Oct. 31, 1933. T. A. BRYSON 1,933,310

APERIODIC MOUNTING FOR CENTRIFUGAL EXTRACTORS

Filed Dec. 12, 1929 2 Sheets-Sheet 1

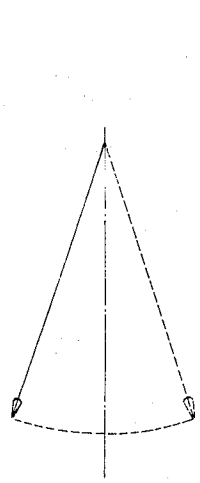


FIG. 2

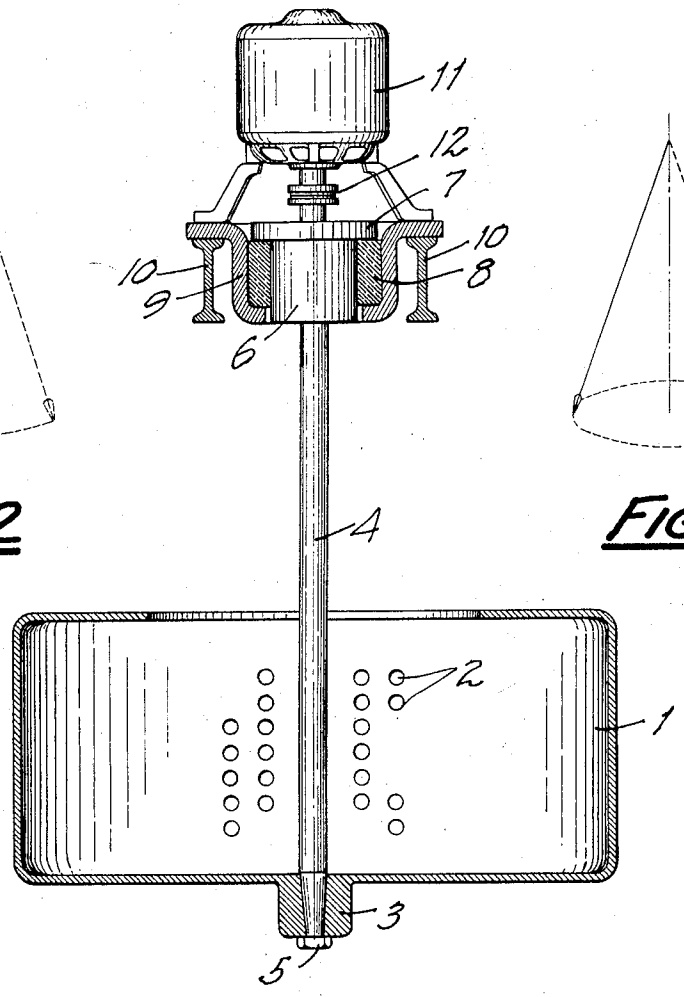


FIG. 1

FIG. 3

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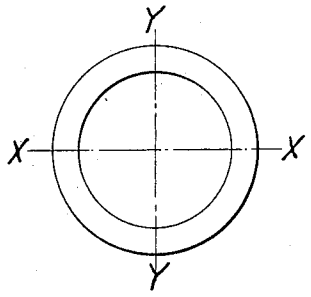


