Sept. 26, 1961 O. GENGENBACH ET AL 3,001,504

ELECTROSTATIC COATING APPARATUS

Filed Dec. 24, 1956 4 Sheets-Sheet 1

Fig. 1

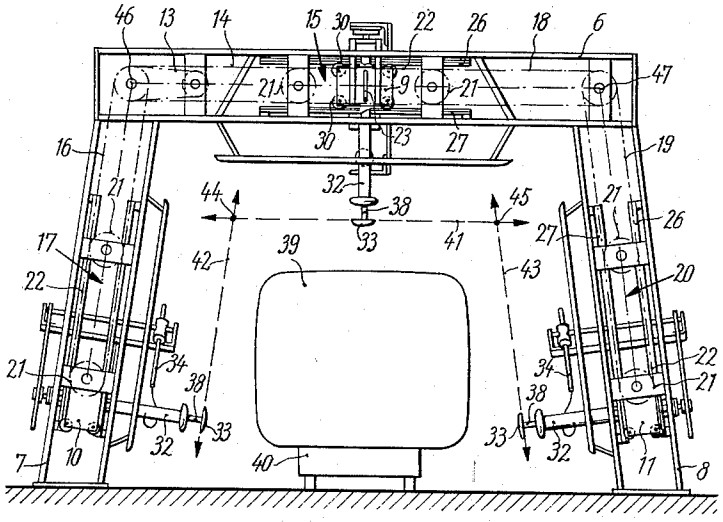
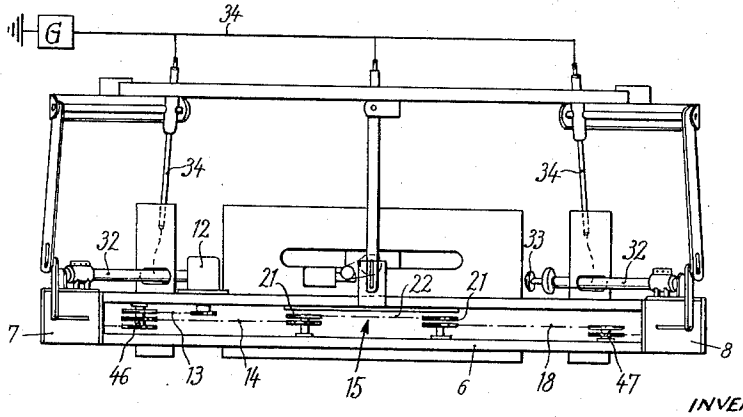


Fig. 2



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Fig. 3

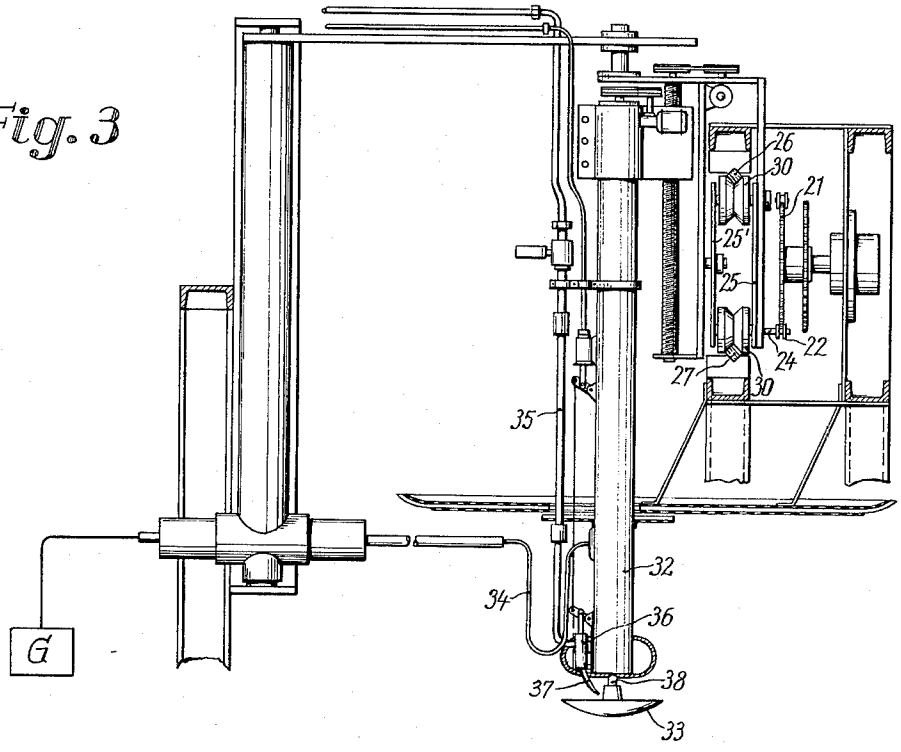
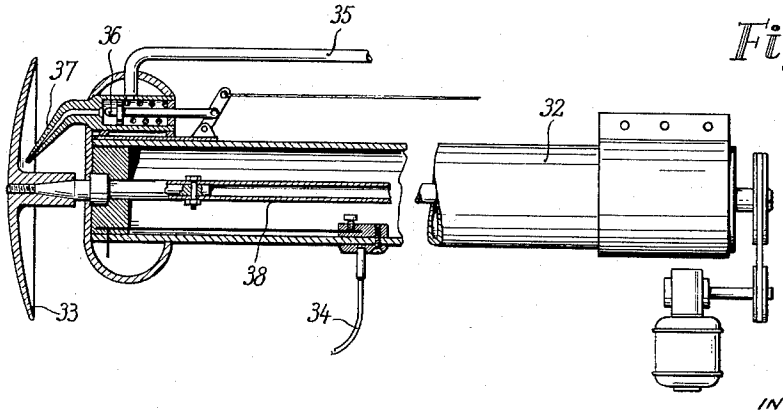


