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(54) **Pivoted segmental bearing**

(57) A shaft (1) is supported for rotation by shoes (3) of rigid antifriction material, pivotally mounted on an annular shoe-support member (5). The bearing has leaf springs (14) which are disposed, angularly equidistant, between the outer surface of the annular shoe-support member (5) and the inner surface of an outer support casing (6), the springs (14) being immersed in a lubricating oil. The annular shoe-support member (5) is resiliently pressed axially against a retaining member of the outer support casing (6) by helical springs (23).

Fig.2

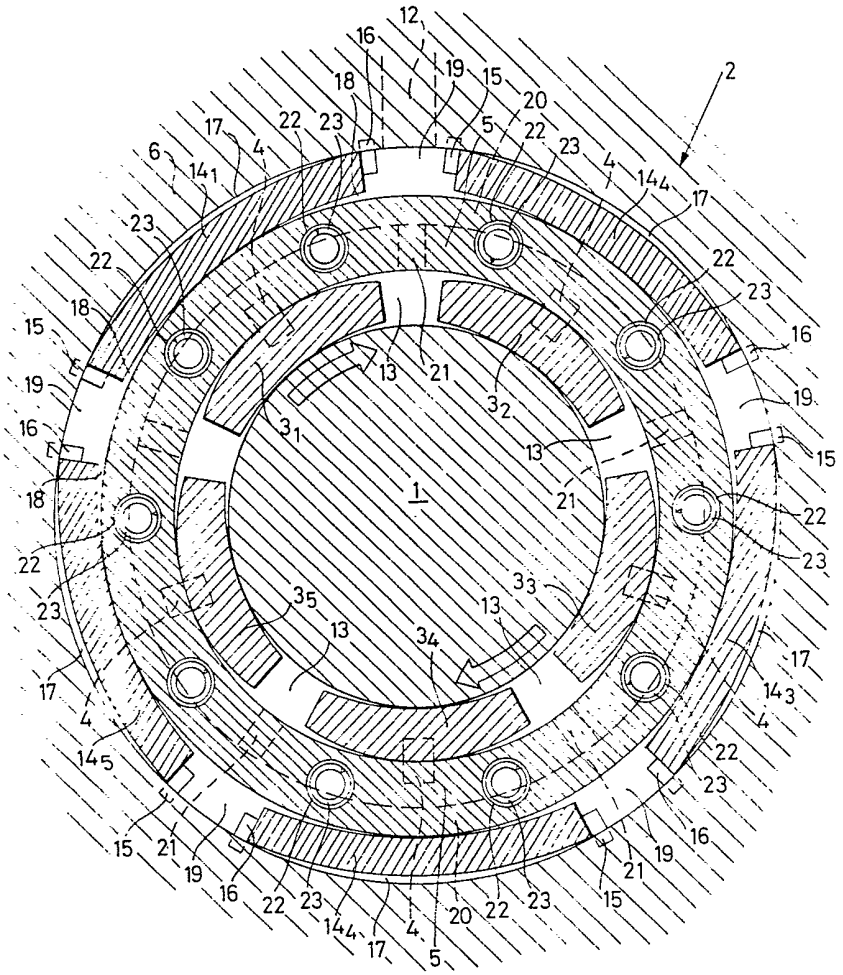

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Fig.1

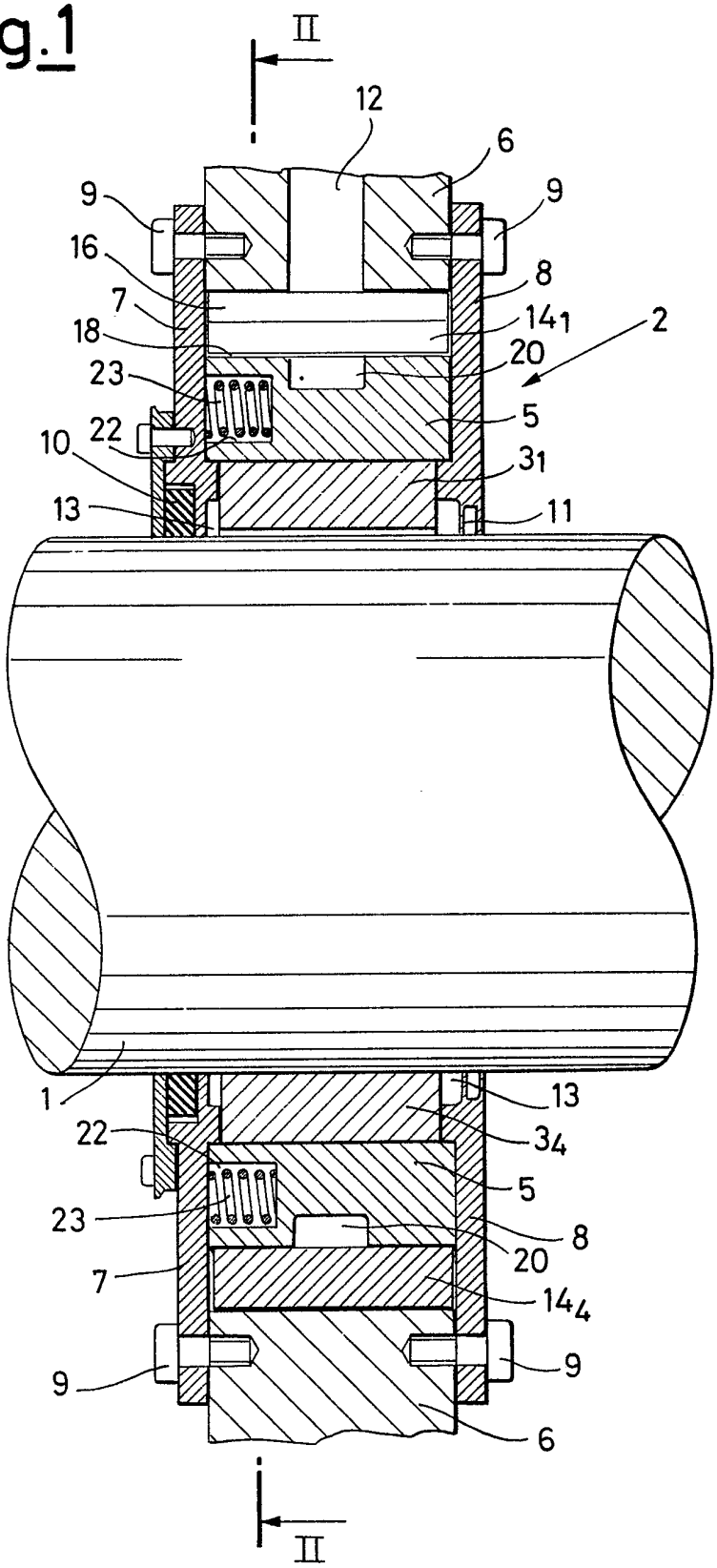

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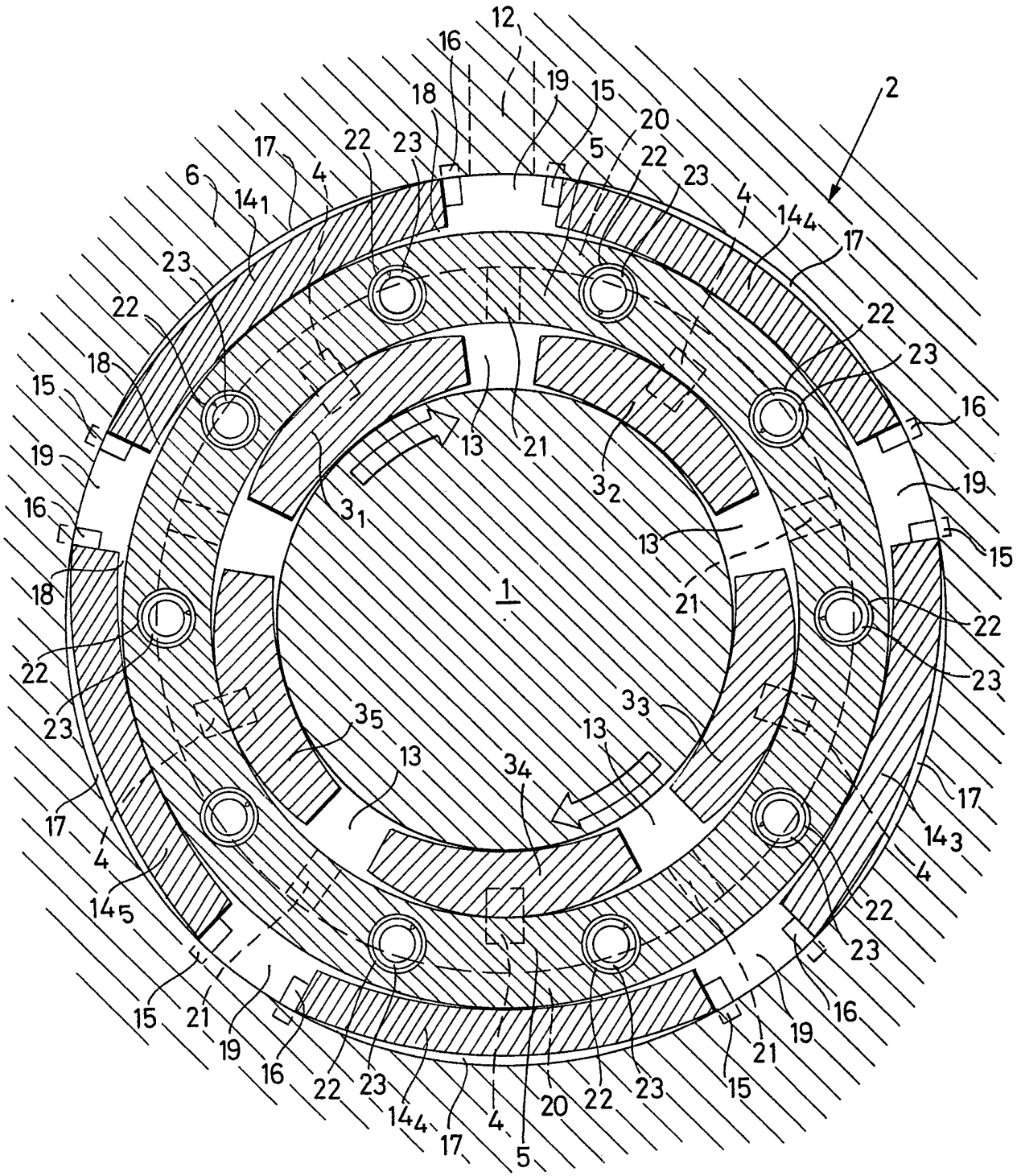
Fig.2



