May 30, 1944. L. D. COBB 2,350,272

SPINDLE

Original Filed July 11, 1939 2 Sheets-Sheet 1

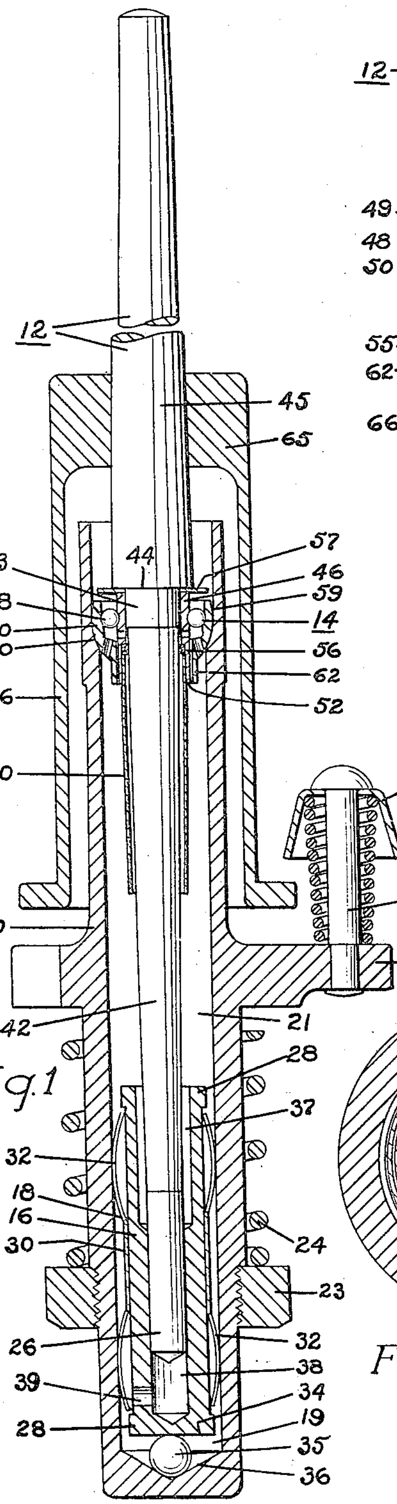

Fig. 1

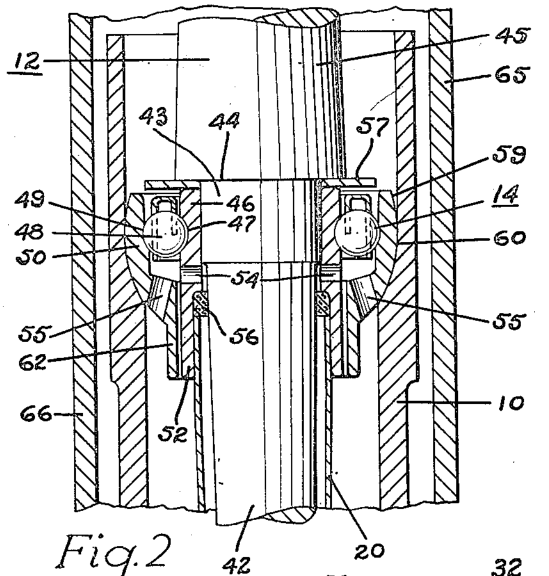

Fig. 2

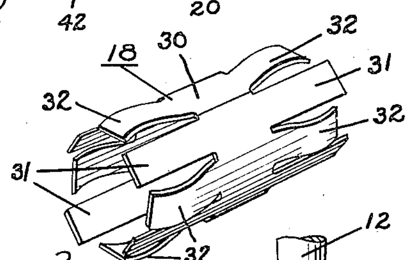

Fig. 3

