May 20, 1930. C. L. RILEY 1,759,629

NEBULIZATION OF FLUIDS

Filed March 31, 1926

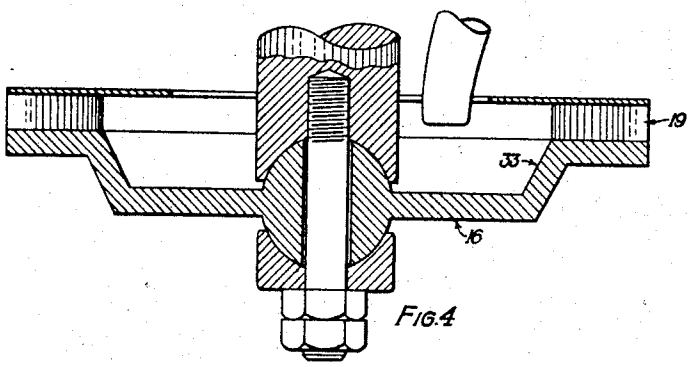


FIG. 4

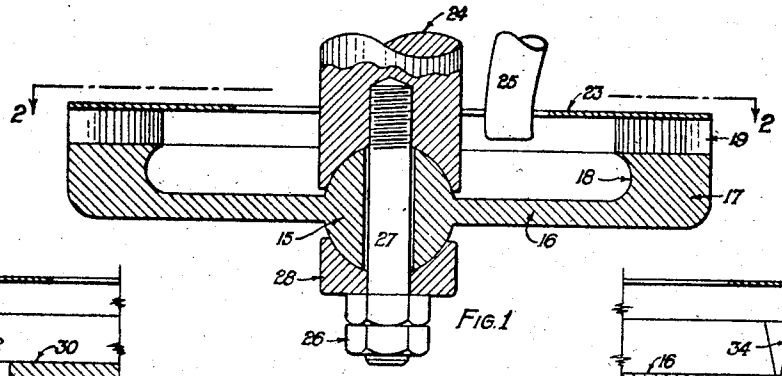


FIG. 1

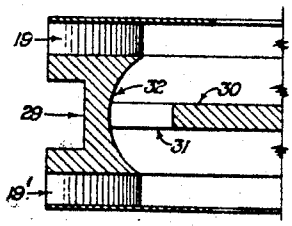


FIG. 3

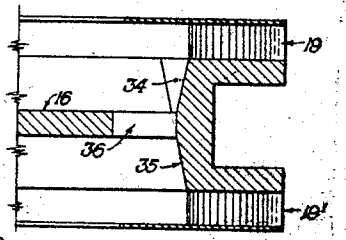


FIG. 5

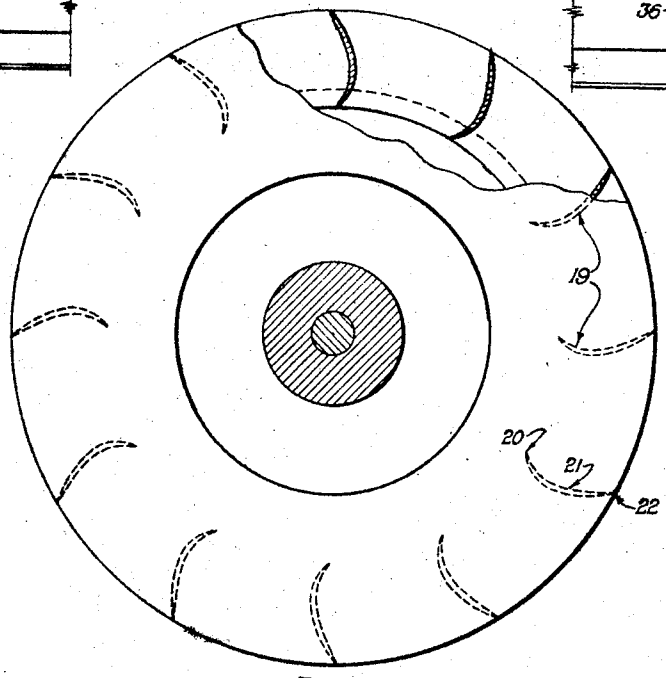


FIG. 2

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UNITED STATES PATENT OFFICE

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NEBULIZATION OF FLUIDS

Application filed March 31, 1926. Serial No. 98,838.

