Sept. 2, 1958 W. E. INGRAM 2,850,322

CENTRIFUGAL SPRAY HEAD

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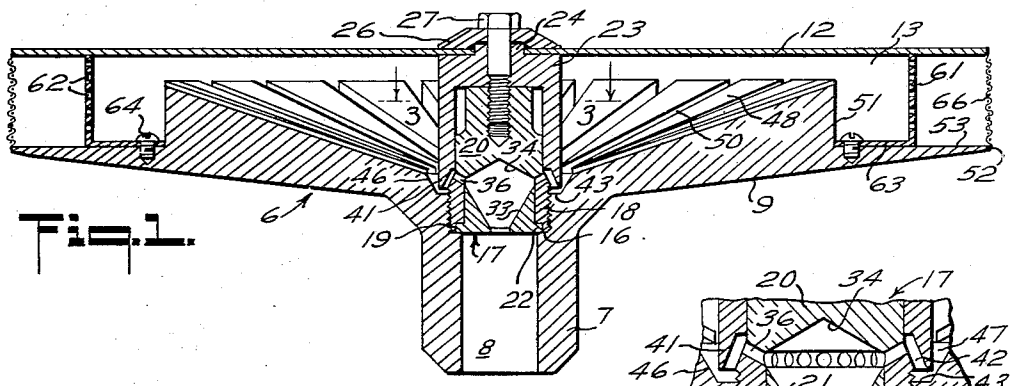


Fig. 1.

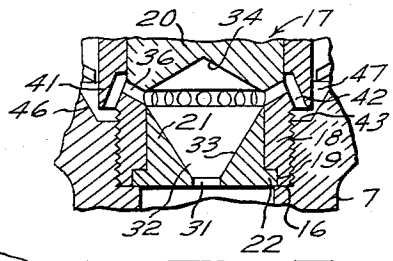
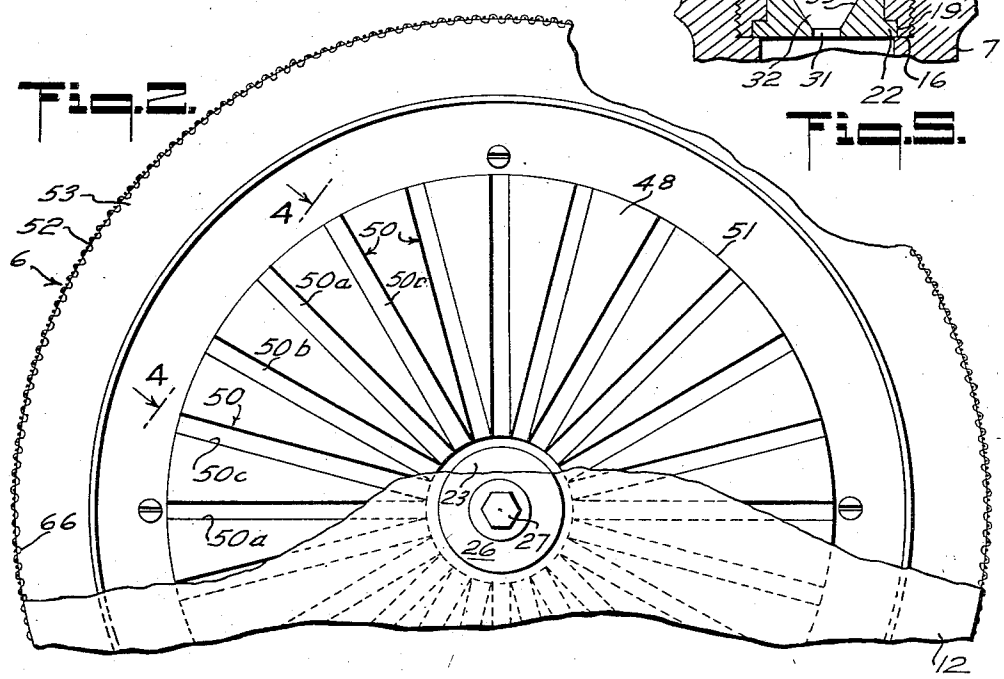


Fig. 5.

Fig. 2.



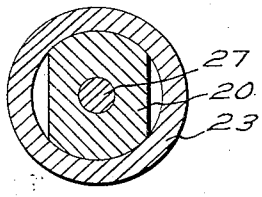


Fig. 3.

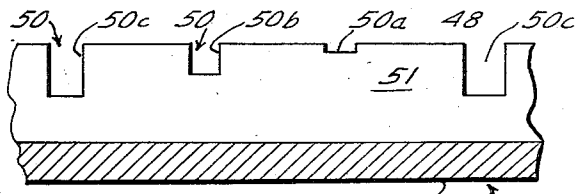


Fig. 4.

