United States Patent

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[54] **NOZZLE FOR DISPERSING VISCOUS FLUIDS**
5 Claims, 4 Drawing Figs.

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[51] Int. Cl. B05b 7/10
[50] Field of Search 239/399–406, 487, 488, 460, 498

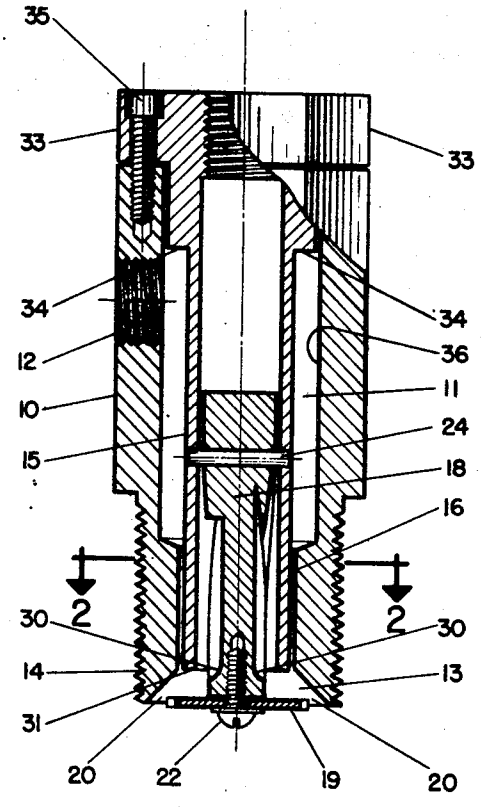
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ABSTRACT: A low-pressure nozzle for atomizing and dispersing a viscous fluid comprising a housing having a chamber and a diverging-wall mixing section. The chamber has inlets for the introduction of a dispersing fluid and an area of reduced cross section communicating with the mixing section. A conduit for the viscous fluid extends through the chamber to the diverging mixing section forming at the reduced cross section of the chamber a discharge outlet for the dispersing fluid. A spiral groove member is positioned in the conduit with one end of this member extending into the diverging mixing section with the grooves terminating in the mixing section by a reduction of depth of the grooves for deflecting outwardly fluid flowing in said grooves. A deflection plate is positioned in the mixing section to form an annulus between the edge of the deflection plate and the walls of the mixing section.



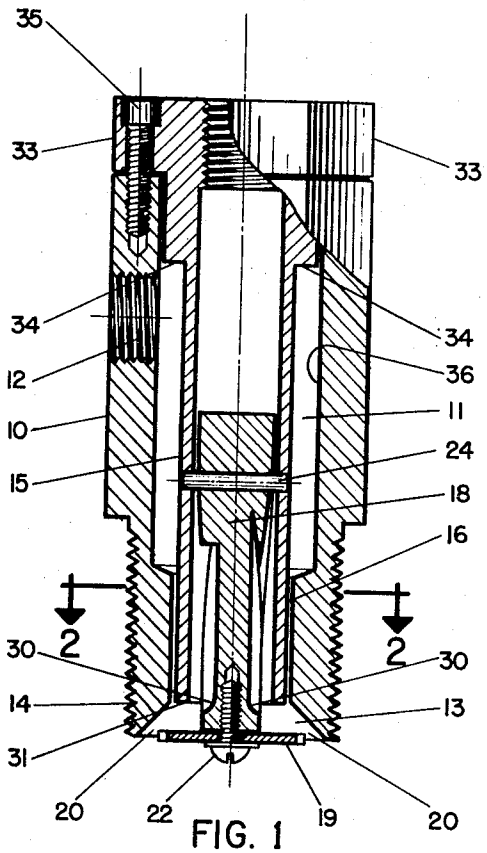


FIG. 1

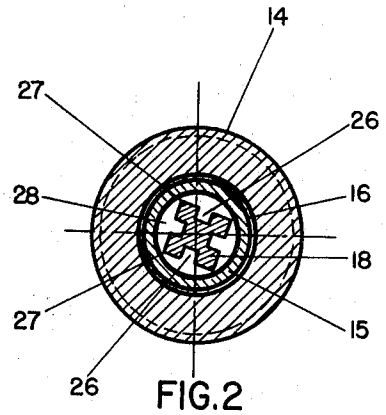


FIG.2

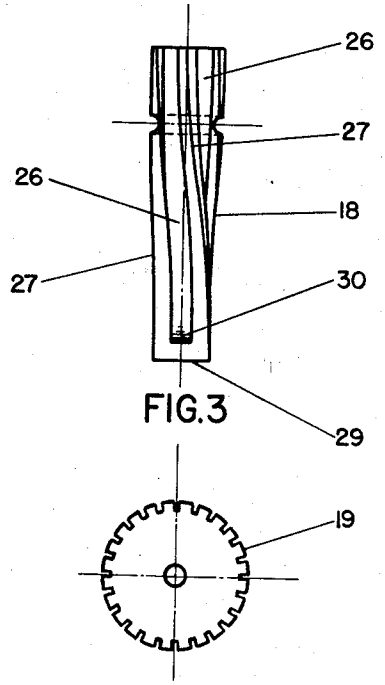


FIG.3

FIG.4

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NOZZLE FOR DISPERSING VISCOUS FLUIDS

This invention pertains to a nozzle for dispersing viscous fluids using low fluid pressures.

