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3,049,860

BEARING ASSEMBLY FOR TEXTILE MACHINERY SPINDLES

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3 Sheets-Sheet 1

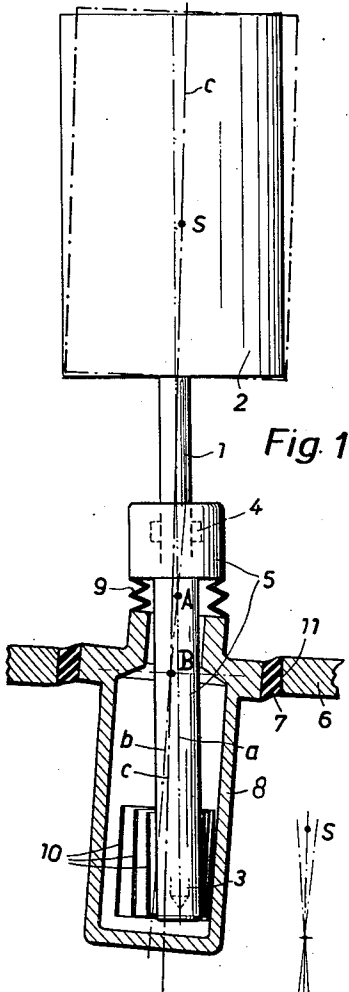


Fig. 2

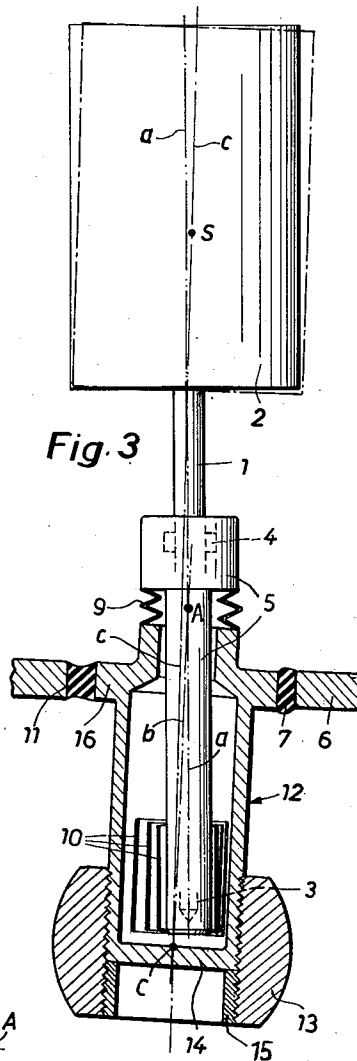
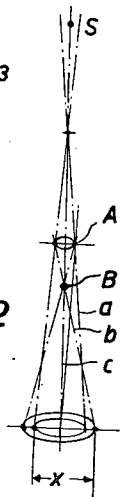


Fig. 4



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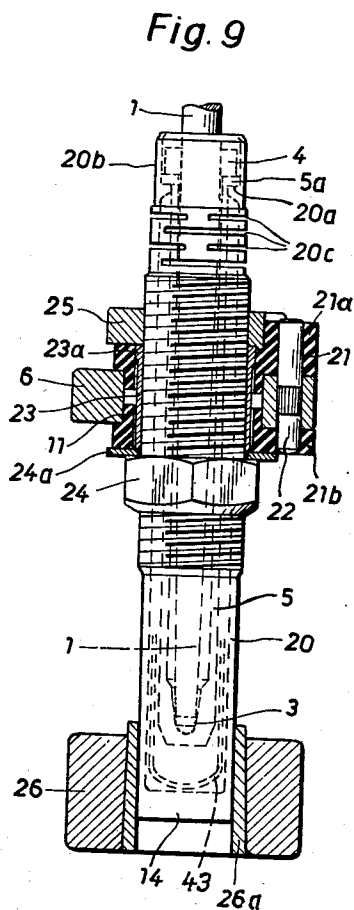
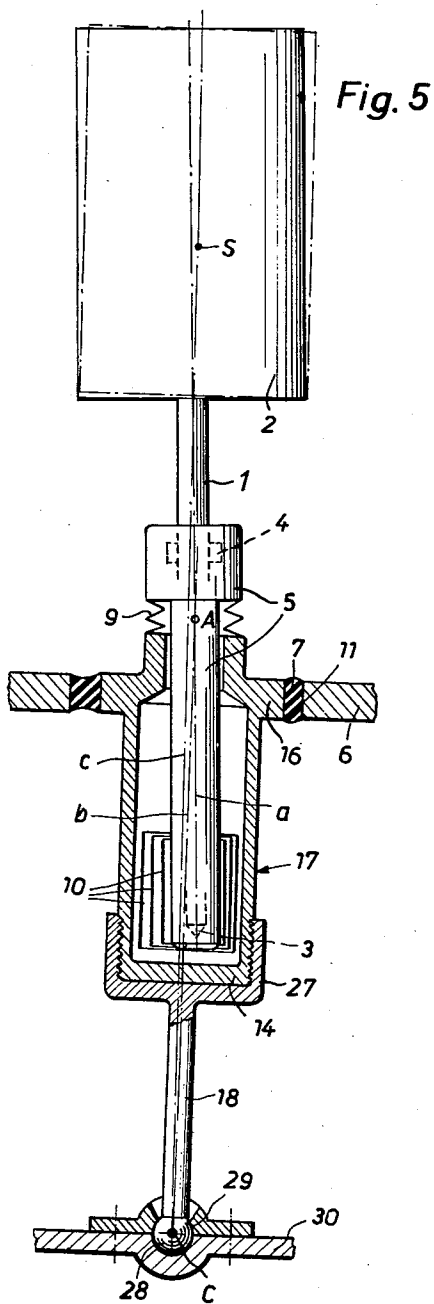
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BEARING ASSEMBLY FOR TEXTILE MACHINERY SPINDLES

