

[54] **CENTRIFUGE WITH BOWL VALVE CONTROL**

[76] **Inventor:** Carl W. Weiland, 2980 Interlaken, Orchard Lake, Mich. 48033

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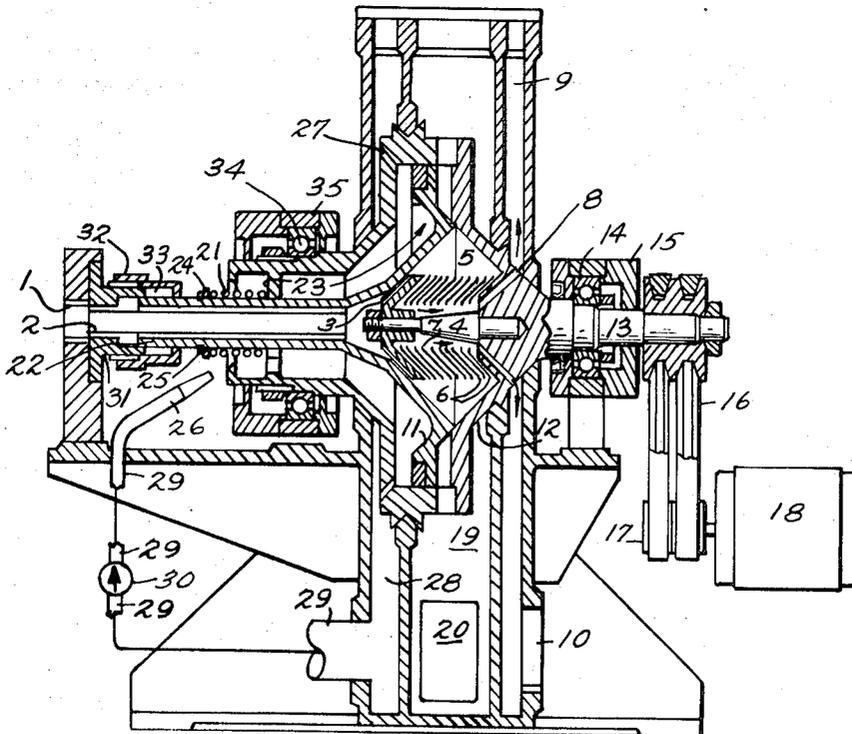
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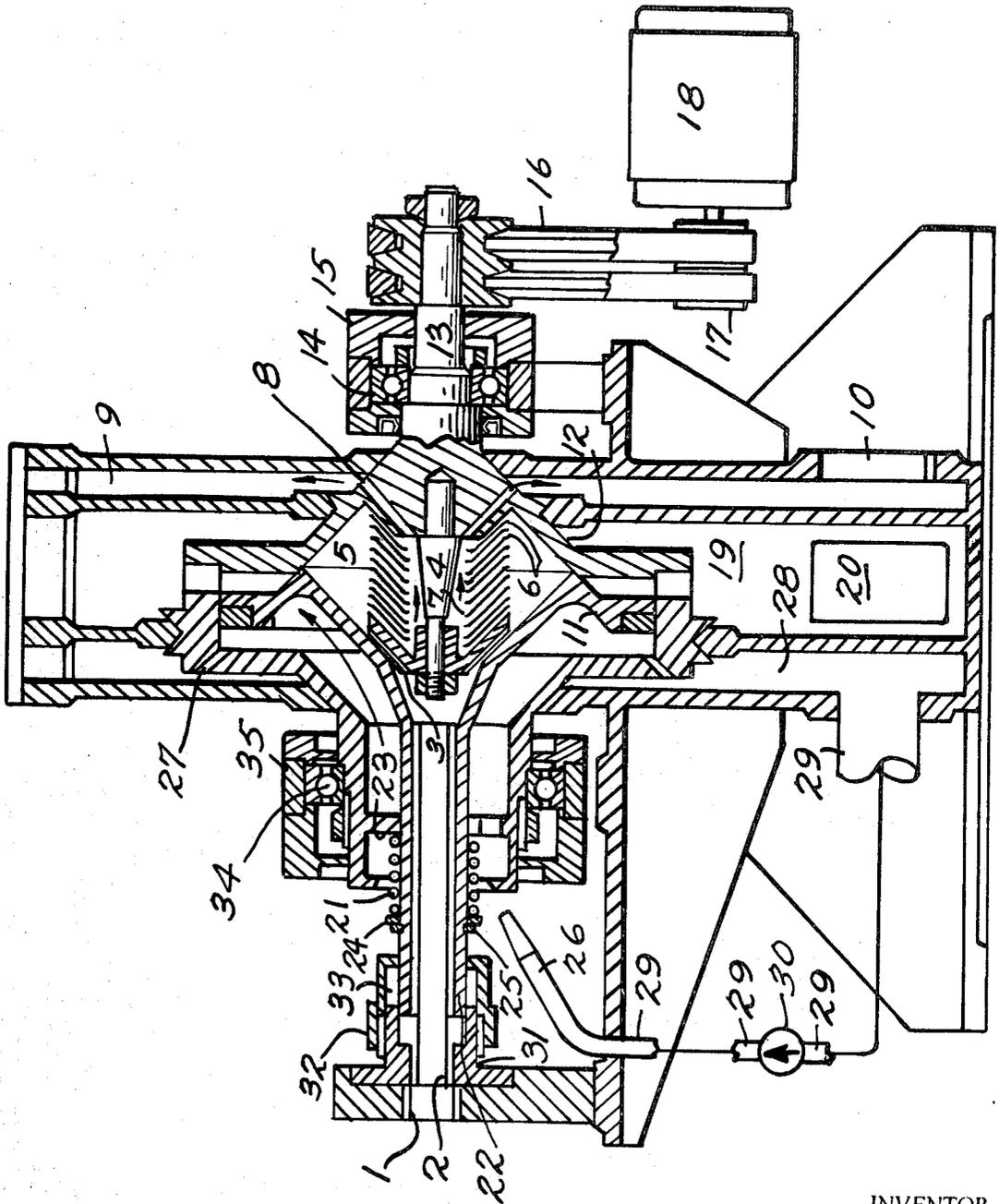
Primary Examiner—George H. Krizmanich
Attorney—Cushman, Darby & Cushman

