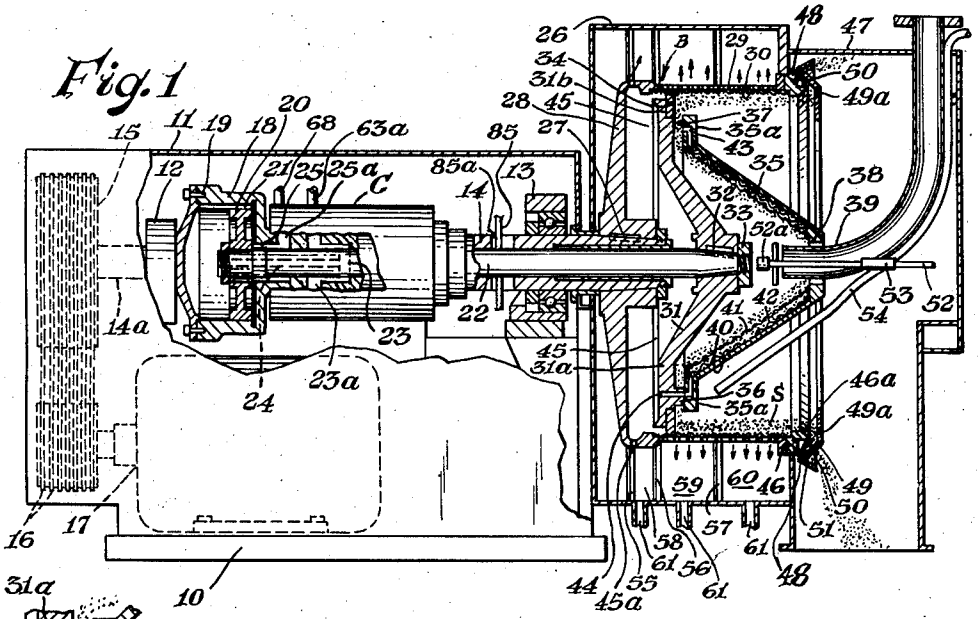
Aug. 11, 1959 H. F. IRVING 2,899,065

CENTRIFUGAL MACHINE

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Fig. 1



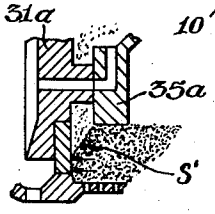


Fig. 6

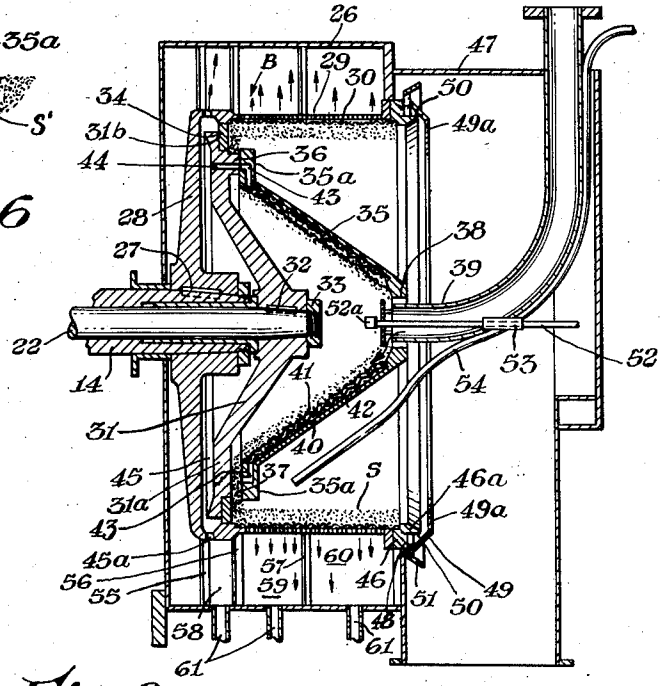


Fig. 2

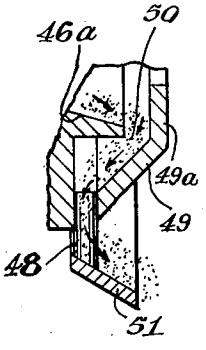


Fig. 7

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Aug. 11, 1959 H. F. IRVING 2,899,065

