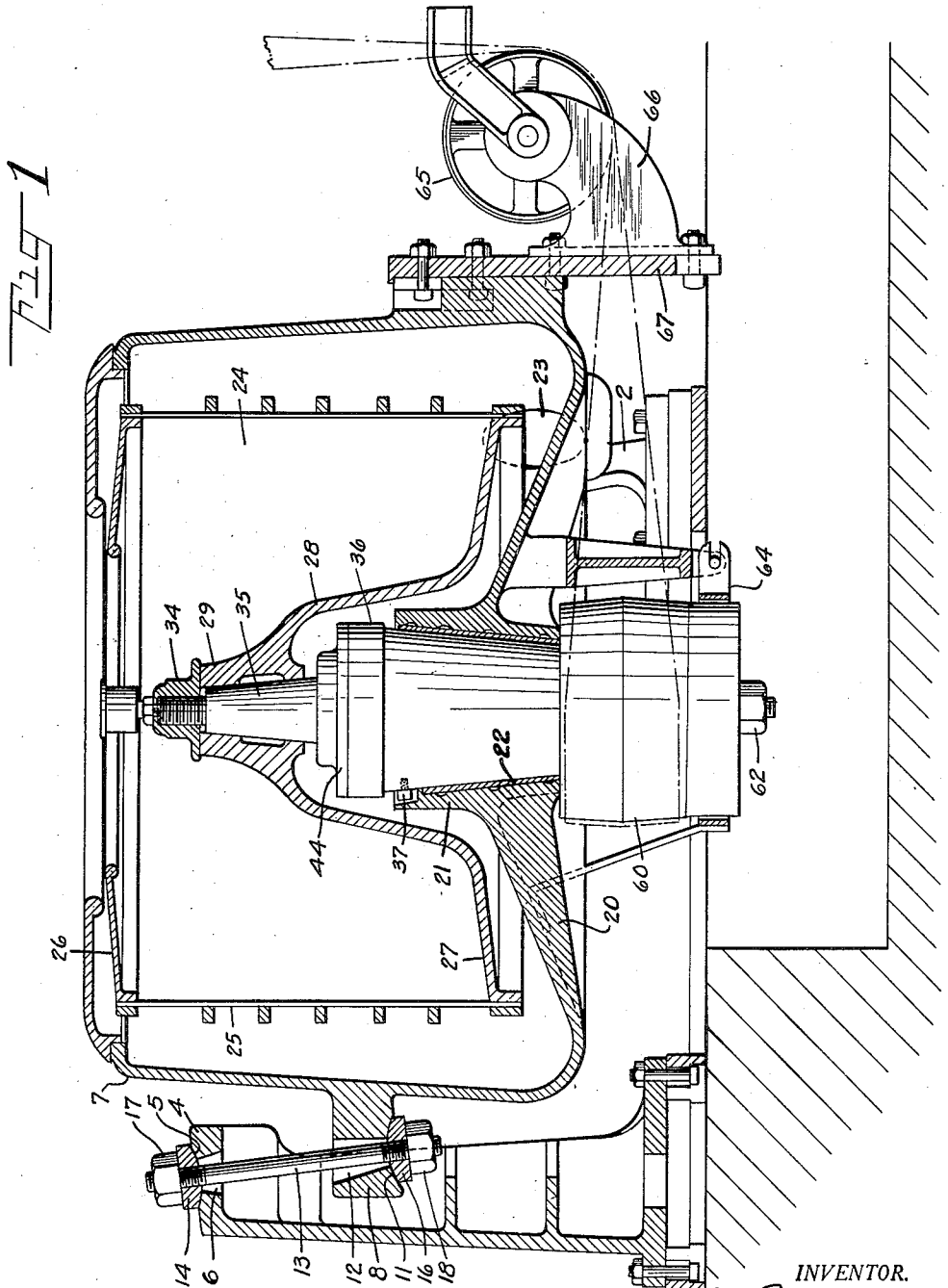
Dec. 30, 1930. T. A. BRYSON 1,786,475

CENTRIFUGAL DRYING MACHINE

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FIG. 1




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Fig 2

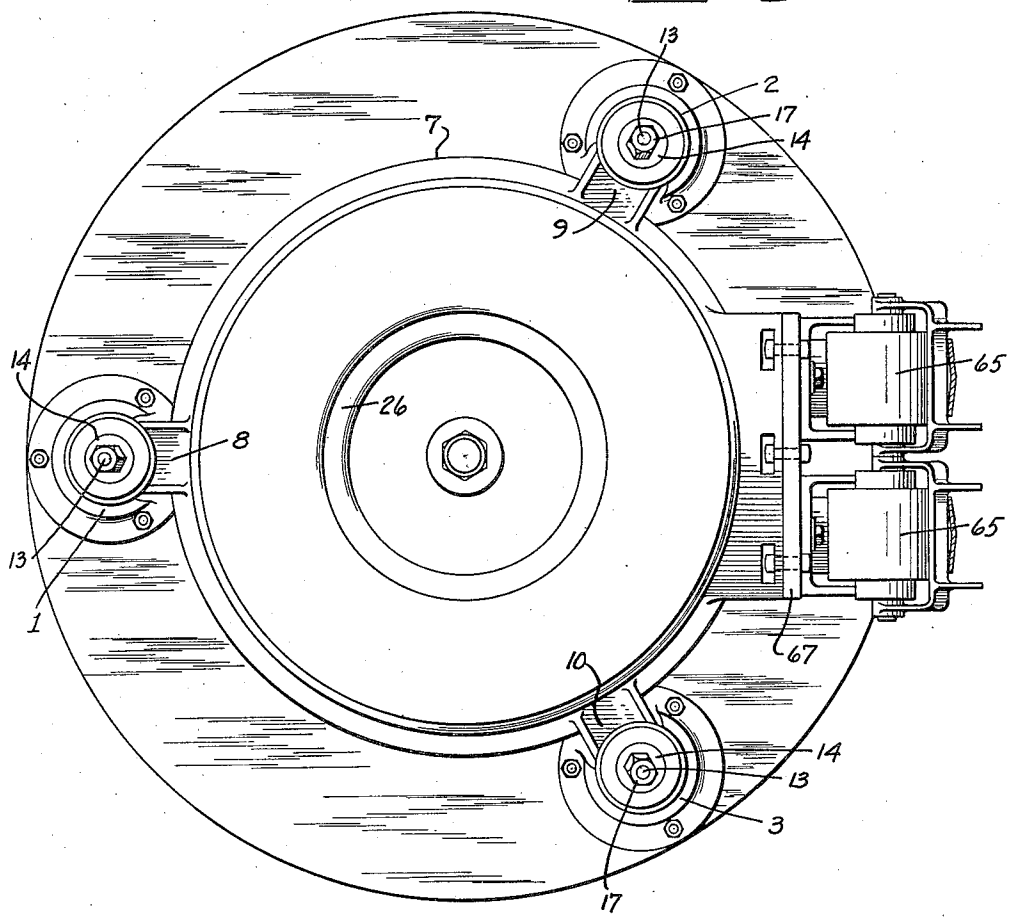
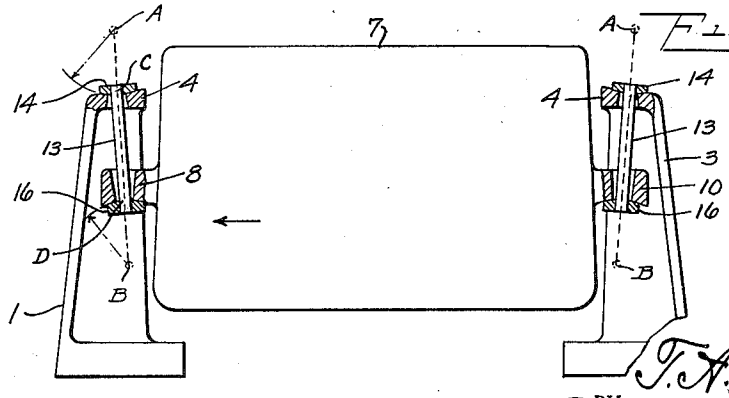



Fig 3




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# UNITED STATES PATENT OFFICE

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## CENTRIFUGAL DRYING MACHINE

Application filed March 19, 1928. Serial No. 262,833.

