July 16, 1946. N. C. CHRISTENSEN 2,404,273

METHOD OF AND APPARATUS FOR SPRAYING

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Fig. I.

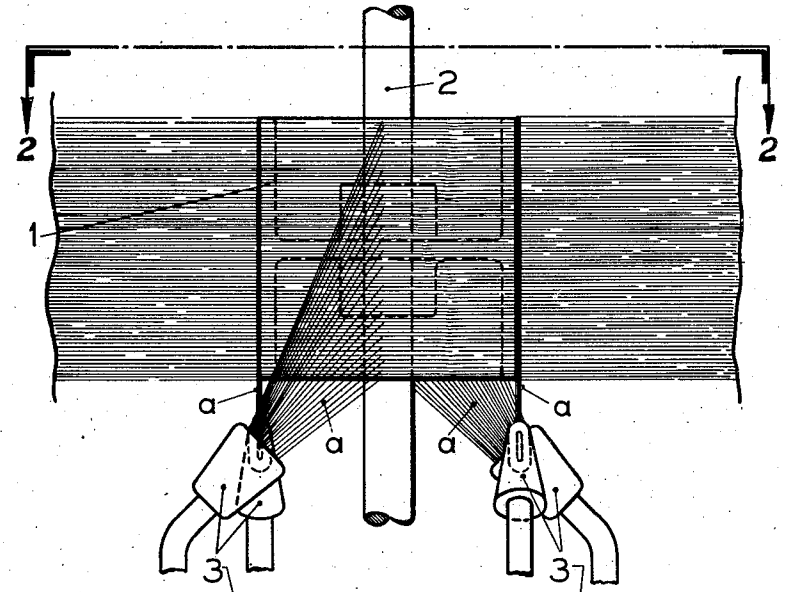
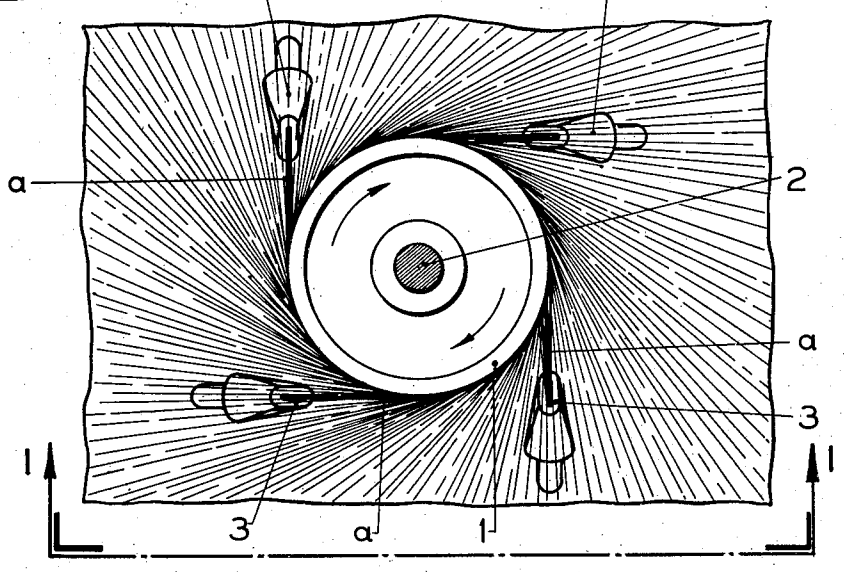


Fig. II.



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Fig. III.