[57] **ABSTRACT**

A centrifuge cavity is defined by first and second bowl sections. The first bowl section is attached to the drive shaft for the centrifuge which drive shaft is mounted in a main bearing. The second shaft is hollow which allows a stationary inlet pipe mounted concentrically therein thus defining a space with said hollow shaft which is blocked by sealing means to allow high pressure operation of the centrifuge. All of the centrifuge discs are carried by the main shaft of the centrifuge, so as to leave the second bowl section relatively free for easy and precise movements relative to the first bowl section. The second bowl section is spring loaded in a direction opposite to the first bowl section in order to urge the bowl sections apart, thus allowing sludge build-up at the periphery of the centrifuge cavity to escape. Opposing the force of the spring is a source of fluid under pressure which is directed at the side of the second section which is opposite to the first section so as to urge the bowl sections into mated, closed positions when the pressure of the fluid is sufficiently high to overcome the force of the spring.

3 Claims, 1 Drawing Figure





INVENTOR

CARL W. WEILAND

BY *Cushman, Dalby & Cushman*
ATTORNEYS

CENTRIFUGE WITH BOWL VALVE CONTROL**BACKGROUND OF THE INVENTION****1. Field of the Invention**

This invention relates to centrifugal separators designed to separate sludge from liquid, and, more particularly, this invention pertains to those centrifugal separators in which the centrifuge cavity is defined by two bowl sections in which a plurality of disc elements are carried for effecting a separation of solids or impurities from a liquid. Such separators have widespread utility in industrial purification and separation applications and can be used in water treatment systems.

2. Description of the Prior Art

Centrifugal separators are well known means for separating impurities or other solids entrained in a liquid from the liquid itself. A well known type of centrifugal separator is the so-called "self-cleaning centrifugal separator." In this type, a centrifuge cavity is defined by two bowl sections each of which is mounted on a separate shaft. Means are provided for moving one of the bowl sections with respect to the other in order to create a separation at the periphery of the centrifuge cavity allowing egress of sludge or other solids which are deposited there due to the centrifugal force generated by the centrifuge. A known expedient for increasing the effectiveness of such centrifuges comprises the provision of a finned disc plate and a plurality of discs within the centrifuge cavity. These elements create a turbulent flow within the centrifuge cavity, which, in effect, forces the larger particles of solid matter out of the liquid. Further, the discs require the liquid within the centrifuge cavity to travel a torturous and extended path which thus extends the time that liquid is exposed to the centrifugal force of the centrifuge cavity.

In the prior art, however, this plurality of discs was either attached to the driven shaft, or a portion of the discs were attached to the driven shaft and a portion were attached to the driving shaft. In the first case, the whole section which moved included the weight of the disc assembly and therefore the perfect mating of the sections, a necessity in centrifugal separators, was difficult to achieve.

In addition, in the first case, the disc assembly was supported by bearings of the second shaft which, for that reason, would have to be larger and more expensive than otherwise.