SPECIFICATION

Pivoted segmental bearing

This invention relates to a segmental bearing for supporting and damping the vibration of a rotating shaft, in particular a gas turbine drive shaft. More specifically, the invention relates to an effective and simple vibration damping system for a pivoted segmental bearing which besides damping the oscillation amplitude of any vibration which arises due to unbalance in the rotating assembly, in particular when passing through critical speeds at low rates of working, also enables the resilience of the shaft support bearing and consequently the critical speeds to be varied, while maintaining the overall size of the bearing practically unchanged.

A pivoted segmental bearing is generally used when large shafts easily subject to vibration have to be supported, since such a bearing is able to support high loads and to damp the vibration. One known pivoted segmental bearing consists of a set of shoes of rigid antifriction material pivotally mounted, in angularly equidistant positions, on the inner surface of an annular shoe-support member disposed about the shaft to be supported and contained in an outer support casing, the chamber in which the shoes are disposed being filled with a lubricating oil under pressure.

In this type of bearing, the damping action upon oscillations generated by vibration of the shaft arises from the fact that the vibration causes the pivoted shoes to oscillate so that the gaps between, on the one hand, the shoes and, on the other hand, the shaft being supported and the annular shoe-support member vary continuously, giving rise to rapid oil movement in the cavities which are formed with resultant pumping and sucking action in the cavities leading to a damping effect.

However, this known bearing has a series of drawbacks, the most important of which is that it is unable to completely absorb unbalance of a certain level because the extent of variation of the gaps, on which the damping effect depends, is minimal. Furthermore, the rigidity of the structure, i.e. the impossibility of varying the resilience of the bearing, leads to the further drawback that it is not possible to appropriately vary the critical speed limit in order to bring it outside the normal range of operation of the shafts to be supported.

Finally, it must be noted that the known bearing and the structure which supports it are generally not of uniform rigidity in the horizontal and vertical planes, so that the theoretical critical speeds become divided.

According to the present invention, there is provided a pivoted segmental bearing, comprising a plurality of shoes of rigid antifriction material pivotally mounted, an angularly equidistant positions, on the inner surface of a shoe-support member contained in an outer support casing provided with two retaining members each of which is provided with a seal gasket for preventing the escape of a lubricating oil which in use fills under pressure the chamber in which said shoes are disposed, there being disposed, between the outer surface of the annular shoe-support member and the inner surface of said outer support casing, a plurality of leaf springs held, in angularly equidistant positions, by lateral positioning pins supported by said outer support casing, the annular chamber in which leaf springs are disposed also being filled in use by said lubricating oil, and means being provided for resiliently pressing said annular shoe-support member axially against one of said retaining members of the outer support casing.

The advantages of the bearing of the invention are, firstly, the entire shoe-support member and its show follow the displacements of the shaft being supported, opposed by the rigidity of the leaf springs. In other words, the bearing is resilient rather than rigid, and its resilience can be easily varied at will be replacing the leaf springs with others of different rigidity. Moreover, if the unbalance of the shaft being supported causes the shoe-support member to move, the latter compresses the leaf springs by bending them, so changing the gaps between them and the annular shoe-support member and the outer support casing, these variations being of a greater extent and involving large areas, thus causing substantial oil movement with a consequent considerable damping effect. Furthermore, the damping effect of the bearing is further increased by the friction between the annular shoe-support member and the retaining members against which the shoe-support member is resiliently pressed.