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3 Sheets-Sheet 2



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3 Sheets-Sheet 3

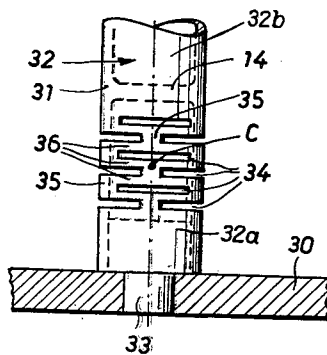


Fig. 6

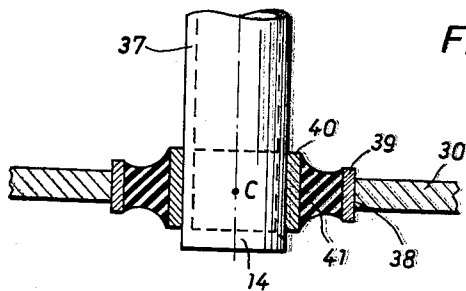


Fig. 7

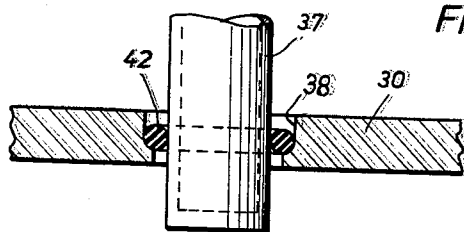


Fig. 8

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1

3,049,860

BEARING ASSEMBLY FOR TEXTILE MACHINERY SPINDLES

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The present invention relates to a bearing assembly for textile machinery spindles, in which a bearing sleeve adapted to receive the spindle shaft is supported in a casing which in turn is retained in a spindle frame in such manner as to be capable of pendular and transverse movements with reference thereto, that portion of the bearing sleeve which is to receive the spindle shaft being yieldingly connected to that portion of the casing which is retained in the spindle frame in such manner that the axis of the bearing sleeve is allowed to effect pendular movements, and rotary movements along conical surfaces, with reference to the axis of the casing.

FIG. 1 of the drawing schematically represents a known spindle bearing assembly of the kind outlined above, and

FIG. 2 schematically represents the paths of the bearing sleeve axis and of the casing axis of the bearing assembly shown in FIG. 1 for certain operating conditions, the angular elongations of these axes being exaggerated for the sake of clarity.

The essential known features of such bearing assemblies will now be described with reference to these two figures, whereupon the objects and features of the invention will be explained.

