Feb. 25, 1969 D. J. GRIBBLE 3,429,513

COMBINATION AGITATOR AND CHOPPER FOR INTAKE OF SLURRY PUMP

Filed Nov. 14, 1966 Sheet 1 of 2

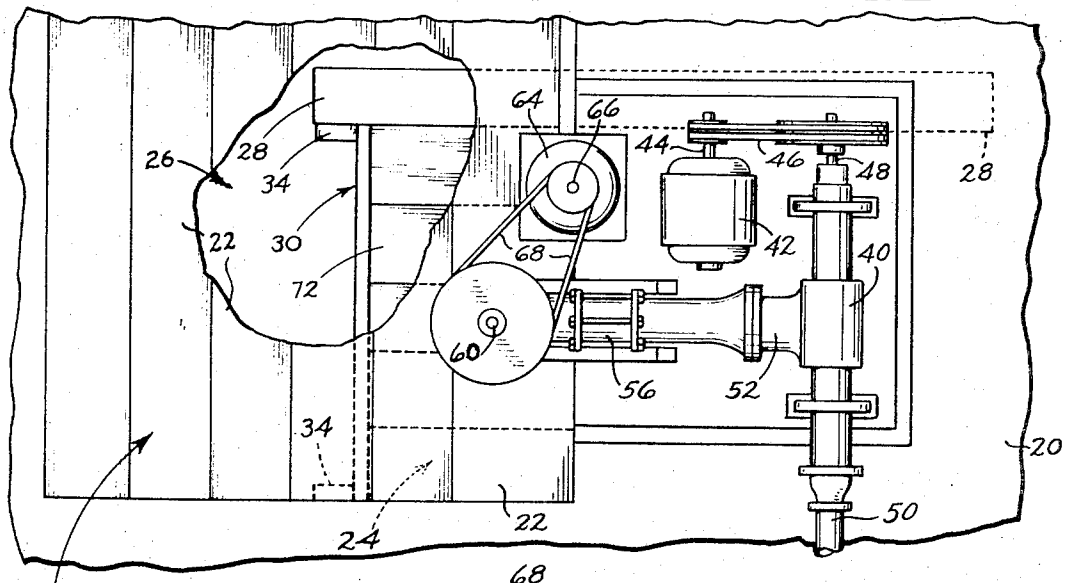


Fig. 2.

