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(54) Improved continuous centrifugal machine.

(57) In a continuous centrifugal machine including an upwardly open frusto-conical centrifugal basket (12) secured to the upper end of a shaft (14) journalled for rotation on bearings in a bearing housing (16), a surrounding curb wall (38), buffering assemblies (40) resiliently mounting the bearing housing, and a drive motor (44) connected through pulleys (50, 82) and a belt (88) with the lower end of the shaft (14), the driven belt pulley (82) is fixed below the basket shaft (14) and connected with it through a stub shaft (84) and a flexible coupling (86) that permits angular and parallel misalignments of the shafts. An adjustable mounting arrangement for the driven pulley (82) enables adaptation of the stub shaft position to variations of the set position of the basket shaft. The belt (88) extends through a radial tunnel (41) superposed by a stationary liquid delivery tunnel (43) of the base structure of the machine, for minimal obstruction of the solids delivery space (28) inside the curb wall. The base structure includes a radial support ring (36) which is spaced inside the curb wall and supports an annular chambering unit (160) that comprises a radial annular base wall (62) and partitions (166, 172, 178) which form a liquid collecting chamber (26) outside the side wall of the basket. The buffering assemblies (40) are joined to the base wall (62) so that these assemblies and the chambering unit (160), with the bearing housing and the basket joined to them, can be preassembled as a unit and placed and fastened together on the support ring.

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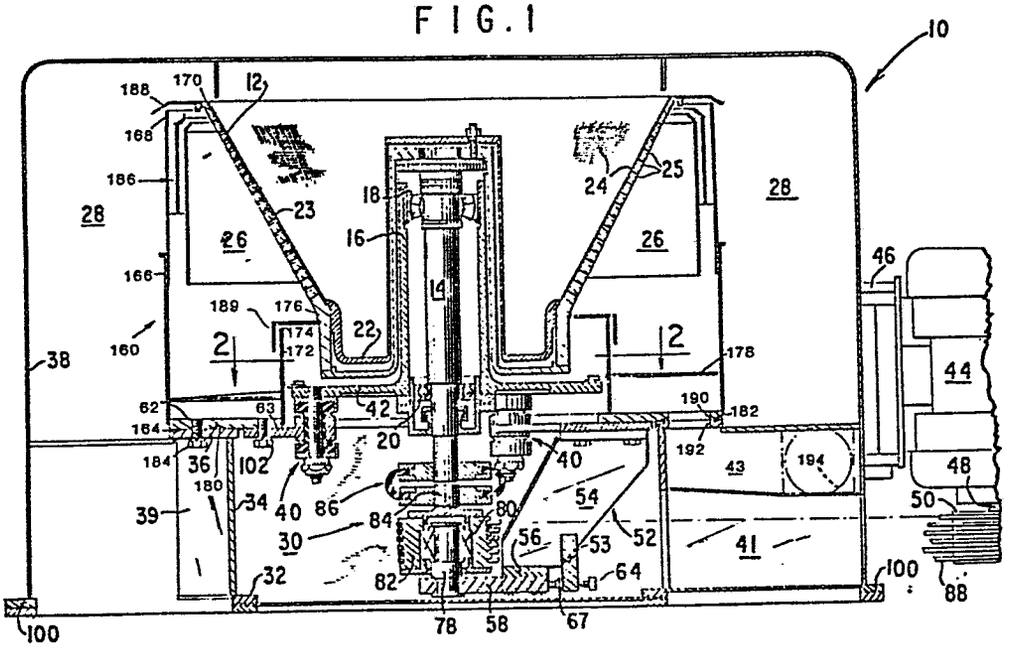
FIG. 1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IMPROVED CONTINUOUS CENTRIFUGAL MACHINE

The present invention relates to an improved continuous centrifugal machine of the conical basket type and is more particularly directed to an improved drive arrangement and improved arrangements of the functional components of such a machine.

Continuous centrifugal machines of the conical basket type are particularly useful for separating sugar crystals from syrup in the manufacture of sugar. Such machines typically include an upwardly open frusto-conical basket having a perforate circumferential side wall onto which a mixture of liquid and solids, for example, massecuite, is fed adjacent the small diameter end of the basket. When the basket is rotated the mixture will travel continuously toward the large diameter end under the influence of centrifugal force. A cylindrical partition concentrically surrounds the basket and has one end proximate to the large diameter end of the basket to form a liquid collecting chamber around the basket. The partition is spaced radially inward from an outer curb wall which borders an annular space for receiving and delivering downward solids that are discharged over a lip at the top of the basket.

In continuous centrifugals of the type mentioned, as disclosed for instance in U.S. Patent No. 3,333,707, the basket is secured to a shaft that is rotated by a drive belt which runs under the basket to and around a driven pulley fixed to the basket shaft. The drive belt is connected with a driving pulley driven by a rotary prime mover such as a motor. In said U.S. patent the basket assembly is mounted for gyratory movement under the influence of imbalanced loads through resilient buffering assemblies which are located at the level of the driven pulley so that gyrations will take place about a point on the rotational axis at the center of the driven pulley, thus limiting overstressing of the drive belt.