In many operations, it is often necessary to atomize and disperse relatively viscous fluid where high-pressure facilities usually required for such dispersions are not available. For example, in the preparation of animal-pelleted feeds, liquid feed binders are used. These feed binders are usually viscous fluids which have to be uniformly dispersed in relatively small quantities throughout large volumes of feed prior to pelleting. Generally, the major portion of the feed constituents are in powder form, and if the binder is not finely dispersed, it is not intermixed with the ingredients but remains in globs or in high concentration in localized areas. This results in a product of nonuniform quality. In addition, globs in the mixture will adhere to the walls and other parts of the equipment interfering with the pelleting operation. In many of the feed mills, the high-pressure steam or air is not available, as would generally be required for the dispersion or atomization of the viscous liquids. Further, the mills are operated at different production capacities, which necessitates the atomization and dispersion of the binders over a wide range of flow rates. In addition, the equipment used has to be of a rugged, simple design, so that it may be economically made and operated and maintained without requiring specialized training.

It is, therefore, an object of this invention to provide a nozzle for dispersing or atomizing viscous fluids. A further object is to provide a nozzle for dispersing viscous fluids operative under low fluid pressures. A still further object is to provide a nozzle which can be easily fabricated and maintained and which may be operated at various flow rates without requiring any adjustment or control of the nozzle.

The above and further objects of the invention will be apparent from the following description of the nozzle as herein described with reference to the accompanying drawings wherein:

FIG. 1 is a sectional view of one embodiment of the nozzle of this invention;

FIG. 2 is a transverse sectional view of the nozzle taken along lines 2—2 of FIG. 1.

FIG. 3 is a side elevation of the spirally grooved member of the nozzle; and

FIG. 4 is a view of the deflection plate of the nozzle of FIG. 1.

Referring to the drawings, the nozzle schematically illustrated comprises a housing 10 having a chamber 11, an inlet 12 communicating with chamber 11, and a diverging-wall mixing section 13. At the discharge end 14 of the housing, the portion of the chamber communicating with mixing section 13 is reduced in size having a smaller cross-sectional area. A conduit 15 extends through chamber 11 to mixing section 13. In passing through the portion of the chamber of reduced cross-sectional area in section 14 of the housing, a passageway 16 is formed between 15 and the housing which serves as a discharge from chamber 11 to mixing section 13. A spirally grooved member 18 is positioned in conduit 15 with a portion of the member extending into mixing section 13. A circular deflection plate 19 is located below the spiral member and is positioned in the mixing section so that at least a portion of the deflection plate is in the mixing section forming an annulus 20 between the wall of the mixing section and the edge of the deflection plate. As shown, the deflection plate is positioned in the mixing chamber by being attached to spirally grooved member 18 by screw 22. The positioning of the deflection plate 19 can be adjusted by use of a space, not shown, between the deflection plate and member 18. The spirally grooved member as shown is positioned in the conduit by use of pin 24.

The spirally grooved member 18 is usually made by machining grooves 26 in a piece of solid stock of a size to fit within conduit 15. As shown in FIGS. 2 and 3, preferably a piece of square bar stock is grooved longitudinally on each face and, after machining, twisted to provide a spiral having a gradual twist of from 10 to 45 degrees per length equivalent to the

inner diameter of the conduit. By using a piece of square stock, a larger passageway for fluid flow is obtained without the additional machining which would be necessary if a piece of round stock were used. The corners 27 of the square stock seat against the inner wall of conduit 15, providing spiraling passageways 28. Grooves 26, in addition to providing more area for flow of the viscous fluid, impart additional turbulence to aid in the atomization and dispersion of the viscous fluid. The grooves as cut in the spiral member do not extend all the way through, but terminate before reaching end 29, which extends into mixing chamber 13. Preferably, the grooves are terminated by decreasing the depth of the groove to provide a concaved or outwardly deflecting surface 30. Member 18 is positioned in the conduit such that the grooves extend into mixing section 13 and preferably such that some reduction in depth of the groove is obtained at the point where the spiral member leaves the conduit or end 31. A reduction in depth at this point is beneficial. A reduction in area increases the velocity and turbulence at this point, which aids in dispersing and deflecting the fluid discharged from the conduit outwardly toward the walls of the mixing section.

Conduit 15 is placed in housing 10 so that the end of the conduit, end 31, is positioned at the beginning of the mixing section. While some variation is permitted, end 31 should be within one-sixteenth of the diameter of the conduit of reaching the mixing section, or extending for about that distance into mixing section 13. As shown in the drawing, conduit 15 is flanged at the top having flange 33 and a section of enlarged diameter or shoulder 34. It is positioned and centered in the housing by being bolted to the housing by screws 35. Flange 33 is seated on top of the housing and shoulder 34 is seated in chamber 11 at the top, with the shoulder or enlarged portion bearing on the inner wall 36 of the chamber to center the conduit.

