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APPARATUS FOR TREATING FLUID SUSPENSIONS

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FIG. 1

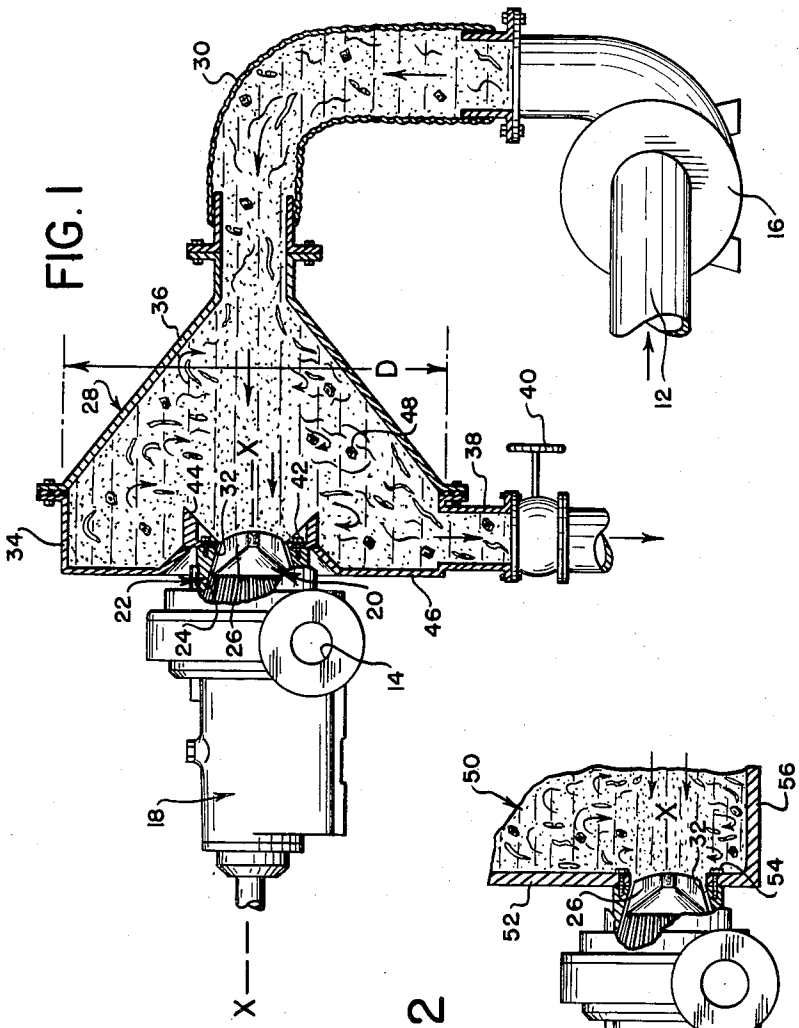
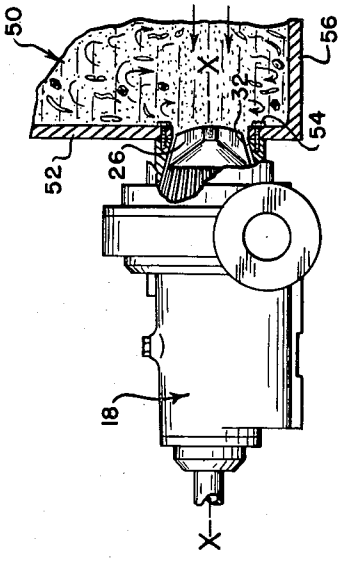


FIG. 2



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APPARATUS FOR TREATING FLUID SUSPENSIONS

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3 Claims. (Cl. 241—46)

This invention relates to apparatus for treating fluid suspensions, and more particularly to apparatus for treating suspensions, for example thick suspensions of cellulosic pulp in water, which contain foreign matter such as metallic fragments, stones, string and the like.

It is often desired that such suspensions be passed through machines including relatively rotating members which have small clearance between them, such as comminuting and grinding machines, and the presence of foreign matter in the suspension leads to the stoppage of these machines and often to their rupture and breakdown.

In accordance with the invention, there is provided in combination a machine having relatively rotatable rotor and stator members and an inlet chamber for supply to the machine of suspension to be treated by it, the inlet chamber being disposed immediately in advance of the machine in the sense of flow of the suspension through the chamber and machine. The chamber possesses a diameter or dimension transverse of that direction of flow large compared with the corresponding dimension of the machine. By means of this construction there is induced in the chamber by operation of the machine a rotation of the suspension which effects a separation of the foreign matter from the suspension passing into the machine, the foreign matter being thrown by centrifugal force to the outer limits of the chamber from whence it can be periodically withdrawn.

