

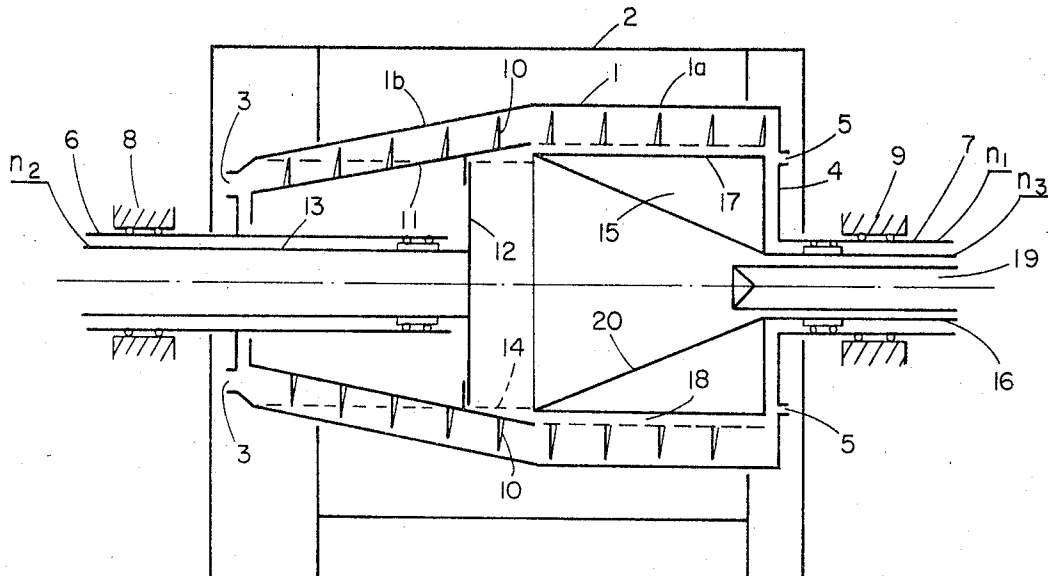
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CONTINUOUSLY OPERATING SOLID-BOWL CENTRIFUGE

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CONTINUOUSLY OPERATING SOLID-BOWL CENTRIFUGE

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5 Claims

ABSTRACT OF THE DISCLOSURE

A continuously operating solid-bowl centrifuge comprising a rotatable outer centrifuge bowl, a coaxially mounted screw conveyor within the bowl for the removal of solids, rotatable at a velocity different from that of the bowl and being immersed for a portion of its length in the centrifuge liquid pool, and a rotationally symmetric accelerating body with an inner wall shaped as a slurry feed cone within the conveyor and totally immersed in the pool, mounted cantilevered within the bowl's hollow shaft and being independently rotatable at a velocity greater than that of either the bowl or conveyor.

The invention relates to a continuously operating solid bowl centrifuge for handling solids which are difficult to settle.

Continuous solid bowl centrifuges consist of a rotating solid bowl and a conveying member mounted concentrically within the bowl. The bowl is rotated at a speed which will give the desired centrifugal force. The conveying member is inter-connected with the bowl by gearing so that it will rotate at a slight difference in speed.

Centrifuges of this type are not always able to effectively separate solids from liquids where the solids are wholly or partially made up of particles in a colloidal size range such as for instance sewage sludges. In applications of this kind the centrate most always has to be returned to the circuit at some point. Since the centrate will contain the extremely fine portion of the solids fed to the machine; that is, particles generally in the range of 2 microns or less, the result is that there can be a buildup of these fines in the system after a period of time, the rate of buildup depending on the proportion of fines left in the filtrate.

One method to improve recovery of fine solids by the centrifuge is to add floc reagents ahead and/or into the centrifuge. In certain sewage wastes it is also possible to bring about flocculation by biological treatment before centrifuging. The additional cost of flocculation can be burdensome.