Fig. 4



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Fig. 6

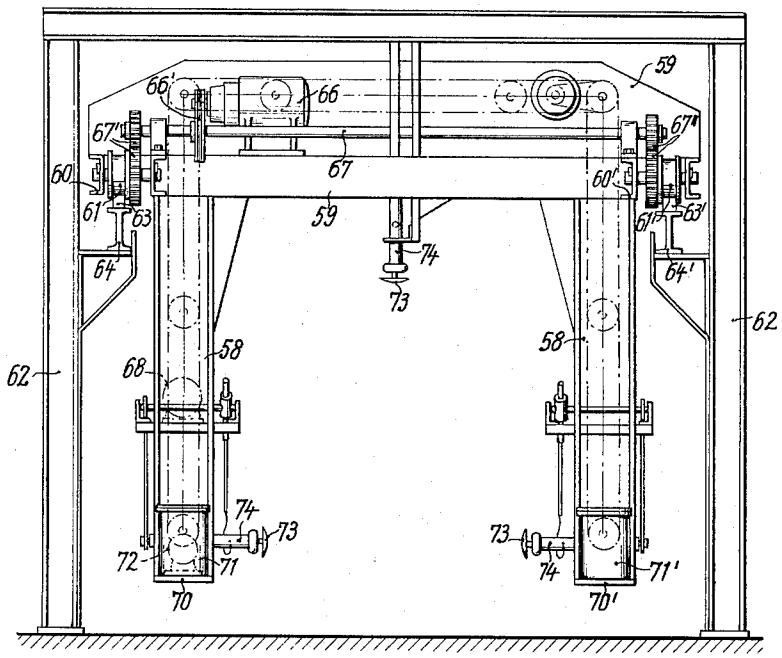


Fig. 7

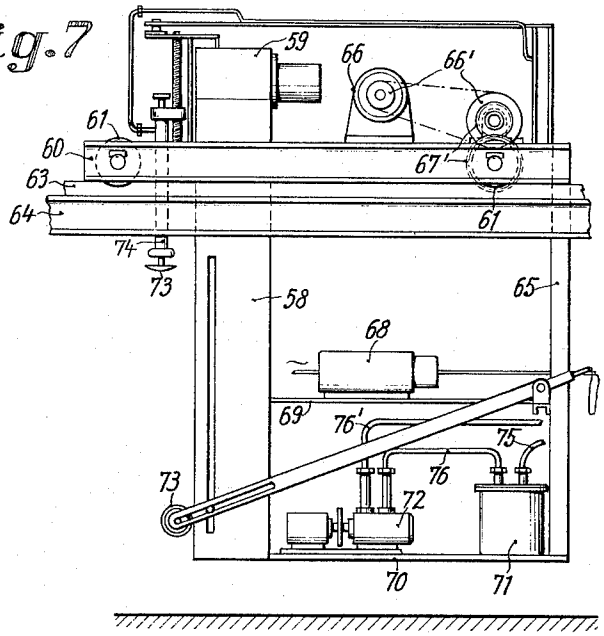
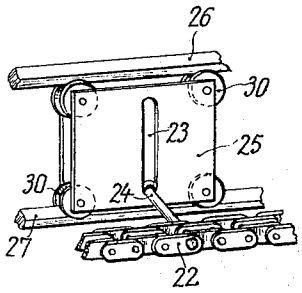


Fig. 5



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Fig 8.

