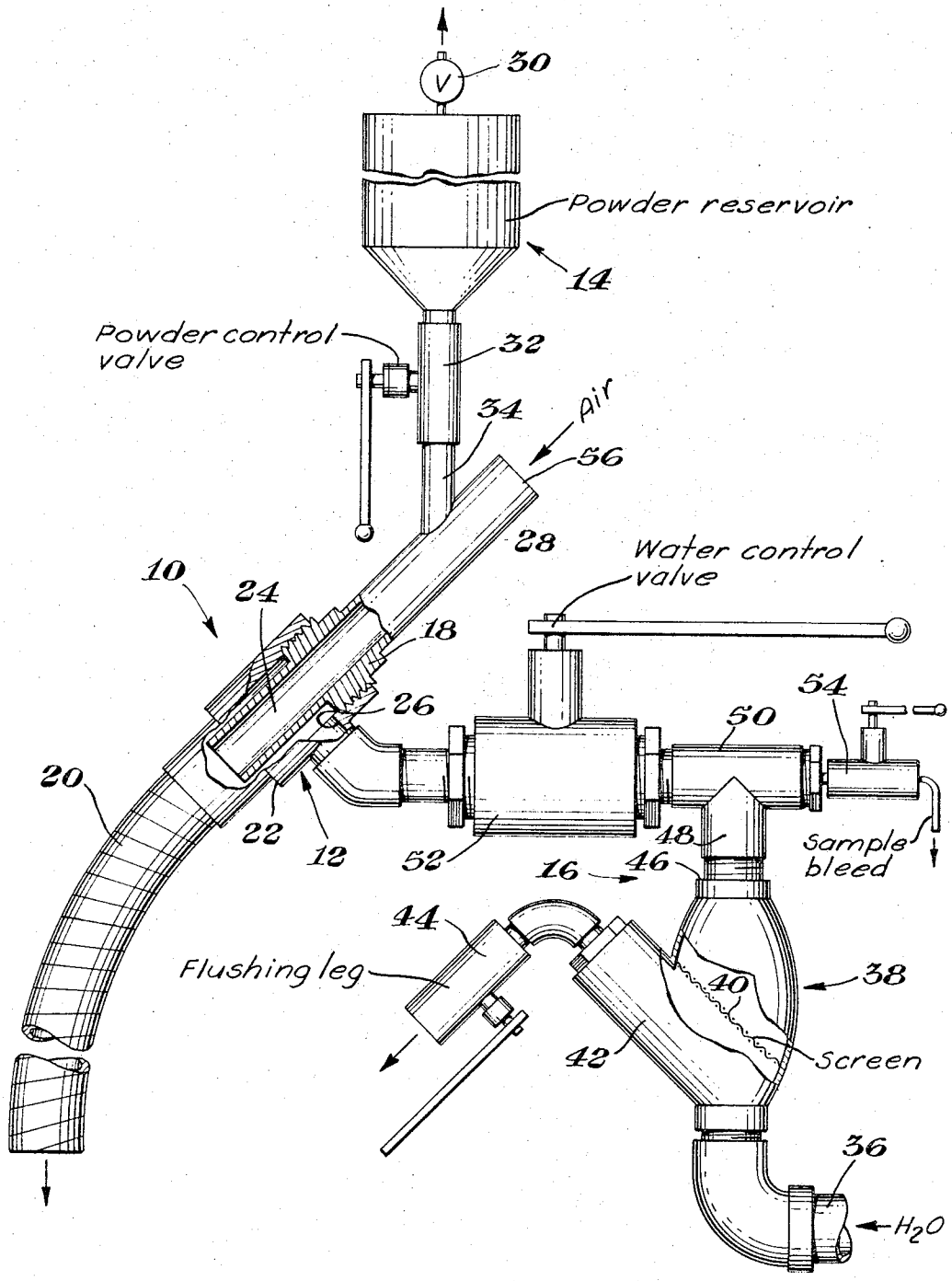
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MIXING APPARATUS

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MIXING APPARATUS

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This invention relates to devices for dispersing powdered solids in liquids and particularly to a portable device of simple structure for preparing and dispersing such dispersions.

