Jan. 21, 1969 F. O'CONOR 3,423,015

CONTINUOUS CENTRIFUGAL SEPARATOR WITH POOL DEPTH CONTROL

Filed Aug. 23, 1967 Sheet 1 of 2

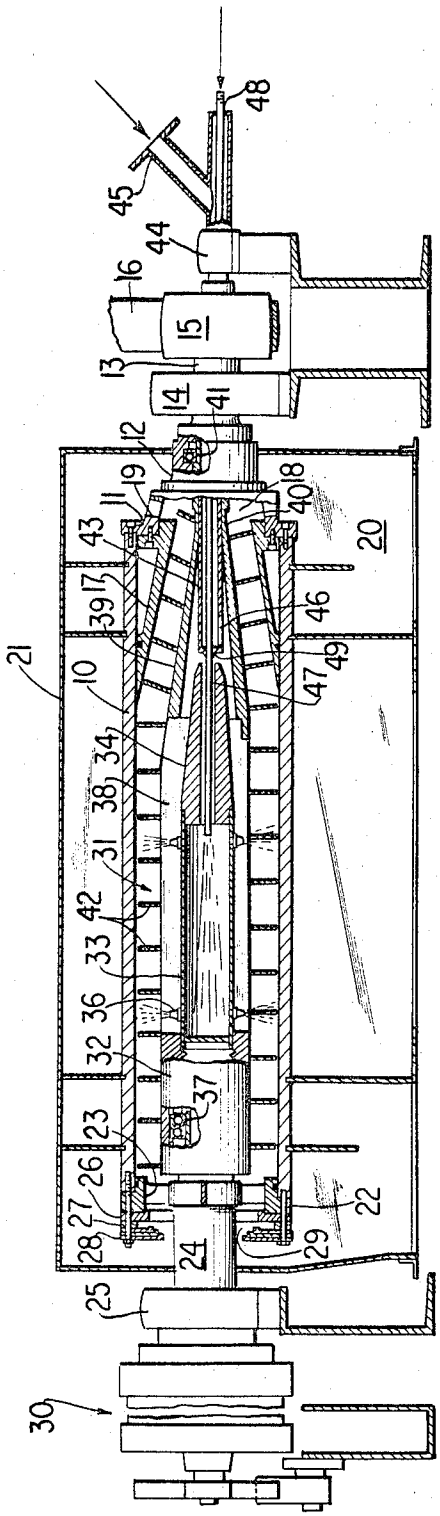

FIG. 1

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FIG. 2

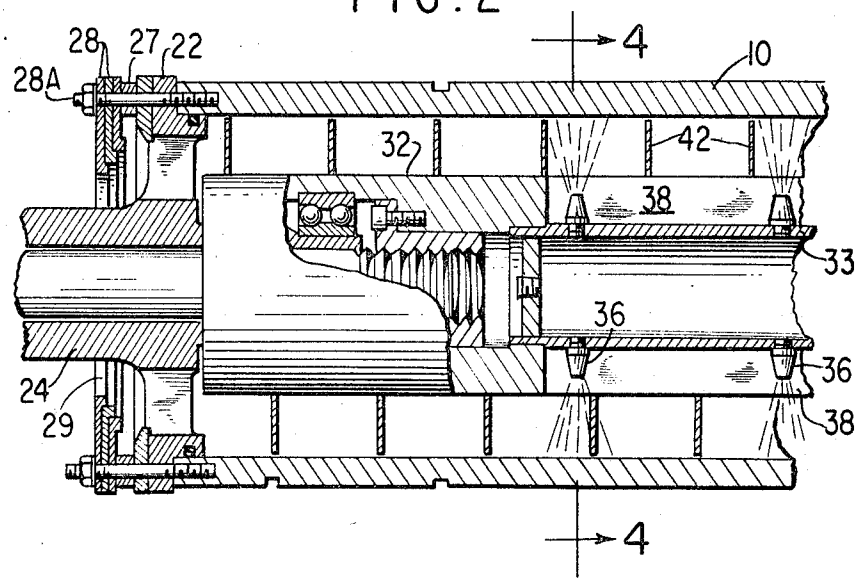
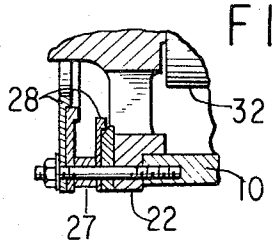