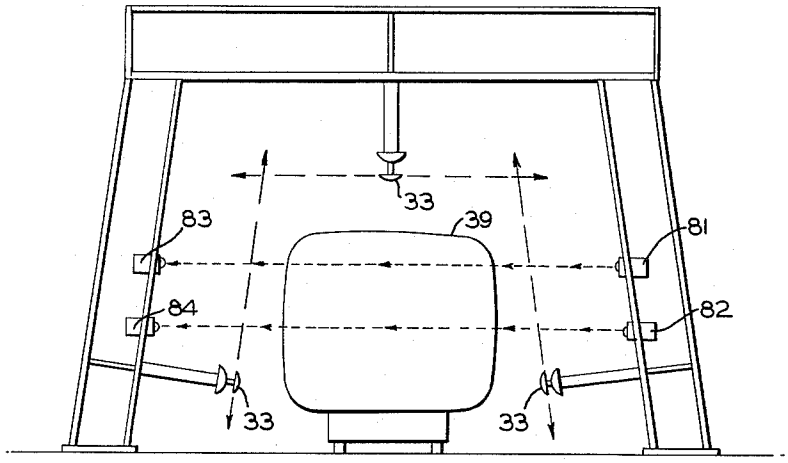
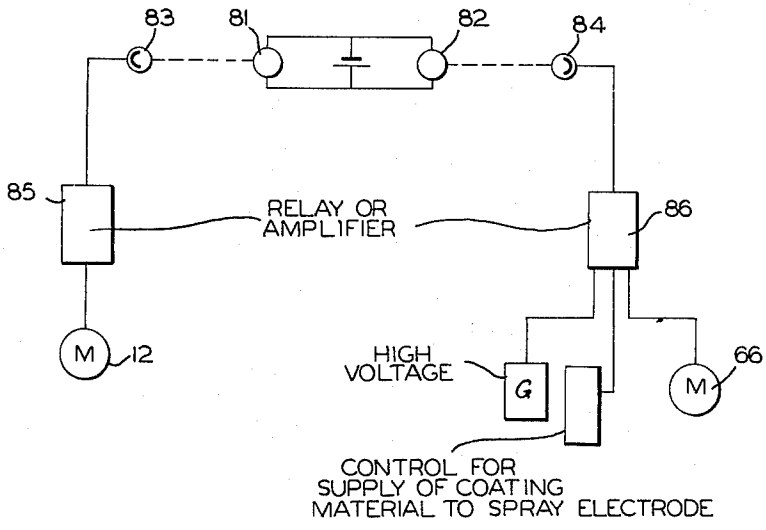


Fig 9.



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United States Patent Office 3,001,504 Patented Sept. 26, 1961

3,001,504
ELECTROSTATIC COATING APPARATUS

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Filed Dec. 24, 1956, Ser. No. 630,181
Claims priority, application Germany Dec. 23, 1955
13 Claims. (Cl. 118—2)

The present invention relates to an apparatus for electrostatically coating large objects, particularly vehicle bodies, with paint, enamel, or the like.

It is the principal object of the present invention to provide an electrostatic spraying apparatus with a plurality or several groups of spray electrodes which are disposed in different positions so as to apply an adequate and uniform coating of paint or enamel on all surfaces of such a large object which are often of irregular shape and disposed within different planes.

Another object of the present invention is to provide the various electrodes or groups of electrodes so as to be movable relative to each other so that the paths scanned by each electrode or electrode group partly intersect or converge with those scanned by other electrodes so that all surfaces will be coated effectively.

A further object of the present invention is to provide suitable means for preventing the individual electrodes which are provided with a high electric potential from affecting each other so that the layer of enamel or the like will be uniform at all points of the surfaces coated, and particularly at such areas thereof which are acted upon by the intersecting paths of several electrodes.

For this purpose, the present invention provides suitable control means for positively controlling the movements of the individual electrodes or groups of electrodes in a definite relation to each other and at a minimum distance from each other, which minimum distance is selected so that the size of the field of high voltage of each electrode does not cause undesirable mutual interference, affecting the deposit of sprayed material, with another electrode.

A control unit according to the invention suitable for this purpose may, for example, consist of a separate operating mechanism for each individual electrode or group of electrodes, and a single motor for driving all of the operating mechanisms. This motor may for this purpose be connected to an intermediate drive shaft which is disposed at the point of intersection of the longitudinal axes of two operating mechanisms and drives these mechanisms directly. These operating mechanisms, in turn, may be connected with the operating mechanisms of any further electrodes or groups of electrodes to drive the same. The driving connection between the intermediate shaft and the different operating mechanisms of the electrodes may consist of any positive driving means such as chain drives and, if necessary, further intermediate shafts. The operating mechanisms of the electrodes preferably consist of carriages which are movable on rails by means of rollers of a suitable shape so as to guide each carriage also laterally, of two sprocket wheels which are rotatably mounted on the frame of the apparatus at the ends of the path of movement of each carriage, of an endless chain entrained on these two sprocket wheels, and a carrier pin forming an extension of one of the link pins of the chain which is slidably guided in a slot extending within the base plate of the carriage and transverse to the direction of movement thereof.