CENTRIFUGAL MACHINE

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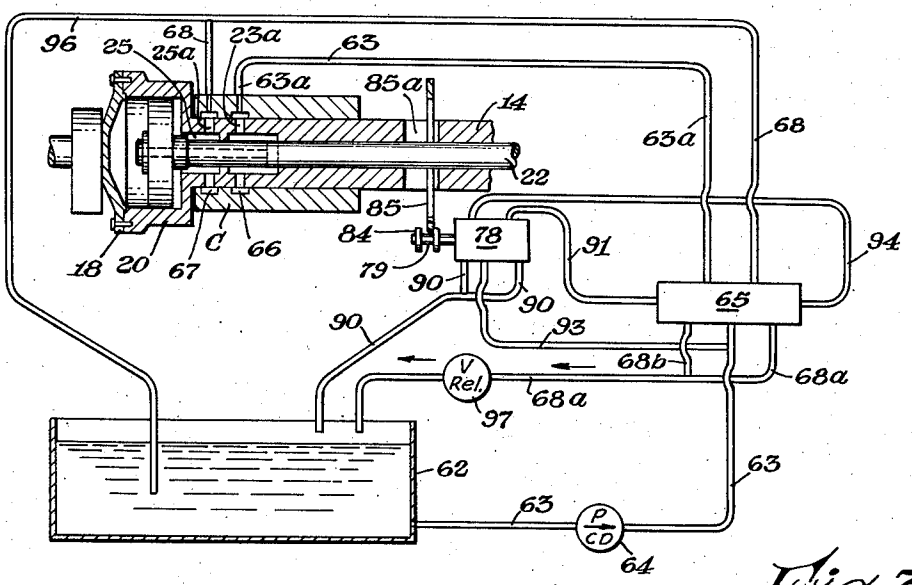


Fig. 3

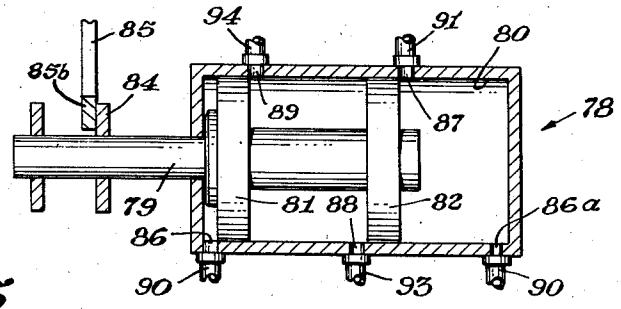


Fig. 5

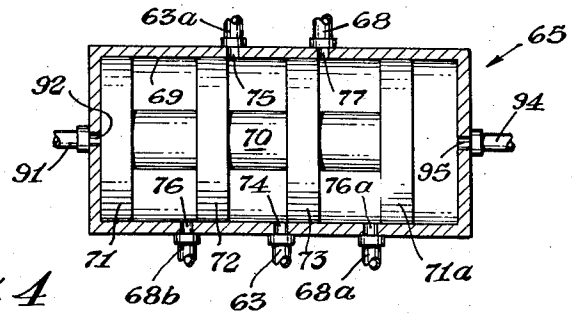


Fig. 4

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United States Patent Office 2,899,065 Patented Aug. 11, 1959

2,899,065

CENTRIFUGAL MACHINE

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Application December 13, 1954, Serial No. 474,940

12 Claims. (Cl. 210—376)

This invention relates to new and useful improvements in centrifugal separating machines and more particularly to continuously operable machines of this type which are well-suited to separating a variety of granular, fibrous, or crystaline solids from liquid mixtures containing the same.

Continuously operating push-type, single stage centrifuges have long been employed for effecting the separation of liquid and solids and are relatively well known. However, it is an object of the instant invention to provide a machine of this type which is particularly well-adapted to separating sugar crystals from a slurry or mixture comprising the crystals and syrup or mother liquor although having a general adaptability for other purposes. Since the syrup in the sugar slurry or massecuite is relatively viscous, many push-type single stage centrifuges which have been used to separate mixtures of this type have employed longer baskets or screens so that the caked solids can be retained until they acquire the required degree of dryness.

