

Aug. 25, 1942.

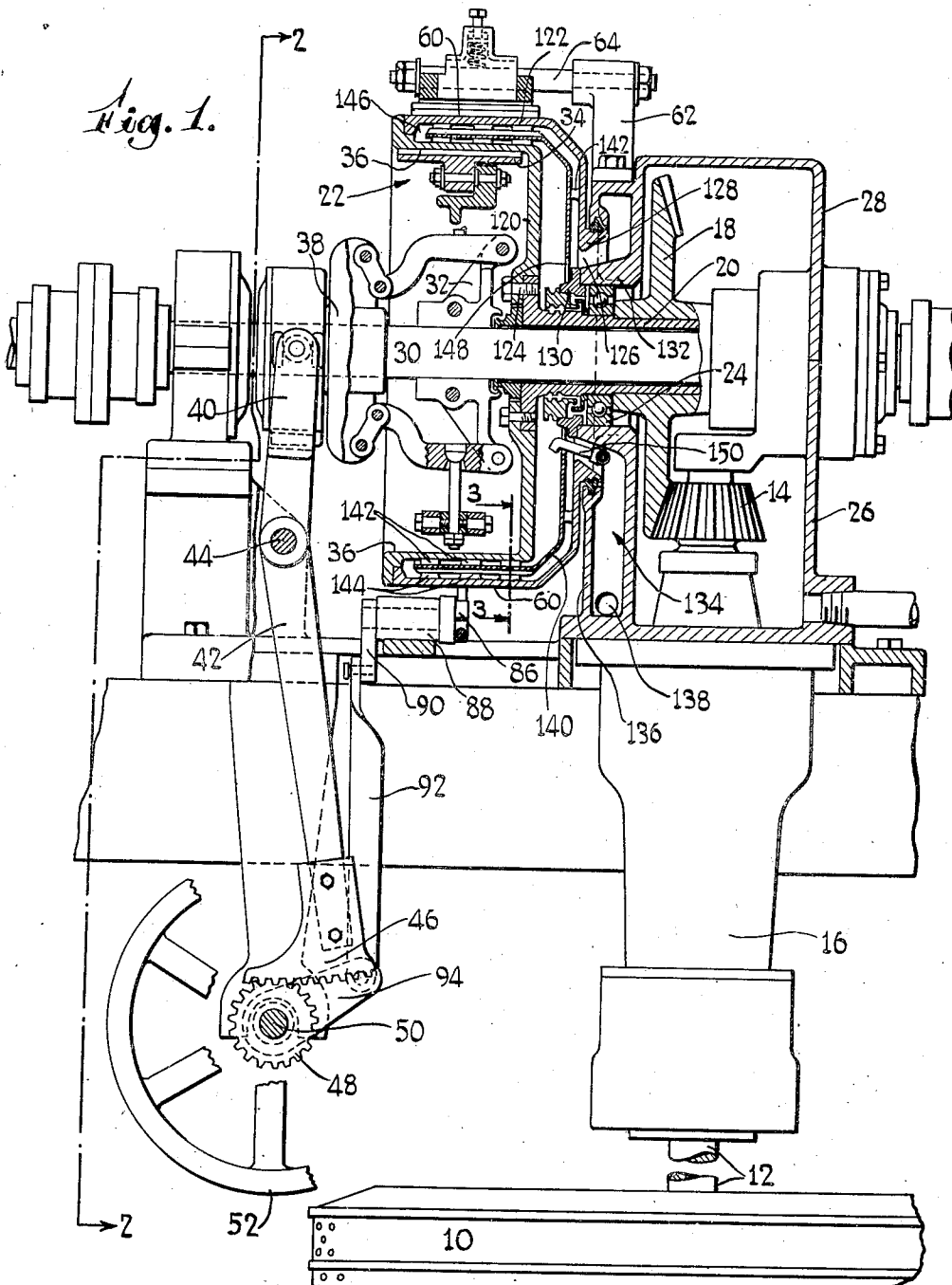
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2,294,207

CENTRIFUGAL APPARATUS

Filed April 16, 1937

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

Fig. 2.

