Sept. 15, 1964 M. A. R. POINT 3,148,832

LIQUID SPRAY COATING DEVICE

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Fig.1

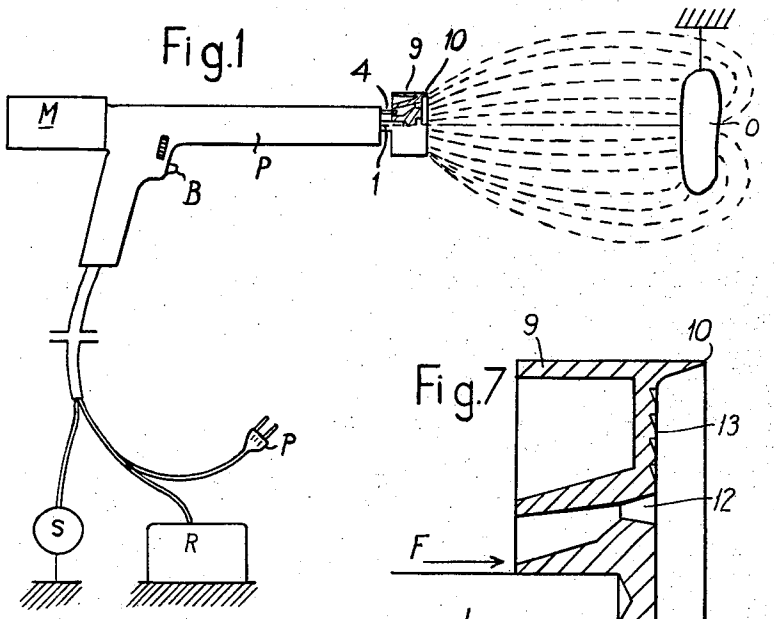

Fig.7

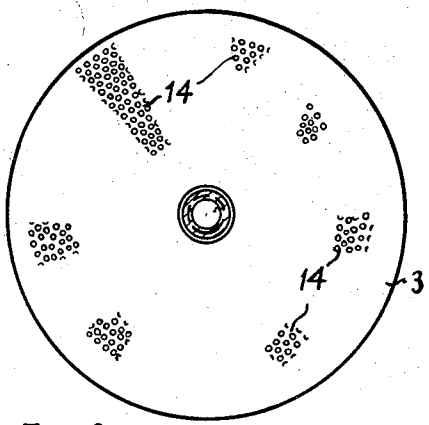

Fig.8a

Fig.8b

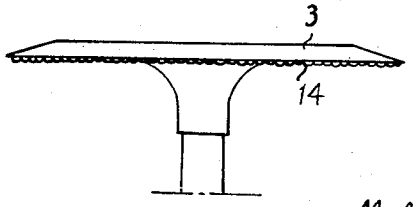

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Fig.2

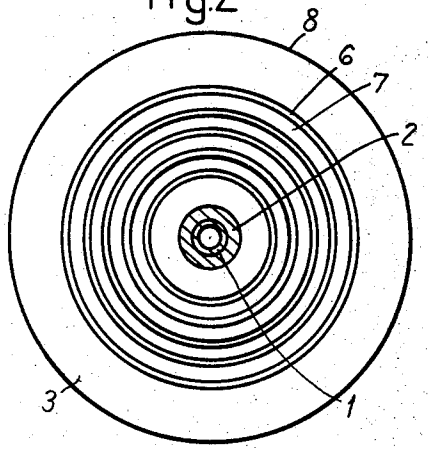


Fig.3

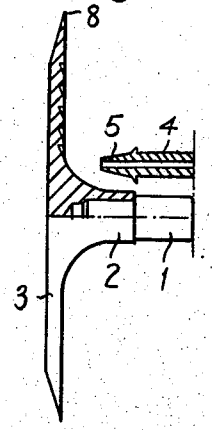


Fig.4

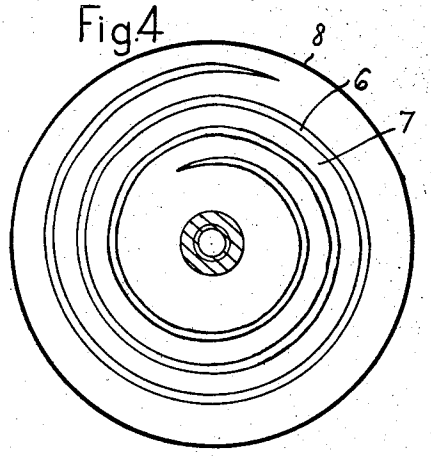


Fig.5

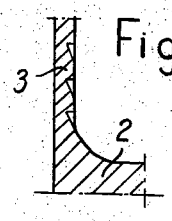
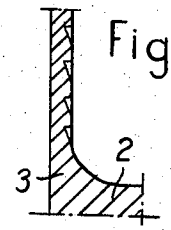


Fig.6



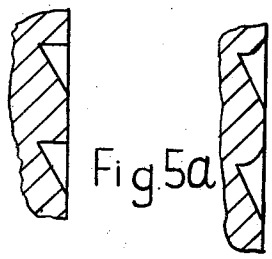


Fig.5a

Fig.6a

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LIQUID SPRAY COATING DEVICE

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Claims priority, application France June 23, 1961
13 Claims. (Cl. 239—15)

This invention relates to liquid spray coating devices of the type comprising a centrifugal sprayer member or head to which a rapid rotation is imparted and having a generally radial surface against which a stream or jet of liquid to be sprayed (e.g. paint) is directed; the liquid on striking the revolving surface progresses radially outwardly thereover under centrifugal force towards a sharp annular peripheral edge of the member at which it is divided into fine particles so that it leaves the outer periphery of the sprayer head in the form of a spray.

Sprayer heads of this type are widely used in various coating processes, especially electrostatic coating processes. In this latter application, the sprayer head is connected to a high D.C. voltage so that the spray particles on moving past the peripheral edge of the sprayer are charged to a high electrostatic potential. The resulting ionized or electrostatically charged cloud of particles is then attracted to and settles on the surface of the work to be coated, usually maintained at ground potential.

Centrifugal sprayer heads of the type specified above have been in wide use for many years and have been constructed in many different forms, e.g. as flat radial discs, and bell- and cup-shaped members of various contours. The applicant's experience in this connection has shown that in many cases the performance of such centrifugal sprayers tends to