

Assembly 32 which includes motor 34 is identical to assembly 31a and operates to elevate and lower the other end of the upper atomizing unit in the same fashion as described above in connection with assembly 31a.

The lower atomizing unit, including heads 16, includes motor-nut assemblies 110 and 111 at its ends which operate to move the lower atomizing unit upwardly and downwardly on columns 27 and 28 in the same manner as described above in connection with the upper assembly carrying heads 14. Motors 35 and 36 provide the power for this movement.

For providing movement of the bases 29 and 30, base 29 may include wheels 37 adapted to ride on tracks 38. Base 30 may be mounted on wheels 39 which cooperate with tracks 40. The two bases may be connected to move in unison by means of rods 41 and 42 which carry at their center portions a platform 43. A motor 44 may be mounted on the platform and drive a gear 45 which meshes into a rack which may be anchored to the base member. When motor 44 is energized gear 45 will rotate with respect to rack 46 whereby the two base members 29 and 30 may be moved backward and forward on tracks 38 and 40 respectively whereby to provide adjustment of the atomizers toward or away from the surfaces being coated.

For automatically controlling the motors 33, 34, 35, 36 and 44 and moving the units 14 and 16 either in a vertical plane or in a horizontal direction there are provided switches 47, 48, 49 and 50 which are attached to the monorail conveyor 10 at different levels as illustrated in Fig. 1. These switches may be actuated by stops such as 51 and 52 which are attached at different levels to the article support 11. The operative relation between the stops 51, 52 and 53 and switches 47, 48, 49 will be described in more detail in connection with the operation of the coating system. Another stop (not shown) associated with the hanger of another type article is arranged to contact switch 50.

Switches 47, 48, 49 and 50 are utilized for initiating the operation of motors 33, 34, 35, 36 and 44. For stopping these motors there may be provided a first set of limit switches 54 and 55 associated with motor 34, and a second set of limit switches 56 and 57 associated with motor 33. For controlling motor 35 there may be provided a set of limit switches 58 and 59 while for controlling motor 36 there may be provided a set of limit

switches 60 and 61. A set of switches 62 and 63 are provided to control motion of motor 44. Switches 54, 55, 58 and 59 may be mounted on an indexing guide 65 which may be fixed to the base or truck 29. For supporting the switches 56, 57, 60 and 61 there may be provided a second indexing guide 66 mounted on base 30 adjacent to the path of motors 33 and 36. Switches 62, 63 are mounted on indexing guide 67 adjacent path of motor 44. Each of the switches 54, 55, 56, 57, 58, 59, 60, 61, 62 and 63 is adjustably mounted on the respective indexing guides and are arranged to have actuating elements which project outwardly into the path of any desired portion of the motor casing with which the particular switches are associated. By adjusting the positions of switches 54, 55, for example, it is possible to preset the upper and lower limits of movement of motor 34 and therewith the left hand end of the upper electrostatic atomizing unit. Similarly, the other switches may be adjusted to determine the upper and lower limits of movement of the ends of the other electrostatic atomizing unit. Thus generally speaking switches 47, 48, 49 and 50 initiate operation of motors 33, 34, 35 and 36 while switches 54, 55, 56, 57, 58, 59, 60 and 61 terminate the operation of these motors. These switches are associated with a circuit as will be subsequently described for automatically positioning the electrostatic atomizing units in accordance with the size and shape of articles to be coated.

For controlling the electrical motors there are provided circuits such as those illustrated in Fig. 3. For controlling each of the motors 33, 34, 35, 36 and 44 there are provided motor energizing and reversing relays 70, 71, 72, 73 and 74 respectively. It will be obvious to those skilled in the art that the contacts of these relays are connected in conventional fashion to the motor windings whereby movement of the relay armature in one direction drives the motor in one direction, whereas movement of the relay armature in the opposite direction drives the motor in the opposite direction. The contacts of each of these relays may be connected to a power source and to the motors as indicated in Fig. 3. The relays in their normal positions are biased to a central position where all of the contacts are open. Thus, when a relay is energized in one direction or the other it operates to close a set of motor energizing contacts.

