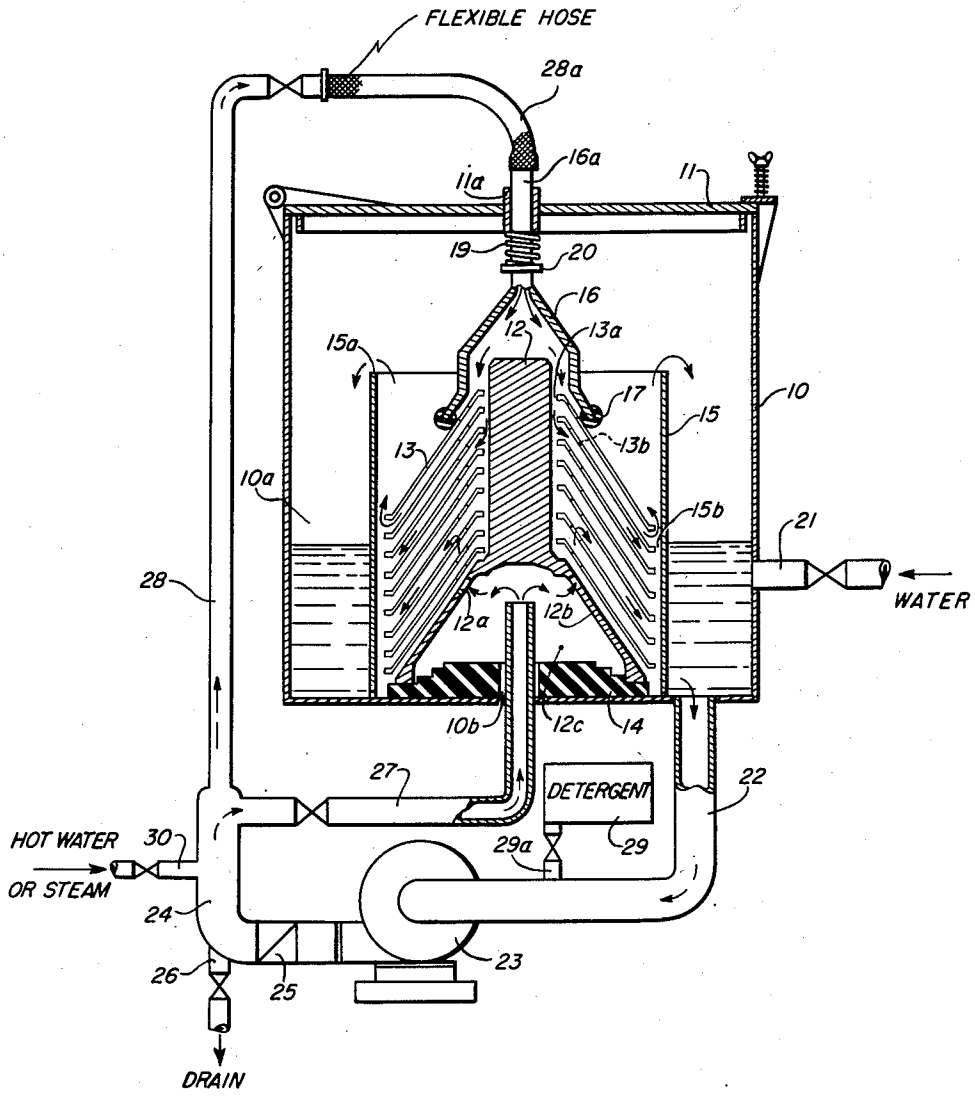
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METHOD AND APPARATUS FOR WASHING DISCS

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METHOD AND APPARATUS FOR WASHING DISCS

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This invention relates to washing of the discs used in centrifuges, such as centrifugal separators, clarifiers, etc. It has particular reference to an improved method and apparatus for washing the discs while they are nested together in a stack.

It is well known that in the use of a disc-type centrifuge, the conical discs (which are stacked in spaced relation in the separating chamber of the rotary bowl) become coated due to a build-up of solid or semi-solid matter on the disc surfaces during the centrifuging operation. Accordingly, in order to maintain a good separating efficiency, it is necessary to clean the discs occasionally. Heretofore, effective cleaning of the discs has required that each of the discs be individually removed from the disc assembly, individually washed, and then individually reassembled, which is a time-consuming manual operation. Moreover, when the discs are reassembled, each disc must be replaced in its exact order numerically in the disc stack, because otherwise the balance or smooth-running characteristic of the centrifuge might be seriously disturbed.