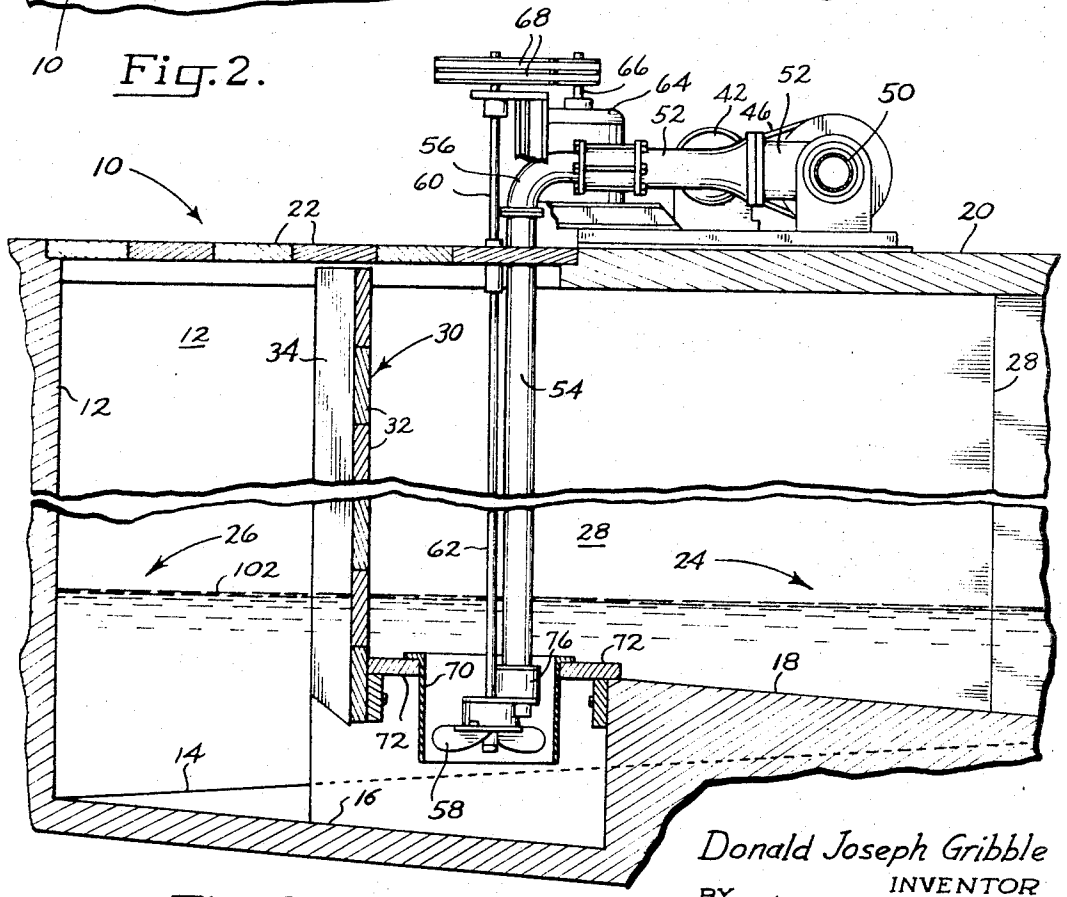


Fig. 1.

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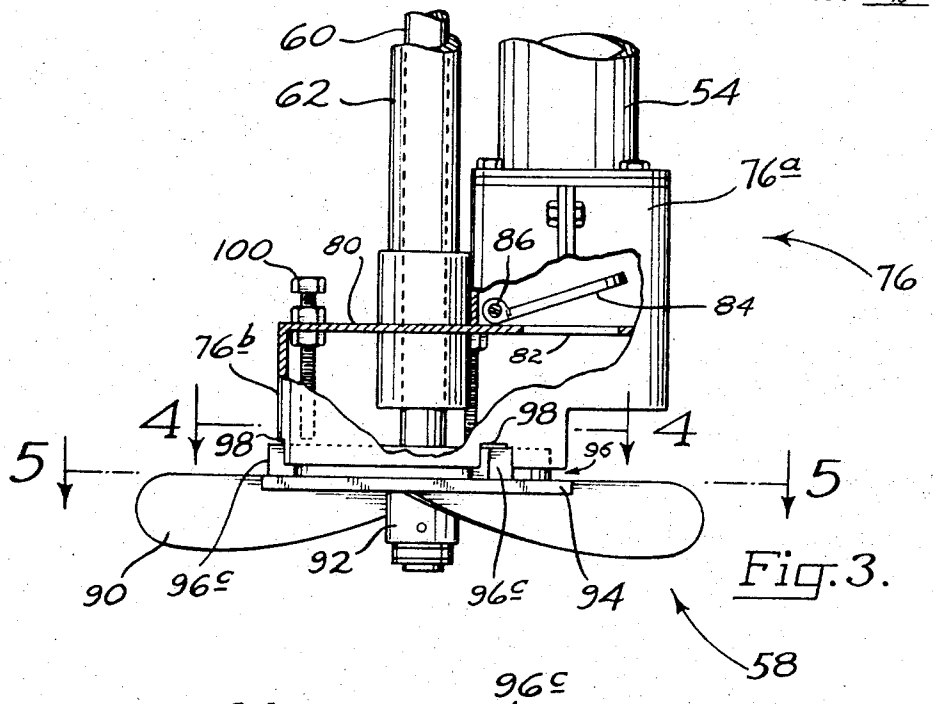


Fig. 3.

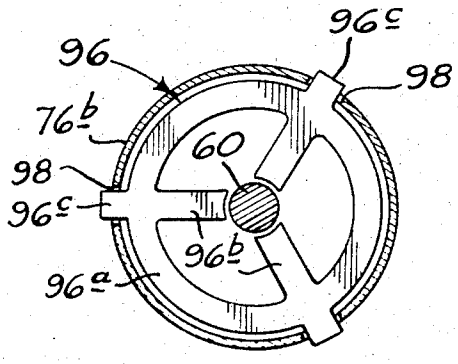


Fig. 4.

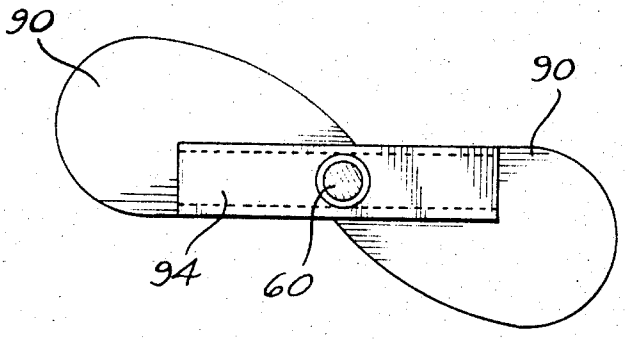


Fig. 5.

