

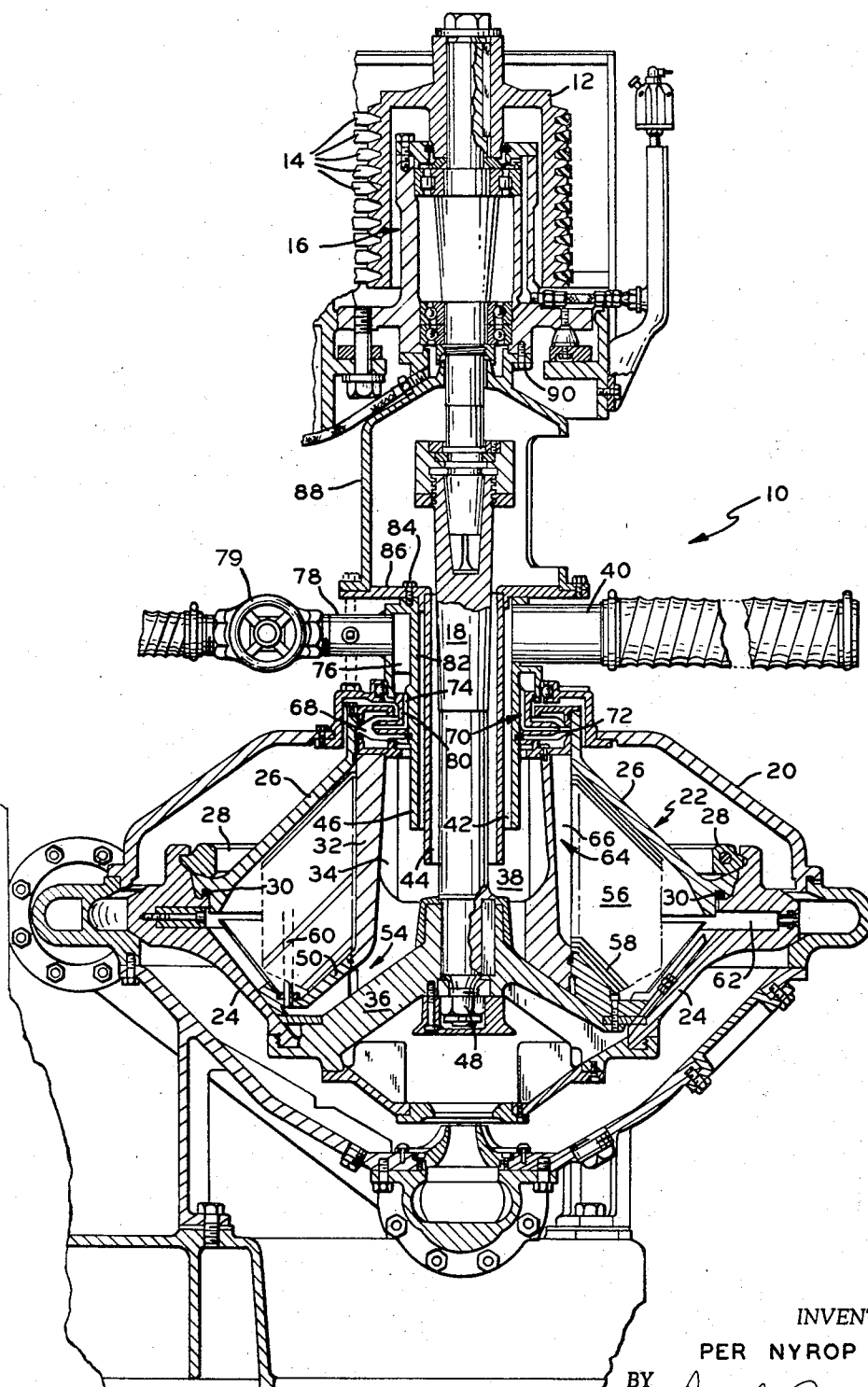
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BEARING MOUNTED OVERFLOW IMPELLER

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BEARING MOUNTED OVERFLOW IMPELLER
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ABSTRACT OF THE DISCLOSURE

The present invention relates to a stationary paring impeller for picking up and discharging centrifugally separated liquid from the rotor to the housing. The impeller is stationary relative to the rotor and is thus responsive to any shifts in position, or precessional rotation, of the rotor relative to the housing.