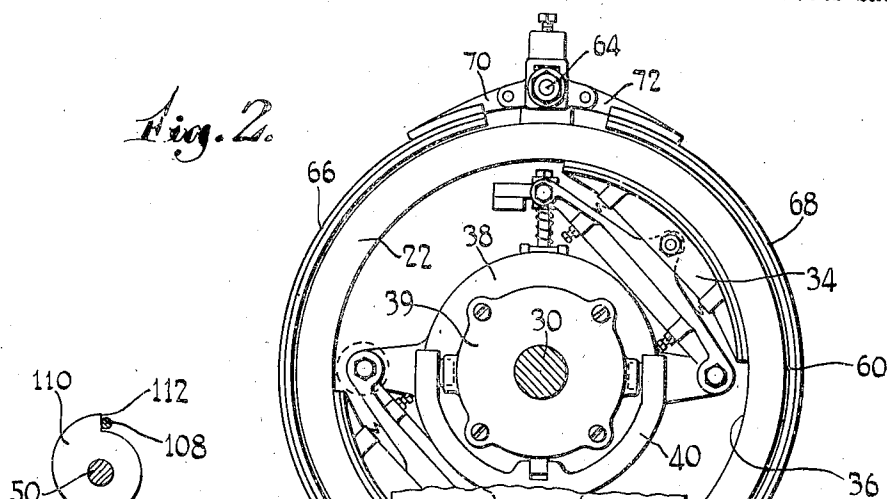


Fig. 4.

