

March 8, 1955

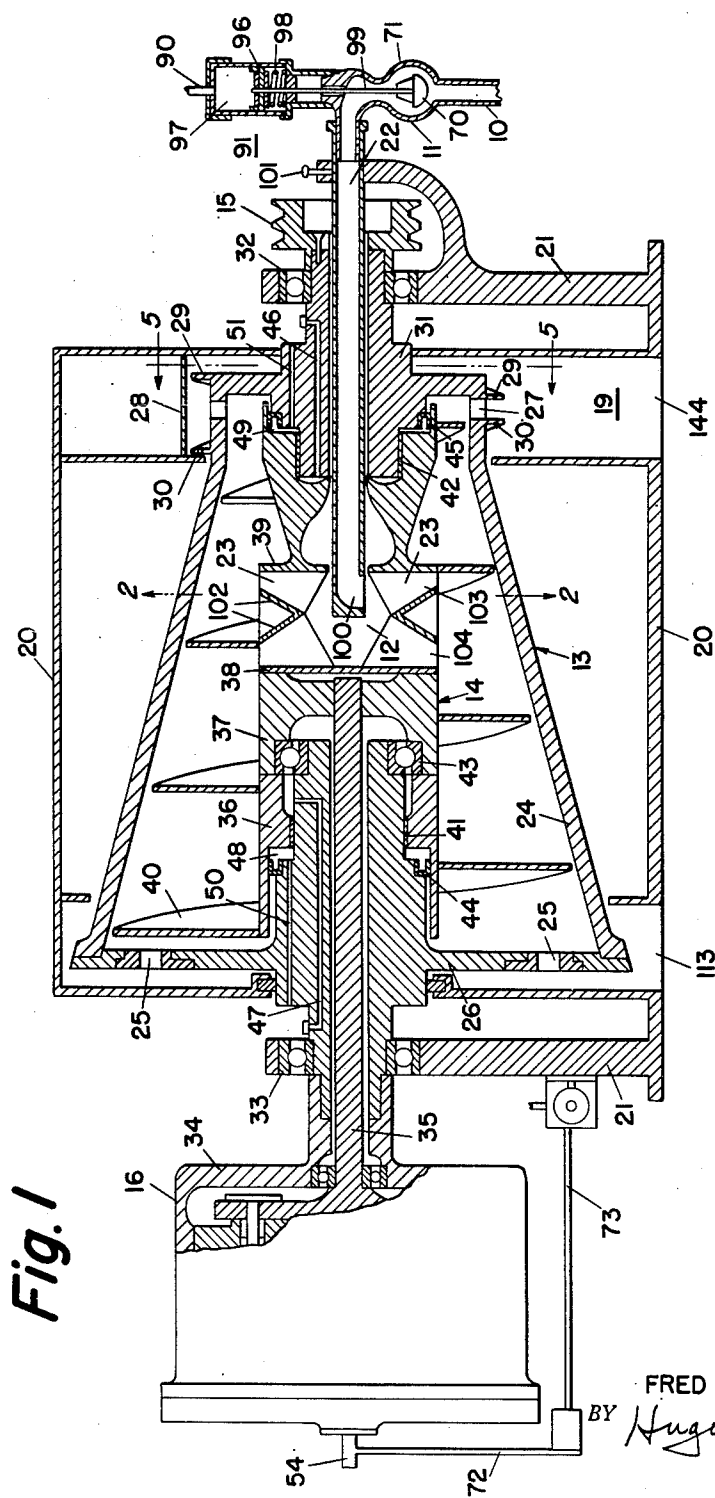
F. P. GOOCH

2,703,676

SOLIDS DISCHARGE MECHANISM FOR CENTRIFUGES

Original Filed Jan. 15, 1947

3 Sheets-Sheet 1



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Fig. 2

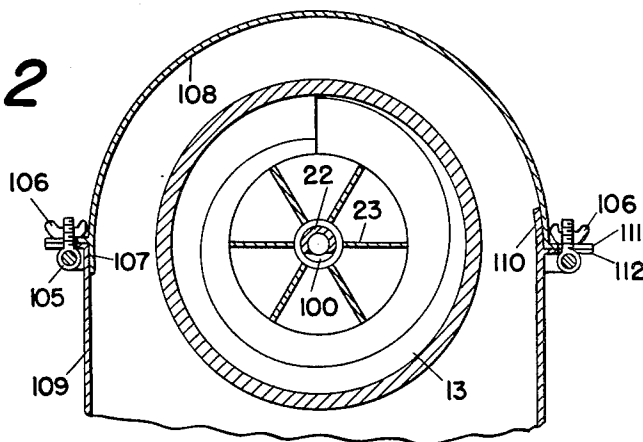