In the case where a portion of the discs was supported by each of the bowl sections the main difficulties arose in properly mating the discs when the sections were brought together after an initial separation and the dynamic imbalance resulting in vibrations due to the rotation of improperly mated disc sections.

SUMMARY OF THE INVENTION

For the above reasons, it is the object of this invention to provide in the centrifuge cavity of the centrifuge separator a plurality of discs which are supported by the axially stationary drive shaft of the centrifugal separator. This, in turn, allows this section to be supported by the main bearings which improves the rigidity of the disc assembly and therefore lessens vibrations. In addition, since the axially movable bowl section does not carry any excess load it may be more easily moved, and its axial movement may be more precisely controlled. The apparatus invented by the applicant for carrying out the above object includes a centrifuge cavity de-

finned by first and second bowl sections, the first bowl section being connected to a first rotatably mounted shaft which is the drive shaft, while the second bowl section is connected to a second rotatably mounted, but hollow, shaft. The first and second shafts are coaxial and the second shaft contains concentrically within it an inlet pipe 1. Means are provided for sealing the space between the stationary inlet pipe and the rotating second shaft. This allows a higher pressure in feeding of liquid into the bowl section without danger of spilling or leaking. Disposed within the centrifuge cavity are a plurality of discs which are mounted upon a rod means which projects from the first shaft.

Other features of the applicant's invention include a means for separating and closing the bowl sections to periodically allow egress of sludge from the bowl sections. This separating and closing means includes a spring means for forcing the second bowl section in a direction opposite to the first bowl section and a source of fluid which is directed at the side of the second bowl section opposite the first bowl section for overcoming the force of the spring means.

BRIEF DESCRIPTION OF THE DRAWING

The drawing shows a side view in section along the center line of a preferred embodiment of applicant's invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

The liquid containing impurities or solids is introduced to the centrifuge separator shown in the FIGURE through inlet 1 and inlet pipe 2. This liquid passes under pressure along the axially disposed inlet pipe 2 until it reaches a disc plate 3 which is attached to the end of an axially mounted projecting rod means 4.

When the centrifugal separator is in operation the disc plate 3 rotates to spin the incoming liquid into a centrifuge cavity 5 defined within two bowl sections 11 and 12. The liquid is then forced through a plurality of discs 6 which create a great turbulence and help to remove the solids from the liquid. The solids are then accelerated under the centrifugal force created by the centrifuge separator, and deposited at the periphery of the centrifuge cavity 5. The clean liquid then passes along the central cavity 7 and the outlet channels 8 to a clean liquid collector chamber 9. This liquid then exits from the clean liquid collector chamber 9 through a clean liquid outlet 10. A pump (not shown) may be provided for carrying away the clean liquid.

The sludge which is collected at the periphery of the centrifuge cavity 5 is periodically removed therefrom by moving the left bowl section 11 relative to the right bowl section 12 by means discussed in more detail below. It is important to note that when the left bowl section 11 moves with respect to the right bowl section 12, no axial motion is imparted to the disc plate 3 or the stack of discs 6. Thus, no additional force is required to move the load of the disc stack, as has been required with prior art arrangements. It is also important to note that the projecting rod means 4 is firmly anchored to a drive shaft 13 which is rotatably mounted by heavy duty ball bearings 14 within bearing retainer 15. This drive shaft 13 may be considered a first shaft for supporting a first bowl section 12 and a stack of discs 6. A second shaft 22 will be described later with reference to support of the first bowl section 11. Because this is

the drive end of the machine, heavy duty ball bearings would be required even in the absence of the load of discs 6. The drive shaft 13 and therefore the centrifuge is powered by a driven pulley means, a pair of endless belts 16, another drive pulley means 17 and motor 18.

The sludge which exits at the periphery of the centrifuge cavity when the left bowl section 11 is moved axially with respect to the right bowl section 12 goes to the sludge collector chamber 19 and is removed from opening 20 by a sludge conveyor means (not shown).