In FIG. 1, the reference numeral 1 indicates the shaft of a textile machine spindle. This shaft carries a yarn package 2 the size and mass distribution of which are subject to variation in the course of the operation of the spindle, and it is rotatably supported in a bearing sleeve 5 by means of an end bearing 3 and a collar bearing 4. The bearing sleeve 5 is supported in a casing 8 which is retained in a spindle frame 6 by means of a resilient member 7 so as to be capable both of swinging and of transverse movement. For this purpose, at least that portion of the bearing sleeve 5 which contains the bearings 3 and 4 is yieldingly connected to at least that part of the casing 8 which is retained in the spindle frame 6 in such a manner that the common axis *a* of the two bearings 3 and 4 (which hereinafter will be termed the axis of the bearing sleeve 5) is enabled to effect swinging movements and rotary movements along conical surfaces with reference to the axis *b* of the portion of the casing 8 which is retained in the spindle frame (which hereinafter will be termed the axis of the casing 8).

This yielding connection between the said portions of the bearing sleeve and of the housing is symbolically indicated by springs 9 in FIG. 1. It may comprise a resilient other portion of either or both the casing 8 and the bearing sleeve 5, or a flexible intermediate member (such as an annulus of U-shaped cross-section) or a ball-and-socket joint, or the like. Moreover, means may be provided for damping the relative movement of these portions of the bearing sleeve and casing, for instance tubular pieces 10 loosely placed within each other

2

in the oil-filled interval between the bearing sleeve and casing.

The resilient member 7 may be, for example, an annular insert made from rubber which has been forced between the wall of an opening 11 in the spindle frame 6 and the casing 8, and connected to these parts by vulcanization.

Such a supporting arrangement permits the spindle shaft 1 not only to rotate about its own geometrical axis which coincides with the axis *a* of the bearing sleeve 5 but also to revolve in such a manner along a conical or cylindrical surface that the axis of gravity of the elements rotating with it, such as the yarn package 2, drive members (not shown), etc. becomes displaced into the stationary longitudinal axis *c* of the bearing assembly and remains immovable. That portion of the bearing sleeve 5 in which the spindle shaft 1 is rotatably supported in the bearings 3 and 4 is associated in that revolving motion of the spindle shaft which permits the spindle to run quietly and steadily.

Since the axis *b* of the casing 8 intersects the axis *a* of the bearing sleeve 5 at a point A in the zone of yielding connection of the bearing sleeve 5 with the casing 8, that point A must describe a circle as the aforesaid portion of the bearing sleeve 5 effects its said revolving movement. Therefore the axis *b* of the casing 8 also effects a revolving movement along a conical surface; the apex of that conical surface is a fixed point B, at which the axis *b* of the casing intersects the axis *c* of the bearing assembly.

In known spindle bearing arrangements of this kind, the element 7 by which the casing 8 is retained in the opening 11 of the spindle frame 6, is only little deformable by transverse movements of the casing 8, the mass of that casing is relatively small, its center of gravity is approximately at the level of the middle plane of the spindle frame 6, and the part of the casing which is below the spindle frame is not held anywhere. As a result, the apex B of the cone along which the axis *b* of the casing 8 revolves, is approximately at the level of the spindle frame 6, as shown in FIG. 1. The distance between the revolving point of intersection A of the two axes *a* and *b* and the point or apex B is limited, so that for a given motion of the axis *a*, and therefore of the point A, with respect to the fixed longitudinal axis *c*, which motion is prescribed by the requirement for steady running of the spindle, the axis *b* of the casing must assume a relatively large inclination with reference to the longitudinal axis *c*. As shown by FIGS. 1 and 2, the axes *a* and *b* will be inclined in opposite directions when the axis *a* is imparted a revolving movement along a cone. The point of the bearing sleeve axis *a* which is at the level of the lower end of the bearing sleeve 5 then has a certain elongation, designated *x* in FIG. 2, from the point situated at the same level on the casing axis *b*, which elongation becomes great already for small deviations of the axis *a* from the fixed axis *c*. As soon as this elongation reaches a certain amount, the lower end of the bearing sleeve 5 forces the tubular pieces 10 against the inside of the wall of the casing 8, whereby the free movement of the bearing sleeve 5 and of the spindle shaft 1 is impaired and self-adjustment of the latter in the manner required for steady running is prevented.

It is one of the objects of the present invention to obviate this drawback.

To achieve this object, the textile machine spindle bearing assembly according to this invention comprises means for exerting onto the said portion of the casing which is retained in the spindle frame, on that side of the spindle frame which is remote from its said yielding connection with the bearing sleeve, forces which will oppose transverse movement of the casing at their point of attack.

Further objects and advantages of the invention will become apparent from the description now to follow, of some embodiments of the invention shown in the accompanying drawings, it being understood that these embodiments are given by way of example only.

