(No Model.)

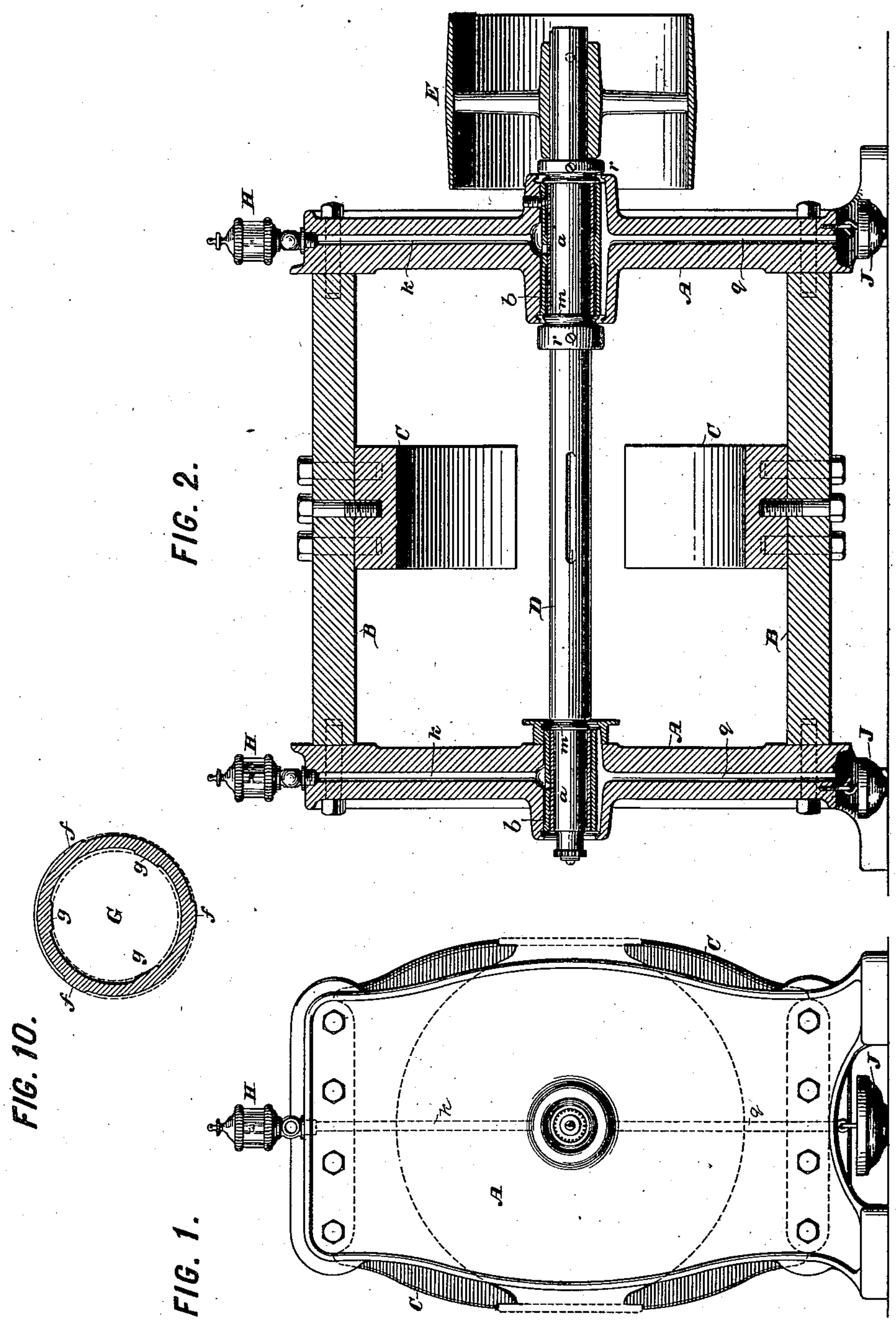
4 Sheets—Sheet 1.

J. J. WOOD.

JOURNAL BEARING.

No. 421,089.

Patented Feb. 11, 1890.



