

Feb. 18, 1969

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3,428,246

CENTRIFUGE APPARATUS

Filed Dec. 21, 1967

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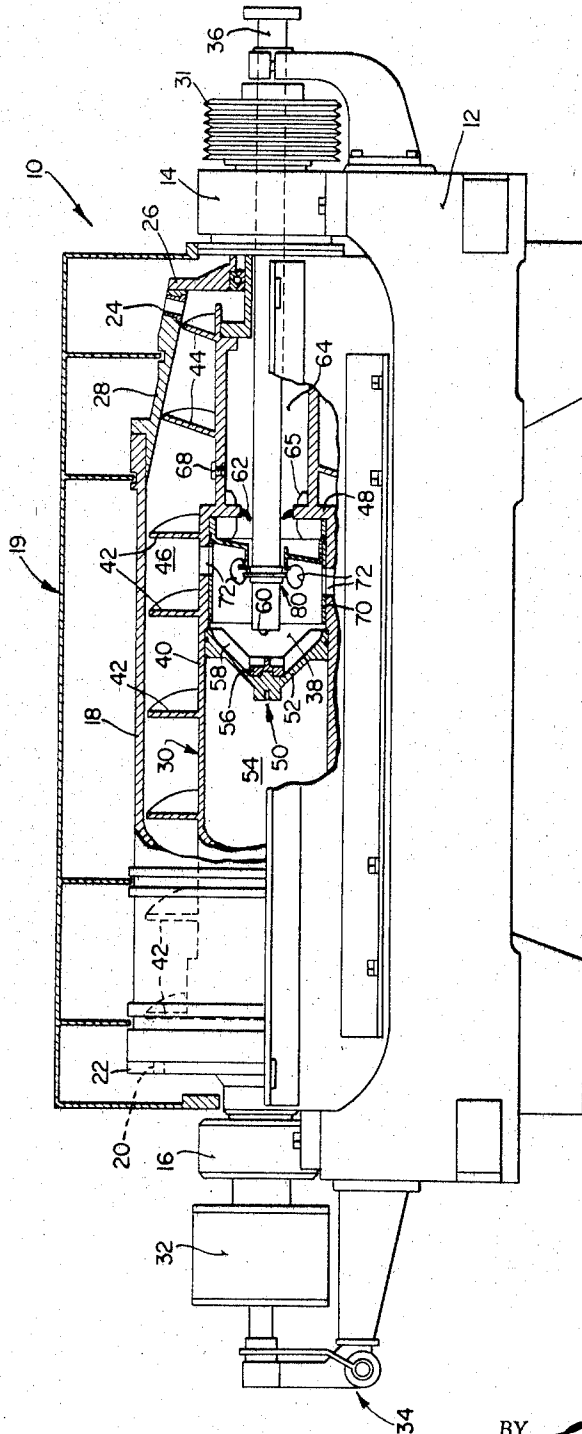