The relay 70 connected to motor 33, and its connections will be described in detail, it being understood that each of the relays 71, 72, 73 and 74 is similarly connected and operates in a similar manner to relay 70. Relay 70 includes a first winding 301, one end of which is connected to a power line 303, the other end of which may be connected by means of conductor 70B, relay operated switch 304, conductor 70A and normally closed motor-operated switch 56 to the other side 308 of the power line. The switch 304 may be controlled by a relay winding 306 connected at one end to power line 313 and at the other end through the contacts of normally open, conveyor switch 47 back to the other side 315 of the power line. Switch 47 is mounted on the monorail conveyor as illustrated in Fig. 1 whereby it may be actuated by the stop 51 to energize relay winding 306, close contacts 304, energize relay winding 301 and close the contacts of relay 70 so as to rotate motor 33 in a clockwise direction, for example. When relay 70 operates it closes holding circuit completed through contacts 316 and the contacts of switch 56. Thus, assuming that clockwise rotation of motor 33 moves assembly 31A upwardly, the rotation of motor 33 may continue until the motor casing impacts the operating arm of switch 56, thereby to open the switch and de-energize winding 301 whereby relay 70 assumes its normal central position with all motor circuit contacts open whereby assembly 31A stops at the desired position.

For operating motor 33 in a counter-clockwise direction, relay 70 is provided with a coil 302, connected at

one end to the power line 309 and at the other end to the power line 310 through conductor 70S, normally open contacts 311 of relay 312, conductor 70T and normally closed motor operated switch 57. Relay 312 is connected across the power line 313, 315 through the contacts of normally open switch 48. Thus, when an article is presented on the conveyor which requires that assembly 31A be lowered to its lowermost position the actuator 52 closes normally open switch 48 thereby to energize relay 312 and close contacts 311. Winding 302 being thus energized moves the armature of relay 70 to close the contacts for energizing motor 33 to drive it in a counter-clockwise direction. The armature of relay 70 in so doing closes contacts 317 to establish a holding circuit for relay winding 302 through the normally closed contacts of switch 57. Motor 33 then rotates in the counter-clockwise direction lowering assembly 31A until such time as the motor casing contacts the actuating arm of switch 57 whereupon the contacts of that switch are opened to de-energize winding 302 so that the armature of relay 70 assumes its central disconnected position and motor 33 becomes de-energized. Relays 71, 72, 73 and 74 have their coils which correspond to coil 301 of relay 70 connected in multiple to relay contacts 304 by the corresponding conductors (71C, 71D) (71E, 71F) (71G, 71H) and (71I, 71J) respectively. Those coils of relays 71, 72, 73 and 74 which correspond to coil 302 of relay 70 are similarly connected in multiple to contacts 311 of relay 312 by conductors (71R, 71Q) (72P, 72X) (73N, 73M) and (74L, 74K) respectively. Each coil correspondingly has associated with it a releasing switch 54, 55, 58, 59, 60, 61, 62 and 63. Relay 71 including its winding, for example, functions in the same manner as relay 70, except that it is under the control of the limit switches 54 and 55. Therefore, when switch 47 is closed by actuator 51, motor 34 operates in a clockwise direction until such time as switch 55 is opened. Similarly, when switch 48 is closed, motor 34 operates in a counter-clockwise direction until such time as switch 54 is opened. It will be obvious that motors 35, 36, and 44 also operate under the control of switches 47 and 48 for starting these motors and under the control of switches 58, 59, 60, 61, 62 and 63 for stopping these motors. With this connection it is evident that closing switch 47 energizes motors to move the atomizers to their uppermost positions and the entire coating assembly backward into contact with stop 63 and that energizing switch 48 moves the atomizers to their lowermost position and the assembly forward against stop 62.