Fig. 3

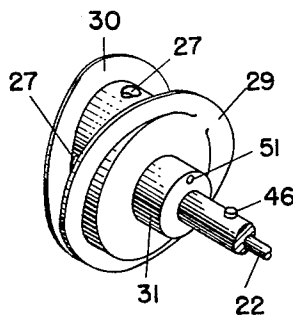


Fig. 4

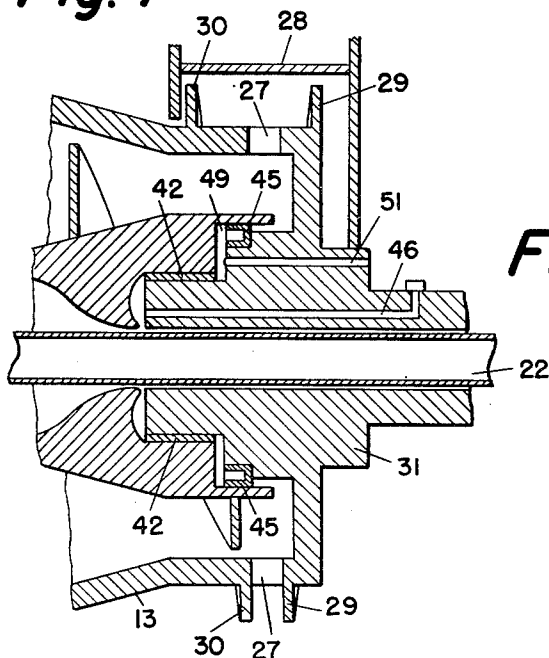
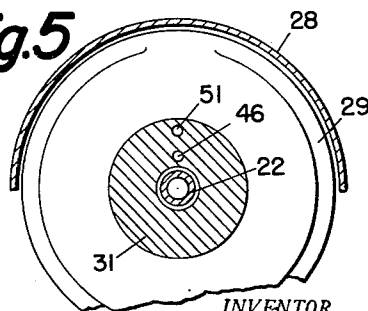


Fig. 5



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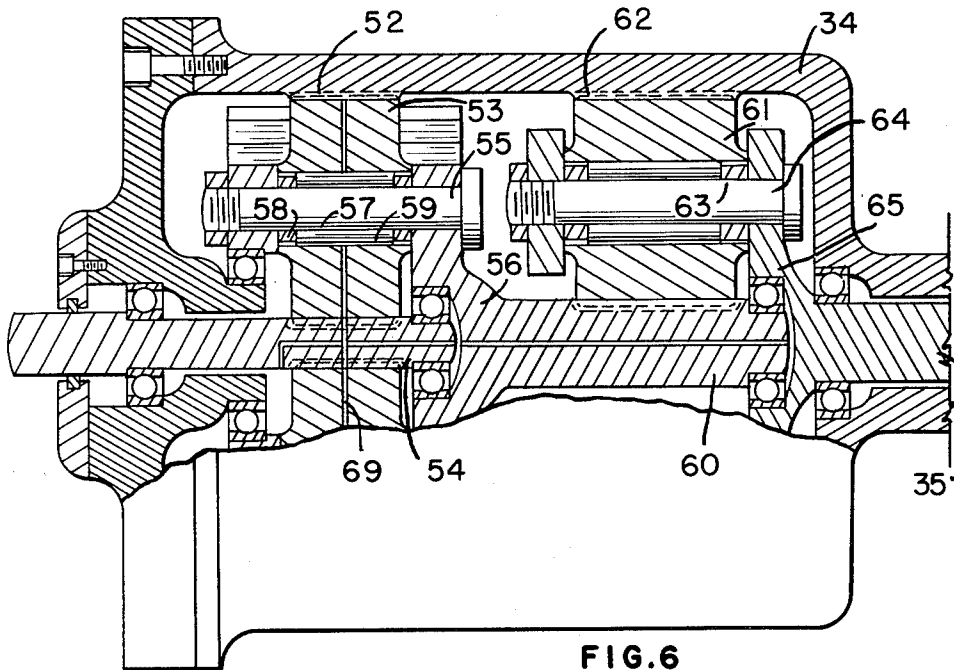