be impaired by a certain amount of unevenness or irregularity in the rate of discharge of the liquid spray from various points around the periphery of the sprayer head. This is especially true in cases where the sprayer head is so constructed that the jet of liquid strikes the rear radial surface of the rotary head at a point off-centre from the axis of rotation thereof, as is frequently the case. Apart from this source of irregular discharge however, minute unevenness in the surface condition of the sprayer head, which is unavoidable in practice, as well as cyclic fluctuations in the rotational velocity, and other causes, all tend to result in the above-mentioned irregular discharge of spray. Certain areas of the discharged cloud tend to be overloaded with liquid while others are deficient in liquid. The efficiency of the coating operation is thereby impaired.

It is an object of this invention to provide an improved centrifugal liquid sprayer which will operate to supply a substantially even homogeneous spray under all circumstances. An object of this invention is to provide such a centrifugal liquid sprayer especially suitable for electrostatic spray coating operations.

The invention will now be further described, by way of example, with reference to the accompanying drawings, wherein

FIGURE 1 is a simplified and partially schematic view of an electrostatic spray-gun equipped with an improved centrifugal sprayer head according to this invention;

FIGURE 2 is a larger-scale view of one embodiment of an improved sprayer head as seen from the rear;

FIGURE 3 is a corresponding axial view, partly in section, showing the improved sprayer head together with parts of its drive shaft and the liquid discharge nozzle;

FIGURE 4 is similar to FIG. 2 and shows a modified form of the invention;

FIGURES 5 and 6 are partial axial cross sections illustrating two different modifications in the contour of the improved sprayer head,

FIGURES 5*a* and 6*a* show perspectively a portion of each of FIGURES 5 and 6 further enlarged,

FIGURE 7 illustrates a further form of centrifugal sprayer head to which the invention has been applied, and

FIGURES 8*a* and 8*b* are respectively a plan view and a side view of a further embodiment of sprayer head.