It is possible, according to the invention, to use as the inlet chamber for the machine a tank of relatively large dimensions, such as a paper mill vat. The inlet chamber may be open or closed, and may be disposed in a system of piping anywhere between the inlet and outlet ends thereof, but it must be placed close to the machine which is to be combined with it for inducing rotational flow of the suspension in the chamber. It is advantageous, but not necessary, that the chamber have its shape generally symmetrical about the flow axis through the machine.

The invention will now be further described in conjunction with the accompanying drawings wherein:

Fig. 1 is a view partly in side elevation and partly in axial, vertical section showing one embodiment of the invention; and

Fig. 2 is a similar view illustrating a modification.

In the embodiment of the invention shown in Fig. 1 the machine and its associated inlet chamber are shown disposed as adjacent elements in a system of piping, the portion of the system shown having an inlet at 12 and an outlet at 14. The piping system may of course include other elements, either upstream of the inlet conduit 12 or downstream of the outlet 14, or both.

The inlet leads to a pump 16, shown as a centrifugal pump. The outlet 14 is a tangential outlet from a machine generally indicated at 18, shown as a comminuting machine, which includes rotor and stator members generally indicated at 20 and 22. These rotor and stator members move past each other with close clearance which, particularly in the comminuting stages of the machine, of which one stage is shown at 24, may for example be of the order of a few millimeters or even a few tenths of a millimeter. The comminuting stage 24 includes cooperating toothed rotor and stator surfaces conforming substantially to a common frusto-conical surface except for the small clearance between them.

A comminuting machine advantageously useable in the invention is that disclosed in U.S. Patent No. 2,888,213 assigned to the assignee hereof, although the invention is not limited to such machines.

The machine 18 includes at its inlet end blades 26 on its rotor. These blades, which may perform a preliminary comminuting function, by their rotation impart a rotary motion to the suspension in the inlet chamber generally indicated at 28 which immediately precedes the machine 18 in the sense of flow of the suspension through the system.

The pump 16 draws the suspension to be treated, from the inlet 12 through any suitable piping connection 30 into the inlet chamber 28. This chamber is distinguished by a diameter D in the portion thereof immediately adjacent the inlet end of the machine and hence adjacent to the rotating blades 26 large compared to the diameter of those blades and large compared to the diameter of the annular passage 32 existing between the rotor and stator elements of the machine at its inlet end. This is the annular passage through which the suspension must flow in order to pass through the machine.

In the embodiment of Fig. 1 the inlet chamber 28 comprises a generally cylindrical portion 34 having the large diameter D referred to and a frusto-conical portion 36 which couples the cylindrical portion 34 with the conduit 30.

For evacuation from the system of the foreign matter separated by the joint action of the machine 18 and inlet chamber 28, the latter is provided at the periphery of its large-diameter cylindrical portion 34 with a drain connection 38, in which a valve 40 is inserted.

The cylindrical portion 34 of the chamber 28 is affixed to the stator 22 of the machine 18 at the inlet end of the latter by means of bolts 42 counter-sunk into a shallow frusto-conical flange 44 which converges, in the direction of flow of the suspension through the machine 18, on the axis X—X of its rotor 20. The flange 44 forms generically part of the end wall 46 of chamber 28.

The arrangement of the wall 46 and flange 44 is such that blades 26 lie, in the embodiment of Fig. 1, not only flush with but upstream of the plane portion of end wall 46 and hence within the cylindrical volume of portion 34 of chamber 28.

In the operation of the machine of Fig. 1 the chamber 28 is filled by operation of the pump 16 with the suspension to be treated by machine 18. Apparatus as shown in Fig. 1 has been successfully operated with a suspension of cellulosic pulp including 5% dry cellulose by weight, with accidental and undesired inclusion of foreign matter to whose elimination the invention is directed. Such foreign matter is indicated in the figure at 48, where it is shown in the process of being thrown outward toward the periphery of the cylindrical portion 34 of chamber 28.

A modified form of apparatus according to the invention is shown in Fig. 2. In this embodiment the machine 18 is shown coupled to an inlet chamber 50 having a plane end wall 52 adjacent the machine 18, the coupling of the machine to the chamber being effected by means of bolts 54 passing into the stator housing of the machine so as to position the blades 26 of the latter flush with the inner surface of wall 52.

The side walls of the chamber, of which only one is shown at 56, are radially farther from the axis of rotation X—X of the machine 18 than the annular inlet

channel 32 of the machine. Consequently the rotational or vortex flow produced by blades 26 in the portion of the suspension adjacent the machine throws particles of foreign matter therein radially outward beyond the annular inlet aperture 32 and consequently such foreign matter does not pass into the machine.

In experiments performed with apparatus as shown in Figs. 1 and 2, employing a suspension of 5% by dry weight of cellulose, applicants observed that the apparatus of these figures performed perfectly for periods of hours, despite the intentional addition to the suspension of particles of metallic foreign matter larger than the clearances of the machine 18.