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(No Model.) 4 Sheets—Sheet 2.

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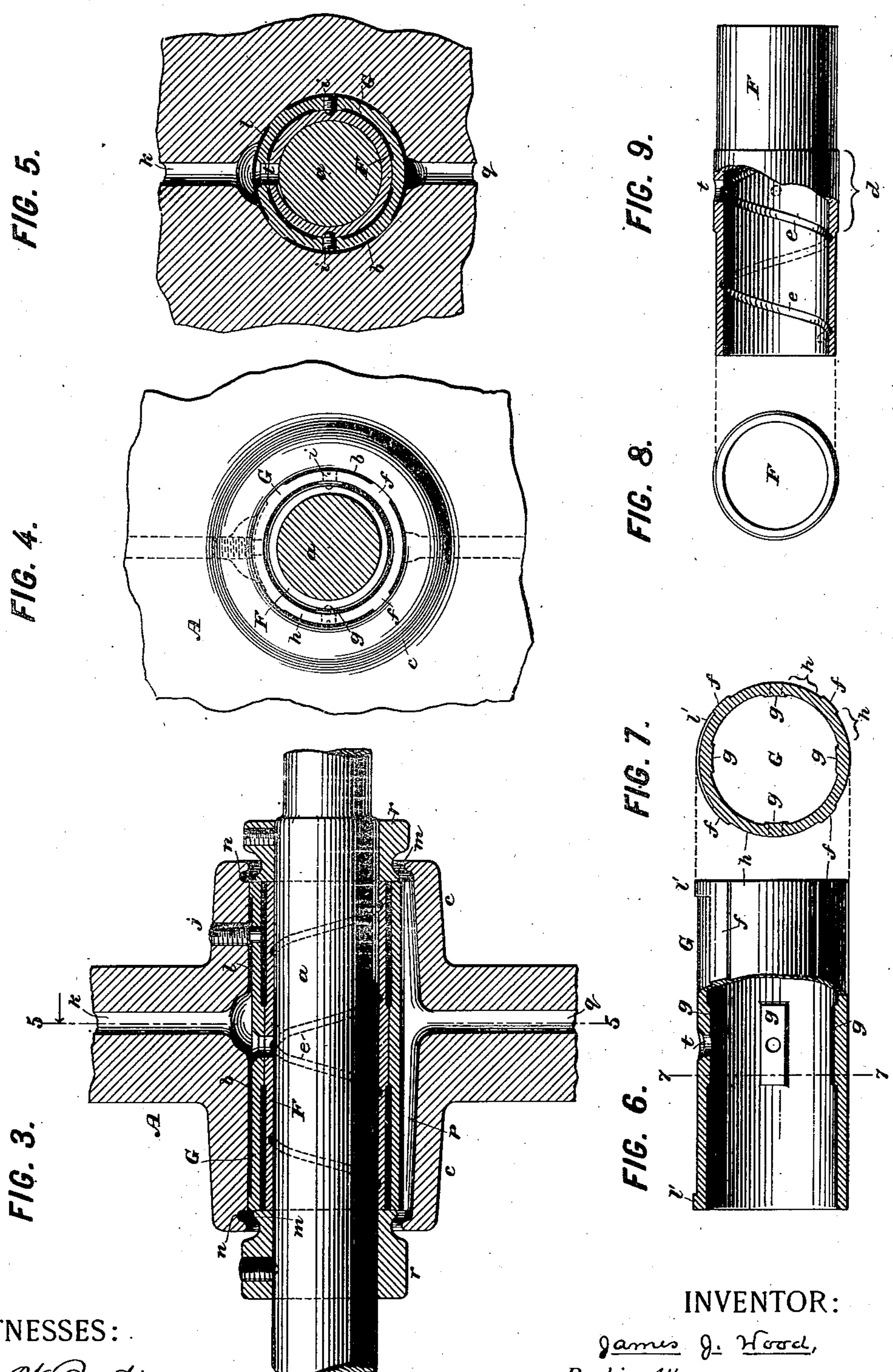

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(No Model.) 4 Sheets—Sheet 3.