In operation it may be assumed that the atomizing heads 14 are to be positioned in such a manner that paint or other coating material may be sprayed evenly and in uniform thickness over the surface of a rectangular product such, for example, as 12A. It may be found experimentally that the heads should be moved to the position indicated in diagram C of Fig. 4 (that is all motors in their uppermost position and the coating assembly retracted) in order to spray properly the article 12A. Accordingly, the actuator 51, associated with article 12A, may be set to a height corresponding to switch 47. Let it be further assumed also that the article 12 is a sheet of material as illustrated in Fig. 1. In such an event it may be found experimentally that it is desirable to set the atomizing heads to the position illustrated in diagram B of Fig. 4 (that is all motors in their lowermost position and the coating assembly forward). Therefore, the actuator 52 may be set to a height corresponding to that of switch 48. Having decided as to the desired positions of the atomizers as shown in diagrams B and C, it is also to be understood that the switches 54, 55, 56, 57, 58, 59, 60, 61, 62 and 63 have been adjusted to the proper positions on the indexing columns 65, 66 and 67 thereby to establish the extreme limits of movement of the motors 33, 34, 35, 36 and 44. With these assumed painting posi-

tions and the circuit as shown in Fig. 3 then operation proceeds as follows.

When the conveyor 10 moves the product 12 to that point where actuator 52 closes switch 48 each of the motors 33, 34, 35, 36 and 44 is energized by the relays 70, 71, 72, 73 and 74 respectively until such time as the switches 57, 54, 59, 61 and 62 are opened thereby to stop the motors with the atomizing heads positioned as illustrated in diagram B of Fig. 4. If any of the limit switches are already open, the motor controlled by the circuit including such limit switch will not be energized.

After the product 12 has been moved beyond the atomizer heads 14 and 16, product 12A will have moved to such a position that the actuator 51 will contact the arm of switch 47 whereupon relays 70, 71, 72, 73 and 74 become energized to reverse the motors 33, 34, 35, 36 and 44 and move the atomizing units until such time as they assume the positions illustrated in diagram C of Fig. 4 whereupon the switches 56, 55, 53, 60 and 63 are all opened simultaneously to de-energize the relays and the motors. Thus, the atomizing units are in a position suitable for coating the product 12A.

Referring to Fig. 4 of the drawings, diagrams B and C illustrate the positions which the atomizing units assume in response to the actuation of switches 47 and 48 which are connected to the motor control relays as already described in Fig. 3. Diagrams A and D illustrate alternative positions which the atomizing assemblies assume in response to actuating switches 49 and 50 which are attached to the conveyor as illustrated in Fig. 1. Diagram E of Fig. 4 illustrates another alternative position which the atomizers may assume. An actuating switch for these positions is not shown. In order to actuate the atomizing units into the positions illustrated in diagrams A and D of Fig. 4, switches 49 and 50 and relays 316 and 318, similar to relays 306 and 312 must be provided. Across the contacts of these relays must be connected in multiple the appropriate coil leads from the various relays 70, 71, 72, 73, 74. It is merely necessary to arrange the connections in such a manner that the motors 33, 34, 35 and 36 may rotate in the proper direction to move the atomizing units to their appropriate up or down position. For example, if Position A of Fig. 4 is to be preset by switch 49 then coil 301 of relay 70 (connections 70W and 70B), the corresponding coils of relays 71 (connections 71C and 71D), relay 72 (connections 72E and 72F) and that coil of relay 73 which corresponds to coil 302 of relay 70 (leads 73N and 73M) are connected in multiple across the contacts of relay 316. If the assembly is to be forward against stop 62 when switch 49 is actuated then connections 74L and 74K should likewise be connected across the contacts of relay 316. If switch 50 is to present the equipment in the arrangement shown in diagram D of Fig. 4, then motors 34 and 33 must be down and motors 35 and 36 must be up. This condition will prevail if connections 70T, 70S, 71R, 71Q, 72E, 72F and 73G, 73H are connected in multiple across the contact of the relay 318 associated with the switch 50. To anyone skilled in the art other connections for further positions will be apparent. It is only necessary to add a relay such as 306 and its corresponding switch such as 47 to the equipment and make the appropriate connections to the motor relays.