Certain liquids exhibit a marked propensity to foam when undergoing centrifugal separation. The degree of foaming produced, which is a function of the amount of gas present and the intensity of the turbulence at the gas-liquid interface, is accentuated when the separated liquid is discharged from the rotor over a dam or weir into the stationary housing reservoir. The liquid rises over the dam and is thrown radially outward in a relatively thin layer toward the walls of the housing. The expanded gas-liquid interface and the relative motion of the liquid through the gas causes the liquid to entrain large quantities of foam producing gas. In addition, as the liquid strikes the relatively quiescent body of separated liquid, previously deposited in the housing, it causes splashing and turbulence which creates still more foam.

The prior art has suggested an approach to this problem which involves using a stationary paring impeller as the pick-up and discharge for the separated liquid. The impeller, which is positioned in a corresponding annular pump chamber in the rotor, has a series of curved flow channels extending from its periphery to a central passageway. The mouth of each flow channel is positioned within the body of rotating liquid to tangentially intercept and divert the liquid into the impeller. The curvature of the channel converts a part of the kinetic energy of the moving liquid particles into static pressure head to, in effect, pump the liquid from the annular chamber through the central passageway to the discharge line. A valve in the discharge line maintains the periphery of the impeller submerged in the liquid and insures sufficient back pressure to prevent the discharge of gas along with the liquid.

It will be noted, however, that while many such paring impellers are shown on various types of centrifuges in the prior art, see for example U.S. Patents 2,139,715; 2,171,136; 2,186,822 and 2,197,911 no such device has, to date, been successfully applied to a top driven vertically suspended commercial-type centrifuge. This is because of the severe precessional problems which have been encountered whenever such an application has been attempted. The prior art discloses this device directly connected to the housing on bottom driven centrifuges, i.e., centrifuges wherein the drive motor and shaft are at the opposite end of the machine from the overflow discharge. It is well known in the art that in the rigidly-supported, bottom driven machines the problem of radial shifting of the axis of rotation and corresponding gyratory rotation does not approach the magnitude encountered in top driven machines. Therefore, any intensification of this almost negligible precession which might be caused by attaching the impeller directly to the housing can also be considered de minimus.

Essentially, top driven centrifuges, i.e., centrifuges wherein the drive motor and shaft are at the same end of the machine as the primary overflow discharge, are,

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to a degree, inherently subject to eccentric rotation and vibrations. The rotor is suspended by the drive shaft and any unbalance condition, whether caused by an uneven distribution of solids in the rotor, the plugging of a discharge nozzle, or imperfections arising in machining or assembly, will result in a shift in the center of gravity of the rotor away from the spin axis and gyratory rotation. The speed of rotation, the amount of unbalance, and the axial position of the unbalance condition are the major variables in determining the degree of gyratory rotation.

When, as stated above, it was attempted to incorporate a paring impeller into a top driven centrifuge, in the manner taught by the prior art, i.e., connecting it directly to the housing, the slightest precession would promptly and rapidly multiply necessitating a discontinuance of operations. Subsequent investigation revealed the major cause for this severe intensification of precession to be the variations in drag and pressure along the periphery of the impeller, resulting from the impeller shifting its position relative to the pump chamber in the rotor and the corresponding and constant shifts in the depth of the impeller in the separated liquid in the pump chamber.

It is therefore an object of the present invention to utilize a paring impeller type pick-up in a top driven centrifuge without increasing the inherent precession of the machine. Applicant has been able to accomplish this objective by a novel support arrangement for the impeller which involves rigidly connecting the impeller through the intermediary of the bearing assembly to the rotor. With this structural arrangement, should an unbalance condition occur and the rotor begin precessional rotation, the paring impeller will shift its position along with, and according to, the shifts in position of the rotor. Thus the impeller will maintain its relative position in the pump chamber of the rotor and the drag and pressure variations which previously caused the severe multiplications of the precession are not encountered.

It is therefore another object of the present invention to connect a paring impeller pick-up to the rotor of a top driven centrifuge.

It is still another object of the present invention to interconnect a paring impeller pick-up, the bearing assembly and the rotor of a top driven centrifuge.

It is yet a further object of the present invention to interconnect the feed tube and the rotor of a top driven centrifuge.

