Oct. 29, 1940. E. ROBERTS ET AL 2,219,875

SUSPENSION AND DRIVING MEANS FOR GYRATORY CENTRIFUGALS

Filed Dec. 1, 1937

Fig. 1.

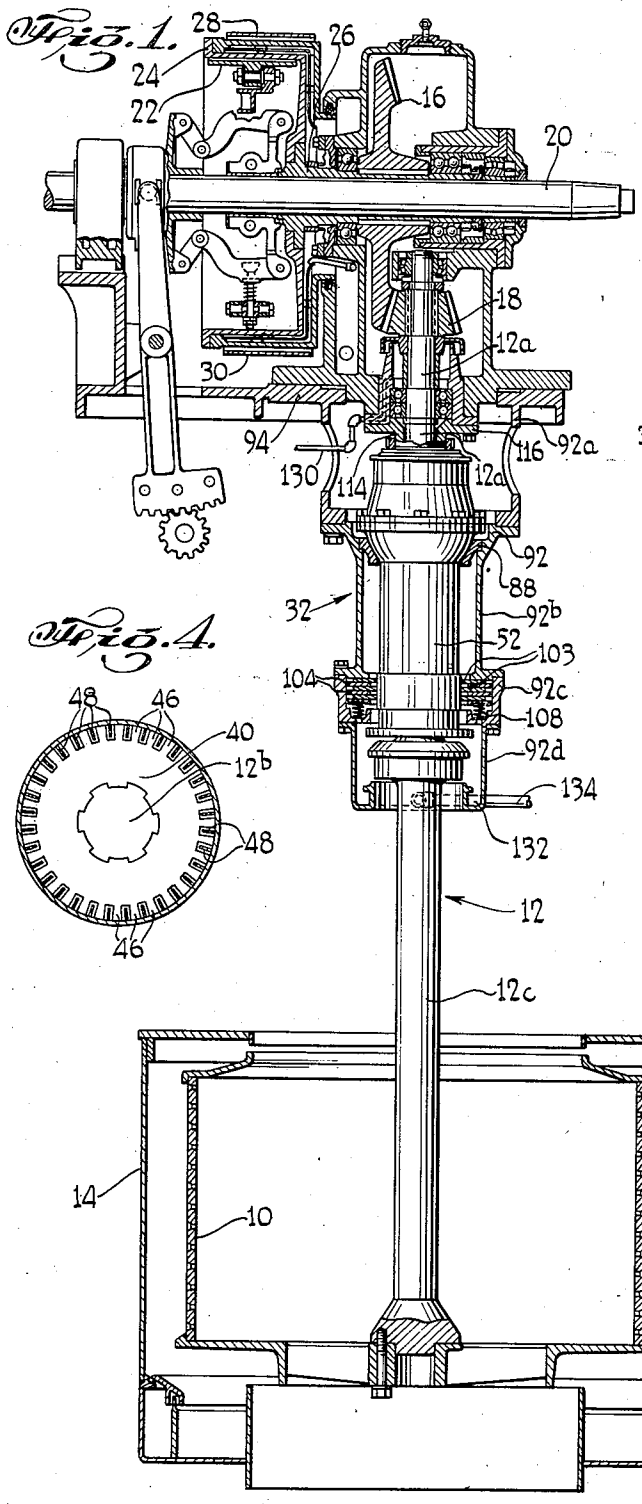


Fig. 2.

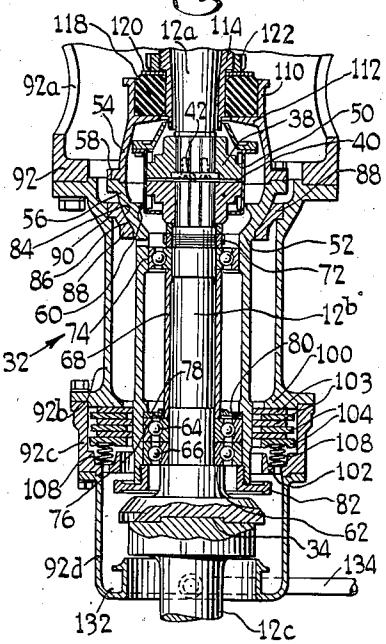
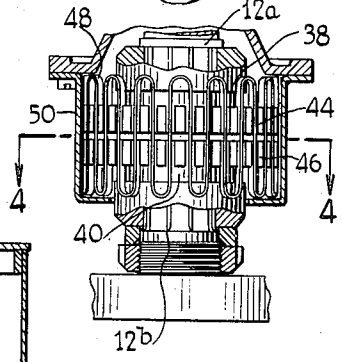


Fig. 4.

