

(19)



Europäisches Patentamt
European Patent Office
Office européen des brevets



(11) Publication number:

0 510 828 A2

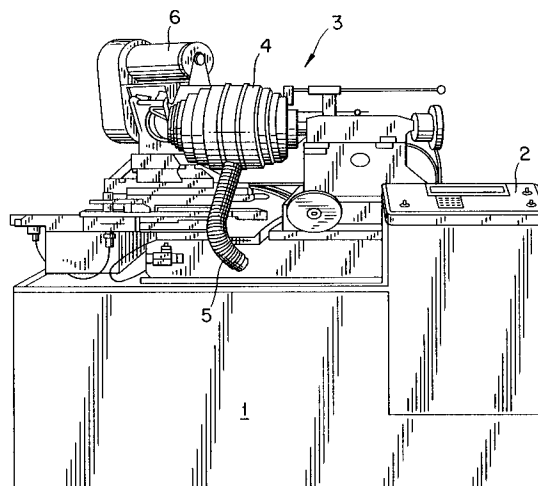
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EUROPEAN PATENT APPLICATION(21) Application number: **92303049.8**(51) Int. Cl.⁵: **B24B 13/00, B24B 55/02**(22) Date of filing: **07.04.92**(30) Priority: **25.04.91 US 691364**(43) Date of publication of application:
28.10.92 Bulletin 92/44(84) Designated Contracting States:
DE ES FR GB IT(71) Applicant: **COBURN OPTICAL INDUSTRIES, INC**
1701 S. Cherokee
Muskogee, OK 74402-0627(US)(72) Inventor: **Hill, Phillip D.**
2202 Nebraska
Muskogee, Oklahoma 74403(US)(74) Representative: **Jenkins, Peter David et al**
PAGE, WHITE & FARRER 54 Doughty Street
London WC1N 2LS(GB)(54) **Apparatus for cutting and shaping material.**

(57) Apparatus for cutting and shaping material which includes at least one bearing arrangement. The bearing arrangement comprising:

- a hollow sleeve member;
- a rotatable shaft disposed in the hollow sleeve member;
- a bearing race assembly disposed between the hollow sleeve member and the rotatable shaft to facilitate the relative rotation therebetween; and
- an end cap disposed to close off the hollow sleeve member and enclose the bearing arrangement.

Fluid is injected into the internal environment of the hollow sleeve member and caused to flow, at least in part, between the components and out of the bearing arrangement so as to prevent the ingress of unwanted material into the arrangement.

Fig. 1**EP 0 510 828 A2**

The present invention relates to apparatus for cutting and shaping material, and, in particular to apparatus for cutting and shaping lens material.

A large percentage of the spectacle lenses manufactured for the market today are manufactured from polymeric materials, such as CR39. With a number of the materials used when the lens blank is subjected to a generating operation, such as lathing, the swarf is deposited in the form of a fine particulate material which is washed away by the flow of cooling material over the lens blank and caught up in a suspension therein. This cooling material and particulate swarf mixture, as would be expected, has an extremely abrasive nature which when in an environment having relatively movable components can cause excessive wear of those materials of the components.

A number of conventional lens generating apparatus include a lathe type lens blank cutting operation. Therefore, the lens generating machine includes a quill which has one end exposed to the environment surrounding the actual cutting environment which will undoubtedly include some of this cooling material and particulate swarf mixture. Now with this conventional arrangement no specific attempt is made to prevent the egress of the mixture between the relatively movable components, except that of high manufacturing quality and low tolerance operation is normally adopted.

Ultimately, this means that it is possible that under certain operating conditions the cooling material and particulate swarf mixture can penetrate between the relative movable components and result in corrosion and/or excessive wear damage thereto.

It should be noted that in normal operation the relatively movable (actually rotational) components may be rotating at a speed in excess of 8000 rpm with respect to one another. Obviously this leads to a high degree of frictional force which is dissipated in the form of heat. Consequently, the lens generator components, in particular the quill, in the vicinity of these relatively rotatable components are subjected to a heating effect.

Now with the normal amount of use that these lens generators are subject to there is a considerable rise in the temperature of the components, and internal environment, of the lens generator in the vicinity of the relatively movable components. This in turn will lead to an expulsion of air in the heated area, some of the expelled air will pass out through the space between the relatively rotatable components.

Now, when the lens generator is not in use air will be drawn back into the general area from which it has been expelled to compensate for the air expelled during generating operation of the generator. It is this drawing back in of air which can

cause cooling material and particulate swarf mixture to be drawn into the space between the relatively rotating components and result in significant corrosion and wear damage.

Clearly, any corrosion and wear damage to the lens generator will cause a reduction in the operating efficiency and accuracy of the lens generator, ultimately, leading to the increase in required maintenance for the lens generator. The present invention is concerned with overcoming the problem of corrosion and excessive wear damage as detailed above.