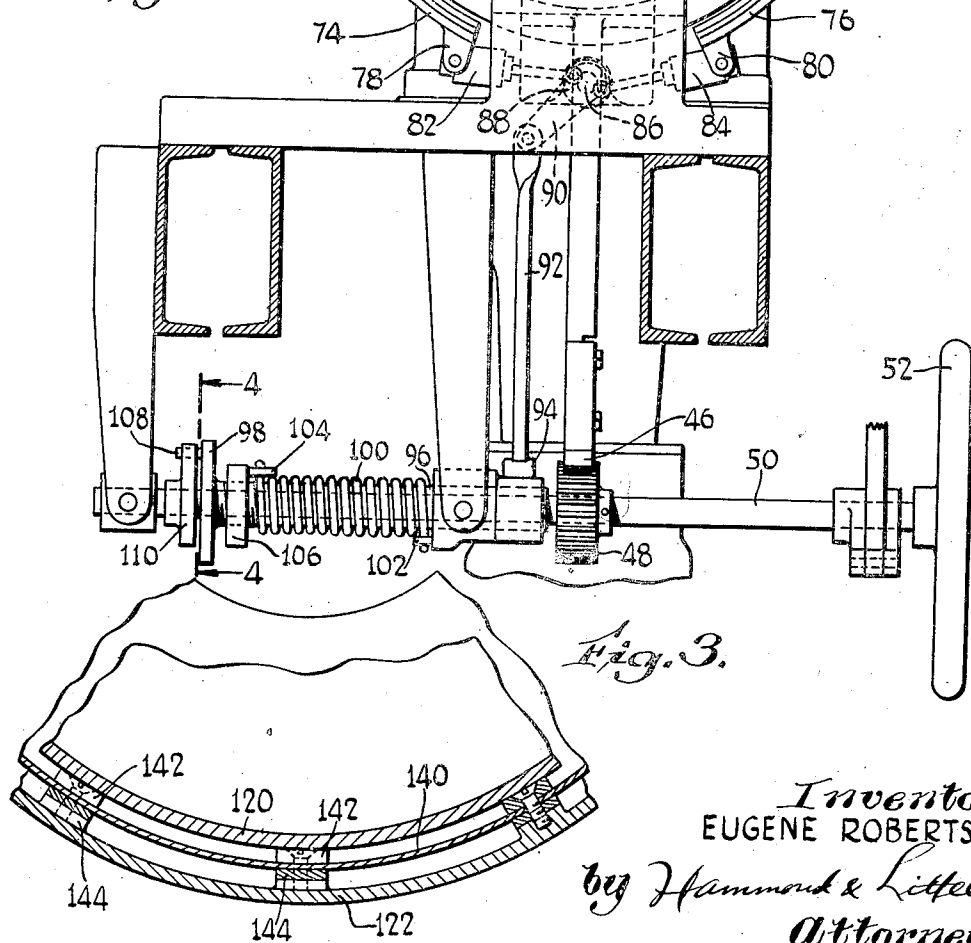


Fig. 3.

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UNITED STATES PATENT OFFICE

2,294,207

CENTRIFUGAL APPARATUS

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Application April 16, 1937, Serial No. 137,282

6 Claims. (Cl. 210—71)

This invention relates to centrifugal apparatus of the type employed in the separation of finely divided solid material from liquid, and it has particular reference to centrifugal apparatus for use in the manufacture of sugar and similar chemical substances, wherein sugar or other crystals are separated from liquors by the application of centrifugal force.

It is now the common practice in this art to employ centrifugals embodying a perforated basket suspended on a gyratory rotatable spindle. In recent years improvements have been made in the manner of carrying out centrifuging operations, an important one involving rapid acceleration of the centrifugals to high operating speeds in order to improve the separation of liquors from granular material and the quality of the final product and to render processing operations more economical.

It is the principal object of the present invention to provide improved centrifugal apparatus which is capable of safe and rapid acceleration and deceleration and prolonged operation at high speeds without attendant difficulties due to break downs, overheating and the like.

Another object of the invention is to provide centrifugal apparatus which permits the elimination of the usual braking means on the gyratory spindle and provides an improved braking arrangement of greater efficiency and higher braking speed.

Another object of the invention is to provide an apparatus embodying overhead power transmission means for connecting the basket spindle with a source of power and overhead braking means for quickly stopping revolution of the basket, in which both means are associated in a compact unitary arrangement.

Still another object is to provide such an apparatus which is capable of extended service and which embodies improved means for localizing and dissipating heat generated by friction during operation of the power transmission and braking means.

A further object of the invention is to provide apparatus of this type including overhead clutching and braking means which are physically separate from the basket spindle and manually operable means for moving the braking and clutching means to operative and inoperative positions in suitable correlation.

When the ordinary centrifugal is operated at high speeds the power necessary to bring the centrifugal to top speed and the braking power necessary to stop the basket in a relatively short

time are very great, and the heat generated by friction in the clutching and braking parts is of such intensity that these parts are quickly deteriorated unless specially adapted for the purpose.

I have found that the operating efficiency of a centrifugal may be greatly increased by eliminating the usual brake on the spindle and providing braking means working in conjunction with parts of the drive transmission means. A simple and compact arrangement giving superior service and providing the requisite clutching, braking and cooling facilities is thus obtained. The removal of braking parts from the spindle eliminates part of the load on the mounting for the basket and spindle and eliminates stresses which otherwise are imposed upon the mounting and spindle during deceleration of the centrifugal. The association of these parts with parts of the drive transmission means pursuant to my invention renders more economical the provision of powerful braking means and localizes the withdrawal of heat generated by clutching and braking parts so that the heat may be dissipated more easily. Other advantages of the invention will be apparent to persons skilled in the art from a reading of the ensuing description.

While the invention may be embodied in many forms of apparatus, I have shown in the accompanying drawings an illustrative embodiment that is particularly suitable for the centrifuging of materials such as sugar massecuites or magmas and similar chemical materials.

In the drawings,

Figure 1 is a front elevation, partly in section, of an illustrative type of centrifugal apparatus constructed in accordance with the invention.

Figure 2 is an end view, partly in section, taken approximately on the line 2—2 of Figure 1.

Figure 3 is a vertical section taken approximately on the line 3—3 of Figure 1.

Figure 4 is a detail sectional view taken on the line 4—4 of Figure 2.