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CENTRIFUGAL SPRAY HEAD

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10 Claims. (Cl. 299—63)

This invention generally relates to spray apparatus, and is more particularly directed towards a centrifugal rotor which may be utilized for directing paint, lacquer or other liquids towards and onto the inner peripheral surface of an article positioned thereover.

Centrifugal spray heads or rotors are widely used for any number of purposes, and while the construction of the present invention is particularly well adapted for painting the inner surface of articles such as cylindrical drums or containers, it will later become evident that such construction would also permit its use for other purposes, such as atomizing and the like.

There are many problems attending the spray painting of the inner surface of a container, and certain of these difficulties are discussed in a copending application, Serial No. 479,353, entitled, Liquid Spray Apparatus and Process. In general, such problems include the undesirable entrapment of air, inconsistency of application on the surface, etc. While the apparatus disclosed in said application provided marked improvements over the prior art, It was found difficult to consistently provide uniform coatings on the exposed container surface, and more particularly the applied coating would sometimes possess a thin lined barber pole effect.

Accordingly, it is an object of the present invention to provide a centrifugal spray device in which the liquid is hurled from the rotor in a relatively wide uniform pattern whereby a larger surface area may be coated than with conventional spray heads.

Another object of the invention is to provide apparatus of the character described in which the liquid to be sprayed is uniformly distributed throughout the entire peripheral extent of the rotor so that consistently uniform coatings may be provided.

A further object of this invention is to provide a spray rotor of the character described including an axial liquid feed chamber, in which means are provided for dispersing the liquid from said chamber completely around the liquid supporting surfaces of the rotor.

A still further object of the invention is to provide a spray device as hereinabove referred to in which the liquid moves radially outwardly on the rotor along a plurality of defined paths of different axial positions.

The invention possesses other objects and features of advantage, some of which, with the foregoing, will be set forth in the following description of the preferred form of the invention which is illustrated in the drawing accompanying and forming part of the specification. It is to be understood, however, that variations in the showing made by the said drawing and description may be adopted within the scope of the invention as set forth in the claims.

Referring to said drawing:

Figure 1 is a vertical cross-sectional view of the spray head of the present invention.

Figure 2 is a portional top plan view of the structure shown in Figure 1, with a portion of the cover plate removed to better illustrate details of construction.

Figure 3 is a cross-sectional view taken substantially in the plane indicated by line 3—3 of Figure 1.

Figure 4 is a cross-sectional view taken substantially in the plane indicated by line 4—4 of Figure 2.

Figure 5 is an enlarged sectional view of a portion of the plug member illustrated in Figure 1.

In broad terms, the rotor or spray head of the present invention is designed to receive paint, lacquer or other liquid, effect a uniform distribution of the liquid completely around the rotor chamber, and then centrifugally cast off the liquid in somewhat atomized form in a relatively wide pattern whereby the problems where a narrow paint application is adopted are effectively overcome.

Apparatus to carry out the foregoing is preferably constructed as illustrated in the drawing, and with reference thereto, it will be seen that my improved spray head includes a rotor body, generally indicated by the numeral 6, having a hollow hub 7 integrally formed therewith. As will be understood, the hub is adapted to be connected to a suitable drive shaft through which the paint or other liquid is delivered to the hub bore 8. The lower surface 9 of the rotor preferably forms a small obtuse angle with the hub axis, and the construction of the upper surface, which comprises an important part of the invention, will be hereinafter discussed in detail.

As will be clear from Figure 1, the hub bore 8 extends completely through the rotor body so that the latter is of generally annular form, and a disc-like cover plate 12 overlies the upper surface of the rotor body in spaced relation thereto so as to define a rotor chamber 13 between the cover and body.

Means are provided for distributing the liquid delivered to the hub bore 8 to the rotor chamber in such a manner that throughout the 360 degrees of peripheral extent of the rotor, a uniform quantity of liquid will be present. In this connection, it should be mentioned that with prior spray heads, stroboscopic analysis has indicated that as little as 30 degrees of the rotor chamber received any liquid, and consequently the efficiency of the rotor was seriously impaired. Therefore, to insure uniformity of liquid discharge at the rotor periphery, it is first necessary to insure a uniform delivery of liquid to the rotor. In the present construction, it will be noted that the upper end of the hub bore is diametrically enlarged and threaded, a shoulder 16 being formed at the juncture of the two bores. A plug member 17 is positioned in the enlarged bore, such as by providing an externally threaded sleeve 18 engageable with the threaded bore, the sleeve having an internal groove 19 at the lower end thereof. The lower portion 21 of the plug forms a press fit with the sleeve 18, and a lower radial flange 22 thereof may be inserted within the groove 19 and clamped between the shoulder 16 and the sleeve. The upper end portion 20 of the plug body is provided with an axial tapped bore and overlying such end is a generally inverted cup shaped member 23 having a boss 24 at the top thereof for engagement with a similarly shaped opening at the center of cover 12, and a bore extending axially through the boss and upper web of the member. An apertured cup shaped washer 26 overlies the boss 24 and adjacent cover portions and a threaded lock bolt 27 extends through the washer, member 23 and into the tapped bore of body portion 20 whereby the rotor, cover and plug are all retained in fixed relation to each other.

