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SCREW-TYPE SOLIDS DISCHARGE CENTRIFUGE HAVING MEANS TO DISCHARGE LIGHT SOLIDS

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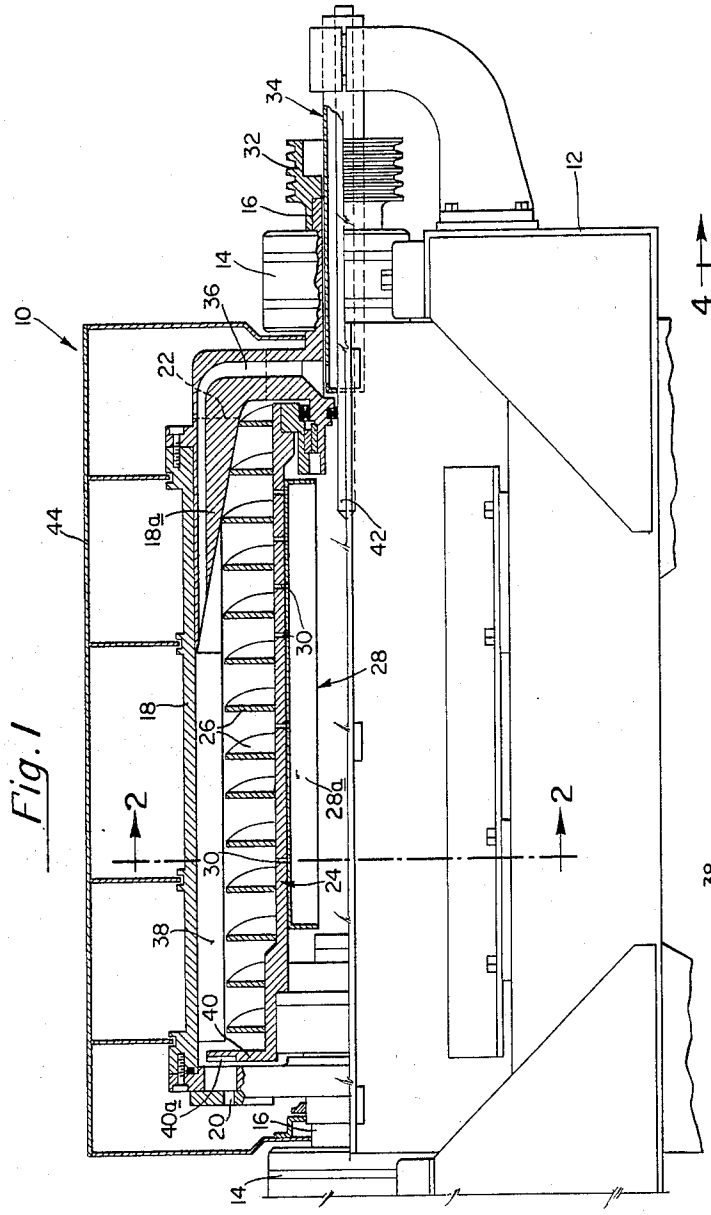


Fig. 1

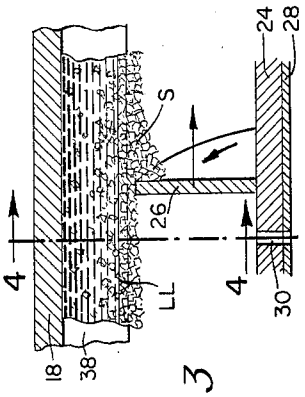


Fig. 3

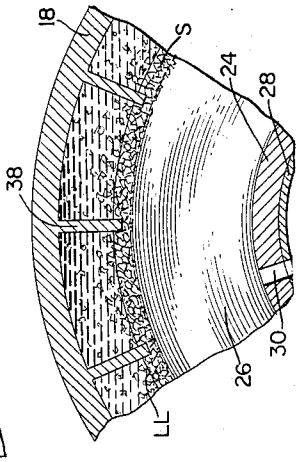


Fig. 4

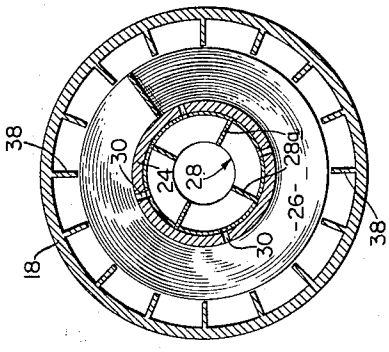


Fig. 2

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SCREW-TYPE SOLIDS DISCHARGE CENTRIFUGE HAVING MEANS TO DISCHARGE LIGHT SOLIDS

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This invention relates to centrifuges. More specifically this invention relates to a centrifuge of the solid bowl type in which means are provided to discharge separated solids from a liquid-solids mixture in which the solids are lighter than the liquid.