The apparatus of my invention embodies, in general, a centrifugal basket suspended by a gyratory spindle in the usual manner, an overhead rotatable power shaft or equivalent power source, drive transmission means for connecting the power source with the gyratory spindle in order to revolve the latter at high speed, such means including a friction pulley, centrifugal clutching means secured to the power shaft to be moved into and out of engagement with the friction pulley, a bevel gear unit connecting the

pulley in direct driving relation with the spindle through a suitable gyratory or flexible driving connection, and braking means positioned adjacent the pulley and adapted to be moved into contact therewith to stop revolution of the basket and spindle. Additional features of the invention include the improved cooling means which I have devised for maintaining circulation of cooling liquid within the pulley sufficient to dissipate heat generated therein by frictional engagement with parts of the driving and braking means, and improved manually operable means for setting clutching and braking means in their respective operative and inoperative positions.

Referring to the drawings, the illustrated apparatus in which the invention is embodied includes the usual basket 10 having a perforated wall which permits the separation of liquid constituents of materials introduced into the basket from solid constituents when the basket is revolved. The basket may be of any type known to be suitable for the heavy duty required under heavy loads at high centrifugal speeds. It is usually surrounded by a curb, or casing, (not shown) and provided with suitable filter linings for ensuring proper filtration of the materials to be treated. The basket is suspended on a rotatable gyratory spindle 12 which may be constructed and connected with drive transmission means, including for example, a driving pinion 14, in any suitable manner. The weight of the spindle and basket is borne directly by a housing 16 enclosing a stub shaft and couplings for connecting pinion 14 with spindle 12. This housing and parts of the drive transmission and braking means subsequently to be described are supported on suitable frame work, for example as shown in Figures 1 and 2.

Pinion 14 may be driven in various ways, but I preferably employ for very high speed operations a meshing bevel gear 18 which is keyed to a rotatable driving member, such as a quill 20. This driving member is fastened to a rotatable friction pulley 22 through which driving and braking power are applied. Bevel gear 18 and the quill 20 to which it is keyed are mounted on appropriate bearings, one of which is illustrated at 24. To protect the gear mechanism and to permit inspection a suitable housing including a lower portion 26 and an upper removable portion 28 is provided. Provision is also made for lubrication of moving parts, but since the manner of lubrication and details of construction are not of primary importance to the present invention description of these features is believed unnecessary.

The friction pulley 22 cooperates with movable clutching means in a manner to permit easy connection of the pulley with a source of power, for example, a rotatable driving member or line shaft 30. In the usual plant arrangement, a plurality of centrifugal units is arranged along the line shaft. Adjacent each unit the shaft 30 extends freely through a quill 20 and has keyed thereto a spider 32 carrying actuating linkage and a plurality of radially movable clutch shoes, such as shown at 34, which are adapted to be moved outwardly by centrifugal force into frictional engagement with the inner surface 36 of friction pulley 22 when the line shaft 30 is rotating. The construction of a suitable form of clutch and of the actuating linkage therefor has been illustrated and described in my United States Letters Patent No. 1,884,873, dated October 25, 1932, and since it does not as such form a part of this

invention, further detailed description will not be given. It suffices to explain that the clutch shoes are released for movement by centrifugal force into frictional engagement with the pulley by movement of a collar 38 away from the pulley along the shaft 30 and that the clutch shoes are retracted from operative engagement with the pulley by axial movement of collar 38 toward the same. The line shaft is rotated constantly during the use of the machines associated therewith, so that each machine can be accelerated at any time by causing the clutch mechanism to become active. In order to actuate the clutch mechanism, I provide a collar 39 which is slidable along the shaft and coupled rotatively to collar 38 and a clevis 40 embracing and connected with collar 39 and joined to an actuating lever 42. Lever 42 is fulcrumed intermediate its ends on a suitable frame, as at 44, and adjacent its lower end it carries a gear segment 46 meshing with a pinion 48 keyed to a control shaft 50 which in turn is keyed to and movable by a manually controllable member such as a hand wheel 52. In the arrangement shown in the drawings, when hand wheel 52 is in the position of Figure 1 the clutch shoes are pressed by centrifugal force into engagement with the inner pulley surface 36, and when the wheel is moved counterclockwise from this position the collar 38 is moved toward the pulley and the clutch shoes are withdrawn from frictional engagement therewith.