Referring to FIG. 1, an electrostatic spray gun is shown in general outline at P. The gun supports a small electric motor M at its rear end, and a shaft 1 rotated by said motor extends along the longitudinal dimension of the gun and projects from its front end, where a centrifugal sprayer head 9 is secured thereon, to be more fully described hereinafter with reference to FIG. 7. A nozzle 4 projecting from the front end of the spray gun P in parallel spaced relation to shaft 1 serves to discharge a jet of coating liquid, e.g. paint, on to a radial surface of the sprayer head 9 as will be later described. The nozzle 4 is connected through the body of the spray gun and a flexible hose connection with a reservoir R of the coating liquid, suitable pumping means, not shown, being provided for discharging the liquid under suitable pressure through the nozzle 4. As will also be later described in detail, the sprayer head 9, which is of conductive material, is formed with a sharp annular forward edge 10 serving as an ionizing electrode, and is maintained at a high D.C. potential e.g. 90 kilovolts, by connection of the sprayer head with a D.C. supply source S through a flexible connector cable extending from the spray gun. A suitable low voltage connection, not shown, is present between source S and motor M to energize the motor and impart rapid rotation to the sprayer head 9. At P is indicated a plug connector for connecting the high-voltage D.C. source S to a suitable source of energy e.g. the A.C. main supply.

The general operation of such an electrostatic spray coating system will now be described. In brief, actuation of a finger control, such as a trigger or the push-button B shown, associated with the spray-gun P, energizes motor M to rotate sprayer head 9, applies a high D.C. potential from source S to the ionizing electrode 10 and delivers coating liquid from reservoir R to the nozzle 4. The liquid jet from the nozzle on reaching a radial surface of sprayer head 9 creeps radially outward over said surface and is discharged into the surrounding atmosphere at the periphery of said head in the form of a finely divided spray. As the spray particles move past the ionizing edge 10 of the sprayer head prior to being thrown off it into space, they are charged to a high electrostatic potential. The resulting cloud of electrostatically charged particles then travel through the air towards the surface of an object O to be coated, near which the spray gun P is held by the operator, which object is electrically conected to ground as shown. The highly charged liquid particles are strongly attracted to the surface of the object O by electrostatic attraction and settle on to all exposed areas of said surface without substantially straying away.

In practice it has been found that the particle density in the ionized cloud leaving the sprayer head is not always as even and homogeneous as would be desired. This may be due to various causes, such as the off-centre position of nozzle 4 relative to the axis of the sprayer head, and/or to surface irregularities in the sprayer head, and/or cyclic variations in the rotational speed of the head. As a result the precipitation of the liquid particles

over the work surface also tends to be irregular unless the operator exerts special care in wielding the spray-gun, thereby rendering the coating process more difficult and lengthy and more dependent on skilled personnel.

In accordance with the invention, it has been found that these objectional conditions can be substantially entirely eliminated by providing the centrifugal sprayer head with means creating obstacles against the radial outward flow of the liquid from nozzle 4 as said liquid creeps under centrifugal force along the radial surface of the sprayer head.