FIG. 6

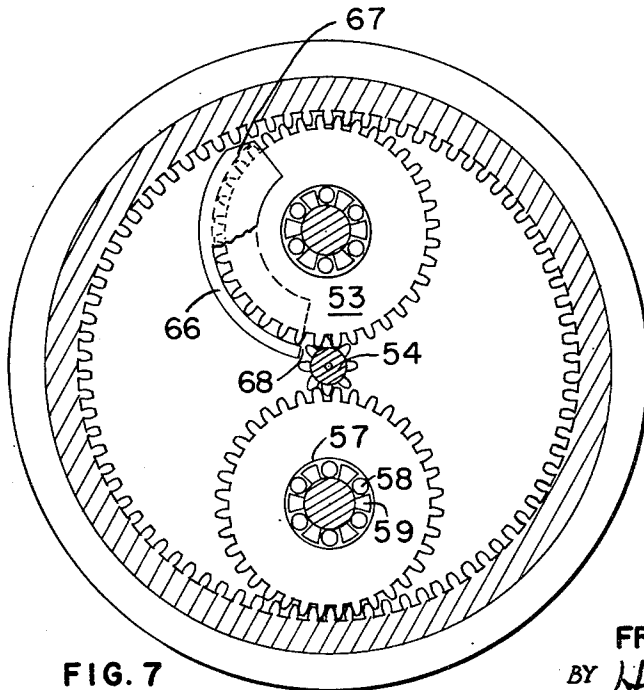


FIG. 7

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SOLIDS DISCHARGE MECHANISM FOR CENTRIFUGES

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Original application January 15, 1947, Serial No. 722,124.
Divided and this application December 30, 1952, Serial No. 328,699

3 Claims. (Cl. 233—7)

This application is a division of my co-pending application Serial No. 722,124, filed January 15, 1947, now abandoned. The invention pertains to an improvement in centrifugal machines designed for separation of liquid from solids. More particularly, it is concerned with a machine of this type in which a mixture of liquids and solids is continuously fed to the rotor, liquid separated from the solids by rotation of the rotor during such continuous feed, and the liquid and solid fractions separately discharged from the rotor.

Features of the improvement involved in the present invention include improved means for directing and impelling solids discharged from the rotor to a receiving zone.

The invention will be described in connection with a machine which, in its preferred form, includes rotating impeller means for impelling solids longitudinally of the rotor to a discharge zone for said solids, and this impeller means is driven at a speed slightly different from the speed of the rotor in order to effect the desired longitudinal movement of the solids.

Further features and advantages of the invention, and the manner in which they have been attained, will be evident from a reading of the following detailed description in the light of the attached drawing, in which,

Figure 1 is an elevation partly in section along the center axis of a machine in which the invention is embodied;

Figure 2 is a transverse vertical section on the line 2—2 of Figure 1;

Figure 3 is a view more particularly illustrating the opposed curved rotating members;

Figure 4 is an enlarged sectional elevation;

Figure 5 is a transverse vertical section on line 5—5 of Figure 1;

Figure 6 is an elevation partly in cross section of the gear box; and

Figure 7 is a transverse cross section of the gear box.