FIG. 3 shows a first embodiment of the spindle bearing assembly according to the invention, in a similar schematic representation as the known bearing assembly shown in FIG. 1;

FIG. 4 is a schematical representation of the paths of the bearing sleeve and casing axes of the spindle bearing assembly shown in FIG. 3, this representation being analogous to that of FIG. 2;

FIG. 5 shows another embodiment of the invention, again in a similar representation as in FIG. 1;

FIGS. 6, 7 and 8 are details each of one further embodiment of the invention; and

FIG. 9 represents, partly in longitudinal section, still another embodiment of the invention.

The spindle bearing assembly according to the invention shown in FIG. 3 differs from the above described known spindle bearing assembly shown in FIG. 1, in that an annular additional weight 13, which is threaded internally, is screwed below the spindle frame 6 onto the casing here designated by 12; it is secured in position on the casing 12 by means of an externally threaded arresting nut 15 which is screwed up against the bottom 14 of the casing. The mass of that additional weight is several times that of the outer wall and bottom of the casing 12, so that it may roughly be assumed that the whole mass associated with the casing 12 is concentrated at the point C, approximately at the level of the casing bottom 14. Moreover, that total mass in the assembly according to FIG. 3 is several times that of the casing 8 in the assembly according to FIG. 1, although the dimensions of the casing are the same.

It will now be assumed that the size and distribution of the masses of the parts which rotate together with the spindle shaft 1, viz., the yarn package 2, the driving members (not shown), etc., are such in the example of FIG. 3 that the axis *a* of the spindle shaft 1 and of the bearing sleeve 5 revolves along a similar cone as in the example of FIGS. 1 and 2. This would be so if firstly the size and distribution of the said rotating masses were the same in both instances, and if moreover the forces acting between the casing 8 or 12, respectively, and the bearing sleeve 5, and the forces acting between the spindle frame 6 and the casing, differed only to a negligible extent. However, as will be shown later on, these conditions are not fulfilled simultaneously.

Under that assumption, the point of intersection A of the axes *a* of the bearing sleeve 5 and *b* of the casing 8 or 12, respectively, describes a circle the radius of which in the instance of FIGS. 3 and 4 is equal to that in the instance of FIGS. 1 and 2. However, since according to FIG. 3 the total mass associated with the casing 12 and which has been assumed to be concentrated at the point C tends to remain at that point due to its inertia, this mass at each movement of the casing 12 is acted upon by inertia forces the resultant of which, being effective at the point C, opposes any transverse movement of the casing at that point C. This point C thus forms the apex of the cone along which the axis *b* of the casing 12 revolves. As a result, the distance between that apex C of the cone of revolution of the axis *b* and the point A is much greater, and therefore the angle between the axis *b* and the fixed axis *c* is much smaller with the arrangement of FIG. 3, than with the

known arrangement according to FIG. 1. Therefore, the distance *y* between the point situated on the axis *a* at the level of the lower end of the bearing sleeve 5 and the point situated at the same level on the axis *b* of the casing 12 is much smaller than according to FIGS. 1 and 2, although the deflection of the bearing sleeve axis *a* with reference to the fixed axis *c* has been assumed to be the same in both case. With the arrangement of FIG. 3, greater deflections of the spindle shaft 1 and of the bearing sleeve 5 are possible than with that of FIG. 1 without the tubular pieces 10 becoming forced into contact with the inside of the casing wall.

While in the arrangement of FIG. 1, the casing 8 suffers no substantial transverse displacement at the level of the spindle frame 6 but only swings about the fixed point B, the revolving motion of the axis *b* of the casing 12 along the said conical surface in the example of FIGS. 3 and 4 calls for a corresponding circular displacement of the casing flange 16 within the spindle frame opening 11, with corresponding local compression and dilatation of the resilient ring 7 in radial directions. This as well as the smaller movements effected at the level of the yielding connection 9 by the portion of the bearing sleeve 5 which contains the bearings 3 and 4 with reference to the portion of the casing 12 which is held within the spindle frame, and also the modified damping of the motion of the lower bearing sleeve end in the casing 12, result in a modification of the forces effective between the spindle frame 6, casing 12 and bearing sleeve 5, as compared with the forces effective under similar conditions in the known assembly according to FIG. 1. In particular, the yielding connection at 9 is spared, while the resilient member 7 is put to heavier contribution for receiving and damping the spindle motion and an improved damping of the motion of the lower end of the bearing sleeve 5 is achieved especially when the yarn package 2 is strongly out of balance.

