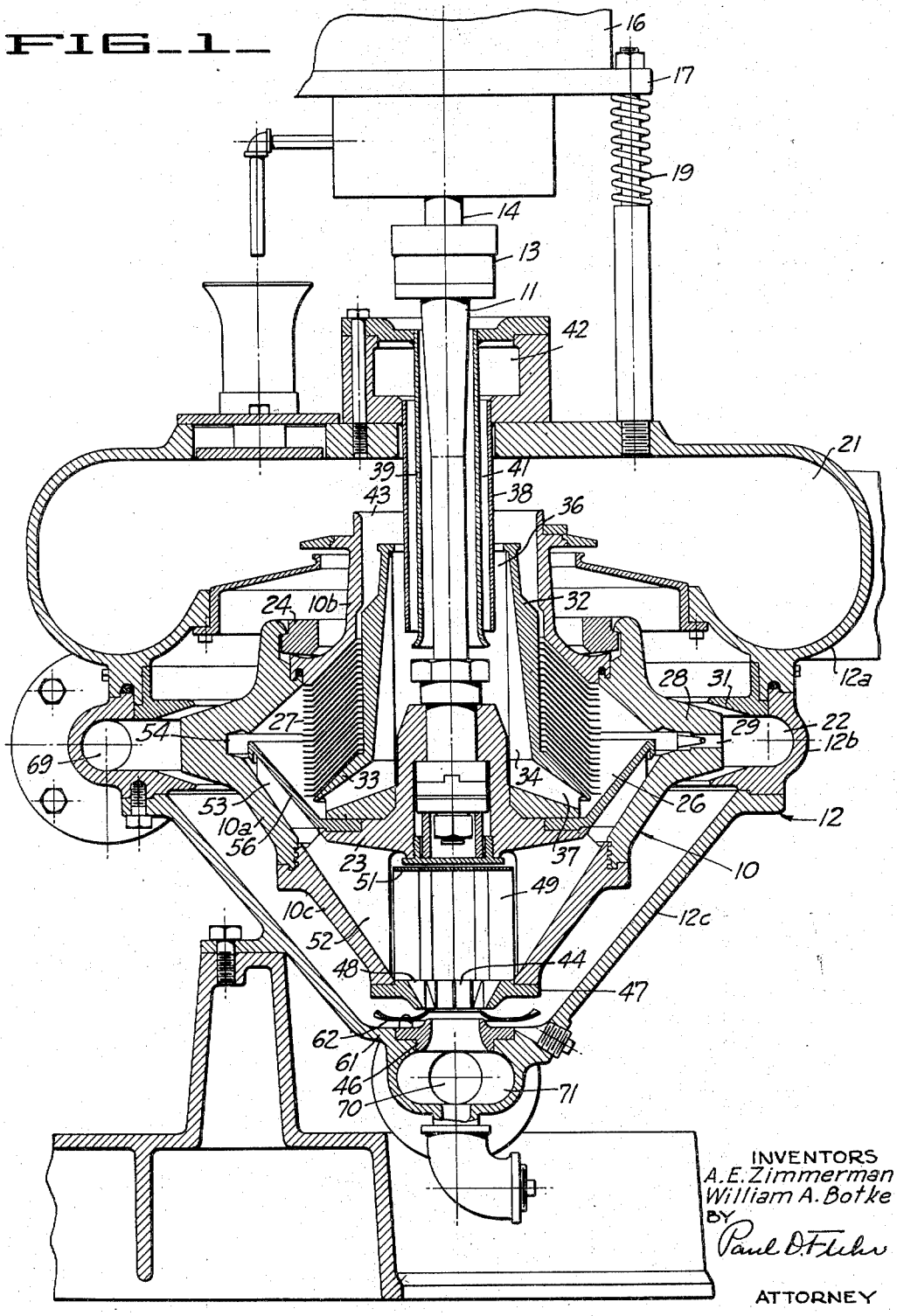
Oct. 10, 1950 A. E. ZIMMERMAN ET AL 2,525,629

