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(71) Applicant: ALLIEDSIGNAL INC. [US/US]; 101 Columbia Road, P.O. Box 2245, Morristown, NJ 07962-2245 (US).

(72) Inventor: ECCLES, Steven, R.; 21820 Grant Avenue, Torrance, CA 90503 (US).

(74) Agent: CRISS, Roger, H.; AlliedSignal Inc., Law Dept. (C.A. McNally), 101 Columbia Road, P.O. Box 2245, Morristown, NJ 07962-2245 (US).

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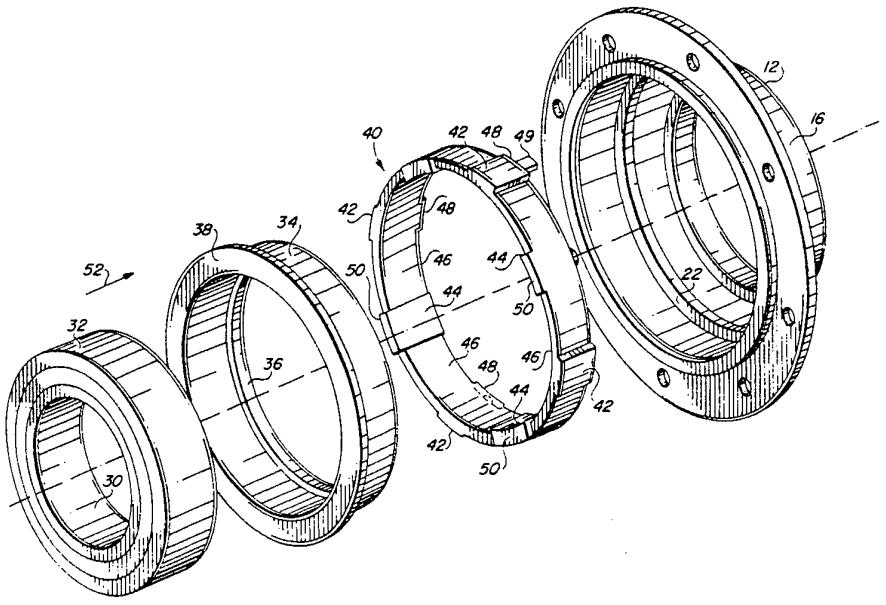

(57) Abstract

A roller ball bearing (14) for carrying both axial and radial loads from a rotating shaft (10) to a stationary housing (12) includes a resilient isolation mount ring (40) disposed between the housing (12) and the outer race (32) of the ball bearing (14). In addition to radially extending pads (42, 44) on the isolation mount (40) to define flexural beam portions (46) therebetween for damping radial motion, the isolation mount ring (40) also includes axially extending pads (48, 50) thereon which engage opposed, radially extending thrust shoulders (22, 39) on the housing (12) and the outer race (32) to transmit axial loading from the bearing (14) to the housing (12). The axial pads (48, 50) space and isolate the radially flexing beam portions (46) of the isolation mount ring (40) to provide a frictionless bearing assembly.

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FRICTIONLESS RESILIENT BEARING MOUNT

TECHNICAL FIELD

This invention pertains to roller bearings of the type subjected to substantial radial and axial loads such as may be utilized in turbomachinery.

BACKGROUND OF THE INVENTION

Turbomachinery such as may be utilized in a ram air turbine for aircraft typically must carry and transmit to the surrounding housing significant radial and axial loads as may be induced upon the turbine governor and blades of such machinery. It has been known previously to utilize a resilient mount ring or isolator between the housing and the outer bearing race in order to resiliently mount a roller ball bearing to the housing for radially journalling the shaft and for absorbing axial loading. While such resilient mount rings are generally effective in many applications of roller ball bearings, the significant axial loads as generated by the turbine governor and blades in a ram air turbine can introduce substantial frictional contact on the mount ring.