In the past considerable difficulty has been experienced in the separation of light solids from the liquid phase in a liquid-solids mixture. For instance, in separating ice solids from a brine liquid the use of a solid bowl centrifuge has been unsatisfactory: the ice solids have formed a solid cake and have virtually defied discharge by conventional ring dam methods. The worm-type centrifuge comprising a solid bowl having a screw conveyor moving solids toward a solids discharge opening has also been found useless for the separation of light solids from a liquid-solids mixture: the light solids have obligingly turned with the conveyor and not progressed to the discharge.

Processors have been forced in such separations to resort to screen centrifuges such as conical screens having screw conveyors, and the so-called pusher machines. Screen centrifuges have, of course, made their separations on the basis of particle size, and for this reason it has been necessary to grow large crystals. The growth of large crystals requires exacting control, expensive and complicated chilling equipment and a great deal of processing time. Processors have not been satisfied with these requirements but have accepted them as part of a Hobson's choice.

Since the centrifugal separation of light solids which may be based primarily on density of the solids rather than solely on particle size would reduce the requirement for expensive and time-consuming crystal growth, the quest for a suitable solid bowl centrifuge arrangement has been pursued. The present invention has for an object the provision of such an arrangement.

A further object of the invention is the provision of such a machine having means for concentrating such light solids in unusual purity.

Additional objects and features of the invention will be apparent from a study of the accompanying specification including drawings in which:

FIGURE 1 is a fragmentary elevation partly in section of an apparatus embodying the invention;

FIGURE 2 is a sectional view taken on the line 2—2 of FIGURE 1;

FIGURE 3 is a greatly enlarged schematic view showing the probable action in an apparatus embodying the invention; and

FIGURE 4 is a sectional view taken on the line 4—4 of FIGURE 3.

Briefly, the invention is a solid bowl centrifuge in which light solids are keyed to rotation with the centrifuge bowl and are scrolled to the solids discharge opening by a screw conveyor extending outward into the solids layer.

Referring more specifically to the drawings, an apparatus embodying the invention is shown in FIGURE 1 and generally designated 10. It comprises a frame 12 mounting a pair of pillow block bearings 14 which support the hub shafts 16 of the centrifuge bowl 18. One end of the centrifuge bowl is provided with a radially adjustable opening 20 for liquid discharge, while the other end is provided with an opening 22 for solids discharge. The wall of

the bowl 18 is formed with a beach 18*a* inclining inwardly to the opening 22.

A conveyor body 24 is mounted on conveyor bearings within the bowl to rotate at a rate different from the speed of the bowl. The bowl 18 and the conveyor 24 are operatively linked for differential rotation by gear box means which is not shown but which may be disposed to the left of the leftward pillow block 14 as shown in FIGURE 1. The bowl and conveyor are driven through a single pulley 32. The relation of the driving and driven elements is as generally described in U.S. Patent 2,703,-766.

The conveyor body 24 is equipped with flights 26 and a rinse distributor 28 including inwardly directed ribs 28*a*. The rinse openings 30 direct a rinse liquid out into the bowl.

Means for feeding mixture to be separated into the bowl comprise a feed tube 34 which extends through the rightward hub shaft 16 as shown in FIGURE 1 and opens toward the feed passage 36. The feed passage 36 conducts the feed mixture under the beach 18*a* and adjacent to the periphery of the bowl. As shown in FIGURE 2 a plurality of ribs 38 extend inward from the peripheral wall of the bowl 18 to a level substantially equal to the level of the outer portion of the liquid discharge opening 20. The flights 26 on the conveyor extend outward to almost touch the inward edges of the ribs 38. Preferably the number of ribs should be great enough so that the solids may form a bridge between ribs. This avoids circulation of liquid and solids between the ribs induced by the relative rotation of the conveyor and bowl. Obviously such circulation would be detrimental to the efficiency of the separation.

A disc dam 40 is disposed on the conveyor body 24 adjacent the liquid discharge opening 20 and functions to block discharge of light solids through the opening 20. To help keep the liquid between the dam 40 and the outlet 20 rotating at the approximate speed of the bowl, radial vanes 40*a* may be provided on the outward face of the dam 40. This will minimize the swirling of liquid moving inward from the periphery of the dam 40 to the outlet 20 and avoid influence on the liquid level in the bowl.