Another factor influencing the length of the basket employed is the washing operation which is desirably carried on during the centrifugation process to rid the caked crystalline particles of ash or impurities. Actually, it is desirable to restrict the length of the basket, for when the length of the cake is increased, the pusher must develop a greater force to discharge it from the basket, which force will tend to compact and subdivide the individual crystals and also tend to buckle the cake. Clearly, if a pre-removal of the greater proportion of the mother liquor can be effected prior to the time the slurry reaches the basket and a portion of the washing operation can be performed during this pre-removal of the liquid, a shorter basket may be employed and less force will be required to discharge the cake. While machines of this type have accomplished such a pre-draining operation, no one has previously designed a machine in which the pre-draining and basket screens may be compactly disposed in concentric relation without sacrificing any of the effectiveness of the pre-draining operation.

Accordingly, one of the prime objects of the instant invention is to design a centrifuge of the continuously operable, so-called "pusher" type which incorporates means for pre-draining a maximum portion of the liquid from the solids prior to the time the mixture is passed to the basket and yet is no less compact than machines in which no pre-draining operation is carried out. Such a machine will charge to the basket solids which immediately form a firm cake that can be readily pushed without humping or stratifying and without imposing variable loads on the basket.

Another object of the invention is to provide a very practical machine of the type described in which a portion of the washing operation can be carried out during the pre-draining stage of centrifugation.

Still another object of the invention is to provide a "pusher" type centrifuge of simple and practical design in which impurities in the mixture which are present

largely in the mother liquor are largely eliminated prior to the time the mixture is charged to the basket.

Another object of the invention is to design a machine of this type in which means is provided for mixing the relatively wet strata of caked solid directly adjacent the basket with the drier solids above it as the cake is discharged so that lumps or masses of sticky crystals which build up and break off will not form on the dry housing wall adjacent the basket.

A further object of the invention is to design a very practical machine of the type described in which there is a re-location of the solid particles between stages of centrifugation, thus mixing the relatively wet crystals adjacent the pre-draining screen with the drier crystals outward thereof when the mixture passes from the pre-draining screen to the basket.

A further object of the invention is to provide a machine in which the funnel for gradually accelerating the mixture to the speed at which the basket is rotated also serves as a pre-draining member, and means is provided for channeling the pre-drained liquid to the opposite side of the pusher.

A further object of the invention is to design a machine in which the pusher is retracted by the pressure of the material itself in accordance with the rate of feed of the massecuite and at the speed which the cake builds so that working of the solid particles and crystal breakdown is reduced to a minimum and the number of strokes per given unit of time taken by the pusher and the cake thickness is in direct ratio to the rate of feed and can be controlled thereby.

A still further object of the invention is to design a centrifugal machine of the type described which is durable and rugged in construction, which comprises relatively few component parts of a simple nature which are readily accessible for cleaning and inspection, which may be easily and simply disassembled for repair and replacement of parts, and will accordingly be relatively inexpensive to maintain and which can be economically manufactured and assembled.

With the above and other objects in view, the present invention consists in the combination and arrangement of parts, hereinafter more fully described, illustrated in the accompanying drawings, and pointed out in the appended claims, it being understood that equivalent changes may be made in the various elements of the invention, without departing from the spirit of the invention or sacrificing any of the advantages thereof.

In the drawings:

Fig. 1 is a part sectional, side elevational view of my novel centrifuge showing the pusher in forward position.

Fig. 2 is an enlarged, fragmentary, sectional view thereof, the pusher being shown in rearward position.

Fig. 3 illustrates schematically the manner in which the pusher is actuated forwardly by a hydraulic pump and is permitted to return under pressure of the material feeding into the basket.

Fig. 4 is a sectional view illustrating schematically one of the multiple way valves which is employed in the system.

Fig. 5 is a sectional view illustrating schematically another valve which is employed in the system to control the valve shown in Fig. 4.

Fig. 6 is an enlarged, fragmentary view showing the material forcing the pusher rearwardly.