Fig. 1

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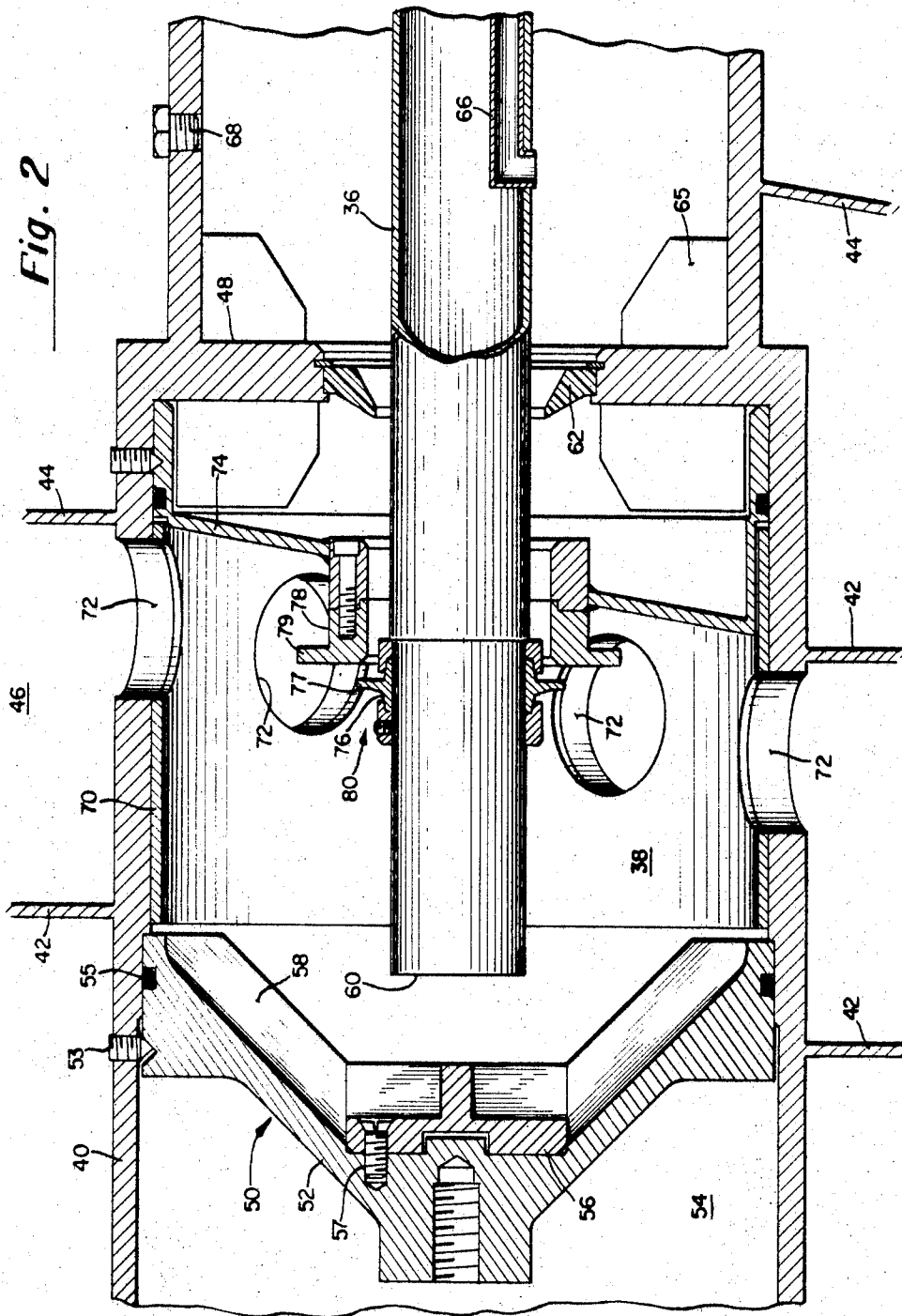
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Fig. 2