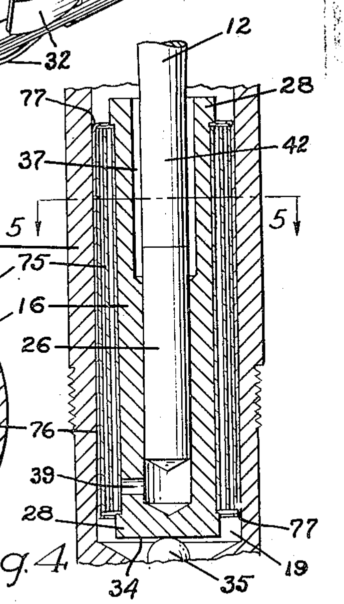

Fig. 4

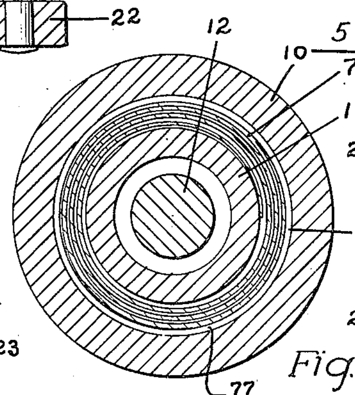

Fig. 5

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SPINDLE

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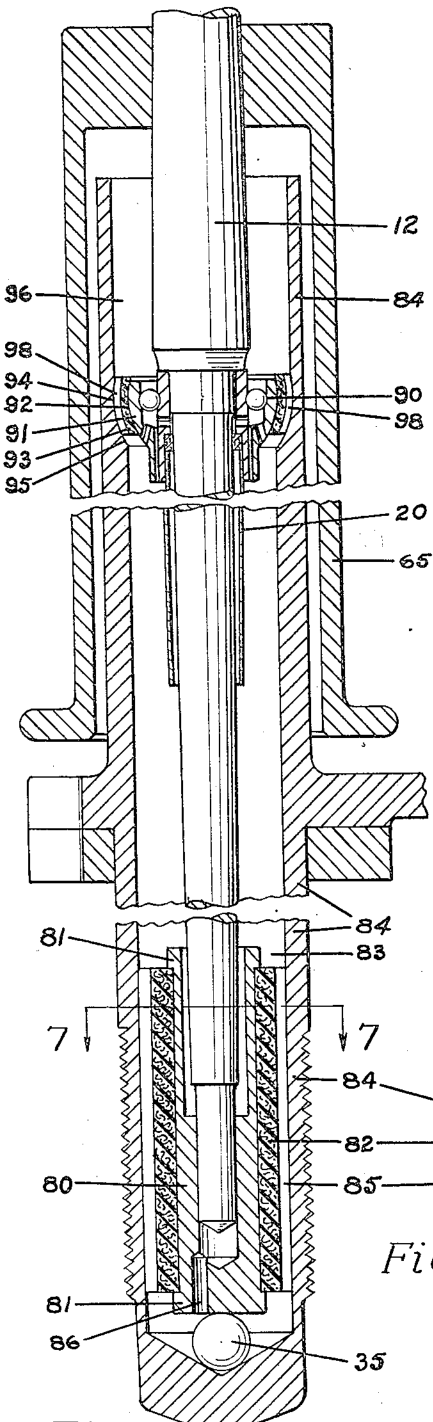