Referring to FIGS. 2 and 3, an improved centrifugal sprayer head is there shown embodying the teachings of the invention and comprising a disc 3 including an axial hub portion 2 adapted to be secured by any suitable means on the protruding outer end of the motor shaft 1. The disc 3 has a bevelled outer periphery to provide a sharp annular edge 8 serving to facilitate the discharge of the liquid in the form of a fine spray, and also serving to ionize the spray particles when the sprayer head is connected to a high-voltage potential as earlier described. Shown at 4 is the previously described liquid discharge nozzle provided with an outlet 5 directed against the outwardly curving base portion of the hub 2. In accordance with the invention, the rear surface of the disc 3 is provided with a set of concentric grooves 7 which define intervening ridges 6 between them providing the aforementioned obstacles against the radial flow of the liquid under centrifugal force. Preferably the grooves 7 are so contoured as to include a radially inner wall of relatively low slope and a considerably steeper, e.g. perpendicular, outer wall as shown in FIG. 3. The provision of such obstacles prevents the formation of continuous radial streams of liquid across the rear surface of the sprayer disc 3. Apparently the presence of such continuous, free-flowing streams in conventional centrifugal sprayer heads of this general type rendered the liquid discharge very sensitive to minor causes of irregularity such as the off-centre position of the liquid outlet 5 or the other causes mentioned earlier herein, and was therefore responsible for the uneven distribution of particles in the cloud thrown off from the sprayer head. The provision of the obstacles according to the invention in impeding the formation of free-flowing continuous radial streams or rivulets of liquid apparently imposes a common, substantially uniform rate of flow for the liquid in all radial directions across the surface of the head, which, in practice, virtually completely cancels the influence of any causes of irregularity which operate in the absence of such obstacles. In any case, and regardless of any particular explanatory theory, it is found that the cloud of spray particles discharged from a revolving sprayer head constructed as described herein consistently shows a remarkably high degree of uniformity not found in the smooth sprayer heads of the prior art.

As shown in FIG. 4, instead of the obstacles being provided in the form of concentric grooves and ridges, they may take the form of a spiral groove 7 defining a continuous spiral ridge 6 around the rear face of the sprayer head. The contouring of the spiral groove may, as shown in FIG. 5, and on an enlarged scale in FIG. 5*a*, assume the same sawtooth shape as that described above with refernce to FIG 3. FIG. 6 illustrates a modified contouring of the obstacles of the invention, in which the radially outer side of the groove rather than being straight and perpendicular as in FIGS. 3 and 5, is accurate, commencing at a steep slope and then tapering off towards the surface of the disc. This shape is again shown on an enlarged scale in FIG. 6*a*. It will be understood that the contour of FIG. 6 may also be used in the case of the concentric grooves shown in FIG. 2.

The number and dimensioning of the grooves and ridges shown in FIGS. 2 to 6 may vary considerably depending on the particular application, and on such factors as the consistency and viscosity of the liquid used, the rate of rotation of the sprayer head, and the contouring of the obstacles. Very satisfactory results have been obtained with typical paint compositions and using a standard spray-gun construction with a rotary sprayer disc about 80 mm. diameter, having from four to six concentric grooves according to FIG. 2, or spiral turns according to FIG. 4, contoured ass hown in FIGS. 3, 5 or 6 and having a depth of from 0.5 to 1 mm.

FIG. 7 illustrates the invention as embodied in another type of centrifugal sprayer head, as is depicted on the gun shown in FIG. 1. The sprayer head includes a generally cylindrical outer body 9 formed with a forwardly jutting sharp annular edge 10 as earlier described. The body includes an inner hub portion 11 suitably secured to motor shaft 1. The sprayer head includes a radial, forwardly directed surface 13 normal to the rotational axis of shaft 1 and located somewhat to the rear of the jutting annular edge 10. Between the outer body portion and the hub portion 11 there are a plurality of circumferentially spaced longitudinal channels which connect through apertures 12 with the front radial surface 13. Coating liquid is directed at the rear of the sprayer head as indicated by arrow F through a nozzle 4 similar to that previously described and not shown in FIG. 7. The liquid flows by centrifugal force along the outwardly flared outer surface of the hub portion 11 and issues through the apertures 12 on to the transverse front surface 13. It then creeps outwardly across said surface by centrifugal force and finally reaches the annular edge 10 from which it is thrown out, preferably in the form of ionized spray particles. In accordance with the invention, the front radial surface 13 is formed with obstacles impeding the radial flow of the liquid across it. Such obstacles may assume the form of concentric circular, or spiral, grooves and ridges as described with reference to FIGS. 2 to 6. The operation of the embodiment last described will be immediately apparent from what has been said earlier herein. It is found that the provision of obstacles, such as grooves or ridges, impeding the formation of continuous free-flowing radial streams of liquid along the forwardly directed radial surface 13 in a sprayer head of the type shown in FIG. 7, has the same beneficial effect as the provision of such obstacles upon a rearwardly directed radial surface as in FIGS. 2 and 4. The homogeneity of the resulting cloud of spray is greatly enhanced.