SUMMARY OF THE INVENTION

It is an important object of the invention to provide a resilient, isolation mount ring for a roller bearing subject both to axial and radial loads, wherein the configuration of the resilient mount ring prevents and precludes frictional rubbing contact of the mount ring with the housing and the bearing race.

More particularly, the invention contemplates a resilient isolation mount ring disposed between the housing and the outer race of the bearing, wherein radially inwardly and outwardly extending pads on the mount ring actively contact the housing and the bearing race to define flexible beam portions between these radial pads. The beam portions are radially flexible in order to resiliently mount the bearing upon the housing in known fashion. With this, the present invention contemplates the addition of axial pads at opposite ends of the mount ring which respectively engage thrust shoulders on the housing and on the bearing race. The

axial pads engage the first shoulders to transmit axial thrust from the bearing to the housing. Importantly, the axial pads serve to space and separate the beam portions of the resilient mount from the housing and the race to avoid frictional contact therewith. In this manner, frictional rubbing of the beam portions of the resilient mount is fully precluded.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an axial cross-sectional view of a bearing constructed in accordance with the principles of the present invention, with portions of the associated stationary housing and rotating shaft also illustrated;

FIG. 2 is an exploded perspective view of various components of the roller bearing, resilient mount, and housing of the present invention;

FIG. 3 is a partial side view of the resilient mount constructed in accordance with the principles of the present invention, with portions exaggerated in relative dimension for clarity of illustration; and

FIG. 4 is a view similar to FIG. 1 but showing a modified version of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now more particularly to FIGS. 1-3, illustrated is a shaft 10 as may be carrying the turbine of a ram air turbine. Such a ram air turbine (not shown) is deployable from the body of an aircraft in an emergency situation into the airstream outside the aircraft. The ram effect of the airstream drives the turbine to generate emergency power. As such, the shaft 10 is subject to significant axial and radial loads, the axial thrust being up to 400 lbs.

The shaft is rotatably mounted within the stationary housing 12 through a bearing assembly generally denoted by the numeral 14. Typically the housing 12 may include a bearing carrier 16 and bearing retainer 18 which are rigidly secured to the main housing 12 through bolts 20. Pertinent to the present invention is the radially inwardly depending thrust shoulder 22 on bearing carrier 16. This first thrust shoulder 22 absorbs axial thrust loading from the bearing assembly 14 to the housing 12. The

bearing assembly 14 is mounted to shaft 10 through conventional securement elements 24, 26.

The bearing assembly 14 illustrated is a conventional roller ball bearing having a plurality of ball bearing elements 28 in rolling engagement with an inner race 30 rigidly secured to rotate with the shaft 10, and an outer race 32 which is stationary. In the embodiment illustrated in FIG. 1, an axially extending thrust liner 34 is disposed between the housing and the outer race 32, and includes radially inwardly and outwardly turned ends 36, 38. Axial thrust 52 directed rightwardly as viewed in FIG. 1 is transmitted from the shaft 10 through the inner race 30, bearing elements 28, outer race 32 to the end 36 of the thrust liner. From here the axial thrust is transferred to the opposite end 38 of the thrust liner 34. A small clearance gap is located between bearing retainer 18 and both the bearing outer race 32 and thrust liner end 38 to preclude any contact during operation.

Importantly, the present invention incorporates a resilient isolation mount ring 40 which is operably disposed between housing bearing carrier 16 and the thrust liner 34 of the bearing. As best depicted in FIGS. 2 and 3, the mount ring 40 includes a first set of radially extending pads 42 which extend radially outwardly from the mount ring 40 to directly engage bearing carrier 16. The first set of radial pads 42 are regularly spaced about the circumference of the mount ring 40, four pads 42 being illustrated in the embodiment of FIGS. 1-3.