The invention relates to centrifugal machines, or hydro-extractors, and more particularly to such machines which are mounted to have horizontal equilibrating movement to adjust or compensate for uneven loading.

Objects and advantages of the invention will be set forth in part hereinafter and in part will be obvious herefrom, or may be learned by practice with the invention, the same being realized and attained by means of the instrumentalities and combinations pointed out in the appended claims.

The invention consists in the novel parts, constructions, arrangements, combinations and improvements herein shown and described.

The accompanying drawings, referred to herein and constituting a part hereof, illustrate one embodiment of the invention, and together with the description, serve to explain the principles of the invention.

Of the drawings:

Fig. 1 is a central vertical section of a machine embodying the invention;

Fig. 2 is a plan view of such a machine; and

Fig. 3 is a partially diagrammatic reduced front elevation of a machine embodying the invention, parts being shown in section.

The invention is directed to providing a novel and useful mounting for the basket casing of a centrifugal machine whereby tilting of the casing, due to the disturbing force of an unbalanced load in the rotating basket, is greatly diminished and practically eliminated, while permitting great freedom of gyration of the rotating basket in a horizontal plane.

In the operating of centrifugal machines for throwing off liquids from solids, it is difficult to load the rotating basket so there is not more weight at one point than at another. When the basket is rotated at high speed on a fixed axis, this uneven loading causes a radial force acting on the bearings supporting the axis. In counteracting this unbalanced centrifugal force, it is desirable to provide some sort of flexible mounting for the basket and its load which will permit, in so far as is practicable, a free gyration of the geometric axis of the rotating basket about a new center of balance determined by the force of the unbalanced load.

A common method of approximating the desired flexible mounting comprises mounting the rotatable basket in bearings in a non-rotatable casing and supporting the casing by a plurality of supporting links oscillatably suspended from fixed standards or pedestals arranged symmetrically about the casing, the links being likewise oscillatably connected to symmetrically disposed bearing lugs on the casing. This arrangement permits the casing to swing in the links and allows the axis of rotation of the basket to shift under an unbalanced force.

One great disadvantage of the above-described mounting lies in the fact that ordinarily the lugs on the casing, to which the supporting links are connected, are located near the bottom or lower portion of the casing. Since the disturbing force of the unbalanced load in the basket acts radially in a horizontal plane approximately at the mid-point of the basket, there is an over-turning movement acting on the whole casing, causing it to "dance" or pound in its supports when the unbalanced force reaches a certain value.

This disadvantage has been largely overcome by the structure shown in my Patent No. 1,311,871, wherein the supporting links are shown connected to the casing lugs at the mid-point of the basket. This arrangement practically extinguishes the lever arm of the moment of the unbalanced force turning about the lugs and consequently the overturning moment is insignificant.

However, even with such a suspension, there is a tendency to tilting of the casing. That is, the movement of the casing on the links is not purely horizontal or translational, but there is also a slight rising and falling of the casing as the unbalanced load swings around in the basket. This tilting is undesirable, since it offers considerable restraint to free gyration and, in a high speed rotor, introduces gyroscopic moments tending to pro-

duce pounding on the supports by lifting the rotor.

The tilting effect last referred to results from the use of the link suspension. In its usual form, whether the links be connected to the casing at or below the mid-point of the basket, for reasons of convenience in arrangement, the links are inclined outwardly and upwardly from the lugs to their points of suspension on supporting pedestals which are usually slightly below the level of the casing top, as shown in my Patent No. 1,311,871. This arrangement leaves the upper part of the casing open and easy of access. The links are usually connected to their supporting pedestals and to the casing lugs by horizontally movable ball and socket joints which permit oscillation of the links about their points of suspension, thereby permitting a certain amount of translational movement of the casing as the links swing.

