June 4, 1935. W. S. BOWEN 2,003,575

SPRAY WHEEL

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Fig. 1

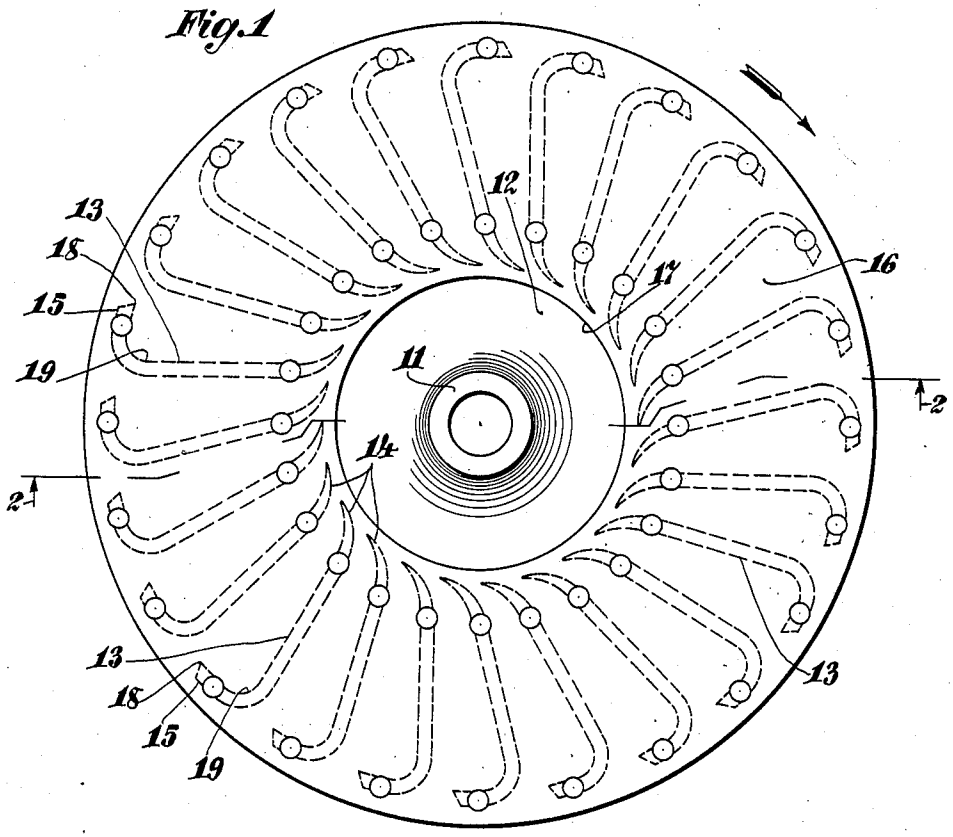
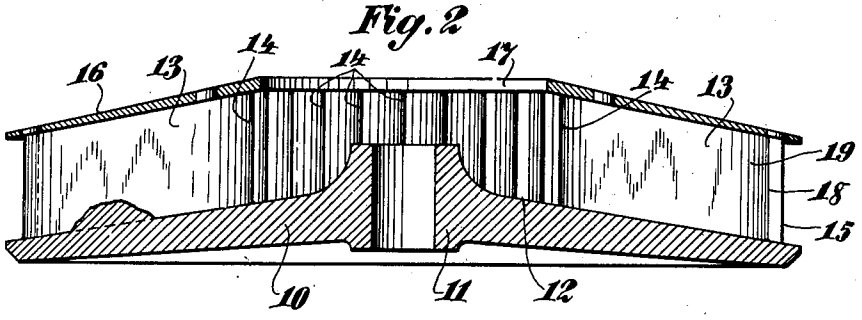


Fig. 2



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SPRAY WHEEL

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7 Claims. (Cl. 299—63)

The present invention relates to devices for spraying fluid substances and embodies, more specifically, a spray wheel which is adapted to form a spray when fluid is supplied thereto and the device rotated under the conditions set forth hereinafter. In this connection, the invention is particularly adapted for use in spray drying mechanisms, the wheel being rotated suitably and the fluid substance supplied thereto in order that the fluid substance may be sprayed into a suitable chamber in uniform and finely divided particles.