In operation of the nozzle, steam, air or other dispersing fluid is introduced into chamber 11 through inlet 12. As shown, the inlet is threaded to provide the attachment of a line carrying the dispersing fluid to the inlet. The dispersing fluid is generally at a relatively low pressure of from about 20 to 60 pounds per square inch. The dispersing fluid passes through chamber 11 and discharges into the mixing section through passageway 16. The viscous fluid is introduced into the nozzle through conduit 15. Also, as shown, the passageway in conduit 15 is threaded to provide means for attachment of a line for supplying the viscous fluid to the conduit. In passing through the conduit, the viscous fluid contacts the spiral member 18, which imparts a spiral motion to the fluid as it is discharged into the mixing chamber. A spiral member of a length of from two to six times the inner diameter of the conduit with a total spiral or twist of from 45° to 180° is usually sufficient to impart the rotational flow. The viscous fluid flows in the grooved channels 26 of member 18 and also in the openings 28 between member 18 and the walls of conduit 15. As the fluid approaches the discharge point from the conduit, the portion of the fluid flowing in grooves 26 is deflected outwardly, which adds turbulence and deflects the spiraling stream into the dispersing fluid which is discharging into the mixing chamber through passageway 16. The viscous fluid is thus intermixed with the dispersing fluid and is dispersed and atomized. The mixture is further atomized by being discharged through annulus 20, which is formed by the edge of the deflection plate 19 and the wall of the mixing section. The atomized and dispersed heavy fluid is then discharged from the nozzle and controlled with the feed constituents or other materials into which it is desirable to disperse the fluid.

It is apparent that various modifications to the preferred embodiment as shown in the drawing can be made without departing from the invention. Other means instead of threaded openings can be used for the attachment of lines for the introduction of dispersing fluid and the viscous fluid to the nozzle. Also, other means may be used for positioning the conduit in the housing. Instead of bolting the conduit to the housing, the conduit could be attached and positioned in the housing

by having the shoulder 34 portion of the conduit and the top of the chamber 11 threaded. Also, it is not necessary to have the conduit constructed such that the flange is an integral part of the conduit. The conduit could be a piece of tubing extending through a plate bolted to the top of the housing with means of attaching the tube to the plate to provide an airtight seal. The only requirement is that the conduit be substantially centered in the chamber in the housing to provide a relatively uniform discharge passage for the dispersing fluid and that the conduit terminate at the desired point at the beginning of mixing chamber 13. When the conduit is made as shown in the drawing, the positioning of the conduit in the housing initially can be adjusted by using a gasket of desired thickness between the housing and the cap portion 36 of the conduit. Thus, the nozzle can be readily constructed without requiring close tolerance machine operations, and by using the proper gaskets it can be disassembled and reassembled without having to make any adjustments. The housing and the conduit can be made from circular, square, hexagonal, or any bar stock employing mainly a series of drilling operations and simple lathe work.

Preferably, the walls of the mixing section diverge or slope outwardly towards the discharge end of the nozzle to form an angle of around 45° with the centerline through the nozzle. However, the slope of the walls of the mixing chamber can be varied to form an angle of from about 35° to 60°.

Various deflection plates can also be used. As shown in FIG. 4, the deflection plate is a circular plate having a serrated edge formed by having relatively closely spaced slots cut a short distance into the plate at its periphery. However, it is not necessary to have the deflection plate slotted. A plain circular plate would be satisfactory, or a deflection plate having different configurations or veins could be used.

What is claimed is:

1. A nozzle for dispersion of a viscous fluid comprising a housing having a chamber therein and a diverging-wall mixing section, said chamber having an inlet for the introduction of a dispersing fluid and an area of reduced cross section communicating with said mixing section, a conduit for the viscous fluid extending through said chamber to the diverging-wall mixing section, said conduit extending through said reduced cross section of the chamber to form a discharge outlet for the dispersing fluid from said chamber, a member positioned in said conduit with one end of said member extending into the diverging mixing section, said member having spiral grooves, said grooves terminating in portion of the member extending into said diverging mixing section by a continual reduction of depth of said grooves at end of grooves for deflecting outwardly fluid flowing in said grooves, and a deflection plate positioned in the mixing section to form an annulus between the edge of the deflection plate and walls of the diverging mixing section.

2. A nozzle according to claim 1 wherein the deflection plate is circular, having a serrated edge.

3. A nozzle according to claim 1 wherein said spirally grooved member is a square rod groove longitudinally on each face of the rod and twisted to provide the spiral.

4. A nozzle according to claim 3 wherein said grooves terminate in portion of the member extending into the diverging section by reduction of depth of said grooves to form a concaved curved surface at end of grooves.

5. A nozzle according to claim 4 wherein the conduit is flanged and is attached to the housing to seat the flanged portion of the conduit to the housing and an upper section of the conduit in the chamber in the housing.

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