The braking means of the apparatus is supported above the frame work which supports the drive transmission and clutching means, and in a manner to operate in association with pulley 22. In addition to inner friction surface 36, the pulley rim presents an outwardly facing friction surface 60. A fixed standard 62 is arranged adjacent the pulley, and to this standard is secured a fulcral pin 64 extending over the vertical plane of the pulley and adapted to provide a support and fulcrum for movable brake bands 66 and 68 (see Figure 2). Each of these brake shoes carries appropriate friction brake pads on its inner side, and each is of arcuate shape corresponding approximately to the shape of the outer friction pulley surface against which it is adapted to be moved. The upper ends of the bands are connected to arms 70 and 72, respectively, which are swivelled on the pin 64 in an appropriate manner. The lower ends of the brake bands are provided with straps 74 and 76, respectively, each of which includes means such as lugs 78 and 80 for pivotal connection with connecting rods 82 and 84, respectively. The inner ends of these connecting rods are secured eccentrically to a spindle 86 which is mounted for oscillation within a fixed socket 88 and carries a crank arm 90 which may be oscillated to and fro in order to move the brake bands toward each other and into frictional engagement with the outer friction surface 60 of the pulley, or to expand the bands away from each other and out of such frictional engagement.

For actuating the braking means I have provided means including a link 92 which is pivotally connected with the crank arm 90 at one end and with a crank arm 94 secured around the control shaft 50 at its other end.

Means are also provided to require that the braking means be moved to an inoperative position whenever the clutching means is moved to operative position. In the illustrated embodiment the crank arm 94 is keyed to a sleeve 96 surrounding control shaft 50 and carrying adjacent its backward end a disc-like member 98. A relative-

ly strong torsional spring 100 surrounds this sleeve 96 and has one of its ends anchored on supporting frame work, as at 102, and its other end anchored, as by a pin 104, to a nut 106 adjustably connected to the sleeve and disc-like member 98. The disc-like member carries a laterally projecting pin 108 which extends into the vertical plane of a cam shaped member 110 keyed to control shaft 50 and into the path of clockwise movement of an abutment 112 on member 110. The arrangement of these parts is such that torsional spring 100 normally tends to move sleeve 96, members 106 and 98 and the crank arm 94 in a counterclockwise direction, such movement tending to swing the crank arm 90 in a manner to engage the brake bands 66 and 68 against the outer friction surface of the pulley. Because of the location of pin 108 with respect to abutment 112, however, member 98 cannot move counterclockwise without also moving cam shaped member 110 and the control shaft counterclockwise and thereby disengaging the clutching means.

With the parts in the position as illustrated in Figures 1 and 2, the hand wheel 52 and control shaft 50 are in an advanced clockwise position in which the clutching means is in operative engagement and the braking means is in inoperative position. It will be apparent that counterclockwise movement of the hand wheel and control shaft results in movement of the clutching means to an inoperative position and permits the braking means to be moved to operative position by spring 100. It should also be apparent that when the braking means is in operative position and it is desired to release this means and to engage the clutching means, both results may be accomplished simply by turning the hand wheel and control shaft in a clockwise direction, whereupon the clutching means is moved to operative position in an obvious manner and the braking means is necessarily moved to inoperative position against the torsion of spring 100 because the abutment 112 on member 110 will necessarily carry along with it pin 108, member 98, sleeve 96, crank arm 94 and the other control elements of the braking means.

In practice, I may employ releasable means, for example, time controlled means, for locking the braking means in inoperative position while the clutching means is in an operative position. Such releasable locking means, however, is not a necessary part of the apparatus, and it is not described in detail herein. The centrifugal force imparted to the clutch shoes by rapid revolution of the line shaft 30 is sufficient in actual operation to keep the clutching means in operative engagement notwithstanding the opposed force of torsional spring 100.