Fig. 3.



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Patented Oct. 29, 1940 2,219,875

UNITED STATES PATENT OFFICE

2,219,875

SUSPENSION AND DRIVING MEANS FOR GYRATORY CENTRIFUGALS

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Application December 1, 1937, Serial No. 177,476

7 Claims. (Cl. 210—71)

This invention relates to new and improved suspension and driving means for gyratory centrifugals of the type employed in the centrifugal separation of liquid from granular solids, as in the recovery of grain sugar from massecuites or magmas consisting of sugar crystals and syrup.

In the manufacture of sugar it is customary to introduce large charges of massecuite or magma into perforated baskets mounted for revolution at high speeds on a suspended gyratory shaft or spindle, to spin the basket and its contents in order to throw most of the syrup away from the sugar grain and then to condition the sugar for further treatment, during the latter part of each centrifuging cycle, by washing and partially drying the crystals retained in the basket. Each charge of material is flowed into the basket while the latter revolves at a relatively low speed, in order to form an annular wall of material inside the basket of substantially uniform thickness and distribution of weight. During the charging operation, however, and during the spinning of the centrifugal at higher speeds there often occurs some non-uniformity in the distribution of material within the basket, which results in forces tending to displace the basket from its normally vertical axis of revolution. To permit the centrifugal to respond to such forces, and to avoid damage to the machinery which might occur from failure so to do, the basket-carrying shaft or spindle is arranged so that it is free to gyrate to a limited extent about its normal axis of revolution.

For some time the prevailing practice in the operation of sugar centrifugals has been to employ perforated baskets having a diameter of approximately 40 inches, each accommodating a charge of about 9 cubic feet of material, and to spin these baskets at top speeds of approximately 1100 R. P. M. It has recently been found, however, that substantial improvements in centrifuging operations may be effected by greatly increasing the acceleration of the centrifugal and greatly increasing the top speeds of revolution.

An object of our present invention is to provide an improved driving suspension for gyratory centrifugals which is especially suited for safely withstanding the severe strains imposed by very rapid acceleration of the centrifugal and operation at high top speeds.

Another object of the invention is to provide a driving suspension characterized by simplicity and strength of construction, in which the principal moving parts of the assembly are enclosed within stationary elements and arranged so as to eliminate danger to attendants, to prevent access of dust or grit thereto, to simplify lubrication thereof and to improve the appearance of the machine.

Another object of the invention is to provide a driving suspension for gyratory centrifugals embodying spindle sections connected together for revolution in unison by flexible coupling means, a unitary hollow sleeve or gyratory head surrounding the coupling and parts of the spindle sections and secured to the lower section by bearings capable of sustaining radial and thrust loads thereon, a stationary hanger surrounding said sleeve or head and providing a support sustaining downward thrusts of the head while permitting gyration about a center located in the zone of the coupling, and means both above and below said center for yieldably resisting gyration of the head.

Still another object of the invention is to provide an improved driving suspension embodying a special form of flexible coupling which connects the spindle sections together for simultaneous revolution while permitting gyration of one of the sections relative to the other.

Another object of the invention is to provide a driving suspension for centrifugals which is equipped with novel means for yieldably resisting gyratory movement of the centrifugal and for increasing the resistance to gyration as the basket spindle moves farther away from its normal axis of revolution.

Other objects and advantages of the invention will be evident from the ensuing description, which sets forth details of one preferred form of construction in which the invention is embodied. The description refers to the accompanying drawing, forming a part hereof, in which

Figure 1 is a front view, partly in section, illustrating a centrifugal basket and a surrounding curb therefor, one form of suspension and driving means for the basket, constructed in accordance with the invention, and means for transmitting power to the latter from an overhead line shaft.

