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(54) **BEARING DEVICE**

LAGERVORRICHTUNG

DISPOSITIF DE SUPPORT

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Description

[0001] The invention belongs to machine building, in particular to mounting assemblies in which rolling bearings are used. The invention can be used in machines and mechanisms where bearing assemblies operate with high speeds and are exposed to significant centrifugal loads, in particular in planetary reduction gearing units, planetary gearboxes, planetary centrifugal mills where strong artificial gravity fields exist.

[0002] A rolling bearing is known from the USSR inventor's certificate No. 176468 dated 20.03.63, international patent classification: F 06C. The above rolling bearing contains inner and outer rings, rolling elements, a cage in the form of a cartridge with teeth on one end. Asymmetric design due to a loose fit of the cartridge bushing on one shaft end is a drawback of the bearing, because in causes cage misalignment. Besides, this design does not provide for the oil supply to the bearing which limits its life time and application area only to low rotation frequencies and low centrifugal overloads.

[0003] A bearing is known from the USSR inventor's certificate No. 1328595 dated 13.06.84, international patent classification: F16 C19/54 which contains a rolling bearing on a shaft and a cogged cage which has an elongated component extending beyond the bearing limits. Additionally a bushing is fastened on the shaft.

[0004] It has a collar enveloping the elongated part of the cage. A cavity for bearing lubrication is provided inside the bushing. During operation lubricant from the cavity reaches the bushing, then the cage, bearing and shaft. However, with such a design in addition to spot friction forces between the cage teeth and rolling bodies additional surface friction forces between the outer surfaces of the cage elongated parts and the inner surface of the bushing collar occur. It results in the increase of losses to friction and heat emission associated with it. Losses repeatedly increase due to high centrifugal overloads in planetary mechanisms which causes bearing overheating and jamming. Besides, lubricant quantity is limited by the volume of the lubrication cavity. In order to fill the cavity it is necessary to disassemble the mechanism. It complicates mechanism operation.

[0005] The above drawbacks are eliminated in the design of the bearing assembly supported by the patent for an invention No. 2216659 RU of 19.10.2001, international patent classification F16C19/54. The assembly contains a body and a shaft placed inside. A rolling bearing and a cogged cage are installed on the shaft. In addition the assembly is equipped with two coaxial bushings one of which is tightly installed on the shaft and the other one is fastened on the body. The cage is placed in a cylindrical slit between these bushings. The body, shaft and bushings are equipped with interconnected passages for lubricant supply to the cage where there are openings for oil reach. Oil is supplied continuously from an external source.

[0006] Such a design reduces friction losses on the cage surface which slides on the oil film between surfaces of the bushing. This allows the cage to withstand practically any loads. Cage location between the additional bushings excludes high-frequency vibrations of the cage caused by bending occurrences and eliminates the fatigue effect on assembly materials. This increases the assembly life time and operating reliability.

[0007] However, when a high-speed and high-power load is attached to the shaft, the design of its mounting assembly does not exclude misalignments of bearing rotation axes. It causes their jamming and reduces assembly functional capacity and its application field.

[0008] A design with two and more bearings is considered to be the most reliable. In this case the load is connected to the shaft between the bearings and evenly distributed between them. Such arrangement excludes misalignment of bearing rotation shafts and allows increasing the unit life time.

[0009] The design of the bearing assembly with two bearings rested on a shaft is given in the figure attached to the above patent No. 2216659. However, to coaxial bushings are located between the bearings, and the cogged cage body is placed between them. It excludes the attachment of a loading gear to the shaft between the bearings.

[0010] An example of a mounting assembly with two bearings is given in the RU patent for invention No. 1036981 of 27.05.82, international patent classification: F16H1/28; 57/08 (prototype). The unit contains a hollow shaft with inner rings of two symmetrical rolling bearings. The rings are fastened on the shaft at intervals. Outer rings of the bearing are installed on the body. Bearing rolling bodies are separated by cages which may be supported either by rolling bodies or by inner or outer rings of the bearings.

[0011] However, such designs can work only with low centrifugal speeds and small overloads.

[0012] When operating with high speeds cages are exposed to strong centrifugal overloads which are transferred to the components supporting the cages. Contact area of the cage supporting parts with either rolling bodies or rings is very small, thus, even with flood lubrication, it causes strong overheating and wear of both cages and bearing rings, as well as rolling bodies of the bearings. It certainly causes a rapid break down of the assembly and the whole mechanism.

[0013] The purpose of the proposed design is to improve the reliability and durability of the bearing assembly, increase the specific speed and extend the life time.