In accordance with the present invention, apparatus for cutting and shaping material includes at least one bearing arrangement, which bearing arrangement comprises

- a hollow sleeve member;
- a shaft disposed in the hollow sleeve member and which is relatively rotatable with respect thereto;
- a bearing race assembly disposed between the hollow sleeve member and the shaft in order to facilitate the relative rotation therebetween; and
- an end cap disposed to close off the hollow sleeve member and enclose, and so protect, the bearing arrangement;

wherein a fluid may be injected into the internal environment of the hollow sleeve member at a point between the bearing race assembly and the end cap, which fluid is caused to flow out, at least in part, between the components without passing through the bearing race assembly.

In the present invention when the injection of fluid into the internal environment of the hollow sleeve member is maintained during the cooling down of the components and environment that have undergone a heating effect, a net outflow of fluid is maintained, and consequently the drawing in of cooling material and particulate swarf is avoided. In this way the corrosion and abrasive wear damage mentioned above is alleviated and the best protection is achieved.

In a preferred embodiment of the present invention the fluid injected into the internal environment of the hollow sleeve member is a gaseous material, and most preferably air.

Preferably, the gaseous material is injected into the internal environment at a pressure of 4-5 psi above the surrounding atmospheric pressure.

In accordance with a second aspect of the present invention, the invention comprises a lens generator which incorporates a bearing arrangement as hereinbefore described.

The invention will now be illustrated by way of description of an example made in accordance with the present invention and as illustrated in the accompanying drawings in which:-

Figure 1 shows a side view of a lens generator made in accordance with the present invention; Figure 2 shows an end view of the lens generator shown in Figure 1 of the drawings;

Figure 3 shows a schematic side view of a first form of bearing arrangement for use in the lens generator as shown in Figure 1 of the drawings; and

Figure 4 shows a schematic side view of a second form of bearing arrangement for use in the lens generator as shown in Figure 1 of the drawings.

Now referring to Figures 1 and 2 of the accompanying drawings there is shown a lens generator which includes a bearing arrangement made in accordance with the present invention.

The lens generator is essentially the same as those presently available in the marketplace, and consequently only a brief outline description will be given here.

The lens generator includes

- a main body part 1 which is substantially hollow but on which the remainder of the lens generator is deployed;
- a control means 2 which includes a microprocessor and which controls the operation of the lens generator;
- a lens cutting section 3; and
- a swarf removal system which includes a hood 4 that is attached to the section side of a pump housed in the main body part 1 by means of a hose 5.

The lens cutting section 3 as with a majority of lathe type cutting arrangements includes:

- a lens blank holding means,
 - a motor 6 which causes the lens blank cutting/grinding means to rotate about its axis, and thereby rotate the lens blank cutting/grinding wheel therein;
 - a lens blank mounted on a block, the block being mounted so that its position is adjustable.
- and
- a quill.

Now referring to Figure 3 of the accompanying drawings there is shown a sectional view of a bearing arrangement for use in one end of the quill of a lens generator made in accordance with the present invention, which bearing arrangement would normally be disposed with the hood 4 of the lens generator. However, it should be readily understood that this is not the only place where such a bearing arrangement may be disposed, and the invention should in no way be limited thereby.

In this particular arrangement the quill comprises

- a hollow metal sleeve;
- a rotatable shaft 12 mounted within the hol-

low metal sleeve;

- an end cap having an orifice 14 so that when the end cap 13 is positioned about an end of the hollow metal sleeve 11 the rotatable shaft 12 extends through said orifice;
- a bearing race assembly 15 disposed between the rotatable shaft 12 and the hollow metal sleeve 11 so that it enables the shaft and the sleeve 11 to rotate with respect to one another; and
- an adjusting nut 16 disposed in one end of the hollow metal sleeve 11, and including an orifice 17 which enables the rotatable shaft 12 to extend therethrough.

The hollow metal sleeve 11 has a throughbore 17 in which is located the rotatable shaft 12. For the most part this throughbore 17 is of constant diameter, however at one end of the hollow metal sleeve the throughbore 17 has an increased diameter. In this way a shelf 18 is defined in the hollow metal sleeve 11.

Immediately adjacent to the shelf 18 there is defined a first circumferentially extending groove 19.

A second circumferentially extending groove 20 is provided in the vicinity of the end of the hollow metal sleeve 11. The area 39 between the second circumferentially extending groove 20 and the end of the hollow metal sleeve 11 is screw threaded.

Externally, the hollow metal sleeve 11 comprises a main portion 22 of constant diameter and an end section 23 of slightly greater diameter than the main portion 22. A circumferentially extending groove 21 divides the main portion 22 and the end section 23.