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3,429,513

COMBINATION AGITATOR AND CHOPPER FOR INTAKE OF SLURRY PUMP

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U.S. Cl. 241—46 6 Claims
Int. Cl. B02c *18/10, 18/40*

ABSTRACT OF THE DISCLOSURE

Slurry processing apparatus including a duct through which slurry is circulated. A shaft extends into the duct and has a propeller on it producing slurry flow. A portion of such flow is directed into casing structure encircling said shaft and from said casing structure into a conduit leading to the intake of a pump. Cutter means interposed between the propeller and casing structure is operated with rotation of the shaft to divide solid materials in the slurry flowing into the casing structure and pump intake.

This invention relates to slurry processing apparatus, and more specifically to a slurry agitator and cutter means adapted to operate in conjunction with each other to maintain the agitator and its drive means free of accumulations of solids and to divide solids contained within the slurry.

In systems wherein a mixture of liquid and solids is processed, such mixture being otherwise known as a slurry, it is frequently necessary to provide a storage region for the slurry until it may be used. A slurry requires circulation or other means of agitation to maintain its solids in suspension and may need treatment to reduce the size of large solids contained in the slurry. Agitation may be produced by a propeller rotated through a motor-driven drive shaft, however, difficulties may arise in the use of such an agitator where the slurry contains solids which tend to accumulate on the agitator. This is especially a problem where the slurry contains fibrous, stringy, or other flexible materials which have a tendency to wrap around a rotating propeller and shaft. The undesirable accumulation of these materials on the propeller and shaft decreases the efficiency of the agitator, and may result in undue wear of the parts within the system.

A general object of this invention is to provide novel means for preventing the accumulation of solids on a slurry agitator and its drive means.

In furtherance of this objective, it is an object to provide apparatus for handling slurries which comprise the combination of a motor-driven rotating shaft, an agitator attached to and rotating with the drive shaft, and cutter means adjacent the agitator adapted to maintain both the agitator and drive shaft free of solid materials which otherwise might collect thereon.

More particularly, it is an object of this invention to provide novel means for maintaining an agitator and its drive shaft free of collections of solid materials which includes a cutter element adjacent the agitator and drive shaft, attached to and rotatable with the shaft and agitator, and a stationary cutter element providing with he first-mentioned cutter element a shearing action for cutting up solids.

Often slurry processing systems also incorporate a distribution pump with an intake for the pump submerged within the slurry. Where the mixture contains solids of appreciable size, damage may occur to the pump if such solids are drawn into it. Screens may be provided at the intake to prevent this, however, such screens are subject to the accumulation thereon of solids suspended in the slurry which plug the pump intake and reduce the working efficiency of the system.

A further object of this invention, therefore, is to provide novel cutter means at a slurry distribution pump intake, adapted to reduce the size of solids suspended in the slurry prior to the slurry entering the pump.

This invention further contemplates the provision of casing structure at the intake of a slurry distribution pump, with chambers through which slurry flows to enter the pump, and a check valve controlling flow between the chambers permitting flow of slurry toward the pump while inhibiting reverse flow. This reduces pump priming problems.

The apparatus of this invention is relatively simple in construction, and as a consequence, is inexpensively produced. It provides trouble free organization for preventing the accumulations of solids on a slurry agitator and its drive means, and for simultaneously dividing large solids within a slurry.

These and other objects and advantages are attained by the invention, and the same is described hereinbelow in conjunction with the accompanying drawings, wherein:

FIG. 1 is a cross-sectional elevation view of slurry treatment apparatus including a storage tank having defined storage chambers therein, a propeller-type agitator, a pump, and motors positioned on a deck above the storage tank which drive the pump and agitator;

FIG. 2 is a top plan view of the apparatus shown in FIG. 1, further illustrating the storage tank, motors and pump;

FIG. 3 is a side elevation view of the propeller-type agitator and associated structure shown in FIG. 1, drawn on a slightly larger scale and with portions of a casing in the structure broken away;

FIG. 4 is a view taken along the line **4**—**4** in FIG. 3, showing in plan one of a pair of cutter elements provided in the structure; and

FIG. 5 is a view taken along line **5**—**5** in FIG. 3, showing in plan a propeller in the agitator and another of the pair of cutter elements in the structure.

Referring now to the drawings and first of all more particularly to FIGS. 1 and 2, at **10** is shown generally a storage tank in which may be stored a mixture of liquids and solids, also referred to herein as a slurry.