Many attempts have been made to design solid bowl centrifuges so as to improve their separating efficiency. One example is the incorporation of the so-called concurrent flow principle. Normally feed enters the centrifuge in a zone located approximately midway between the effluent discharge end of the bowl and the solids discharge ports at the extreme opposite end. The incoming feed has a tendency to disturb solids which have already settled out and thus reduces separating efficiency. In the concurrent flow, feed enters at the end of the bowl opposite to the solids discharge ports and the clarified liquor is skimmed off approximately at a point where the solids emerge from the liquid in the bowl and are conveyed to the solids discharge ports. Both solids and liquids therefore flow in the same direction and there is no resuspension of solids which have already settled out. (U.S. Patent 1,383,313.)

Another means of providing increased separating efficiency is to extend the length of the bowl. Solid bowl centrifuges have been designed with a diameter to length ratio as of high as 1:5. With solid bowl centrifuges having a high diameter to length ratio and operating at relatively high speeds improved settling ability has been shown to be possible but the classifying effect may still persist even though only the very finest particles will appear in the centrate.

Another design involves a conveying member with a relatively narrow or ribbon type helix. In this design that portion of the helix which lies between the effluent ports and the feed zone is completely submerged in the liquid. (French Patent 958,825.) As a result, the incoming slurry does not follow the turns of the helix but rather can travel in a direction parallel to the axis from point of feed to point of effluent discharge. This axial flow reduces the flow velocity but acceleration of the slurry to full bowl speed occurs only relatively close to the point of effluent discharge. The invention is based on an improvement of this design which provides rapid acceleration to full bowl speed or even above bowl speed of the liquid which lies above the helix. The acceleration is effected by immersing in the liquid an accelerating body having rotationally symmetric form, mounted coaxially with respect to the bowl and supported independently with respect to the bowl and conveyor. This accelerating body can be driven at greater rotational speeds than either conveying member or centrifuge bowl. It therefore imparts a higher rotational velocity starting in the region of the surface of the liquid which rotational velocity is higher than could be obtained with the screw conveyor and centrifuge bowl alone. This makes it possible to separate finer particles than previously thus increasing the efficiency of solids removal. In a particularly advantageous design the inner wall of the accelerating body may be shaped in a known manner as a feed inlet cone increasing in diameter in the direction of slurry flow and accelerating the incoming feed slurry as it passes along the wall of the cone.

The accelerating body is expediently mounted independently of the hollow shaft of the centrifuge bowl. It is also advantageous to provide it with an independent drive and thus avoid the need for limiting the speed of this accelerating body.

The drawing is a schematic longitudinal section of an example form of centrifuge construction according to the invention.

The centrifuge consists of an outer solid bowl 1, which is surrounded by a housing 2. The solid bowl of the centrifuge comprises a cylindrical part 1a and a conically reduced part 1b. At the end of the conical part there are provided apertures 3 for the removal of solid matter, and in the opposite end wall 4 there are provided apertures 5 for the removal of clarified fluid. The shafts 6 and 7 of the centrifuge bowl are rotatably mounted outside the housing 2 in bearings 8 and 9 respectively.

Within the centrifuge bowl 1 there is mounted a screw conveyor 10 for the removal of solid matter whose shape corresponds approximately to that of the centrifuge bowl 1. In the conical part the helical turns are mounted on a conically shaped screw conveyor drum 11, while in the cylindrical part they are unsupported or, as is not shown in the drawing, are partially supported by means of bars or the like, so that unhindered settling of solid matter is assured. The screw conveyor drum 11 is connected to the drive shaft 13 for the screw conveyor through an end plate 12, and the drive shaft in turn is rotatably mounted in the hollow shaft 6 of the centrifuge drum. The height of the screw conveyor helical turns in relation to the liquid overflow 5 is so chosen, that the turns in the cylindrical

portion are located completely below the cylindrical liquid level 14 which establishes itself within the centrifuge.

Coaxially with respect to the centrifuge bowl 1 and the screw conveyor 10 there is mounted, in the region of the cylindrical portion of the centrifuge, an accelerating body 15 which is supported overhung and rotatably with the aid of shaft 16 in the hollow shaft 7 of the centrifuge bowl 1. The outer bowl 17 of the accelerating body is rotationally symmetric. In the construction shown in the example it is cylindrical, but it may also be conical or have any other rotationally symmetric shape. The diameter of this part is so chosen that the accelerating body protrudes into the liquid bath, but maintains a free radial distance from the screw conveyor 10, so that between the conveyor screw 10 and the accelerating body there remains a ring-shaped flow channel 18 for the fluid.