Fig.6

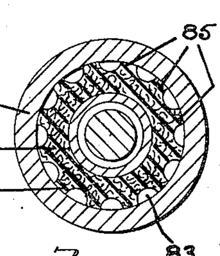

Fig. 7

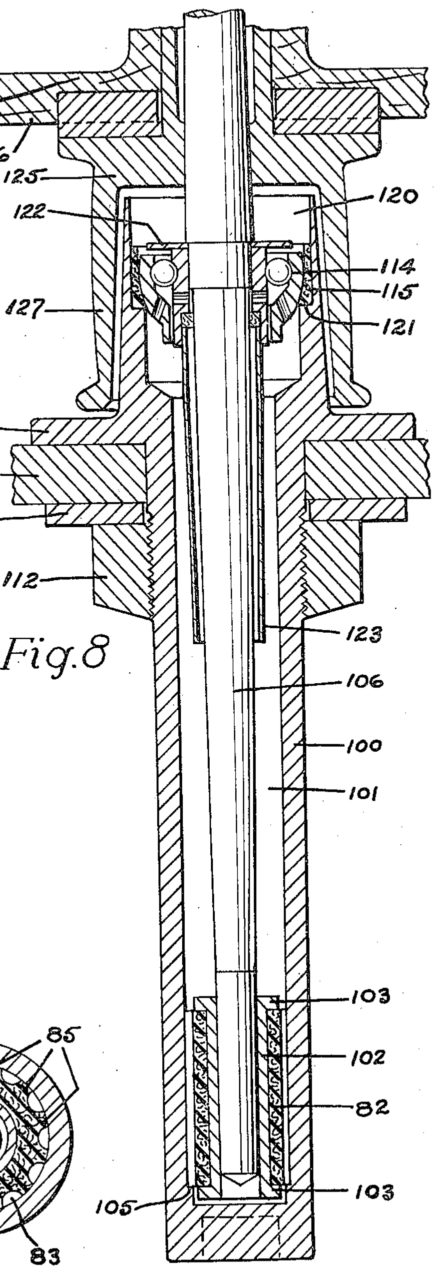

Fig.8

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UNITED STATES PATENT OFFICE

2,350,272

SPINDLE

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16 Claims. (Cl. 308—152)

This invention relates to spindles as commonly employed in the textile industry for spinning, twisting and the like, and particularly to antifriction bearings for supporting spindles.

It is desirable to rotate spinning machine spindles at many thousands of revolutions per minute to produce a rapid twisting and winding of a suitable thread or yarn on bobbins respectively carried by these spindles, and this high operating speed necessitates that the spindles must be freely running and precisely balanced so that the center of gravity of each spindle will lie within the geometrical axis of spindle rotation. An out of balance condition in such a rapidly rotating spindle results in objectionable spindle vibration that is not only injurious to the spindle bearings, but also results in frequent breakage of the thread while it is being wound on the bobbin. Another difficulty common to high speed spinning spindle rotation results from the fact that due to the inaccuracies of bobbin manufacture coupled with the uneven winding of the thread or yarn upon the bobbin, the center of gravity of a bobbin carried by a spindle rarely coincides with the axis of spindle rotation, and this causes an increased spindle vibration that is usually very great as the spindle reaches a critical speed.

An object of my invention is to provide a simple and easily constructed spindle structure which will overcome the above objectionable features.

Another object is to provide improved means for yieldably mounting a spindle which may shift its axis to automatically compensate for an out of balance condition of a bobbin carried thereby. A further object is to provide an improved spindle mounting that has a self-aligning antifriction bearing which supports the entire weight of the spindle. Another object resides in the provision of an improved spindle mounting and lubricating means wherein a measured amount of lubricant is automatically fed to an antifriction spindle bearing at a rate controlled by the speed of spindle rotation.

To these ends, and also to improve generally upon devices of the character indicated, the invention consists in the various matters hereinafter described and claimed.

In the accompanying drawings:

Figure 1 is a vertical central section through a spindle assembly made in accordance with my invention;

Figure 2 is an enlarged fragmentary view partly in section and showing the antifriction bearing of Figure 1 and its associated parts;

Figure 3 is a perspective view of the pilot spring of Figure 1;

Figure 4 is an enlarged fragmentary sectional view showing another embodiment of a pilot spring assembled with the lower end of my spindle;

Figure 5 is an enlarged cross section taken along the lines 5—5 of Figure 4 and looking in the direction of the arrows;

Figure 6 is a fragmentary vertical section showing another embodiment of my invention;

Figure 7 is a cross section taken along the lines 7—7 of Figure 6 and looking in the direction of the arrows; and

Figure 8 is a fragmentary vertical section showing another embodiment of my spindle and its mounting.

Generally stated, a spindle casing, as 10, supports a spindle blade, as 12, for high speed substantially frictionless rotation by an upper antifriction bearing, as 14, and a yieldably mounted lower bearing, as the stepped sleeve bearing 16. The anti-friction bearing 14 is seated for universally tiltable movement in the casing, and the bearing 16 is laterally and yieldably positioned, as by the pilot spring 18, so that the blade 12 is free to bodily tilt without affecting the axial alignment of the bearings. With this construction the blade will shift its axis to compensate for an out of balance condition of a bobbin of thread or yarn carried by the blade, and the blade will not be subjected to harmful vibrations when it rotates at a critical speed as has been the case with former spinning spindle structures. The lower end of the casing, which contains the bearing 16, forms a lubricant well 19, and a tapering pump sleeve, as 20, secured at its upper end to the bearing 14, surrounds the blade and has its reduced lower end communicating with the lubricant in the well 19 so that the centrifugal forces of rotation will feed the lubricant up the rotating sleeve 20 and through the bearing 14 at a measured rate which is controlled by the speed of blade rotation.