Fig. 7 is an enlarged, fragmentary view showing the circumferentially spaced lugs which connect the intermixing baffles to the basket throw-off ring.

Referring now more particularly to the accompanying drawing wherein I have shown preferred embodiments of my invention and more particularly to Fig. 1, the machine comprises a base 10 with a drive housing 11 sup-

porting bearings 12 and 13 in which a tubular drive shaft 14 is journaled. A drive sheave 15 mounted on the reduced end 14*a* of the shaft 14 is connected by belts 16 to the shaft of a motor 17 which is adapted to drive the shaft at relatively high speeds.

Formed as an integral portion of the shaft 14 is a pressure fluid cylinder 18, the two portions of which may be bolted together as at 19. A piston 20 keyed in the cylinder as at 21 so as to rotate therewith, is provided in the cylinder 18, and is reciprocated in the cylinder in a manner which will be later described. A pusher control assembly C of conventional design is provided to control the forward operation of the piston 20 and the piston rod or shaft 22 is transversely bored as at 23 and longitudinally bored as at 24 to admit pressure fluid from the assembly C to the outer face of the piston 20 so as to drive the latter forwardly to the position in which it is shown in Fig. 1. Provided in the shaft 14 and communicating with the passage 23 when the piston is in rearward position is a port 23*a* leading to the control assembly C. Further, the internal diameter of the shaft 14 is enlarged as at 25 to transmit fluid to the control assembly C through the transverse passage 25*a* when the piston is moved forwardly and to admit fluid to the front face of the piston when it is returned to original position by the pressure of the material feeding into the basket as will later be described. A positive displacement constant delivery pump 64 (Fig. 3) supplies the pusher control assembly in a manner which will later become apparent.

The tubular shaft 14 extends from the drive housing 11 into a wet housing 26 which is bolted to the housing 11 and a drum or basket B is keyed thereon as at 27, the basket B comprising a radial end wall or hub 28 with a perforated cage 29 having a screen 30 supported therein. A frusto-conical pusher wall 31 is keyed as at 32 to the tapering end of the shaft 22 which extends into the wet housing 26 beyond the shaft 14, and a nut 33 threaded on the end of the shaft 22 maintains the wall 31 in position. The wall 31 has a laterally turned flange 31*a* which is recessed as at 31*b* to receive a scraper ring 34. Additionally, an accelerating funnel or distributor member 35 having a laterally turned flange 35*a* is supported a spaced distance from the portion 31*a* of the wall 31 on circumferentially spaced, integral lugs or bosses 36 formed on the flange 31*a* so as to form passages 37 between the flanges 31*a* and 35*a* leading to the screen 30. The funnel 35, it will be observed, is concentric with the screen 30 and is substantially co-extensive therewith. The annular flange portion 35*a* of the funnel 35 terminates a spaced distance from the basket 30 and serves as a leveling ring.

The outer end wall of the funnel 35 is bored as at 38 to freely admit the slurry supply pipe 39 and the interior wall thereof is recessed as at 40 to carry a pair of superposed frusto-conical screens 41 and 42, the top screen 41 being a woven screen and the under screen 42 which supports the screen 41 being a mesh screen. Connecting with the inner edge of the recess 40 are angular passages 43 which lead through the flange 35*a* of the funnel and communicate with the passages 44 through the flange 31*a* of the pusher wall 31. When the wall 31 is in rearmost position as shown in Fig. 2, it is spaced from the hub 28 of the basket to form a chamber 45, and liquid proceeding through the passages 44 will pass to the wet housing 26 through the circumferentially spaced ports 45*a* in the basket B immediately adjacent the wall 28 when the piston 20 is in its rear position as well as when it is in its forward position.

