Feb. 13, 1968 A. C. LAVANCHY ETAL 3,368,747

CENTRIFUGE

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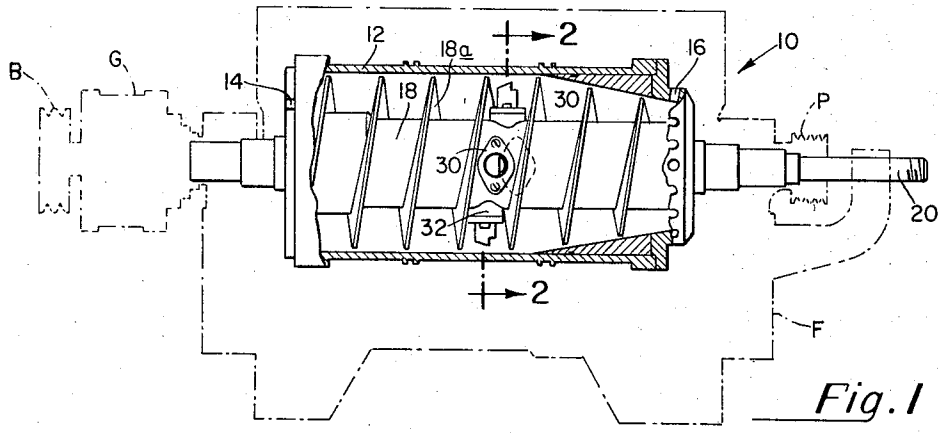