The resilient mount ring 40 also includes a second set of radial pads 44 which extend radially inwardly from the resilient mount 40 to directly engage the outer surface of the thrust liner 34. These second radial pads 44 are also regularly spaced about the circumference of the mount ring in alternating, interdigitated relation to the first set of radial pads 42. Between the first and second sets of pads 42, 44 are defined a plurality of flexible beam portions 46 of the resilient mount 40. These flexible beam portions 46 are flexible in a radial direction in order to stiffly, yet resiliently mount the bearing assembly 14 upon the housing 12. By permitting the bearing assembly 14 to move a radial direction, the resilient isolation mount 40 acts like a spring to absorb shaft and rotor vibrations. The radial dimensions of the first and second sets of radial pads 42, 44, are exaggerated in proportion to the remainder of the mount ring 40 for clarity

of illustration. It will be appreciated by those skilled in the art that the number, placement, and height or radial dimension of the radial pads 42, 44 are chosen in order to provide the resiliency needed for absorbing radial motion in the particular application of the bearing.

In the resilient isolation mount ring 40 of the present invention there is also included a first set of axially extending pads 48 which extend axially from a first end face of the isolation mount ring 40 into direct engagement with the first thrust shoulder 22 on the housing bearing carrier 16. Importantly, the first set of axial pads 48 are disposed at the same circumferential location as the first set of radial pads 42 such that both the sets of pads 42, 48 engage the housing bearing carrier 16 in non-moving relation thereto.

Additionally, the resilient isolation mount 40 includes a second set of axial pads 50 which extend axially from a second, opposite axial end of the mount ring 40 to directly engage a second thrust shoulder 39 defined at the end 38 of thrust liner 34. Axial pads 50 are located at the same circumferential stations as the second set of inwardly extending radial pads 44 such that both the axial pads 50 and radial pads 44 contact the thrust liner 34 in non-moving relation thereto.

Preferably, an anti-rotation tab 49 extends further axially from one of the axial pads 48 to be loosely received in a groove in the bearing carrier housing 16. Tab 49 prevents rotation of resilient mount ring 40.

In operation, radial loading on shaft 10 is transmitted through the bearing assembly 14 to the outer surface of thrust liner 34 to the inwardly extending first set of radial pads 44 on the isolation mount ring 40, through the mount ring 40 to the second set of outwardly extending radial pads 42 to ultimately be transmitted to the housing bearing carrier 16. The flexible beam portions 46 of the mount ring 40 can flex radially to absorb radial vibrations and motion. Axial thrust, as illustrated by the arrow 52 in FIG. 3, is transmitted through the bearing assembly to the thrust liner 34 and the second thrust shoulder 39. From here the axial thrust is transmitted through the second set of axial pads 50 on mount ring 40, through the mount ring 40 itself, and then to the first set of axial pads 48 for ultimate transmission to the housing bearing carrier 16.

Importantly, the first and second sets of axial pads 48, 50 axially space the beam portions 46 from the thrust liner 34 and the bearing carrier 16. As a result, the beam portions 46 can flex radially in non-contacting relation to the first and second thrust shoulders 22, 39. Elimination of this sliding friction and substantially all contact between the radially flexible beam portions 46 and the adjacent axial thrust shoulders 22, 39 allows free and predictable radial flexure of the beam portions 46. This permits the isolation mount ring 40 to be designed for absorbing radial motion in a highly predictable fashion. In comparison, prior art arrangements allow direct contact between the radial flexing beam portions of the isolation mount ring upon the adjacent axial thrust faces.

FIG. 4 illustrates a modified arrangement of the present invention inasmuch as the thrust liner 34 of FIG. 1 has been eliminated. In particular, the bearing assembly 140 illustrated in FIG. 4 is a flanged bearing having a radially upstanding flange 142 at one end thereof to define the second thrust shoulder 139. The same resilient mount ring 40 is illustrated in FIG. 4, but with the axially extending pads 50 directly contacting the second thrust shoulder 139 integrally formed on the outer race 136 of bearing assembly 140. It will be apparent that the FIG. 4 arrangement operates in the same manner as described above with respect to FIGs. 1-3.