Commercially available devices for dispersing solids in liquids commonly include eductors which employ an eductor developed vacuum in their operation.

Some commercially available units marketed for mixing fire-retardants with water are of the vacuum developing eductor type.

In such devices a powdered solid is discharged through a port into a partial vacuum created by the flow of water through the eductor. If the water flow changes, so does the degree of vacuum produced and so the rate of flow of the particulated solids changes too. So-called "slugs" of powder may be introduced into the dispersing devices which result a non-homogenous (lumpy) output of the dispersing device.

If the solid feed port plugs or is closed and the water flow is appreciably reduced, water tends to back flow, effectively disabling the device. Disassembling, cleaning and drying are required before the device may again be operated.

The main problem sought to be solved by the prior art resides in the fact that powdered particles resist wetting. The individual particles tend to cling together in lumps and wetting at the surface of the lump as a whole is favored.

Often, where such action is permitted, the problem is solved by pre-mixing the solutions or dispersions in large agitated tanks. The mixed material may then be pumped through more or less conventional piping to wherever it is to be used or stored.

The above mentioned pre-mixing procedure is usually not practical for field use in preparing solutions or dispersions for agricultural or fire-fighting applications.

In fire-fighting, particularly, natural water supplies must be used whenever possible to minimize water hauling.

Efficient fire-fighting operation requires "on the spot" mixing with the lightest, simplest, most rugged equipment available.

Similarly, "on the spot" mixing is highly preferable for agricultural applications such as charging sprayers or introducing chemicals into irrigation water.

Accordingly, a principal object of this invention is to provide an improved apparatus for making solutions or dispersions from particulated materials and liquids.

Another object of this invention is to provide an improved, more reliable to operate apparatus for making solutions or dispersions from particulated materials and liquids.

A further object of this invention is to provide an improved, reliable and economical apparatus for making solutions and dispersions from particulated materials and liquids.

In accordance with this invention there is provided mixing apparatus comprising a mixing head having coupled to it valve and screen apparatus adapted to be coupled to a source of liquid which is under pressure.

A particulated materials reservoir is coupled to a gas inlet tube which extends from said mixing head. The gas inlet tube extends axially into said mixing head and ends downstream from the part of said mixing head to which the valve and screen apparatus are coupled.

A nozzle is coupled to the output end of the mixer head.

The invention, as well as additional objects and advantages thereof, will best be understood when the following detailed description is read in connection with the accompanying drawing in which the single figure shows an elevational view, partly broken away and in section, of apparatus in accordance with this invention.

Referring to the drawing, there is shown mixing apparatus, indicated generally by the numeral **10**, which comprises a mixing head, indicated generally by the numeral **12**, a particulated materials reservoir, indicated generally by the numeral **14**, and a liquid feed assembly, indicated generally by the numeral **16**.

The mixing head **12** is a hollow T-shaped member which has a bushing **18** coupled to one end and a nozzle or "snout" **20** coupled to its other or output end **22**. The bushing **18** has a tube **24** coupled thereto which extends axially into the interior of the mixing head **12**, ending at a point well beyond the bore **26** (the side entry bore of the T) towards the output end **22** of the head **12**. The outer diameter of the tube **24** is a major fraction of the inner diameter of the head **12**.

A second tube **28** is coupled in end-to-end relationship with respect to the tube **24** and extends outside of the head **12** in the opposite direction in which the nozzle **20** extends.

The particulated materials reservoir **14**, which may have venting means **30** therein, is fixedly coupled to the tube **28** through a valve **32** and tubing **34**. The reservoir **14** is coupled so that, during operation, the reservoir **30** is disposed above the mixing head **12**.

The liquid feed assembly **16** is coupled at one end to a source of liquid (water, for example) as from the tubing **36** and at the other end to the bore **26** in the mixing head **12**.