Further, in such known continuous centrifugal machines the partition forming the liquid collecting chamber is connected through a vertically telescoping slip joint with

a rigidly fixed base structure of the machine. A liquid delivery outlet leads from this floor structure into an outlet conduit or tunnel extending radially across the solids delivery space.

Operating difficulties are encountered in the use of the machines mentioned in that gyrations of the rotating basket assembly and/or variations of the shaft position set by the buffering assemblies cause uneven loading and wear of the drive belt. Also, the separate accommodations provided in the base structure for the drive belt and for the outflow of collected liquid obstruct objectionally the flow of solids from the machine. Further, the arrangements of the machine structures are such that difficulties exist in assembling the components, including inter alia difficulty in sealing the liquid collecting chamber and difficulty in assembling the rotary basket and bearing housing with the base structure of the machine.

The principal object of the present invention is to provide an improved continuous centrifugal machine of the type mentioned by which difficulties or shortcomings such as those noted above can be overcome.

According to one feature of the invention, the driven pulley of the machine is mounted in a fixed position below the basket shaft and is connected with that shaft through a flexible coupling that permits angular and parallel misalignments of the axes of the basket shaft and the driven pulley. As a result, the basket shaft is unrestrained by and does not vary the moment loads of the driving belt, and the resilient buffering assemblies are isolated from the influence of belt loads on the driven pulley. An adjustable mounting arrangement for the driven pulley in this drive system enables the position of a coupling stub shaft fixed to the driven pulley to be adapted readily to variations of the basket shaft position set by the basket mounting and buffering structures.

According to another feature of the invention the rigid base structure of the machine is provided with a support ring distinct from the structures that form the liquid collecting

chamber, which structures are mounted on a radial annular base wall as parts of a unitary chambering assembly that can be installed as a unit in the machine simply by seating the base wall onto and fastening it to the support ring, thus forming a liquid collecting chamber outside and beneath the basket side wall. The same base wall, moreover, has the resilient buffering assemblies of the bearing housing and basket fixed to it so that a unified assembly of the chambering unit with the basket and its shaft, bearing housing and mounting structures may be prepared and easily installed as a unit on the support ring, as well as easily removed from it and the curb of the machine for repair or maintenance.

Still another feature and advantage of the invention is provided with the arrangements noted above in that a delivery conduit or tunnel for the liquid collected in the liquid collecting chamber is provided as a stationary part of the base structure of the machine at a location overlying the belt tunnel of the drive system, with communication to this delivery tunnel through an outlet opening formed in the base wall and the support ring. Thus, difficulties of sealing liquid collecting and delivery structures are avoided and an important reduction is achieved of the surface area of structures across the solids delivery space that can obstruct the free flow of solids from the machine.

Further, by virtue of the arrangements mentioned, a floor partition of the liquid collecting chamber can be sloped spirally about the bottom of this chamber to the liquid outlet opening, thus aiding the flow of collected liquid to this opening.

The above mentioned and other objects, features and advantages of the invention will be further apparent from the following detailed description of an illustrative embodiment thereof, which is to be read in connection with the accompanying drawings. In the drawings:

FIG. 1 is a vertical cross-sectional view of a continuous centrifugal machine in accordance with the present invention;

FIG. 2 is a horizontal cross-sectional view taken along

plane 2-2 in FIG. 1 but partly broken away below this plane to reveal parts in the base space of the machine;

FIG. 3 is an enlarged side elevational view, partly in cross-section, of a pulley mounting assembly for adjusting the alignment of the shafts connected through the flexible coupling;

FIG. 4 is a rear elevational view of parts of the adjustable pulley mounting assembly; and

FIG. 5 is a vertical cross-sectional view of the unitary chambering structure of the machine.

As shown in FIG. 1, the illustrative embodiment of the improved continuous centrifugal machine of the present invention is generally indicated at 10, and includes a frusto-conical basket 12 mounted for rotation on a normally vertical basket shaft 14 that is supported for rotation in a bearing housing 16 on upper and lower bearing 18 and 20 respectively. The basket may be driven at high speed by a rotary prime mover such as a motor through an improved system for connecting the motor to the basket shaft as described below.

When the machine is operated a mixture of liquids and solids to be separated is fed into the basket 12 through a supply pipe (not shown) that extends from above the basket and discharges at a location adjacent the bottom 22 of the basket. The mixture travels upwardly and outwardly along the inner surface of the frusto-conical side wall 23 of the basket under the influence of centrifugal force. A perforated screen 24 is mounted adjacent the side wall of the basket, which itself is provided with suitable drain openings 25 extending therethrough. Thus, as the mixture travels upwardly along the side wall, centrifugal force also causes liquid constituents to travel outwardly through the screen and the side wall openings 25 for collection in a liquid collecting chamber 26 to be further described below. Solid constituents of the mixture are discharged radially outwardly over the top edge of the basket and fall for collection through an outer solids delivering space 28 provided between the outer wall of chamber 26 and a surrounding curb wall 38.