Referring particularly to the drawings, in the illustrated embodiment of Figures 1, 2 and 3 the generally cylindrical casing 10 has a central bore 21 open at its upper end and closed at its lower end which forms the lubricant well 19. An intermediate casing flange 22 is arranged to rest on a spindle rail (not shown), and a nut 23, threaded on the lower end of the casing, compresses a coiled spring 24 against the under side of the rail to demountably fasten the spindle assembly in position. The blade 12 is provided with a lower cylindrical end 26 journalled and axially floating in the bearing 16 that is generally cylindrical and of a smaller external diameter than the bore 21 at the bottom of the casing 10. The upper and lower ends of the bearing 16 terminate in the peripheral flanges 28 between which is located the pilot spring 18. An intermediate annular portion 30 of the pilot spring closely fits over the bearing 16 and has the longitudinally extending peripherally spaced fingers 31 and 32 extending from its opposed ends. The fingers 31 are substantially straight and aligned with the cylindrical portion 30 to substantially abut the flanges 28 and to axially locate the spring 18, and the fingers 32, which alternate with the fingers 31, are outwardly convexed into resilient engagement with the casing 10 to normally centrally position the bearing 16. The flat bottom face of the bearing 16 is supported on the ball 35 received in the conical seat 36 at the bottom of the bore 21. A counterbore 37 surrounds the blade 12 above the cylindrical end 26 which is journalled in the bore 38, and an oil passage 39 communicates between the well 19 and the bore 38 so that lubricant within the lower end of the well 19 may freely circulate through the bearing 16.

An intermediate portion 42 of the blade 12 tapers upwardly and outwardly to a cylindrical seat 43 that terminates in a shoulder 44 from which the blade portion 45 tapers to its reduced upper end. The antifriction bearing 14, which vertically supports the blade 12, has an inner bearing ring 46 pressed over the seat 43 and provided with a raceway 47 in which roll the bearing balls 48 that also roll within the raceway 49 of the outer race ring 50. If it is desired to relieve the bearing 14 of the vertical load, the conical lower end of the blade may be supported in the bottom of the bearing 16. The ring 46 has a downwardly extending sleeve-like extension or skirt 52 spaced about the blade beneath the seat 43, and the tapering sleeve 20, which surrounds the tapered blade portion 42 in spaced relation, has its enlarged upper end frictionally pressed into this depending skirt 52. Lateral passages 54 extend through the inner bearing ring 46 at the upper end of the skirt 52 and communicate with the ball chamber, so that lubricant drawn up by the rotating sleeve 20 will be fed out through the ports 54 and into the ball chamber from whence it may drain back into the well 19 through the ports 55 in an inwardly projecting portion of the outer race ring 50 and also between depending extensions of the race rings of the bearing 14. I preferably provide a felt washer 56 within the upper end of the skirt 52 and beneath the ports 54 to filter the oil entering the bearing and to prevent excessive flood lubrication of the bearing 14 at high spindle speeds. An annular deflection shield or slinger 57 is positioned between the ring 46 and the shoulder 44 to prevent splash of lubricant out of the upper end of the casing 10. The outer race ring 50 has a parti-spherical face 59 matingly received for universally tilting movement in a similar seat 60 formed in the casing 10, and an inwardly projecting portion of this outer race ring 50 is also provided with an axial extension or depending sleeve 62 that surrounds the skirt 52 in closely spaced relation. The spaced relation of the skirt 52 and the sleeve 62 is shown exaggerated for clarity of illustration, but is usually just sufficient to provide a clearance between these parts during normal spindle blade rotation and to freely admit an oil film in this annular space. A whorl 65 is mounted on the upper tapered spindle portion 45 and provided with a pulley flange 66 spaced about the upper end of the casing 10. A locking device, which in the present instance is shown as a spring pressed cup 70 pivotally mounted on a post 71, is secured to the flange 22 and overlies a flanged portion at the lower end of the whorl to removably secure the blade and bearing assembly in position.