The assembly **16**, as shown, comprises a T-like element **38** which has a strainer screen **40** disposed across the output flow path of the element. The side port **42** is coupled to a valve **44**.

The output end **46** of the element **38** is coupled to the side inlet **48** of a T-coupling **50**. A liquid flow control valve **52** is coupled between the bore **26** of the mixing head **12** and one end of the T-coupling **50**. A bleed valve **54** is coupled to the other end of the T-element **50**.

In operation, with the tubing **36** coupled to a source of liquid which is under pressure and with the valves **44** and **54** closed and valve **52** open, water (or other suitable liquid) enters the mixing head **12** through the side bore **26** and then exits through the nozzle **20**. A partial vacuum is created in the tubes **24** and **28** which communicate with the atmosphere (at the end **56** of the tube **28**). The partial vacuum causes air to flow from the tube **28** into the mixing head **12**, carrying with it particulated material from the reservoir **14** (with the valve **32** opened to permit a suitable flow of powder).

The powder, which flows by gravity into the tube **28**, then is carried by air flow into the tube **24**, becoming pre-dispersed during its passage down the tubes **24** and **28** before it enters the stream of liquid near the output end of the mixing head **12**.

If, during operation, the nozzle is elevated above the unit or is plugged, any water back up which results is discharged through the tube **28** without wetting the tube **34** through which the particulated material is introduced to the air stream.

Because the operator of the apparatus controls the powder flow rate by means of the valve **32** the powder flow rate is, within practical limits, independent of vari-

ations in the water flow. Experience has shown that adequate proportioning control of the powder to liquid ratio is readily obtained if the pumping rate is reasonably steady.

One use to which this apparatus is particularly well suited is for producing and applying dispersions of fire retardant materials.

Because so-called "natural" sources of water are so often used in fire fighting operations, the screen **40** catches material from the liquid which might tend to clog the mixing head **12**. The screen **40** may usually be cleaned by opening the valve **44** and closing the valve **52**, thereby sweeping adhering material from the screen.

The valve **54** may be coupled to a sample bleed line or to a pressure gauge, for example.

It should be emphasized that having the outer diameter of the tube **24** be a major fraction of the inner diameter of the head **12** results in, for a given volume rate of flow of liquid, a higher linear flow rate or water velocity, for example, giving better mixing where the powder-air and water streams come together downstream and prevents any splash back of water into the inner tube. Further, the higher water velocity and the cylindrical shape of the water stream just below the outlet of the inner tube ensures that no solids will contact or adhere to the mixing head wall.

What is claimed is:

1. Mixing apparatus for preparing solutions or dispersions from a mixture of particulated materials and liquids, comprising a tubular mixing head having side walls, an input end and an output end, said side walls having a liquid entry port disposed a substantial distance from said output end and between said input end and output end, said input end being closed and having a fluid impervious walled tubular element extending therethrough which has an input and output end, the output end of said tubular element extending beyond said liquid entry port in the direction of the output end of said mixing head, the tubular element being in alignment with the longitudinal axis of said mixing head, the input end of said tubular element extending externally of said mixing head substantially beyond said input end of the mixing head, a particulated materials reservoir, valved means rigidly coupling said reservoir to said tubular element between said mixing head and the input end of said tubular element, a nozzle, said nozzle being coupled to the output end of said mixing head, valved means coupled to said liquid entry port for introducing liquid under pressure to said mixing head, and means for introducing gas into said tubular element at a location further from said mixing head than where said reservoir is coupled to said tubular element.

2. Apparatus in accordance with claim **1**, wherein said valved means for introducing liquid includes a filter screen.

3. Apparatus in accordance with claim **1**, wherein said particulated materials reservoir is vented.

4. Apparatus in accordance with claim **1**, wherein the diameter of the tubular element within the mixing head is a major fraction of the diameter of said mixing head.

5. Apparatus in accordance with claim **1**, wherein said nozzle is flexible.

6. Apparatus in accordance with claim **1**, wherein a filter screen and screen cleaning means are incorporated into said means for introducing liquid.

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