A rigidly fixed supporting base structure of the centrifugal machine comprises a base ring 32, a cylindrical column 34 secured to and projecting upwardly from the base ring, and a curb support ring 100. A strong radially extending support ring 36 is mounted on the upper end of the column 34 at a location spaced inward from the curb wall 38. The curb wall is secured at its lower margin to the curb ring 100. As shown in FIGS. 1 and 2, for increased rigidity, several vertical stiffening ribs 39 extend radially between the column 34 and the curb wall. Also extending between them is a radial arrangement of a belt tunnel 41 superposed by a liquid outlet tunnel 43.

At least three resilient mounting or buffering assemblies, which are generally indicated at 40 and may be of the type described in U.S. Patent No. 3,333,707, are equally spaced apart inside the support ring 36 and a base wall 62 that forms part of a chambering unit described further below. Hangers 63 for the buffering assemblies 40 are secured by bolts 102 to an inner portion of the base wall 62. The bearing housing 16 is formed at its lower end with a surrounding support flange 42 that extends radially outward to hub formations which are parts of the buffering assemblies 40. The resilient buffering assemblies 40 interconnect the base wall 62 and the bearing housing so that the gyratory assembly of the bearing housing, the basket shaft and the basket can gyrate to a limited extent, against resistance imposed by the elastic elements of the buffering assemblies, about a point on the axis of shaft 14 when the rotary mass of the basket with material in it is imbalanced.

A large electric motor 44, the prime mover, is mounted by a suitable mounting bracket 46 to the outer side of the curb wall 38 and has a vertically arranged drive shaft 48 that carries a drive pulley 50. The drive pulley 50 drives a wide multiple-unit V-belt 88 which extends through the belt tunnel 41 to and about a driven pulley 82 coupled with the basket shaft 14.

According to the present invention, the driven pulley 82 is mounted in a fixed position below and substantially coaxially with the basket shaft 14, as by being fixed on a non-rotary support shaft 78 through anti-friction rotary bearings

80, and is flexibly coupled with the lower end of the basket shaft 14 through a flexible coupling 86 which joins the shaft end with an upwardly protruding stub shaft 84 mounted on and for rotation with the pulley 82.

The flexible coupling 86 directly transmits torque between the pulley 82 and the basket shaft 14 while permitting angular and parallel misalignments between the axes of the basket shaft and the stub shaft under the working conditions of the machine. A flexible coupling suitable for this purpose is available commercially, for instance as a "Dodge Paraflex" coupling.

In order to establish and maintain alignment of the basket shaft with the stub shaft 84 for balanced operation of the coupling between the pulley 82 and the basket shaft 14, an adjustable mounting and positioning arrangement is provided for effecting fine adjustments of the position of the support shaft 78 of the driven pulley 82 relative to the axis of rotation of the basket shaft. This arrangement, as shown in FIGS. 1-4, is supported by a mounting bracket 52 which is rigidly fixed to part of the base structure of the machine and has an inverted T shape formed by a vertical web portion 54 and a horizontally arranged butt plate 56. The bracket 52 holds in cantilevered relation an adjustably positioned arm 58 in which the support shaft 78 is fixed, and which holds this shaft and the pulley 82 securely in a desired set position. The arm 58 is adjustable in position relative to the butt plate 56 both radially in directions toward and away from the driving pulley 50 and in either direction transverse to the radial directions. For this purpose the arm is provided with radially and laterally enlarged openings 60 and is secured to the butt plate 56 by lock bolts 62 that pass through these openings and are threaded in bores tapped into the butt plate. A lug 53 depending from the mounting bracket has a set screw 64 threaded in a bore 66 of the lug, with an end of this screw bearing radially against the outer end of the adjustment arm. The set screw 64 is held in any set position by a locknut 67 which, when loosened, lets this set screw be turned to adjust the position of the adjustment arm 58 in a

radial direction. For setting the arm position transversely, an upstanding plate 70 is secured by bolts 72 to one side of the adjustment arm 58 and two set screws 74 passed through it are engaged with a side edge portion of the butt plate 56. One of the screws 74 is threaded through a tapped bore 76 in the plate 70 and bears at its end against the adjacent side edge of the butt plate 56.

The other set screw 74 passes freely through a bore in the plate 70 and is threaded in a bore tapped into the adjacent side of the butt plate. Thus, by turning the screws 74, the arm may be adjusted in either direction of their motion to set the adjustment arm in a desired position within the range of adjustment provided by the enlarged openings 60.