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FIG. 13.

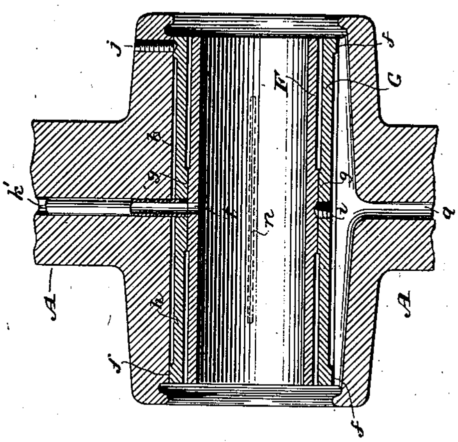

FIG. 12.

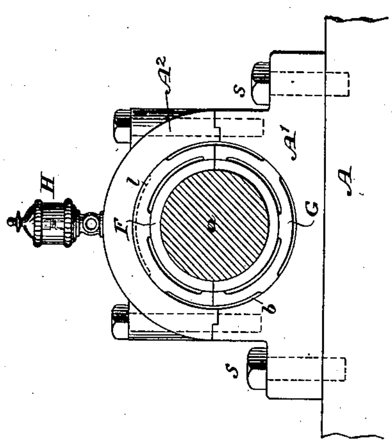

FIG. 15.

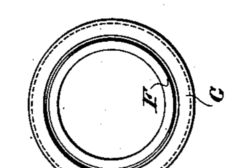

FIG. 14.

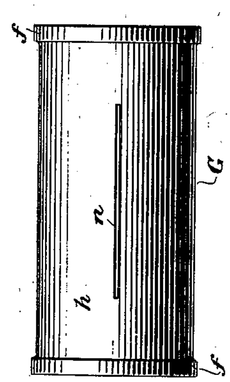

FIG. 11.

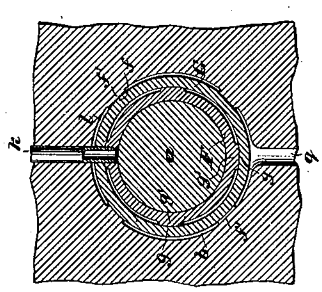

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FIG. 19.

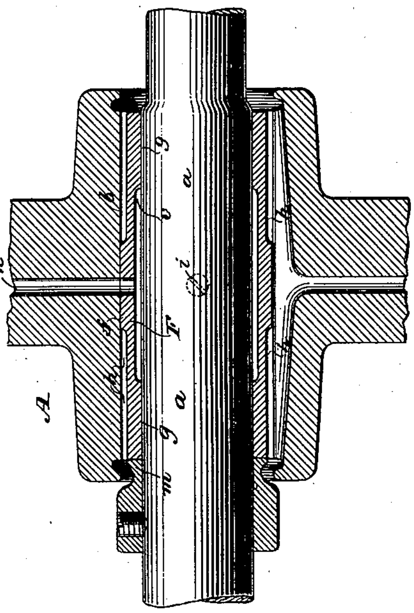


FIG. 16.

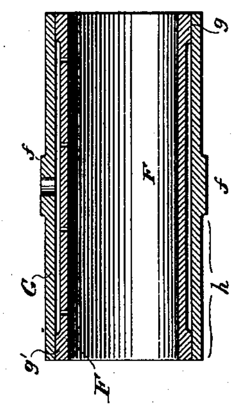


FIG. 18.

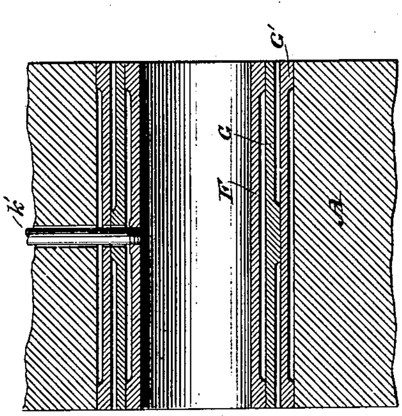
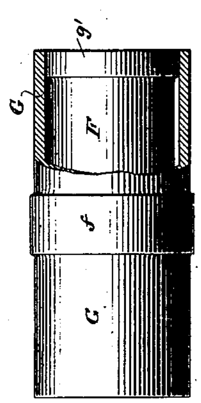


FIG. 17.