FIG. 2a



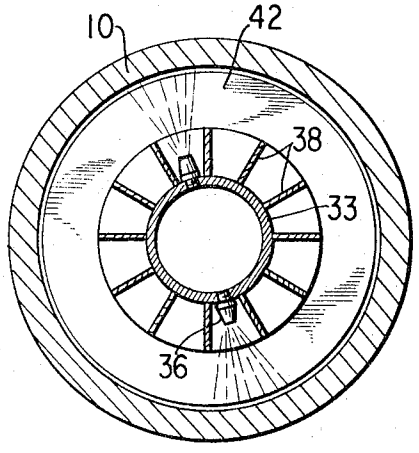


FIG. 4

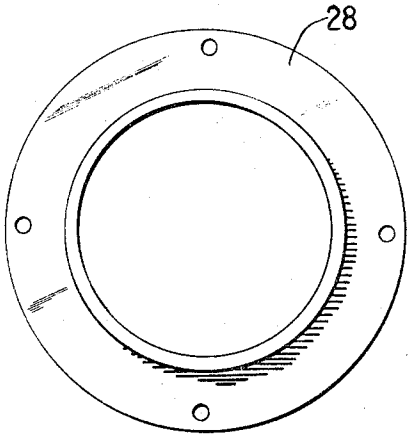


FIG. 3

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CONTINUOUS CENTRIFUGAL SEPARATOR WITH POOL DEPTH CONTROL

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Int. Cl. B04b 1/06, 3/00, 5/00

ABSTRACT OF THE DISCLOSURE

A horizontal type centrifugal separator having a plurality of rings with varying inner diameters removably mounted at the end of the drum adjacent the liquid collecting chamber. The separator also includes a stationary pipe extending axially into the rotating element of the separator-conveyor assembly for discharging a washing liquid therein, the liquid emerging through openings in the tubular element by centrifugal force. Further, radial vanes extend longitudinally on the outer surface of the tubular element and terminate above the pool formed along the inner wall of the drum.

The present invention relates to a horizontal type centrifugal separator and more particularly to an improved arrangement for adjusting the depth of the pool within the separator, for introducing a washing liquid into the rotating tubular element, for accelerating the slurry to the speed of the rotating parts, and for preventing a preliminary separation of the slurry as may occur in the conventional design of an inner bowl. A preliminary separation can clog the feed chamber, preventing operation and necessitating the dismantling of the machine for clean-out.

Horizontal type centrifugal separators have been used for the separation of the solids from a slurry which is introduced into the separator. With slurries having a relatively low solids content, there is often a churning of the slurry during the operation of the separator, thus increasing the difficulty of separating the solids and thus reducing the efficiency of the process. Difficulties have also been encountered since at certain pool depths incoming slurry may mix with separated solids and cause some of the solids to be carried out of the effluent. Such separators are generally provided with a structure for maintaining a constant pond depth. The desirability of adjusting the depth of the pond has been recognized and various arrangements have been devised for this purpose. However, such an adjustment usually requires stopping the operation of the separator and substituting different dam plates for the dam plates installed at the liquid collecting end of the drum. The time required for making this adjustment was unduly long and prolonged the downtime of the separator, thus adding to the inefficiency of the operation.

An object of the present invention is to provide an improved arrangement for adjusting the pool depth of a horizontal type centrifugal separator.

Another object of the invention is to provide a horizontal type centrifugal separator wherein the churning of the slurry is kept to a minimum and washing liquid is introduced into the interior of the rotating tubular element.

In one aspect of the invention, there may be provided a horizontal type centrifugal separator having a relatively long, horizontally disposed drum which is mounted for rotation about a horizontal axis. Within the drum there is rotatably mounted a separator-conveyor assembly having a cylindrical portion on one end with a tubular element of smaller diameter extending axially therefrom. The tubular element is provided with apertures in its

walls and has a conical portion at its other end. The separator-conveyor assembly also comprises a conical member extending over the conical end of the tubular element. A plurality of longitudinally extending radial vanes are mounted on the tubular element between the cylindrical portion and the conical member. A spiral blade or vane is mounted around the cylindrical portion of the separator-conveyor assembly, the radial vanes and the conical member to form a screw conveyor. The drum and separator-conveyor assembly are rotated in the same direction but at different speeds. Slurry is continuously fed into the separator-conveyor assembly between the conical member and the tubular element conical portion through a stationary pipe or tubular member extending axially into the assembly. A second pipe extends coaxially through the first pipe and into the tubular element for introducing a washing liquid therein. At the end of the drum opposite the end into which the slurry is fed, there is formed a liquid collecting chamber. The outer end of the drum at the liquid collecting chamber end has removably mounted thereon a plurality of rings having varying inner diameters, with the inner diameters progressively decreasing away from the drum.