When a bobbin which is out of balance is mounted on the upper end of the blade above the whorl 65, the centrifugal forces set up by the blade rotation will urge the blade to angularly shift its axial position to compensate for this out of balance condition. The yieldably mounted bearing 16 coupled with the freely and universally tiltable antifriction bearing 14 will permit the shifting of the blade, and the skirt 52 will momentarily engage the sleeve 62 as a plain bearing during such shifting movement so that the outer race ring 50 will be tilted and always maintained substantially axially aligned with the inner race ring 46 and there will be no tendency for the balls 48 to laterally climb and bind in their respective raceways 47 and 49. It will be understood that the radius of transverse curvature of the raceways is slightly greater than the radius of the balls as is usual in ball bearings. The outer race ring 50 is restrained from rotation in the spindle casing 10 by the frictional engagement of the parti-spherical face 59 in the seat 60, and this frictional engagement is not sufficient to prevent the universally tilting movement of the bearing 14 as a unit in the casing.

Figures 4 and 5 show a modified structure wherein the spring 18 of Figure 1 is replaced by the pilot spring 75 wound from a flat strip into a resilient spaced spiral whose inner convolution embraces the bearing 16 between the end flanges 28 and whose outer convolution may resiliently engage the inner wall of the casing 10. For convenience, I preferably provide a unit-handling spring and bearing assembly wherein the spring 75 is radially compressed into seated relation within a sleeve 76 that is slidably received in the bore 21, and the curled over spring retaining flanges 77 on sleeve 76 axially hold this spring in the sleeve.

Figure 6 shows another embodiment of my invention wherein the lower end of the spindle blade 12 is journalled in and axially floats in the bearing 80, generally similar to the bearing 16 of Figure 1 and supported by the ball 35. The bearing 80 is surrounded between its end flanges 81 by the resiliently yieldable pilot sleeve 82 composed of rubber or other suitable inherently resilient material, such as a synthetic rubber-like substance commonly known by the trade name "neoprene." The pilot sleeve 82, which is compressively received within the bottom of the bore 83 in the casing 84, that is generally similar to the casing 10, has the longitudinally extending peripherally spaced ribs 85 that are compressed within the bottom of the casing to aid the inherent yieldability of the pilot sleeve 82, and a lubricant passage 86 is provided in the bottom of the bearing 80 to facilitate lubricant circulation through the bearing 80.

An antifriction bearing 90, generally similar to the bearing 14 of Figure 1, supports the blade 12 at the upper end of the casing 84, and the outer race ring 91 of this bearing has a parti-spherical face 92 matingly seated in an inherently resilient and deformable sleeve 93, composed of rubber or other suitable resilient material, such as "neoprene," and provided with a parti-spherical outer face 94 concentric with the outer race ring face 92 and matingly seated in a similarly curved face 95 recessed in the counterbore 96 at the top of the casing 84. The curvature of the face 94 has a maximum diameter exceeding the diameter of the counterbore 96 so that the sleeve 93 will deform into slightly interlocked seated engagement with the face 95 and, if desired, the face 94 may be also longitudinally ribbed at 98 in a similar manner to that of the member 82. The yieldability of pilot-sleeve 82 and the sleeve 93 coupled with the universally tiltable relation between the sleeve 93, the bearing 90 and the casing 84 cooperatively serve to yieldably support the spindle blade 12 and act as a vibration dampener, while the blade is free to tiltably adjust itself during rotation so that its axis passes through the center of gravity of the blade and bobbin assembly. The blade 12 is rotated by the whorl 65, and lubrication is supplied to the antifriction bearing in the same manner as shown with relation to the structure of Figure 1.

Figure 8 shows another embodiment of my invention wherein a casing 100, provided with a bore 101, closed at its lower end, supports a lower sleeve bearing 102 through a yieldable pilot sleeve 82, similar to the pilot sleeve of Figure 6, located between the bearing end flanges 103. A shoulder 105 near the lower end of the bore 101 supports the pilot sleeve 82 so that the bearing 102 is yieldably located for lateral movement above and out of contact with the bottom of the casing. The lower end of the blade 106 is journalled in the sleeve bearing 102. The upper end of the casing has a flange 110 arranged for support on a spindle rail 111, and a nut 112, threaded on the casing 100, engages a washer 113 to clamp the assembly in position.

