

April 30, 1946.

E. GUSTAFSSON ET AL

2,399,182

SPRAY DRYING DEVICE

Filed Feb. 16, 1944

Fig. 1.

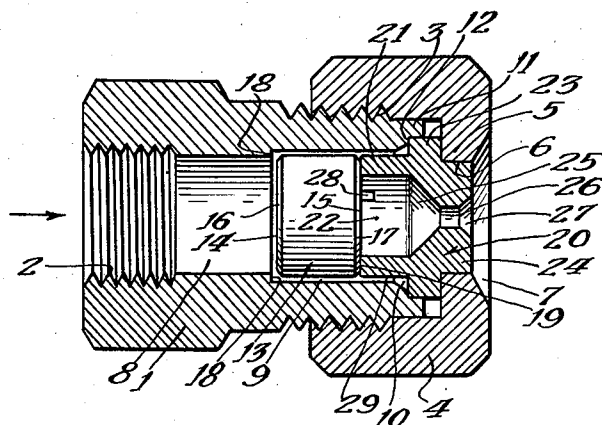


Fig. 2.

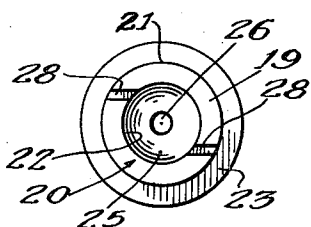


Fig. 3.

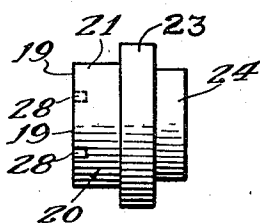


Fig. 4.

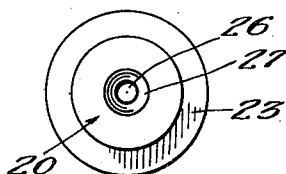


Fig. 5.

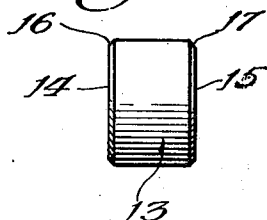
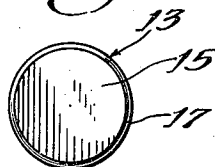


Fig. 6.



Inventors:
Eric Gustafsson
John W. Baur
By Louis A. Bisson,
Attorney.

UNITED STATES PATENT OFFICE

2,399,182

SPRAY DRYING DEVICE

Eric Gustafsson and John W. Baur, Chicago, Ill.,
assignors to Binks Manufacturing Company,
Chicago, Ill., a corporation of Delaware

Application February 16, 1944, Serial No. 522,570

5 Claims. (Cl. 299—120)

The present invention relates to devices for spraying liquids or liquid-like materials, such as solutions, emulsions, colloids, or the like, to produce therefrom a dry powder-like mass, and is particularly useful for the spray drying of milk, eggs, blood, etc.

Among the objects of the invention is to provide a novel spraying device with a novel nozzle provided with a whirl chamber having a tangentially or secantly related inlet passage or passages, and a co-axial discharge orifice, the cross sectional areas of the passage or passages and the orifice bearing, within a given range, a pre-determined ratio for obtaining a differential of pressure between the inlet passage and the discharge orifice for any given substance sprayed, to give the desired and the best result therefor, such as the best size of dried material particle resulting from the particular material being sprayed.

Another object of the invention is to provide a novel spraying nozzle device which is capable of using much reduced hydraulic pressure from what has been necessary for the desired result, incidentally involving a less costly operating of the pumps and associated mechanism, while still obtaining more uniform results, and also obtaining a uniformity of the size of particles produced.

Other objects, capabilities, advantages, features, and the like are comprehended by the invention as will later appear, and as are inherently possessed by the invention.

Referring to the drawing:

Fig. 1 is a longitudinal sectional view, on an enlarged scale, of a device constructed in accordance with the invention;

Fig. 2 is a rear end view of the nozzle;

Fig. 3 is a side view of the nozzle;

Fig. 4 is a front view of the nozzle; and,

Figs. 5 and 6 are respectively side and end views of a button used in the device.

Referring more in detail to the drawing, the embodiment selected to illustrate the invention is shown as comprising a tubular body 1 having at its rear end a threaded portion 2 for connection to a supply duct (not shown), and at its forward end a threaded portion 3 for the coupling of a nut cap 4. This cap 4 has an annular lip 5 provided with a circular opening 6 and flared mouth 7.