CENTRIFUGE CONSTRUCTION

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FIG. 1



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CENTRIFUGE CONSTRUCTION

Filed June 7, 1947 2 Sheets-Sheet 2

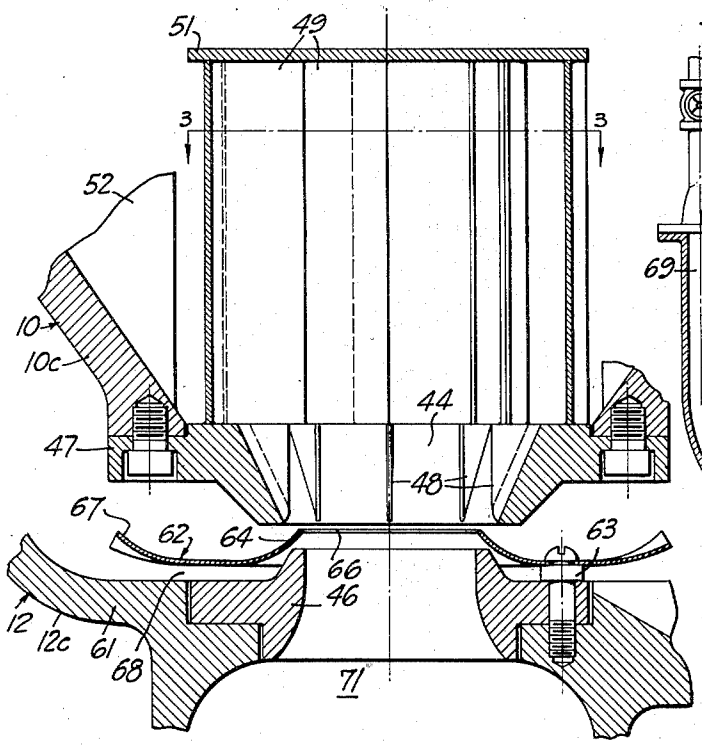


FIG_2_

FIG_4_

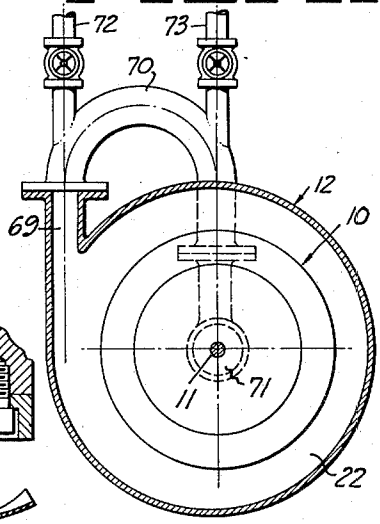


FIG_3_

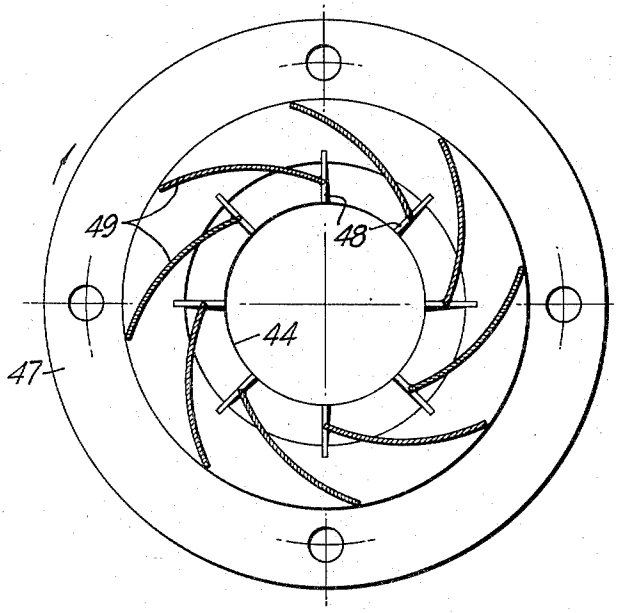
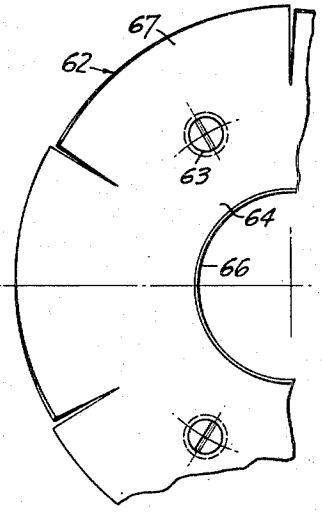


