

Sept. 10, 1963

C. A. KEMPF

3,103,311

CENTRIFUGAL ATOMIZER AND METHOD

Filed Sept. 2, 1960

2 Sheets-Sheet 1

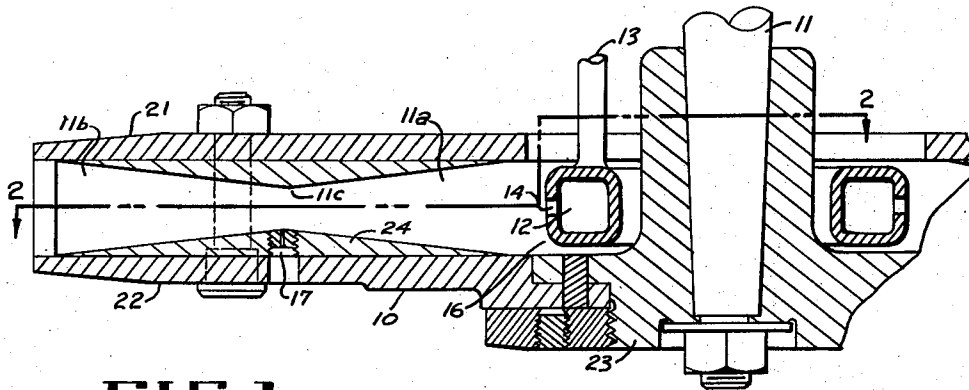


FIG. 1.

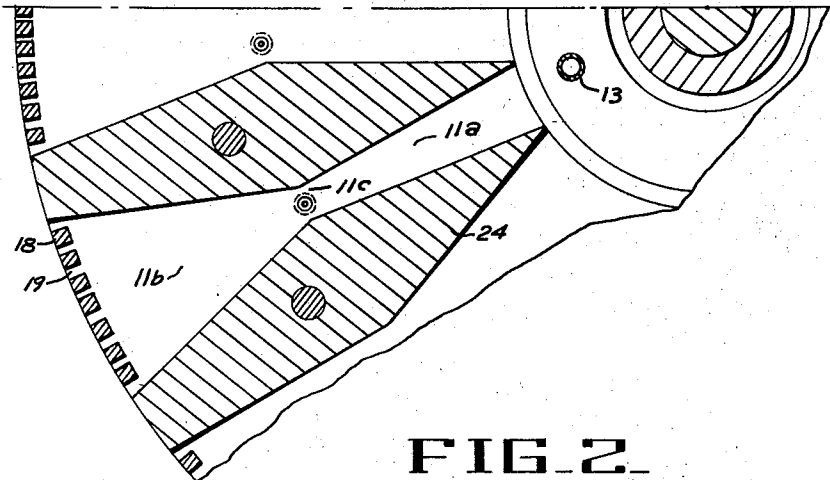


FIG. 2.