Further objects, features, and advantages of the present invention will be apparent from the following detailed

description thereof, particularly when read with reference to the accompanying drawings, in which—

FIG. 1 shows a front view of the apparatus according to the invention for electrostatically coating car bodies and provided with a mechanism for controlling the movement of the electrodes;

FIG. 2 shows a plan view thereof;

FIG. 3 shows an enlarged elevation of one of the spray electrodes together with its operating mechanism;

FIG. 4 shows an elevation, partly in section of a support of an electrode;

FIG. 5 shows a perspective view of a part of the control mechanism for one electrode;

FIG. 6 shows a front view of a modified apparatus according to the invention for coating car bodies;

FIG. 7 shows a side view of the apparatus shown in FIG. 6;

FIGURE 8 shows a front view of the apparatus generally as seen in FIGURE 1, but without details of the operating mechanisms for the various spray electrodes, and including photocell control apparatus for sensing the presence of a large object, such as a vehicle body, in a position to be sprayed; and

FIGURE 9 is a schematic illustration of control circuitry for automatically operating the apparatus of this invention under control of the photocells as illustrated, for example, in FIGURE 8.

Referring to the drawings, and first particularly to FIGS. 1 to 5, the apparatus according to the invention consists of a gate-shaped frame which is primarily composed of uprights 7 and 8 and a crosshead 6. Each of these frame members which are composed of sectional beams is provided with one dish-shaped spray electrode 33 which, in turn, is supported by an arm 32 of insulating material which extends toward the inside of the frame. All electrodes 33 are connected with an electric high-tension generator G by partly flexible conductors 34 so as to be charged with a high voltage relative to the ground. During the operation, the coating material, for example, liquid paint or enamel, is continuously supplied to electrodes 33 through pipe or hose lines 35, as shown in FIGS. 3 and 4, each of which is provided with a check valve 36 and a nozzle 37.

In order to attain a uniform distribution of paint or enamel along the inner surface of electrodes 33, they are mounted on rotating shafts 38. As long as the car body 39 to be coated, resting on a grounded movable support 40, passes through the framework between electrodes 33, paint will be sprayed from the electrodes upon the car body in the finest possible dispersion through the influence of the strong electric field maintained between the electrodes and the car body. The supports 32 of electrodes 33 are slidably mounted, for movement toward and/or away from the car body, on the frame of the apparatus so as to be movable in the longitudinal direction of supports 32 and follow the contours of the car body while the latter moves past the electrodes in the direction normal to the plane of FIGURE 1 of the drawings. The strength of the electric field and therefore the amount of coating material sprayed by each electrode within a certain unit of time thus remains substantially constant.

The aforementioned longitudinal movement of the insulating supports 32 may be effected by an apparatus shown in FIGURE 3 which is described in detail in a copending application Serial No. 624,110 filed November 23, 1956, and assigned to the same assignee of the present invention.

For insuring that the spray electrodes will cover all the surfaces of the car body while the latter passes through the apparatus, they are also moved at a uniform motion back and forth or upwardly and downwardly in the direction of arrows 41, 42, and 43 along frame members 6, 7,

and 8 so that their paths of movement or the extension thereof will converge and intersect at points 44 and 45. For this purpose, electrode supports 32 are suspended on carriages 9, 10, and 11, respectively which are movable on wheels 30 which have grooved peripheries which engage and roll along guide rails 26 and 27 which are secured within frame members 6, 7, and 8, as shown particularly in FIGS. 3 and 5, the grooved wheels preventing transverse movement with respect to the rails 26 and 27. The positive movement of the three carriages 9, 10, and 11 is transmitted by chain drives 15, 17, and 20, respectively, each of which consists of two sprocket wheels 21 which are rotatably mounted on a stationary part of the framework, an endless chain element 22 on sprockets 21, and a carrier pin 24 which forms an extension of one of the link pins of chain 22 toward one side thereof and is slidably guided in a slot 23 in base plate 25 of the respective carriage. The pin 24 is slidable along the slot 23 and reverses its position therein and the direction of movement of the carriage when the pin passes around the sprocket wheels. The movements of the carriages 9, 10, and 11 are so synchronized and controlled that the distances between the carriages are at all times sufficient to prevent the electric fields of the individual spray electrodes from disturbing each other during spraying. Thus, the endless chain 22 may be continuously driven in one direction while the carriages are driven first in one and then the other direction.