[0014] In order to achieve this assigned goal the design of the support for the cages, on which at least two rolling bearings with cages are mounted at intervals, is modified. In the proposed design the support for the cages is arranged as a hollow pipe and located inside the shaft coaxially to the shaft and the cylindrical rod which is fastened on the body and equipped with oil supply passages.

[0015] The support for a cage may be placed on the cylindrical rod with a gap, or the cylindrical rod may be

placed with a gap on the support for the cage.

[0016] In the proposed design various solutions for the cage separating part may be used; in particular, they can be toothed or riveted.

[0017] The support for the cage and the cylindrical rod may corbel out of the body limits; also, it is possible to design separate supports for cages.

[0018] In order to reduce friction load cages are installed with a gap in relation to the rings of the rolling bearings. Fastening of the cages on the support passing inside the hollow shaft substitutes the friction between the support and the shaft with the friction between the support and the cylindrical rod located inside the shaft. In this case, due to the decrease of the diameter of contact surfaces friction losses and the linear speed of support sliding movement are reduced, and the load uniformity increases. Besides, due to the support location inside the shaft overall dimensions and weight of the assembly components decrease which reduces the inertia of components rotation and increases the specific speed. Continuous oil supply to the moving parts of the support assembly ensures a long-term uninterrupted operation of the mechanism.

[0019] The proposed support assembly is presented on the drawing, Fig. 1, where a longitudinal section of the assembly is shown.

[0020] The support assembly contains the shaft 1 in the form of a shallow pipe. At the ends of the shaft, separated from each other, rolling bearings are installed. Their inner rings 2 are mounted on the shaft 1, and the outer rings 3 are installed in the body 4. Roller bodies 5 are placed between the rings 2 and 3. If a cogged cage 6 is used, they are separated by the cage teeth. Other types of cages 6, in particular, riveted ones, may be used in this design.

[0021] A support 7 for the cage 6 is also represented by a hollow pipe which is mounted coaxially inside the pipe of the shaft 1. The pipe of the support 7 for the cage 6 is mounted with a gap on the cylindrical rod 8 which is fastened on the body 4. Alternatively, it is possible to mount the support 7 with a gap inside the cylindrical rod 8 fastened coaxially inside the body 4.

[0022] Passage 9 for lubricant supply to the gap between the rod 8 and the support 7 for the cage 6 is provided inside the cylindrical rod 8 and the body 4. Leaving the gap the lubricant, by gravity or splashing, is delivered to the remaining components of the assembly.

[0023] The rod 8 may be designed with an outshoot extending beyond the limits of the bearing or body 4.

[0024] Alternatively, it is possible to use for each cage 6 separate supports 7 mounted coaxially to the shaft 1 on one cylindrical rod 8, or each support 7 may be located on its cylindrical rod 8 coaxial to the shaft 1.

[0025] The support assembly operates the following way:

When the shaft 1 rotates the inner rings 2 mounted on the shaft 1 transfer the rotation to the roller bodies 5 which impact the cage 6 and make it rotate. In this case the cage 6 rotates with a frequency lower that the rotation frequency of the shaft 1.

[0026] The tubular support 7 of the cage 6 slides along the rigidly fastened cylindrical rod 8. During operation oil is supplied under pressure to the passage 9 of the cylindrical rod 8. Through the openings in the rod 8 it enters the gap between the support 7 for the cage 6 and the rod 8. Due to the above the support 7 for the cage 6 slides, practically without any friction, over the surface of the rod 8 being supported by the oil film named the oil wedge. Thus, the rolling bearings receive loads transferred to them from the shaft, and the support 7 sliding over the rod 8 form together a friction bearing which compensates for the harmful impacts of the centrifugal forces on the cage 6. It allows the cage 6 and the support assembly to withstand practically any speeds and centrifugal loads. When the supplied lubricant is cooled a thermal factor of the components is reduced.

[0027] The gap between the cogged part of the cage 6 and the bearing rings excludes their mutual contact and increases the reliability of the assembly operation. Besides, the location of bearing assemblies at the ends of the shaft 1 excludes a possibility of misalignment. It allows increasing the loads, i.e. to extend the life time of the support assembly.

[0028] The load is applied to the shaft 1 in the gap between the bearings.

[0029] Such arrangement allows maximizing the use of the strength properties of both the shaft 1 and the bearings to extend the life time and reliability of the assembly operation.

[0030] Thus, all the above drawbacks of the known assemblies with the similar application have been eliminated in the design of this bearing assembly.

[0031] The invention resolves the task to improve the reliability and durability of the bearing assembly, increase the specific speed and extend the life time.