To adjust the position of the stub shaft 84 for proper driving action through the flexible coupling, the lock bolts 62 and the locknut 67 are first loosened and the set screws 74 are disengaged from the butt plate 56. By then turning the set screw 64, the arm 58 can be pushed radially in the direction away from pulley 50, or can be brought to a position radially nearer to it by the tension of the drive belt 88. The range of radial adjustment is determined by the radial length of the openings 60 less the diameter of the lock bolts 62. Also, the set screws 74 can be turned to set the adjustment arm transversely to any desired position within the range of adjustment provided by the width of the openings 60 less the diameter of the bolts 62. When the pulley 82 and stub shaft 84 are properly positioned for providing the required alignment of the stub shaft relative to the basket shaft, the lock nut 67 and lock bolts 62 are tightened so that the arm 58 will be held securely in the set position.

The drive system provided for the machine enables a substantially uniform smooth driving action of the belt 88 to be maintained through the flexible coupling 86 and avoids the variations of moment loads on the belt which exist when the driven pulley is fixed to the gyratory basket shaft.

Also, the resilient buffering assemblies function without being affected by moment loads of the belt on the driven pulley.

To the extent that those assemblies from time to time may let a change occur in the set position of the axis of the basket shaft, a resultant irregularity of driving action through the flexible coupling can be compensated by an adjustment of the position of the driven pulley carrying the stub shaft 84.

As shown in FIGS. 1 and 5, a unitary chambering structure 160, sometimes referred to herein as a chambering unit, is supported on the support ring 36, occupying the space between tha ring and the side wall of the basket. The chambering unit is an annular assembly that comprises a radial annular base wall 62 having a downwardly facing surface 164 which is seated on the support ring 36 and can be easily fastened to it, as by bolts 184 accessible from below the support ring. The chambering unit also comprises outer and inner cylindrical partitions 166 and 172 which are mounted on and project upward from the base wall in concentric relation about the basket 12. The outer partition has an upper end 168 disposed adjacent the upper end 170 of the side wall of the basket. The inner partition 172 is spaced horizontally from the outer partition and has an upper end 174 disposed adjacent the lower end 176 of the basket side wall.

An annular floor partition 178 located above the base wall 62 spans the space between the inner and outer partitions and, with them, forms the liquid collecting chamber 26 outside and beneath the side wall of the basket. The floor partition desirably extends spirally about the space between the vertical partitions 166 and 172 so as to lead liquid efficiently by gravity from the collecting chamber into a liquid outlet opening (FIG. 1) formed by aligned openings 190 and 192 through the base wall 62 and the support ring 36. The confronting surfaces of wall 62 and ring 36 may be easily sealed about the opening 190, as by a sealing cement or a gasket 182 placed between them.

The upper portion of the outer partition 166 comprises a plurality of concentric rings which at their top edges are located near to a lip structure 188 at the top of the basket, thus providing a labyrinth-type seal for directing into the

liquid collecting chamber 26 the liquid thrown from the upper region of the basket side wall.

The lower, smaller end 176 of the basket 12 has a skirt 189 extending outward and then downward therefrom in concentric overlapping relation to the upper end of the inner partition 172, so that liquid thrown from the lower region of the basket side wall will pass over the skirt 189 into the liquid collecting chamber.

The liquid outlet opening (190, 192) through the base wall 62 and the support ring 36 delivers liquid from the collecting chamber 26 into a liquid discharge tunnel 43 extending radially outward and downward to a liquid delivery port 194 formed in the curb wall 38. By virtue of the space height provided in the base structure of the machine for the described drive arrangement, the liquid outlet tunnel 43 can be formed as a stationary part of the base structure that overlies and is substantially coincident with the belt tunnel 41. Consequently a considerable reduction is achieved of the area of structures extending across the path of fall of solids from the machine through the solids delivery space 28. This in turn reduces troubles from the accumulation of solids, such as centrifuged sugar crystals, on such obstructing structures.

It will be apparent from the foregoing that the chambering unit 160 is a unitary assembly of the base wall 62, the inner and the outer partitions 172 and 166 and the spirally sloped floor partition 178 and that this assembly may be easily installed by being seated in place on and fastened to the support ring 36. Since the base wall of this unitary assembly also provides the support for the basket assembly of the machine in the arrangement according to the invention, the basket with its shaft, bearing housing and buffering assemblies can be pre-assembled with the chambering unit so that a unitary assembly of all these components can be hoisted into the curb wall and set and fastened in operating position on the support ring 36 with the liquid outlet openings 190 and 192 aligned. Any resultant imprecision of alignment of the basket shaft with the stub shaft 84 can be overcome by adjustment of

the set position of the driven pulley carrying the stub shaft. The unitary assembly of course is also removable as a unit from the base structure and the curb of the machine in the event of occasion to remove it for repair or maintenance.

A preferred embodiment of the present invention has been illustrated in the drawings and described in detail. It will be apparent that the new features of the invention may be employed in other forms and ways and are not restricted to particulars of the illustrated embodiment except as may be required for fair construction of the appended claims.