The operation of the electrical control system has been described in connection with that type of system where switches 47, 48, 49 and 50 are mounted on a monorail conveyor for actuation by actuating members such as 51 and 52 but it will be obvious to those skilled in the art that switches such as 47, 48, 49 and 50 plus additional switches may be mounted on a control board for operation by an attendant. In this case, these switches may be normally open push buttons which can be manipulated by the attendant as he observes the articles of various types progressing along the conveyor. It is only neces-

sary that the attendant know the various positions of the atomizing assemblies which are required for each of the different types of articles being coated. Thus when an article of a particular type is presented for coating the attendant can push the proper push button switch and move the atomizing assemblies into that position which is known to provide a uniform coating on the various surfaces of the particular article.

Fig. 5 of the drawings illustrates another embodiment of this invention which comprises a single atomizing head 500, mounted for movement in all directions relative to the surface to be coated, and means whereby this movement may be controlled from a remote station. A servo-motor 501 operates a pinion gear meshing with a vertically disposed rack 502 for moving the head 500 upwardly and downwardly. Lateral motion of the head 500 in a plane parallel to the surface being coated is provided by a servo-motor 503 having a pinion gear meshing with a rack 504. Motor 503 may be mounted on a base 506 which is in turn movably supported on tracks 507 by the wheels 515 whereby base 506 may be driven on tracks 507.

This entire assembly may be mounted so as to move in a direction perpendicular to the surface being coated. The servo-motor 509 may be mounted on a strut 511 extending between the rails 507 and may be provided with a pinion adapted to mesh with a rack 510. Rails 508 and rack 510 may be mounted on a suitable base whereby motor 509 drives the assembly, mounted on rails 507, toward or away from the article to be coated.

Fig. 6 of the drawings illustrates a control mechanism for driving the electrostatic atomizing assembly illustrated in Fig. 5. The three servo-motors 501, 503 and 509 shown in Fig. 5 may be electrically connected in accordance with conventional practice to servo-indicators 512, 513, and 519 respectively. The servo-indicators are mounted and arranged on a frame 520 in a manner corresponding to the mounting of the servo-motors illustrated in Fig. 5. Operating handle 521 may be movably mounted on this frame for movement relative to a plane 522 supported on the same frame. Plane 522 may comprise a surface representative of a surface to be coated. Servo-indicator 512 is arranged in operative relationship with handle 521 by means of a pinion and rack to generate electrical control currents representative of vertical movement of handle 521. Servo-indicator 513 may be mounted on a traveling base for movement in a horizontal plane and may be provided with a pinion and rack whereby it generates electrical currents representative of the horizontal movement of handle 521. Servo-indicator 519 may be connected structurally to handle 521 and cooperate with a rack to generate electrical currents representative of movement of handle 521 toward and away from the plane 522. Thus, in accordance with well known operation of servo-motor circuits the electrostatic atomizing head 500 may be caused to execute the identical motions imparted to the handle 521 by an operator. Thus, an operator, situated at a point remote from the articles to be coated, may move handle 521 through whatever motions may be necessary to apply a coating material to an article of a particular size and shape. By means of the servo-motor mechanism the electrostatic head 500 executes the same motions and accomplishes the coating operation under the complete and sole control of an operator.

From the foregoing description it will be apparent that this invention provides a control system for coating equipment which is adapted to cooperate with a conveyor for automatically positioning the atomizing apparatus so as to provide a uniform coating on articles of different sizes and shapes. The control system is also adapted to be manipulated from a remote point by an operator, either by push-button control or by a servo-mechanism, for controlling an atomizing system in such a manner that a

uniform coating may be deposited on articles of different sizes and shapes.

While there has been described two embodiments of my invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the invention, and it is, therefore, aimed in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of the invention.

I claim:

1. Coating apparatus adapted to coat articles of different sizes and shapes comprising an atomizing unit, means for adjustably supporting said atomizing unit, said supporting means being adapted to adjustably move said atomizing unit to a plurality of different fixed predetermined coating positions for coating articles of different sizes and shapes, and electromotive means operably associated with said adjustable supporting means for moving said atomizing unit to said different fixed predetermined coating positions.