Claims:

1. A roller bearing for mounting, a rotatable shaft to a stationary housing, comprising:

first and second bearing races respectively secured to said housing and said shaft;

roller bearing elements in rolling contact with and between said first and second races;

a first thrust shoulder extending radially inwardly from said housing;

a second thrust shoulder operably carried on said first race and extending radially outwardly therefrom;

a resilient mount ring disposed between said housing and said first bearing race, said ring having first and second sets of pads extending radially outwardly and inwardly from said ring and being regularly alternately spaced about the circumference of said resilient mount ring to define radially flexible beam portions between adjacent pads, said beam portions radially flexible to resiliently mount said bearing to said housing; and

said resilient mount ring further including first and second sets of axial pads extending axially from opposite ends of said mount ring to engage said first and second thrust shoulders respectively, said first and second sets of pads axially spacing said beam portions from said housing and said first race to prevent frictional contact therewith upon radial flexing of the beam portions.

2. A roller bearing as set forth in Claim 1, further including an axially extending thrust liner having opposite ends extending radially inwardly and outwardly, said outwardly extending end defining said second thrust shoulder, said liner operably carried on said first race and located radially between said first race and said resilient mount ring, said liner transmitting axial thrust from said first race to said resilient mount ring.

3. A roller bearing as set forth in Claim 2, wherein said first set of axial pads engaging said first thrust shoulders are disposed at the same circumferential locations as said first set of radial pads extending radially outwardly from said mount ring to contact said housing.

4. A roller bearing as set forth in Claim 3, wherein said second set of axial pads engaging said second thrust shoulders are disposed at the same circumferential locations as said second set of radial pads extending radially inwardly from said mount ring to contact said first race.

5. A roller bearing as set forth in Claim 1, wherein said first set of axial pads engaging said first thrust shoulders are disposed at the same circumferential locations as said first set of radial pads extending radially outwardly from said mount ring to contact said housing.

6. A roller bearing as set forth in Claim 5, wherein said second set of axial pads engaging said second thrust shoulders are disposed at the same circumferential locations as said second set of radial pads extending radially inwardly from said mount ring to contact said first race.

7. A roller bearing as set forth in Claim 1, wherein said second thrust shoulder is integrally formed on said first race.

8. A roller bearing as set forth in Claim 7, wherein said first set of axial pads engaging said first thrust shoulders are disposed at the same circumferential locations as said first set of radial pads extending radially outwardly from said mount ring to contact said housing.

9. A roller bearing as set forth in Claim 8, wherein said second set of axial pads engaging said second thrust shoulders are disposed at the same circumferential locations as said second set of radial pads extending radially inwardly from said mount ring to contact said first race.

10. A roller bearing as set forth in Claim 1, further including an anti-rotation tab extending axially from one of said first set of axial pads into engagement with said housing to prevent rotation of said mount ring.

AMENDED CLAIMS

[received by the International Bureau on 15 May 1995 (15.05.95); original claim 1 amended; remaining claims unchanged (1 page)]

1. A roller bearing for mounting, a rotatable shaft to a stationary housing, comprising:

first and second bearing races respectively secured to said housing and said shaft;

roller bearing elements in rolling contact with and between said first and second races;

a first thrust shoulder extending radially inwardly from said housing;

a second thrust shoulder operably carried on said first race and extending radially outwardly therefrom;

a unitary, endless resilient mount ring disposed between said housing and said first bearing race, said ring having first and second sets of pads extending radially outwardly and inwardly from said ring and being regularly alternatively spaced about the circumference of said resilient mount ring to define radially flexible beam portions between adjacent pads, said beam portions radially flexible to resiliently mount said bearing to said housing; and

said resilient mount ring further including first and second sets of axial pads extending axially from opposite ends of said mount ring to engage said first and second thrust shoulders respectively, said first and second sets of pads axially spacing said beam portions from said housing and said first race to prevent frictional contact therewith upon radial flexing of the beam portions.