The operating mechanisms of the three electrodes 33 are driven by a motor 12 which is mounted on the crosshead 6 and through a chain drive 13 drives an intermediate shaft 46 which is disposed at the point of intersection of the longitudinal axes of chain drives 15 and 17 and drives these chain drives positively by intermediate chain drives 14 and 16, respectively. Chain drive 20 for the third operating mechanism is driven directly by chain drive 15 through a second intermediate shaft 47 which is rotatably mounted on the framework at the point of intersection of the longitudinal axes of these two chain drives and which is connected with these chain drives by two further chain drives 18 and 19.

The speed and distance traveled by carriages 9, 10, and 11 is exactly equal. Their movement is started from their basic position as shown in FIG. 1 in a specific cycle caused by the positive transmission of motion through chain drives 15, 17, and 20, respectively, so that carriage 9 together with the respective electrode 33 will move from its central position as shown to one of its end positions or in the direction toward point 44, while carriages 10 and 11 move from their basic position as shown in the same direction up to a central position at one-half of the height of their path of movement. When carriage 9 then retracts to its central position as shown in FIG. 1, carriages 10 and 11 continue to move to their upper end positions toward points near 44 and 45, respectively. When carriages 10 and 11 then move downwardly to their starting position, carriage 9 simultaneously moves toward its other end position near point 45 and back again to its central position as shown. This cycle of movements, in which the three electrodes 33 are positively maintained at a distance from each other which amounts to at least one-half the length of their entire travel, is of advantage for various reasons and particularly also because the forces due to inertia produced by the periodical out of phase reversals or acceleration and deceleration of carriages 9 and 10 supporting electrodes 33 and their lead conductors largely balance each other within the framework and at least do not add to each other so as to affect the stability of the framework. This advantage is of great importance particularly if the framework of the apparatus is not mounted in a stationary position, but is moveable as subsequently described.

In a stationary apparatus, particularly if the objects to be coated and therefore also the surfaces to be scanned by the electrodes are not too large so that carriages 9, 10, and 11 and their operating mechanisms may be made of a relatively light weight, such operating mechanisms may also be modified so that all electrodes always move simultaneously at an equal distance from each other from one end of their travel to the other. If in such event, as distinguished from FIG. 1, electrode 33 on carriage 11 would, for example, be disposed at the upper end of its travel near point 45, electrode 33 on carriage 9 would be located at the left end of its travel near point 44, while carriage 10 with its electrode would assume the lower end position as shown in FIG. 1. Although in such a case the dynamic forces acting upon the framework of the apparatus would add to each other, the weight of the operating parts moving upwardly and downwardly, which otherwise has to be overcome by the common motor of the apperatus, would be completely compensated so that the motor may be of much lower strength and the operating mechanisms may be considerably simplified. Chain drives 13, 14, 16, 17, 18, 19, and 20 may as shown in FIG. 1, then be entirely omitted and carriages 10 and 11 be suspended at both ends of a carrying chain which runs on sprocket wheels mounted on the intermediate shafts 46 and 47 and is secured at its center to carriage 9. The smaller driving motor 12 may then through a reduction gear be connected to one of sprocket wheels 21 or chain 22 of the sole remaining operating mechanism 15 to drive the same directly.

A further embodiment of the invention is illustrated in FIGS. 6 and 7, in which the gate-shaped framework consisting of the freely suspended arms 58 and the crosshead 59 is movable in the longitudinal direction of the object to be coated, for example, the body of a bus. For this purpose, the gate-shaped framework is suspended on longitudinal girders 60 and 60' on which two or more pairs of rollers 61 and 61' are rotatably mounted which, in turn, rest upon guide rails 63 and 63' supported by longitudinal girders 64 and 64', respectively, which are secured to walls 62 of the housing of the apparatus. Crosshead 59 supports a motor 66 which drives one of the pairs of rollers 61, 61' at a uniform speed by means of a gear 66', which may be infinitely variable, and through a transverse shaft 67 and two reduction gears 67' and 67''. The direction of rotation of motor 66 is reversible so that frame 58, 59 may be moved back and forth along rails 63, 63' within housing 62.