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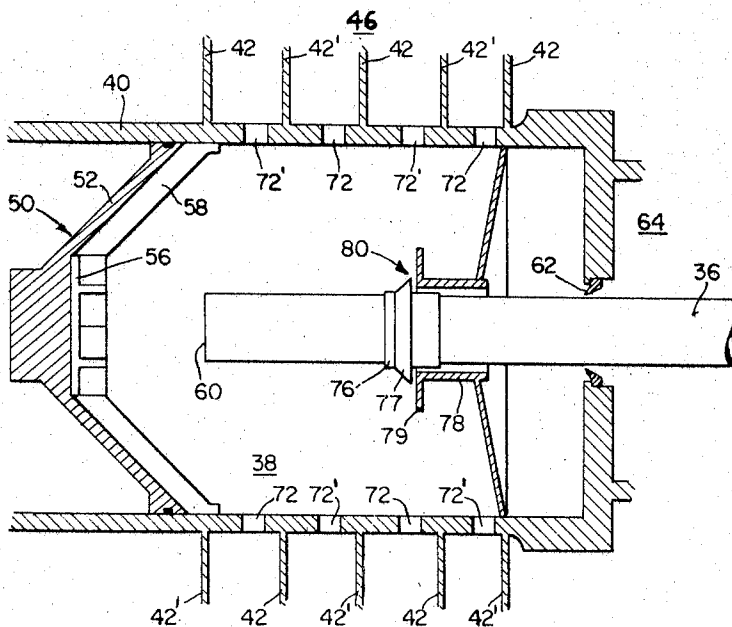
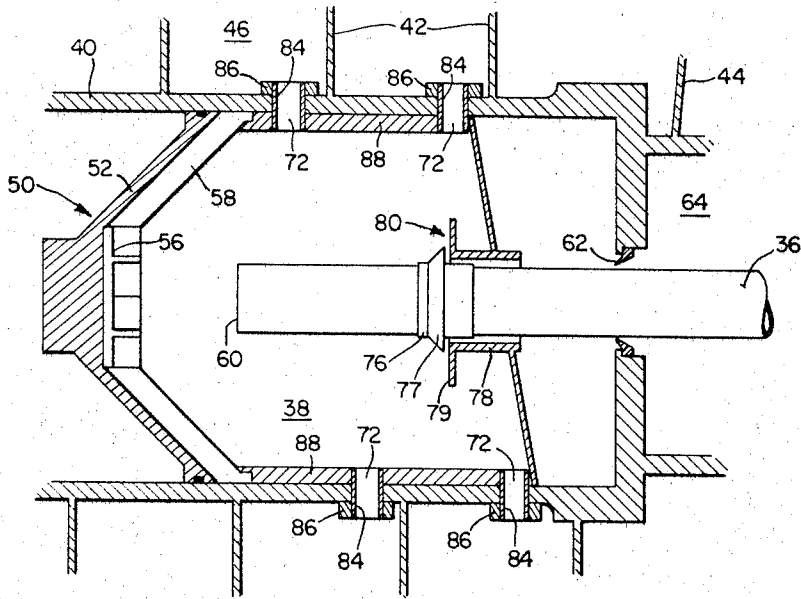
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3,428,246

CENTRIFUGE APPARATUS

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Filed Dec. 21, 1967, Ser. No. 692,590

U.S. Cl. 233-7

10 Claims

Int. Cl. B04b 1/20

ABSTRACT OF THE DISCLOSURE

In a continuously discharging centrifuge with a screw conveyor and having a stationary feed tube for delivering feed to a feed chamber within the hub of the screw conveyor, solids are prevented from accumulating in the feed chamber by means of an inclined baffle plate which is disposed in the feed chamber to deflect the solids through passages in the hub leading outwardly to the separating chamber, thereby avoiding erosion or other damage of the feed tube by accumulated solids.

This invention relates to centrifuge apparatus, such as those employed for dewatering slurries so as to yield nearly dry solids and highly clarified liquid, and especially centrifuge apparatus of the kind having an internal screw conveyor for separating solids sedimented toward the wall of a solid bowl while liquid simultaneously exits separately through a liquid discharge opening.

The screw conveyor is usually mounted on a rotatable hub or hollow member which interiorly defines a chamber for receiving the slurry from a stationary feed tube. Failure of the feed tube can result when solids accumulated within the hub are rotated with the hub and there is eroding and/or binding contact with the stationary feed tube.

Briefly, the present invention seeks to avoid such feed tube failures by preventing the accumulation of solids in the feed chamber by means of a novel inclined baffle plate and deflector assembly for deflecting solids through feed passages in the hub leading to the separating chamber.

In the drawings:

FIGURE 1 is an elevational view of centrifuge apparatus embodying the invention with portions broken away to show the interior thereof partly in section and partly in elevation;

FIGURE 2 is an enlarged fragmentary view of the apparatus of FIGURE 1, showing the invention in detail;

FIGURE 3 is a view similar to FIGURE 2, but on a smaller scale, showing a modified form of the invention; and

FIGURE 4 is a view similar to FIGURE 3 showing the invention in another modified form.

As shown in FIGURE 1, a centrifuge embodying the invention is generally designated by the numeral 10. It comprises a frame 12 having main bearings 14 and 16 in which are journaled the ends of a hollow centrifuge bowl 18. The latter is of annular cross section and is adapted for rotation about an axis within a housing 19. A plurality of liquid discharge openings 20 annularly disposed about the rotational axis are provided in one end wall 22 of the bowl 18 and a plurality of similarly disposed solids discharge openings 24 are provided in the bowl adjacent the other end wall 26.