Figure 2 is a vertical section showing details of the illustrated form of gyratory suspension and driving means.

Figure 3 is an elevation, partly in section, showing the flexible coupling means included in the assembly of Figure 2, and

Figure 4 is a horizontal section taken on the line 4—4 of Figures 2 and 3.

Prior centrifugal machines of which we are aware are of three principal types. Some are driven by electric motors directly connected to the vertical spindle of each centrifugal and are provided with brake drums on the spindle and braking means cooperating with the same to decelerate the machine upon completion of each centrifuging cycle. Some are driven by quarter-turn belts running between a pulley on the spindle and a larger pulley on a line shaft and are decelerated by braking means on the spindle, as in the motor driven centrifugals. Others, of the type illustrated and described in the copending

application of Eugene Roberts, Serial No. 61,835, filed January 31, 1936, now United States Letters Patent No. 2,128,575, are driven in groups from an overhead horizontal driving member through a driving unit which transmits power from said member to the spindle of the centrifugal, and in this type of machine also the braking means heretofore has included a brake drum mounted on the spindle itself.

The apparatus in which our present invention is embodied for purposes of illustration is similar to that illustrated in the identified copending application with respect to the manner of transmitting driving power from an overhead shaft to the centrifugal basket, but it departs from the particular form of apparatus illustrated in said application in that the braking means is eliminated from the spindle and the gyratory suspension means for the basket is constructed in a different manner in order better to attain the objects set forth above.

Referring to the drawing, the illustrated form of apparatus includes a perforated basket 10 suspended on a vertical shaft or spindle 12 and surrounded by a casing or curb 14. A driving unit including a set of transmission gears 16 and 18 transmits driving power to the spindle from a horizontal line shaft 20 through centrifugally actuated clutch shoes, such as shown at 22, connected to the line shaft and a cooperating friction rim 24 connected with gear 16 through a quill 26. The braking means includes brake pads 28 and 30 which cooperate with a friction surface on the outside of rim 24. This particular type of driving assembly is described in the copending application of Eugene Roberts, Serial No. 137,282, filed April 16, 1937; since it does not constitute an essential part of the invention claimed in this application further description thereof is believed to be unneceesary.

The particular construction provided by the present invention relates to the gyratory suspension and driving means for the basket, located intermediate transmission gear 18 and the lowermost section of spindle 12. This construction is designated generally by the numeral 32 in Figures 1 and 2 of the drawing.

The basket supporting spindle 12 is composed of at least two spindle sections, including in the illustrated form an uppermost section 12*a* to which gear 18 is secured at one end, a lower, intermediate section 12*b* and a lowermost section 12*c* which is removably secured to section 12*b* for movement therewith by means of an interengaged tongue and groove 34 and 36 on adjacent ends of the respective sections and connecting means (not shown) holding said ends together. The several spindle sections normally are arranged in vertical alignment. The adjacent ends of sections 12*a* and 12*b* are spaced apart a slight distance and connected together for revolution in unison by flexible coupling means which positively transmits driving power from one section to the other but permits section 12*b* to gyrate about the vertical axis independently of section 12*a*. For example, the adjacent ends of sections 12*a* and 12*b* are provided with radially enlarged blocks 38 and 40, respectively, which are keyed to the ends thereof and locked thereto by suitable means such as shown at 42. Each block is formed with a circumferential series of spaced lugs 44 and 46, and the lugs of each series are arranged in vertical alignment as indicated in Figure 3. A continuous strip 48 of heavy resilient spring material is arranged to extend between each vertically aligned pair of lugs, forming undulations which embrace each pair and prevent the lugs of one series from revolving relative to those of the other but permit movement of one series relative to the other about axes transverse to the normal vertical axis of the spindle. As shown in Figure 2 and in greater detail in Figure 3, the strip 48 is confined against outward movement away from lugs 44 and 46 by a stationary surrounding housing 50, which normally does not contact the strip but ensures against dislodgement of the same under any tensions that might be encountered during use of the machine. It will be apparent that the described arrangement permits gyration of spindle sections of 12*b* and 12*c* together relative to section 12*a* and that the weight of sections 12*b* and 12*c* and of the centrifugal basket which they carry is borne independently of section 12*a*.

