

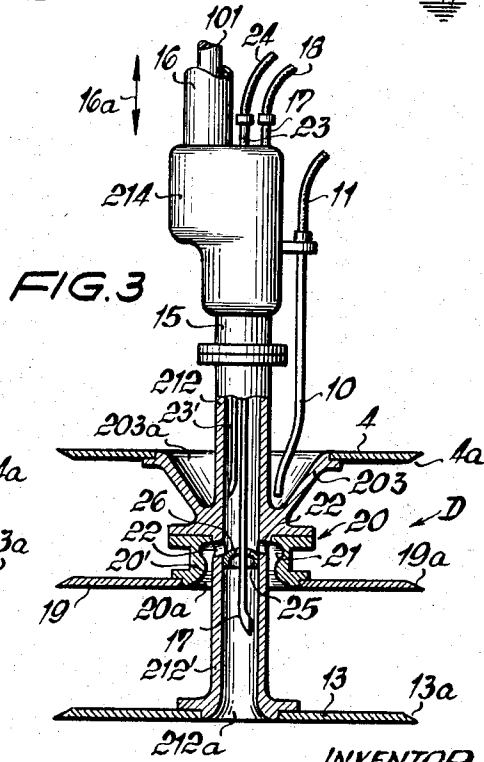
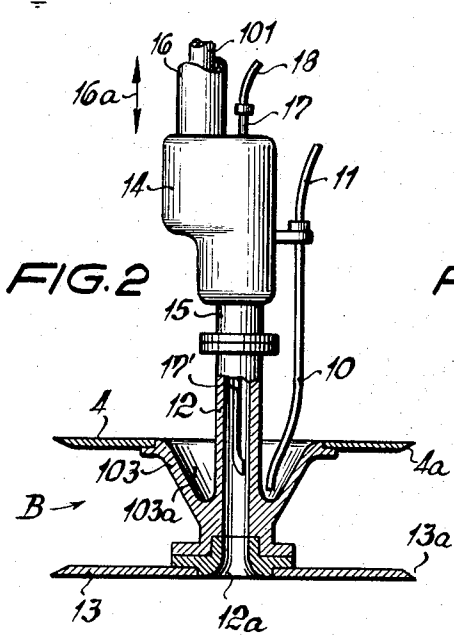
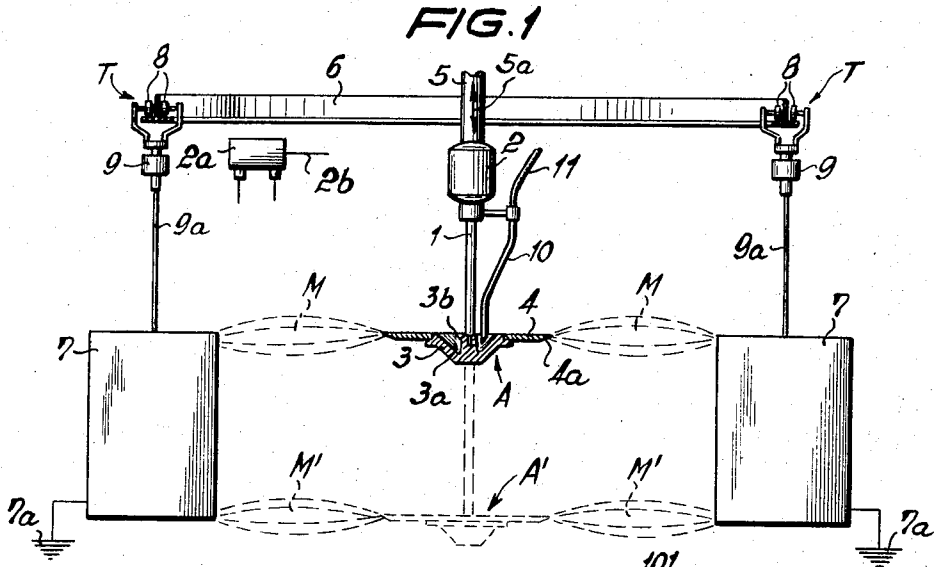
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PAINTING APPARATUS

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PAINTING APPARATUS

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The present invention relates to painting apparatus in general, and more particularly to a painting or spraying apparatus which applies coats of finely atomized paint to two or more articles at a time. Apparatus to which my invention pertains may be utilized for spraying lacquer onto housings of domestic or commercial ice-boxes and similar bulky articles.