The association of clutching and braking means with a common pulley, in a heavy-duty centrifugal machine operating on short cycles, necessarily results in the generation of a great deal of heat in the pulley and in the clutching and braking parts. The degree of friction to which the pulley is subjected will be to some extent understood when it is pointed out that frictional engagement of the clutching means is employed to accelerate the centrifugal to speeds of greater than 1250 R. P. M. within 40 seconds, and that the centrifugal may be brought to a stop from speeds of the order of 2000 R. P. M. within a braking period of considerably less than a minute. The load to which this driving and braking power must be applied, including the weight of a normal

charge of massecuite in a 40 inch centrifugal basket, is usually more than one ton.

To enable rapid and constant dissipation of heat generated in the clutch and braking means, I have provided special cooling means for withdrawing this heat through the interior of the clutch pulley, which means constitutes an improvement over the apparatus disclosed in my United States Letters Patent No. 2,060,826, granted November 17, 1936.

The pulley comprises a hollow radially extending portion, or spider, and a communicating hollow rim presenting on its inner and outer sides the friction surfaces mentioned above. Although the pulley might be formed in one or any number of pieces, the preferred practice is to employ a pulley made up of an inner member 120 and an outer member 122, these members being spaced apart throughout most of the radially extending and rim portions of the structure but joined together at their outer ends so as to form communicating annular spaces closed at an outer end in order to prevent spilling of liquid onto parts of the driving or braking means. Inner member 120 is secured to the quill 20 adjacent shaft 30, for example as indicated at 124, so that the escape of liquid beyond member 120 is obviously impossible. Communicating with the annular space within the radially extending portion of the pulley is an annular liquid escape opening 126 which is bordered on the outside by an annular flange 128 on outer member 122 and on the inside by sealing means 130 and a lateral wall 132 of a receptacle 134 for cooling liquid. The receptacle 134 is preferably a stationary casing formed in conjunction with the housing 26—28 or the transmission gears. It includes a side wall 136 having an annular opening which surrounds the flange 128 on the pulley and is sealed against the flange in a manner to avoid leakage of liquid therebetween but to permit relative rotation of the pulley. It communicates with a discharge port 138 for carrying away liquid collected in the receptacle.

The annular space within the pulley is divided into liquid entrance and exit channels by an annular partition 140 which is spaced from inner and outer pulley members 120 and 122 by suitable spacing and reinforcing means, such as lugs 142 and 144. The partition terminates short of the closed outer end of the space within the pulley rim and short of the sealing means 130 so that the liquid entrance and exit channels are in communication, as at 146 and 148. A supply pipe 150 projects into one of these channels, preferably into the inner channel by extending through the opening 148. A stream of cooling liquid, for example water, may be flowed from pipe 150 continuously during operation of the centrifugal, or appropriate control means may be provided for establishing and terminating the flow of liquid at any desired intervals.

In the operation of the cooling means, cooling liquid is directed into the inner channel from pipe 150, and the liquid flows radially outwardly into the pulley rim under the influence of centrifugal force and into the outer channel through the communicating space 146. As more liquid is introduced into the inner channel, the excess is forced back through the outer channel and thence through the escape opening 126, whence it is collected by the receptacle 134 and passed off through port 138.

The frictional engagement of clutch bands 34 and of brake bands 66 and 68 with inner and outer friction surfaces 36 and 60, respectively, of the

pulley rim during acceleration and deceleration of the centrifugal generates a great deal of heat. This heat, however, is localized in the pulley rim, and the flow of cooling liquid inside the rim keeps it dissipated substantially as rapidly as it is generated. The cooling liquid exerts a "wiping" effect close to the points of heat generation, so that the heat exchange is very efficient, and heated liquid is constantly displaced from these points by relatively cool liquid. Moreover, the rate of flow may be varied in accordance with varying requirements of the apparatus.