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UNITED STATES PATENT OFFICE.

JAMES J. WOOD, OF BROOKLYN, NEW YORK.

JOURNAL-BEARING.

SPECIFICATION forming part of Letters Patent No. 421,089, dated February 11, 1890.

Application filed October 9, 1889. Serial No. 326,465. (No model.)

To all whom it may concern:

Be it known that I, JAMES J. WOOD, a citizen of the United States, residing in Brooklyn, in the county of Kings and State of New York, have invented certain new and useful Improvements in Journal-Bearings, of which the following is a specification.

This invention relates to journal-bearings applicable to machinery generally.

The object of the invention is to provide a bearing which will not bind the journal in case of its expansion through heating, as sometimes occurs by reason of deficient or suspended lubrication.

Another object of the invention is to provide bearings which will allow of a slight imperfection of alignment without interfering with the perfect running of the shaft.

To these ends my improved bearing is constructed with the bearing-frame bored out somewhat larger than has been heretofore usual and with a yielding or elastic bushing interposed between the journal and the bearing-frame. This yielding bushing consists of a tubular sleeve having internal bearing-faces for upholding (either directly or through the intermediation of an inner bushing) the journal which turns within it, and having external bearing-faces which are seated in the bore in the bearing-frame. The internal and external faces are arranged in different positions, instead of being in line with or directly opposite one another, and the portions of the sleeve intervening between the external and internal faces are made sufficiently thin to be suitably elastic or yielding, so that any slight changes in the size or in the axial position of the journal relatively to the unyielding bearing-frame will be compensated for or taken up by the flexure or slight distortion of these intervening yielding portions. In the preferred construction an inner bushing is provided in which the journal turns, and between this bushing and the bore in the bearing-frame is interposed the yielding bushing or sleeve. This yielding bushing has its external and internal bearing-faces constructed preferably as feet projecting slightly from its general internal and external surfaces, and these feet are preferably extended longitudinally, the difference of position of the external and internal bearing-faces being in angular direction. Either the internal or the external feet or bearing-faces are made short and confined to the middle portion of the bushing, so that the journal and inner bushing may be canted angularly slightly out of the true alignment of the shaft by a corresponding distortion of the yielding bushing.

Having given thus a general or preliminary outline of my invention, I will now proceed to describe it in detail in its preferred form and in certain modified forms, with reference to the accompanying drawings, wherein—

Figure 1 is an end elevation of the frame of a dynamo-electric machine, to the armature-shaft of which my invention is applied. Fig. 2 is a vertical longitudinal section of said frame and shaft, showing both the bearings of the shaft constructed according to my invention. Fig. 3 is a fragmentary section of one of the bearings shown in Fig. 2, on a larger scale. Fig. 4 is a transverse section of the shaft, showing in elevation the bearing seen in Fig. 3. Fig. 5 is a transverse section on the line 5 5 in Fig. 3. Fig. 6 is a side elevation partly in longitudinal mid-section, and Fig. 7 is a transverse section on the line 7 7, showing the preferred form of the yielding bushing. Fig. 8 is an end elevation, and Fig. 9 a side elevation, partly in longitudinal mid-section, showing the preferred form of the inner bushing. The remaining views show modifications. Fig. 10 is a transverse section answering to Fig. 7. Fig. 11 is a transverse section of another modification, the view answering to Fig. 5. Fig. 12 is an elevation, answering to Fig. 4, of a further modification of the bearing, the shaft being in section. Figs. 13, 14, and 15 show another modification, Fig. 13 answering to Fig. 3 except that the shaft is removed, Fig. 14 being a side elevation of the outer bushing, and Fig. 15 an end view of the two bushings. Figs. 16 and 17 show another modification, Fig. 16 being a view answering to Fig. 3, and Fig. 17 a side elevation of the bushings, the outer one partly in section. Fig. 18 is a section answering to Fig. 3, showing another modification. Fig. 19 is a similar section showing still another modification.

