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Thrust bearing device.

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Description

The present invention relates to a thrust bearing device lubricated by liquid.

Hereinafter, a thrust bearing device of the type referred to above has involved the use of plural tilting pads, each pad being designed to have a particular configuration such as projecting or inflating in the central region thereof. These pads serve to constitute one of the opposing sliding surfaces. Use of these pads has in turn involved the employment of several related means and many parts which demand additional expense for the installation and maintenance thereof, maintenance being difficult. There has accordingly been a demand for a thrust bearing device of the above type which requires fewer parts and is not expensive to manufacture, install or maintain.

US-A-1,409,552 discloses a bearing comprising a disk, a sliding shoe member with a plurality of sliding shoes, and interposed flexible necks arranged to permit the tilting of said shoes. Oil films are automatically maintained between the bearing surfaces of said bearing. Springs can be used which will permit the flexing of a base ring which connects said shoes, so that the shoes can assume slightly tilted positions. Said springs also introduce an additional element of resiliency between a support and the bearing members which assists in equalizing the pressure among several bearing segments or shoes. Furthermore, US-A-1 409 552 discloses a bearing the sliding shoe member of which comprises a flexible base ring without using springs (figure 6).

Patent abstracts of Japan, Vol. 9, No. 19 (M-353) (1741), January 25, 1985 disclose a thrust bearing according to the preamble of claim 1. This bearing can be easily manufactured and has a large load capacity by solidly forming a base portion, a support portion and a sliding portion formed in such a manner, that wedge shaped oil film is easily formed to be a thrust bearing place. The base portion is a circular flat plate having rigidity and the support portion has a width and a height such that it can be bent a little by thrust load. The sliding portion has a thickness such that it can be easily bent.

FR-A-1010959 relates to a bearing using a support with a plastic layer on top of which a layer forming shoes and having cavities is provided.

It is an object of the present invention to provide a thrust bearing device lubricated by liquid, the bearing device comprising relatively few components which facilitates installation and maintenance thereof.

The above object is accomplished by a thrust bearing device according to claim 1.

The sliding disk is made of carbon impregnated with plastics or Babbitt metal. Further, details of the device will be explained following the brief description of the drawings noted below.

Fig. 1 illustrates a conventional thrust bearing device employing a tilting pad system;

Figs. 2A, 2B and 2C illustrate the construction of a thrust bearing device according to the present invention in which Fig. 2A shows a cross-section of the device wherein a IS sliding shoe member is arranged to be stationary;

Fig. 2B is a plan view of the sliding shoe member as viewed from the top; and

Fig. 2C shows a side view of the sliding shoe member;

Figs. 3A and 3B schematically illustrate the function of the device; and

Figs. 4A 4B and 4C show another embodiment of the invention wherein the sliding shoe member is employed as a rotary member; Fig. 4A is a cross section of the device, Fig. 4B a plan view of the sliding shoe member as viewed from the bottom and Fig. 4C a side view of the shoe member.

Before explaining the present invention, an example of prior art is explained by referring to Fig. 1. As shown in Fig. 1, the rotary side of the bearing device comprises a rotary disk 101; and a thrust disk 103 adapted to hold in place the disk 101 and attached to a main shaft 102; and the stationary side of the device comprises plural tilting pads 104 adapted to slidably contact the sliding surface of the rotary disk 101; retaining means 105 for retaining the tilting pads 104; and a complicated alignment mechanism constituted by several components 106 adapted to keep the respective sliding surfaces of the tilting pads 105 coplanar and this stationary side of the bearing device is simply placed on a bracket 107 of the motor.

Each of the sliding surfaces of tilting pads 104 is given a particular shape which is configured in a so-called centrally projected or inflated shape, the center portion being higher than the opposite ends, so that a wedge shaped lubricating film is properly formed between the centrally projected surfaces of the tilting pads and the surface of the rotary disk 101 during the relative rotation therebetween. In this drawing, 108 is a radial bearing, 109 a rotor and 110 a stator.

In the conventional thrust bearing device explained above, the following drawbacks may be observed.