A translational movement of the casing toward any particular link under the influence of the radial force of the unbalanced load, causes the link to swing outwardly about its point of suspension on the pedestal support. Due to the inclination of the link, the outward swinging movement will be on the downwardly inclined arc of a curve whose center is the ball and socket suspension of the lug on the pedestal and whose radius is the link length. Accordingly, the lug of the casing will follow the downward curve of the link end, with a consequent falling or lowering of the adjacent edge of the casing. At the same time, the opposite side of the casing will move inwardly away from its supporting pedestals with a corresponding rise of the casing edge as the adjacent links swing inward on an upwardly inclined curve. Hence, as the unbalanced load swings around within the casing, there is continual rising and falling or tilting of the casing, with the hereinbefore described attendant disadvantages.

It is evident that the sharpness of the tilting action is a direct function of the curvature of the arc through which the links oscillate about their points of suspension. A flatter curve could be obtained by increasing the length of the links to thereby increase the radius of the arc; or by using vertical links, which would likewise eliminate the tilt. However, in the commercial form of centrifugal suspension, neither of these methods is practicable, since long links require longer and heavier pedestals which would project above the top of the casing and counteract the advantages of an open-top machine, as well as making a heavier and more cumbersome installation. On the other hand, it is not always convenient to employ vertical links.

The present invention provides a link suspension embodying all the advantages of short inclined links while eliminating practically entirely the undesirable tilting, by providing a short link having an effective radius of oscillation much greater than the actual link length, whereby the link swings in a relatively flat arc and so maintains the casing in a practically horizontal plane.

In the present preferred embodiment of the invention the ball and socket connections of the suspending links for the basket casing are modified by providing curved seats of comparatively flat curvature in the supporting pedestals and casing lugs, the radii of said curves being preferably of one-fourth or larger proportion of the link length, although it will be understood that the invention is not limited to any particular radius. The links are provided with suitable bearing members, corresponding to the balls of a ball and socket joint, curved to cooperate with the curved seats.

It will be understood that the foregoing general description and the following detailed description as well, are exemplary and explanatory of the invention but are not restrictive thereof.

Referring now in detail to the present preferred embodiment of the invention illustrated by way of example in the accompanying drawing, there are provided, symmetrically arranged about the machine, three standards or pedestals 1, 2 and 3, mounted upon and secured to the floor or some suitable base.

In accordance with the invention, the casing is supported from the standards by freely movable joints having a relatively flat curvature, whereby the sharply curved swinging movement of the supporting members is greatly reduced. As embodied, each of the pedestals has at its top an over-hung head 4 which has an upwardly opening, spherically cupped recess 5, the curve of said recess having a radius preferably of one-fourth or larger proportion of the length of a supporting link (Fig. 3), although it will be understood that the present invention is not limited to any particular radius for the link bearing seats. The head 4 of the standard is also provided with an aperture or hole 6 below the recess 5 and opening downwardly therefrom with an increasing diameter in the downward direction.

Located within the standards 1, 2 and 3 is a casing 7, of general cylindrical form, within which casing is the rotating basket for holding the material to be dried. Upon the outside of the casing 7 are three symmetrically disposed lugs, 8, 9 and 10, the lugs being positioned preferably substantially centrally of the height of the casing. Each of these lugs has upon its bottom side a downwardly opening, spherically cupped recess 11, the curvature of said recess being preferably of the same degree as that of the hereinbefore-described recess 5. The lugs are likewise provided with an aperture or

hole 12 opening upwardly from the recess and increasing in diameter in the upward direction.