In painting apparatus which spray liquids, such as lacquer to another type of paint, the liquid must be subjected to an exceptionally fine atomizing action to make sure that the coats formed by atomized material are of uniform thickness and of eye-pleasing appearance. As a rule, such apparatus utilize revolving blades or disks which transformer films of liquid into sprays or mists of finely atomized particulate matter which is hurled against the surface to be painted. It was found that the formation of a uniform spray depends mainly on the rate at which the liquid is being fed to one or more revolving disks or blades. Even small fluctuations in the rate at which the liquid is admitted to the revolving blades or disks will result in the formation of a film of non-uniform thickness and, on atomization, such films will yield sprays or mists which contain outsized droplets and which are not suited for precision coating of articles with lacquer or certain other types of paint.

Accordingly, it is an important object of my invention to provide an improved painting or spraying apparatus wherein the liquid is invariably fed in such a way that it forms one or more films of absolutely constant thickness so that such film or films may be atomized and thereby transformed into mists or sprays which contain particles of equal size and do not contain any outsized droplets.

Another object of the invention is to provide a painting or spraying apparatus of the just outlined characteristics which can form two or more types of sprays at a time, which can apply two or more types of liquid at a time, and which can be rapidly converted from spraying of one type to spraying of another type of paint or another liquid.

A further object of the invention is to provide a painting or spraying apparatus which embodies a novel centrifugal distributor, wherein such distributor may simultaneously form and apply two, three or more annular sprays, and wherein each of such sprays consists of identically atomized particles.

An additional object of the invention is to provide an electrostatic painting or spraying apparatus of the above outlined characteristics which is especially suited for large-scale lacquering of bulky articles, such as housings for ice boxes, and wherein all sides of two or more bulky articles may be coated in a continuous operation.

A concomitant object of my instant invention is to provide a novel receptacle for use in the centrifugal distributor of a painting or spraying apparatus which embodies the above outlined features and advantages.

A further object of the invention is to provide a novel supply system which feeds accurately metered quantities of liquid to two or more receptacles of the improved distributor.

An additional object of the invention is to provide a painting or spraying apparatus wherein the distributor may be readily taken apart and reassembled with little loss

in time so that each of its components may be subjected to thorough cleaning, especially when the apparatus is to be converted from spraying one type of liquid to applying coats which consist of another type of liquid.

Briefly stated, one feature of my invention resides in the provision of an apparatus for applying coats of atomized paint or other liquid or liquefied material, preferably in an electrostatic field and preferably simultaneously to the surfaces of two or more bulky articles. In its simplest form, the apparatus comprises a centrifugal distributor including a rotary receptacle and an annular washer-like sprayer or atomizer which is rigid with and surrounds the receptacle. The receptacle has an end face provided with an annular chamber which includes an inner annular portion distant from the sprayer. The apparatus further comprises supply means for supplying liquid into the inner portion of the annular chamber and drive means for rotating the distributor at high speed so that the liquid entering the inner portion of the annular chamber is subjected to the action of centrifugal force and overflows radially outwardly to form a film of constant thickness which flows along and is atomized at the periphery of the sprayer.

If the distributor comprises two or more receptacles and an equal number of sprayers, one of the receptacles is provided with an axial bore through which the liquid is supplied to the chambers of the other receptacles.

The novel features which are considered as characteristic of the invention are set forth in particular in the appended claims. The improved painting apparatus itself, however, both as to its construction and its mode of operation together with additional features and advantages thereof, will be best understood from a perusal of the following detailed description of certain specific embodiments with reference to the accompanying drawings, in which:

FIG. 1 is a diagrammatic side elevational view of a painting apparatus for housings of ice boxes which embodies one form of my invention and whose centrifugal distributor comprises a single sprayer, the distributor being shown in axial section and in two end positions one of which is indicated by phantom lines;

FIG. 2 is an enlarged fragmentary side elevational view of a modified painting apparatus with a duplex (two-sprayer) distributor which is shown in axial section; and

FIG. 3 is a similar fragmentary side elevational view of a third painting apparatus comprising a triplex (three-sprayer) distributor which is shown in axial section.