Rinse liquid may be delivered to the inside of the conveyor body 24 by means of an inner rinse supply tube 42 concentric with the feed tube 34. The rinse liquid accelerated by the ribs 28 rotates at the speed of the conveyor and moves outward through the openings 30 to contact the solids. For this purpose the openings 30 are concentrated in the area of the beach and thereadjacent.

A casing 44 is provided with suitable partitions to segregate the liquid and solid discharges as is well known in the art.

In operation, a feed mixture such as a brine suspension of ice crystals is delivered through the feed tube 34 and passages 36 into the bowl 18. The ice crystals being lighter than the brine move inward toward the liquid level which is determined by the position of the opening 20. The ice crystals rise inwardly of the liquid level and form a cake (FIGURES 3 and 4) inward of the ribs 38. The conveyor flights 26 scrape the top surface of the ice cake as shown and move it toward the solids discharge opening 22. Behind the flight 26 more ice solids push upwardly for their engagement by the flights in turn on the next differential rotation of the conveyor.

It will be seen that the ribs will key the ice cake to rotation with the bowl 18 and that the differential speed of the flights 28 will result in a movement of the ice solids towards the solids discharge opening. The solids engaged by the flight 26 tend to turn at the speed of the bowl due to their friction with the adjacent ice held by the ribs 38.

The machine is especially effective in the separation and purification of ice solids since the conveyor in pushing the solids toward the solids discharge outlet breaks up any crust of rinse liquid which coats the solids. As a result the solids may be better permeated and contacted by the rinse.

While a brine suspension of ice crystals has been illustratively used in this discussion, it should be understood that the invention is adapted for use with many light solids; that is, many solids lighter than the liquid with which they are in admixture. As an example it is contemplated that an apparatus embodying the invention may be used in separating solid paraxylene from its liquid lower-melting isomers. Its operation in winterizing of vegetable oils and dewaxing of petroleum oils by fractional crystallization is contemplated.

Variations on the structure disclosed are reasonable within the scope of the invention. For instance, the invention may be applied to a centrifuge having a bowl with a vertical axis such as disclosed for example in U.S. Patent 3,061,181. Therefore, it is to be understood that the above particular description is by way of illustration and not of limitation, and that changes, omissions, additions, substitutions, and/or other modifications may be made without departing from the spirit of the invention. Accordingly, it is intended that the patent shall cover, by suitable expression in the claims, the various features of patentable novelty that reside in the invention.

I claim:

1. A centrifuge comprising a solid bowl having discharge openings at opposite ends for liquid and solids, respectively, the liquid discharge opening being disposed at a level spaced inward from the periphery of the bowl, the solids discharge opening being spaced inward from the liquid discharge opening, a screw conveyor within the bowl for moving solids to the solids discharge opening, flights on the screw conveyor extending outward to a level in the bowl just inward of the first-mentioned level, and ribs secured to the periphery of the bowl and extending inward approximately to said first-mentioned level along a substantial portion of their length.

2. A centrifuge as described in claim **1** wherein the wall of the bowl is formed with a beach portion extending

from the outer periphery of the bowl to the solids discharge opening.

3. A centrifuge as described in claim **2** wherein feed is delivered to the bowl through a passage which extends outward of the inner surface of the beach portion and terminates in a discharge opening adjacent the periphery of the bowl.

4. A centrifuge comprising a solid bowl having a solids discharge opening, and a liquid discharge opening actward from the solids discharge opening, a screw conveyor in the bowl having flights for moving solids to the solids-discharge opening and a plurality of ribs extending inward from the bowl wall to the radius of the liquid discharge opening for substantially the entire length of the bowl, the conveyor flights extending out to the level.

5. A centrifuge comprising

(a) a solid bowl having substantially longitudinal ribs extending inward to a first radius along a substantial portion of their length,

(b) a conveyor disposed coaxial with and inside the bowl and having flights extending out to the first radius,

(c) the bowl having a liquid discharge port at the first radius, and

(d) the bowl having a solids discharge port inward from the first radius.

6. The method of separating light solids from mixture with a heavier liquid which comprises introducing the mixture to a zone of centrifugation wherein the solids float to a layer inward of the liquid, keying the floating solids layer to rotation with the bowl, and engaging solids in the layer with a spiral conveying surface rotating relative to the bowl to move the solids inward to a solids discharge opening.

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