It should now be apparent that I have provided improved centrifugal apparatus in which the driving and braking means are arranged in a compact manner and in an overhead position remote from the attendant of the centrifugal. The driving means is capable of prolonged, trouble-free service under heavy loads and short operating cycles. It is flexible in use, permitting the selection of acceleration rates and maximum speeds best suited for the particular quality of material undergoing treatment. All braking parts are removed from the basket spindle; hence radial strains on the spindle of the kind heretofore encountered are eliminated and the apparatus may be operated at very high speeds with greater efficiency and safety. The braking means presents a much greater braking surface than heretofore used and therefore provides much increased braking power. The control means for the driving means and braking means ensure actuation of these means in proper correlation. The improved cooling means prevents the accumulation of injurious heat in the braking and driving parts and thus reduces wear and eliminates the need for frequent replacement. It is sealed so that there is no opportunity for harmful leakage of cooling liquid or contamination of friction parts of the apparatus. Because of these advantages and others which will be obvious to persons skilled in the art, the improved apparatus is well adapted for prolonged, heavy-duty service involving rapid acceleration and deceleration and high speed revolution of the centrifugal basket.

The principles of the invention may be embodied in various arrangements of apparatus and are not restricted to details of the illustrated driving, braking, cooling and control mechanisms. I desire that the invention be accorded a scope in keeping with the spirit of the specification with only such limitations as are required by the claims.

I claim:

1. Heavy-duty high speed centrifugal apparatus for sugar manufacture and the like comprising a vertical gyratory spindle, a centrifugal basket of the filtering type suspended on said spindle, a line shaft adapted to be rotated constantly, a friction rim surrounding said shaft and having inner and outer friction surfaces, a bevel gear unit between said rim and said spindle, said unit including a gear connected with said rim to be rotated therewith and a gear connected said spindle through a positive but flexible connection, clutching means carried by said line shaft for movement by centrifugal force into engagement with said inner friction surface during rotation of said shaft, whereby to accelerate and drive the centrifugal through said rim, said gear unit, said connection and said spindle, braking means mounted adjacent said rim for movement into frictional engagement with said outer friction surface, whereby to decelerate the centrifugal, actuating means for retracting and releasing said

clutching means and actuating means for applying and releasing said braking means.

2. Heavy-duty high speed centrifugal apparatus for sugar manufacture and the like comprising a vertical gyratory spindle, a centrifugal basket of the filtered type suspended on said spindle, a line shaft adapted to be rotated constantly, a friction rim surrounding said shaft and having inner and outer friction surfaces, a bevel gear unit between said rim and said spindle, said unit including a gear connected with said rim to be rotated therewith and a gear connected with said spindle through a positive but flexible connection, clutching means carried by said line shaft for movement by centrifugal force into engagement with said inner friction surface during rotation of said shaft, whereby to accelerate and drive the centrifugal through said rim, said gear unit, said connection and said spindle, braking means mounted adjacent said rim for movement into frictional engagement with said outer friction surface whereby to decelerate the centrifugal, actuating means for retracting and releasing said clutching means, actuating means for applying and releasing said braking means and control means including a single manually operable member connected with the aforesaid actuating means for controlling the actuation of said clutching and braking means.

3. Heavy-duty high speed centrifugal apparatus for sugar manufacture and the like comprising a vertical gyratory spindle, a centrifugal basket of the filtering type suspended on said spindle, a line shaft adapted to be rotated constantly, a friction rim surrounding said shaft and having inner and outer friction surfaces, a bevel gear unit between said rim and said spindle, said unit including a gear connected with said rim to be rotated therewith and a gear connected with said spindle through a positive but flexible connection, clutching means carried by said line shaft for movement by centrifugal force into engagement with said inner friction surface during rotation of said shaft, whereby to accelerate and drive the centrifugal through said rim, said gear unit, said connection and said spindle, braking means mounted adjacent said rim for movement into frictional engagement with said outer friction surface, whereby to decelerate the centrifugal, actuating means for retracting and releasing said clutching means, actuating means for applying and releasing said braking means, and control means including a shaft common to the aforesaid actuating means for controlling the same, said control means being operative to release said braking means when said clutching means is released and to retract said clutching means when said braking means is applied.