In accordance with the invention, the casing 7 and the rotatable basket therewithin are provided with a multi-point, horizontally swinging suspension. As embodied, the over-hung heads 4 of the respective pedestals 1, 2 and 3 and the corresponding lugs 8, 9 and 10 on the casing are connected by links comprising rods 13, passing through the corresponding standard head 4 and the casing lug 8, 9 or 10. Nesting within the curved cup 5 of each head is a segmental bearing member 14 having a curved undersurface 15 cooperating with the curved surface of cup 5. A similarly shaped member 16 nests within the cup 11 of the casing lug. The corresponding rod 13 passes through central apertures in the segmental members 14 and 16 and has suitable fastening means at its ends, preferably nuts 17 and 18, taking on to the threaded ends of the rod 13.

The centrifugal machine of the present invention may be provided with a mounting and bearings similar to those shown and described in my Patent No. 1,311,871, cooperating with the means already described for equilibrating and unbalanced rotating load, and for preventing "dancing" or chattering on the suspending links, heating of the bearings, and thumping or pounding of the basket shaft.

As embodied, the bottom 20 of the casing 7 is upwardly inclined inwardly and has one or more outlets 23. The casing floor terminates in an upwardly extending flanged hub 21. The hub 21 has a central aperture 22 of conical form with the diameter decreasing in a downward direction, the aperture serving as a seat for the housing of the basket shaft.

The basket 24 may be of usual form, having vertical side walls 25, and having at the top an overhanging lip or flange 26. The bottom 27 of the basket is also upwardly inclined inwardly toward its center, and has at its central portion a bell-shaped upward projection 28. The part 28 terminates in a hub 29, which hub is centrally apertured, the aperture decreasing conically upwardly, to form a seating for the basket upon its shaft.

The basket shaft 35 at its upper end is tapered decreasingly upwardly to fit the basket hub 29, the basket being angularly fixed to its shaft in any suitable manner. A cap piece 34, provided preferably with an oil cup, covers the end of the shaft and is fastened to hub 29. Encircling shaft 35 below the basket hub 29 is a housing 36, the housing being outwardly conically formed to seat within the hub 21 of the suspended casing 7, as shown in Fig. 1. The housing 36 is held against rotation relatively to the casing 7 by suitable means, such as a set screw 37 nesting in a recess in the casing hub 21.

The housing 36 may be provided with both radial and horizontal or thrust bearings for the rotating shaft 35, as more fully shown and described in my Patent No. 1,311,871. Briefly described, a radial bearing is provided, preferably substantially on the horizontal level of the points of suspension of the casing 7, while a horizontal thrust or sustaining bearing within the housing for the shaft and basket may be provided below the radial bearing, both said bearings preferably engaging the shaft by means of reduced inwardly projecting shoulder portions on the shaft. A suitable cap 44 encircles shaft 35 and fits over the top of bearing houing 36. The basket 24 and its vertical shaft 35 are thus rotatively supported by the horizontally movable non-rotating casing 7.

Another radial-bearing for the shaft 35 may be provided, at or near the bottom of the housing 36, and preferably at the point of drive for the shaft 35. This bearing may be of any suitable structure, a preferred embodiment being more particularly shown and described in my Patent No. 1,311,871. By having one radial bearing at approximately the center of gravity of the basket and its load, and the other radial bearing in line with the belt pull, the eccentricity of bearing load is reduced to a minimum.

The embodied driving means for the basket shaft comprises a pulley 60 fixed to the end of the shaft 35, just below the lower radial bearing. Pulley 60 is suitably fitted on shaft 35, its hub being angularly fixed to the shaft by a set screw or other means, and being held on the shaft by a nut 62. A pulley brake is shown in part by 64. Pulley 65 is journaled in supporting arms 66, which arms are fixed to a plate 67, supported by the casing 7.

From the foregoing it will be seen that the points of suspension are substantially on the horizontal center line of the basket, and that the radial thrust due to an unbalanced load is taken up on the radial bearing substantially in the horizontal line or level of the points of suspension of the casing and of the center of the basket.

Furthermore, referring particularly to Fig. 3, it will be seen that by providing the case lugs and pedestals with spherical seats of long radii having centers at A and B, the tendency to tilting of the casing is practically entirely eliminated.