A non-rotary gyratory head or hollow sleeve 52 surrounds the flexible coupling means described above and preferably extends above and below the same in spaced relation to spindle sections 12*a* and 12*b*. This gyratory head suitably may be formed of an upper tubular portion 54 and a lower tubular portion 56, which are joined together as at 58. It will be apparent, however, that the head may consist of a single hollow metallic member. In the zone of the flexible coupling means the inside of the surrounding part of the head may carry inwardly extending ribs, such as indicated at 60, which serve to prevent undue outward movement of casing 50.

Between the lower portion of the hollow gyratory head and spindle section 12*b*, means are provided for transmitting radial and thrust loads from the spindle to the head. Such means preferably comprises angular bearings which strongly secure the head to the spindle section, preventing relative axial movement between the same under the downward thrust of the centrifugal basket and its contents, and transmitting radial loads from the spindle directly to the gyratory head. A preferred form of such bearing means is illustrated in Figure 2. The spindle section 12*b* presents an upwardly facing annular shoulder 62 upon which rest the inner races of a pair of adjacent angular bearings 64 and 66 located between the spindle section and the head. A tubular sleeve 68 extends vertically from the inner race of bearing 66, and above sleeve 68 is located another angular bearing 70 having an inner race in contact with the sleeve. The inner races for these several bearings and sleeve 68 are all held firmly together and pressed against shoulder 62 by means of a nut 72 threaded on spindle section 12*b* at a point beneath block 40. The outer race of bearing 70 fits against a cylindrical supporting surface 74 on the inside of gyratory head 52, and the outer races of bearings 64 and 66 lie in contact with a cylindrical surface 76 on the inside of the head. An annular ring 78 overlies bearings 64 and 66 at the lower end of sleeve 68 and is provided with passages for directing lubricant to the bearings. This ring rests against a downwardly facing shoulder 80 on the head 52. The ring and the outer races of bearings 64 and 66 are kept together and pressed against shoulder 80 by means of a cap 82, which threadedly engages the inside lower end of the head.

It will be readily understood that the described arrangement of angular bearings in relation to spindle section 12*b* and the gyratory head 52 results in transmission of downward thrusts of

the spindle to the head, as well as in direct transmission of radial loads from the spindle to the head and gyration of the head in response thereto.

In the zone of the flexible coupling means the outside of the head is formed with a convexly spherical surface **84**, which cooperates with a concavely spherical surface **86** formed on the inside of an annular ring **88**. Ring **88** rests upon an annular shoulder **90** formed on the inside of a hanger **92**, which acts as the supporting structure upon which the entire centrifugal is suspended. In the illustrated form, hanger **92** comprises several sections including an upper section **92***a*, a second section **92***b*, a third section **92***c* and a lower section **92***d*. All these sections are secured together, for example, by bolts as illustrated. Section **92***a* is formed integrally with a base support or foundation **94** forming the principal framework for the mounting of the centrifugal and its overhead driving mechanism.

The spherically curved surfaces **84** and **86** formed on the head and ring **88**, respectively, constitute ball and socket means supporting the head, the spindles secured thereto, the centrifugal basket **10** and its contents against downward movement while permitting gyration of these parts about a point located in the zone of the flexible coupling means, so that the basket and spindle may seek and revolve around their actual center of gravity during each centrifuging cycle.

While it is necessary to provide means enabling gyration of the basket and spindle to a limited extent during operation, it is also important to resist abrupt movements away from the normal axis of revolution and to inhibit swaying of the basket and spindle in response to small forces which would have no harmful effect on the equipment if resisted. The driving suspension of our invention embodies improved means for accomplishing these objectives, in combination with the arrangement described hereinabove.