The subject matter which Applicant regards as his invention is particularly pointed out and distinctly claimed in the concluding portion of this specification. The invention, however, as to its organization and method of operation together with further objects and advantages thereof will best be understood by reference to the following description taken in conjunction with the accompanying drawing which is a side elevational view, in section, of a top driven centrifuge incorporating the present invention.

Referring now to the drawing a single overflow centrifuge 10 is shown to illustrate an exemplary application of the present invention. However, it should be understood that the present invention is not limited in its application to the particular centrifugal apparatus disclosed and, as will be described below, is equally as applicable on multiple overflow centrifuges.

The centrifuge 10 includes a drive sheave 12, having a series of belts 14 and a main bearing housing and assembly 16, a drive shaft 18, a housing 20 and a rotor 22. The rotor 22 has a frusto-conical bowl 24 and a matching cover 26 which are held in position by a clamp ring 28. The bowl 24 and cover 26 have matching inter-engaging rim portions suitable sealed by O-ring seal 30.

A tapered generally cylindrical shell 32 having a plu-

rality of equally spaced axially extending vanes 34 surrounds shaft 18 and seats upon a rotor hub 36 to form a feed well 38. Feed material is introduced into feed well 38 through conduit 40 and passage 42 formed between inner and outer concentric tubes 44, 46. The rotor hub 36, which is generally conical in shape, is formed integrally with bowl 24 and is suitably secured to the shaft 18 by means of hub nut 48.

An annular feed impeller 50, seated upon rotor hub 36, extends outwardly from feed well 38 and has a plurality of radially extending vanes 52 which define outwardly extending channels 54 for the feed material. The vanes 34 in the feed well 38 serve to impart rotary motion to the feed material to deliver the feed material downward and outward to channel 54.

A separating chamber 56, having a stack of nested separating discs 58, occupies the space in the rotor overlying the feed impeller 50 to separate the feed material into its component fractions. Suitable means, such as circumferentially spaced vertical feed tubes 60 are provided for distributing the feed material onto the separating discs. The tubes extend from channel 54 axially through the disc stack and have vertical inboard and outboard slots all along their length to discharge the feed material onto the individual discs.

The disc stack, because of its nested closely spaced relationship, enhances the separation of the feed mixture into the light and heavy phases by reducing the settling distance to the axial distance between discs. The heavy phase or under flow is caused to move outward by centrifugal force while the lighter phase or overflow moves inward due to the inward velocity of the mother liquor. The underflow, now in the form of a concentrated slurry, is discharged from the disc stack and collects along the inner surfaces of the rotor for subsequent discharge through nozzles 62 and possible recycle, in a manner well known in the art.

The lighter phase winds its way to the inner end of the disc stack where it is discharged into annular chamber 64 between the disc stack and cylindrical shell 32. Chamber 64 has a plurality of equally spaced vanes 66 which transport the overflow axially until it is discharged into annular pump chamber 68 adjacent the drive motor end of the centrifuge.

A stationary, annular paring impeller 70 having a plurality of curved flow channels 72 and a central passageway 74, is positioned within the pump chamber 68 to transfer the separated liquid from the rotor to the housing reservoir 76. The overflow liquid continues to rotate with the pump chamber 68 until it completely submerges the mouth of the impeller and enters the flow channels tangentially. The curvature of the stationary flow channels reacts with the rotating liquid to transform a portion of the kinetic energy of the liquid particles into static pressure head to, in effect, pump the liquid out of the rotor. The liquid, now under the influence of the pressure head, rises through central passageway 74 and housing reservoir 76 for final discharge through conduit 78. A valve 79 in conduit 78 is adjusted to maintain the periphery of the impeller submerged in the liquid and to create sufficient back pressure in the discharge line to prevent the discharge of gas along with the liquid.

Previous attempts to utilize a stationary paring impeller discharge on a top driven centrifuge, i.e., the type shown in the Figure, have had to contend with severe precession problems. Concentricity and balance are basic problems in the specification and design of top driven centrifuges and as a result some precession and gyratory rotation are to be expected. It is relatively impossible to build a machine of this type which is perfectly balanced at the start and which is not subjected to some degree of plugging or uneven solids build-up. Precession and gyratory rotation of the rotor necessitates corresponding gyratory rotation of the liquid in the pump chamber 68. Thus, when it was attempted to attach the paring impeller di-

rectly to the housing, as is taught by the prior art, the variations of drag and pressure along the periphery of the impeller had a multiplying effect on the precession that was already present in the machine.