In the drawings, the machine illustrated includes a feed conduit 10 controlled by a valve 11 for delivery of a mixture of liquid and solids into the hollow centrifugal rotor designated generally 13. The solids are impelled longitudinally of the rotor by a rotating scroll 14 of the nature of an impeller which causes these solids to move toward the right-hand end of the rotor as illustrated in Figure 1, at which end the rotor and impeller are driven by means of a pulley 15. The driving connection between the two includes a gear box 16 at the opposite end of the machine interconnecting the drives of the rotor and impeller and causing differential rotation of these two elements. A housing 20 surrounds the rotor, the housing, rotor and associated parts being secured to a frame 21.

Slurry fed to the machine through feed conduit 10 passes through the valve 11 into conduit 22, which directs the slurry to a delivery zone 12 in the central portion of the rotor, where the slurry is discharged through a series of rotating blades 23 into the conical bowl 24 of rotor 13. Here the mixture undergoes centrifugation which deposits the heavier solids on the inner wall of bowl 24. The separated liquid flows through liquid discharge ports 25 in end piece 26 of the rotor, said discharge ports 25 defining the zone of discharge of liquid from said rotor 13. Meanwhile, the solids are moved along the inner wall of bowl 24 by the impeller 14 and are discharged through solids-discharge ports 27 into a receiver in the form of a chute 19.

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In accordance with this invention, a portion of the solids are discharged against the curviform collecting shield 28 in the upper portion of receiver 19. Solids which impinge against this surface are removed therefrom by a pair of rotating members 29, 30 surrounding the rotor and passing closely adjacent to the surface of collecting shield 28. Although these members may be rotated independently of the rotor, being supported in such case on bearings mounted on the rotor or on any suitable supporting member, more conveniently they are formed as shown; i. e., as opposed rotating members or surfaces attached to the rotor on opposite sides of discharge ports 27, and having circumferentially varying axial distances from ports 27 which ports define the zone of discharge of solids from the rotor. These rotating members assist in conveying solids around the axis of the rotor and depositing them in receiver 19.

The rotor 13 is driven by means of pulley 15 attached to an end piece 31 which is integral with bowl 24 of the rotor. Bearings 32 and 33 mounted at opposite ends of frame 21 permit rotation of the rotor about its axis. The end piece 26 at the large end of the rotor is attached to bowl 24 of the rotor for rotation therewith. In turn, casing 34 of gear box 16 is connected to end piece 26. Impeller 14 is driven from shaft 35, which is rotated at a speed differing from that of the casing 34.

The impeller may be composed of sections such as 36, 37, 38 and 39, each connected to the other for rotation as a unit. The curviform solids-conveying surface 40 may be connected to one or more of these sections for rotation at an angular speed differing from the angular speed of rotor 13. The impeller is supported by means of bearings such as 41 and 42 from end pieces 26 and 31. A thrust bearing 43 may be provided to prevent longitudinal movement with respect to the rotor. The seal 44 between section 36 of the impeller and end piece 26 of the rotor and the seal 45 between the hollow hub section 39 and end piece 31 serve to prevent passage of materials being subjected to centrifugation into the bearings 41 and 42 and to prevent contamination of these materials by lubricant from the bearings, as described and claimed in co-pending application Serial No. 327,763, filed December 24, 1952, which has matured into Patent No. 2,679,974, granted June 1, 1954.

The bearings 41 and 42 may be lubricated from an external source through the channels 46 and 47. Excess lubricant passing through the bearings will be thrown into the areas 48 and 49 adjacent to the seals 44 and 45. Here the lubricant will serve to assist in sealing the bearings from material which may reach the seals from the zone of centrifugation in the rotor. When the levels of materials in the areas 48 and 49 rise towards the bearings 41 and 42, material is drawn off through the vents 50 and 51 before these levels reach the bearings. Preferably these vents discharge outside the bowl housing 20 in order to furnish an immediate warning of seal difficulty with the discharge of any materials which may build up in the chambers 48 and 49.