At the extreme end of the hollow metal sleeve 11 there is a projecting ring 24 which is formed integrally of the hollow metal sleeve 11. This projecting ring 24 has an internal diameter substantially the same as the end section 23 of the hollow metal sleeve 11 but an external diameter substantially less than said sleeve 11 and projecting along the longitudinal axis of the hollow metal sleeve 11. The internal surface of this projecting ring 24 is screw threaded.

The rotatable shaft 12 comprises a main section 25, a bearing section 26, a threaded portion 27 and an end section 28. The bearing section 26, threaded portion 27 and the end section 28 are immediately adjacent to one another at an end of the rotatable shaft 12, being separated from one another by steps 45 and 46 respectively.

The end cap 13 comprises an essentially disk-like member having a hub-like centre 29 that projects inward and defines the orifice 14 through which, in the constructed lens generator, the rotatable shaft 12 extends. The internal surface of the

hub-like centre is provided with a screw threaded portion which engages with the threaded portion 27 on the rotatable shaft 12 to hold the rotatable shaft 12 and the end cap 13 in position with respect to one another.

The disk-like member is also provided with two inwardly projecting flange-like members 29 and 30. The first of these flange-like members 29 is positioned at the extreme edge of the disk-like member, and the second flange-like member 30 is spaced between the hub-like centre and the first flange-like member so as to define two annular space 31 and 32.

The bearing race assembly 15 includes two ball bearing race arrangements. Each of the ball bearing race arrangements comprises an inner race member 33 which is in engagement with the rotatable shaft 12, and an outer race member 34 which is in contact with the increased diameter section of the throughbore 17. Ball bearings 35 are mounted between the inner race member 33 and the outer race member 34 of each ball bearing race arrangement to facilitate relative motion therebetween.

The adjusting nut 16 is a ring-like member having two upwardly extending members 36 and 37. The first of those upwardly extending members 36 is on the outer edge of the ring-like member and on its outer face, with respect to the quill, has a screw threaded portion 38 which engages the screw thread provided in the area 39 of the hollow metal sleeve 11 to hold the adjusting nut 16 and the hollow sleeve member in relative position.

The second upwardly extending member 37 is inwardly spaced from the first upwardly extending member 37, so defining an annular space.

A skirt member 43 extends around the outer periphery of the adjusting nut 16 on the side thereof not including the members 26 and 27 and from a longitudinal sense facing inwards. The skirt member 43 is provided with a series of holes 44 which communicate with the space defined within the skirt member 43.

In the assembled form the rotatable shaft 12 is disposed in the throughbore 17 of the hollow metal sleeve 11.

The ball bearing race arrangements are disposed between the rotatable shaft 12, over the bearing portion 26 thereof, and the inner surface of the throughbore 17 of increased diameter. The innermost ball bearing race arrangement being forced into the position where the outer race member 34 thereof abuts against the shelf 18 of the hollow metal sleeve 11, and the two ball bearing race arrangements are in contact with one another.

The adjusting nut 16 is located about the rotatable shaft 12, and the screw threaded portion 38 thereof engaged with the area 39 of the hollow

metal sleeve. The adjusting nut 16 is rotated until it has correctly located the ball bearing race arrangements in the hollow metal sleeve 11, and is then used to hold said ball bearing race arrangement in position.

The end cap 13 is then located about the end of the rotatable shaft 12, and the screw threaded portion of the hub-like centre 29 of the end cap 13 is engaged with the threaded portion 27 of the rotatable shaft 12. The end cap 13 is then screwed down onto the threaded portion 27 of the rotatable shaft 12, and in so doing the flange-like member 29 is outwardly disposed with respect to the projecting ring 24, which projecting ring 24 along with the upstanding member 36 of the adjusting nut 16 is disposed in the annular space defined between the flange-like members 29 and 30. Further, the upstanding member 37 of the adjusting nut 16 is disposed in the annular space defined by the second flange member 20 and the hub-like centre 29 of the end cap 13.

The engagement of the various members in the respective annular space as detailed above is relatively tight in order to provide some degree of tightness, and thereby provide a degree of sealing so as to prevent the ingress and egress of liquid borne material, for example swarf particles in the cooling material used during the lens generating operation.

Now in accordance with the present invention, a connection means 40 is provided in the hollow metal sleeve 11 in the vicinity of the end thereof having the projecting ring 24. The connection means 40 in this particular example includes a screw threaded internal surface 41 to enable location and securing of a screw threaded hose nipple. A connecting passage 42 extends from the base of the connecting means 40 to the second circumferentially extending groove 20 so as to enable the passage of a gaseous material, for example air, from the hose to a position between the bearing race assembly and the end cap 13.