FIG. 4

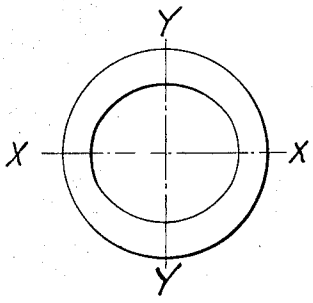


FIG. 6

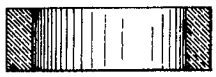


FIG. 5



FIG. 7

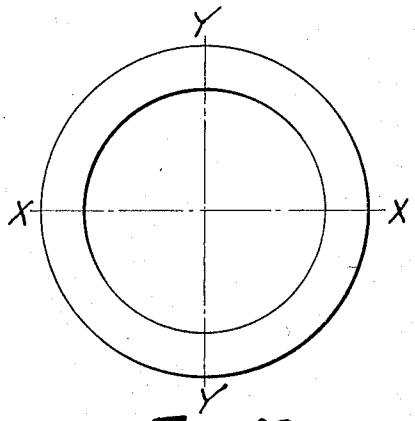


FIG. 10

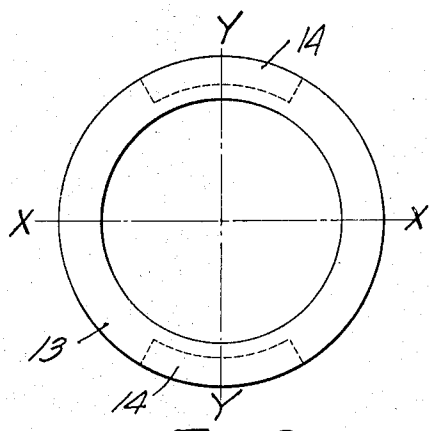


FIG. 8

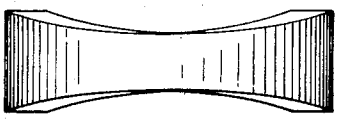


FIG. 11

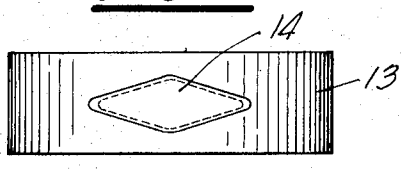


FIG. 9

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Patented Oct. 31, 1933 1,933,310

UNITED STATES PATENT OFFICE

1,933,310

APERIODIC MOUNTING FOR CENTRIFUGAL EXTRACTORS

Tandy A. Bryson, Troy, N. Y., assignor to Tolhurst Machine Works, Inc., New York, N. Y., a corporation of Delaware

Application December 12, 1929
Serial No. 413,548

21 Claims. (Cl. 308—143)

My invention relates to centrifugal extractors and particularly to a means for substantially reducing or entirely eliminating gyroscopic sail or precession in a device of this character, and to a means for attaining this desirable end without undue resistance to "whip" oscillation.

My invention includes the novel elements and the combinations and arrangements thereof described below, and the invention itself together with the objects and advantages thereof will be understood from a reading of the description and reference to the accompanying drawings, in which—

Fig. 1 is a fragmentary elevation view partially in section, of a centrifugal separator;

Figs. 2 and 3 are diagrammatic representations of a pendulum;

Figs. 4 and 5 are a plan and section view, respectively, of the present type of cushion for supporting the spindle bearing;

Figs. 6 and 7 are a plan and section view, respectively, of one type of my improved cushion;

Figs. 8 and 9 are a plan and side view, respectively, of my preferred type of cushion; and

Figs. 10 and 11 are a plan and side view, respectively, of a modified type of my cushion.

Referring particularly to Fig. 1, 1 represents the basket having the usual perforations, 2, in the sides thereof, only a few of which are shown. The bottom of the basket is provided with a hub, 3, which fits the tapered end of the spindle, 4, and is secured thereon by the nut, 5. The spindle is supported in the bearing box, 6, which is provided at the top with a flange, 7, resting upon an annular cushion of resilient material, 8. This cushion rests in frame, 9, which is stationary and supported by I beams, 10, or otherwise. The spindle, 4, may extend through the bearing box, as shown, and in any event is connected to the driving motor, 11, through a flexible coupling, 12. The bearing is preferably and usually a considerable distance from the basket and it will be quite clear that the resilient bearing support, 8, will, by allowing the spindle to oscillate or sway, permit the basket to spin about an axis through its center of mass.

In operation of centrifugal separators it is generally impossible to so place the load in the basket that the center of mass will lie upon the spindle axis. Consequently in accordance with the principle of dynamics that a rotating body, free from external forces, will spin about an axis extending through its center of mass, it is usual to provide a flexible mounting for the spindle to the end that external forces tending to prevent the mass from spinning about that axis will be reduced to the extent to which the spindle is free to move.

It is therefore desirable, for the purpose of reducing to the minimum these reactive forces on spindle and bearings, to employ a bearing support of maximum flexibility and one which will impose the minimum restraint upon the "whipping" motion of the spindle which occurs when rotation takes place on an axis not coincident with its geometric axis.

Another characteristic of rotating bodies, now to be described, has heretofore required for its control, a considerable restriction in the flexibility of mounting and, therefore, it has been impossible for the designer to eliminate from bearings and spindle these undesirable reactive stresses.