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August 7, 1985

Divisional Application of September 3, 1981
divided out from 81 900 473.0 (US8100072)
The Western States Machine Company
Our Ref.: Q 701 M Div. I (Dr.S/bi)

Claims

1. In a continuous centrifugal machine (10) including a rigidly fixed base structure (32,34,100), a bearing housing (16), a normally vertical basket shaft (14) journalled for rotation on bearings in said bearing housing, an upwardly open frusto-conical centrifugal basket (12) secured to the upper end of said shaft for rotation therewith, a stationary curb wall (38) mounted on said base structure and surrounding said basket, means (40) for resiliently mounting said bearing housing to permit gyration of said basket about a point on the axis of said shaft, rotary drive means including a motor (44) mounted to one side of said curb wall and means (50,88,82) connecting said motor with the lower end of said shaft for rotating said basket, the improvement wherein said connecting means comprises:
an upwardly facing radial support ring (36) mounted on said base structure (32,34,100) inside said curb wall (38) and surrounding said housing mounting means (40) and an annular chambering unit (160) supported on said support ring, said chambering unit including a radial annular base wall (62) having a downwardly facing surface (164) seated on said support ring, radially spaced inner and outer annular partitions (166,172) mounted on and extending upwardly from said base

wall and having respective upper ends (168,174) disposed adjacent the lower and upper ends respectively of the said side wall (23) of said basket (12), and a floor partition (178) extending about and radially spanning the space between said annular partitions, said partitions together forming a liquid collecting chamber (26) directly outside and under said basket wall (23) and spaced radially inward from said curb wall (38); and means fixing said bearing housing mounting means (40) to portions of said base wall (62) and radially inside said support ring (36); said bearing housing mounting means (40), said chambering unit (160), said bearing housing (16) and said basket (12) constituting a unitary assembly that as a unit is assembleable onto and removable from said support ring inside said curb wall.

2. A continuous centrifugal machine according to claim 1, said outer partition (166) comprising on an upper portion thereof means (186) coacting with means (188) on the upper end of said basket side wall (23) to direct into said collecting chamber (26) liquid thrown from the upper region of the basket (12), the lower end (176) of said basket wall (23) having means (189) thereon extending over the upper end of said inner partition (172) for directing liquid into said collecting chamber (26), said base wall (62) and said support ring (36) having an opening (190,192) therethrough for conducting liquid from said collecting chamber (26), said floor partition (178) being spaced above said base wall and sloped spirally toward said opening for flowing liquid thereinto.

3. A continuous centrifugal machine according to claim 1, said base wall (62) and said support ring (36) having an opening (190,192) therethrough for conducting liquid from said collecting chamber (26), said base structure (32,34,100) comprising a fixed liquid conducting tunnel (43) extending radially away and downward from said opening, said base structure (32,34,100) further comprising a radial tunnel (41) extending beneath and substantially coincident with said

liquid conducting tunnel (43) and through which said belt means (88) extends between said pulleys.

4. A continuous centrifucal machine according to claim 1, 2 or 3,and means comprising a plurality of bolts (184) extending vertically through and accessible from beneath said support ring (36) for securing said chambering unit (160) in the machine.