(1) It is expensive to manufacture since the alignment mechanism constituted by the many components 106 is complicated;

(2) a retaining means constituted by components 105 is required in order to allow excessive freedom for tilting pads 104;
(3) fabrication and maintenance is not easy because of the special configuration given to the sliding surface of the tilting pads 104;
(4) installation of the thrust bearing device is limited to a particular procedure since the alignment mechanism constituted by components 106 is not fixed to the motor bracket 107;
(5) there is difficulty involved in using common components on the rotary and stationary sides; and
(6) maintenance is not easy because of the high precision required of the components 106 constituting the alignment mechanism.

In view of the foregoing, the present invention has been conceived by unifying several components on the side, i.e., either the stationary or rotary side, of the thrust bearing device so as to overcome the drawbacks noted above without adversely affecting the performance heretofore achieved in prior art.

Now the present invention will be explained hereunder.

In Fig. 2, an embodiment of a thrust bearing device according to the present invention is illustrated in which a motor casing is filled with liquid which serves to lubricate the thrust bearing device. A metallic thrust disk 2 is mounted at the lower portion of a primary shaft 1 of a motor by adapting a shrinkage fitting. On the lower surface of the thrust disk 2 is disposed a sliding disk 3 which is arrested with the disk 2 by a pin 4, the disk 3 being made of a material primarily comprising carbon impregnated with plastics or Babbitt metal.

The disk 3 has a sliding surface on the lowest side and constitutes the rotary side of the thrust bearing device.

Below the disk 3, a sliding shoe member 5 is disposed and constitutes the stationary side of the thrust bearing device. The member 5 is of metal and is provided with plural sliding shoes 5a as shown in Figs. 2B and 2C. Each shoe 5a has a flat sliding surface that forms a segment of a common co-planar surface and is supported on a common base 5c through a rib 5b. In other words, the shoe member 5 is made in one piece and the sliding surfaces of the shoes 5a are disposed in a common flat plane constituting a sliding surface of the shoe member 5 opposing and slidably contacting the lower surface of the disk 3. The shoe member 5 is fixed on a motor bracket 6 by means of a screw 8 with an elastic bearing sheet 7 made of rubber or the like interposed between the bracket 6 and the shoe member 5.

The lower end of the shaft 1 is rotatably supported by a radial bearing 10. A collar 9 is placed around the shackle 8. In the drawing, 12 is a rotor, and 13 denotes a secondary conductor.

The thrust bearing device illustrated in Fig. 2 functions as shown in Fig. 3 which will be explained below.

Fig. 3A schematically shows a condition wherein no load is applied on the thrust bearing device. Since no load is applied in the axial direction on the shoe member 5, the shoe 5a is not deformed. However, when load is applied in the axial direction as shown in Fig. 3B, the shoe 5a is deformed downwardly in proportion to the applied load assuming its rib 5b to be the center of deformation and a liquid film in a wedge shape is formed between the rotary disk 3 and the shoes 5a. Also, the portion of the base 5C below the rib 5b is deformed with the deformation of elastic sheet 7. Hence a high loading capacity can be expected of this device as in the case of a conventional thrust bearing device employing a tilting pad system.

Also, due to the presence of the elastic bearing sheet 7, the inevitable manufacturing tolerances created between the sliding surface of the disk 3 and the top surface of the bracket 6 are absorbed or compensated for by the deformation of the sheet 7. This prevents local contact of the sliding surfaces of the shoes 5a and the sliding mode of the respective shoes is kept uniform.

In Fig. 4, another embodiment of the present invention is illustrated in which the stationary side and the rotary side of the thrust bearing device shown in Fig. 2 are interchanged with each other.

In this case, a sliding shoe member 13 made of metal is arranged to be a rotary side member. The shoe member 13 is configured in a similar manner to the shoe member 5 shown in Fig. 2 and is provided with plural sliding shoes 13a each having a flat sliding surface arranged with the other shoe surfaces in a common plane and supported on a common base 13C by a rib 13b, respectively. The shoe member 13 is fixed to a primary shaft 11 of a motor by means of a shrinkage fitting or the like. A disk 15 constitutes a stationary side member having a sliding surface and is placed on a motor bracket 16 with an elastic bearing sheet 17 made of rubber or the like interposed therebetween.