The outer end wall of the wet housing 26 terminates short of the basket B and a throw-off ring 46 including an outwardly tapered flange 46*a* extending into a dry housing 47 is provided on the outer end of the basket B. Supported outwardly of the flange 46*a* to rotate with the basket B is a frusto-conical baffle member 49 which includes a lateral flange 49*a* projecting radially inwardly beyond the screen 30 to channel the solids discharged down to the passage 50 defined between the rearwardly and inwardly extending portion of the baffle 49 and the ring 46. The baffle portion 49 is secured to the base of the member 46 by widely spaced lugs 48 which also support a forwardly and outwardly extending frusto-conical baffle member 51 which directs the flow of solids from the annular passage 50 to the dry housing proper. The baffles 49 and 51 effect a thorough inter-mixture of the relatively wet solid particles immediately adjacent the screen and the relatively drier particles inward thereof in a manner which will be later described. The particles which were disposed in the caked mass immediately adjacent the screen may have a residual liquid content of from 4% to 6% by weight, and this is what is meant by the term "relatively wet" as used in the specification and claims. The liquid content of the solid particles in the cake which are located radially inward of these particles will be 1% to 2% by weight and these particles will be accordingly termed "relatively dry."

The mixture may be washed in the pre-draining stage of centrifugation by the laterally directed spray from a hose 52 which enters the stationary supply pipe 39 through a seal 53 and has a nozzle 52*a* on the end thereof for directing the wash liquid to the solids on the sides of the funnel 35. The spray from a second wash hose 54 can be directed to the material on the inner portion of the screen 30 to remove any remaining impurities. Partitions 55, 56, and 57 separate the wet housing 26 into compartments 58, 59 and 60 which can be drained off separately through the discharge pipes 61 and, as will be apparent, the so-called green and wash liquids may be segregated in this manner. A conveyor (not shown) may be provided in the lower portion of the dry housing to carry off the dried and intermixed crystals.

The pusher wall 31 is shown in rearward position in Fig. 2, and it will be clear that this wall is moved forwardly to the position in which it appears in Fig. 1 when pressure fluid reaches the rear face of the piston 20 through the ports 23*a*, 23, and 24, and exhausts from the front of the piston through the passages 25 and 25*a*. This pressure fluid is supplied from a reservoir 62 (see Fig. 3) through lines 63 and 63*a* by the pump 64 which forces the fluid through a multiple-way valve 65 and thence into the collection chamber 66 in the collector C. The fluid which is forced out of the cylinder 18 when the piston 20 moves forwardly moves through the passages 25 and 25*a* into the collection chamber 67 in the collector C, thence through a line 68, back to the valve 65, and finally into a line 68*a* which leads to the reservoir 62. Alternatively, the fluid could return through the line 96 which will later be discussed.

The valve 65 (see Fig. 4) is formed with an interior cylinder 69 in which is a slide 70 having lands 71, 71*a*, 72, and 73. Passages 74, 75, 76, 76*a* and 77 which communicate with the lines 63, 63*a*, 68*b*, 68*a* and 68, respectively, lead into the cylinder as shown, and in the position in which the valve is depicted the lines 63 and 63*a* and 68 and 68*a* are clearly in communication, and the piston 20 is accordingly moved forwardly. The position of the member 70 is controlled by another multiple-way valve 78 which has a slide 79 in the cylinder 80 formed therein. The one end of the slide 79 which has interior lands 81 and 82 extends from the valve housing and has spaced-apart flanges 84 thereon. A pin 85 fixed on the shaft 22 and movable in a slot 85*a* in the shaft 14 has an annular ring 85*b* disposed between these flanges 84 and clearly as the piston 20 moves forwardly, will tend to force the slide 79 to the right.

Passages 86, 86*a*, 87, 88 and 89 communicate with the interior of the cylinder 80, the passages 86 and 86*a* communicating with a line 90 leading to the reservoir, the passage 87 communicating with a line 91 leading to a passage 92 in the one end wall of the valve 65, the passage