Fig. 1

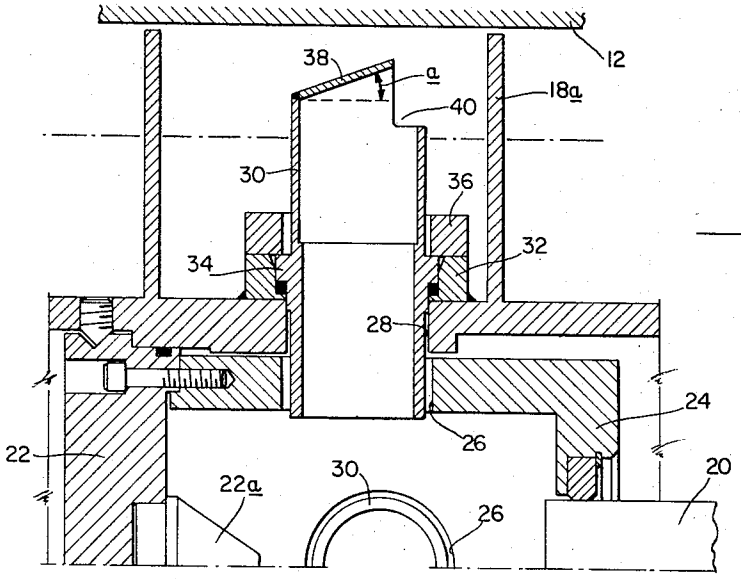

Fig. 3

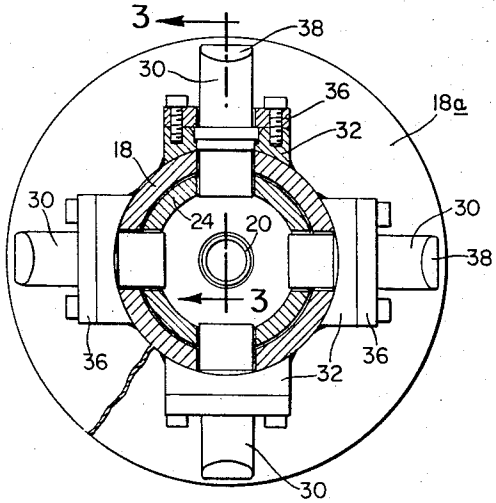

Fig. 2

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Fig. 4

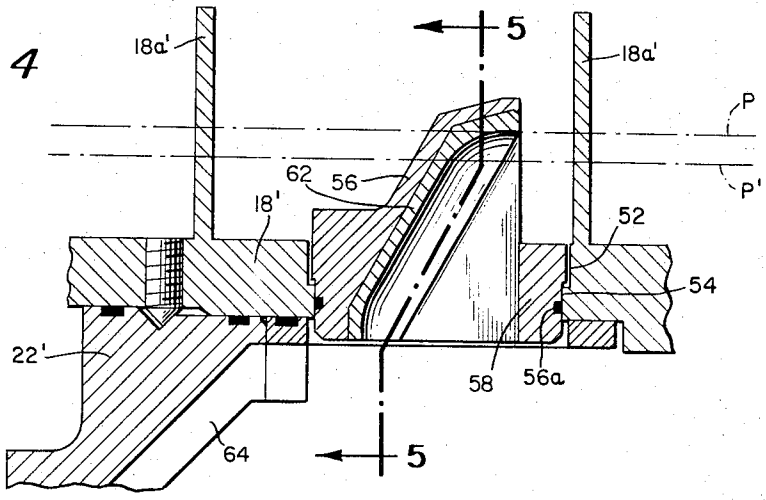
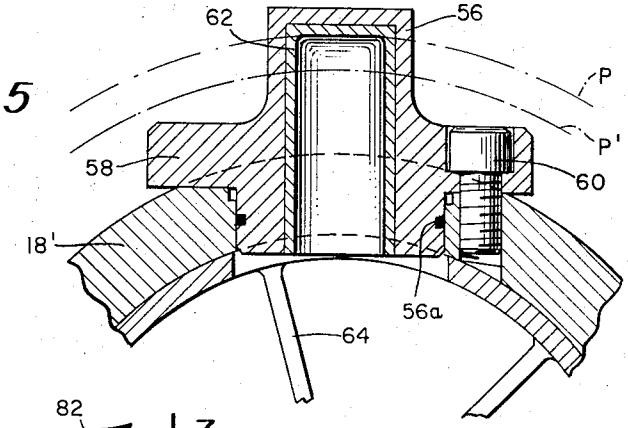


Fig. 5



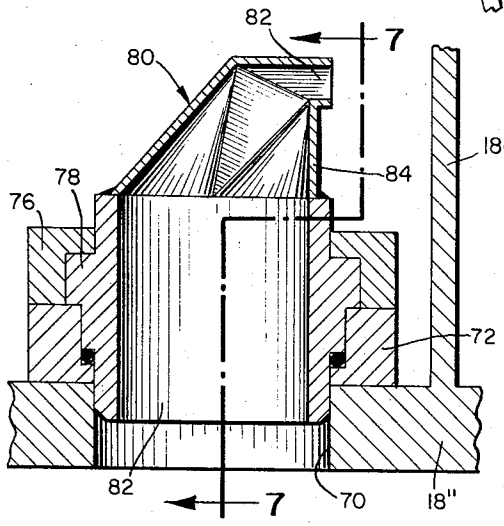


Fig. 6

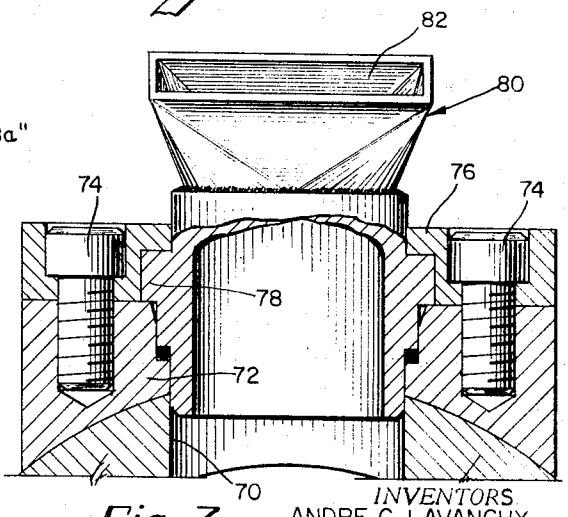


Fig. 7

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CENTRIFUGE

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Continuation-in-part of application Ser. No. 498,296, Oct. 20, 1965. This application Sept. 2, 1966, Ser. No. 585,995

5 Claims. (Cl. 233—7)

ABSTRACT OF THE DISCLOSURE

In a continuous solids discharge centrifuge having a screw conveyor, feed nozzles are provided which extend out into the pond and direct the feed towards the solids discharge end of the centrifuge bowl.