2. A roller bearing as set forth in Claim 1, further including an axially extending thrust liner having opposite ends extending radially inwardly and outwardly, said outwardly extending end defining said second thrust shoulder, said liner operably carried on said first race and located radially between said first race and said resilient mount ring, said liner transmitting axial thrust from said first race to said resilient mount ring.

3. A roller bearing as set forth in Claim 2, wherein said first set of axial pads engaging said first thrust shoulders are disposed at the same circumferential locations as said first set of radial pads extending radially outwardly from said mount ring to contact said housing.

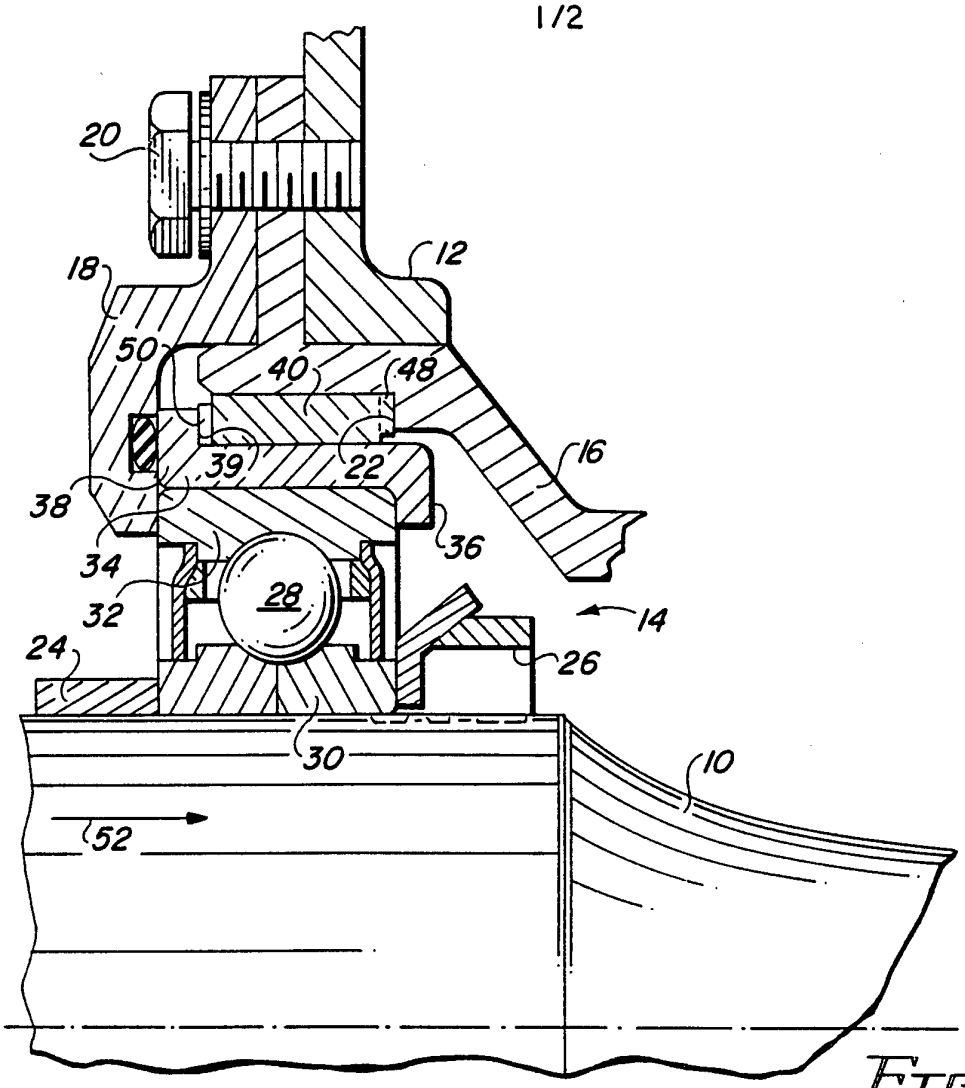

FIG. 1

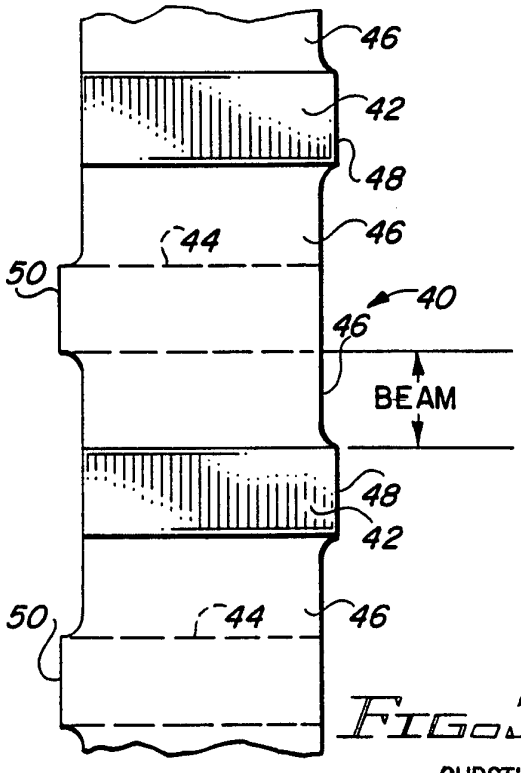

FIG. 3

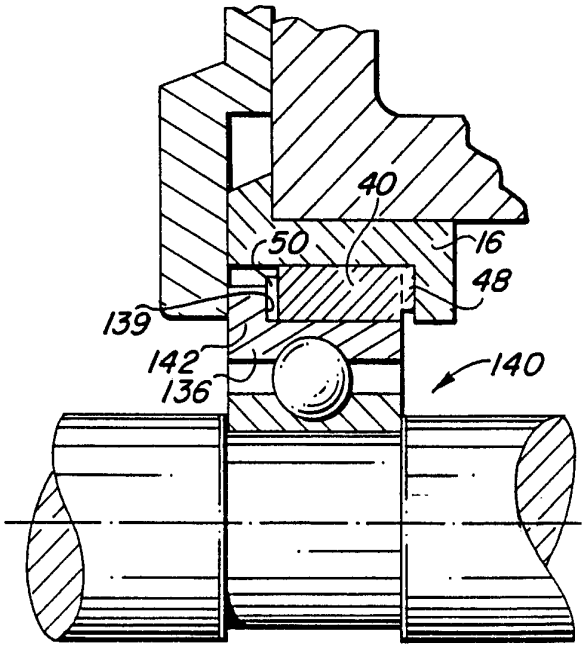

FIG. 4

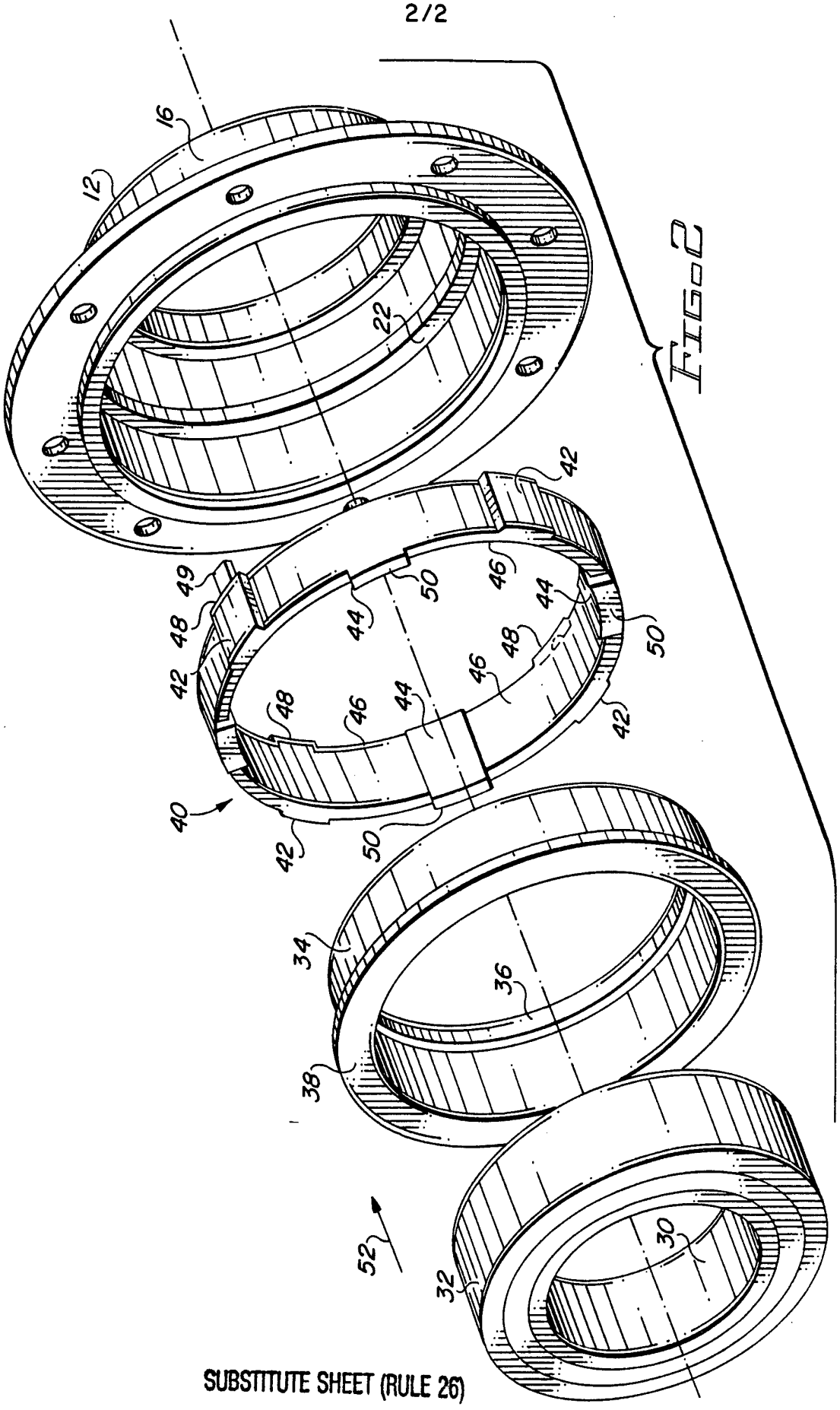

Fig. 2

INTERNATIONAL SEARCH REPORT

Internat al Application No
PCT/US 94/13502

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 F16C27/04 F01D25/16

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 F16C F01D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US,A,4 952 076 (WILEY) 28 August 1990 see the whole document	1,6,7,9
A	FR,A,2 234 808 (VSESOJUZNI ...) 17 January 1975 see page 15, line 22 - page 16, line 3; figures 10,3	1
A	GB,A,126 561 (HINDLE) 5 June 1919 see the whole document	1
A	US,A,4 981 415 (MARMOL) 1 January 1991 see figure 5	1,2
A	DE,A,37 28 039 (KLÖCKNER-HUMBOLDT-DEUTZ) 2 March 1989 see figures 1,2	1

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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3 March 1995	23. 03. 95

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INTERNATIONAL SEARCH REPORT

Information on patent family members

Internal Application No
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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US-A-4952076	28-08-90	NONE	
FR-A-2234808	17-01-75	NONE	
GB-A-126561		NONE	
US-A-4981415	01-01-91	NONE	
DE-A-3728039	02-03-89	NONE	