Referring to FIG. 1, there is shown an electrostatic painting or spraying apparatus which comprises a simple centrifugal distributor A and a drive including a vertical shaft 1 serving to rotate the distributor about a fixed axis. The shaft 1 is driven by a variable-speed electric motor 2 and its lower end is connected with the central portion of a dish-shaped or funnel-shaped receptacle 3 which forms part of the distributor A. The distributor further comprises a flat annular washer-like spraying element 4, hereinafter called sprayer or atomizer, which is affixed to the periphery of and extends radially outwardly from the receptacle 3. If desired, the sprayer 4 and its receptacle 3 may form an integral one-piece unit, and the peripheral portion of the sprayer is provided with a sharp annular edge 4a which is located in the plane of the top face of this member. The cross sectional area of the annular chamber 3a in the top face of the receptacle 3 increases outwardly and upwardly, and this chamber 3a surrounds a concentric hub 3b which is secured to the lower end of the shaft 1.

The motor 2 is mounted at the lower end of a reciprocable push rod 5 which forms part of a reciprocating mechanism serving to move the shaft 1 up and down (see

the double-headed arrow 5a) so that the distributor A can move between the solid-line position and the phantom-line position A' of FIG. 1. For example, the push rod 5 may form part of a double-acting hydraulic or pneumatic cylinder-and-piston unit, or this push rod may be provided with a rack which is driven by a reversible pinion, not shown.

The painting apparatus of FIG. 1 further comprises a conveyor which is utilized to advance a series of articles 7, here shown as housings for household ice boxes, and to change the angular position of such articles not only with reference to the axis of the shaft 1 but also with reference to the vertical axis of each individual article. The conveyor comprises a fixed arcuate guide rail 6 which forms a loop or a complete annulus about the distributor A. The articles 7 are suspended on trolleys or dollies T whose wheels 8 are guided by the lower flange of the rail 6 which, in the embodiment of FIG. 1, is of inverted T-shaped profile. The trolleys T are driven by a mechanism, not shown, in such a way that each article 8 completes one-half, three-fourths or even a complete circle about the distributor A. Each trolley T further comprises a spinning or turning device 9 which causes the respective article 7 to spin about the axis of a suspension rod, cable or cord 9a so that, when the distributor A travels up and down in response to reciprocation of the push rod 5, the articles orbit in the path defined by the fixed rail 6 and each article is caused to rotate about the axis of the respective rod, cord or cable 9a. If the articles 7 are housings for ice boxes of rectangular cross section, the spinning devices 9 will turn such housings at regular intervals and always through an angle of 90 degrees so that each exposed surface of each housing is coated with a layer of paint in a fully automatic way. The control system which regulates the operation of the push rod 5 and of the spinning devices 9 is preferably such that the reciprocatory movements of the distributor A and/or the angular movements of the articles 7 may be continuous or intermittent and are carried out at any desired speed.

The source which supplies lacquer or another type of paint to the annular chamber 3a of the receptacle 3 comprises a rigid vertical pipe 10 which is secured to the housing of the motor 2 and receives a stream of paint through a flexible hose 11 leading to a tank, not shown. The discharge end of the pipe 10 extends into the annular inner or bottom portion of the chamber 3a, i.e., into a portion located close to the lowermost portion of the hub 3b and distant from the sprayer 4.

In operation, the motor 2 drives the shaft 1 at high speed which may be a multiple of 1,000 r.p.m. The pipe 10 does not rotate with the shaft 1 but is compelled to share all reciprocatory movements of the distributor A which latter rotates at the speed of the shaft. The paint which enters the inner portion of the chamber 3a is subjected to the action of centrifugal force and overflows from the chamber to form a thin layer or film which creeps along the outwardly diverging surface surrounding the chamber 3a and thereupon along the coplanar horizontal top end faces of the parts 3, 4 so as to be transformed into a very fine spray or mist M which is propelled against the nearest surfaces of the articles 7. The distribution of paint is very uniform and the sharp annular edge 4a also contributes to greater uniformity of the spray M. As the distributor A travels toward or away from its lower end position A', the spray M also travels toward and away from the phantom-line position M' and provides the surfaces of the articles 7 with coats of uniform thickness.

The speed of the push rod 5 may be selected in such a way that the mist M forms a satisfactory coat along one side of each article 7 at the time the distributor A completes a downward stroke and a return stroke, i.e., while the distributor travels from the solid line position to the phantom-line position A' and back to the solid

line position. While the articles 7 and their trolleys T travel along the fixed guide rail 6, the spinning devices 9 may be operated continuously or at regular intervals so that all sides of each article are coated with a uniform layer of laquer or other type of paint while each article travels along the rail 6 through an angle of 180 degrees, 270 degrees or more. The rate at which the pipe 10 delivers paint into the chamber 3a is also selected in such a way that the material which is sprayed by the distributor A during a predetermined interval of time suffices to form a satisfactory coat on each of the articles 7. It is clear that the painting apparatus of FIG. 1 may and normally does comprise a large number of trolleys T so that the distributor A can paint a corresponding number of articles 7 at a time.