4. Heavy-duty high speed centrifugal apparatus for sugar manufacture and the like comprising a vertical gyratory spindle, a centrifugal basket of the filtering type suspended on said spindle, a line shaft adapted to be rotated constantly, a friction rim surrounding said shaft and having inner and outer friction surfaces, a bevel gear unit between said rim and said spindle, said unit including a gear connected with said rim to be rotated therewith and a gear connected with said spindle through a positive but flexible connection, clutching means carried by said line shaft for movement by centrifugal force into engagement with said inner friction surface during rotation of said shaft, whereby to accelerate and drive the centrifugal through said rim,

said gear unit, said connection and said spindle, braking means mounted adjacent said rim for movement into frictional engagement with said outer friction surface, whereby to decelerate the centrifugal, actuating means for retracting and releasing said clutching means, actuating means for applying and releasing said braking means, said rim having a hollow space between said inner and outer surfaces, means for introducing cooling liquid into said space to cool the rim and means for carrying away used cooling liquid.

5. Heavy-duty high speed centrifugal apparatus for sugar manufacture and the like comprising a vertical gyratory spindle, a perforate centrifugal basket suspended on said spindle, a constantly rotating horizontal line shaft above said spindle, a friction rim surrounding said shaft and having a radial spider and inner and outer parallel friction surfaces, a bevel gear unit including two meshing bevel gears between said rim and said spindle, a quill surrounding said line shaft and connecting one of said bevel gears directly with said spider, means including a flexible connection for connecting the other of said bevel gears directly with said spindle, clutching means keyed to and carried by said line shaft for movement by centrifugal force into engagement with said inner friction surface during rotation of said shaft, whereby to accelerate and drive the centrifugal, a fixed support adjacent the outside of said rim, braking means including two movable brake bands mounted on said support for movement into frictional engagement with said outer friction surface, whereby to decelerate the centrifugal, actuating means including a sleeve slidable along said shaft for retracting and releasing said clutching means, and actuating means connected with said brake bands for applying and releasing said braking means.

6. Heavy-duty high speed centrifugal apparatus for sugar manufacture and the like comprising a vertical gyratory spindle, a perforate centrifugal basket suspended on said spindle, a constantly rotating horizontal line shaft above said spindle, a friction rim surrounding said shaft and having a radial spider and inner and outer parallel friction surfaces, a bevel gear unit including two meshing bevel gears between said rim and said spindle, a quill surrounding said line shaft and connecting one of said bevel gears directly with said spider, means including a flexible connection for connecting the other of said bevel gears directly with said spindle, clutching means keyed to and carried by said line shaft for movement by centrifugal force into engagement with said inner friction surface during rotation of said shaft, whereby to accelerate and drive the centrifugal, a fixed support adjacent the outside of said rim, braking means including two movable brake bands mounted on said support for movement into frictional engagement with said outer friction surface, whereby to decelerate the centrifugal, actuating means including a sleeve slidable along said shaft for retracting and releasing said clutching means, actuating means connected with said brake bands for applying and releasing said braking means, a control shaft disposed between said line shaft and said basket, a hand wheel keyed to said control shaft, and means on said control shaft connected with the aforesaid actuating means for controlling and coordinating the positions of said clutching means and said braking means in accordance with the position of said hand wheel.

EUGENE ROBERTS.

CERTIFICATE OF CORRECTION.

Patent No. 2,294,207.

August 25, 1942.

EUGENE ROBERTS.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 2, second column, line 43, for the word "shoes" read --bands--; page 4, first column, line 64, claim 1, after "connected" insert --with--; and second column, line 6, claim 2, for "filtered" read --filtering--; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 29th day of September, A. D. 1942.

(Seal)

Henry Van Arsdale,
Acting Commissioner of Patents.