This application is a continuation-in-part of application Ser. No. 498,296, filed Oct. 20, 1965, and now abandoned.

This invention relates to centrifuge feed means. More specifically this invention relates to means for delivering centrifuge feed out into the centrifuge bowl in a way which minimizes the disturbance of solids already settled in the bowl. It has particular reference to continuously operating solids-discharge centrifuges.

It is old in the art to provide a solid bowl centrifuge with an axial screw conveyor adapted to move solids toward one end of the bowl for discharge. Such a centrifuge is shown in the Reed Patent 3,148,145. Conventionally in such centrifuges the feed has been delivered through an axial feed tube to a feed-receiving pocket inside the centrifuge conveyor. From the pocket feed has passed outwardly into the bowl through a plurality of nozzles in the conveyor. Such nozzles normally have taken the form of a straight tubular element mounted in the centrifuge conveyor and extending in a radial direction. Usually the feed nozzles have stopped short of the pond; that is, inward of the liquid level within the centrifuge bowl. In some instances, however, the feed nozzles have extended out into the pond in an effort to reduce the turbulence created at the vapor-liquid interface by the incoming feed material.

Under the present invention its is possible to improve the capacity of such a centrifuge while producing an effluent of the same clarity. This is accomplished by extending the feed nozzles out into the pond and providing their distal ends with deflecting surfaces and openings directing the incoming feed toward the solids discharge end of the bowl. Experimentation has indicated that a centrifuge equipped with nozzles embodying our invention can achieve 1.4 to 1.5 the capacity of the conventionally equipped centrifuge with the same clarity. This is a truly remarkable and unexpected performance.

Other objects of the invention will be understandable with reference to the following specification including drawings in which:

FIGURE 1 is an elevational view of a centrifuge having part of the bowl broken away to show the conveyor inside. The outline of the centrifuge is shown in phantom;

FIGURE 2 is an enlarged fragmentary sectional view on the line 2—2 of FIGURE 1;

FIGURE 3 is an enlarged fragmentary sectional view taken on the line 3—3 of FIGURE 2;

FIGURE 4 is a fragmentary sectional view of a modified form of feed nozzle embodying the invention;

FIGURE 5 is a fragmentary sectional view taken on the line 5—5 of FIGURE 4;

FIGURE 6 is a fragmentary sectional view of a further modification of a nozzle embodying the invention; and

FIGURE 7 is a sectional view taken on line 7—7 of FIGURE 6.

Briefly, in a continuous solids discharge centrifuge having a screw conveyor the invention is the provision of feed nozzles which extend out into the pond and direct the feed toward the solids discharge end of the centrifuge bowl.

Referring more specifically to the drawings, a centrifuge embodying the invention is generally designated **10** in FIGURE 1. It comprises a frame F mounting a bowl **12** having a liquid discharge port **14** at one end and a solids discharge port **16** at the other end. The bowl is provided with shafts and mounted for rotation to be driven by pulley P.

Within the bowl is disposed an axial screw conveyor **18** which is journaled in bearings in the end of the bowl and adapted to be rotated at a speed different from that of the bowl by gear box G to achieve a scrolling action of the solids towards the solids discharge port **16**. Speed differential may be regulated by backdrive pulley B. An axially disposed feed tube **20** extends inward through a bowl shaft and terminates inside of the conveyor (FIG. 3). Mounted transversely within the body of the conveyor **18** is a diffusion target plate **22** at which the feed is projected as it issues from the feed tube **20**. The target **22***a* secured to the plate directs the feed outwardly and the feed thereby forms a shallow pool within the cup **24** which is also secured to the target plate **22**. Openings **26** are provided in the cup and aligned openings **28** in the body of the conveyor. Feed distributing nozzles **30** extend through these openings from outside the conveyor.