My invention relates to the nebulization of fluids, and particularly to nebulization effected by high speed rotors. The object of my invention is to effect nebulization of a fluid stream by centrifugal discharge of the fluid simultaneously and with substantial uniformity at all points around the periphery of the rotor, and also to positively impel the fluid at the peripheral linear speed of the rotor so that the fluid is discharged at such speed, augmented by the velocity of centrifugal off-throw.

One of the difficulties encountered on centrifugal dispersion of fluid which is fed in a stream to a centrifugal dispersing unit, such as a plane disc rotor, arises from the fact that the major portion of the stream is discharged at the rotor within a more or less restricted arcuate area determined by the period of time required for the liquid to travel from its point of incidence adjacent the axis of the rotor to the peripheral throw-off point. The throw-off area is not sharply defined, since the liquid as it travels outwardly under the influence of centrifugal force, is more or less dispersed over the surface of the rotor. There is however, a point of maximum discharge, from which the discharge tapers off in both directions around the periphery of the rotor. There is also a variation in the size and velocity of the particles discharged at the different peripheral points. This condition is not favorable for spray drying. Uniformity of size in the particles of the nebula, and uniformity of discharge in all directions around the rotor, is the ideal condition, not only with respect to the product itself, but also with respect to the action upon the nebula of the current of gas passing through the drying chamber.

My invention effects such a uniform distribution and is applicable to all fluids, not only to mobile fluids, but also to thick or viscous fluids, such as concentrates, muds, etc., which are only sluggishly mobile.

My underlying thought is to gather the stream in an annulus from which the fluid escapes evenly in all directions by centrifugal force through impellers which positively drive the fluid at the high speed of the rotor, and discharge it at this speed, augmented by the velocity of centrifugal off-throw. The rotor is driven at high speed, say from 5,000 to 10,000 revolutions per minute or more, and the impellers are preferably shaped to effect the discharge of the fluid at even greater velocity than the rotor under the influence of centrifugal force.

In the accompanying drawing—

Fig. 1 is a vertical section through a rotor in which my invention is embodied in one form;

Fig. 2 is a broken section on the line 2—2, Fig. 1;

Fig. 3 is a partial vertical section illustrating a modified construction;

Fig. 4 is a vertical section illustrating another modification; and

Fig. 5 is a partial section illustrating still another modification.

In the form shown in Figs. 1 and 2 the rotor comprises a hub 15, a web 16 extending therefrom, and a heavy peripheral rim 17, the inner periphery of which is concaved to afford a channel 18. The rotor is preferably cut from a cylindrical disc of metal, such as tool steel, which has sufficient tensile strength to withstand the heavy stresses to which it is subjected by its very rapid rotation. The heavy rim 17 exerts a fly wheel effect, which stabilizes the rotor during operation.

Upon the upper surface of the rim 17 are secured (or cut from a block) a series of impeller surfaces or vanes 19, the inner margins 20 of which are preferably sharpened to an edge. The leading faces of the vanes are concaved, as at 21, and the outer or throw-off margins 22 are preferably slightly in advance of the inner margins 20, so that the off-throw of the fluid under the action of centriugal force is actually accelerated beyond the linear speed of the rotor periphery.

Overlying the vanes 19 and extending inward beyond their inner margins, is a cover ring 23, the inner margin of which is spaced sufficiently from the driving shaft 24 to accommodate the feed spout 25 by which the fluid stream is led to the unit.

The rotor is clamped to the shaft 24 by nuts 26 on pin 27, which passes axially through

the ball hub 15 and cupped bearing block 28.

In operation the fluid is delivered in a stream through spout 25 to the web 16, over which it spreads and is outwardly distributed to the channel 18 in which it gathers. A fluid annulus builds up within the channel 18 under the influence of centrifugal force, until the channel is filled, whereupon it overflows simultaneously at all points around its periphery. The overflow now moves outwardly along the upper surface of the rim 17 under the action of centrifugal force. Inasmuch as the liquid has not yet attained the speed of rotation of the rim 17, the overflow from the channel is encountered by the vanes 19 and positively propelled thereby at the linear speed of rotation of the unit. At its periphery its speed approximates two miles or more per minute. Travelling outward along the leading faces of the vanes under the action of centrifugal force, the liquid is not only attenuated by spreading vertically over the faces of the vanes, but its linear speed is actually accelerated beyond that of the rotor by reason of the forward inclination of the outer margins of the vanes. Consequently the discharge velocity of the liquid is even greater than the lineal velocity of the rotor periphery, by reason of the augmented velocity due to centrifugal off-fling. The forces of disassociation thus imparted to the liquid, combined with their impact against the surrounding atmosphere, result in the production of a very fine nebula which is ideal for spray drying purposes. Moreover, the distribution of the nebula on all sides of the rotor fills the active area of the drying chamber uniformly, and evenly loads the current of gas flowing therethrough. Uniformity of product not hitherto attained also results from the conditions stated.