2. Coating apparatus adapted to coat articles of different sizes and shapes comprising an atomizing unit for creating a spray of atomized coating material, a conveyor for conveying a plurality of articles of different sizes and shapes successively into receptive relation with said spray, motive mechanism for moving said atomizing unit, and means operatively connected to said motive mechanism to move said unit into a fixed predetermined spatial relationship relative to one of said articles on said conveyor and to move said unit into a different fixed predetermined spatial relationship relative to a following article where such article is of different size and shape.

3. Coating apparatus adapted to coat articles of different sizes and shapes comprising a plurality of atomizing units for creating sprays of atomized coating material, a conveyor for conveying a plurality of articles of different sizes and shapes successively into receptive relation with said sprays, motive mechanism for moving said atomizing units and means operatively connected to said mechanism to arrange said units into fixed predetermined positions with respect to one of said articles and to rearrange said units into different fixed predetermined positions with respect to a following article where such article is of a different size and shape.

4. Coating apparatus adapted to coat articles of different sizes and shapes comprising an atomizing unit, spatially adjustable supporting means connected to said atomizing unit, electromotive means drivingly connected to said supporting means, and an electrical control circuit connected to said electromotive means and operable to effect adjustment of said atomizing unit relative to said articles into a plurality of different fixed predetermined coating positions for successively coating articles of different sizes and shapes.

5. Coating apparatus adapted to coat articles of different sizes and shapes comprising a plurality of multiple head atomizing units for creating sprays with adjustable patterns, separate vertically adjustable supports connected to the opposite ends of each of said units, motors drivingly connected to each of said supports for independently elevating or lowering each end of each unit thereby to alter the spray patterns created thereby, and a control circuit connected to said motors and including means operable to energize said motors for adjusting the spray patterns emitted by said units.

6. Coating apparatus adapted to coat articles of different sizes and shapes comprising a pair of spaced columns, a plurality of multiple head atomizing units for creating sprays with adjustable patterns, supports connected to the opposite ends of each of said units for adjustably connecting said units to and between said columns, reversible motors connected to each of said supports for independently, adjustably moving each end of each unit thereby to alter the spray patterns created thereby, and a control circuit connected to said motors and including switches

operable selectively to determine the direction of rotation of said motors for adjusting the spray patterns emitted by said units.

7. Coating apparatus adapted to coat articles of different sizes and shapes as they are moved on a conveyor, comprising spaced pairs of rails extending perpendicularly to the direction of travel of said conveyor; a frame including trucks mounted on said rails and a vertical screw-threaded column mounted on each truck, driving means including a rack, pinion and motor drivingly connected together and operatively connected with said frame for moving said frame toward and away from said conveyor; means comprising limit switches in the path of movement of said frame and coupled to said motor; a plurality of multiple head atomizer units, each unit being provided at its opposite ends with elevator nuts threaded on said columns and elevator motors drivingly connected to said nuts for rotating them on said columns to elevate and lower said units; and indexing means comprising posts mounted on said trucks adjacent said columns and limit switches electrically coupled with said elevator motor and adjustably mounted on said posts in the path of movement of each elevator nut for stopping said elevator motors and therewith vertical motion of the ends of said units at different predetermined elevations.

8. An article coating system comprising a conveyor adapted to move articles of various sizes and shapes and including suspension supports for said articles, a coating unit disposed adjacent the path of movement of said articles and comprising a plurality of atomizing heads, adjustable supports for movably supporting said atomizing heads and motors operably connected to said adjustable supports for effecting adjustments thereof; motor starting switches electrically coupled to said motors and supported on said conveyor adjacent the path of movement of said suspension supports at different levels correlated to the size and shape of said articles, switch actuating members mounted on said suspension supports at different levels correlated to the size and shape of said articles for operating said motor starting switches, and motor stopping switches electrically coupled to said motors and disposed adjacent said adjustable supports in the path of movement thereof for de-energizing said motors when said supports assume predetermined positions correlated to the size and shape of said articles.