[0032] For this purpose in the support assembly containing the hollow shaft 1 on which at least two rolling bearings with cages 6 are mounted at intervals the design of the fastening of the support 7 for the cage 6 is modified. In the proposed design the support 7 for the cage 6 is represented by a hollow pipe and located inside the shaft 1 coaxially to the shaft 1 and the cylindrical rod 8 which is fastened on the body 4 and equipped with oil supply passages.

[0033] The support 7 for the cage 6 may be placed on the cylindrical rod 8 with a gap, or the cylindrical rod 8 may be placed with a gap on the support 7 for the cage 6. In the proposed design various solutions for the cage 6 separating part may be used; in particular, they can be toothed or riveted.

[0034] The support 7 for the cage 6 and the cylindrical rod 8 may corbel out of the 4 limits; also, it is possible to design separate supports 7 for cages 6.

[0035] In order to reduce friction load cages 6 are in-

stalled with a gap in relation to the rings of the rolling bearings.

[0036] Fastening of the cages 6 on the support 7 passing inside the hollow shaft 1 substitutes the friction between the support and the shaft 1 with the friction between the support and the cylindrical rod 8 located inside the shaft 1. In this case, due to the decrease of the diameter of contact surfaces friction losses and the linear speed of support 7 sliding movement are reduced, and the load uniformity increases. Besides, due to the location of the support inside the shaft 1 the overall dimensions and weight of the assembly components are reduced.

[0037] It brings down the inertia of components rotation and increases the specific speed. Continuous oil supply to the moving parts of the support assembly ensures a long-term uninterrupted operation of the mechanism.

[0038] The proposed technical solution can be widely used in machines and mechanisms where bearing assemblies operate with high speeds and are exposed to significant centrifugal loads, in particular in planetary reduction gearing units, planetary gearboxes, planetary centrifugal mills where strong artificial gravity fields exist.

Claims

1. A support assembly having: a body (4); a hollow shaft (1); at least two rolling bearings with cages (6) mounted on the hollow shaft (1) **characterized in that** a support (7) for the cages (6) is a hollow pipe which is located inside the hollow shaft (1) and coaxially to the hollow shaft (1) and a cylindrical rod (8) which is fastened on the body (4) and equipped with oil supply passages (9).

2. The support of claim 1, wherein the support (7) for the cages (6) is mounted on the cylindrical rod (8) with a gap.

3. The support of claim 1, wherein the cylindrical rod (8) is mounted on the support (7) for the cages (6) with a gap.

4. The support of claim 1, wherein the cages (6) are cogged.

5. The support of claim 1, wherein the cages (6) are riveted.

6. The support of according to claims 1 to 5, wherein the support (7) for the cages (6) and the cylindrical rod (8) corbel out of the limits of the body (4).

7. The support according to claims 1 to 6, wherein the cages (6) have separate supports (7).

8. The support of claim 1, wherein the cages (6) are installed with a gap in relation to inner rings (2) and outer rings (3) of the rolling bearings.

Patentansprüche

1. Lagervorrichtung, umfassend: einen Körper (4); eine Hohlwelle (1); wenigstens zwei Wälzlager mit Käfigen (6), die an der Hohlwelle (1) montiert sind, **dadurch gekennzeichnet, dass** eine Lagerung (7) für die Käfige (6) ein hohles Rohr ist, das innerhalb der Hohlwelle (1) und koaxial mit der Hohlwelle (1) und einem zylindrischen Stab (8) angeordnet ist, der an dem Körper (4) befestigt ist und mit Ölzufuhrdurchlässen (9) versehen ist.

2. Lagervorrichtung nach Anspruch 1, wobei die Lagerung (7) für die Käfige (6) mit einem Abstand an dem zylindrischen Stab (8) montiert ist.

3. Lagervorrichtung nach Anspruch 1, wobei der zylindrische Stab (8) mit einem Abstand an der Lagerung (7) für die Käfige (6) montiert ist.

4. Lagervorrichtung nach Anspruch 1, wobei die Käfige (6) verzahnt sind.

5. Lagervorrichtung nach Anspruch 1, wobei die Käfige (6) vernietet sind.

6. Lagervorrichtung nach den Ansprüchen 1 bis 5, wobei die Lagerung (7) für die Käfige (6) und der zylindrische Stab (8) aus den Begrenzungen des Körpers (4) vorkragen.

7. Lagervorrichtung nach den Ansprüchen 1 bis 6, wobei die Käfige (6) separate Lagerungen (7) aufweisen.

8. Lagervorrichtung nach Anspruch 1, wobei die Käfige (6) mit einem Abstand in Bezug auf Innenringe (2) und Außenringe (3) der Wälzlager angeordnet sind.