While the apparatus of the invention has been described herein in terms of two preferred embodiments, various modifications may be made in the apparatus described without departing from the scope of the invention as set forth in the appended claims. For example, the impeller means or vanes shown at blades 26 in the drawings may take other forms, according to the nature of the suspension or slurry to be treated.

Moreover, and particularly when the apparatus of the invention is inserted into and forms part of a system of piping, the inlet chamber of the apparatus of the invention being then closed, the inlet chamber may be cylindrical in shape, with the inlet to and the outlet from the chamber one in each of the end walls of the cylinder to which the inlet chamber then conforms. The inlet to and outlet from the chamber are then preferably collinear, but are eccentrically positioned with respect to the axis of the cylindrical chamber itself. With this construction the inlet chamber includes an eccentric portion—that farthest from the common axis of the collinear inlet to and outlet from the chamber. The operation of the machine with its moving rotor at the outlet from the chamber then produces relatively little rotary motion and little centrifugal turbulence in this eccentric portion of the chamber, and the foreign matter (which is for the most part denser and heavier than the pulp or other matter intentionally included in the suspension), being ejected from the zone adjacent the collinear axis of the machine rotor and outlet and inlet apertures to the chamber, accumulates in this eccentric portion of the chamber. The machine is accordingly protected from such foreign matter.

In the two preferred embodiments of the invention as illustrated in Figures 1 and 2, the machine coupled to the inlet chamber performs two functions: first it imparts the desired rotary motion to the suspension in the inlet chamber by means of blades 26, secondly, it produces a comminuting action on the suspension passing through it; the portion of the machine which performs the first function must be the first one to be reached by the flow of the suspension passing through the machine. Without departing from the scope of the invention, the part played by the machine formed of relatively rotatable stator and rotor members and coupled to the inlet chamber may be limited to the first function as hereabove indicated, that is imparting the desired rotary motion to the suspension in the inlet chamber; in this case, it may include only the elements necessary to impart said rotary motion.

We claim:

1. Apparatus for treating a viscous suspension in which particles of foreign matter are suspended by the viscosity of said suspension, said apparatus comprising a stator, a rotor mounted for rotation within the stator, said rotor and stator defining an annular passage therebetween through which said suspension is to be passed, said passage being coaxial in the axis of rotation of said rotor, said passage having a radial dimension small compared to its radial distance from said axis, an inlet chamber disposed in advance of said rotor and stator in the sense of flow of suspension through said chamber and passage, said chamber having a cross section transversely of said axis substantially greater than the diameter of said passage, an inlet connection to said chamber disposed substantially coaxially of said axis, and impeller means disposed on the end of said rotor exposed to said chamber, said impeller means having a diameter small compared to said cross section and said stator being shaped to expose to said chamber the major fraction of the diameter of said impeller means, whereby said suspension is subjected to rotation within said chamber in its passage between said inlet connection and said annular passage, said apparatus further comprising an outlet from said chamber at the periphery thereof remote from said axis.

2. Apparatus for treating a viscous suspension in which particles of foreign matter are suspended by the viscosity of said suspension, said apparatus comprising a stator, a rotor mounted at one end thereof for rotation within said stator, said rotor and stator defining an annular passage therebetween through which said suspension is to be passed from the other end of said rotor toward said one end, said other end of said rotor being unsupported, said passage being coaxial with the axis of said rotor, said passage having a radial dimension small compared to its radial distance from said axis, an inlet chamber disposed in advance of said rotor and stator in the sense of flow of suspension through said chamber and passage, said chamber having a cross section transversely of said axis substantially greater than the diameter of said passage, and impeller means disposed on the end of said rotor exposed to said chamber, said impeller means having a diameter small compared to said cross section and said stator being shaped to expose to said chamber the major fraction of the diameter of said impeller means, whereby upon rotation of said rotor the suspension within said chamber is subjected to rotation before entry to said passage, said apparatus further comprising an outlet from said chamber at the periphery thereof remote from said axis.

3. Apparatus for treating a viscous suspension in which particles of foreign matter are suspended by the viscosity of said suspension, said apparatus comprising a stator, a rotor mounted at one end thereof for rotation within said stator, said rotor and stator defining an annular passage therebetween through which said suspension is to be passed from the other end of said rotor toward said one end, said other end of said rotor being unsupported, said passage being coaxial with the axis of said rotor, said passage having a radial dimension small compared to its radial distance from said axis, an inlet chamber disposed in advance of said rotor and stator in the sense of flow of suspension through said chamber and passage, said chamber having a cross section transversely of said axis substantially greater than the diameter of said passage, means defining an inlet to said chamber substantially coaxially of said axis, and vanes disposed on the end of said rotor exposed to said chamber, said vanes having a diameter small compared to said cross section and said stator being shaped to expose to said chamber the major fraction of the diameter of said vanes, said apparatus further comprising an outlet from said chamber at the periphery thereof remote from said axis.

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