The disk 15 is primarily made of carbon impregnated with plastics or Babbitt metal and is arrested on the bracket 6 by means of a pin 21. Reference number 22 is a rotor and 23 denotes a secondary conductor. In this embodiment, a rotary disk similar to the disk 2 shown in Fig. 2 may be omitted so that the construction of the rotary side can be further simplified. The function of the shoe member 13 is almost the same as that of the shoe member 5 of Fig. 1.

It is apparent that the configuration of the sliding shoe member 5 or 13 may be complex; how-
ever, it can be easily manufactured by casting using a lost-wax process or the like. Further the
sliding surfaces of plural shoes can be machined at
one time in a common plane (lapping finish). With
the construction of the thrust bearing device ac-

a) A high thrust loading capacity can be ex-
pected similar to that of a device employing a
so-called tilting pad system;
b) The manufacturing tolerances of the related
parts can be absorbed by an elastic bearing
sheet;
c) An alignment mechanism is not required;
d) Cost saving can be expected by as much as
1/3 - 1/5 of the cost of the stationary side of a
conventional device;
e) Manufacturing is easy since fabrication of
complex surfaces such as the centrally projec-
ted or inflated configuration required in the tilting
pad system is not necessary;
f) Provision of excessive freedom of the bearing
components such as the tilting pads is unnec-
essary which facilitates assembly and installa-
tion of the thrust bearing device as a whole; and
g) Components on the rotary side and the sta-
tionary side may be interchanged since the
shoe member is a unitary member.

Claims

1. "A thrust bearing device lubricated by liquid
comprising: a sliding disk (3) having a sliding
surface; and a sliding shoe member (5) pro-
vided with plural sliding shoes (5a) unitarily
supported on a common base (5c) through
respective ribs (5b), each shoe having a flat
sliding surface coplanar with the surfaces of
the other shoes and adapted to slidably con-
tact said sliding surface of said sliding disk (3),
said sliding shoe member (5) being arranged
to be the stationary side of the thrust bearing
device and said sliding disk (3) being arranged
to be the rotary side of the thrust bearing
device, wherein each shoe (5a) is unitarily con-
ected to said rib (5b) at a lengthwise central
region thereof and, when a load is applied, the
shoe (5a) is elastically deformable by being
bent towards the common base (5c), the cen-
ter of bending being defined by the rib (5b),
characterised in that
the thrust bearing device for an electric motor
is within a motor casing,
the sliding disk (3) is fixed to a motor shaft (1),
the sliding shoe member (5) is disposed on a
motor bracket (16), with an elastic sheet (7)
terposed therebetween,
when a load is applied the sliding shoe mem-
ber (5) with its portions where the ribs (5b) are
located is moved towards the motor bracket
(16) by the common base (5c) which is deform-
able with the deformation of the elastic sheet
(7)."

2. A thrust bearing device as claimed in Claim 1
wherein said disk (3) is made of carbon imp-
regnated with plastics or Babbitt Metal and
said shoe member (5) is made of metal.

3. A thrust bearing device as claimed in Claim 1
wherein said common base (5c) includes a
recess in the bottom thereof for receiving and
confining said elastic sheet therein.