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FIG. 1

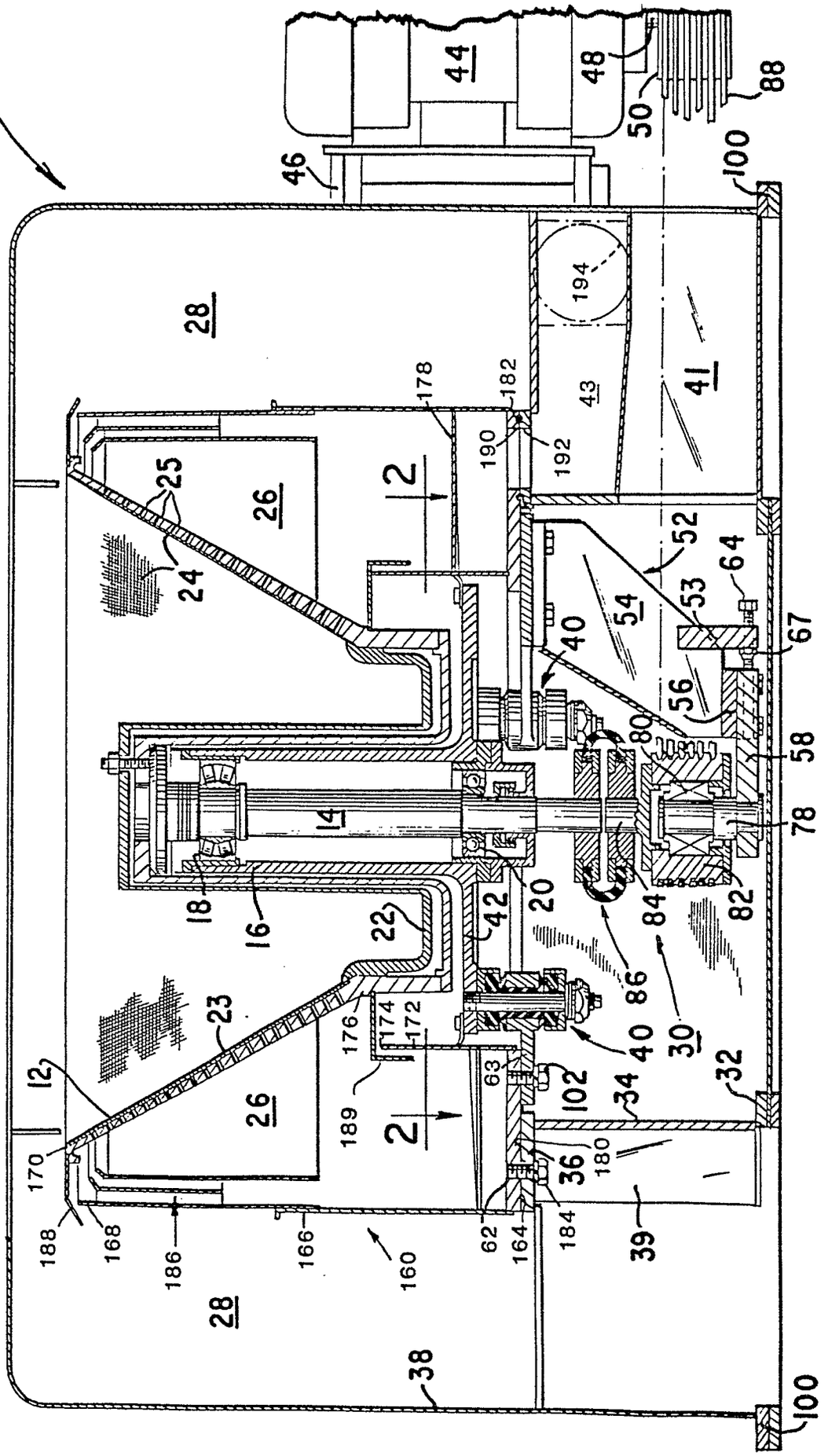

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FIG. 1