Now the means by which the left bowl section 11 is moved with respect to the right bowl section 12 will be discussed. This means essentially comprises a spring 21 concentrically mounted about a hollow shaft 22 which supports the left bowl section 11. The spring is compressed between a stationary member 23, a collar 24 which is attached to the hollow shaft 22 by a fastening means 25. The spring 21 tends to force the left bowl section 11 in the leftward direction as shown in the drawing. This movement effects an opening of the centrifuge cavity. However, this force can be overcome by the hydraulic pressure of a stream of liquid issuing through a nozzle 26 and acting upon the side of the left section 11 opposite to the right bowl section, namely, the left side of the left bowl section 11. In the preferred embodiment, the fluid then exits through passages 27 to a hydraulic liquid collector chamber 28, and exits therefrom through a hydraulic liquid output conduit 29. It is returned via a hydraulic liquid pump 30 disposed within the output conduit 29. Preferably, the hydraulic liquid is continuously circulated to avoid any build up of residue or impurities. In operation, the hydraulic pressure system, just described, circulates liquid at a sufficiently high pressure to overcome the force of spring 21 (and any internal bowl pressure) when it is desired to maintain the bowl sections in closed, sealed positions relative to one another.

When dumping of sludge is required, the pumping of liquid through the hydraulic system is stopped, or the pressure of the system is reduced, so that the spring 21 can cause the bowl sections to move apart. This can be done while centrifuging is continued without stopping the drive shaft 13.

Because it may be desirable to centrifuge a liquid having a greater than atmospheric pressure, a sealing means may be provided between the inlet pipe 2 and the hollow shaft 22. The sealing means comprises a ring 31 affixed to the inlet 1 and a ring 32 affixed to the hollow shaft 22. The rings 31 and 32 define a cavity which is filled with the sealing ring 33.

Because the shaft 22 is hollow and because it supports only the lighter load of left bowl section 11, a light duty ball bearing 34 is all that is required for rotatably mounting this shaft. The light duty ball bearing 34 rests within the stationary retainer 35. Additionally, the left bowl section 11 is easily moved axially with light forces.

In summation, a self-cleaning centrifuge is shown in which all the discs and the disc plate are supported by the input shaft. Since this shaft is supported by the heavy main drive bearings the discs are more rigidly supported than in the prior art and thus the centrifuge separator is less prone to excessive vibrations. Moreover, since the axially movable bowl section carries no disc load, less force is required to move it and its movement can be more precisely controlled. Finally, the centrifuge contains a sealing means between its input

pipe and the centrifuge cavity which allows centrifuge operations at higher pressures than those known to the prior art.

While the preferred embodiment of applicant's invention has been described above, it should be obvious to one skilled in the art that many modifications within the scope of this embodiment are possible. For instance, the hydraulic liquid pump 30 may be controlled by a timer mechanism for periodically moving the left bowl section 11 to the left to open the centrifuge, or this pump's operation may be manually controlled. Also, the rod means 4 may comprise an integral extension of the drive shaft 13.

What is claimed is:

1. In a centrifuge separator having first and second bowl sections defining a centrifuge cavity, said first bowl section being connected to a first rotatably mounted shaft and said second bowl section being connected to a second rotatably mounted shaft, said first and second shafts being mounted coaxially, and drive means connected to said first shaft for rotating said centrifuge and a plurality of discs deposited within said cavity, the improvement comprising a rod means extending from said first shaft for supporting all of said plurality of discs from the first shaft so as to leave said first bowl section free for axial movements which function to open and close the centrifuge cavity, and means for moving said second shaft and second bowl section axially with respect to said first shaft and first bowl section, to separate said bowl sections and allow sludge to discharge therefrom and then to return said bowl sections to contact, including (a) a spring means for urging said first and second bowl sections axially away from each other so as to open the centrifugal cavity to discharge sludge therefrom, and (b) a hydraulic pressure means for urging said first and second bowl sections into mating engagement to effect a closing of the centrifugal cavity.

2. In a centrifuge separator having first and second bowl sections defining a centrifuge cavity, said first bowl section being connected to a first rotatably mounted shaft and said second bowl section being connected to a second rotatably mounted shaft, said first and second shafts being mounted coaxially, and drive means connected to said first shaft for rotating said centrifuge and a plurality of discs deposited within said cavity, the improvement comprising a rod means extending from said first shaft for supporting all of said plurality of discs from the first shaft so as to leave said first bowl section free for axial movements which function to open and close the centrifuge cavity, and means for moving said second shaft and second bowl section axially with respect to said first shaft and first bowl section, to separate said bowl sections and allow sludge discharge therefrom and then to return said bowl sections to contact, including a stationary member, a collar attached to said second shaft, a spring mounted in compression between said collar and said stationary member for moving said second bowl section away from said first bowl section, and fluid pressure means for urging said second section into mating engagement with said first section.

3. The centrifuge of claim 2 wherein said fluid pressure means operates at a sufficiently high pressure to normally maintain the bowl sections closed against the urging of said spring means, and including means for reducing the pressure in said pressure means, during a centrifuging operation, to a sufficiently low level to permit an automatic opening of the centrifugal cavity by the urging of said spring means.

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