Revendications

1. Un assemblage de support ayant : un corps (4) ; un axe creux (1) ; au moins deux paliers à rouleaux avec des cages (6) montés sur l'axe creux (1) **caractérisé en ce qu'**un support (7) pour les cages (6) est un tuyau creux qui est situé à l'intérieur de l'axe creux (1) et de façon coaxiale par rapport à l'axe creux (1) et une tige cylindrique (8) qui est fixée sur le corps (4) et équipée de passages d'alimentation en huile (9).

2. Le support de la revendication 1, où le support (7) pour les cages (6) est monté sur la tige cylindrique

(8) avec un espace.

3. Le support de la revendication 1, où la tige cylindrique (8) est montée sur le support (7) pour les cages (6) avec un espace.

4. Le support de la revendication 1, où les cages (6) sont dentées.

5. Le support de la revendication 1, où les cages (6) sont rivetées.

6. Le support selon les revendications 1 à 5, où le support (7) pour les cages (6) et la tige cylindrique (8) sont en dehors des limites du corps (4).

7. Le support selon les revendications 1 à 6, où les cages (6) ont des supports séparés (7).

8. Le support de la revendication 1, où les cages (6) sont installées avec un espace en rapport avec des anneaux inférieurs (2) et des anneaux extérieurs (3) des paliers à rouleaux.

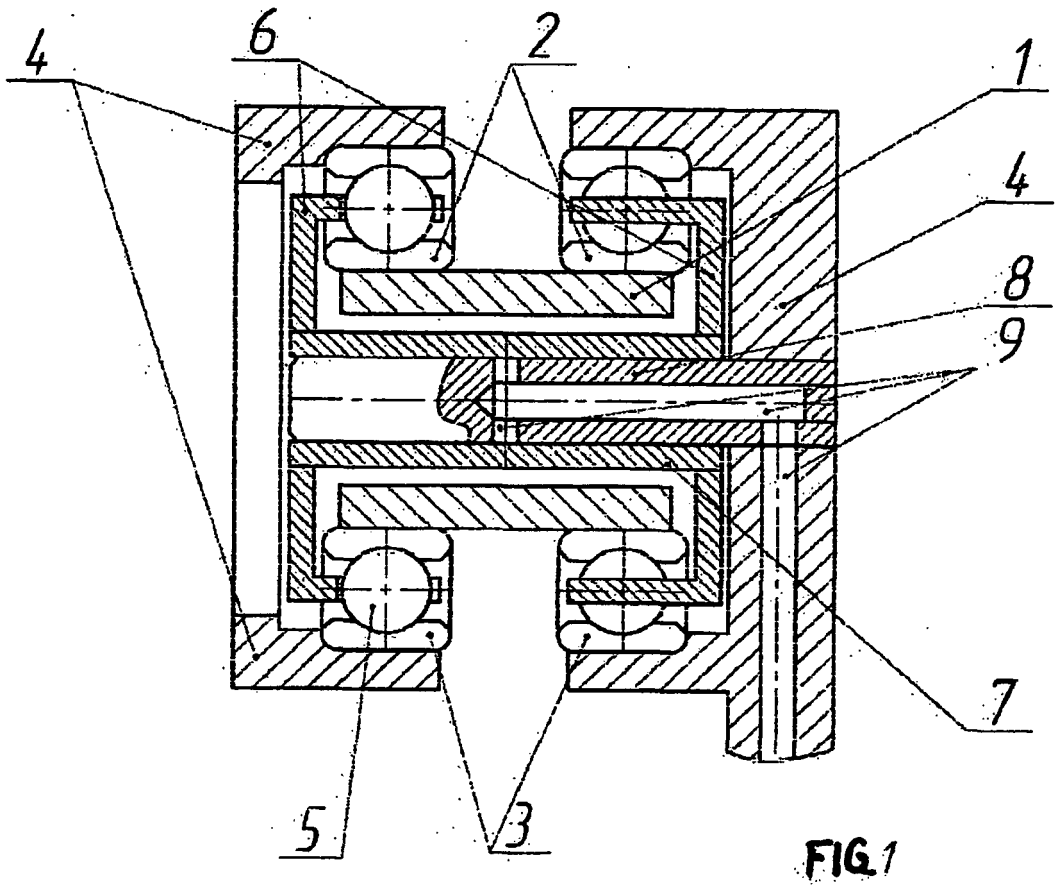

FIG.1

REFERENCES CITED IN THE DESCRIPTION

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