Within the body 1 is provided a cylindrical passage 8 leading to a cylindrical chamber 9, of larger diameter than the passage 8, the chamber 9 having a flaring forward end portion 10 at the forward end 11 of the body 1. Within the

flared end 11 is provided an annular seat or shoulder 12.

Within the chamber 9 is a cylindrical member or button 13 which is of smaller diameter than the chamber 9 and yet of larger diameter than the passage 8, so that there is provided a surrounding space in the chamber 9 between the button 13 and the wall of the chamber 9 so as to provide a passage from the passage 8 to the forward portion of the chamber 9, as shown in Fig. 1. The button 13 has flat ends 14 and 15 and may have chamfered edge portions 16 and 17 so that the flat face 14 may be spaced from the shoulder 18 formed at the junction of the passage 8 and the chamber 9, and that the flat face 15 may seat squarely in sealing contact against the rear end 19 of the nozzle 20, as shown in Fig. 1.

The nozzle 20 comprises a cylindrical skirt portion 21 for including a cylindrical whirl chamber portion 22, an annular collar portion 23 adapted to seat with a sealing contact with the shoulder or seat 12 and to be clamped with a sealing contact by the lip 5, and a round frontal nozzle portion 24 fitting closely in the opening 6 of the lip 5. The chamber 22 has a forward tapered portion 25 leading to an orifice 26 in turn leading to a flared port 27 in the front end of the nozzle 20.

The rear end 19 of the skirt 21 is provided with one or more (two being shown) channels 28 disposed tangentially or secantly relative to the whirl chamber 22. These channels are preferably rectangular or square in cross section as shown, but may be of other form if desired. When the nozzle 20 is in place the face 15 of the button will seat against the end 19 of the nozzle 20 under the force of the liquid or fluid passing through the device so that the face 15 will form the fourth side wall of the channel or channels 28.

The axial dimension of the button 13 is less than the distance from the shoulder 18 and the rear end 19 of the nozzle 20 so as to afford passage radially along the surface 14 of the button 13 to and into the annular portion of the chamber 9 surrounding the button 13. The button ensures a uniform distribution of the fluid about the skirt 21 to the channels 28. It will be noted that the diameter of the skirt 21 is less than that of the chamber 9 so that there is an annular extension or chamber portion 29 where the liquid may freely flow around the skirt 21 and have free access to the channels 28 regardless of whether or not the button 13 be concentrically or eccentrically located in the chamber 9.

By reason of the sealing contact between the rim or collar 23 and the annular shoulder or seat 12 access of the liquid or fluid to the threads 3 of the body 1 and the cap 4 will be prevented.

With different kinds of liquids or fluids being sprayed different ratios of the cross sectional areas of the channels 28 and the orifice 26 may be used. The change in ratio is effected by using different nozzles 20 having the particular ratio to accommodate the particular fluid to be sprayed. Replacing a nozzle for another is facile necessitating merely unscrewing the cap 4 and removing the nozzle 20, replacing it by another nozzle 20, and screwing the cap 4 in place.

The theory by which the nozzle works can be described in terms of energy. The potential energy of pressure which is given to the liquid or fluid by the pump is transformed into kinetic energy of motion when it passes through the channels 28 into the low pressure whirl chamber 22. The low pressure in the whirl chamber is obtained by having the discharge orifice 26 larger than the intake channels 28. The whirl is obtained by having the channels 28 set off center, that is, tangentially or secantly, as described. It was found by experiment that the best results were obtained when the area of the channels 28 were about 70% to 90% of the discharge orifice 26. If the area of the channels is decreased it will drop the pressure in the whirl chamber, the angle of spray will increase and the particle size will decrease. If the channels are increased in cross sectional area, the opposite will be the result. As the particle size determines the solubility, the larger particles dissolve slowly because of the surface contact being small compared to size and the very small particles being almost insoluble, because of surface tension, it is important that the size be held accurately. The present invention is designed to meet such situations.

The sizes of the channels 28, the area of the orifice 26, and the percentages as referred to above are indicated in the following table:

Nozzle No.	Area of both slots	Area of orifice	Percentage
10-4.....	0.001240	0.001385	89.5
10-5.....	0.001922	0.002765	69.5
10-6.....	0.000800	0.000962	83.1

An object of the invention is to maintain a given ratio between the cross sectional areas of the channels 28 and the orifice 26. If the area of the channels 28 be reduced the differential of the pressure at the channels 28 and the orifice 26 will increase and, hence, the velocity through the channels will increase, and resultantly the angle of spray will increase, and the particle size will decrease.