9. An article coating system comprising a conveyor adapted to move articles of various sizes and shapes and including supports for said articles; a coating unit disposed adjacent the path of movement of said articles and comprising a plurality of atomizing heads, means including adjustable supports for movably supporting said atomizing heads, and motors drivingly connected to said adjustable supports for effecting adjustments thereof; motor starting switches electrically coupled to said motors and supported adjacent the path of movement of said articles at different levels correlated to the size and shape of said articles, switch actuating members mounted on said conveyor at different levels correlated to the size and shape of said articles for operating said motor starting switches, and motor stopping switches electrically coupled to said motors and disposed in the path of movement thereof for de-energizing said motors when said supports assume predetermined positions correlated to the size and shape of said articles.

10. An article coating system comprising a conveyor adapted to move articles of various sizes and shapes and including supports for said articles; a coating unit disposed adjacent the path of movement of said articles and comprising a plurality of atomizing heads, means including adjustable supports for movably supporting said heads, and motor drivingly connected to said adjustable supports for effecting adjustments thereof; motor starting switches electrically coupled to said motors and supports adjacent the path of movement of said articles, the location of said switches being correlated to the size and shape

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of said articles; switch actuating members mounted on said conveyor in a location correlated to the size and shape of said articles for operating said motor starting switches; and motor stopping switches electrically coupled to said motors and mounted to be actuated by said supports for deenergizing said motors when said supports assume predetermined positions correlated to the size and shape of said articles.

11. An article coating system comprising a conveyor adapted to move articles of various sizes and shapes and including supports for said articles, a coating unit disposed adjacent the path of movement of said articles and comprising a plurality of atomizing heads, means including adjustable supports for movably supporting said heads and motors drivingly connected to said adjustable supports for effecting adjustments thereof, motor starting switches electrically coupled to said motors and supported adjacent the path of movement of said articles, switch actuating members operatively associated with said articles for operating said motor starting switches, and motor stopping switches electrically coupled to said motors and mounted to be actuated by said supports for deenergizing said motors when said supports assume predetermined positions correlated to the size and shape of said articles.

12. A plural position, automatically adjustable, coating apparatus having, in combination, means for producing a spray of coating material, a plurality of adjusting motors operatively associated with said spray producing means, motor control and reversing relays connected to said motors, each of said relays including a first coil and contacts operative to connect a motor for rotation in one direction and a second coil and contacts operative to connect said motor for rotation in the opposite direction, a starting circuit coupled in parallel to said first coil of each relay and including a normally open switch representative of an article to be coated of a particular type for energizing said motor and adjusting said spray producing means, and holding circuits connected to each of said first coils and including normally closed limit switches for deenergizing said holding circuits and stopping said motors when said spray producing means is in a predetermined position for coating said article, a second starting circuit coupled in multiple to said second coil of each relay and including a second normally open switch representative of a different article to be coated for energizing said motors and readjusting said spray producing means, and holding circuits connected to each of said second coils and including normally closed limit switches for de-energizing said holding circuits and stopping said motors when said spray producing means is in a second predetermined position for coating said different article.

13. A plural position, automatically adjustable, coating apparatus having, in combination, means for producing a spray of coating material, a plurality of adjusting motors operatively associated with said spray producing means, motor control and reversing relays connected to said motors, each of said relays including a first coil and contacts operative to connect a motor for rotation in one direction and a second coil and contacts operative to connect said motor for rotation in the opposite direction, a starting circuit coupled to said first coil of each relay and including a switch representative of an article to be coated of a particular type for energizing said motor and adjusting said spray producing means, and limit switches coupled to said first coils for de-energizing said relays and stopping said motors when said spray producing means is in a predetermined position for coating said article, a second starting circuit coupled to said second coil of each relay and including a second switch representative of a different article to be coated for energizing said motors and readjusting said spray producing means, and limit switches coupled to said second coils for de-energizing said relays and stopping said motors when said

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spray producing means is in a second predetermined position for coating said different article.