In connection with the liquid distribution from the hub bore 8 to the rotor chamber, it will be noted that the lowermost edge of plug portion 21 is provided with a central aperture 31 in communication with the bore 8, such aperture also communicating with an enlarged conical chamber 32 formed by the inner wall 33 of the chamber diverging outwardly from the aperture. The

lower surface 34 of plug portion 20 is of inverted conical form with its apex aligned with the axis of aperture 31. A plurality of circumferentially spaced apertures 36 are provided immediately above the plane defined by the wall 33 merging with the inner wall of the sleeve 18, the upper edge surface of the latter being of generally flat frusto-conical shape and forming the lower edge of the respective apertures. By way of example, if the central aperture is ⅜ inch in diameter, some twenty-four apertures 36 of 3/32 inch diameter may be successfully utilized. In other words, the effective cross-sectional area of the apertures 36 should be in excess of that of the inlet aperture 31. To further insure proper liquid distribution, the lower end of member 23 is provided with a flange 41 having an inner wall 42 directly opposed and substantially normal to the axes of apertures 36.

In operation, liquid pumped into hub bore 8 from any suitable source enters through aperture 31 and first engages the inverted conical wall 34 from which it is deflected towards the conical wall 33 and finally through the apertures 36. Emerging from the apertures, the liquid strikes the flange or skirt 41 from which it is directed downwardly through a geenrally inverted frusto-conical passage 42 to engage a generally flat annular surface 43 of the rotor surrounding the hub bore and in spaced relation to the distal end of the flange 41. Thus, the liquid in passing from bore 8 to the surface 43 which forms a portion of the rotor chamber must engage a plurality of angularly related surfaces, resulting in uniform distribution of the liquid over the entire annular surface 43.

The outer periphery of surface 43 is bounded by a short frusto-conical wall 46 disposed at an angle of about thirty degrees from the hub axis. Wall 46 terminates radially outwardly of flange 41 whereby a liquid passage 47 is formed therebetween, and the upper edge of the wall then continues radially outwardly in a relatively flat frusto-conical surface 48 offset approximately seventy degrees from the hub axis.

It might be expected that the liquid emerging from passage 47 would upon rotor rotation, climb up on wall 46 and then move outwardly due to centrifugal force along the rotor surface 48. This, however, would result in the previously mentioned undesirable feature of having the liquid confined in a narrow band upon leaving the rotor. Accordingly, as an important feature of the present invention, selected paths for liquid travel across the rotor are provided so as to materially increase the width of the liquid dispersal pattern and result in superior and more uniform application of the liquid on an article being painted.

With particular reference to Figures 2 and 4 of the drawing, it will be seen that the upper surface 48 of the rotor is provided with a plurality of grooves or slots, generally designated by the numeral 50, and extending radially outwardly from passage 47 to a peripheral axial wall 51 spaced radially inwardly of the periphery 52 of the rotor, a relatively flat surface 53 in parallel relationship to cover 12 extending from the lower edge of the wall to said periphery. Thus, these grooves are each directed radially outwardly and upwardly towards the cover. When liquid emerges from the passage 47, the greater portion thereof will pass through the slots 50 while the surface 48 will remain substantially clear of the liquid. Accordingly, by having the slots of varying depth, the path followed by the liquid in its radial outward movement will have a substantially wider pattern than if the liquid moved along a single surface and a more efficient dispersal and distribution of the liquid results. By way of example, and as best illustrated in Figure 4 of the drawing, slots of three different depths are used, a slot 50*a* being approximately ⅛ inch deep, an adjacent slot 50*b* being approximately ⅜ inch deep, and the next adjacent slot 50*c* being approximately ⅝ inch deep. This pattern of slot depths is continued around the complete periphery of the rotor body whereby the rapidly spinning rotor will cast off the liquid in a pattern approximately ½ inch wide instead of a pencil-line pattern. While these dimensions have been tested and found adequate, it is apparent that other slot depths could be utilized, depending on rotor size, rotational speed, and like factors.