FIG 5



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UNITED STATES PATENT OFFICE

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CENTRIFUGE CONSTRUCTION

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Application June 7, 1947, Serial No. 753,302

1 Claim. (Cl. 233—16)

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This invention relates generally to centrifuges of the type adapted particularly for the continuous separation and discharge of solid components from a feed material containing suspended solids.

Continuous centrifuges of the type disclosed in Letters Patent 1,923,454, 1,847,751 and 2,060,-236 utilize a so-called return circuit by means of which a large part of the centrifugally separated underflow is continuously returned into the centrifuge rotor. A commercial machine of this character makes use of a volute which surrounds the rotor, and which receives the centrifugally separated underflow. The rotor is provided with a lower conical shaped impeller portion which has an axially disposed opening faced downwardly, and which is adapted to receive the returned underflow material. A pipe connects from the volute to a nozzle disposed below the lower end of the rotor, whereby a closed return circuit is formed to deliver the underflow into the impeller under the pressure developed by the volute. The impeller in turn is constructed in such a manner as to deliver the returned material into an annular chamber forming a part of or communicating with the separating chamber of the rotor.

With centrifuges as described above a particular problem is involved in connection with pumping of the returned underflow material into the centrifuge separating chamber. For optimum operation the returned material should be delivered to the separating chamber under a relatively high pressure head consistent with the speed of operation of the rotor, and the pressure must be relatively constant to insure stability of operation with a desired maintenance of the gravity of the underflow. Inability of the impeller or the parts of the return circuit to deliver underflow at a proper pressure head into the separating chamber serves to limit the speed of operation and the separating capacity of the machine. A further difficulty involved is the reintroduction of the underflow into the rotor in such a manner as to minimize spill of material or spraying of the material from the exterior surfaces of the rotor. Any spilling or spraying of the material as it is being introduced into the rotor, complicates the problem of removing such spilled material from the housing of the machine. Also the power consumption of the machine is increased, and the dynamic stability of the machine is disturbed. In addition such spilled material tends to find its way into the collecting

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means for the separated fractions, thus interfering with the desired sharpness of separation.

It is an object of the present invention to improve upon machines of the above character, particularly with respect to the means for introducing the underflow material back into the centrifuge rotor.

A further object of the invention is to provide an improved centrifuge of the above character which has a new and novel type of pumping or impeller means for the return of underflow material back into the centrifuge chamber.

A further object of the invention is to provide improved impeller means for a centrifuge of the above type which will minimize any spill or splashing of material from the rotor.

Additional objects and features of the invention will be apparent from the following description in which the preferred embodiment has been set forth in detail in conjunction with the accompanying drawing.

Referring to the drawing—

Figure 1 is a side elevational view partly in section showing a machine incorporating the present invention.

Figure 2 is an enlarged detail in section illustrating the construction of the impeller.

Figure 3 is a cross-sectional detail taken along the line 3—3 of Figure 2.

Figure 4 is a diagrammatic plan view showing connections for the return of underflow discharge material to the rotor, for removal of discharged material, and for introduction of wash liquor.

Figure 5 is a plan detail illustrating the construction of the pick-up ring utilized in Figure 3.