14. A plural position, automatically adjustable, coating apparatus having, in combination, means for producing a spray of coating material, a plurality of adjusting motors operatively associated with said spray producing means, motor control and reversing relays connected to said motors, each of said relays including contacts operative to connect a motor for rotation in one direction and contacts operative to connect said motor for rotation in the opposite direction, a starting circuit coupled to each relay and including a switch representative of an article to be coated of a particular type for energizing said motor and adjusting said spray producing means, and a first set of limit switches coupled to said relays for de-energizing them and stopping said motors when said spray producing means is in a predetermined position for coating said article, a second starting circuit coupled to said relays and including a second switch representative of a different article to be coated for energizing said motors and readjusting said spray producing means, and a second set of limit switches coupled to said relays for de-energizing them and stopping said motors when said spray producing means is in a second predetermined position for coating said different article.

15. A plural position, automatically adjustable, coating apparatus having, in combination, means for producing a spray of coating material, a plurality of adjusting motors operatively associated with said spray producing means, a motor control and reversing circuit connected to said motors and including a first set of contacts operative to connect each motor for rotation in one direction and a second set of contacts operative to connect each motor for rotation in the opposite direction, a starting circuit coupled to said motor control and reversing circuit and including a switch representative of an article to be coated of a particular type for effecting operation of said first set of contacts and energizing said motors in one direction for adjusting said spray producing means, and a first set of limit switches coupled to said motor control circuit for de-energizing and stopping said motors when said spray producing means is in a predetermined position for coating said article, a second starting circuit coupled to said motor control and reversing circuit and including a second switch representative of a different article to be coated for effecting operation of said second set of contacts for energizing said motors in the opposite direction and readjusting said spray producing means, and a second set of limit switches coupled to said motor control circuit for de-energizing and stopping said motors when said spray producing means is in a second predetermined position for coating said different article.

16. A plural position, automatically adjustable, coating apparatus having, in combination, means for producing a spray of coating material, a plurality of adjusting motors operatively associated with said spray producing means, a motor spray producing means, a motor energizing circuit connected to said motors and operative to connect said motors for operation in either direction, a control circuit coupled to said energizing circuit and including a switch representative of an article to be coated of a particular type for actuating said control circuit to operate said motors in predetermined directions and adjusting said spray producing means for coating said article, a second control circuit coupled to said energizing circuit and including a second switch representative of a different article to be coated for actuating said control circuit to operate said motors in different predetermined directions and readjusting said spray producing means for coating said different article.

17. A coating apparatus controllable from a remote point to coat an article comprising an atomizing head, an adjustable vertical standard for supporting said head, a first servo-motor mechanism for adjusting said standard, a base for supporting said standard, second and third

servo-motor mechanisms for imparting lateral and longitudinal movement to said base, and remote control apparatus coupled to said servo-motor mechanisms comprising a remotely located handle, an adjustable vertical support for said handle, a servo-indicator mechanism connected to said support and electrically coupled to said first servo-motor whereby vertical movement of said handle is duplicated by said head, a base for carrying said support and including mechanism for permitting lateral and longitudinal movement of said support, and servo-indicators coupled to said base and electrically connected to said second and third servo-motor mechanisms whereby lateral and longitudinal movement of said handle is duplicated by said head.

18. A coating apparatus controllable from a remote point to coat an article comprising an atomizing head, an adjustable vertical standard for supporting said head, a first servo-motor mechanism for vertically adjusting said standard, supporting means including a second servo-motor mechanism for imparting lateral movement to said standard, supporting means including a third servo-motor mechanism for imparting longitudinal movement to said standard, and remote control apparatus coupled to said servo-motor mechanisms comprising a remotely located handle, an adjustable vertical support for said handle, a servo-indicator mechanism connected to said support and electrically coupled to said first servo-motor whereby vertical movement of said handle is duplicated by said head, structure for carrying said support and including mechanism for permitting lateral and longitudinal movement of said support, and servo-indicators coupled to said mechanism and electrically connected to said second and third servo-motor mechanisms whereby lateral and longitudinal movement of said handle is duplicated by said head.

19. A coating apparatus controllable from a remote point to coat an article comprising an atomizing head, a standard for supporting said head, a universal mounting for said standard, a first servo-motor mechanism for vertically adjusting said standard, second and third servo-motor mechanisms for imparting lateral and longitudinal movement to said standard, and remote control apparatus coupled to said servo-motor mechanisms comprising a remotely located handle, a universal mounting for said handle, a servo-indicator mechanism responsive to vertical motion of said mounting and electrically coupled to said first servo-motor whereby vertical movement of said handle is duplicated by said head, and servo-indicators responsive to longitudinal and lateral movement of said mounting and electrically connected to said second and third servo-motor mechanisms whereby lateral and longitudinal movement of said handle is duplicated by said head.