Considering the unbalanced force in the rotating basket to be acting at a given moment in the direction of the arrow in Fig. 3, the tendency of the casing is to move to the left and for the link 13 to swing about its center of suspension. In the old form of

link mounting, wherein a ball and socket joint was used, the link 13 would pivot about the center C at or near the pedestal seat. As hereinbefore explained this would cause a downward movement of the lug 8 and its adjacent edge of the casing. However, by removing the centers of the pedestal and lug seats to points A and B respectively, link 13 does not pivot about its actual point of suspension C, but due to the counteracting influences of the flat curved seats at C and D, the action is that of a link whose length is the distance between the two centers A and B. In other words, the effective swinging radius of the link is that of a much longer link having the length AB, and consequently the arc of oscillation of the casing lug 8 is much flatter than if the ball and socket joints had been used. At the same time the lugs 9 and 10 and the opposite edge of the casing are restrained from swinging upwardly by the similar action of the pedestal and lug joints. As a result, the tilting or violent rising and falling of the casing is practically eliminated.

Certain additional advantages result from the provision of the hereinbefore described spherical seats of long radii. Sliding between the bearing surfaces of the joints is greatly promoted since the sliding, taking place at a greater distance from the seat centers A and B results, for a given amount of angular swing of the link, in more motion of the contacting surfaces. This is important in promoting better lubrication since grease or other lubricant is more freely wiped between the bearing surfaces.

A further advantage results from eliminating the tendency of a regular ball and socket joint to become wedged. The force acting between the contacting surfaces is more nearly perpendicular thereto, or in other words, the intensity per square inch of pressure is more nearly equalized over the whole area of contact. It is well known that the practical difficulties in machining a ball and socket to a good fit are very great. If the ball is very slightly over size there is a powerful pinch of the socket upon it, while if the ball is small the entire load is concentrated near the bottom of the socket, with rapid wear and probable cutting. The same degree of accuracy in machining a portion of two spheres of longer radius results in much greater uniformity in load distribution because in using only a small proportion of the whole hemisphere, errors in machining and variations in pressure do not become serious.

The invention in its broader aspects is not limited to the specific mechanisms shown and described but departures may be made therefrom within the scope of the accompanying claims without departing from the principles of the invention and without sacrificing its chief advantages.

What I claim is:

1. A supporting apparatus for the casing of a centrifugal separator including in combination a casing and a plurality of oscillatable supporting members connected to the casing and suspended from above to permit gyratory movement of the casing, said supporting members having radii of oscillation substantially greater than the actual length of the supporting members in order to prevent tilting of the casing.

2. A supporting apparatus for the casing of a centrifugal separator including in combination a casing and a plurality of oscillatable supporting members suspended from above and connected to the casing to provide a multi-point horizontally movable suspension therefor, said supporting members having centers of oscillation above their respective points of suspension.

3. A multi-point horizontally movable suspension for the casing of a centrifugal separator including in combination a plurality of links from which the casing is suspended and supports from which the links are oscillatably suspended, said links being mounted to oscillate in an arc whose radius exceeds the link length.

4. A centrifugal drying machine including in combination a casing, a rotatable basket within the casing, and a plurality of horizontally movable casing supporting devices connected to the casing in a horizontal plane substantially through the middle point of the basket and having effective radii of oscillation substantially greater than the actual length of said supporting devices.

5. In a multi-point flexible suspension for the casing of a centrifugal machine a link connected to the casing and suspended to oscillate in an arc whose radius exceeds the actual link length.

6. In a multi-point flexible suspension for the casing of a centrifugal machine a link connected to the casing and suspended to oscillate about a center a substantial distance above its point of suspension.

7. A multi-point horizontally movable suspension for the casing of a centrifugal separator including in combination a plurality of links connected to the casing, supports from which the links are suspended, a curved bearing seat in each support, and a curved bearing member on each link cooperating with said seat to oscillatably suspend the link, the center of curvature of the bearing surfaces being a substantial distance above the support.