I will first describe the construction of my invention shown in Figs. 1 to 9.

Although here shown as applied to a dynamo-electric machine, it is obvious that my invention is applicable generally as a bearing for machinery, and is not limited to dynamo-machines or to other machines having frames and shafts similarly arranged.

In the particular machine shown in Figs. 1 and 2, A A are the opposite end frames constituting the bearing-frames for the shaft. B B are the cores of the field-magnets, which constitute connecting cross-frames for uniting the frames A A. C C are the pole-pieces of the dynamo. D is the armature-shaft, and E the pulley. The shaft D is hung in two bearings in the end frames A A. One of these bearings is shown in detail in Figs. 3 to 9, inclusive, while the other bearing is of substantially the same construction. In each bearing the shaft-journal *a* turns in a bushing F, which is preferably made of gun-metal or any other suitable metal, and which is shown in detail in Figs. 8 and 9. This bushing F is held in a yielding bushing G, (shown in detail in Figs. 6 and 7,) and the bushing G is supported in the bore *b* in the bearing-frame A. The bearing-frame A is preferably widened at the bearing by being cast with bosses on its opposite sides to form a hub *c*, as usual.

The inner bushing F presents no especial characteristics and need not essentially differ from any ordinary bearing-bushing heretofore used. Preferably, however, it is formed with an enlargement or collar *d*, Fig. 9, around its middle portion, and on its inner or bearing surface it has, preferably, spiral grooves *e e* for facilitating the distribution of oil over the surface of the journal.

The bearing-frame A has its bore *b* turned somewhat larger than heretofore, sufficiently to leave room around the inner bushing F for the yielding bushing or sleeve G. This yielding bushing G embodies the characteristic features of my invention. It consists of a tube or sleeve preferably cylindrical, or approximately so, and having external and internal bearing-faces, lettered, respectively, *f f* and *g g*, as best shown in Fig. 7, where there are four of each such faces. These respective faces are preferably raised somewhat beyond the general exterior and interior contours of the sleeve, so that they may be readily faced off by boring, turning, or milling. The construction of these bearing-faces as such projecting feet, however, is not essential. The internal and external bearing-faces are arranged at different positions, so that they are not opposite or in line with one another, and between them are the portions *h h* of the tube, which are out of contact both exteriorly and interiorly and are sufficiently thin to be slightly yielding or elastic. The result of this construction is that in case the journal *a* should run dry, and the journal and bushing F should consequently expand, their expansion will simply press the portions *g g* of the sleeve G outwardly, while the portions *h h* of the sleeve will yield or flex, their flexure taking up the expansion, so that the bushing F is not bound fast, and so that consequently the bushing is not made to tightly embrace the journal and lock it fast, as would be the case if it were seated tightly in an unyielding bore of the bearing-frame. As the journal and bearing-bushing F subsequently cool down and contract the outward thrust against the faces *g g*, due to the expansion of the bushing, is relieved, and the elasticity of the portions *h h* of the bushing G restores the latter to its normal shape.

It is essential to the full realization of the use of my invention that the inner bushing F shall be made of a metal having a higher coefficient of expansion than that of the journal *a*, so that as the bearing heats and the journal expands the bushing F shall expand in a greater ratio, and thereby shall cause the journal to run more loosely instead of tightening around the journal, as would otherwise be the case. In practice the shaft is best made of steel and the bushing of gun-metal or phosphor-bronze, which have a coefficient of expansion about double that of steel. With such a bushing fitted solidly in an unyielding bore in the bearing-frame, as has been practiced prior to my invention, if the bearing heats, the expansion of the bushing, instead of taking place in an outward direction, as it does according to my invention, is forced by reason of the unyielding nature of the bore in the side frame to take place in an inward direction, so that the bore in the bushing is contracted, while the journal is at the same time expanded by the heat, and the two are thereby caused to weld fast. The construction introduced by my invention enables the bushing to expand outwardly, so that by reason of its expansion at a greater ratio than the journal there is no possibility of its binding the journal or becoming welded to it. The outer or yielding bushing G is preferably made of a metal having a comparatively-low coefficient of expansion—such, for example, as cast-iron—but this is not essential.