INVENTOR.
CLAYTON A. KEMPF
BY *Fletcher and Swain*
ATTORNEYS

Sept. 10, 1963

C. A. KEMPF

3,103,311

CENTRIFUGAL ATOMIZER AND METHOD

Filed Sept. 2, 1960

2 Sheets-Sheet 2

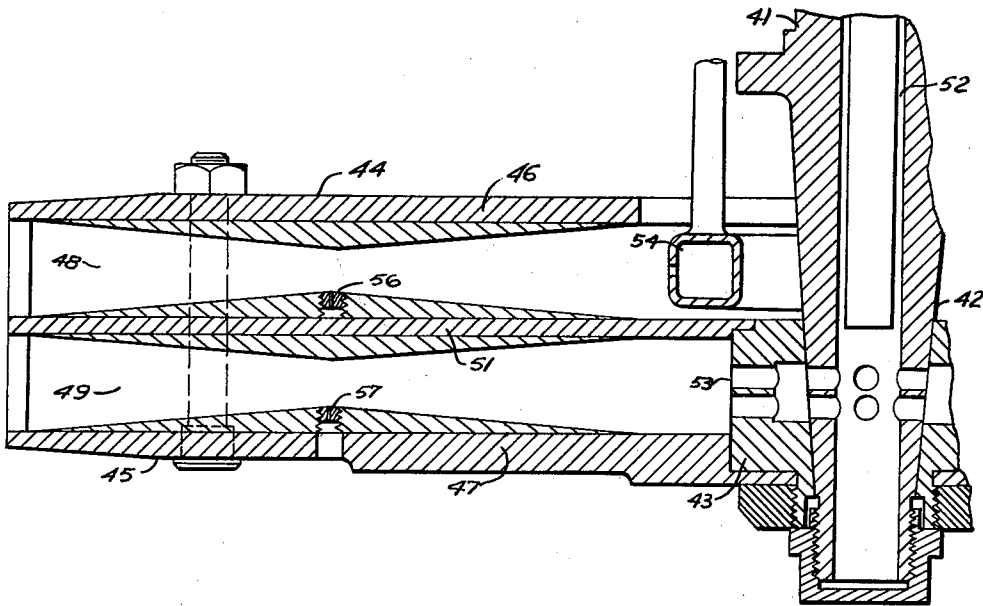


FIG. 4

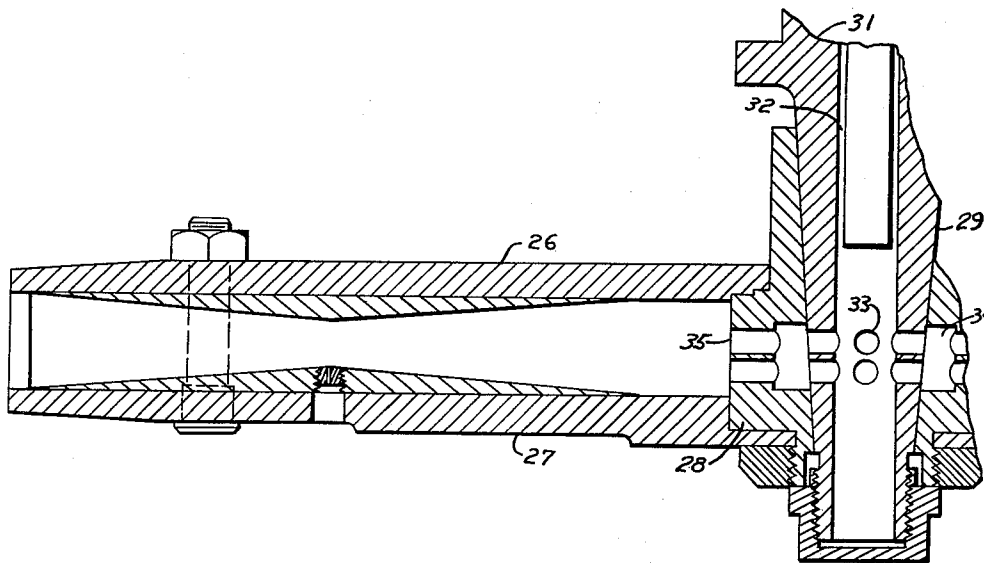


FIG. 3

INVENTOR.
CLAYTON A. KEMPF

BY

Flaherty & Swain

ATTORNEYS

1

3,103,311

CENTRIFUGAL ATOMIZER AND METHOD

Clayton A. Kempf, Berkeley, Calif., assignor to Foremost Dairies, Inc., San Francisco, Calif., a corporation of New York

Filed Sept. 2, 1960, Ser. No. 53,794

7 Claims. (Cl. 239-7)

This invention relates generally to centrifugal atomizers and atomizing methods suitable for use with various equipment, including spray dryers, spray concentrators, and the like.

Centrifugal atomizing devices for spray dryers generally employ an atomizing head mounted upon a shaft and rotated at relatively high speed. The fluid material to be atomized is fed to the head, and as it moves outwardly by centrifugal force it is acted upon by atomizing means such as a plurality of circumferentially spaced bars. A typical atomizer of this type is shown in Peebles et al. 1,939,364. In general, all such atomizers are limited with respect to capacity, having reference to the quantity of a given fluid feed which the atomizer will atomize to a given droplet size, by a given speed of rotation. Also it is well known that power consumption tends to be excessive for the higher operating capacities. Attempts to increase capacity by the use of vanes, pins, or pegs, to impart rotary velocity to the feed material, have not been effective in this respect, particularly because any increase in capacity gained in this manner is accompanied by excessive and uneconomical increase in power consumption.

In general, it is an object of the present invention to provide a centrifugal atomizer which is capable of relatively high operating capacity without excessive uneconomical power consumption.

A further object of the invention is to provide a new centrifugal atomizer which utilizes the principles of aspiration to induce outward movement of the fluid feed away from the central region where the feed is introduced.