The conveyor is provided with an apertured boss **32** around each opening **28** in the conveyor. The nozzles are each formed with an annular rib **34** which is received in the opening in the boss. A clamping plate **36** secured the nozzle by its rib **34** in the boss. Suitable sealing means may be provided.

At its distal end the nozzle is provided with a flat baffle **38** which deflects the feed in a rightward direction as shown in FIGURE 3. In that direction an opening **40** is formed in the tubular nozzle body. In other words the feed nozzle opening **40** and the baffle **38** direct the feed toward the rear surface of the next adjacent conveyor flight **18***a*. More generally the opening **40** and the baffle **38** direct the incoming feed in the direction of the end of the centrifuge bowl having the solids discharge port **16**. This is the preferred direction. However, some of the benefits of the invention may be achieved by directing the opening in the nozzle and the baffle in a direction opposite the direction of rotation. Preferably the baffle as shown in FIGURE 3 is angled (angle *a*) in the range from 45° to 15° from the horizontal.

The opening **40** on the tubular feed nozzle is disposed completely outward beyond the outermost level of the liquid discharge port **14**. This provides for the submerged

introduction of feed into the centrifuge pond and minimizes the disturbance caused by the introduction. However, the baffle is disposed radially inward of the distal edge of the screw flights **18***a*.

Actual tests using a conveyor equipped with feed nozzles as disclosed in FIGURE 1 and operating on dispersed clay indicated a 1.4 to 1.55 improvement in the capacity of a conventional machine having feed nozzles as shown in the aforementioned patent for the same clarity of discharge effluent through the port **14**.

As shown in FIGURES 4 and 5 a modified form of the invention may comprise a more open type feed nozzle arrangement. In this arrangement the conveyor body **18'** having the flights **18***a'* is provided with the target plate **22'**. The wall of the conveyor body **18'** is provided with an opening which is enlarged as at **52** to provide a circumferential surface **54**. In this version the feed tube takes the form of a scoop-shaped nozzle **56** having an enlarged flange **58** which abuts against a shoulder on body **18'** and is provided with suitable sealing means **56***a* in sealing engagement with the surface **54**. Bolt means **60** holds the nozzle on the body. The inside surface of the scoop-shaped nozzle may be coated with an abrasive resistance surfacing. In a preferred form the surfacing may be a tungsten carbide insert sintered in suitable shape then epoxied into the nozzle opening.

The level of the pond may be at P for instance or P'. When the level is at P' the bulk of the feed entering through the opening of the nozzle **56** is introduced to the pond beneath the surface thereof. When the level of the pond is set at P the feed is introduced at the surface level. In either case the feed is directed toward the solids discharge end of the centrifuge toward the rear face of the flight **18***a'* to the right of the nozzle as shown in FIGURE 4.

Within the conveyor accelerator ribs or vanes **64** promote radial acceleration of the feed.

In an actual field test in the plant of a corn processor two identical screw centrifuges were set up side by side. In one of the machines the four feed nozzles were conventional as shown in the U.S. Patent 3,148,145. In the other the nozzles were directional of the type shown in FIGURES 4 and 5, the openings of the nozzles being directed toward the solids discharge end of the centrifuge. To both machines was led a feed of distillers' "slops," or stillage, for dewatering. The fine fiber insoluble solids were present in the feed to a degree indicated in the table below and the feed rate for each machine ranged between 25 to 40 gallons per minute. A series of readings were taken, readings on both machines for each of a number of feed input rates. In the table below the electrical load on the machine fairly represents the feed rate since both machines had identical "no load" readings. The results provide a direct comparison between operation with the conventional nozzles and the directional nozzles.

Insoluble solids in Feed, percent w./w.	Amperage in each P-3000	Insoluble solids in discharges, percent w./w.			
		Conventional nozzles		Directional nozzles	
		Effluent	Cake	Effluent	Cake
1.86	20	0.46	20.6	0.05	20.8
2.09	20	0.29	22.7	0.06	22.1
2.17	15	0.33	23.2	0.02	22.2
2.17	19	0.45	22.9	0.13	20.3
1.54	16	0.20	(*)	0.04	(*)
1.54	22	0.31	(*)	0.07	(*)

*Data not available.