It is to be noted that the axially elongated bowl 18 is mainly of imperforate cylindrical construction. However, the end portion 28 of the bowl adjacent the end wall 26 is convergent or trunco-conical form, its inner surface gradually decreasing in diameter towards the solid discharge openings 24 in order to provide a drying "beach"

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which inclines inwardly toward the axis of rotation and the solids discharge openings 24. Although not so limited, the invention is shown applied to a horizontal axis machine wherein the annular array of solids discharge openings 24 are at a radius smaller than that of the liquid discharge openings 20.

Mounted in ball, roller, or other suitable bearings adjacent the ends of the solids bowl 18 is a conveyor 30. The bowl 18 is rotated by connection through a pulley 31 to suitable drive means, such as a motor (not shown). The rotation of the bowl 18 is transmitted to a gear box 32, the output from which is conducted through a spline shaft within the bowl shaft to the conveyor 30. As is conventional, stationary torque control means 34 will serve to hold a pinion (not shown) located in the gear box 32 from rotation.

The process feed stream, or liquid-solids mixture to be separated, is delivered in the form of a slurry to the interior of the centrifuge through a stationary feed tube 36. The latter projects in axial direction and terminates concentrically of a feed chamber 38 partly defined by the interior of a hub 40 carrying outwardly projecting, helical or cylindrically coiled screw flights 42 and spiral or conically coiled screw flights 44 of the conveyor 30. The flights 42 and 44 are mounted on the hub 40 for rotation therewith relative to the bowl 18, preferably at a speed sufficiently different from the speed of the bowl to move settled solids to the solids discharge opening 24 for discharge therethrough.

The elongated annular region, lying radially between the outer surface of the hub 40 and the inner surface of the bowl 18 and lying axially between the end walls 22 and 26 of the bowl 18, is the separating chamber or centrifuging zone; and it is designated generally by the numeral 46.

The feed chamber 38 within the hub 40 lies intermediate the ends thereof and extends in axial direction from a partition 48 to an accelerator 50. The latter comprises a generally cup-shaped plate 52 having the rim thereof secured by radial screws 53 in annular sealing relationship with the inner surface of the hub 40 to close off an adjacent space 54. An O-ring 55 is interposed between the rim of the plate 52 and the inner surface of the hub 40 to ensure a fluid-tight seal therebetween. The plate 52 receives centrally thereof a vane assembly 56 secured thereto by screws 57. The vane assembly is adapted to cooperate with guide members 58 on the plate 52 for imparting radial and tangential velocity to the slurry delivered thereto by the feed pipe 36. As shown, the discharge or outlet end 60 of the feed pipe 36 lies concentrically inside the hub 40 within the feed chamber 38, axially intermediate the partition 48 and the accelerator 50.

An annular seal 62 is secured to the inner circular edge of the partition 48 and extends radially inwardly to a position close to the outer surface of the feed pipe 36.

It is the function of the partition 48 and seal 62 to separate the feed chamber 38 from the adjacent, axially elongated annular space 64. The latter is disposed between the feed pipe 36 and that portion of the hub 40 of reduced diameter lying radially inwardly of the trunco-conically shaped hub portion 28. The annular space 64 optionally serves as a rinse chamber for those centrifuging applications where it is desirable to introduce an auxiliary washing liquid via a separate tube 66 (see FIG. 2) to the rinse chamber 64. When in operation, the liquid will flow with the aid of acceleration vanes 65 through a radial passageway in the hub 40 (shown closed by a plug 68) into that portion of the separating chamber 46 bounded outwardly by the trunco-conically shaped hub portion 28, and in which portion the spiral flights 44 scroll separated solids up the inclined beach toward the solids discharge openings 24.

Further provided is a cylindrical inner liner 70 for the inner surface of the hub 40 which extends for the length of the feed chamber 38. The liner 70 may be of stainless steel material, but it may be of another hard surfaced steel or any suitable abrasion resistant material, in order to minimize corrosion and erosion of the hub 40. In addition, an annular array of feed passages 72 are provided. The feed passages 72 extend in radial direction through the liner 70 and the hub 40 in order to provide communication between the feed chamber 38 and the separating chamber 46. It will be noted that the feed passages 72 are positioned between the flights of the conveyor 30, and therefore they are angularly spaced in a generally helical path about the axis of rotation.