A primary object of the present invention is to provide a method and apparatus by which the discs of a disc-type centrifuge can be washed thoroughly without removing them from the disc assembly.

The effectiveness of the washing provided by the invention is due principally to the simultaneous actions of a cleansing fluid (such as hot water and a detergent, steam, etc.) forced outwardly through the spaces between the stacked discs from the usual holes at their inner or central portions, and vibration of the discs endwise of the stack. In the preferred practice of the invention, the discs are urged together by imposing a yielding force upon the stack endwise thereof, while forcing the cleansing fluid outwardly through the disc interspaces under a pressure sufficient to overbalance this yielding force and thereby create an unstable condition of the discs. In this way, the flow of the fluid to the outer edges of the discs, where it is discharged from the disc spaces, is accompanied by movements of the discs endwise of the stack and a pulsating effect of the fluid streams between the discs, which greatly aid in loosening and removing solid deposits from the surfaces of the discs. The washing action can be enhanced by forcing streams of the cleansing fluid into the disc holes and interspaces from both ends of the stack, so that the streams merge between the discs in the outward flow of the fluid; and it can be further enhanced by imposing a back pressure upon the discharge of the fluid from the outer edges of the discs. I also prefer to recycle the discharged fluid from the outer edges of the discs to the inner holes thereof, so that the spaces between the discs form part of a closed fluid circuit.

A washing apparatus made according to the invention

comprises a container for receiving the disc stack and having a side wall surrounding the stack and forming a clearance with the outer edges of the discs. The container has a fluid outlet communicating with this clearance and also has a fluid inlet leading to one end of the stack. By means of partitioning, a path is formed for passage of the fluid from the inlet to the outer clearance by way of the inner holes of the discs and the disc interspaces, to prevent the fluid from by-passing these spaces on its way to the clearance surrounding the discs. The apparatus is provided with means for delivering the cleansing fluid under pressure to the inlet, so that the pressure of the fluid flowing through the disc inter-spaces acts to enlarge these spaces by forcing the discs apart. A yielding biasing device normally urges the discs together and thereby opposes this enlargement of the spaces, so as to provide the unstable condition of the discs as previously described. Preferably, the fluid outlet from the clearance around the discs is arranged so as to maintain in this clearance a substantial pressure head against the discharge of fluid from the outer edges of the discs, which facilitates building up of the fluid pressure between the discs; and this may also be facilitated by providing only a narrow clearance around the discs.

In the preferred apparatus, the wall surrounding the discs is formed by a vertical cylinder mounted on the bottom of a vessel and surrounded by a chamber for receiving the fluid discharged from the clearance around the discs. The chamber has a top opening through which the disc stack can be inserted in the cylinder and a movable cover for the opening. A hollow head in the vessel has an enlarged lower end adapted to seal around the inner hole of the top disc in the stack, and an upper extension extending through the cover of the vessel to form an inlet to the head. The head forms a partitioning means slidable relative to the cover and is urged into sealing engagement with the top disc by a spring seated against the cover, whereby the spring also forms the biasing device for urging the discs together. At the bottom of the disc stack is a second partition means comprising the conical wall of a disc carrier which flares downward to form a recess, and a sealing element for supporting this wall around its lower or enlarged end on the vessel bottom. A second inlet opens through this bottom to allow passage of fluid upward through the recess and through an opening in the carrier wall leading to the inner hole of the bottom disc in the stack. The top and bottom inlets to the stack are supplied with cleansing fluid through pipe lines branching from a pump which is fed through a return line from the vessel chamber receiving the discharge from the discs, so that the fluid is recycled through the discs under pressure from both ends of the stack.

For a better understanding of the invention reference may be had to the accompanying drawing, in which the single illustration is a schematic view, partly in vertical section, of a preferred form of the apparatus.

The apparatus as illustrated comprises a tank or vessel 10 having a top opening adapted to be closed by a movable cover 11. The top opening is of sufficient size to receive the disc carrier 12 and its stack of conical discs 13. It will be understood that carrier 12 is preferably the carrier on which the discs 13 are normally mounted in the centrifugal bowl (not shown), so that when the bowl top has been removed the discs may be lifted as a unit from the bowl by means of the projecting central part of carrier 12 and lowered as a complete stack into the vessel 10. The discs are supported on the carrier

12 in vertically spaced relation to each other, by means of the usual caulks (not shown) between the discs; and in the spaces between the discs the separating action takes place in the centrifugal bowl and the cleaning action takes place in the vessel 10.