Tank **10** includes the usual side walls, such as the ones shown at **12**, and a floor made up of sloping floor portions **14**, **16**, and **18**. Covering the top of the tank is a platform **20** and decking **22**.

The interior of the tank is divided into at least a pair of chambers, shown at **24** and **26**, by a pair of vertical walls **28** and **30**. Wall **28** which may be a concrete wall extends between the sides of the tank but terminates short of these sides to provide a flow path for slurry around the ends of the wall. Wall **30**, which is generally at right angles to wall **28** and is shown joining the left end of the wall in FIGS. 1 and 2, is formed from a series of planks **32** fastened to uprights **34**. Chamber **24** extends to the right of wall **30** in FIG. 1 and is bounded along its base by floor portion **18**. Chamber **26** extends to the left of wall **30** and thence to the far side of wall **28** in FIG. 1 and is bounded by floor portions **14**, **16**.

Mounted on platform **20** above the storage tank is a pump **40** utilized in withdrawing slurry from the tank. The pump is driven by energizing a motor **42** which has its output shaft **44** connected by belts **46** to pump shaft **48**. Fluid is exhausted from the pump through discharge conduit **50**. The slurry is supplied the pump intake **52** through an elongated conduit **54** which extends downwardly into the storage tank and which has its upper end connected by pipe structure **56** to the pump intake.

Adjacent the base of the storage tank is a propeller-type agitator, generally shown at **58**, which, as will be-

come more fully apparent, is operated to produce circulation of the slurry and, through such circulation, slurry agitation. The agitator is rotated under power through a power-driven drive shaft **60** which extends downwardly into the storage tank through a pipe **62**. Drive shaft **60** is rotated under power by energizing a motor **64** mounted on the platform **20** adjacent motor **42**. Connecting the output shaft **66** of motor **64** and the upper end of drive shaft **60** are belts **68** trained over suitable pulleys secured to the output shaft and drive shaft respectively.

As is best seen in FIG. 1, the propeller-type agitator is mounted within the confines of a cylindrical shroud or duct **70**. Such shroud, which is open at opposite ends, is supported adjacent the base of the tank on a platform **72** which extends between the base of wall **30** and the left margin of floor portion **18** in FIG. 1. The interior of shroud **70** provides a flow path for slurry from chamber **26** through the shroud into chamber **24**.

Referring now more particularly to FIGS. 3, 4, and 5, suitably fastened to the base of pipe **62**, which encases drive shaft **60**, and conduit **54**, providing for the feed of slurry to the pump, is casing structure **76**. This includes a substantially cylindrical portion **76***a* concentric with conduit **54** and a substantially cylindrical portion **76***b* concentric with pipe **62**. Casing wall **80** closing off a part of cylindrical portion **76***b* is provided with an opening, shown at **82**, permitting slurry within the chamber defined within cylindrical portion **76***b* to pass into the chamber defined within the interior of cylindrical portion **76***a*. A check valve, more specifically a flapper valve **84**, hinged to the casing structure at **86** swings upwardly to the position shown in FIG. 3 to accommodate slurry flow upwardly into the latter of these two chambers. Slurry flow in the reverse direction, however, is inhibited by the valve dropping downwardly to close off opening **82**.

Propeller-type agitator **58** comprises a propeller **90** which is nonrotatably secured to the base of drive shaft **60** through suitably securing the hub **92** of the propeller to an end portion of the drive shaft protruding below casing structure **76**. As contemplated herein, with operation of the agitator the slurry is simultaneously subjected to a chopping action effective to divide solids in the slurry, whereby entanglement of solid material on the drive shaft is inhibited and the material supplied the pump is in such form as to be easily handled by the pump.

To this end it will be noted that secured to shaft **60** directly adjacent propeller **90** is an elongated cutter element, more specifically a bar, shown at **94**. Shaft **60** extends through the bar at a point located midway between its ends. Each longitudinal edge of the bar is sharpened as by beveling the edge on the underside of the bar along its length. The bar fits within a suitably recessed region extending along the trailing edges of the agitator propeller so that the top face of the bar is flush with the trailing edges where such edges extend outwardly on the propeller blades from the ends of the bar.

Superimposed over bar **94** is another cutter element comprising what is referred to herein as shear plate **96**. Such shear plate includes an annnular expanse **96***a* encircling the drive shaft, and integral with this expanse arms **96***b*, which extend radially of shaft **60**. Projecting outwardly from the annular expanse, at approximately the location of the arms, are projections **96***c*. The shear plate rests on bar **94**, and projections **96***c* are received within notches **98** formed in the casing structure, with the shear plate in this manner prevented from rotating with rotation of shaft **60**.