It is desirable to be able to adapt the size and position of the addition weight 13 to the particular operating conditions such as the weight and the moment of inertia of the yarn package 2, the stiffness of the yielding elements 7 and 9, the speed of the spindle shaft 1, etc., in particular in order to avoid a critical speed of rotation to coincide with the normal operating speed. This requirement can be met by adjusting the position of the additional weight 13 on the outer screw thread of the casing 12, and by replacing the additional weight 13 with one of different dimensions.

The embodiment shown in FIG. 5 differs from that according to FIG. 3 in that a tail 18 is screwed onto the lower end of the casing, here designated by 17, which tail is provided with an integral screw cap 27 at its upper end and with a ball head 28 at its lower end. This ball head 28 is swingably retained in a socket 29 provided on a part 30 of the textile machine frame, which part is rigidly connected to the spindle frame 6; the ball-and-socket connection thus formed permits swinging of the tail 18 through a small angle from the vertical in all directions. In this instance, the socket 29 practically altogether prevents the ball head 28 from moving in a transverse direction, so that the apex C of the cone along which the axis *b* of the casing is permitted to move coincides with the center of the spherical socket 29. Therefore, the axis *a* of the bearing sleeve 5 and the axis *b* of the casing 17 move in the same manner as described with reference to FIGS. 3 and 4, with the difference that the forces which retain the casing axis at its point C no longer are inertia forces but reaction forces exerted by the spherical socket 29 on the ball head 28.

FIG. 6 represents a detail of a further embodiment of the invention, which otherwise resembles that shown in FIG. 5. In that FIG. 6 as in FIG. 5, the reference number 30 indicates a part rigidly connected to the spindle frame. The tubular peripheral wall 31 of the casing, here designated by 32, extends downwards beyond the bottom 14 of the casing and is fitted onto a pin 33 pressed into a

5

hole in the part 30. In its portion comprised between the bottom 14 and the pin 33, the peripheral wall 31 of the casing 32 has slots 34 milled into it in parallel transverse planes, at angularly offset places, so that the lowermost portion 32a of the casing 32, which is secured to the fixed part 30, is connected to the portion 32b retained in the spindle frame 6, by a series of resilient ring segments 36 integrally connected to each other by short bridges 35. Thereby, the said portion 32b of the casing 32 which is retained in the spindle frame 6 is further retained at the part 30 in such a manner as to be able to swing about a point situated in the zone of the slots 34 and ring segments 36. That point forms the apex C of the cone described by the axis b of the casing 32 when the axis a of the bearing sleeve 5 revolves along its own cone.

FIG. 7 relates to still another example in which the portion of the casing, here designated by 37, which is retained in the spindle frame 6, extends downwards into an opening 38 of the fixed part 30 which is rigidly connected to the spindle frame 6. Between the casing 37 and the wall of the opening 38 there is a resilient element comprising an outer metal ring 39 and an inner metal ring 40 between which a rubber ring 41 is vulcanized. This rubber ring is narrower and is made from rubber of a less resilient grade than the ring 7 (FIG. 4) by means of which the casing is held in the spindle frame 6, so that practically it permits the casing 37 to effect only swinging movements but no transverse displacements. The apex C of the cone described by the axis b of the casing 37 then is situated in the zone of the resilient element 39—41.

FIG. 8 represents a simplified embodiment in which a plain rubber ring 42 of circular cross-section is interposed between the casing 37 and the wall of the opening 38.

FIG. 9 represents still another example of the spindle bearing assembly according to the invention, which is notable mainly because of some constructional features. 1 again designates the spindle shaft, which is supported in a bearing sleeve 5 by means of a foot bearing 3 and a collar bearing 4. At its top this bearing sleeve has an outer flange 5a on which the collar bearing 4 rests and which in turn is supported on an inner shoulder 20a of the casing 20. A peripheral wall 20b of the casing 20 extends upwardly from the shoulder 20a. It is flanged inwards at its edge to locate the bearing 4 and thereby the flange 5a of the bearing sleeve 5. Below its shoulder 20a, the casing 20 has a plurality of angularly offset slots 20c milled into it in parallel transverse planes. The material left between these slots forms resilient ring segments which are connected to each other by circumferentially offset bridges. Thus, a yielding connection is provided between that portion of the casing 20 which is retained in the spindle frame 6 and that portion thereof which is connected to the bearing sleeve 5; this yielding connection permits the bearing sleeve to effect swinging movements, and rotary movements along conical surfaces, with reference to the portion of the casing which is held in the spindle frame.