The centrifuge illustrated in Figure 1 of the drawing consists generally of the rotor 10 carried by the vertical shaft 11, and disposed within the stationary housing 12. As will be presently described the rotor is provided with various passages, including a passage for the inflow of fluid feed material, a passage for discharge of lighter centrifugally separated overflow and a passage for supplemental fluid liquid which is preferably made up of the heavier centrifugally separated discharge material or underflow. The rotor shaft 11 is connected by coupling 13 to the vertical shaft 14 of a bearing assembly 16. The bearing assembly includes a ring 17 carried by the spring mounting 19.

The housing 12 can be conveniently formed of a plurality of separable sections 12a, 12b and 12c. Section 12a forms a volute chamber 21 for re-

ceiving centrifugally separated overflow, and section 12b is formed to provide the volute chamber 22 which receives underflow or heavier separated material.

The body of the rotor 10 is likewise preferably made of a number of separable annular parts, including in this instance the main part 10a, and the upper and lower conical shaped parts 10b and 10c. Part 10a has an inner structure 23 which is attached to the lower end of the rotor shaft 11. Parts 10a and 10b are retained together by suitable means such as the expansible clamping ring 24. Within the separating chamber 26 of the rotor there is a group of spaced separating discs 27 such as are commonly used in centrifuges. Mounted within the outer peripheral wall 28 of the main body part 10a are the circumferentially spaced nozzles 29, each of which is provided with a discharge orifice directed backwardly with respect to the direction of rotation. The annular periphery 28 of the rotor body part 10a is accommodated within a diverging portion 31 or throat ring of the housing part 12b.

The lower portion 10c of the rotor forms an impeller for the return of heavier centrifugally separated underflow material back into the rotor. Thus the lower end of the rotor part 10c is provided with an axially and downwardly faced opening 44. This opening is directly above a nozble 46 carried by the lower part of the housing, and which as will be presently explained serves to direct a jet or solid stream of the returned underflow material upwardly into the impeller, and through the opening 44. The opening 44 is formed in a ring 47 which is removably clamped to the lower part of the body part 10c. The opening 44 is divergent upwardly (Figure 2) and is provided with a plurality of circumferentially spaced vanes 48. These vanes have inner vertical edges, and for convenience their outer edges can be fitted within grooves provided within ring 47 as illustrated. The vanes extend in planes radial with respect to the axis of rotation.

Ring 47 also serves to mount a vane assembly which extends into the impeller, and which aids in securing the desired pumping action with a minimum of spill. This assembly consists of a plurality of circumferentially spaced and vertically extending vanes 49 which have their lower ends attached to the ring 47, and their upper ends attached to the disc 51. The vanes 49 are inclined to the direction of rotation as indicated in Figure 3, and preferably they are slightly curved whereby their convex faces are toward the direction of rotation. In general it can be explained at this point that when a jet of the return underflow material is discharged upwardly from the nozzle 46 into the lower portion of the rotor, it is spread laterally by impact with the disc 51, and then acted upon by the rotating vanes 49 to force the material outwardly in a radial direction without material splatter.

Surrounding the vanes 49 are the radially extending vertical webs or vanes 52 which serve to act upon and impart rotary velocity to the material. The material passing through the spaces between the vanes 52 passes upwardly through passages 53 to the outer annular space 54 which forms a part of or communicates with the main separating chamber 26, and which also communicates with the discharge nozzles 29. The inner walls of passages 53 are defined by the conical-shaped member 56, which is upwardly divergent, and which is attached to the structure 23.