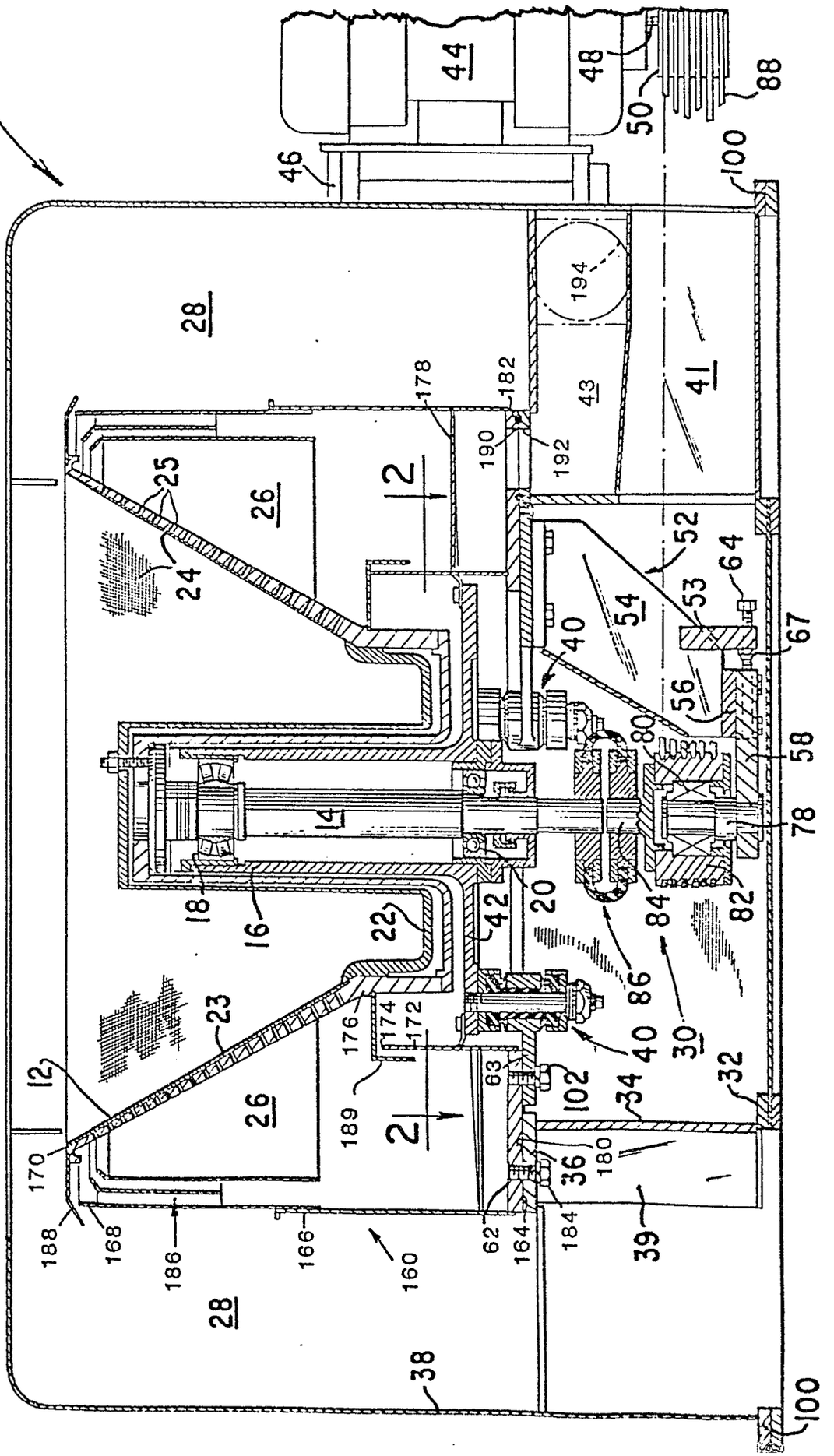

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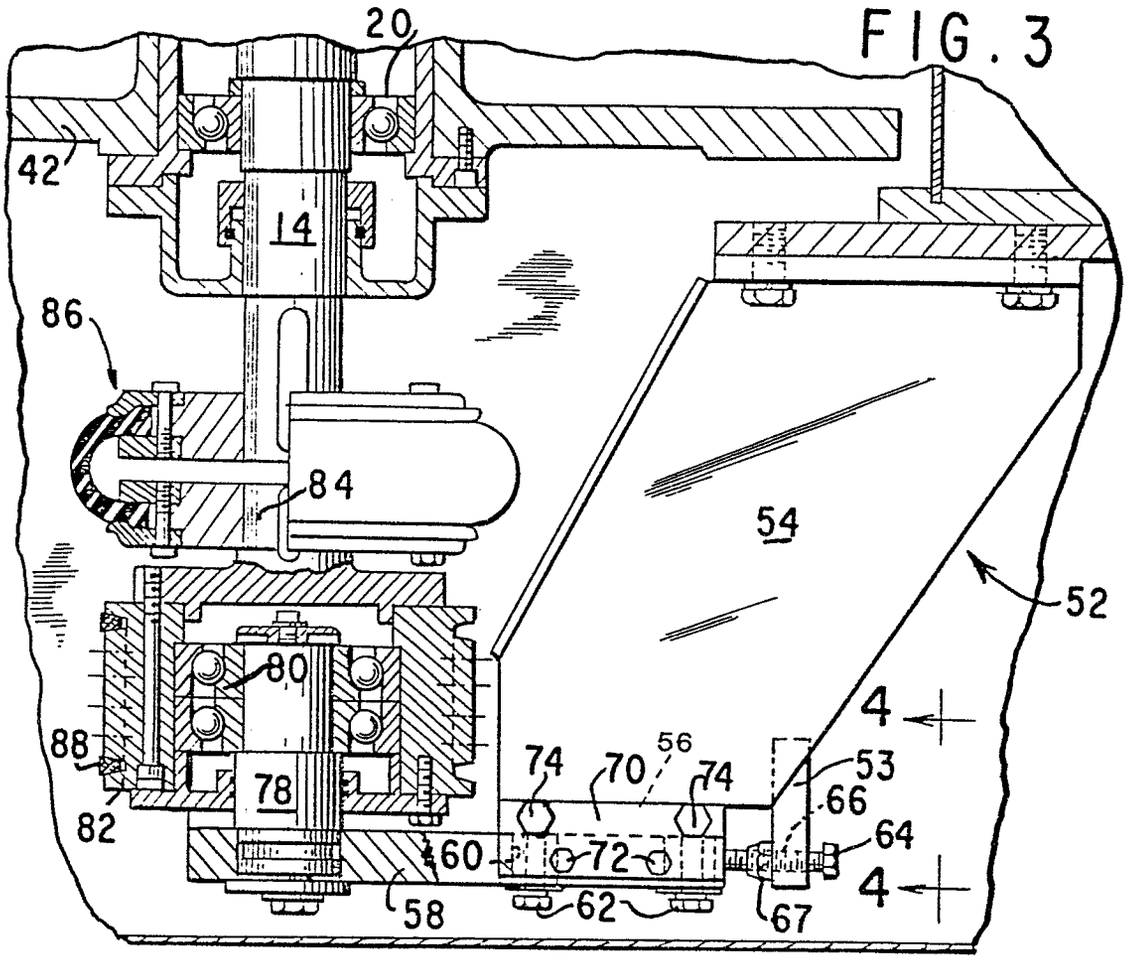
FIG. 3