Longitudinal girders 60 further support girders 65 suspended therefrom which are connected to frame arms 58 by base plates 69, 70, and 70'. Base plate 69 supports an electric high-tension generator 68 which is connected with the saucer-shaped spray electrodes 73 by partly flexible electric conductors. Electrodes 73 are mounted on insulating arms 74 which are movably suspended on frame arms 58 and crosshead 59. The paint or enamel is supplied to electrodes 73 from containers 71 and 71' resting on base plates 70 and 70', respectively, through partly flexible lines 75. A motor-driven compressor 72 mounted on base plate 70 places the paint in containers 71 and 71' through lines 76, 76' under pressure so that the paint will flow through lines 75 and a pressure-reducing valve in each line in a uniform current to electrodes 75 regardless of the respective elevated position thereof. The means for moving electrodes 73 in the direction of girders 58 and 59 are similar to those described with reference to FIGS. 1 to 5, and the movement of electrodes 73 is therefore positively controlled and they are always maintained at a certain minimum distance from each other.

An important feature of the latter spraying apparatus according to the invention which is capable of traveling in the longitudinal direction of the housing is the fact that all equipment necessary for its operation is mounted thereon and thus movable therewith, so that only the lower voltage current for the operation of the compressor motors, the main motor 66, the motor 12, as in FIGURE 2, for moving electrodes along girders 58 and 59 and the high-tension generator 68 needs to be supplied through a flexible cable or through bus bars and sliding

contacts, and no flexible hose for supplying compressed air or paint to the movable framework will be required.

The movable spraying apparatus as above described is particularly of advantage for coating very large objects such as the bodies of busses or railroad cars which generally are not assembled on a constantly moving conveyor but, according to the so-called cyclic method, in a step-by-step movement. In this case, the housing of the spraying apparatus may be connected directly to a baking or drying oven so that several successive spray jobs may be carried out within the housing, separated by intermediate drying of the paint in the attached oven. The car body would therefore be moved back and forth between the spray housing and the baking oven in a so-called pilgrim-step movement until, after the last drying step, it finally leaves the spraying plant so that the next car body can enter. Since the cyclic assembly method usually allows adequate time between the entry of two successive car bodies into the spray housing to carry out several spray jobs on one car body and also to dry the paint between these jobs, the spraying plant according to the invention may thus be fully and economically utilized and be made of relatively small proportions. However, the movable electrostatic spraying apparatus according to the invention may also be used to advantage in combination with a progressive assembly line wherein the objects to be coated are advanced in a continuous movement since the progression of the conveyor in accordance with the speed of assembly of the object thereon is often too fast to allow a proper spraying operation in a stationary apparatus.

The various controls for starting and stopping motor **66** and for moving the framework back and forth, for turning on and shutting off the spraying mechanism, and for starting and stopping the operating mechanisms of the electrodes may be automatically operated in accordance with relative movement between the object being coated and the spraying apparatus in a manner known such as by means of photoelectric cells, light traps, time-control and contact switches, or the like.

The automatic control of the apparatus according to this invention may be effected in response to the interruption of the light beams between light sources **81** and **82** and the photocells **83** and **84**, respectively, these light sources and photocells being positioned, for example, as seen in FIGURE 8. It is understood that like control apparatus may be similarly mounted on the apparatus shown in FIGURE 6.

The light sources **81** and **82** may be energized from any suitable electrical source and, when the light beams therefrom to the photocells **83** and **84** are interrupted by the vehicle body **39**, an appropriate signal from the photocell actuates the relays or amplifiers indicated at **85** and **86** to effect a desired automatic control function. The relay or amplifier indicated at **85** is connected to control a motor, such as the motor **12**, for shifting the spray electrodes along the intersecting paths as seen most clearly in FIGURE 1. The actuation of the relay or amplifier **86** by the photocell **84** is effective to control the high voltage source, so that the spray electrodes will be energized therefrom and also to control the supply of coating material to the spray electrodes by suitably controlling the operation of a motor-driven compressor, such as that illustrated at **72** in FIGURE 7, together with the actuation of the valve **36** seen in FIGURES 3 and 4 for controlling the flow of the coating material at the spray electrodes. The amplifier also may be connected to energize a motor, as seen in FIGURE 9, to effect relative movement at a desired rate between the vehicle body and the frame which carries the spray electrodes. This motor may be, for example, a motor **66** shown in FIGURE 7 for driving the gate-shaped framework along the guide rails **63** and **63'**.

Although our invention has been illustrated and described with reference to the preferred embodiments thereof, we wish to have it understood that it is in no way limited to the details of such embodiments, but is capable of numerous modifications within the scope of the appended claims.