From the top of the stack, communication can be had to the spaces between the discs by way of their central holes 13*a* through which the post of carrier 12 extends with a clearance, and also by way of their usual distributing holes 13*b* arranged at the inner portions of the discs in vertical rows spaced equidistantly about the axis of the disc stack. From the bottom of the stack, communication can be had to the disc spaces through holes 12*a* in a downwardly bearing conical wall 12*b* of the carrier 12, the holes 12*a* leading to the disc holes 13*b* from a recess 12*c* formed by the wall 12*b*. When the discs 13 and their carrier 12 are mounted in the centrifugal bowl, the feed to the bowl passes through the bottom of the bowl into recess 12*c* and thence through holes 12*a* into the disc stack; and the clearance provided by the central holes 13*a* in the discs serve to convey the light separated component upwardly to a corresponding outlet of the bowl, as will be readily understood by those skilled in the art.

On the bottom of the vessel 10 is a sealing element in the form of a water proof resilient platform 14, on which the lower or enlarged end of the conical wall 12*b* rests. The platform 14 may be in the form of a flat circular disc or may have the upper surface stepped, as shown, to accommodate disc carriers of several sizes. The combined weight of the disc carrier 12 and the disc stack 13 is sufficient to effect a liquid seal between the bottom of the disc carrier and the resilient water-proof platform.

A container in the form of an open cylinder 15 surrounds the disc stack with a close clearance (in the order of ⅛ inch). It is placed in the vessel 10 on the bottom thereof and also surrounds the disc carrier 12 and the sealing element 14. The height of the cylinder 15 is such that its upper or outlet edge 15*a* is somewhat higher than the inner edge of the uppermost disc 13 of the disc stack, in order to insure that all portions of all of the discs will be submerged in a column of water within the cylinder.

The funnel-shaped head 16 has its enlarged lower end provided with a gasket 17 adapted to engage the upper surface of the top disc of the disc stack 13 and seal around the inner hole 13*a* and the distributing holes 13*b* of this disc. That is, the gasket 17 surrounds the central hole 13*a* and the group of disc holes 13*b* in the uppermost disc with a slight clearance. At its upper end, the head has a hollow extension 16*a* forming a fluid inlet to the head, and this reduced end of the head extends through a central boss 11*a* in the cover with a close sliding fit. A compression spring 19 surrounds the small end of the head 16 and is confined between the boss 11*a* of the cover and an external flange 20 on the head. This spring exerts downward pressure to effect a liquid seal between the resilient gasket 17 of the head and upper surfaces of the top disc 13 of the disc stack. The spring 19 also serves as a yielding biasing device urging the discs together against the bottom gasket 14.

Through a valved pipe 21, a washing fluid, such as water, is delivered into an annular chamber 10*a* formed between the side wall of vessel 10 and the inner cylinder 15. A bottom discharge line 22 conducts liquid from the chamber 10*a* to a pump 23. The pump 23 and its associated piping should have a volumetric capacity somewhat greater than the total through-flow capacity of the spaces between all of the discs 13 in the stack at the region of the distributing holes 13*b*, when the discs are normally spaced. The outlet from the pump is through a pipe 24 having a check valve 25 therein to prevent return flow to the pump. A valved drain pipe 26 is arranged at the low point of pipe 24 in order to drain the entire system. The pipe 24 is divided to form two fluid supply lines or delivering means from the pressure side of pump 23. One branch line 27 extends through a bottom inlet 10*b* of the vessel into the recess 12*c* under the disc carrier. The other branch line 28 is connected through a flexible hose 28*a* to the reduced extension 16*a* of the head 16. A detergent supply tank 29 communicates through a valved duct 29*a* with pipe 22 at the inlet side of pump 23. Also, a steam or hot water supply pipe 30 may be connected to pipe 24 at the outlet or pressure side of pump 23.