88 communicating with a line 93 leading to the line 63, and the passage 89 communicating with a line 94 leading to a passage 95 in the opposite end wall of the valve 65. During the forward motion of the piston 20, the lines 93 and 94 are in communication to keep the valve 70 in the position in which it is shown. By the time the piston 20 has reached the front of the cylinder and is beginning to be pushed rearwardly (see Fig. 6), the slide 79 has been moved to the right to open up the passage 87 and line 91 to the passage 88 and line 93 and to permit the line 94 to exhaust to the passage 86 which leads through the line 90 to the reservoir 62. Thus, pressure fluid is forced through the line 91 to move the slide 70 to the right and open up the passage 77 and line 68 above the valve 65 to the passage 74 and line 63 below the valve. Further, the line 63*a* will now exhaust to the line 68*b* as the piston 20 moves rearwardly. Since the line 96 leading to the reservoir 62 is always open to the line 68, the oil forced through the line 68 will take the path of least resistance (the line 96) back to the reservoir 62 and will not force the piston 20 rearwardly. As the slowly building cake (see Fig. 6) moves the piston 20 rearwardly, however, oil from the line 68 under virtually no pressure will fill the space in front of the piston 20 and this is very important since the system must be maintained in centrifugal balance. The piston 20 will accordingly have a very rapid forward stroke and a relatively slow return stroke controlled by the amount of solid particles being deposited at S' (see Fig. 6). If it appears that the rate of feed is not sufficient to build the cake up to the leveling ring 35*a*, a conventional relief valve 97 which interposes resistance in the line 68*a* leading to the reservoir 62 can be cut in to slow the return rate of travel of the piston 20. A system such as described wherein the return travel of the piston 20 depends on the rate at which slurry is fed into the system through the pipe 39 and the rate at which the cake builds is superior in a great many respects to conventional machines. Obviously, there will not be a continuous working of the crystals of the continuously building cake which will mean less crystal breakdown and less passage of crystals through the screen 30. Further, rates of feed are often very different and the machine can operate very efficiently at both low and high rates of feed. In the former case, the cake will be permitted time to build up to the leveling ring 35*a* so that it will have a maximum retention time on the screen 30. As the piston 20 moves rearwardly, the ring 85*b* will, of course, return the slide 79 to the left back to the position in which it is shown in Fig. 5 and the slide 70 will accordingly be returned to the left as shown. The stroke of the continuously reciprocating wall 31 is such as to discharge only the front portion of the casked solids S which are virtually free of liquids to the dry housing 47.

In operation, the sugar slurry or massecuite reaches the interior of the basket through the stationary pipe 39 and funnel 35 which gradually accelerates the mixture prior to discharging it through the passages 37 to the screen 30. The greater proportion of mother liquor is drained off to the wet housing 26 through the screens 41 and 42 prior to the time the mixture reaches the screen 30 and a portion of the washing operation to remove impurities not carried off with the mother liquor can also be carried out during this pre-draining operation. Liquid pre-drained through the screen 41 travels rearwardly through the meshes of the screen 42 which is within the recess 40 and thence proceeds through the passages 43 and 44 to the chamber 45 rearwardly of the pusher wall 31. Ports 45*a* as previously noted, drain the space 45 to the chamber 58 in the wet housing 26. The wash hose 52 delivers a prescribed spray of water to the mixture on the screen 41 which is insufficient to flood the retained solids such that difficulty will be encountered in pushing them when they reach the screen. When the solids reach the latter screen 30, there is, of course, a relocation of the solid particles as they pass from the screen 41 and the hose 54 thence completes the washing operation.

When the solids are discharged from the outer end of the screen 30 by the pusher wall 31, the relatively drier particles which were located in the cake substantially inward of the screen tend to be fanned outwardly, while particles immediately adjacent the screen which are relatively "wet" will not necessarily be perceptibly thrown axially outward of the screen and in conventional machines would leave the flange 46*a* of the ring 46 in substantially a radial path. These relatively wet and sticky crystals tend to collect and in many instances will adhere and build up on the partitioning wall separating the wet and dry housings before breaking off in relatively large pieces. Since this deposition is unsightly and the collections of sticky crystals are undesirable in the finished product, I have found it practical to intermix the relatively wet and relatively drier particles. The portion 49*a* of the baffle 49 catches and deflects the relatively dry particles inwardly to the channel 50 so that they pass through and become thoroughly intermixed with the wetter particles. The resulting intermixture will not collect on the partitioning wall referred to and will provide a uniform product.

It should be apparent that I have perfected a very efficient centrifugal machine which is compact in design and permits ready access to its various elements for cleaning and inspection purposes.

It is to be understood that the foregoing drawing and description thereof is in all cases to be taken as merely illustrative of the invention rather than as limiting the scope thereof and for a determination of the scope of the invention attention is directed to the appended claims.