Mounted on wall **80** of the casing structure above expanse **96***a* at approximately the point where each arm **96***b* joins with the expanse is a travel limiting stud **100**. In FIG. 3 only two of such studs are shown as the other one has been removed from the drawing. These studs limit the upward travel permitted the shear plate with respect to bar **94**, and obviously with adjustments made in the position of these studs the amount of free travel permitted the shear plate may be changed.

Describing now how the apparatus described may be operated to produce agitation of the slurry and chopping up of solids in the slurry, motor **64** is operated to produce rotation of drive shaft **60** and the propeller-type agitator which is at the base of the shaft. With rotation of the agitator, slurry (which typically might be at the level indicated at **102**) is caused to circulate within the tank with such passing from chamber **26** and through shroud **70** into chamber **24**, thence to return to chamber **26** by flowing around the right end of wall **28** in FIG. 1. With such circulation solids in the slurry tend to be maintained in suspension. When it is desired to remove slurry from the tank, pump **40** which constitutes a distribution pump in the apparatus is operated through energizing of motor **42**. With energizing of the pump a low pressure condition results in conduit **54** and slurry is drawn into the conduit through casing structure **76**, with such slurry then traveling to pump intake **52**. Valve **84** opens to accommodate slurry flow through aperture or opening **82**. Slurry on flowing into the casing structure passes through openings defined in the shear plate between the arms **96***b* of the shear plate. Solids in such slurry are subjected to a shearing action as the ends of bar **94** move in repeated shearing strokes across the lower faces of arms **96***b*.

To stop the distribution of slurry the pump is stopped. Valve **84** closes to hold a column of the slurry in conduit **54**. Slurry flow into the casing structure stops. The propeller-type agitator then functions only to produce circulation within the storage tank.

The apparatus of the invention has been found to constitute a practical answer to the problem involved in handling slurry which otherwise would tend to produce fouling of the propeller-type agitator and damage to the pump if permitted to flow into the pump.

While an embodiment of the invention has been described, variations and modifications are possible without departing from the invention. It is desired to cover all such modifications as would be apparent to one skilled in the art, and that come within the scope of the appended claims.

It is claimed and desired to secure by Letters Patent:

1. Slurry processing apparatus comprising a power-driven rotatable shaft, an agitator mounted on said shaft for rotation with the shaft and operable on such rotation to produce a flow of slurry in a path extending along the shaft toward one end of the shaft, cutter means including a cutter element mounted on said shaft toward said one end of the shaft from the agitator in the flow path of said slurry movable with the shaft, operable on movement to divide solids in the slurry, casing structure mounted adjacent said cutter means defining a chamber receiving slurry flowing in said path and past the cutter means, and conduit means connecting with said chamber for channeling slurry from said chamber.

2. The apparatus of claim **1**, wherein said cutter means further comprises a shear plate which encircles the shaft and said shear plate has spaced-apart cutter arms extending radially outwardly from the shaft, each of said arms including a cutting edge, said cutter element moving in a shearing stroke over said cutting edges on rotation of said shaft.

3. The apparatus of claim **1** which further comprises a pump for pumping the slurry, and wherein the intake of said pump is connected to said conduit means to be supplied slurry through said conduit means.

4. Slurry processing apparatus comprising a duct, a power-driven rotatable shaft and a propeller mounted on said shaft for rotation with the shaft, said propeller on rotation of the shaft producing a flow of slurry in a path extending through the duct in a direction generally paralleling the axis of the shaft, casing structure spaced along the axis of said shaft from said propeller and inwardly of the sides of the duct whereby a passage is provided for slurry flow through the duct and around the outside of the casing structure, said casing structure defining a cham-

ber for receiving a portion only of the slurry flowing in said path through said duct, cutter means including a cutting element mounted on said shaft adjacent the propeller operable on rotation of the shaft to divide solids in the slurry received in said chamber, and conduit means connecting with said chamber for channeling slurry from said chamber.

5. The apparatus of claim 4, wherein the propeller is mounted on one end of the shaft and the flow of slurry produced by the propeller is from said one end toward the shaft's opposite end, the casing structure encircles the shaft and is located toward the shaft's opposite end from the shaft's said one end, and said cutter means is located toward the casing structure from the propeller.

6. The apparatus of claim 4 which further comprises a pump for pumping slurry, and wherein the intake of said pump is connected to said conduit means to be supplied slurry by the conduit means.

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U.S. Cl. X.R.

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