Applicant addressed himself to this problem and through the mode of attachment hereinafter described has been able to utilize a paring impeller discharge on a top driven centrifuge without any effect on the inherent precession of the machine. As can be seen from an inspection of the Figure the central passageway 74 has an external wall 80 and an internal wall 82 which descends to form concentric tube 46 and ascends to form the interior wall of the housing reservoir 76. Interior wall 82 is attached, by any suitable means, such as screws 84, to structural member 86, which is, in turn connected at one end to tube 44 and at the other end to shaft housing 88. The shaft housing is attached, such as by screw mean 90, to the bearing housing and assembly 16. Thus through the intermediary of the bearing assembly and the drive shaft, the paring impeller is fixed in relation to, and becomes an integral part of, the rotor. In this manner any precession of the rotor and, correspondingly, the liquid in pump chamber 68, will be directly transmitted to the paring impeller so that the paring impeller can change its position along with and according to, the shifts in position of the rotor. With the cause of drag and pressure variations avoided the major cause of precession multiplication is removed.

It should be understood that while only one pump chamber and paring impeller combination are shown, this particular centrifuge being of the single overflow type, the same connection can be used for two or more pump chambers and paring impellers, in stacked relation on a multiple overflow centrifuge wherein all the overflows exit at the drive proximate end of the machine. It will be noted that, as described above, the tubes 44, 46 which make up feed conduit 42 are also attached, in this manner to the rotor. This further improves the concentricity of the over-all machine and reduces another possible source of precession and gyratory rotation.

As this invention may be embodied in several forms without departing from the spirit or essential character thereof, the present embodiment is illustrative and not restrictive. The scope of the invention is defined by the appended claims rather than by the description preceding them, and all embodiments which fall within the meaning and range of equivalency of the claims are, therefore, intended to be embodied by those claims.

I claim:

1. A centrifugal separator comprising a housing, a rotor, a separating chamber in said rotor, means to introduce a feed material to be separated into said separating chamber, at least one means to discharge separated underflow from said separating chamber, means to discharge separated overflow from said separating chamber, at least one annular chamber in said rotor to receive at least a part of the separated overflow from said separating chamber and a stationary paring impeller in said annular chamber to transfer the separated overflow in said annular chamber to said housing, the axis of said stationary paring impeller being fixed in relation to the axis of said rotor.

2. A centrifugal separator comprising a housing, a rotor, said rotor having a feed well and a separating chamber, means to introduce a feed material to be separated to said feed well, means to transfer said feed material from said feed well to said separating chamber, means to discharge separated underflow from said separating chamber, means to discharge separated overflow from said separating chamber, at least one pump chamber in said rotor to receive at least a part of the separated overflow from said separating chamber, a stationary paring impeller in said pump chamber to discharge the separated overflow from said rotor, and means interconnecting said rotor and said paring impeller so that the paring impeller will shift its

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position along with and according to precessional shifts in the position of the rotor relative to the housing.

3. A centrifugal separator as defined in claim 2 further including a drive shaft connected at one end thereof to said rotor and wherein said means interconnecting said rotor and said paring impeller is a bearing assembly of said drive shaft.

4. A centrifugal separator as defined in claim 2 wherein said last mentioned means interconnects said rotor and said means to introduce a feed material to be separated to said feed well.

5. A centrifugal separator as defined in claim 3 wherein said bearing assembly and drive shaft interconnects said rotor and said means to introduce a feed material to be separated to said feed well.

6. A centrifugal separator comprising a housing, a rotor, a drive shaft connected at one end thereof to said rotor, drive means connected to the other end of said drive shaft, a separating chamber in said rotor, means to introduce a feed material to be separated to said separating chamber,

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means to discharge separated underflow from said separating chamber out of said rotor, a pump chamber in said rotor adjacent the drive proximate end of said centrifuge to receive separated overflow from said separating chamber, a stationary paring impeller in said pump chamber to receive the separated overflow and discharge it out of said rotor, and means interconnecting said paring impeller and said drive shaft.

7. A centrifugal separator as defined in claim 6 wherein said last mentioned means is a bearing assembly.

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