It is further to be emphasized that various equivalent changes may be made in the various elements which comprise the invention without departing from the spirit of the invention or the scope of the claims.

What I claim is:

1. In a centrifugal machine, a separating drum and end wall therefor, means for moving one of said end wall and drum axially relative to the other, means for revolvably supporting said drum, an imperforate distributor shell disposed in concentric relation with said drum mounted for rotation therewith and having a tapering interior surface with its end of largest diameter spaced from said end wall to form a feed passage therebetween, means revolving said drum and end wall in unison, means feeding a mixture comprising liquid and solid components to the opposite end of said distributor, means including screening spaced inwardly from said tapering interior surface of the shell for pre-draining liquid components from said mixture in the distributor shell and channeling them through said distributor shell to the face of said end wall remote from the distributor shell, and means exerting a force to move said end wall rapidly forwardly removing said force at the end of the forward travel of the wall to permit it to return slowly under pressure of the solids congregating in said feed passage so that the speed of the return stroke is in direct ratio with the rate of feed.

2. The combination defined in claim 1 in which means is provided for slowing down the travel of the return stroke when the rate of feed is very low to permit the solids to form a substantial cake on the interior of the drum.

3. In a centrifugal machine, a perforate separating drum and end wall therefor, one of which is mounted for movement axially relative to the other; supply means feeding a slurry to said drum; means communicating with said supply means disposed opposite said end wall at a spaced distance therefrom to form a feed passage therebetween for slurry to reach said separating drum from said supply means; means revolving said drum; a drive member connected with one of said end wall and drum for driving one of said end wall and drum forwardly in

one force exerting direction; means associated with said drive member exerting a force to move said drive member forwardly operable at the end of said forward stroke to remove said force; and means disassociating said force exerting means and drive member at the end of said forward stroke so no force is exerted on the drive member thereby to permit the pressure of the solid components of the slurry building into a cake in said feed passage to return said one of the end wall and drum which is driven forwardly.

4. In a centrifugal machine; a perforate, separating drum and end wall therefor one of which is mounted for movement axially relative to the other; supply means feeding a slurry to said drum; means communicating with said supply means disposed opposite said end wall at a spaced distance therefrom to form a feed passage therebetween for slurry feeding from said supply means to said drum; means revolving said drum; and means connected with one of said end wall and drum for moving one of the end wall and drum axially relative to the other; driving one of said end wall and drum forwardly in one direction; and means for disabling said means moving one of the end wall and drum at the end of said forward stroke to permit the pressure of the solid components of the slurry building into a cake in said feed passage to return said one of the end wall and drum which is driven forwardly.

5. The combination defined in claim 4 in which said means moving one of the end wall and drum axially includes a fluid pressure cylinder provided on said machine and a piston fixed to said end wall reciprocable in said cylinder, means transmitting fluid under pressure to one face of said piston for forcing the piston in said direction, means exhausting fluid from the opposite face of said piston when the piston is moved in the said direction, and means filling the cylinder adjacent said opposite face of the piston with fluid under no pressure when the wall is forced to return to maintain the cylinder in centrifugal balance.

6. In a centrifugal machine; a relatively reciprocable, perforate separating drum and end wall therefor; supply means feeding a slurry to said drum; means within said drum communicating with said supply means and having a peripheral surface disposed opposite said end wall and spaced therefrom to form a feed passage therebetween for slurry proceeding from said supply means to said drum; means revolving said drum; and fluid pressure means including; a source of fluid under pressure, an exhaust line opening to atmospheric pressure, and a fluid pressure cylinder and ram connected to said end wall; and means operable to communicate fluid under pressure from said source with one end of said cylinder, while communicating the opposite end with said exhaust line to drive said end wall forwardly, operable at the end of said forward stroke to divert said source of fluid under pressure from said cylinder, while opening said end of the cylinder previously communicated with said source to said exhaust line so that the pressure of the solid components of the slurry building into a cake in said feed passage can return said end wall.