Sections **92***b* and **92***c* of the hanger extension provide inwardly extending ledges or flanges **100** and **102**, respectively, which with the vertical wall of section **92***c* form an annular chamber partially enclosing means for yieldably contacting head **52** below the center of gyration thereof to resist swaying movement of the head about said center. In the form illustrated this means comprises a plurality of spaced annular metallic rings **103** which surround and contact the outer surface of the head and a plurality of spaced annular metallic rings **104** which lie in face to face contact with rings **103**, the rings of each series lying between and spacing apart those of the other. The outer edges of rings **104** are arranged adjacent the inside surface of hanger section **92***c* so that they are free to move laterally but only to a limited extent. As shown in Figure 2, however, rings **103** normally are spaced from the inside wall of section **92***c* a considerable distance, and they may be moved laterally to a corresponding extent and must necessarily be so moved whenever the basket spindle sways from its normal axis of revolution.

The lowermost ring **104** is spaced vertically from flange **102**, and a series of expansile coil springs **108** is compressed between the underside of this ring and the flange. The series of springs **108** keeps each of the rings **103** and **104** in firm frictional engagement with the contacting rings, and by means of this frictional engagement lateral movement of rings **103** relative to rings **104** and, consequently, gyratory movement of head **52** and the centrifugal basket and spindle are resisted.

A special feature of our present construction is that the resistance of rings **103** and **104** to swaying movement of the basket spindle increases in progressive stages, as the spindle moves farther from its normal axis of revolution. The top ring **103** is constantly in frictional engagement with stationary ledge **100**. The lowermost ring **104** is spaced the smallest distance from wall **92***c*, while the top ring **104** is spaced farther from wall **92***c* and intermediate ring **104** still farther. Thus, as the spindle first sways from its normal axis, for example, under an unbalanced load, the first resistance is the friction between top ring **103** and ledge **100**. With further swaying, the lowermost ring **104** strikes wall **92***c*, and its frictional engagement with lowermost ring **103** then becomes effective. Thereafter, the top ring **104** strikes wall **92***c* and brings two more frictional engagements into play and finally the intermediate ring **104** contacts the wall and an additional pair of frictional engagements becomes effective.

In addition to the described means for resisting gyration of the spindle and basket, we provide buffer means yieldably contacting the head **52** above the center of gyration. For example, the upper portion **54** of the head terminates in a vertical flange **110** and is formed with an inwardly and laterally extending flange **112**. The upper spindle section **12***a* is surrounded by a stationary tubular member **114** which is secured to a part of the structure enclosing gears **16** and **18**, as at **116**, and extends downwardly opposite flange **110** toward block **38** on the end of section **12***a*. A resilient annular ring **118**, of rubber or other yieldable material, is placed between flanges **110** and **112** and the lower portion of stationary member **114**, preferably under partial compression. This ring or buffer may be securely held in place, for example, by an overlying metallic washer **120** which is forced against the buffer by a nut **122** threadedly engaged with member **114**. The arrangement of these parts is such that the buffer constantly contacts the upper end of the gyratory head **52** inside the same and constantly resists swaying movement of the head and the basket spindle around the center of gyration.

The form of construction above described is capable of withstanding severe strains encountered in the operation of the centrifugal at very high speeds with rapid acceleration and deceleration to and from top speeds. It readily responds to decentralizing forces encountered in the operation of the centrifugal which might otherwise cause damage to the machine, but at the same time it prevents the basket and spindle from swaying unduly in response to small forces.

The flexible coupling and bearings of the assembly are well shielded against access of dirt or grit, and all of the moving parts are enclosed within stationary elements which provide greater safety for attendants of the centrifugals. Thorough lubrication of the moving parts is obtained, for example, by introducing lubricant between spindle section **12***a* and member **114** through a conduit **130**, permitting the lubricant to flow by gravity into contact with the flexible coupling means, the bearings and rings **103** and **104**, and collecting the used lubricant in a trough-like channel **132** formed in the lower section **92***d* of the hanger, from which channel it may be withdrawn through pipe **134** and disposed of as desired.

In describing the illustrated embodiment of

our invention we have set forth details of construction of a preferred type of coupling means and of preferred arrangements of means for resisting gyration of the head, as well as other details which need not necessarily be embodied in constructions utilizing the broader essentials of the invention. We recognize that these various details of construction may in some instances be eliminated and in others substituted by equivalents, and we therefore intend the invention to be given a scope consistent with the spirit of the specification as restricted only by the terms of the claims.