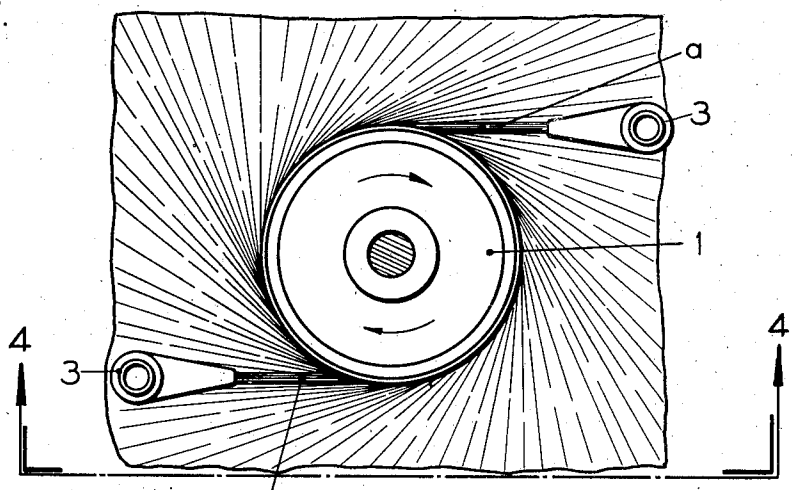
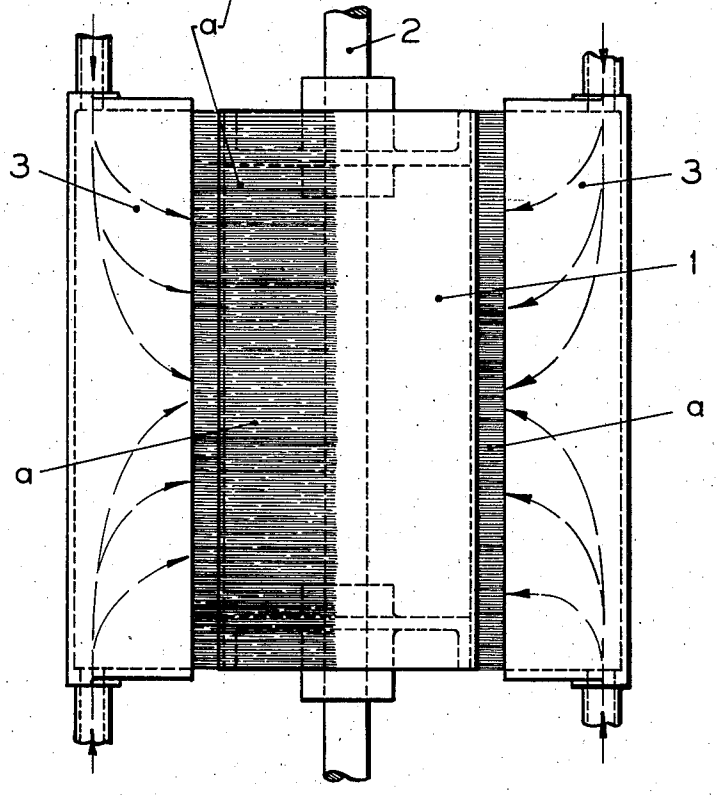


Fig. IV.



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2,404,273

METHOD OF AND APPARATUS FOR SPRAYING

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Application July 24, 1944, Serial No. 546,285

4 Claims. (Cl. 299—63)

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This invention relates to methods of and apparatus for spraying liquids or suspensions of finely divided solids in liquids.

The spraying principle may be used for any of the purposes for which liquid spraying apparatus is used, for example, absorption, chemical interaction, evaporation, heat exchange, gas purification, and in short all of the functions familiar in gas and liquid contact apparatus.

In referring to liquids as the medium sprayed in the remaining portion of this specification the term should be read as meaning a liquid as such or suspensions of finely divided solids in liquids.

The invention contemplates the use of four main components, a spraying cylinder which is driven at suitable speed, some means for projecting a liquid against the periphery of the rotary cylinder, some means for collecting liquid and delivering it to the spraying nozzles, and usually some form of housing through which the gaseous interacting medium is passed.

In the preferred mode of carrying out the invention a cylinder is mounted on a vertical axis and rotated at high speed. One or more nozzles are used to direct a fan shaped jet of liquid against the cylinder, the direction of projection being such that the fan sheet of projected liquid is approximately tangent to the cylinder and moving in a direction opposite to the direction of the surface of the cylinder at the point of contact.

The principle of the invention will now be described with reference to the accompanying drawings, in which

Figure 1 is an elevation of a rotary cylinder against which a fan shaped spray of liquid is projected by a plurality of nozzles located below the lower margin of the cylinder. Four such nozzles are shown.

Figure 2 is a plan view of the arrangement illustrated in Figure 1.

Figure 3 is a plan view similar to Figure 2 in which two nozzles are used, the nozzles being elongated and located opposite to the cylinder rather than below the cylinder.

Figure 4 is an elevation of the structure shown in Figure 3.

Referring first to Figures 1 and 2 the cylinder is indicated at 1 and is mounted on a rotary shaft 2. The nozzles 3 are of such form that each projects a sheet of liquid a against the surface of the rotor 1. As indicated in Figure 2 the sheet of liquid delivered by each nozzle is substantially tangent to the surface of the cylinder, and this surface moves in a direction opposite to

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the motion of the sprays. See the arrows on Figure 2.

As suggested the projected material may be a liquid or a suspension of finely divided solids in a liquid and it is supplied to the nozzles by any suitable mechanism such as pumps (not shown). One or more nozzles may be used. The drawings indicate the possible use of four.

Figures 3 and 4 show similar arrangements in which corresponding parts bear the same reference numerals primed. The essential difference is that the nozzles 3', of which two are shown, are opposed to and approximately coextensive with the length of the cylinder 1'. In this way the sheet of liquid a' projected by the nozzle is perhaps a little more accurately directed along an element of the cylinder, but the effect is substantially the same except to the extent that the nozzles 3' interfere with the projected spray.

The character of the spray depends on two controlling factors, the speed of the rotor and the rate of delivery of liquid. As the speed of the rotor increases, the fineness of the spray increases, while increase in the rate of supply of liquid results in increasing coarseness of the spray. Anything from a fine mist to a relatively coarse rain may be produced by the coordination of the two factors above mentioned.