Another object of the invention is to provide a new atomizing method applicable to centrifugal atomizer heads.

Additional objects and features of the invention will appear from the following description in which the preferred embodiments have been set forth in detail in conjunction with the accompanying drawing.

Referring to the drawing:

FIGURE 1 is a side elevational view in section illustrating an atomizer constructed in accordance with my invention.

FIGURE 2 is a cross sectional detail taken along the line 2-2 of FIGURE 1.

FIGURE 3 is a view like FIGURE 1, but showing another embodiment.

FIGURE 4 is a view like FIGURE 1, but showing a further embodiment.

The atomizer illustrated in FIGURES 1 and 2 consists of a head or body 10 which may be formed of a plurality of parts assembled and mounted upon the rotary shaft 11. The body parts are formed to provide a plurality of passages which extend radially as shown in FIGURE 2. Each passage is venturi-shaped, including an inner portion 11a which is outwardly convergent, an outer portion 11b which is outwardly divergent, and an intermediate restricted portion 11c which forms the venturi throat.

Means are provided for feeding fluid material into the inner passage portions 11a. In FIGURES 1 and 2 the feed means consists of an annular hollow member 12 which connects with the feed pipe 13, and which is provided with a plurality of discharge openings 14. The

2

inner portion of the body is provided with an annular space 16, in which the member 12 is accommodated.

Means is provided for admitting controlled amounts of air into the throat portions 11c of all of the passages. Thus as shown in FIGURE 1, an orifice fitting 17 is mounted in the lower side of the body, and each fitting is in communication with the associated throat 11c.

Fluid atomizing means is carried by the outer periphery of the atomizer and extends across the outer open ends of the flow passages. Thus as shown in FIGURES 1 and 2, a plurality of spaced parallel teeth or bars 18 extend across the portion 11b of each passage, whereby material delivered through the slots or openings 19 between these bars is caused to be atomized. Such bars correspond generally to the atomizer bars used in centrifugal atomizers of the type disclosed in said Peebles et al. patent. For handling the heavier bodied fluids, a second row of such bars can be provided, located just inside the single row illustrated.

Various structural details can be used to form the venturi-like passages. In the construction illustrated in FIGURES 1 and 2, the body is formed of the upper and lower annular plates 21 and 22, the lower plate being attached to the hub 23. The structure 24 between these plates can be molded or otherwise formed to provide the desired passages. If desired, the structure 24 can be formed of a plurality of segments assembled side to side, or it may be formed of a plurality of tubes shaped to form the venturi-like passages, and surrounded by a filler medium.

It is desirable to design the passages 11 in such a manner as to obtain optimum venturi effect. Thus the throat portion 11c of each passage can be located at a point about one-half the distance from the axis of the shaft 11, to the periphery of the device. Also each throat may be located a distance from the inner end of the passage portion 11a which is about two-fifths the total length of each passage.

Operation of my atomizer is as follows: Assuming its use in connection with a spray dryer for the manufacture of a dry powdered product, such as dried milk, it is mounted in the upper portion of a drying chamber which is adapted to receive hot air or other drying medium. The shaft 11 is generally vertical whereby the body of the device is in a horizontal plane. The body may be, say, 12 inches in diameter, and may be provided with from, say, 3 to 8 or more venturi-like passages. The throats 11c of each passage may be annular in section and may, for example, measure about 1/4 to 1 inch in diameter. The speed of rotation may vary with different types of fluid feed, but in a typical instance may be of the order of from 9000 to 15,000 r.p.m. Assuming that feed material is being supplied at a constant rate to the hollow annular member 12, in feed well 16, such material passes through the throats 11c, and is delivered to the bars 19, where the material forms films which break into atomized droplets. By virtue of the venturi effect, a sub-atmospheric pressure exists in each throat 11c, and this has the effect of inducing flow of fluid feed through the same, or, in other words, fluid feed material is virtually sucked through the throats for delivery to the bars 18. Air is continually bled into each throat portion 11c through the orifice fittings 17, and in effect such air is homogeneously distributed through the fluid feed, thus reducing its overall density. Feed material aerated in this manner is more readily and effectively atomized. In addition to the foregoing, the continual drawing in of a controlled amount of air through the orifice fitting 17 serves to aid acceleration of fluid feed material toward the periphery of the atomizer, or, in other words, toward the bars 18.