The outer longitudinal edges of the radial vanes are continuous with the outer peripheral surface of the separator-conveyor assembly cylindrical portion and terminate above the liquid pond so as not to contact the liquid along the inner wall of the drum and thus create turbulence in the pond.

Other objects, advantages and features of the present invention will be apparent upon reference to the following description and accompanying drawings, which are exemplary.

In the drawings:

FIG. 1 is a longitudinal sectional view taken in a vertical plane of a horizontal type centrifugal separator incorporating the present invention;

FIG. 2 is a view of a portion of FIG. 1 but in enlarged scale, showing the arrangement on the drum for adjusting the pond depth;

FIG. 2A is an enlarged broken view showing the spacer rings of FIG. 2 in a different position;

FIG. 3 is a plan view of one of the adjustable dam rings of FIG. 2; and

FIG. 4 is a transverse sectional view taken along the line 4—4 of FIG. 2.

Referring to the drawings wherein like reference symbols indicate the same parts throughout the various views, a specific embodiment of the present invention will be described in detail.

The centrifugal separator comprises a relatively long, hollow drum **10** mounted for rotation about a horizontal axis. The drum **10** has a dry end plate **11** mounted on one end thereof, the plate having a housing portion **12** and a shaft **13** extending therefrom which is journaled in a bearing **14**. A pulley **15** is mounted on the shaft **13** and is drivingly connected by a belt **16** to a source of power for rotating the drum.

A hollow insert **17** of a generally truncated conical form is fastened within the drum **10** and one end thereof may form with a portion of the dry plate or trunnion **11** a collecting chamber **18** for receiving the separated solids. Radial ports **19** are provided in dry trunnion **11** for discharging the collected solids into a chamber **20** located within a housing **21** surrounding the drum **10**.

The opposite end of the drum **10** has mounted therein a wet end trunnion **22** having effluent discharge ports **23** therein and a hollow shaft **24** extending axially therefrom and in alignment with hollow shaft **13**. The shaft **24** may be journaled in and extend beyond a bearing **25** which is similar to bearing **14**.

Mounted on the outer face of wet trunnion **22** is a mounting ring **26**, spacer ring collars **27** and a plurality of dam rings **28** which form a liquid collecting chamber **29**. Liquid is discharged through the radial spaces between the spacer collars **27**. The dam rings **28** are detachably mounted by stud bolts **28A** and have varying inner diameters and a lip surrounding their inner diameters. The rings **28** are positioned so that their inner diameters progressively decrease outwardly from the drum. By positioning a plurality of such dam rings at the wet end of the drum, the depth of the pond may be easily adjusted by changing the position of the spacer collars with respect to the dam rings. For example, by repositioning the outer dam ring and collars, the depth would be decreased to the inner diameter of the outer remaining ring.

The shaft **24** may be provided at its extended end with a gear reducing unit **30** having a plurality of planetary gear stages therein.

Mounted within the drum **10** is a separator-conveyor assembly indicated generally at **31** and comprising a cylindrical portion **32** and a tubular element **33** extending axially therefrom with a tapered or conical end **34**. The tubular element is provided with a plurality of openings **35** in which may be mounted nozzles **36**. The cylindrical portion **32** may be provided with antifriction bearings **37** so as to be journaled on the inner end of hollow shaft **24**, and is attached to a shaft passing through the hollow shaft **24**.

A plurality of longitudinally extending radial vanes **38** may be equally spaced about and fixed to the outer periphery of the tubular element **33**. These vanes are of a lesser height than the pond depth so as to provide an annular space between their outer longitudinal edges and the inner periphery of the drum **10**, so that clarified liquid may pass over the top of the vanes without disturbing previously settled solids.

A hollow conical member **39** may have a base portion suitably fastened to the vanes **38** and includes a hollow shaft extension **40** that is journaled in an antifriction bearing **41** located in the housing portion **12** of end trunnion **11**.

A spiral strip or vane **42** surrounds the outer faces of the cylindrical portion **32**, the radial vanes **38** and the conical member **39**. The strip thus forms a screw conveyor and the spiraling is such that the solids separated from the slurry are moved toward dry end trunnion **11**.

A stationary slurry feed tube **43** extends into the conical member **39** and has its outer end supported by a fixture **44**. The slurry is introduced through the inlet **45**. The feed tube is non-rotatably supported and its longitudinal axis may be in line with the rotational axis of the drum and rotating element. The wall of the feed tube **43** is provided with an opening **46** through which the slurry is discharged within the conical member **39**.