Having thus fully disclosed our invention, what we claim is:

1. An apparatus for electrostatically spraying large objects with paint, enamel or the like comprising a plurality of spary electrode units, means for supplying a high electric tension to said units, and means for moving said units during the spraying positively and simultaneously along intersecting paths, said moving means comprising a separate operating mechanism for each of said electrode units, a single motor for synchronously driving all of said units, each said separate operating mechanism comprising a separate drive element continuously movable during a spraying operation, means for connecting said motor to continuously drive each said drive element and means operatively connecting said drive element and the respective spray electrode unit to reciprocally move the latter along a longitudinal axis corresponding to one of said paths in response to continuous movement of said drive element during said spraying operation and for controlling the movement of said units in a positive relation to each other, said first mentioned connecting means at all times during said spraying operation positioning said spray electrodes relative to each other to maintain them at a minimum distance from each other to prevent mutual interference during spraying due to the field of high tension of each electrode.

2. An apparatus as defined in claim 1, including three spray electrode units and wherein the connecting means between said motor and said drive elements comprises an intermediate shaft connected to said motor for positively driving two of said operating mechanisms and disposed at the point of intersection of the longitudinal axes of said two mechanisms, and means for connecting one of said two mechanisms with the operating mechanism of the other electrode unit for driving the same.

3. An apparatus as defined in claim 2, wherein the connecting means between said motor and said drive elements comprises chain drives for positively connecting said intermediate shaft with said two operating mechanisms, as well as the latter with the other operating mechanism for driving the same.

4. An apparatus as defined in claim 1, wherein each of said operating mechanisms comprises a pair of guide rails, a carriage between said rails and having rollers movable on said rails, said rollers being of a suitable shape so as to guide said carriage on said rails along the direction thereof and to prevent transverse movement of said carriage with respect to said rails, a pair of sprocket wheels rotatably mounted in a fixed position near both ends of said rails, an endless chain around and connecting said sprocket wheels, said carriage having a slot therein extending transverse to the direction of movement thereof along said rails, and a carrying pin forming a lateral extension of a link of said chain and engaging with said carriage within said slot to drive said carriage, said pin being slidable along said slot so as to reverse the position of said carrying pin on said carriage and the direction of movement of said carriage when said link passes around said sprocket wheels.

5. An apparatus for electrostatically coating large objects with paint, enamel, or the like comprising a plurality of spray electrodes, means for supplying a high tension to said electrodes, means for supporting at least one of said electrodes on each side laterally of the object to be coated, means for supporting at least one upper electrode above said object, means for moving said lateral supporting means upwardly and downwardly, means for moving said upper supporting means back and forth in a direction transverse to said object, and means for controlling the operation of said moving means so that when said lateral supporting means move upwardly from their lower end position to a position substantially centrally of the height of said object, said upper supporting

means move from their central position toward one of their end positions, and when said upper supporting means then return to their central position, said lateral supporting means continue to move to their upper end position, and while when said lateral supporting means then move downwardly to their lower end position, said upper supporting means move toward their other end position and then back to their central position.

6. An apparatus for electrostatically coating large objects with paint, enamel, or the like comprising a plurality of spray electrodes, means for supplying a high tension to said electrodes, means for supporting at least one of said electrodes on each side laterally of the object to be coated, means for supporting at least one electrode above said object, means for moving said lateral supporting means upwardly and downwardly, means for moving said upper supporting means back and forth in a direction transverse to said object, said moving means comprising a separate operating mechanism for each electrode, and means for controlling the operation of said operating mechanisms so that all of said supporting means reciprocate during a spraying operation with at least one of said spray electrodes reversing its direction of movement while another continues moving in one direction, the reciprocating movement of said spray electrode being from one of their end positions to the other at a sufficient distance from each other to prevent mutually disturbing effects of the electric fields of said electrodes.

7. An apparatus for electrostatically spraying large objects with paint, enamel or the like, comprising a plurality of spray electrode units, means for supplying a high electric tension to said units, means for moving said units simultaneously along convergent paths during spraying, said moving means comprising for each said electrode unit a separate driving means continuously movable during spraying operation for positively moving the unit first in one direction and then in the opposite direction along its path, said moving means being so constructed and arranged to control the movement of said units in a positive relation to each other and coordinate their movement to prevent said units from reaching the limiting positions of movement of the units in the direction of convergence along the respective paths at the same time in order to maintain said units at a sufficient distance distance from each other to prevent the electric fields of individual units from disturbing each other during spraying.

8. An apparatus for electrostatically coating large objects with paint, enamel or the like, comprising a plurality of spray electrode units, means for supplying a high electric tension to said units, means for moving said units along converging paths during spraying, said moving means comprising a single motor for driving each of said units first in one direction and then in the opposite direction along its respective path, at least one of said units being driven by said moving means so that its reversal of direction is out of phase with the reversal of another of said units to reduce the inertial load on said motor during each reversal, and means for maintaining said units at a sufficient distance from each other to prevent the electric fields of individual units from disturbing each other during spraying.