Although the foregoing discussion has been limited to a centrifugal machine in which the rotor is directly driven from a source of power and the impeller is driven through suitable gearing connected to the rotor, this arrangement of drive is not to be regarded as a limitation of the invention. It will be obvious that the impeller may be directly driven from the source of power, that the gear box may be driven from the impeller, and that the rotor may be revolved at a speed differing from that of the impeller through the medium of the gear box. Another suitable method of drive may be to connect a section of the gear box directly to a source of power.

The differences in speed of rotation of the impeller member 14 and the rotor 13 obtained through the gear box 16 are achieved by means well known in the art, many different power transmission mechanisms having been disclosed for this purpose. As illustrated this includes a planetary system having a pinion 54, the rotation of which is restricted by a lever 72 and connecting link 73 attached to control mechanism forming no part of this invention.

As illustrated in the drawings, the differences in speed of rotation of the impeller member 14 and the rotor 13

obtained through the gear box 16 are achieved through driving the gear box casing 34 from the end piece 26 of the rotor 13. Within this casing 34 is an internal gear 52 which meshes with a plurality of planet gears 53. These planet gears mesh with and rotate about pinion 54 which is coaxial with the casing 34, and the rotation of which is restricted as above pointed out. The planet gears are carried on journals 55 which may be part of or rigidly attached to a supporting spider 56.

Rotation of the planet gears 53 is around the bearings 57 having cages 58 and rollers 59 and fitting over the journals or shafts 55. Each journal or shaft 55 serves as an inner race for its respective bearing. Journals or shafts 55 rotate with the spider 56 about the central axis of the gear box 16 upon rotation of casing 34.

A central pinion 60 shown integral with the spider 56 meshes with a second series of planet gears 61. In turn these planet gears 61 mesh with a second internal gear 62 within the gear box casing 34. The planet gears 61 are carried by bearings 63 which may be of the same form as the bearings 57. These bearings rotate on shafts or journals 64 which are attached to or may be integral with the spider 65.

Extending from the spider 65 is the shaft 35 which, as previously mentioned, drives the impeller 14 within the rotor 13. Rotation of gear box 16 causes the planet gears 61 to revolve around the inside of the internal gear 62 carrying the journals 64 with them and thus rotating the spider 65 and the shaft 35. As a result, the shaft 35 is driven at a speed differing from that of the casing 34 by the ratio provided in the gearing. Other well-known combination of planetary gearing may be used in like manner to accomplish the same purpose.

The rate of feed of slurry into the rotor of the centrifugal is controlled by the valve 11 acting in the feed conduit 10. As illustrated, gate 70 and the body 71 of this valve are so formed by use of curved surfaces against the flow line of the slurry that solids suspended in the liquid portion of the slurry which may impinge upon surfaces of the valve or valve body cannot remain thereon because the angles of the surfaces to the lines of flow are greater than the dynamic angle of repose of the solids.

A valve motor 91 is illustrated in Figure 1 as having a piston 96 which acts under fluid pressure within chamber 97 against the reaction of the spring 98, fluid pressure being admitted through line 90. Valve gate 70 is shown attached to piston 96 by means of piston rod 99; thus, the position of the piston 96 determines the aperture of the valve 11. Any other means for controlling valve 11 may be provided.

The extent of the centrifugal operation to which materials in the feed slurry are subjected is controlled by adjusting the axial position of the slurry feed means so that the location of the zone of discharge of slurry from the feed conduit may be axially moved. One method of doing this is by changing the position of the conduit 22 which relocates the discharge port 100 in which the slurry passes into the discharge zone 12. Conduit 22 may be positioned by means of a lock screw 101 or any similar positioning device so that the discharge port 100 may be located in any desired relationship with the deflectors 102. A plurality of openings in the conduit 22, each individually controlled, or relocation of the discharge lip of the port 100 may be used to accomplish this same purpose.