For best results it has been found that the area, combined, of the two channels 28 is preferably 80% of the area of the orifice 26, for the desired size of a given kind of material being dry sprayed. If the particles be too small they become too dry and if too large they are not dry enough when using a given drying temperature. If other materials are used it has been found that the same ratio of 80% is still best.

With our device we are able to reduce the hydraulic pressure of from 5,000# to 6,000#, usually heretofore used, to from 2,500# to 2,200#, and, hence, gain in reduced costs of operating the pumps, etc., and still obtain more uniform results and also uniformity of particle size.

While we have herein described and upon the drawing shown an illustrative embodiment of the invention it is to be understood that the invention is not limited thereto but comprehends other constructions, details, arrangements of parts, features or the like without departing from the spirit of the invention.

Having thus disclosed the invention, we claim:

1. A spraying device of the character disclosed and comprising a tubular body open at its forward and rear ends, a tubular nozzle member at the forward end of the body and having an annular skirt extending into said body, means for holding the nozzle member in sealing engagement with the forward end of the body, said nozzle member having an orifice at its forward end and said skirt having a cylindrical whirl chamber open at its rear end and having a tapered passage at its forward end communicating with said orifice, said rear end of said skirt being provided with a secantly disposed channel, and a free element in said body at the rear end of the skirt and having a face for contacting the rear end of the skirt with a sealing engagement and to form a wall for the open side of the channel.

2. A spraying device of the character disclosed and comprising a tubular body open at its forward and rear ends, a tubular nozzle member at the forward end of the body and having an annular skirt extending into said body, means for holding the nozzle member in sealing engagement with the forward end of the body, said nozzle member having an orifice at its forward end and said skirt having a cylindrical whirl chamber open at its rear end and having a tapered passage at its forward end communicating with said orifice, said rear end of said skirt being provided with a secantly disposed channel, and a free element in said body at the rear end of the skirt and having a face for contacting the rear end of the skirt with a sealing engagement and to form a wall for the open side of the channel, said skirt being of less diameter than that of the chamber in the body to provide an annular chamber portion about the skirt and between said skirt and said body.

3. A spraying device of the character disclosed and comprising a tubular body open at its forward and rear ends, a tubular nozzle member at the forward end of the body and having an annular skirt extending into said body, means for holding the nozzle member in sealing engagement with the forward end of the body, said nozzle member having an orifice at its forward end and said skirt having a cylindrical whirl chamber open at its rear end and having a tapered passage at its forward end communicating with said orifice, said rear end of said skirt being provided with a secantly disposed channel, and a free element in said body at the rear end of the skirt and having a face for contacting the rear end of the skirt with a sealing engagement and to form a wall for the open side of the channel, said skirt being of less diameter than that of the chamber in the body to provide an annular chamber portion about the skirt and between said skirt and said body, and said free element being of less diameter than said body chamber for providing a passage to said annular chamber portion.

4. A spraying device of the character disclosed and comprising a tubular body open at its forward and rear ends, a tubular nozzle member at the forward end of the body and having an annular skirt extending into said body, means for

holding the nozzle member in sealing engagement with the forward end of the body, said nozzle member having an orifice at its forward end and said skirt having a cylindrical whirl chamber open at its rear end and having a tapered passage at its forward end communicating with said orifice, said rear end of said skirt being provided with a secantally disposed channel, and a free element in said body at the rear end of the skirt and having a face for contacting the rear end of the skirt with a sealing engagement and to form a wall for the open side of the channel, said forward end of the body having an annular seat provided within said body and said nozzle member having a collar for having a sealing engagement with said seat and within said body.

5. A spraying device of the character disclosed and comprising a tubular body open at its forward and rear ends, a tubular nozzle member at the forward end of the body and having an annular skirt extending into said body, means for holding the nozzle member in sealing engagement

with the forward end of the body, said nozzle member having an orifice at its forward end and said skirt having a cylindrical whirl chamber open at its rear end and having a tapered passage at its forward end communicating with said orifice, said rear end of said skirt being provided with a secantally disposed channel, and a free element in said body at the rear end of the skirt and having a face for contacting the rear end of the skirt with a sealing engagement and to form a wall for the open side of the channel, said forward end of the body having an annular seat provided within said body and said nozzle member having a collar for having a sealing engagement with said seat and within said body, said holding means being in the form of a cap connected to said body and to said nozzle member for holding them in sealing engagement by way of said seat and collar.

ERIC GUSTAFSSON.
JOHN W. BAUR.