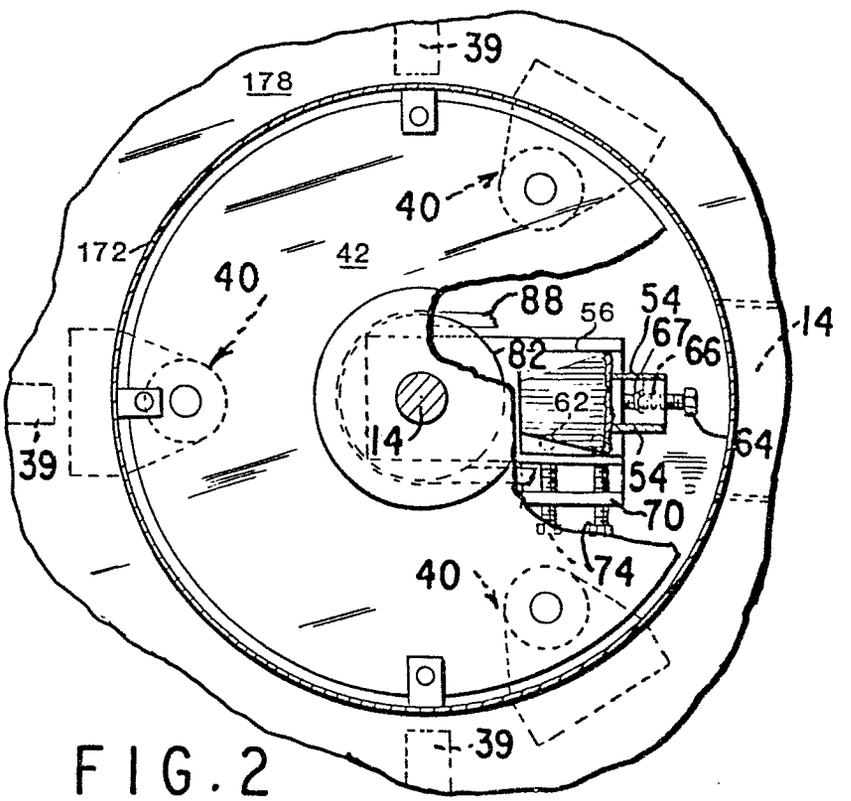


FIG. 2

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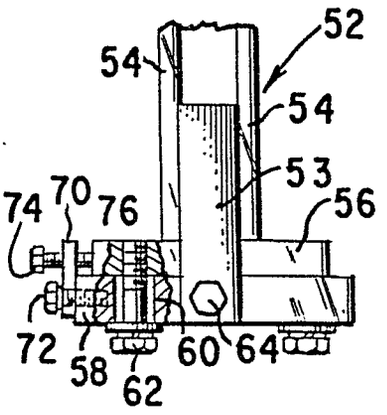
FIG. 4



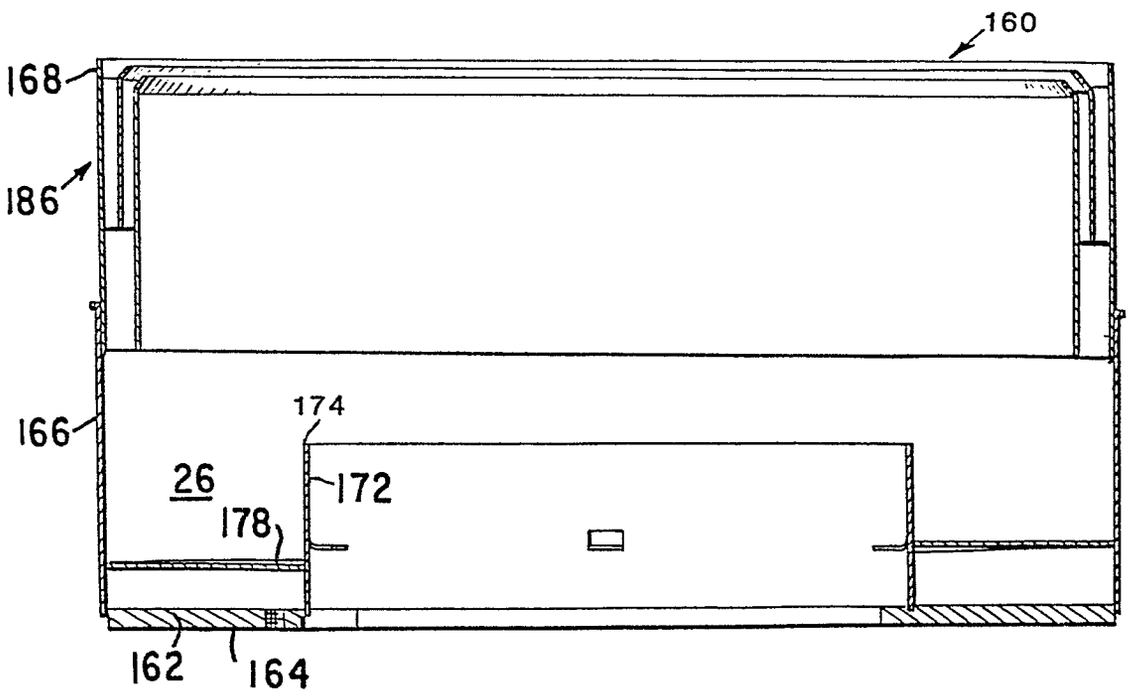


FIG. 5