Slurry is fed to the machine through a zone 103 of the impeller when the conduit 22 is at the right as shown in Figure 1. When the conduit 22 is at the left instead of at the right as shown in Figure 1, the feed slurry passes into the rotor through a zone 104 of the impeller. This zone 104 is more remote from the solids-discharge port 27 than the zone 103 and therefore solid materials in the slurry are subjected to centrifugation for a longer period of time if the slurry is fed through the zone 104 than if the slurry is fed through the zone 103. The deflectors 102 serve to direct the slurry selectively or in any desired relative proportion into the zones 103 and 104. Blades 23 serve to accelerate the movement of the slurry as it passes radially through the impeller hub into the hollow body of the rotor.

The rotor cover 20 is formed in sections to permit rapid opening and inspection of the rotor and discharge conduits. This is accomplished by clamping means such as the swivelled studs 105 which are normally held in

place by the wing nuts 106. To prevent discharge of materials thrown from the rotor ports under centrifugal force, the baffle 107 which may be integral with or attached to an upper section 108 of the rotor cover overlaps lower section 109 in the direction of rotation of the rotor 13. On the other side of the rotor a baffle 110 integral with or attached to the lower section 109 of the rotor housing overlaps the upper section 108 in the direction of rotation of the rotor. The upper section of the rotor housing 108 may be supported from the lower section 109 by means of the flanges 111 and 112 on the upper and lower sections respectively.

The baffles 107 and 110 prevent leakage of liquid and solid materials discharged from the bowl through ports 25 and 27 respectively to the area adjacent to the machine. The discharge of liquid is confined to the conduit 113 and the discharge of solids to the conduit 144 which have appropriate connections for delivery of separated materials into receiving vessels not a part of the machine. Use of these baffles permits the employment of quick locking features such as the swivel studs described to fasten the upper section of the rotor housing to the lower section. Gaskets between the sections of the housing may be dispensed with because of this baffling. These two elements, quick fasteners and the absence of a gasket, greatly facilitate removal of a section of the rotor housing whenever it is desirable or necessary to inspect the rotor and the discharge conduits for liquid and solid materials.

Various modifications are possible within the scope of the invention and I do not therefore wish to be limited except by the scope of the following claims.

I claim:

1. In a centrifugal machine for the separation of solids from liquids, the combination comprising, a centrifugal rotor for the separation of solids from liquid and having separate zones of discharge for said solids and liquid, means for feeding a mixture of solids and liquid to said rotor, rotating impeller means for impelling solids longitudinally of said rotor, means for rotating said rotor and said impeller means at different rates, a curviform collecting shield outside said rotor and radially spaced from the zone of discharge of solids from said rotor, a receiver for solids discharged from said zone of discharge of solids, and opposed rotating surfaces surrounding said rotor and interposed between said rotor and said collecting shield and positioned on opposite sides of said zone of discharge of solids, said opposed rotating surfaces having circumferentially varying axial distances from said zone of discharge of solids and acting to displace into the receiver solids gathered on the said curviform collecting shield.

2. In a centrifugal machine for the separation of solids from liquids, the combination comprising, a centrifugal rotor for the separation of solids from liquid and having separate zones of discharge for said solids and liquid, a curviform collecting shield outside said rotor and radially spaced from the zone of discharge of solids from said rotor, a receiver for solids discharged from said last-mentioned zone, and opposed rotating members surrounding said rotor and located between said rotor and said collecting shield, said members being positioned on opposite sides of said zone of discharge of solids and having circumferentially varying axial distances from said zone of discharge of solids and acting to displace into the receiver solids gathered on said curviform collecting shield.

3. A centrifugal machine for the separation of solids from liquids, comprising a centrifugal rotor for the separation of solids from liquid and having separate zones of discharge for said solids and liquid, a curviform collecting shield outside said rotor radially spaced from said zone of discharge of solids, a receiver for solids discharged from said last-mentioned zone, and a member on each side of said zone of discharge of solids fixedly mounted circumferentially on the outside of said rotor, each said member being positioned radially inward from said shield and closely adjacent thereto and having portions of varying axial distances from said zone of discharge of solids, said members acting to displace into the receiver solids gathered on the curviform collecting shield.

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