In Fig. 3 I have indicated a modification of construction in which the rim 29 extends both above and below the web 30, the latter being apertured at 31 adjacent the rim to permit the fluid to fill the channel 32, which now also extends both above and below the web. From this channel the fluid escapes at both margins to the upper and lower surfaces of the rim, and to the vanes 19 and 19′ thereon. The operation of this apparatus is substantially like that of Figs. 2 and 3, but the output capacity of the unit is doubled.

In Fig. 4 another modification is shown in which the web 16 merges into an outwardly inclined surface 33 instead of into a channel such as 18. In a construction of this type the retardation of outward dispersal of the fluid from the web 16 is not so marked as in the case of a channel such as that first described; but the incline 33 does serve as a distributing baffle even in the case of mobile fluids, by which an even distribution thereof to the impeller vanes is effected. The construction is more particularly suitable, however, for the handling of heavy or sluggishly mobile fluids, upon which the retarding action of the incline 33 is more marked. The degree of inclination may be varied to meet the requirements of the fluid to be handled, being in some cases more marked than shown in the drawing, and in other cases less marked. In order to secure the retardation of outward dispersal, and an even distribution of the fluid stream to all of the impellers, some inclination, or its equivalent, is always maintained.

In Fig. 5 I have modified the construction in Fig. 4 to effect a discharge from both the upper and lower margins of the rotor. Here the web 16 merges at its outer periphery into upwardly inclined facets 34 and alternate downwardly inclined facets 35, the former leading to the upper series of vanes 19, and the latter leading the fluid through ports 36 in the web to a lower series of vanes 19′.

It will be realized that the shape of the vanes 19 may be modified in many ways to produce the same or different effects, while still embodying the thoughts which underlie my invention. Similarly the particular shape of the rotor unit as a whole may be varied, while still accomplishing my results and practicing the features of my improved method by which they are attained.

My copending application Serial No. 97,136, filed March 24, 1926, is directed in part to the rotor construction, certain features of which are illustrated in Figure 5 of this case.

With the understanding, therefore, that the foregoing description and the accompanying drawings illustrate only certain embodiments of my thoughts in certain ways of carrying out my method, I claim,

1. A high speed centrifugal nebulizer unit comprising a peripheral ring of impeller vanes, a web lying radially inward of said vanes, said web being substantially radial and adapted to receive and centrifugally disperse a fluid stream fed thereto, and means intermediate said web and vane ring to receive said dispersed fluid and to distribute the same to the impeller ring simultaneously and uniformly at all points.

2. A high speed centrifugal nebulizer unit comprising a peripheral ring of impeller vanes, a web lying radially inward of said vanes and in a different plane, said web being substantially radial and adapted to receive and centrifugally disperse a fluid stream fed thereto, and means intermediate said web and vane ring to receive said dispersed fluid and to distribute the same to the impeller ring simultaneously and uniformly at all points.

3. A high speed centrifugal nebulizer unit comprising a rotor having a peripheral ring of impeller vanes, and means for feeding fluid to the inner margins of said vanes for centrifugal dispersal thereby, said vanes hav-

ing their peripheral margins arranged radially in advance of their inner margins to accelerate the off-throw velocity of the fluid.

4. A high speed centrifugal nebulizing rotor having a central substantially radial dispersing surface, a distributing surface circumferentially in extension of said dispersing surface, and a series of impeller vanes around said distributing area, said vanes being axially spaced from the periphery of the distributing area.

5. A high speed centrifugal nebulizing rotor having a central substantially radial dispersing surface, a distributing surface circumferentially in extension of said dispersing surface, and a series of impeller vanes around said distributing area, said vanes being axially spaced from the periphery of the distributing area, together with a hood confining the fluid to the impeller vanes.

6. A high speed centrifugal nebulizing rotor having a central substantially radial dispersing surface, a distributing surface circumferentially in extension of said dispersing surface, and a series of impeller vanes around said distributing area, said vanes being axially spaced from the periphery of the distributing area, together with a hood confining the fluid to the impeller vanes, said hood extending radially inward beyond the inner margins of said vanes.

In testimony whereof I have signed my name to this specification.

CHAMPLAIN L. RILEY.