The washing liquid is fed by the pump through the disc stack from opposite ends thereof, via supply lines 27 and 28, under sufficient pressure to somewhat overbalance the yielding biasing force of spring 19. This causes the discs to separate to some extent against the action of spring 19, with the result that the pressure between them momentarily decreases and allows the spring to return the discs to their normal positions, at which time the pressure again builds up and the cycle is repeated. In this way an unstable condition of the discs is established, which causes them to vibrate endwise of the stack and thus greatly facilitates the cleaning action of the washing fluid passing between the discs to their outer edges.

To facilitate creation of the necessary fluid pressure between the discs for momentarily overbalancing the force of spring 19 and vibrating the discs, it is preferable that the pump 23 operate against a back-pressure imposed upon the discharge of the fluid from the outer edges of the discs. This back pressure can be established by locating the fluid overflow outlet 15*a* of the container 15 well above the discs 13, so that the pressure head of the fluid in the container opposes the discharge from the discs. The back pressure on this discharge can be further increased by providing only a narrow clearance 15*b* between the outer edges of the discs and the surrounding container 15.

In the preferred practice of the invention, the disc stack 13 and the disc carrier 12 are removed as a unit from the centrifuge bowl and given a quick rinse with a hose. The unit is then placed on the platform 14 in vessel 10 and a quantity of cool water run into the vessel from pipe 21. Then the head 16 is placed over the disc stack 13 as shown. Spring 20 is placed over the small end of the head 16 and the cover 11 is closed and latched. Flexible hose 28*a* is attached to the exposed small end of the head 16 and the pump 23 is started. The water in chamber 10*a* of vessel 10 is drawn through pipe 22 into pump 23, passes check valve 25 in pipe 24, and goes under pressure through supply lines 28, 28*a* and 27 to and through the spaces between the discs of the stack 13. The parts 12*b*—14 and 16 constitute partition means forming paths for passage of the liquid from the inlets 10*b* and 16*a*, respectively, to opposite ends of the disc stack.

The flow through pipes 28 and 28*a* enters the central area of the disc stack via head 16 and flows outwardly through the spaces between the discs either from within the central openings 13*a* of the discs or from the aligned distributing holes 13*b*. Upon reaching the outer edges of the discs, the water accumulates within the clearance 15*b* until it reaches the outlet 15*a* formed by the top edge of cylinder 15, whereupon it overflows into chamber 10*a*. The flow through pipe 27 enters the recess 12*c* beneath the disc carrier 12 and flows through holes 12*a* and outwardly through the spaces between the discs from the aligned distributing holes 13*b* this flow joining the above-noted flow from pipes 28 and 28*a*.

After this rinsing step has been completed, a detergent or steam or hot water, or a combination of these, is added to the circulating stream from pipes 29*a* and/or 30, as may be needed. After a period determined by the need at hand, the detergent supply and steam, etc., are shut off and the drain pipe 26 is opened and clean

water is added via pipe **21** and circulated. This flow is continued until the drain stream runs clean, at which time the clean water supply and the drain are closed, the pump shut down, and steam is admitted to the system from pipe **30** for quick drying and/or sterilizing of the discs and disc carrier. It will be understood that either or both the initial step of hosing the disc stack **13** and disc carrier **12**, and the final steam sterilizing step, may be omitted in some instances.

It will be apparent from the foregoing that the discs comprising the disc stack of the centrifuge may be washed without the time-consuming manual labor involved in disassembling and reassembly of each disc making up the stack. Moreover, since the disc stack does not have to be taken apart in any way, all danger of changing the order or numerical sequence of the discs is avoided.

I claim:

1. A washing apparatus comprising a container for receiving a stack of spaced conical discs having holes at their inner portions, the container having a side wall surrounding the stack and forming a clearance with the outer edges of the discs, the container having a fluid outlet communicating with the clearance and also having a fluid inlet leading to one end of the stack, partition means forming a path for passage of fluid from the inlet to said clearance by way of said holes and the spaces between the discs, means for delivering a fluid under pressure to said inlet whereby the pressure of the fluid flowing through said spaces acts to enlarge the spaces, and a yielding biasing device normally urging the discs together to oppose said enlargement of the spaces.

2. Apparatus according to claim 1, in which the container has a second fluid inlet leading to the other end of the stack and connected to said fluid delivering means, and partition means forming a path for passage of fluid from the second inlet to said clearance by way of said holes and spaces.

3. Apparatus according to claim 1, in which said fluid outlet is located at a level substantially above the outer edge of the top disc in the stack, whereby a back pressure is created on the discharge of fluid from said spaces.