20. A method of coating articles of different sizes and shapes comprising the steps of creating a plurality of fixed sprays of atomized coating material arranged to overlap each other, passing a plurality of articles of different size and shape into receptive relation with said sprays, orienting said sprays in unison relative to articles of one size and shape to predetermined fixed positions to deposit a uniform coating on last-mentioned articles, passing a second article having a different size and shape into receptive relation with said sprays, and as the second article approaches said receptive relation reorienting said sprays in unison relative to said article to different fixed predetermined positions to deposit a uniform coating on said second article.

21. A method of coating articles of different sizes and shapes comprising the steps of creating a fixed spray of atomized coating material, passing an article of a certain size and shape into receptive relation with said spray, electromotively orienting said spray with respect to said article to a predetermined fixed coating position to deposit a uniform coating on said article, passing a second article of a different size and shape into receptive relation with

said spray, and electromotively reorienting said spray with respect to said article to a different fixed predetermined coating position to deposit a uniform coating on said second article.

22. A method of coating articles of different sizes and shapes comprising the steps of creating a spray of atomized coating material, successively conveying a plurality of articles of different sizes and shapes into receptive relation with said spray, and selectively orienting said spray into a different predetermined fixed spatial relationship with each of said articles to deposit a uniform coating on each article.

23. Coating apparatus adapted to coat articles of different sizes and shapes as they are moved on a conveyor; comprising spaced pairs of rails extending perpendicularly to the direction of travel of said conveyor; a frame including a pair of trucks, one mounted on each pair of said rails, and a vertical column mounted on each truck; driving means including a motor mounted on said frame for moving said frame toward and away from said conveyor; indexing means comprising limit switches in the path of movement of said frame and coupled to said motor; a plurality of multiple head atomizer units, each unit being provided at its opposite ends with elevator means and motors drivingly connected to said elevator means, said elevator means being movably mounted on said columns to elevate and lower said units; and means comprising limit switches electrically coupled with said elevator motors and adjustably mounted adjacent the path of movement of the corresponding elevator means for stopping said elevator means and therewith vertical motion of the respective ends of said units at predetermined elevations.

24. Coating apparatus adapted to coat articles of different sizes and shapes as they are moved on a conveyor; comprising a frame including a pair of spaced vertical columns mounted for movement toward and away from said conveyor; driving means including a motor mounted on said frame for moving said frame toward and away from said conveyor; means comprising limit switches in the path of movement of said frame and coupled to said motor; a plurality of atomizer head units, each unit being provided at its opposite ends with an elevator means and a motor drivingly connected to said elevator means, each of said elevator means being movably mounted on one of said columns to elevate and lower said units; and means comprising limit switches electrically coupled with said elevator motors and adjustably mounted adjacent the path of movement of the corresponding elevator means for stopping said elevator means and therewith vertical motion of the respective ends of said units at predetermined elevations.

25. Coating apparatus adapted to coat articles of different sizes and shapes as they are moved on a conveyor; comprising a frame mounted for movement toward and away from said conveyor; driving means including a first motor mounted on said frame for moving said frame toward and away from said conveyor; an atomizer head unit including elevator means for movably connecting said unit to said frame and a second motor operably connected to said elevator means to elevate and lower said unit in a plane parallel to the path of conveyor movement; and means coupled with said motors for energizing and de-energizing said motors to move said atomizing unit from one fixed predetermined coating position to another.

26. Coating apparatus adapted to coat articles of different sizes and shapes as they are moved on a conveyor, comprising a frame, an atomizer head unit mounted on said frame for movement to different fixed predetermined coating positions, means for elevating and lowering said unit in a plane parallel to the path of conveyor movement to different fixed predetermined coating positions, and means for initiating the movement of said atomizing unit from one fixed predetermined coating position to another.

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