According to the invention there is disposed in the feed chamber 38 a baffle plate 74 which is inclined to a plane normal to the rotational axis, and with its peripheral edge contacting the inner surface of the liner 70. The baffle plate 74 limits the axial extent of the feed chamber 38 in one axial direction and also prevents the flow of feed in axial direction along the outer extremities of the feed chamber 38 to any great extent beyond the passages 72. Preferably, the baffle plate 74 has its peripheral edge disposed adjacent the marginal edges of the passages 72, at a greater axial distance from the accelerator 50 than the passages 72. The plate 74 deflects any portion of the mixture, tending to bypass the passages 72, out through the passages 72 into the separating chamber 46.

Also in accordance with the invention, the feed pipe 36 and the baffle plate 74 are provided with respective radially extending, annular members 76 and 78. The stationary member 76 and the rotating member 78 have respective radial flanges 77 and 79 which are in radially overlapping relationship, although axially spaced, so as to comprise a deflector assembly 80 which effectively guards against the passage of feed scattered toward the annular space between the members 76 and 78, with the result that the auxiliary chamber 64 is kept free of feed.

It is a feature of the present invention that the flange 79 of the annular member 78 extends radially outwardly from a point adjacent the inner regions of the feed chamber 38; and furthermore that the annular member 78 is disposed intermediate the baffle plate 74 and the accelerator 50, in position to deflect any inwardly flowing feed material in reverse outward direction toward the feed passages 72.

From the foregoing it can be seen that, in operation, feed is introduced to the feed chamber 38 by means of the feed pipe 36. Upon discharge from the outlet 60 the feed is directed toward the accelerator 50, whereupon the feed is driven at increased angular velocity for flow in radially outward and reverse axial direction and then back along the outer extremities of the feed chamber 38 toward the passages 72. Unlike previous arrangements which permitted an accumulation of solid material within the feed chamber 38, however, the baffle plate 74 of the present arrangement deflects the feed through the feed passages 72 and thereby minimizes recirculation of feed throughout the feed chamber 38. By means of the deflector assembly 80, any recirculated feed material is deflected back outwardly toward the outer extremities of the feed chamber for passage through the feed passages 72 into the separating chamber 46.

By minimizing the accumulation of solids material within the feed chamber 38 the opportunity for abrasive solid material to erode the feed pipe 36 is minimized. Also minimized is the possibility of accumulated feed twisting the stationary feed pipe 36 while traveling at a high angular velocity.

The invention may be embodied in modified apparatus according to FIGS. 3 and 4 wherein like reference numerals are applied to parts correspondingly similar to those of FIGS. 1 and 2.

Referring to FIG. 3, the passages 72 are fitted with wear sleeves 84 which line the radially extending sur-

faces of the passage 72, and project both inwardly and outwardly thereof. A collar 86 for each wear sleeve 84 may be employed for positioning and securing the sleeve 84 to the conveyor hub 40. Due to the inwardly projecting inlet end of the wear sleeve 84, an annular cake 88 of solid material having a smooth inner surface will accumulate on the inner surface of the hub 40, to the inner extent of the wear sleeve 84, as shown. However, other solids accumulations will not be found in the feed chamber 38 because of the effectiveness of the baffle plate 74. Furthermore, if the flange 77 of the annular member 76 is made of a suitable elastomeric material, it is possible to position the deflector assembly 80 as shown in FIG. 3 by readily inserting the feed pipe 36, and mounted member 76 and flange 77 through the seal 62 and through the member 78 on the baffle plate 74, after which the flanges 77 and 79 will have a radially overlapping positional relationship for deflecting scattered feed from openings between them leading to the auxiliary chamber 64.

In the modification of FIG. 4 the deflector assembly 80 is shown to be the same as in FIG. 3, but the helical screw flights are here designated 42 and 42' in order to designate a double helical screw flight, and thus extend the inventive concept generally to screw conveyors having multiple helical flights. With the double helical arrangement shown, the feed passages 72 and 72' will extend along double helical paths in order to continue the concept of providing feed passages 72 between adjacent conveyor flights. In such arrangements, however, a modified baffle plate 74' will now have an edge configuration which partly follows closely the margin of the helical path of the one helical series of passages 72 and partly follows in like manner the other helical series of passages 72'. Thus, the surface of the baffle plate 74' may comprise two flat half sections which intersect; and intersecting conic half sections can also be employed. The periphery of plate 74' is disposed adjacent end passages 72 and 72' of the respective series, these passages usually being located 180° apart in a common plane lying normal to the rotational axis.