In order to prevent the relative displacement of the bushings, the inner bushing F is held to the bushing G by means of set-screws *i i*, (shown best in Fig. 5,) which are screwed through the outer bushing partly into the inner one. The outer bushing is held in place by a set-screw *j*, (shown best in Fig. 3,) which is screwed through the boss *c* and enters the bushing G.

The bearing-faces *f* and *g* on the sleeve or bushing G are extended preferably in longitudinal direction, as clearly shown in Fig. 6, so that the yielding portions *h h* are in the form of longitudinal strips extending between the bearing-faces. In fact, the entire portion of the bushing G extending from one foot or bearing-face *f* to the next face *f* is essentially yielding, the only unyielding portions of the bushing being the bearing-faces *f f* themselves, which are seated against the unyielding bore *b* in the bearing-frame. Owing, however, to the thickening of the bearing-faces *g g* in the preferred construction, as shown in Fig. 7, the yielding or flexure of the metal is chiefly confined to the intervening portion between these faces and the faces *f f*.

As shown in Figs. 3 and 6, the inner faces *g g* are made quite short and arranged midway of the length of the bushing G to come in contact with the collar *d*, Fig. 9, on the bushing F, while the external feet or faces *f f* extend from end to end of the bushing G. This shortening of the inner faces facilitates the yielding of the bushing G to compensate for any slight tilting of the journal out of true alignment of the bushing. For example, in case the bearing-bores *b b* in the two end frames A A in Fig. 2 are not brought exactly in line with one another, so that the axes of the bores and the axis of the shaft do not exactly coincide, their want of coincidence will be compensated for by the distortion or flexure of the bushing G, the inner faces *g g* of which will stand at a slight inclination relatively to the outer faces *f f*. This is an important advantage, since by the use of my improved bearing it is not necessary that the two bearings shall be bored with great nicety of workmanship, so as to be in exactly the same line, to do which heretofore it has been necessary to bore or counterbore or ream the two bores *b b* both at one time by the use of a special boring-bar or reamer. Instead my invention permits of the bores being formed by boring the frames A A before they are put together and by the use of any ordinary boring-machine and jigs. Any want of nice accuracy of alignment, which with a solid bushing as heretofore applied would cause the shaft to bind and heat or cut at its journals, will with my improved bearing produce no effect whatever upon the shaft, which runs as smoothly and freely as if the two bearings were in perfect alignment.

The lubrication of the journal is easily effected in the use of my invention. An oil-cup H, having a controllable drip-feed, is mounted on top of each of the frames A, an oil-duct *k* being formed through each frame to conduct the oil from this cup down to the bearing. The oil enters the narrow hollow space or chamber *l*, Figs. 3 and 5, on top of the bushing G and flows down through an opening *t* in the upper side of the two bushings G and F, where it communicates with the spiral grooves *e e*, by which the oil is distributed over the journal. The oil is kept from running out of the space *l* at the opposite ends by flanges *l'*, formed on the ends of the bushing G to close this space. The oil which passes out at the opposite ends of the journal is thrown off centrifugally from beads *m m* and is caught in annular grooves *n n*, formed in the bosses *c c*, and from these grooves it runs down and flows through the bottom channel *p* into a bore *q*, extending down through the frame, as shown in Fig. 2, and opening at the bottom thereof, where a drip-cup J is placed to receive the overflowing oil. The longitudinal thrust of the shaft may be resisted in any way known in machinery. If it is desired to resist it at the bearing or at one of the bearings, this can be done by fastening collars *r r* on the shaft, as shown in Fig. 3, in which case the beads *m m*, for centrifugally throwing off the oil, may well be formed on these collars, as shown; or these beads may be formed by being turned on the shaft itself, as shown at the left-hand bearing in Fig. 2.