8. A multi-point horizontally movable suspension for the casing of a centrifugal separator including in combination a plurality of links connected to the casing, supports from which the links are suspended, a curved bearing seat in each support, and a curved

bearing member on each link cooperating with said seat to oscillatably suspend the link, the radii of curvature of the bearing surfaces being of approximately one-fourth or greater proportion of the link length.

9. In a multi-point flexible suspension for the casing of a centrifugal machine a link connected to the casing, a support for suspending the link having a curved bearing seat, and a curved bearing member on the link cooperating with said curved seat to oscillatably suspend the link, the link being adapted to oscillate in an arc whose radius exceeds the actual link length.

10. In a multi-point flexible suspension for the casing of a centrifugal machine a link connected to the casing, a support for suspending the link having a curved bearing seat, and a curved bearing member on the link cooperating with said curved seat to oscillatably suspend the link, the center of curvature of the bearing surfaces lying beyond the end of the link.

11. In a multi-point flexible suspension for the casing of a centrifugal machine a link connected to the casing, a support for suspending the link having a curved bearing seat of relatively flat curvature, and a similarly curved bearing member on the link cooperating with said curved seat to oscillatably suspend the link, the link being adapted to oscillate in an arc whose radius exceeds the actual link length.

12. In a multi-point flexible suspension for the casing of a centrifugal machine a link, a support having a curved seat, a curved bearing member on the link cooperating with said seat to suspend the link, a curved seat on the casing, and a second curved bearing member on the link cooperating with the curved seat on the casing to support said casing, the centers of curvature of all the bearing surfaces lying beyond the adjacent ends of the link.

13. In a multi-point flexible suspension for the casing of a centrifugal machine a link, a support having a curved seat, a curved bearing member on the link cooperating with said seat to suspend the link, a curved seat on the casing, and a second curved bearing member on the link cooperating with the curved seat on the casing to support said casing, the radii of curvature of the bearing surfaces being not less than one-fourth of the link length.

14. A multi-point horizontally movable suspension for the casing of a centrifugal separator including in combination a plurality of links connected to the casing, supports from which the links are suspended, an upwardly concave curved bearing seat in each support, and a downwardly convex curved bearing member on each link cooperating with said seat to oscillatably suspend the link, the center of curvature of the bearing surfaces being a substantial distance above the support.

15. In a multi-point flexible suspension for the casing of a centrifugal machine a link, a support having an upwardly concave curved seat, a curved bearing member on the link cooperating with said seat to suspend the link, a downwardly concave curved seat on the casing, and a second curved bearing member on the link cooperating with the curved seat on the casing to support said casing, the centers of curvature of all the bearing surfaces lying beyond the adjacent ends of the link.

16. In a multi-point flexible suspension for the casing of a centrifugal machine a link connected to the casing and oscillatably suspended from a support, the connection between the link and support comprising a curved, freely moving joint having relatively flat bearing surfaces less than a hemisphere in extent.

17. In a multi-point flexible suspension for the casing of a centrifugal machine a link connected to the casing and oscillatably suspended from a support, the connections between link and support and link and casing comprising curved freely movable joints having relatively flat bearing surfaces less than a hemisphere in extent.

18. In a multi-point flexible suspension for the casing of a centrifugal machine a link connected to the casing and oscillatably suspended from a support, the connections between link and support and link and casing comprising curved, freely movable joints having centers of curvature lying beyond the corresponding ends of the links whereby the effective length of the link is the distance between said centers.

19. A supporting apparatus for the casing of a centrifugal separator including in combination a casing and a plurality of oscillatable supporting members connected to the casing to permit gyratory movement of the casing, said supporting members having radii of oscillation substantially greater than the actual length of the supporting members in order to prevent tilting of the casing.

20. A centrifugal machine including in combination a casing, a rotatable basket therewithin and means for supporting the basket including a plurality of downwardly and inwardly inclined links supporting the basket and suspended to oscillate in an arc whose radius exceeds the actual length of the link.

In testimony whereof, I have signed my name to this specification.

TANDY A. BRYSON.