We claim:

1. Suspension and driving means for gyratory centrifugals comprising, in combination, a spindle including two vertically aligned spindle sections connected together by flexible coupling means, a hollow gyratory head surrounding said coupling means and extending above and below the same in spaced relation to said spindle sections, bearing means between said head and the lower of said spindle sections for transmitting radial and thrust loads of said lower section to the head, means intermediate the upper and lower ends of said head constantly sustaining downward thrust of the same and permitting gyration of the same in response to radial movement of the lower spindle section, means yieldably contacting the head above said last recited means for resisting such gyration and means yieldably contacting the head below the last recited means for resisting such gyration.

2. Suspension and driving means for gyratory centrifugals comprising, in combination, a spindle including two vertically aligned spindle sections connected together by flexible coupling means, a centrifugal basket and shaft carried by said lower section, a hollow gyratory head surrounding said coupling means and extending therebelow in spaced relation to at least part of the lower spindle section, bearing means arranged in spaced relation between said head and lower spindle section for transmitting radial and thrust loads from the latter to the head, a stationary supporting hanger surrounding said head in the zone of said coupling and therebelow, ball and socket means on said head and hanger providing a seat for said head to sustain constantly the downward thrust thereof and to permit gyration thereof about a center located in the zone of said coupling means, and means below said ball and socket means and intermediate the lower portion of said head and said hanger to resist such gyration.

3. Suspension and driving means for gyratory centrifugals comprising, in combination, a spindle including two vertically aligned spindle sections connected together by flexible coupling means, a centrifugal basket and shaft carried by said lower section, a hollow gyratory head surrounding said coupling means and extending therebelow in spaced relation to at least part of the lower spindle section, bearing means in the space between said head and lower spindle section for transmitting radial and thrust loads from the latter to the head, a stationary supporting hanger surrounding said head in the zone of said coupling and extending therebelow, ball and socket means on said head and hanger providing a seat for said head to sustain constantly the downward thrust thereof and to permit gyration thereof about a center located in the zone of said coupling means, and means below said ball and socket means and between the lower portion of said head and said hanger for resisting such gyration, said last recited means including a plurality of laterally movable ring members extending outwardly from said head, a plurality of annular rings of greater diameter than said ring members, means supported by said hanger limiting the lateral movement of said annular rings, and means yieldably holding said annular rings in frictional engagement with said ring members.

4. In suspension and driving means for gyratory centrifugals, the combination of a spindle including two vertically aligned spindle sections connected together by flexible coupling means, a hollow gyratory head surrounding said coupling means and extending above and below the same in spaced relation to said spindle sections, means for transmitting radial and thrust loads from the lower of said spindle sections to said head, a hanger supporting said head for requisite gyration, a stationary member surrounding the upper of said spindle sections above said coupling means, and yieldable buffer means inside the upper extension of said head between the same and said member for resisting gyration of the head.

5. In suspension and driving means for gyratory centrifugals, the combination of a spindle including an upper drive-transmitting section and a lower gyratory basket-carrying section and flexible coupling means connecting said sections together, said coupling means comprising blocks secured in spaced relation to the adjacent ends of said spindle sections and resilient strip spring means interengaged with both blocks so as to lock the sections together for revolution in unison while permitting gyration of the lower section.

6. In suspension and driving means for gyratory centrifugals, the combination of a gyratory basket-carrying spindle adapted to be rotated about a normal substantially vertical axis of revolution, means for driving the spindle and means resisting movement of the spindle away from said normal axis, the last named means including means increasing the resistance to such movement in successive stages.

7. In suspension and driving means for gyratory centrifugals, the combination of a gyratory basket-carrying spindle adapted to be rotated about a normal substantially vertical axis of revolution, means for driving the spindle and means resisting movement of the spindle away from said normal axis, the last named means including a plurality of spaced friction members laterally movable with said spindle, a second plurality of movable spaced friction members extending beyond the first named members and spacing apart and being spaced apart by the same, means holding said members in frictional engagement and means for successively limiting movement of the friction members of said second plurality as the spindle moves farther from its normal axis.

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