A further advantage is the considerable compactness of the structure, the overall size of which is slightly increased in the radical direction but not in the axial direction, relative to the overall size of known bearings.

According to a preferred embodiment of the present invention, the leaf springs have a width equal to the length of the annular shoe-support member, and are formed from a single cut ring having a radius greater than that of the shoe-support member. In this manner, it is possible to obtain spring radii and thicknesses with very strict tolerances and in an economical and simple manner, thus providing uniformity in the gaps associated with the springs and consequently a uniform load distribution, and thus giving a structure having uniform rigidity in all directions.

In a further embodiment of the present invention, the means for resiliently pressing the annular shoe-support member axially against one of the retaining members of the outer support casing comprises a series of helical springs which are inserted into a corresponding series of axial cavities provided, in angularly equidistant positions, on the circumference of the annular shoe-support member, and which cooperate with the other of the retaining members of the outer support casing.

Finally, according to a further preferred embodiment of the invention, the annular shoe-support member has a circumferential groove in

its outer surface and radial bores therethrough, in order to facilitate passage of the lubricating oil.

For a better understanding of the invention, reference will now be made, by way of example, to the drawings in which:

Figure 1 is a partial lateral section through a pivoted segmental bearing 2 according to the invention; and

Figure 2 is a section through the bearing along the line II—II of Fig. 1.

With reference to the Figures, there is shown a gas turbine shaft 1 to be supported by the pivoted segmental bearing 2. The bearing 2 consists of a number n of shoes of rigid antifriction material 3_n (Figure 2 shows five shoes 3_1, 3_2, 3_3, 3_4 and 3_5) which are disposed angularly about the shaft 1 and are pivotally supported by pivots 4 on the inner surface of an annular shoe-support member 5 which is contained in an outer support casing 6 closed by two retaining members 7 and 8 which are fixed to the casing 6 by screws 9. The retaining members 7 and 8 are provided with seal gaskets 10 and 11 respectively, for preventing the escape of a lubricating oil which is fed under pressure through a feed duct 12 in the casing 6 and which completely fills the annular chamber 13 in which the shoes 3_n are disposed.

Between the outer surface of the annular shoe-support member 5 and the inner annular surface of the outer support casing 6, there is disposed a number n of leaf springs 14_n (Figure 2 shows five leaf springs 14_1, 14_2, 14_3, 14_4 and 14_5) held, in angularly equidistant positions, by pairs of lateral positioning pins 15 and 16, supported by the casing 6.

The leaf springs 14_n have a width equal to the length of the annular shoe-support member 5 (see Figure 1) and are formed by cutting a single ring of a radius greater than the radius of the shoe-support member 5, so as to ensure uniformity of the gaps 17 and 18.

In order to facilitate the passage of lubricating oil from the duct 12 to the chamber 13, and to ensure that the oil totally fills the annular chamber 19 in which the leaf springs 14_n are present, the annular shoe-support member 5 is provided with a circumferential groove 20 in its outer surface, and with radial bores 21 therethrough.

Finally, the annular shoe-support member 5 also has a number of circumferential axial cavities 22 in which are housed a corresponding number of helical springs 23 which cooperate with the retaining member 7 of the outer support casing 6 in order to resiliently press the annular shoe-support member 5 against the other retaining member 8.

CLAIMS

1. A pivoted segmental bearing, comprising a plurality of shoes or rigid antifriction material pivotally mounted, in angularly equidistant positions, on the inner surface of a shoe-support member contained in an outer support casing provided with two retaining members each of which is provided with a seal gasket for preventing the escape of a lubricating oil which in use fills under pressure the chamber in which said shoes are disposed, there being disposed, between the outer surface of the annular shoe-support member and the inner surface of said outer support casing, a plurality of leaf springs held in angularly equidistant positions by lateral positioning pins supported by said outer support casing, the annular chamber in which said leaf springs are disposed also being filled in use by said lubricating oil, and means being provided for resiliently pressing said annular shoe-support member axially against one of said retaining members of the outer support casing.

2. A bearing as claimed in Claim 1, wherein said means for resiliently pressing said annular shoe-support member axially against one of said retaining members of the outer support casing comprises a series of helical springs which are inserted into a corresponding series of axial cavities provided, in angularly equidistant positions, on the circumference of said annular shoe-support member, and which cooperate with the other of said retaining members of the outer support casing.

3. A bearing as claimed in Claim 1 or 2, wherein said leaf springs have a width equal to the length of the annular shoe-support member, and are formed by cutting a single ring having a radius greater than that of the shoe-support member.

4. A bearing as claimed in Claim 1, 2 or 3, wherein said annular shoe-support member has a circumferential groove in its outer surface and radial bores therethrough.

5. A pivoted segmental bearing substantially as hereinbefore described with reference to the drawings.

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