For retaining it in the spindle frame 6, the casing 20 has a flange 25 screwed thereon. This flange 25 rests on a rubber cushion 21 which has a centering collar extending into the opening 11 of the spindle frame; moreover, the rubber cushion 21 has a projection 21a which engages a recess of the flange 25 to secure it against rotation. On the lower side of the spindle frame 6, another rubber cushion 21b, which is similar to the rubber cushion 21 except that it does not have a projection like 21a, is pressed against the spindle frame by means of a nut 24 and a washer 24a. The distance between the flange 25 and the washer 24a and therefore the compression of the rubber cushions 21, 21b is determined by a spacing sleeve 23. This sleeve 23 makes a tight fit on the casing 20 but excepting a narrow centering surface 23a at its upper end leaves some play within the openings of the rubber cushions 21, 21b through which it passes. The

6

centering surface 23a tightly fits the opening of the upper rubber cushion 21. Both rubber cushions 21 and 21b are secured against rotation in the spindle frame 6 by a pin 22. This arrangement permits the casing 20 to effect both swinging and transverse movements with reference to the spindle frame 6. The resilience of the connection, which relies on the transmission of forces through the rubber of the cushion 21 between the centering surface 23a and the wall of the opening 11 of the spindle frame, depends on the initial compression of the rubber which is determined by the length of the sleeve 23 and the position of the surface 23a with reference to the spindle frame, and thus can be predetermined by appropriate dimensioning of the parts.

At its lower end the casing 20 carries an additional weight 26 which is clamped to it by means of a sleeve 26a of wedge-like cross-section. As in the example according to FIGS. 3 and 4, the inertia of this weight 26 opposes transverse movements of the lower end of the casing 20.

Preferably, the lower part of the casing 20 is filled with oil which in known manner surrounds cup-shaped inserts 43 loosely placed within each other in the interval between the peripheral walls of the bearing sleeve 5 and the casing 20, whereby an effective damping of the movements of the bearing sleeve 5 with reference to the casing 20 is obtained.

The operation of the assembly shown in FIG. 9 is the same as described with reference to FIGS. 3 and 4.

I claim:

1. A textile mill spindle bearing assembly comprising in combination:

- (a) a frame member;
- (b) a casing having a substantially rigid portion in an attachment zone of which it is yieldingly attached to said frame member for transverse parallel and swinging displacement relative thereto;
- (c) a bearing sleeve having a bearing support portion;
- (d) radial and axial bearing means integral with or secured to said bearing support portion of said bearing sleeve;
- (e) a spindle rotatably supported in said radial and axial bearing means;
- (f) yielding means connecting said bearing support portion of said bearing sleeve to said rigid portion of said casing; and
- (g) holding means engaging said casing in a zone of its said rigid portion situated on the side of its said attachment zone remote from its connection to said bearing sleeve by said yielding means, for exerting on the casing, at the said point, forces which tend to counteract transverse displacement thereof.

2. A bearing assembly as claimed in claim 1 in which said holding means comprise a stabilizing weight carried by said casing in a zone of its said substantially rigid portion situated on the side of its said attachment zone remote from its connection to the bearing sleeve by the said yielding means.

3. A bearing assembly as claimed in claim 1 in which said holding means comprise an auxiliary support member rigidly connected to said frame member, said rigid portion of the casing being swingably connected to said auxiliary support member on the side of its said attachment zone remote from its connection to the bearing sleeve by the first-mentioned yielding means.

4. A bearing assembly as claimed in claim 3 in which said casing has a further portion resiliently connected to its said rigid portion and attached to the auxiliary support member.

5. A bearing assembly as claimed in claim 4 in which the said casing comprises a plurality of flexible arcuate segments connecting the said further portion and the said rigid portion of the casing to each other.

6. A bearing assembly as claimed in claim 3 comprising a yieldable member engaging, on one hand, the

said rigid portion of the casing and, on the other hand, the said auxiliary support member.

7. A bearing assembly as claimed in claim 6 in which the said auxiliary support member has an internal surface defining an opening, said rigid portion of said casing extends into said opening, and said yieldable member is a ring of resilient material interposed between said rigid portion of the casing and said internal surface of the support member. 5

8. A bearing assembly as claimed in claim 3 comprising a ball and socket joint connecting said rigid portion of the casing to said auxiliary support member.

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