Patentansprüche

1. Eine Axiallagervorrichtung, die durch Flüssig-
keit geschmiert wird, weist folgendes auf:
eine Gleitscheibe (3) mit einer Gleitoberfläche;
und ein Gleitschuhgled (5), das mit vielen
Gleitschuhen (5a) versehen ist, die einheitlich
auf einer gemeinsamen Basis (5c) durch ent-
sprechende Rippen oder Stege (5b) getragen
sind, wobei jeder Schuh eine flache Gleitober-
fläche besitzt, die koaxial mit den Oberflä-
chen der anderen Schuhe liegt und die in der
Lage ist, gleitbar die Gleitoberfläche der Gleit-
scheibe (3) zu kontaktieren, wobei das Gleit-
schuhgled (5) auf der stationären Seite der
Axiallagervorrichtung angeordnet ist und die
Gleitscheibe (3) auf der Drehseite der Axialla-
gervorrichtung angeordnet ist, wobei jeder
Schuh (5a) einheitlich mit dem Steg (5b) ver-
bunden ist an einem länglichen Mittelbereich
davon und wenn eine Last angelegt wird, der
Schuh (5a) elastisch verformbar ist, indem er
in Richtung der gemeinsamen Basis (5c) gebo-
gen wird, wobei die Biegunungsmitte durch den
Steg (5b) definiert wird,
dadurch gekennzeichnet, daß sich die Axial-
lagervorrichtung für einen elektrischen Motor
innerhalb eines Motorgehäuses befindet, das
die Gleitscheibe (3) an einer Motorwelle (1)
befestigt ist, das das Gleitschuhgled (5) an
einem Motorbügel oder Träger (16) mit einem
elastischen Flächenelement (7) dazwischen an-
gerichtet, angeordnet ist;
daß sich das Gleitschuhgled (5), wenn eine
Last angelegt wird, mit seinen Teilen, wo die
Steg (5b) angeordnet sind, in Richtung des
Motorbügels (16) durch die gemeinsame Basis
(5c) bewegen, die mit der Verformung des
elastischen Flächenelements (7) verformbar ist.

2. Axiallagervorrichtung nach Anspruch 1, wobei
die Scheibe (3) aus Carbon hergestellt ist, der
mit Plastik oder Babbitmetall imprägniert ist, wobei das Schuhglied (5) aus Metall hergestellt ist.

3. Axiallagervorrichtung nach Anspruch 1, wobei die gemeinsame Basis (5c) eine Ausnehmung in dessen Boden besitzt zur Aufnahme und zum Einschließen des elastischen Flächenelements darinnen.

Revendications

1. Dispositif formant palier de butée lubrifié par un liquide comprenant : un disque coulissant (3) possédant une surface coulissante; et un élément de coussinet coulissant (5) présentant une pluralité de patins coulissants (5a) supportés unitairement sur une base commune (5c) par des nervures respectives (5b), chaque patin possédant une surface coulissante plate coplanaire avec les surfaces des autres coussinets et apte à venir en contact coulissant avec ladite surface coulissante dudit disque coulissant (3), ledit élément de coussinet coulissant (5) étant disposé pour être le côté stationnaire du dispositif formant palier de butée et ledit disque coulissant (3) étant disposé pour être le côté rotatif du dispositif formant palier de butée, dans lequel chaque patin (5a) est connecté unitairement à ladite nervure (5b) à une région centrale dans le sens de la longueur de celle-ci et, lorsqu’une poussée est appliquée, le patin (5a) est deformable élastiquement en étant incliné vers la base commune (5c), le centre d’inclinaison étant défini par la nervure (5b), caractérisé en ce que le dispositif formant palier de butée pour un moteur électrique se trouve à l’intérieur d’un carter de moteur, le disque coulissant (3) est fixé à un arbre de moteur (1), l’élément de coussinet coulissant (5) est disposé sur un support de moteur (16) avec une feuille élastique (7) interposée entre ceux-ci, lorsqu’une poussée est appliquée, l’élément de coussinet coulissant (5) avec ses portions où les nervures (5b) sont localisées, est déplacé vers le support de moteur (16) par la base commune (5c) qui est deformable conjointement avec la déformation de la feuille élastique (7).

2. Dispositif formant palier de butée selon la revendication 1, dans lequel ledit disque (3) est réalisé en carbone imprégné avec du plastique ou un métal antifriction, et ledit élément de coussinet (5) est réalisé en métal.

3. Dispositif formant palier de butée selon la revendication 1, dans lequel ladite base commune (5c) comprend un évidement dans son fond pour recevoir et confiner ladite feuille élastique à l’intérieur.
Fig. 1