Spray wheels for use in connection with spray drying apparatus are now commonly used, these wheels being rotatable and certain of the existing types of wheels being adapted to receive the substance to be sprayed axially thereof and discharge the same peripherally. In order that the spraying operation may be controlled more effectively and to provide a spray wheel construction wherein the fluid is spread evenly over the discharge surface of the mechanism to form a film of uniform thickness, the present invention has been conceived and an object thereof is to provide an improved form of spray wheel construction by means of which fluid substances may be sprayed in such fashion that the resulting particles thereof are of uniform size.

A further object of the invention is to provide a spray wheel construction wherein the operation of the wheel may be effectively controlled and fluid substances sprayed effectively therefrom to produce particles of uniform size.

Further objects, not specifically enumerated above, will be apparent as the invention is described in greater detail in connection with the accompanying drawing, wherein:

Figure 1 is a plan view of a spray wheel constructed in accordance with the present invention, the vanes of the wheel being illustrated in dotted lines.

Figure 2 is a view in section, taken on the plane indicated by the broken line 2—2 of Figure 1, and looking in the direction of the arrows.

With reference to the above drawing, the invention is embodied in a wheel 10 having a central hub portion 11 which is adapted to be secured to any desired spindle to effect the rotation of the wheel. The wheel is formed with a top surface 12 which slopes downwardly and outwardly away from the hub 11 and upon this top surface a plurality of vanes 13 are mounted, the vanes being so positioned as to lead backwardly from the direction of rotation which is indicated by the arrow in Figure 1. It will be seen, as viewed in Figure 1, that the inner end 14, of each vane 13, lies in a plane which passes through the axis of the wheel, this plane lying well in advance of the outer edge 15 of the vane in the direction of rotation of the wheel. In this fashion, the vane is of the type commonly termed as a backward leading vane and functions in the manner described in detail hereinafter.

In order that the fluid may be confined to general radial movement, an annual cover plate 16 is secured to the tops of the vanes, having a central opening 17 through which the fluid substance may be introduced into the spray wheel. As clearly shown in Figure 1, the outer edges 15 of the vanes 13, are formed with comparatively sharp vertical cutting edges 18 which form weirs over which the substance flows as it is directed outwardly by centrifugal force. The outer ends 15 of the vanes are curved to form recesses 19 in order that the fluid may be trapped therein and the flow over the edges 18 properly controlled.

In operation, fluid is introduced through the openings 17 while the wheel is rotating rapidly. The fluid falls upon the curved top surface 12 and is deflected outwardly radially by the centrifugal force. The leading faces of the vanes 13 increase the radial speed of the outwardly flowing fluid and the maximum centrifugal force in the fluid occurs at the vertical edge or weir 18. At this point atomization is produced by the internal shear within a thin film. Inasmuch as the wheel is being rotated rapidly the centrifugal force will not only cause the fluid to be directed radially and horizontally but also this force will tend to cause the fluid to be spread evenly over the faces of the vanes so that a film of uniform thickness may be formed at the outer edge 18. In this fashion, particles of uniform size result from the spraying operation.