From the above table it can be seen that there was a marked reduction in the solids content of the effluent. The solids content of the effluent of the machine having the conventional nozzles varied in the range from roughly 4 to 16 times the solid content of the effluent of the directional nozzle machine for the same feed.

With the same set-up, the two machines being in side-by-side comparison, a series of readings were then taken on a feed comprising a slurry of fine fibers from wet corn milling. The feed was in the range of 25 to 50 gallons per minute. The results may be tabulated:

Insoluble solids in Feed, percent w./w.	Amperage in each P-3000	Insoluble solids in discharges, percent w./w.			
		Conventional nozzles		Directional nozzles	
		Effluent	Cake	Effluent	Cake
4.37	18	0.41	(*)	0.04	(*)
4.37	20	0.41	28.0	0.04	25.5
3.59	16	0.33	22.9	0.03	20.7
3.59	22	0.22	23.7	0.03	22.6

*Data not available.

From the above it can be seen generally that in using directional nozzles the liquid effluent contained in each case is roughly a tenth of the insoluble solids of the screw centrifuge having conventional nozzles.

Other direct comparisons were made of the same type machine, one having conventional nozzles and the other directional nozzles of the type shown in FIGURES 4 and 5. For instance, the soft flocky non-packing solids in underflow from a settling basin containing activated domestic sewage were centrifugally dewatered in the two machines. With the directional nozzle machine as shown in FIGURES 4 and 5 a reasonable settling in the bowl could be achieved employing an economical level of polyelectrolyte coagulant. Using the screw machine with the conventional feed nozzles, on the other hand, the amount of polyelectrolyte necessary to effect a reasonable separation was economically prohibitive. The advantage of the directional nozzles is abundantly clear.

A modified feed nozzle is shown in FIGURES 6 and 7. The conveyor body **18''** formed with the flight **18***a''* is provided with an opening **70** communicating with the feed supply on the inside of the conveyor. The opening is reinforced with a collar **72** to which is secured by bolt means **74** a clamping ring **76**. The clamping ring is undercut as shown to hold tightly the flange **78** of the nozzle proper **80**. The opening through the nozzle **80** terminates upwardly as shown in FIGURES 6 and 7 in a flat mouth **82** directed toward the solids discharge end of the centrifuge. The mouth is connected to the body of the nozzle **80** by a transition element **84**.

In the preparation of this application the following art was considered: U.S. 3,148,145, 2,600,372, 775,320, and 750,668.

The present invention may be embodied in other specific forms without departing from the spirit or central attributes thereof and, accordingly, reference should be made to the appended claims rather than the foregoing specification as indicating the scope of the invention.

We claim:

1. In a centrifuge comprising a hollow bowl having a solids discharge port at one end and a liquid discharge port at the other end and outward from the solids discharge port, a conveyor having screw flights and mounted on the axis of the bowl for moving solids toward the solids discharge port, means for rotating the bowl and the conveyor at different speeds, and feed means including a feed pipe extending axially into the conveyor, the conveyor having a feed receiving pocket and at least one feed nozzle extending outward from the conveyor into the bowl, the distal end of the feed nozzle having an opening facing toward the solids discharge port and adapted to direct feed mixture in that direction and toward the rear surface of the adjacent screw flight, there being clear space between the latter and said opening.

2. A centrifuge as described in claim **1** wherein the feed nozzle extends to a point located at a greater radius than the liquid discharge port and having an opening to

deliver feed to the bowl at a level radially outward from the liquid discharge port.

3. A centrifuge as described in claim 2 wherein the distal end of the feed nozzle is disposed inward of the distal edges of the screw flights.

4. A centrifuge as described in claim 1 wherein the inside of the nozzle is coated with a hard surfacing material.

5. A centrifuge as described in claim 1 wherein the feed nozzle has an enlarged portion of its base which abuts against an outwardly facing shoulder about an opening in the conveyor and a clamping plate holds the portion inward against the shoulder.

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