9. An apparatus for electrostatically spraying large objects with paint, enamel or the like comprising a plurality of spray electrode units, means for supplying a high electric tension to said units, means for moving said units during the spraying positively and simultaneously along intersecting paths, for controlling the movement of said units in a positive relation to each other, and for maintaining them at a minimum distance from each other, said minimum distance being selected according to the field of high tension of each electrode, said moving means comprising a separate operating mechanism for each of said electrode units, a single motor for synchronously driving all of said units, a gatelike frame for supporting said moving means and said electrode units and adapted to be disposed around the object to be coated, means for moving said frame in the longitudinal direction of said object, all the means required for operating said apparatus being mounted on said movable frame, including motors for driving said moving means and for moving said frame, an electric high-tension generator, at least one container for holding a supply of coating material, and an air compressor driven by a motor for supplying said coating material from said container to said electrode units, so that only a low-tension current has to be supplied to said motors and generator from the outside of said frame for operating the entire apparatus.

10. An apparatus for electrostatically spraying large objects with paint, enamel or the like comprising a plurality of spray electrode units, means for supplying a high electric tension to said units, means for moving said units during the spraying positively and simultaneously along intersecting paths, for controlling the movement of said units in a positive relation to each other, and for maintaining them at a minimum distance from each other, said minimum distance being selected according to the field of high tension of each electrode, said moving means comprising a separate operating mechanism for each of said electrode units, a single motor for synchronously driving all of said units, a gatelike frame for supporting said moving means and said electrode units and adapted to be disposed around the object to be coated, means for moving said frame in the longitudinal direction of said object, stationary supporting rails at each side of said frame, said frame having vertically extending side arms and a cross arm connecting the arms at their upper ends, rollers rotatably mounted on said frame near the upper end thereof and resting on said rails for supporting said frame so that said side arms are freely suspended, and means for rotating at least some of said rollers so as to move said frame along said rails.

11. An apparatus for electrostatically spraying large objects with paint, enamel or the like comprising a plurality of spray electrode units, means for supplying a high electric tension to said units, means for moving said units during the spraying positively and simultaneously along intersecting paths, for controlling the movement of said units in a positive relation to each other, and for maintaining them at a minimum distance from each other, said minimum distance being selected according to the field of high tension of each electrode, said moving means comprising a separate operating mechanism for each of said electrode units, a single motor for synchronously driving all of said units, a gatelike frame for supporting said moving means and said electrode units and adapted to be disposed around the object to be coated, means for moving said frame in the longitudinal direction of said object, a stationary housing around said frame, supporting rails mounted on and extending longitudinally within said housing at each side of said frame, said frame comprising supporting members extending longitudinally of said rails, cross arms connecting said members, rollers rotatably mounted on said frame near the upper end thereof and resting on said rails for supporting said frame thereon, driving means connected to at least some of said rollers for moving said frame along said rails, side arms depending from said supporting members near each end thereof and terminating above the ground, supporting platform means connecting said side arms at each side of said frame, an electric high-tension generator, at least one container for holding a supply of coating material, and an air compressor for supplying said coating material from said container to said electrode units, said generator, container, and compressor being mounted on said platform means.

12. An apparatus for electrostatically spraying large objects with paint, enamel or the like comprising a plurality of spray electrode units, means for supplying a high electric tension to said units, means for moving

said units during the spraying positively and simultaneously along intersecting paths, for controlling the movement of said units in a positive relation to each other, and for maintaining them at a minimum distance from each other, said minimum distance being selected according to the field of high tension of each electrode to prevent undesirable mutual interference between electrodes during a spraying operation, said moving means comprising a separate operating mechanism for each of said electrode units, a single motor for synchronously driving all of said units, and means for automatically initiating and stopping the operation of said operating mechanisms, said electrode units, and said motor in accordance with predetermined relative movement between the object to be coated and the spraying apparatus.

13. An apparatus for electrostatically spraying large objects with paint, enamel or the like comprising a plurality of spray electrode units, means for supplying a high electric tension to said units, means for moving said units during the spraying positively and simultaneously along intersecting paths, for controlling the movement of said units in a positive relation to each other,

and for maintaining them at a minimum distance from each other, said minimum distance being selected according to the field of high tension of each electrode to prevent undesirable mutual interference between electrodes during a spraying operation, said moving means comprising a separate operating mechanism for each of said electrode units, a single motor for synchronously driving all of said units, a gatelike frame for supporting said moving means and said electrode units and adapted to be disposed around the object to be coated, means for moving said frame in the longitudinal direction of said object, and means for automatically initiating and stopping the operation of the entire apparatus including the means for moving said frame in accordance with predetermined relative movement between the object to be coated and said apparatus.

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