To complete the rotor construction, a perforated annular metal band 61 extending between surface 53 and cover 12 is provided. The apertures 62 therein are in the neighborhood of 0.02 inch in diameter and cover a large portion of the surface thereof so as to provide an open area greatly in excess of the area provided by the liquid inlet openings and passages to the rotor chamber. The band is provided with an inwardly directed radial flange 63 by means of which the band may be secured by screws 64 or the like to surface 53 adjacent wall 51, The band serves to break up relatively large droplets of liquid emerging from the ends of the slots 50; and to further insure adequate dispersion, an annular screen 66 is secured between the cover and rotor body in any suitable manner, the screen being approximately a 25 mesh, and positioned radially outwardly of the band 61. In this manner, the liquid moving radially outwardly along the grooves 50 will pass through the band and screen in a relatively wide path, thereby affording the previously discussed advantages in spray techniques. It will also be appreciated that where the terms "upper" or "lower" were used herein, it was solely with reference to the position of the parts as illustrated, since the rotor could be repositioned for use with the axis thereof horizontal, inclined, etc. without detracting from the operability thereof.

What is claimed is:

1. Spray apparatus including a rotor having a hollow hub and a base extending radially outwardly therefrom, a cover secured to said base in generally parallel spaced relation thereto, means defining a liquid passage from said hollow hub to the space between said base and cover, the surface of said base in opposed relation to said cover being of relatively flat conical configuration, and said surface having a plurality of radially extending slots of varying depth in which liquid may move upon rotor rotation.

2. Spray apparatus including a rotor having a hollow hub and a base extending radially outwardly therefrom, a cover secured to said base in generally parallel spaced relation thereto, means defining a liquid passage from said hollow hub to the space between said base and cover, the surface of said base in opposed relation to said cover being of relatively flat conical configuration, and said surface having a plurality of radially extending slots of varying depth in which liquid may move upon rotor rotation, the slots of the same depth being generally symmetrically positioned on said surface.

3. A spray head including a rotor body having an axially extending hollow hub thereon and a chamber extending generally annularly about the hub, a cover plate disposed in generally parallel spaced relation to said body, an axially extending member positioned between said hub and cover, said member having an axially extending chamber therein with an open end of said chamber in communication with the bore of said hub and another end of said chamber having a generally inverted conical top wall in opposed relation to said open end, said axial chamber adjacent said open end having a generally conical side wall extending towards said top wall, and means defining a plurality of radially extending apertures adjacent the juncture of said walls and providing communication between said axial chamber and said annular chamber.

4. Apparatus as set forth in claim 3 including an axial skirt overlying said apertures in radial spaced relation thereto for deflecting liquid emerging therefrom generally axially and towards the inner surface of said body.

5. Apparatus of the character described comprising a

rotor having an axially extending hub and a pair of axially spaced and radially extending surfaces defining a rotor chamber therebetween, fluid passage means between said hub and said chamber including an axial chamber in communication with the bore of said hub and a plurality of radially extending apertures interconnecting said axial chamber and said rotor chamber, and one of said rotor surfaces having a plurality of radially extending outwardly-inclined liquid passages of varied spacing from the other surface thereof.

6. Spray apparatus including a rotor having a hollow hub and a base extending radially outwardly therefrom, a cover secured to said base is generally parallel spaced relation thereto, means defining a liquid passage from said hollow hub to the space between said base and cover, the surface of said base in opposed relation to said cover being provided with a plurality of radially extending slots with the base of each slot being at a different axial distance from said cover than the next adjacent slot.

7. Centrifugal spray apparatus including a rotor having a central opening and a central hollow hub extending axially therefrom in alignment with said opening, a cover disposed in axially spaced relation to said rotor and secured thereto, a central annular portion of said rotor having a generally frusto-conical surface terminating in a generally axial wall, and the peripheral portion of said rotor having a transaxial annular wall spaced at a greater distance from said cover than is the peripheral portion of said frusto-conical surface, and means on said frusto-conical surface defining a plurality of radial slots extending from said central opening to said axial wall.

8. Apparatus as set forth in claim 7 further characterized by said slots being of different depths with slots of the same depth being substantially equally positioned on the rotor surface.

9. Apparatus as set forth in claim 8 in which plug means are provided in said central rotor opening, said means having an internal space in communication with said hollow hub and opposed conical surfaces defining said space, and said plug means being also provided with a plurality of radial passages communicating with said space and said slots respectively.

10. Liquid spray apparatus of the character described, including a rotor comprising transaxially extending opposing walls defining a chamber surrounding the rotor axis and provided with a central portion for the intake of liquid and an annular oulet forming the periphery of the chamber, one of said walls having on the interior of the chamber a plurality of radial passages extending substantially from said central portion to the peripheral outlet and with the bases of certain of the passages being at a different axial location than the bases of adjacent passages whereby the liquid will be directed from the passages to correspondingly different portions of the outlet.

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