Fig. 10 shows three outside and three inside bearing feet or faces applied to the bushing G instead of four, as are shown in the previous figures. Any number of these feet or faces may be used instead.

Instead of forming the bearing-faces *f* and *g* as projecting feet upon the sleeve G, this sleeve may be made as a plain tube and its bearing-faces be determined by projections *f' f'* on the interior of the bore or opening in the bearing-frame A and by outward projections *g' g'* on the bushing F, as shown in Fig. 11. The portions of the tube or sleeve G between the projections constitute the yielding or flexible parts to the same effect as the portions *h h* in Figs. 3 to 7.

Although my invention is most advantageous as applied to bearings formed in solid frames which are bored out to admit the shaft through them, yet it is applicable to bearings which are mounted on frames so as to be removable therefrom or adjustable thereon, and to those which are made with a bearing-cap to admit of the removal of the shaft by lifting it out instead of by drawing it out endwise. Fig. 12 shows a pillow-bearing A' mounted on top of the frame A and fastened thereto by bolts *s s*. The bearing is made with a removable bearing-cap A^2, of usual construction, and the bushings F and G are diametrically divided, so that by removing this bearing-cap and lifting off the upper halves of these bushings the shaft may be lifted out.

My invention may be modified in numerous ways without departing from its essential features. I will proceed to describe some such modifications, leaving other possible modifications to be inferred by those skilled in the art.

In the modification shown in Figs. 13, 14, and 15 the inner bushing F is or may be of the same construction as shown in Figs. 8 and 9, and the bearing-frame A and its bore *b* and oil-ducts are of the same construction. The bushing G, however, is considerably modified, in that its internal bearing-faces *g g* are merged into one single bearing-face extending entirely around the internal circumference of the bushing at its middle, while its external bearing-faces *f f* are provided only at its opposite ends, where they are made in the form of flanges extending around the bushing and fitting tightly in the bore *b*. Between the outer bearing-faces *f f* and the inner bearing-face *g* is a considerable portion of the sleeve which is out of contact both externally and internally, and it is this which forms the yielding or flexible portion of the bushing. As the bushing F expands the middle bearing portion *g* of the bushing G expands also, the expansion being taken up by the flexure of the portions *h h*. To prevent either the bursting of the middle portion of the bushing G or its undue resistance to expansion, it is preferably slitted longitudinally, as shown at *n* in Fig. 14, so that this slit may open out slightly as the inner bushing expands. The respective bushings are held against displacement by set-screws *i* and *j*. The oil is introduced through a tube *k'*, which screws into the bushing G and communicates with the orifice *t* in the inner bushing.

The construction shown in Figs. 16 and 17 is precisely the reverse of that just described, in that the inner bearing-faces of the bushing G are at its ends, while its outer bearing-face is at its middle. The inner bearing-faces are the portions in contact with flanges *g'* on opposite ends of the inner bushing F, while the outer bearing-face *f* is formed as a collar or band on the exterior of the middle portion of the bushing G.

Fig. 18 shows a further amplification of these last two modifications, the inner bushing F and the yielding bushing G next outside of it, being of the construction last described and a second yielding bushing G', of the same construction as the bushing G in Fig. 13, is added outside of the bushing G, so that the expanding and contracting or angular movements of the inner bushing are compensated for by the yielding or flexure of both the outer bushings G G'.

Fig. 19 shows a modification embodying, as I believe, the simplest form of which my invention is susceptible. The bushings F and G are here combined into one bushing, which performs the functions of both. This bushing has interior bearing-faces *g g* at its opposite ends, in which the shaft-journal *a* turns, the bushing being cut away between them at *v*, thereby forming an oil-space. On its exterior the bushing has a bearing-face *f*, extending in the form of a collar around its circumference. The intermediate portions *h h* constitute the yielding or elastic parts of the bushing. The bushing may be held in place by a set-screw *i*, (shown in dotted lines.)

The several modifications shown in Figs. 13 to 19, inclusive, are equally adapted with the preferred construction first described to allow some deflection of the axis of the shaft from exact alignment or coincidence with the axis of the bore *b* of the bushing by reason of the distortion of the yielding portion of the metal *h h* intervening between the external and internal bearing-faces.