The spraying action of the distributor A may be improved if the particles forming the mist M travel in an electrostatic field, especially if the paint is a lacquer consisting of synthetic plastic material. The distributor A is then connected to one pole of a source 2a of high-voltage D-C current (see the conductor 2b) and the articles 7 are grounded as shown at 7a. The electrostatic field between the distributor A and the articles 7 enhances the atomization of particles which form the spray M and assists such particles in advancing toward the nearest surfaces of the articles.

The painting apparatus of FIG. 1 may utilize an exceptionally simple and inexpensive drive because the output shaft 1 of the motor 2 may be coupled directly to the receptacle 3. In many presently known spraying apparatus, the output shaft of the motor is eccentric with reference to the distributor because the distributor receives paint through a revolving supply pipe which is coaxial therewith. Therefore, the driving connection between the motor and the distributor of such conventional apparatus invariably comprises a bulky, complicated and expensive transmission.

FIG. 2 shows a portion of a modified painting apparatus whose duplex distributor B comprises two flat washer-like sprayers 4 and 13. The hub of the upper receptacle 103 is formed as a vertical tube 12 and the second sprayer 13 is coaxially secured to the lower end of this tube. The annular surface bounding the outlet 12a at the lower end of the tube 12 flares radially outwardly with a smooth transition into the lower end face of the sprayer 13. The upper end of the tube 12 is provided with an annular flange which is coupled to a similar flange at the lower end of a vertical output shaft 15 forming part of a variable-speed transmission 14. The motor 2 (not shown in FIG. 2) drives the input shaft 101 of the transmission 14 and the input shaft 101 is reciprocable up and down as indicated by a double-headed arrow 16a. The shaft 101 is surrounded by a sleeve 16 which consists of insulating material. The sleeve 16 constitutes a rigid non-rotary connector between the housing of the motor 2 and the case of the transmission 14 and serves to reciprocate the distributor B in response to reciprocation of the push rod 5, not shown in FIG. 2.

The annular chamber 103a in the upper end face of the receptacle 103 receives paint through the pipe 10 which is fixed to the discharge end of a flexible hose 11. The second sprayer 13 receives paint through a rigid conduit 17 which extends through the case of the transmission 14 and includes a nozzle 17' non-rotatably extending into the axial bore of the tube 12. The orifice of the nozzle 17' discharges against the internal surface of the tube 12 so that the paint flows downwardly toward and along the lower end face of the lower sprayer 13 and forms a mist or spray as soon as it leaves the annular edge 13a of the lower sprayer. The upper end of the conduit 17 receives paint from a flexible hose 18. The hoses 11 and 18 may but need not deliver the same type of paint. The orifice of the nozzle 17' is preferably but need not be located in close proximity to the lower end face of the sprayer 13. Uniform distribution of paint which issues

from the orifice of the nozzle 17' begins along the internal surface of the lower end face of the sprayer 13 where the paint forms a thin film of constant thickness which is atomized as soon as it leaves the annular edge 13a. The atomizing action of the upper sprayer 4 is the same as described in connection with FIG. 1. The distributor B may be connected to a source of high-voltage D-C current in the same way and for the same purpose as described in connection with FIG. 1.

Referring finally to FIG. 3, there is shown a portion of a further painting or spraying apparatus including a triplex distributor D. This distributor is provided with the sprayers or atomizers 4, 13 and with a third or median annular sprayer or atomizer 19 which is located at a level intermediate the sprayers 4 and 13. As shown in FIG. 3, the distance between the planes of the sprayers 4 and 13 may exceed the distance between the planes of the sprayers forming part of the distributor B.

The construction of the transmission 214 whose output shaft 15 is drivingly coupled to a vertical tube 212 of the distributor D is the same as that of the transmission 14 shown in FIG. 2. However, the case of the transmission 214 supports a further rigid conduit 23 which receives paint from a flexible hose 24 and whose nozzle 23' discharges such paint against the internal surface of the tube 212 for delivery to the annular edge 19a of the median sprayer 19. The tube 212 comprises a downward extension 212' which carries the lower sprayer 13 and whose outlet 212a feeds a film of paint for delivery to the annular edge 13a.