In the broad sense of the invention, the baffle plate 74' may be bounded by two space curves so as to traverse the inside circumference of the feed chamber 38 whereby the feed follows along, or parallel to, the path of the feed passages 72 and 72'. Accordingly, a baffle plate 74' with a periphery which is wholly or partly helical is also within the scope of the invention.

A baffle plate 74 with a helical periphery is also usable for the embodiments of FIGS. 1, 2 and 3 where the passages 72 follow a single helical path, instead of a baffle plate 74 which may be flat, simply curved, or of a single conic section.

Although the invention has been shown in but several forms, it obviously is susceptible of additional changes and modifications. For example, the invention may be applied to vertical axis machines, screen decanter apparatus, and centrifuges having a bowl wholly of conical construction.

What is claimed is:

1. In centrifuge apparatus for separating solids from a liquid-solids mixture, a hollow bowl mounted for rotation about an axis and provided with a liquid discharge opening and a solids discharge opening, said bowl having an annular inner surface with a portion thereof decreasing in diameter approaching one end thereof, and with said solids discharge opening being disposed at said one end, a screw conveyor disposed within said bowl and mounted for coaxial rotation therein, said conveyor including an axially elongated hub radially spaced from said bowl to define therewith an annular separating chamber and further including flights mounted on said hub for movement therewith relative to said bowl within said separating chamber for conveying separated solids therealong to said solids discharge opening, at least a portion of the space within said hub providing a feed chamber

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for receiving the mixture to be separated, said hub being provided with a plurality of angularly spaced passages extending between adjacent flights generally in radial direction from said feed chamber to said separating chamber, a feed tube extending axially into said feed chamber for conducting the mixture thereto, vanes within said feed chamber mounted to rotate with said hub in axially spaced relationship with the outlet of said feed tube for receiving said mixture from said feed tube and increasing the velocity thereof, and the improvement comprising a baffle plate within said feed chamber having its peripheral edge disposed adjacent said passages for deflecting the mixture from said vanes through said passages to said separating chamber.

2. Centrifuge apparatus according to claim 1 wherein said feed tube is stationary and said plate is inclined to a plane normal to said axis.

3. Centrifuge apparatus according to claim 1 wherein said baffle plate is secured to said hub for rotation therewith and the peripheral edge of said baffle plate is in abutting relationship with the inner surface of said hub.

4. Centrifuge apparatus according to claim 1 wherein the baffle plate and the vanes are in spaced relationship, with the outlet end of said feed tube disposed between them and opening toward said vanes, said passages communicating with the feed chamber between said vanes and said baffle plate.

5. Centrifuge apparatus according to claim 1 wherein the outer wall of said bowl is imperforate and said passages in said hub are disposed in series along a generally helical path about said axis.

6. Centrifuge apparatus according to claim 5 further including annular members in radially overlapping relationship and mounted concentrically within said feed chamber on the respective baffle plate and feed tube.

7. Centrifuge apparatus according to claim 6 wherein

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the annular member mounted on the feed tube extends in radial direction for redirecting inwardly flowing feed outwardly toward said feed passages.

8. Centrifuge apparatus according to claim 1 including an annular partition about said feed tube dividing space within said hub into said feed chamber and an auxiliary chamber which are axially adjacent one another, with said auxiliary chamber being disposed radially inwardly of that surface portion of said bowl of decreasing diameter and with the outlet end of said feed tube being disposed in said feed chamber.

9. Centrifuge apparatus according to claim 8 further including means for conducting a rinse liquid to said auxiliary chamber, and a passageway in said hub for flow of rinse liquid from said auxiliary chamber to said separating chamber.

10. Centrifuge apparatus according to claim 1 wherein said screw conveyor includes multiple helical flights, and with said feed passages being angularly spaced about said axis along helical paths between said flights.

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U.S. Cl. X.R.

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