In the embodiment shown in FIGURE 3, fluid feed ma-

3

terial is introduced downwardly through a hollow shaft, instead of using the annular hollow member 12. Thus, in this instance, plates 26 and 27 are provided, which correspond to the plates 21 and 22. The lower plate is secured to the hollow hub 28, which in turn is fitted upon the lowered tapered end 29 of the hollow shaft 31. Fluid feed introduced downwardly through the passage 32 in the hollow shaft passes through the openings 33, the annular space 34, and the openings 35, after which it is delivered into the inner ends of the venturi-like passages. Plate 26 in this instance is fitted upon the hub 28. With this construction, substantially no air is admitted to the inlet ends of the Venturi-like passages.

As shown in FIGURE 4, venturi-like passages may be provided in two tiers, and each tier may be used for the same or a separate fluid feed. Thus in this instance the hollow shaft 41 has a lower tapered end portion 42, upon which the hub 43 is mounted. The body consists of plates 44 and 45, the lower plate being mounted upon the hub 43. The structures 46 and 47 are formed to provide the two tiers of venturi-like passages 48 and 49. The structures may be separated by the intermediate plate 51, which is likewise mounted upon the hub 43. The lower tier of passages is supplied with fluid feed introduced through the shaft passage 52, in the hub openings 53. The upper tier of passages is supplied with feed from the annular hollow member 54, which corresponds to the hollow member 12 of FIGURE 1. Each tier passage is provided with orifice fittings 56 and 57, corresponding to the orifice fittings 17 of FIGURE 1. The upper fittings 56 may all communicate with a common duct (not shown), which is in communication with the atmosphere.

It will be evident that with a multi-tier atomizer as shown in FIGURE 4, a plurality of separate fluids can be atomized into a common treatment chamber, for certain specialized treatment effects. Also the device in this instance has a greater capacity, whether used with a single fluid material or with separate feed materials.

I claim:

1. In a centrifugal atomizer for atomizing fluid feed materials, an annular body adapted to be rotated about a central axis, means on the body rotating therewith defining a plurality of separate venturi passages each extending in a generally radial direction, each passage having inner and outer portions and a restricted throat portion therebetween, and means for introducing a fluid feed into the inner end portions of said passages at regions located inwardly of said throats.

2. In a centrifugal atomizer for atomizing fluid feed materials, an annular body adapted to be rotated about a central axis, means on the body for rotation therewith defining a plurality of separate Venturi passages extending in a generally radial direction, each passage having inner and outer portions and a restricted throat portion there-

4

between, means for introducing a fluid feed into the inner end portions of said passages at regions located inwardly of said throats, and means defining an orifice extending laterally into the throat portion of each passage for bleeding exterior air directly into the throats of said passages.

3. In a centrifugal atomizer for atomizing fluid feed materials, an annular body adapted to be rotated about a central axis, rim means formed on the periphery of the body and having circumferentially spaced openings therein, means on the body for rotation therewith extending inwardly from said rim means and a plurality of separate defining venturi passages, each of said passages including an inner portion convergent outwardly, an outer portion divergent outwardly, and an intermediate throat portion of restricted cross-sectional area between said inner and outer portions, said outer passage portions serving to deliver fluid feed material against the said rim portion, and means for introducing fluid feed material into the inner end portions of said passages at regions located inwardly of said throat portions.

4. A centrifugal atomizer as in claim 3 together with orifice means for bleeding exterior air directly into the throat portions of said passages.

5. A centrifugal atomizer as in claim 1 in which two tiers of said passages are provided, together with separate means for introducing fluid feed material into the inner ends of said passages.

6. The method of atomizing a body of fluid, comprising the steps of: rotating said fluid about a fixed axis to cause said stream of said fluid to flow, by centrifugal force, in a stream generally radial to said axis; progressively restricting the cross sectional area of said stream as it flows outwardly from said axis to a predetermined value at a predetermined position, to increase the velocity thereof; introducing air into said stream at said predetermined position, to increase the volume thereof; then progressively increasing the cross sectional area of said stream outwardly from said predetermined position; and finally removing all confining restriction from said stream.

7. The method of claim 6 including the further step of breaking said stream up into a multiplicity of smaller streams just prior to removing all confining restriction therefrom.

References Cited in the file of this patent

UNITED STATES PATENTS

2,357,050	McCrum	Aug. 29, 1944
2,645,525	Nyrop	July 14, 1953

FOREIGN PATENTS

76,954	Denmark	Jan. 11, 1954
138,203	Sweden	Nov. 25, 1944