The median sprayer 19 is carried by an annular attachment or nipple 20 which is affixed to the receptacle 203 and/or to the tube 212 and whose internal surface surrounds an annular groove 21 located radially outwardly of and surrounding several discharge ports 22 in the wall of the tube 212. The outlet 20a at the lower end of the nipple 20 communicates with the groove 21 and the surface which surrounds the outlet 20a flares downwardly and outwardly with a smooth transition into the lower end face of the median sprayer 19. The orifice of the nozzle 25 is located at a level above the discharge ports 22 so that the stream of paint delivered by the conduit 23 flows for a while along the internal surface of the tube 212 before it is caused to pass through such ports and into the annular groove 21. The hoses 11, 18 and 24 may but need not deliver the same type of paint, and the distributor D may be connected with a source 2a of high-voltage D-C current in the same way as described in connection with FIG. 1.

It will be seen that the nipple 20 actually constitutes a receptacle for delivery of paint to the annular edge 19a of the median sprayer 19, and that the annular chamber (including the groove 21 and the outlet 20a) of this receptacle 20 again receives paint in the bottom or inner zone thereof, i.e., in the groove 21 which receives paint from the discharge ports 22. In other words, the nipple 20 resembles an inverted receptacle 3, 103 or 203. The same holds true for the extension 212' of the tube 212 whose lower end portion constitutes an inverted receptacle for the paint which is supplied to the annular edge 13a of the lowermost sprayer 13. The outlet 212a is comparable to an annular chamber whose bottom or inner portion (actually the uppermost portion) receives paint which trickles along the internal surface of the extension 212'. The paint-conveying end face of the sprayer 4, 13 or 19 is invariably located at the maximum-diameter end of the respective annular chamber because the paint which enters such chambers is subjected to the action of centrifugal force and flows toward and beyond the maximum-diameter end of the chamber. In the chamber 203a, the paint delivered by the pipe 10 flows upwardly and toward the upper end face of the sprayer 4. On the other hand, paint which enters the outlets 20a and 212a flows downwardly and outwardly to advance along the lower end faces of the sprayers 19 and 13.

The apparatus of FIG. 3 may comprise a distributor with four or more sprayers. In such distributors, the tube 212 will be provided with two or more sets of ports 22 and supports two or more nipples 20.

When the painting apparatus of FIG. 3 is in actual use, the sprayers 4 and 13 receive films of lacquer or another paint in the same way as described in connection with FIG. 2. The hose 24 feeds a third stream of paint to the conduit 23 whose nozzle 23' discharges against the internal surface of the tube 212 above the ports 22. The tube 212 rotates at high speed to drive the sprayers 4, 13 and 19, the receptacle 203, and the nipple 20. Therefore, the paint issuing from the orifice of the nozzle 23' is subjected to the action of centrifugal force and is expelled through the ports 22 to accumulate in the annular groove 21. Once the groove 21 is filled, the overflowing paint travels along an internal annular bead 20' and through the outlet 20a of the nipple 20 to form a film of constant thickness which advances toward and is atomized along the edge 19a of the median sprayer 19.

The tube 212 further accommodates an apertured intercepting device in the form of an inverted cup-shaped baffle or stop 25 which is telescoped into the bore of the tube 212 directly below or close to the discharge ports 22. The baffle 25 collects paint which issues from the nozzle 23' and fails to pass immediately through the ports 22, particularly such paint which travels along the internal surfaces of ribs or webs between the ports. The top faces 26 of the baffle preferably resembles a cone or hemisphere which diverges downwardly and outwardly to direct the paint into the ports 22. Any fluctuations in the rate of outflow of paint through the ports 22 (such as might be due to the collecting action of the top face 26 on the baffle 25) are compensated for by the annular groove 21 which collects the paint and allows a uniform annular film to descend along the internal surface of the bead 20' and on toward the outlet 20a. The nozzle 17' of the conduit 17 passes through a centrally located aperture of the baffle 25.

A very important advantage of multiplex distributors, such as the distributor B or D, is that they can atomize large quantities of paint per unit of time. For example, the output of the distributor D shown in FIG. 3 may be exactly three times the output of the distributor A. Thus, the distributor D may be utilized in painting apparatus wherein an exceptionally large number of articles may be provided with layers of lacquer or the like in a simultaneous operation and at the same rate as or faster than in the apparatus of FIG. 1.