Coaxially positioned within feed tube **43** and nonrotatably supported therein is a feed pipe **47** for introducing washing liquid into the rotating element. The feed pipe **47** extends through an opening in conical end **34** into the interior of the tubular element **33**. The outer end of feed pipe **47** extends outwardly at **48** and is connected to a source of supply for the washing liquid. Feed pipe **47** is secured at **49** to the end of feed tube **43** so as to be stationary.

In the operation of the separator in accordance with the present invention, the rotation of the pulley **15** will rotate drum **10**, and with it gear box **30**, in a clockwise direction. Under the action of the planetary gear units therein, the conveyor assembly **31** will also rotate in the same direction as drum **10** but at a lower speed.

The slurry is fed through feed tube **43** and is discharged through opening **46** into the conical member **39**. The rotary speed of the slurry is caused to increase as it passes through the throat of conical member **39** so that it is substantially at the rotary speed of the liquid within the pond extending along the length of drum **10** when the slurry reaches the pond. As a result, turbulence is prevented in the pond when it is reached by the slurry, and the slurry is also prevented from contacting dry solids.

The vanes **38** cause centrifugal separation of the solids from the slurry with the solids moving radially outwardly toward the drum and the liquid remaining radially inwardly thereof. The spiral flights **42** of the conveyor move the solids toward the dry end trunnion **11** and they are discharged through ports **19** into the chamber **20**.

The liquid continues to move toward the wet end trunnion **22** and is discharged through ports **23** into chamber **29**. The depth of the accumulated liquid is regulated by the adjustable dam rings **29** by selecting a dam ring the diameter of which corresponds to the desired depth of the pond.

During this separating operation, washing liquid may be introduced through feed pipe **47** into the rotating element **33** from where it is discharged under centrifugal force through the nozzles **36**.

Thus, it can be seen that the present invention provides an improved horizontal type centrifugal separator having an arrangement whereby the depth of the pond may be rapidly changed. There is also provided a stationary feed pipe for introducing washing liquid into the rotating element with the liquid being discharged from the element through openings therein. The heights of the radial vanes are so selected as to terminate above the pond in order not to interfere with the pond during the separating operation.

It is to be understood that various details of construction and arrangement of parts can be changed without departing from the spirit of the invention except as defined in the appended claims.

What is claimed is:

1. In a horizontal type centrifugal separator, a drum mounted for rotation about a horizontal axis, a separator-conveyor assembly having a cylindrical portion with a tubular element of smaller diameter extending axially therefrom, there being a conical portion at the other end of said tubular element and apertures in said tubular element, a conical member at the other end of said separator-conveyor assembly and extending over said tubular element conical end portion, radial vane means extending longitudinally on said tubular element between said cylindrical portion and said conical member, spiral means around said cylindrical portion, said radial vane means and said conical member to form a screw conveyer, means for rotating said drum and separator-conveyor assembly at different speeds, means for continuously feeding slurry into said separator-conveyor assembly between said conical member and said tubular element conical end portion, means for introducing a washing liquid into said tubular element with said liquid being discharged centrifugally therefrom through said apertures, a liquid collecting chamber within said drum at the end thereof opposite from that into which the slurry is fed, and adjstable means at said drum end for adjusting the depth of the pool within said drum.

2. In a horizontal type centrifugal separator as claimed in claim **1** wherein said slurry feeding means comprises a stationary tubular member extending axially into said conical member and terminating short of said tubular element conical end portion.

3. In a horizontal type centrifugal separator as claimed in claim **2** wherein said liquid introducing means comprises a second stationary tubular member extending axially through said first tubular member into said tubular element.

4. In a horizontal type centrifugal separator as claimed in claim **1** wherein said adjustable means comprises a plurality of rings having varying inner diameters.

5. In a horizontal type centrifugal separator as claimed in claim **4** wherein said inner diameters progressively decrease away from said rum.

6. In a horizontal type centrifugal separator as claimed in claim 4 and further comprising means for detachably securing said rings to the end of said drum.

7. In a horizontal type centrifugal separator as claimed in claim 1 wherein the outer longitudinal edges of said radial vane means are continuous with the outer peripheral surface of said separator-conveyor assembly cylindrical portion.

8. In a horizontal type centrifugal separator as claimed in claim 1 and further comprising means on said separator-conveyor assembly forming with said drum a solids

chamber and a liquid pool, the outer longitudinal edges of said radial vane means terminating above the liquid pool.

References Cited

UNITED STATES PATENTS

1,383,313	7/1921	Landreth	233—7
2,600,372	6/1952	Milliken	233—7
3,096,282	7/1963	Trotter	233—7
3,348,767	10/1967	Ferney	233—7

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