An antifriction bearing 114, generally similar to the bearing 14 of Figure 1, is ball-seated in a deformably resilient sleeve 115 which may be composed of a suitable molded material, such as rubber or "neoprene." This sleeve 115, which holds the bearing 114 out of contact with the casing 100, is compressed within the counterbore 120 at the top of the casing 100 and seated at its lower end on a casing shoulder 121. A shield 122 overlies the antifriction bearing 114, and a pump sleeve 123 provides lubrication to the bearing 114 in the same manner as shown in the corresponding parts of Figure 1. The upper end of the blade 106 carries the whorl 125 which supports a bobbin 126 and has a depending pulley 127 spaced about the upper end of the casing 100.

In the various embodiments shown, the deformable rubber-like sleeve members that respectively surround the upper and lower bearings are each in frictional and resilient embracing engagement therewith, but it has also been found convenient in certain installations to intimately bond these sleeve members to the bearings or to the casing as by vulcanizing or by suitable adhesives.

I claim:

1. In a device of the character indicated, a casing, a spindle blade extending into the casing, a parti-spherical seat in the casing, an antifriction bearing supporting the weight of the blade and rotatably guiding the blade, said bearing being socketed for a universally tiltable movement in said seat, and another bearing yieldably mounted in said casing and non-supportably receiving said spindle blade.

2. In a device of the character indicated, a casing, a spindle blade extending downwardly into the casing, a parti-spherical seat within the upper end of the casing, an antifriction bearing provided with a pair of relatively rotatable race rings, one of said rings supporting the weight of the blade, and said other ring being matingly socketed in said seat for universally tiltable movement, and a yieldably mounted bearing in the bottom of the casing, said bearing non-supportably and rotatably receiving said spindle blade.

3. In a device of the character indicated, a casing having a downwardly extending lubricant chamber, a parti-spherical seat in the upper end of said lubricant chamber, a spindle blade extending downwardly into said lubricant chamber, an antifriction bearing having a parti-spherical outer face matingly socketed for a universally tiltable movement in said seat, said bearing supporting the entire weight of said spindle blade, a second bearing rotatably but non-supportably receiving the lower end of the spindle blade, and a resilient member yieldably positioning said second bearing in the lubricant chamber.

4. In a device of the character indicated, an antifriction bearing comprising a pair of relatively rotatable race rings, rolling elements between and in rolling engagement with said rings, and interengageable sleeve-extensions on said rings which co-operate to maintain the rings in substantially coaxial relation.

5. In a spindle bearing, an inner race ring, an outer race ring, rolling elements between said race rings and permitting said race rings to tilt relatively to each other, the outer race ring having an outer parti-spherical surface to provide for universally tilting movement in a seat, and interengageable axially projecting sleeve extensions on said race rings which co-operate to maintain the race rings in substantially coaxial relation.

6. In a device of the character indicated, an antifriction bearing comprising a pair of relatively rotatable inner and outer race rings separated by rolling elements in contact therewith, a cylindrical skirt extension on and coaxial with the inner race ring, and a sleeve extension on and coaxial with the outer race ring and surrounding said cylindrical extension in closely spaced relation, said extensions being interengageable to maintain the race rings in substantially coaxial alignment during their relative rotation.

7. In a spindle bearing, an inner race ring, an outer race ring, rolling elements between said rings and allowing for tilting movements of said rings relatively to each other, the outer race ring having an external parti-spherical surface to provide for universally tilting movement in a seat, a cylindrical skirt extension on and coaxial with the inner race ring, the outer race ring having an annular portion projecting inwardly towards said skirt and terminating in an axial sleeve extension closely surrounding said skirt for engagement therewith whenever one of said race rings tilts out of co-axial alignment with said other race ring.