The spindle and basket form a conical pendulum identical with the simple pendulum shown in Figs. 2 and 3 with the exception that the former is spinning on its axis. Although the spindle bearing, 6, is placed as far as practicable from the center of mass of the basket, it is clear that any accidental sway of the axis of rotation causes an angular movement of the spindle. When the spindle is slightly deflected it will tend to move back to its normal position, but by reason of the fact that it is spinning rapidly, and in accordance with the gyroscopic principle, it will actually move at right angles to the restoring force supplied by the resilient element, 8, and, instead of returning directly to its normal position, the spin axis will describe a cone about this position. Since this gyroscopic motion produces an angular change of position of the spin axis, the gyroscopic torque is increased and the amplitude of "sail" or precession increases until the machine is wrecked; or until the wide "sail" causes so much energy to be absorbed in friction of the mounting parts that sway energy is dissipated as fast as it is built up.

Heretofore, attempts have been made to control this gyroscopic sweep or precession by employing for the resilient member, 8, a material of less flexibility than would otherwise be desirable, a material having high internal friction wherein the energy generated is destroyed, or by using, in conjunction with a resilient member, friction elements for the purpose of dissipating this energy. The latter construction, although a substantial advance in the art of mountings, is not a complete solution of the problem since the amount of friction which can be employed is limited by the resistance which may be imposed

to "whip" oscillation, previously described. Any friction obviously reduces the flexibility and resiliency of the mounting, and from this standpoint is an undesirable factor. Moreover, the friction members develop heat near the bearing housing, which is a distinct disadvantage and, when loading a machine at speed, a sudden heavy charge may cause a sway of such initial amplitude that any damping effect of the friction elements is entirely overcome.

The present invention is based on the fact that the frequency of the gyroscopic sail is equal, or closely related to, the frequency of the oscillating parts of the machine considered as a conical pendulum. If the spindle of the machine shown in Fig. 1 is deflected and released, assuming the basket is not rotating, it will oscillate at a certain frequency irrespective, within limits, of the amplitude of oscillation which, of course, will decrease at a rate dependent upon the rate at which the energy developed by the original impulse is dissipated by friction. Under suitable conditions, instead of oscillating in a plane, as shown in Fig. 2, it will swing in a circle, as shown in Fig. 3. For any given machine, this frequency will vary with the stiffness of the mounting.

Where the annular cushion, 8, of resilient material, is of the form and character shown in Figs. 4 and 5, that is, where the meridian or radial sections are identical in all respects, its stiffness is uniform in all meridian planes, and it will permit the machine to swing like a conical pendulum. In such a case, all conditions are satisfactory for cumulative gyroscopic sail or precession.

On the other hand, if the meridian or radial sections of the cushion, 8, are not uniform either in size or character or both, so that, considering the machine as a simple pendulum (Fig. 2) the resistance which the cushion offers to oscillation in one meridian plane differs from the resistance which it offers to oscillation in one or more of the other meridian planes, the machine will have different sail frequencies in these different planes.

Figs. 6 and 7, 8 and 9, and 10 and 11 are plan and section views of annular cushions having meridian sections, X—X and Y—Y, possessing different characteristics. In Figs. 8 and 9, the different characteristics are obtained by placing, in an ordinary rubber buffer, 13, inserts, 14, of non-resilient material or material having resilient characteristics differing from that of the material in buffer, 13, such as wood or metal. Instead of using different material in different sections of the cushion it is possible to form the buffer so that section X—X will differ in size or shape from section Y—Y, as illustrated in Figs. 6, and 7, 10 and 11. In the latter case appropriate modifications in the form of bearing, 6, and frame, 9, would be made so that the various elements would fit properly together. Other means of fabricating or forming the cushion, 8, to obtain meridian sections differing from each other in resiliency or stiffness might be mentioned, but the above are deemed sufficiently illustrative of my invention which is to be understood as comprehending, in its broader aspects a bearing mounting providing a different degree of restraint to vibration in one plane through the spindle axis than it does in another.

Since the gyroscopic effect promotes conical pendulum action at conical pendulum frequency it is obvious that with any of the cushions illustrated in Figs. 6, 7, 8, 9, 10 and 11 the natural period of sail changes four times during one sail cycle. The effect of this is to break up entirely the tendency to sail at any frequency whatever since the inertia of the loaded basket is too great to be quickly accelerated or decelerated within the period of a single sail cycle.