Through the hollow drive shaft 16, a slurry feed tube 19 extends into the interior of the double-walled accelerating body 15. The internal wall 20 of the accelerating body represents a slurry feed cone which widens in the flow direction of the entering fluid.

During operation the centrifuge bowl 1 rotates at r.p.m. n_1 , while the conveyor screw 10 for solid removal rotates at a slightly lower r.p.m. n_2 in the same direction. The accelerating body, which is driven independently, rotates in the same direction as the screw conveyor and the centrifuge bowl, but with an r.p.m. n_3 which is higher than n_1 or n_2 . The slurry introduced through tube 19 impinges upon the rotating slurry inlet cone 20 and is pre-accelerated by the latter. The slurry then reaches the pool and flows essentially through the ring-shaped channel 18 to the centrate overflow 5. Along this path it is further accelerated by accelerating body 15, so that at least its surface rotates at a higher velocity than the solid removal screw conveyor 10 and the centrifuge bowl 1. The fine solids suspended in the slurry are therefore subjected to high centrifugal forces, so that even very fine particles are driven outward into the range of the solid removal screw conveyor. Even during the settling process these particles are transported to the solid outlet by the helical turns of the conveyor screw. During this transportation process the solid particles are able to deposit completely onto the inner wall of the bowl. The liquid removed from the surface of the slurry is practically free of solids.

The accelerating body of the centrifuge according to the invention is also particularly advantageous during starting of the centrifuge. During this process the accelerating body can be used in the sense of a fluid clutch. For this purpose the machine is first charged with water prior to the starting process. When the water level inside the centrifuge has risen to overflow 5, one starts first the motor for accelerating body 15. By fluid friction the entire system is then set into slow rotation, so that one can subsequently start the main motor for the centrifuge without causing excessive starting torque.

Other embodiments of the invention will occur to those skilled in the art and are within the following claims.

What is claimed is:

1. A continuously operating solid bowl centrifuge for slurries containing solid materials which are difficult to settle, comprising a rotatable outer centrifuge bowl; a screw conveyor located within said bowl for the removal of solid materials, said conveyor being rotatable at a velocity different from said bowl and being located to be immersed completely in the centrifuge liquid pool over a portion of its axial length; and a rotationally symmetric accelerating body having a radial free distance with respect to said solid removal conveyor, said accelerating body being located to be immersed in said pool, being mounted coaxially with respect to said screw conveyor and said centrifuge bowl, and being independently rotatable.

2. A solid bowl centrifuge according to claim 1, characterized by said accelerating body having an inner wall shaped as a slurry feed cone which widens in the direction of slurry flow.

3. A solid bowl centrifuge according to claim 1, characterized by the shaft of said centrifuge bowl being hollow and said accelerating body being mounted cantilevered within said shaft.

4. A solid bowl centrifuge according to claim 1, characterized by a rotational drive to which said accelerating body is connected so that said accelerating body is rotatable with a velocity of rotation greater than that of either said bowl or said conveyor.

5. A continuously operating solid bowl centrifuge for slurries containing solid materials which are difficult to settle, comprising a rotatable outer centrifuge bowl, the shaft of said bowl being hollow; a screw conveyor located within said bowl for the removal of solid materials, said conveyor being rotatable at a velocity different from said bowl and being located to be immersed completely in the centrifuge liquid pool over a portion of its axial length; a rotationally symmetric accelerating body having a radial free distance with respect to said solid removal conveyor, said accelerating body being located to be immersed in said pool, and being mounted cantilevered within said shaft, coaxially with respect to said screw conveyor and said centrifuge bowl, said accelerating body having an inner wall shaped as a slurry feed cone which widens in the direction of slurry flow; and a rotational drive to which said accelerating body is connected so that said accelerating body is independently rotatable with a velocity of rotation greater than that of either said bowl or said conveyor.

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