4. Apparatus according to claim 1, comprising also a fluid return line connected between said outlet and fluid delivering means.

5. Apparatus according to claim 1, comprising also an outer vessel surrounding the container and forming a collector for the fluid discharged from said outlet, said fluid delivering means including a fluid supply line leading into the collector, a pipe connection between the collector and said container inlet, and a pump in said connection.

6. Apparatus according to claim 1, comprising also an outer vessel surrounding the container and forming a collector for the fluid discharged from said outlet, said fluid delivering means including a fluid supply line leading into the collector, a pipe connection between the collector and said container inlet, and a pump in said connection, the apparatus also including a second fluid supply line leading into said connection between the pump and the container inlet.

7. Apparatus according to claim 1, in which said partition means include a funnel-like member at one end of the disc stack, said member being connected at its reduced end to said fluid delivering means, and a sealing gasket on the enlarged end of said member surrounding the hole in the adjacent disc.

8. Apparatus according to claim 1, in which said partition means include a funnel-like member at one end of the disc stack, said member being connected at its reduced end to said fluid delivering means, and a sealing gasket on the enlarged end of said member surrounding the hole in the adjacent disc, said biasing device engaging the funnel-like member and urging the gasket against the adjacent disc.

9. Apparatus according to claim 1, in which said partition means include a disc carrier having a conical wall located at one end of the disc stack and flaring away from the stack to form a recess into which said inlet opens, said conical wall having a hole leading from the recess to the hole in the adjacent disc, and a sealing element between said inlet and the outer portion of said conical wall.

10. A washing apparatus for centrifuge discs of conical shape stacked in spaced relation and having holes at their inner portions, which comprises a vessel having a top opening through which the stack can be inserted in the vessel, a cylinder on the bottom of the vessel and of a size sufficient to receive and surround the disc stack with a close uniform clearance, the cylinder having a fluid outlet and forming with the side wall of the vessel a chamber for receiving fluid from said outlet, a hollow head having a lower end adapted to seal around the hole in the top disc of the stack, the head also having an upper extension forming an inlet to the head, a movable cover for said vessel opening and through which the head extension passes, the head being slidable relative to the cover, a yielding biasing device interposed between the cover and the head and adapted to urge said lower end against the top disc, a fluid supply line connected to the head extension, and a fluid discharge line leading from said chamber.

11. Apparatus according to claim 10, comprising also a pump, and return piping connecting the pump between said discharge and supply lines to form a fluid circuit through the vessel.

12. Apparatus according to claim 10, comprising also a pump, and return piping connecting the pump between said discharge and supply lines to form a fluid circuit through the vessel, and a pipe leading into said circuit for delivering fluid thereto.

13. Apparatus according to claim 10, comprising also a pump, and return piping connecting the pump between said discharge and supply lines to form a fluid circuit through the vessel, a pipe leading into said circuit for delivering fluid thereto, and a drain pipe leading from the circuit.

14. Apparatus according to claim 10, comprising also a disc carrier having a conical wall adapted to underlie the disc stack and flaring downward to form a recess below the stack, said conical wall having a hole at its inner portion for passage of fluid from said recess to the hole in the bottom disc of the stack, a sealing element on the bottom of the vessel within the cylinder and forming a seat for the enlarged lower end of said conical wall, the vessel bottom having a fluid inlet leading into said recess, and a second fluid supply line connected to said bottom inlet.

15. Apparatus according to claim 14, comprising also a pump, and return piping connecting the pump between said discharge line and the fluid supply lines.

16. Apparatus according to claim 1, in which said partition means include a member located at one end of the disc stack and having a hollow portion adapted to engage the adjacent disc around the hole therein, said member being connected to said fluid delivering means to supply fluid to said hollow portion.

17. Apparatus according to claim 1, in which said partition means include a member located at one end of the disc stack and having a hollow portion adapted to engage the dajacent disc around the hole therein, said member being connected to said fluid delivering means to supply fluid to said hollow portion, said biasing device engaging said member to urge the same against said adjacent disc.

18. Apparatus according to claim 1, in which said partition means include a member located at one end

of the disc stack and having a hollow portion adapted to be received in the adjacent disc, said fluid delivering means opening into said hollow portion.

19. Apparatus according to claim 1, in which said partition means include a member located at one end of the disc stack and adapted to engage the adjacent disc, said biasing device engaging said member and urging the same against the adjacent disc.

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