It is desirable to incorporate with the machine means such as disclosed and claimed in co-pending application Serial No. 753,301, filed June 7, 1947, which serves to collect and return material which is spilled into the housing 12. Thus the lower portion 12c of the housing is conical shaped, whereby spilled fluid material is collected in the lower part of the housing and in the proximity of the lower end of the rotor. The lower end wall 61 of the housing is fitted with the nozzle 46, and it will be noted that the mounting of the parts is such that an annular space is provided between these parts and the adjacent lowermost end of the rotor. Interposed within this space there is a relatively flat ring 62 which is mounted in spaced relationship with the lower wall of the housing, as by means of spacing studs 63. The inner edge portion 64 of this ring is bent upwardly as illustrated in Figure 2, and the opening 66 within the ring is slightly larger than the opening in the nozzle 46 and slightly smaller than the opening 44. The outer edge portion of the ring can be bent upwardly as illustrated and formed in a manner disclosed in said co-pending application to provide a plurality of circumferentially spaced deflecting vanes 67 which aid in directing collected spilled material into the space 68 underlying the ring 62. It will be evident that when a jet of material is discharging upwardly through the nozzle 46 the proximity of the inner edge of ring 62 to the jet of material causes an aspirating action which sucks material through the space 68. Thus when spilled material drains to the lower portion of the housing it is immediately sucked through the space 68 to merge with the jet of returned material.

As illustrated diagrammatically in Figure 4 the material collected in volute 22 discharges through the tangential pipe 69, and pipe 70, whereby the underflow material is delivered to the space 71 directly below the opening of the nozzle 46. A valve controlled pipe 72 is also provided for the removal of underflow material from the system, and an additional pipe 73 connects with the pipe 70 to enable introduction of a supplemental wash liquid, such as fresh water. Considerable fluid pressure is developed by the volute 22 whereby the underflow material discharges upwardly through the opening 44 with considerable velocity and in the form of a relatively compact upwardly directed jet.

In place of a return circuit as described above, we may use a circuit including a vent box as disclosed in Peltzer 2,039,605.

Operation of the centrifuge described above is as follows: Assuming that the machine is being rotated at a suitable speed and is being supplied with a feed material containing solid constituents, a heavier underflow is established from the peripheral nozzles 29 and is received in the volute 22. The centrifugally separated overflow is continuously discharged over lip 43 and received in chamber 21. Pressure developed in the volute 22 causes flow under pressure through the pipes 69 and 70 whereby underflow material is discharged back into the rotor through the nozzle 46, in the form of a compact upwardly directed jet as previously described. This jet strikes the disc 51 and is deflected or spread radially, whereby the material is immediately acted upon by the inclined vanes 49. These vanes serve to force the material outwardly into the zone of operation of the vanes 52 without however imparting any great amount of rotary

velocity to the same, and without such impact as might cause splashing or splattering. Vanes **52** immediately act upon the fluid material to impart rotary velocity to the same, and the material passes between these vanes to passages **53** and from thence into the space **54**. The pumping action just described supplies the material to the space **53** under considerable pressure, whereby proper separating conditions can be obtained within the centrifuge chamber at relatively high speeds and within the centrifuge chamber at relatively high speeds and capacity.

Any spray or splash-back which may tend to occur from within the impeller is largely trapped by the vanes **48** and delivered back into the impeller. Also the overlapping relation of the inclined vanes **49** tends to minimize and prevent any splash-back from the spaces between the vanes **52**.

We claim:

In a continuous centrifuge of the type including a vertically disposed rotor arranged for separate discharge of centrifugally separated underflow and overflow fractions, and having means for separately collecting the underflow and overflow fractions and for continuously returning a substantial part of the underflow material back into the centrifuge rotor, an impeller forming the lower part of the rotor, a nozzle ring attached to the lower end of the impeller and providing a lower axial opening faced downwardly, said opening being proportioned to receive an upwardly directed jet of returned underflow material, a vane assembly within the impeller of

the rotor and disposed above said opening, said assembly comprising a plurality of circumferentially spaced and vertically extending vanes mounted upon and extending upwardly from the ring, said vanes being inclined to the direction of rotation, and a plurality of vanes mounted within the impeller and surrounding said first named vane assembly, said last vanes serving to impart rotary velocity to the returned material after such material passes between the first vanes whereby the returned material is delivered under pressure to the separating chamber of the rotor, said first named vanes forming means serving to seal against back splash from the vanes of the impeller.

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