In the operation of the foregoing spray wheel, a thin film of fluid is forced under high pressure or with an unbalanced force over a relatively sharp edge so that internal shear takes place within the film. For any given speed of the wheel the maximum centrifugal force exerted by the fluid on the disc at any particular radius exists when the fluid comes in contact with a surface which is parallel to the axis of rotation and perpendicular to the radius of the wheel. If such a surface is formed by a bend at the peripheral end of a vane preferably lagging behind the radius in the direction of rotation, the liquid will move out radially along the vane and exert only a fraction of its centrifugal force as a normal force on the vane. When, however, the liquid passes the peripheral bend and reaches the sur-

face which is perpendicular to the radius, the centrifugal force of the liquid and the normal force on the surface become equal and equivalent to the centripetal force exerted by the surface on the liquid. The centrifugal force exerted by the liquid at this point is perpendicular to the point of motion of the liquid so that when the liquid reaches the edges of the surface, the centripetal force ceases and the centrifugal force becomes suddenly unbalanced. The film is thus driven over the sharp edge of the surface and the side of the film next to the sharp edge is held back by friction against the edge while the rest of the film is free to move under its own potential energy due to centrifugal force. This conflict of friction on one side of the film operating in one direction and the centrifugal force on the other side of the film operating in the opposite direction, sets up the necessary internal shear and atomization results. Mere velocity will not accomplish this result.

It is to be noted that the angularity between the surface parallel to the axis of rotation and perpendicular to the radius and the straight or approximately radial portion of the vane is less than 90°. The discharging surface thus serves as a small plenum chamber in which the centrifugal force will have a chance to spread out the film evenly over the entire surface. This makes for a film of uniform thickness and, consequently, atomized particles of uniform size and is a vital feature in controlling the atomization. The factors controlling the design of the wheel include the volume of fluid fed to the wheel in cubic inches per second; the peripheral speed in inches per second, the height of the vanes in inches and the number of vanes. As shown, the inner ends of the vanes are preferably scooped forwardly.

While the invention has been described with specific reference to the accompanying drawing, it is not to be limited, save as defined in the appended claims.

I claim as my invention:

1. A spray wheel formed with a plurality of vanes extending outwardly and leading backwardly with respect to the direction of rotation of the wheel, said wheel being adapted to receive a fluid adjacent the center thereof, and portions on the outer ends of the vanes lying in planes substantially parallel to tangents to the periphery of the wheel at the ends of the vanes.

2. A spray wheel formed with a plurality of vanes extending outwardly and leading backwardly with respect to the direction of rotation of the wheel, said wheel being adapted to receive a fluid adjacent the center thereof, said vanes being formed with plenum chambers adjacent the outer ends thereof.

3. A spray wheel formed with a plurality of vanes extending outwardly and leading backwardly with respect to the direction of rotation of the wheel, said wheel being adapted to receive a fluid adjacent the center thereof, and portions on the outer ends of the vanes lying in planes substantially parallel to tangents to the periphery of the wheel at the ends of the vanes, the outer ends of the vanes being formed with a cutting edge substantially parallel to the axis of the wheel.

4. A spray wheel formed with a plurality of vanes extending outwardly and leading backwardly with respect to the direction of rotation of the wheel, said wheel being adapted to receive a fluid adjacent the center thereof, the outer ends of the vanes being formed with forward leading portions terminating in cutting edges parallel to the axis of the wheel.

5. A spray wheel formed with a plurality of vanes extending outwardly and leading backwardly with respect to the direction of rotation of the wheel, said wheel being adapted to receive a fluid adjacent the center thereof, the outer ends of the vanes being formed with forward leading portions lying at acute angles with respect to the vanes and terminating in cutting edges parallel to the axis of the wheel.

6. A spray wheel formed with a plurality of vanes extending outwardly and leading backwardly with respect to the direction of rotation of the wheel, said wheel being adapted to receive a fluid adjacent the center thereof, the outer ends of the vanes being formed with forward leading portions lying at acute angles with respect to the vanes and terminating in cutting edges parallel to the axis of the wheel, the inner ends of the vanes being formed with forwarding leading scoop portions.

7. Homogenizing means comprising a rotatable head having a blade lying in a plane parallel to the axis of the head to impart centrifugal force to a substance, a flange on the blade forming a surface perpendicular to the blade against which the substance impacts under centrifugal force, and a cutting edge on the flange parallel to the axis of the head to subject the particles of the substance to shearing stresses under centrifugal force.

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