If too much liquid is supplied to the rotor the fan of spray is first distorted and ultimately largely destroyed. It is true, however, that the higher the speed of rotation of the cylinder, the greater the quantity of liquid which may be successfully fed thereto. The size of the fan of spray thrown off by the rotor depends on the speed of the rotor. As speed is increased, the size of the fan of projected droplets increases until a critical point is reached at which fine mist is thrown off. Thereafter increasing speed diminishes the size of the fan.

With cylinders of ordinary size (say 12 inches in diameter) effective spraying starts at a surface speed approximating 1,000 feet per minute. At 1,400 feet a complete fan of spray is formed, and at 3,000 feet a fan of maximum size is produced. Above 4,500 feet per minute the size of the fan diminishes markedly because of the fineness of the projected mist.

A 12 inch cylinder rotating at 650 R. P. M. with one supply nozzle will spray approximately ten gallons per minute per square foot of rotor surface. With two supply nozzles this amount can be increased to about fifteen gallons per minute and with four nozzles about twenty gallons per minute. The amount sprayed can be doubled by

increasing the speed to 1,200 R. P. M. Rotors as large as 48 inches in diameter have been used successfully.

Generally stated the arrangement shown in Figures 1 and 2 is suited for comparatively short rotors, whereas that shown in Figures 3 and 4 is suited for rotors of considerable length.

I am aware that use has been made of spraying cylinders which are mounted on a horizontal axis which dip very slightly into a bath of liquid to be sprayed. This prior art type of sprayer is highly desirable because of the flexibility of control which it affords and because of the extensive and uniform fan of mist or spray which it will produce. Its greatest limitation is the necessity for accurate maintenance of the level of the bath.

The arrangement disclosed in the present application has two decided advantages. Its operation is stable without regard to the level of any bath so that in case of need, the device may be used on moving vehicles and the like. Another advantage is that the rotors may be mounted on vertical shafts so that in those devices in which gases are caused to flow in contact with the sprays, the paths of flow may be vertical. This not only saves space, but it facilitates gravity flow of liquid from stage to stage in those types of devices such as gas scrubbers in which the same liquid is sprayed a number of times and caused during each spray to contact the flowing gas at a different point in the gas path.

While the invention is particularly useful for liquid gas and contact purposes, it is available for a considerable number of other purposes, for as stated it may be used in almost any situation where spraying is required.

What is claimed is:

1. The method of making a spray from liquids or fluid mixtures of finely divided solids and liquids which consists in projecting said liquid or mixture upon the surface of a rotating cylinder in the form of a sheet approximately tangent to the surface of said cylinder and rotating said cylinder about its axis at such speed that liquid or fluid supplied to said surface is thrown from the surface of said cylinder as a rain or spray, said sheet of liquid or fluid mixture being projected in opposite direction to the motion of the cylinder in the zone of contact.

2. The method of making a spray from liquids or fluid mixtures of finely divided solids and

liquids which consist in projecting said liquid or mixture upon a longitudinal zone on the surface of a rotating vertical cylinder in the form of a moving sheet approximately tangent to the surface of said cylinder and rotating said cylinder about its vertical axis at such speed that liquid or fluid mixture supplied to said surface is thrown from the surface of said cylinder as a rain or spray, said sheet of liquid or fluid mixture being projected upon said surface in such direction that a component of its movement is substantially opposite to the movement of the cylindrical surface in the zone of contact.

3. The apparatus for making a spray from liquids or fluid mixtures of finely divided solids and liquids which consists of a cylindrical rotor arranged to rotate about its axis, a plurality of nozzles arranged to supply liquid or fluid mixture to longitudinal zones on the surface of said cylinder in the form of moving sheets approximately tangent to the surface of said cylinder, means for supplying said liquid or mixture to said nozzles as described, and means for rotating said cylinder about its axis at such speed that liquid or fluid mixture supplied to said rotor as described is thrown from the surface of said cylinder as a rain or spray, said rotor being arranged to rotate in such direction that the movement of the surface of the rotor is substantially opposite to the movement of the liquid in said sheet or sheets in the zone of contact.

4. The apparatus for making a spray from liquids or fluid mixtures of finely divided solids and liquids which consists of a vertical cylindrical rotor arranged to rotate about its vertical axis, at least one nozzle beneath said rotor arranged to supply liquid or fluid mixture to a longitudinal zone on the surface of said cylinder in the form of a moving sheet approximately tangent to the surface of said cylinder, means for supplying said liquid or mixture to said nozzle, means for rotating said cylinder about its axis at such speed that liquid or fluid mixture supplied to said rotor is thrown from the surface of said cylinder as a rain or spray, said rotor being arranged to rotate in such direction that the movement of the surface of the rotor is substantially opposite to a component of the movement of the liquid in said sheet in the zone of contact.

NIELS C. CHRISTENSEN.