8. In a spindle bearing, an inner race ring, an outer race ring, rolling elements located in a chamber between said race rings and allowing relative rotation and relative tilting movement of said race rings, the outer race ring having an outer parti-spherical surface arranged for uni-

versally tilting movement in a seat, the inner race ring having a sleeve axially extending therefrom, the outer race ring having an annular portion projecting inwardly towards said sleeve and terminating in an axial extension closely surrounding said sleeve for engagement thereby to maintain said race rings in substantially coaxial alignment, and the inner race ring having a radial port communicating with said rolling element chamber.

9. In a spindle bearing, an inner race ring, an outer race ring, rolling elements in a chamber between and rotatably engageable with said race rings and permitting relative tilting movements of said race rings, the outer race ring having an external parti-spherical surface arranged for universally tilting movement in a seat, said inner race ring having a cylindrical skirt axially extending therefrom, the outer race ring having an annular inwardly projecting portion terminating in an axial extending sleeve portion closely surrounding and engageable with said cylindrical skirt when the axes of said race rings locate out of coaxial relation, said inner race ring being provided with a radial port communicating with said chamber, and said annular inward projecting portion of the outer race ring being provided with a drain port leading from said chamber.

10. In a device of the character indicated, a spindle casing, a spindle blade extending downwardly into said casing, a parti-spherical internal seat in said casing, an antifriction bearing having an outer race ring and an inner race ring, said outer race ring being matingly socketed for universally tiltable movement in said seat and said inner race ring rotatably supporting said spindle, an annular downwardly projecting skirt extension on the inner race ring and spaced about said spindle blade, and an annular sleeve extension on the outer ring surrounding said skirt extension in closely spaced relation, said skirt extension being engageable with said sleeve extension to tilt the outer race ring in said seat and thereby maintain it in substantially coaxial relation with said inner race ring.

11. In a device of the character indicated, a casing having a bore, a spindle blade extending into the bore, a sleeve bearing in said bore and receiving said blade, a flange at each end of said sleeve bearing, a pilot spring yieldably positioning the sleeve bearing in said bore, an intermediate annular portion of said spring embracing said sleeve bearing, annularly spaced fingers longitudinally extending from the ends of said intermediate portion and convexed into resilient engagement with said casing, and straight finger portions longitudinally extending from said intermediate portion in alternating spaced relation to said convexed fingers and abuttingly engageable with said flanges to longitudinally position said spring.

12. In a device of the character indicated, a casing, a bearing within the casing, and a spirally wound flat spring having an outer convolution resiliently mounted within the casing and having an inner convolution secured to the bearing, whereby the bearing is yieldably positioned within the casing.

13. In a device of the character indicated, a casing, a sleeve slidably mounted in the casing, a bearing within and spaced from the sleeve, a spirally wound flat spring between the bearing and the sleeve, and means securing the sleeve, spring and bearing in unit-handling relation.

14. In a device of the character indicated, a casing having a parti-spherical seat, a resilient deformable sleeve in the seat, externally spaced ribs on said sleeve matingly conforming with said seat, an internal parti-spherical seat in the sleeve concentric with the seat in the casing, and an antifriction bearing ball-socketed in universally tiltable mating relation with said internal seat.

15. In a device of the character indicated, a casing having a lubricant well, a bearing outer race ring seated in the casing at the upper end of the well, a rotatable inner race ring within the outer race ring, a spindle extending into the casing and rotatably supported by said inner race ring, elements in rolling engagement with the race rings, a downwardly extending skirt on the inner race ring and annularly spaced about the spindle, said skirt being apertured to provide lubricant communication between said annular space and the rolling elements, and a downwardly and inwardly tapering and rotatable pump sleeve radially spaced about the spindle and secured at its enlarged upper end within said skirt.

16. In a device of the character indicated, a casing having a lubricant well, a ball bearing provided with inner and outer race rings, a seat in the casing tiltably receiving the outer race ring, a spindle extending into the well and rotatably carried by said inner race ring, an annular skirt on the inner race ring radially spaced about the spindle and having a passage extending therethrough into communication with the space between said race rings, the outer race ring having drain passages communicating with the lubricant well, a tapering and rotatable pump sleeve extending downwardly into the well in radially spaced relation about the spindle and having an enlarged upper end pressed into said skirt, and an annular pervious filtering member within the skirt above said sleeve which prevents excessive lubrication of the bearing.

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