Various other embodiments and modifications may be conceived within the scope of the invention. Thus as shown in FIGURES 8*a* and 8*b* the obstacles, rather than being provided in the form of one or more continuous grooves and/or ridges, may take the form of separate recesses and/or projections 14 on the radial surface of the sprayer, preferably arranged in staggered array thereon so as to prevent positively the formation of continuous rivulets radially along the surface. While in all of the embodiments illustrated the obstacles were shown provided upon a surface extending normally to the rotational axis, this is not essential, provided the surface on which said obstacles are provided has a radial component of direction so that the liquid flowing along it will be subject to centrifugal force. The invention is applicable to centrifugal liquid sprayer heads of other than the two basic forms shown.

I claim:

1. An electrostatic spray coating device comprising a rotary member having a surface generally radial to the axis of rotation of the member, said member having a sharp annular peripheral edge portion of electrically conductive material continuous with said surface, means for maintaining said edge portion at a high electric potential, means for directing a viscous coating composition onto said surface whereby said composition will flow radially outward along the surface by centrifugal force and will be thrown off from said peripheral edge portion as an ionized spray, and means defining generally cir-

cumferentially extending obstacles on said surface, said obstacles all terminating at the same level, for impeding and decelerating the free radial flow of said composition and to improve the circumferential uniformity of said spray.

2. A device as claimed claim 1, wherein said radial surface faces rearwardly of said member and said directing means is positioned rearwardly of said member for causing the composition to strike said surface directly.

3. A device as claimed in claim 1, wherein said radial surface faces forwardly of said member and said directing means is positioned rearwardly of said member, and aperture means are provided through said member communicating with said surface for allowing the composition to pass thereto.

4. A device as claimed in claim 1, wherein said obstacle defining means comprise a plurality of radially spaced concentric grooves of the same depth.

5. A device as claimed in claim 1, wherein said obstacle defining means comprise at least one continuous spiral groove of uniform depth having a plurality of turns.

6. A device as claimed in claim 4, wherein said grooves have a generally sawtooth cross-sectional contour with a radially inwardly directed wall surface of relatively low slope and a radially outwardly directed wall surface of relatively steep slope, whereby to decelerate the radial flow of said liquid.

7. A device as claimed in claim 6, in which the radially outwardly directed wall surface commences with a relatively steep slope which tapers to a shallower slope towards the surface of the disc.

8. A device as claimed in claim 5, wherein said continuous spiral groove has a generally sawtooth cross-sectional contour with a radially inwardly directed wall surface of relatively low slope and a radially outwardly directed wall surface of relatively steep slope, whereby to decelerate the radial flow of said liquid.

9. A device as claimed in claim 8, wherein the radially outwardly directed wall surface commences with a relatively steep slope which tapers off to a shallower slope towards the surface of the disc.

10. An electrostatic spray coating device comprising

a rotary member having a surface generally radial to the axis of rotation of the member, said member having an annular peripheral edge portion of electrically conductive material continuous with said surface, means for maintaining said edge portion at a high electric potential, means for directing a viscous liquid on to said surface whereby the liquid will flow radially outward along the surface by centrifugal force and will be thrown off from said peripheral edge portion as an ionized spray and means defining obstacles on said surface for impeding and decelerating the free radial flow of said liquid without breaking up the liquid, said obstacles all terminating at the same level, whereby to improve the circumferential uniformity of said spray.

11. A device as claimed in claim 10, wherein said means defining obstacles comprise a plurality of separated elements disposed in non-aligned array.

12. A device as claimed in claim 10, wherein said radial surface faces rearwardly of said member and said directing means is positioned rearwardly of said member for causing the viscous liquid to strike said surface directly.

13. A device as claimed in claim 10, wherein said radial surface faces forwardly of said member and said directing means is positioned rearwardly of said member, and aperture means are provided through said member communicating with said surface for allowing said viscous liquid to pass thereto.

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