7. In a centrifugal machine, a perforate separating drum, an axially movable end wall for said drum disposed within said drum, means rotating said drum and end wall in unison, means simultaneously reciprocating said end wall within the drum, a distributor funnel comprising an imperforate wall having an interior tapering collecting surface disposed in substantially concentric relation with said drum mounted on said end wall with its end of largest diameter spaced from said end wall to define a radial feed passage to said drum therebetween, screening on the collecting surface covering said surface and spaced therefrom, means for feeding a mixture comprising solid and liquid components to the end of said distributor funnel remote from said end wall, the distributor funnel being recessed to channel liquid components drained through said screening to the large diameter end of said distributor funnel, tubular lugs on said end wall supporting said distributor funnel with the interiors thereof communicating with the recess in said distributor funnel, said end wall having ports therein in communication with the interiors of the lugs to channel liquid pre-drained through said screening to the side of said end wall remote from the distributor funnel for discharge.

8. The combination defined in claim 7 in which additional screening of relatively heavy mesh mounted in the recess in said distributor funnel supports said first-mentioned screening and assists in channeling said liquid components to the large diameter end of said distributor funnel.

9. In a centrifugal machine; a housing; a separating drum within said housing; means revolvably supporting said drum within the housing; an end wall for said drum within said drum; means for moving one of said end wall and drum axially in a reciprocable path relative to the other; an imperforate coniform distributor shell having an end of small diameter and an end of large diameter supported concentrically within said drum with the end of large diameter adjacent said end wall; means for revolving said drum and said distributor shell; means for feeding a slurry having liquid and solid components into the end of said shell which is of small diameter; screen means mounted on the interior wall of said distributor shell at a spaced distance outwardly therefrom to provide a channel between said screen means and shell for fluid separated by centrifugal force from the solids collecting on said screen means; and means connecting with said channel and leading from said distributor to said end wall for channeling the liquids so predrained to a face of the end wall remote from the distributor for discharge.

10. In a centrifugal machine; a housing; a separating drum within said housing; means revolvably supporting said drum within the housing; an end wall section for said drum within said drum; means for moving one of said end wall section and said drum axially in a reciprocable path relative to the other; a distributor shell section having an imperforate interior surface which increases in diameter from an end of small diameter to an end of large diameter supported within said drum with the end of large diameter adjacent said end wall section; means for revolving said drum and said distributor shell section; means for feeding a slurry having liquid and solid components to the interior of said shell section to said end of small diameter; filter means mounted on the interior surface of said distributor shell section at a spaced distance outwardly therefrom to provide a channel behind said filter means for fluid separated by centrifugal force from the solids collected by said filter means; and means connecting with said channel and leading from said distributor shell section to said end wall section for channeling the liquids so predrained to a face of the end wall section remote from the distributor shell section for discharge.

11. In a centrifugal machine; a housing; a separating drum within said housing; means revolvably supporting said drum within the housing; an end wall for said drum within said drum; means for revolving said drum and end wall; means for moving said end wall axially in a reciprocable path relative to the drum; an imperforate distributor shell having a tapering interior wall portion with an end of small diameter and an end of large diameter supported within said drum for rotation therewith with the end of large diameter adjacent and spaced from said end wall; means for feeding a slurry having liquid and solid components into the end of said shell which is of small diameter; a screen mounted on the interior wall of said distributor shell at a spaced distance outwardly therefrom to provide a channel behind said screen for fluid separated by centrifugal force from the solids collecting on said screen; said end wall having port means leading from the face thereof adjacent said distributor shell to a face

of said end wall remote from the distributor shell for discharge; and means connecting the said channel with said port means of said end wall.

12. The combination defined in claim 11 in which said means connecting the channel and port means comprises a radially extending flange on said distributor shell at its end adjacent said end wall having port means therein communicating with said channel; and circumferentially spaced tubular supports mounting said distributor shell on said end wall and extending between said end wall and flange, communicate said port means in the flange and in the end wall.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 2,899,065 August 11, 1959

Henry Francis Irving

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 7, line 12, after "therefor" insert a comma; line 18, strike out "and"; line 21, after "other" strike out the semicolon.

Signed and sealed this 31st day of October 1961.

(SEAL)
Attest:

ERNEST W. SWIDER
Attesting Officer

DAVID L. LADD
Commissioner of Patents

USCOMM-DC