I prefer to make the internal bushing F of gun-metal and the yielding bushing G of cast-iron, or, in the construction shown in Fig. 19, to make the entire bushing of gun-metal.

I claim as my invention the following-defined novel features and combinations, substantially as hereinbefore specified, namely:

1. A yielding bushing for journal-bearings, consisting of a tubular sleeve formed with internal and external bearing-faces arranged in different positions with elastic or yielding portions of the sleeve intervening, whereby an expansive thrust against the inner faces will be compensated for by the flexure of said intervening yielding portions.

2. A yielding bushing for journal-bearings, consisting of a tubular sleeve formed with internal and external bearing-faces arranged to extend longitudinally of the sleeve in different angular positions, with elastic or yielding portions of the sleeve intervening, whereby an expansive thrust against the inner faces will be compensated for by the flexure of said intervening yielding portions.

3. A journal-bearing consisting of the combination, with the journal and supporting-frame, of a yielding bushing within which the journal turns, constructed as a tubular sleeve with internal bearing-faces to support the journal and with external bearing-faces seated against the frame, the internal and external faces being located out of coincidence with one another, with elastic or yielding portions of the sleeve intervening, whereby the bushing compensates by the flexure of its yielding portions for changes in the size or position of the journal relatively to the frame.

4. A journal-bearing consisting of the combination, with the journal and supporting-frame, of an inner bushing in which the journal has its bearing and a yielding bushing intervening between said bushing and the frame, constructed as a tubular sleeve with internal bearing-faces in contact with the inner bushing and with external bearing-faces seated against the frame, the internal and external faces being located out of coincidence with one another, with elastic or yielding portions of the sleeve intervening, whereby the bushing compensates by the flexure of its yielding portions for changes in the size or position of the journal and inner bushing relatively to the frame.

5. A journal-bearing consisting of the combination, with the journal and supporting-frame, of an inner bushing, in which the journal has its bearing, of a metal having a higher coefficient of expansion than the metal of the journal, whereby as the bearing heats the bushing tends to expand in greater ratio than the journal and thereby to loosen the fit of the journal, and a yielding bushing intervening between said bushing and the frame, constructed with internal bearing-faces to support the inner bushing and with external bearing-faces arranged out of coincidence therewith and seated against the frame,

whereby the yielding bushing compensates by its flexure for changes in the size of the inner bushing.

6. A journal-bearing consisting of the combination, with the journal and supporting-frame, of an inner bushing in which the journal has its bearing and a yielding bushing intervening between said bushing and the frame, constructed as a tubular sleeve with external bearing-faces in contact with the frame and internal bearing-faces supporting the inner bushing, said external and internal bearing-faces being arranged the one at the ends and the other at the middle portion of the sleeve, and with elastic or yielding portions intervening between said internal and external bearing-faces, whereby by the flexure or distortion of the intervening portions the bushing compensates for deflections of the journal and inner bushing out of true alignment or coincidence with the axis of the bearing.

7. The combination, with a bearing-frame formed with an oil-duct leading to its bearing-bore, of a bearing-bushing and a yielding bushing intervening between said bushing and the bore, constructed as a tubular sleeve with internal bearing-faces in contact with the bearing-bushing and external bearing-faces extending longitudinally in contact with the bore, and with external flanges extending between said external bearing-faces on the side communicating with the oil-duct to prevent escape of oil, and an oil-duct formed through the two bushings for admitting the oil from said duct therethrough to the journal.

8. The combination, with the bearing-frame and inner or bearing bushing, of an intermediate yielding bushing and a screw or pin uniting the inner to the intermediate bushing, and a screw or pin uniting the intermediate bushing to the bearing-frame, whereby the displacement of the bushings relatively to each other and to the frame is prevented.

In witness whereof I have hereunto signed my name in the presence of two subscribing witnesses.

JAMES J. WOOD.

Witnesses:

ARTHUR C. FRASER,
JNO. E. GAVIN.