As stated above, the painting apparatus utilizing the distributor B may but need not spray two different types of paint, and the distributor D may spray as many as three types or colors of paint. If two or more types of paint are used, the sprays or mists formed by the sprayers 4, 13 or 19 may be mixed on the surfaces of the articles 7 so as to change the color of the ultimate coat or to form a multicolored coat.

If the painting apparatus utilizes a distributor with two or more sprayers which atomize different types or colors of paint, the individual sprayers may be driven at different speeds. For example, and referring to FIG. 2, the lower sprayer 13 may be driven by a second transmission located below the distributor B, or the transmission 14 may comprise two coaxial output shafts which are driven at different speeds and each of which is coupled to one of the sprayers 4 and 13.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can, by applying current knowledge, readily adapt it for various applications without omitting features which fairly constitute essential characteristics of the generic and specific aspects of my contribution to the art and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be secured by Letters Patent is:

1. In an apparatus for applying coats of atomized liquid paint, particularly lacquer, and including a centrifugal distributor having an elongated upright rotary shaft, at least one first distributor disk rigid and coaxial with said shaft and including a horizontal upper endface provided with a substantially funnel-shaped central first recess having a lower end and being adapted to receive liquid paint, and a paint-supply tube extending along said shaft into said recess and having an opening located in the region of said lower end for discharging liquid paint into said recess, the improvement consisting in providing said shaft as a hollow shaft extending through said lower end of said recess and downwardly beyond said first disk; at least one second distributor disk rigid with said hollow shaft downwardly spaced from said first disk and also having an endface provided with a second recess, said hollow shaft being constructed and arranged so that the interior thereof communicates with said second recess; and supply means for supplying paint through said paint-supply tube into said first recess, and through said hollow shaft into said second recess.

2. In an apparatus as defined in claim 1; further comprising at least one third distributor disk rigid with said hollow shaft intermediate said first and second disks and having a substantially horizontal endface provided with a third recess; and at least one port provided in said hollow shaft and communicating with said third recess for supplying paint thereinto.

3. In an apparatus as defined in claim 2, wherein said endface is a lower endface of said distributor disk, and wherein said third recess is provided inwardly of said lower endface with an annular groove which surrounds said port for receiving and evenly circumferentially distributing paint issuing from said port, said third recess having a cross-section which converges and thereupon diverges in the direction from said annular groove toward said lower endface.

4. In an apparatus as defined in claim 2, and further comprising an annular base member arranged within said hollow shaft below the level of said port and operative for intercepting paint advancing through said hollow shaft and for guiding the intercepted paint to said port.

5. In an apparatus as defined in claim 3, wherein said endface is a lower endface of said third distributor disk, and wherein said third recess is provided inwardly of said lower endface with an annular groove which surrounds said port for receiving and evenly circumferentially distributing paint issuing from said port, said third recess having a cross-section which converges and thereupon di-

verges in the direction from said annular groove toward said lower endface.

6. In an apparatus for applying coats of atomized paint, a centrifugal distributor including an elongated vertical tube, a pair of annular receptacles rigid with and surrounding said tube, a third annular receptacle rigid with the lower end of said tube, each of said receptacles having an end face provided with an annular chamber and each of said chambers having an inner annular portion nearer to the axis of said tube, said tube further having at least one port communicating with the inner portion of the chamber in one receptacle of said pair of receptacles and said one receptacle being located at a level between the other two receptacles, and three annular sprayers each rigid with and each surrounding one of said receptacles; first supply means for supplying paint to the inner portion of the chamber in the other of said pair of receptacles; second supply means for supplying paint through the upper end of said tube and to the inner portion of the chamber in said third receptacle; third supply means for supplying paint through the upper end of said tube and through said port to the inner portion of the chamber in the one of said pair of receptacles; baffle means provided in said tube beneath said port for intercepting such paint which is delivered by said third supply means and fails to pass through said port; and drive means for rotating said distributor so that the paint entering said chambers is subjected to the action of centrifugal force to overflow radially outwardly along and to be atomized at the peripheries of the respective sprayers.

7. A structure as set forth in claim 6, wherein said baffle means comprises an annular portion having a top face which slopes outwardly and downwardly to guide the intercepted paint to said port and wherein said second supply means comprises a tubular portion extending through and downwardly beyond the annular portion of said baffle means.

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