While I have described my invention in its preferred embodiment it is to be understood that the words which I have used are words of description rather than of limitation and that the drawings are merely illustrative. Hence changes, within the purview of the appended claims, may be made without departing from the true scope and spirit of my invention.

What I claim is—

1. In a device of the character described, the combination with a spindle, of a bearing therefor, and a resilient mounting for said bearing characterized by the fact that different portions of said bearing mounting differ substantially in resilience.

2. In a device of the character described, the combination with a spindle, of a resilient support therefor characterized by the fact that the resiliency of said support varies when measured in different planes through the spindle axis.

3. In a device of the character described, the combination with a spindle, of a flexible mounting therefor including a resilient seat for said mounting characterized by different degrees of resiliency in different planes through the spindle axis.

4. In a device of the character described, the combination with a spindle, and a bearing for said spindle, of a seat for said bearing comprising an annulus of resilient material; the resistance to distortion of said annulus being greater in some sections than in others.

5. A bearing mounting for an oscillating spindle of a centrifugal separator comprising an annulus of resilient material having inserts of substantially non-resilient material therein.

6. A bearing mounting for the spindle of a centrifugal machine comprising an annulus of resilient rubber having inserts of comparatively non-resilient and non-compressible material therein.

7. A bearing mounting for the spindle of a centrifugal machine comprising an annulus of resilient rubber having oppositely disposed inserts of comparatively non-resilient and non-compressible material therein; whereby the resilient characteristics of those meridian sections of the unit which include the inserts differ from the characteristics of those sections which do not include the inserts.

8. In a device of the character described, a spindle, a bearing for said spindle, and a flexible mounting for said bearing having different degrees of flexibility around the same whereby said mounting offers different degrees of restraint to angular oscillation of said spindle in different planes through the axis thereof.

9. A bearing mounting for a spindle of a centrifugal separator comprising an annulus of resilient material, said annulus being more resilient in some portions than in others.

10. In a device of the character described, a spindle, a mass mounted thereon, a bearing for said spindle and a flexible mounting for said bearing, the same being less flexible in certain portions than in others whereby said mounting offers different degrees of restraint to angular oscillation of said spindle in different planes passing through the axis thereof.

11. A bearing mounting for an oscillating

spindle of a centrifugal separator comprising an annulus of resilient material wider at one portion than at another.

12. A bearing mounting for an oscillating spindle of a centrifugal separator comprising an annulus of resilient material thicker at one portion than at another.

13. In a device of the character described, the combination with a spindle, of a bearing therefor, and a mounting supporting the spindle and bearing and including yielding means for restoring the shaft to its normal position with forces of different magnitudes in different positions of the shaft when out of its normal position.

14. In a device of the character described, the combination with a spindle, of a bearing therefor, and a mounting supporting the spindle and bearing and including a resilient annulus compressed by the spindle, said annulus having distinctly different resiliencies in different diametral planes.

15. In a device of the character described, the combination with a spindle, of a bearing therefor, and a mounting supporting the spindle and bearing and including an annular member formed of resilient material and means for varying the resiliency of said annulus in certain axial planes.

16. In a device of the character described, the combination with a spindle, of a bearing therefor, and a mounting supporting the spindle and bearing and including an annular resilient member compressed by the weight of the spindle and its load, said member having a circumferentially varying resiliency whereby dangerous sway of the spindle is avoided.

17. In a device of the character described, the combination with a spindle, of a bearing therefor, and a mounting supporting the spindle and bearing and including a rubber annulus supporting said spindle and its load, said annulus having a non-resilient insert to vary its resiliency in a certain part.

18. A member for use in a suspended centrifugal machine including a resilient annulus, the resiliency of which is distinctly different in certain parts of its circumference from its resiliency in other parts.

19. A member for use in a centrifugal machine mounting including an annulus formed of resilient material and provided with circumferentially spaced inserts having a different resiliency.

20. A member for use in a centrifugal machine mounting including an annulus formed of rubber and provided with circumferentially spaced non-resilient portions.

21. A member for use in a centrifugal machine mounting including an annulus formed of rubber and provided with circumferentially spaced non-resilient portions embedded in the rubber.

TANDY A. BRYSON.