The gaseous material is introduced into the connecting passage 42 at a pressure slightly in excess of the surrounding atmosphere, normally 4-5 psi in excess, and is forced to flow around the second circumferential groove 20. The gaseous material is then caused to flow between the adjusting nut 16 and the hollow metal sleeve 11, through the holes 44 in the skirt 43 and into the space defined in the adjusting nut 16. The gaseous material then flows between the adjusting nut 16 and the end cap 13, and the end cap 13 and the projecting ring 24 of the hollow metal sleeve 11 where it flows into the atmosphere.

Now in normal operation of the lens generator the bearing race assembly and the components in the immediate vicinity thereof undergo a heating

effect resultant from frictional forces between the moving components. This causes any air in this area to expand resulting in a net outflow of air along a similar route between the end cap 13 and the adjusting nut 16 to the flow of gaseous material mentioned above.

When the lens generator is not operating, the bearing race assembly and surrounding components cool, resulting in a net flow of material into the area along the route previously mentioned for the net outflow of material. A majority of the material drawn into the area under normal conditions will be air from the surrounding atmosphere. However, in a majority of cases an amount of cooling liquid used during the lens generation process, including some particulate material from the lens blank(s) cut will be drawn into the area.

This in turn would cause corrosion and wear type damage to the end cap 13 and the adjusting nut 16 if action was not taken.

In the present invention it is proposed that the flow of gaseous material through the hose and communicating passage is maintained during the cooling process. In this way a net flow of air from the area between the end cap 13 and the projecting ring 24 of the hollow metal sleeve 11 is maintained, so preventing any material from the vicinity of the lens generating operation being drawn into the bearing arrangement. Thereby, the damage caused by corrosion and wear damage because of by particulate material in the cooling liquid can be alleviated.

Now referring to Figure 4 of the accompanying drawings there is shown a sectional view of a second embodiment of bearing arrangement for use in a quill of a lens generator made in accordance with the present invention.

The bearing arrangement shown here is essentially the same as that shown in Figure 3 of the drawings and, consequently, like numerals have been used to describe like components.

In the present embodiment the rotatable shaft 12 is of hollow construction, with the end section 28 being separated from the threaded portion 27 by a shelf 30 and a groove 31 and the threaded portion 27 being separated from bearing section 26 by a step 52 and a groove 53. A skirt member 54 is circumferentially disposed about the rotatable shaft 12 and is located with respect thereto by a number of splines 55.

Further, in this example the bearing section 26 is an integral part of the main part of the rotatable shaft 12.

In the assembled condition the end cap 13 abuts against the shaft 50; the innermost ball bearing race arrangement inner race member abuts against the skirt member 54 and a circumferential ring is provided that abuts against the inner race

member of the outermost ball bearing race arrangement and the step 53 to locate the arrangement in position.

In assembly the completely assembled rotatable shaft and ancillary equipment is inserted into the hollow metal sleeve 11 in a ready assembled condition.

The operation of the gaseous flow is identical to that described with regard to the first example.

Claims

1. Apparatus cutting and shaping material includes at least one bearing arrangement, which bearing arrangement comprises

- a hollow sleeve member;
- a shaft disposed in the hollow sleeve member and which is relatively rotatable with respect thereto;
- a bearing race assembly disposed between the hollow sleeve member and the shaft in order to facilitate the relative rotation therebetween; and
- an end cap disposed to close off the hollow sleeve member and enclose the bearing arrangement

wherein a fluid is injected into the internal environment of the hollow sleeve member at a point between the bearing race assembly and the end cap, which fluid is caused to flow out, at least in part, between the components without passing through the bearing race assembly.

2. Apparatus as claimed in claim 1, wherein the fluid injected into the internal environment of the hollow sleeve member is a gaseous material and most preferably air.

3. Apparatus as claimed in claim 2, wherein the gaseous material is injected at a pressure 4-5 psi above the surrounding atmospheric pressure.

4. A lens generator incorporating a bearing arrangement, which bearing arrangement comprises

- a hollow sleeve member;
- a shaft disposed in the hollow sleeve member and which is relatively rotatable with respect thereto;
- a bearing race assembly disposed between the hollow sleeve member and the shaft in order to facilitate the relative rotation therebetween; and
- an end cap disposed to close off the hollow sleeve member and enclose the bearing arrangement

wherein a fluid is injected into the internal environment of the hollow sleeve member at a point between the bearing race assembly and the end cap, which fluid is caused to flow out, at least in part, between the components without passing through the bearing race assembly. 5

5. A lens generator as claimed in claim 4, wherein the fluid injected into the internal environment of the hollow sleeve member is a gaseous material and most preferably air. 10

6. A lens generator as claimed in claim 5, wherein the gaseous material is injected at a pressure 4-5 psi above the surrounding atmospheric pressure. 15

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Fig. 1

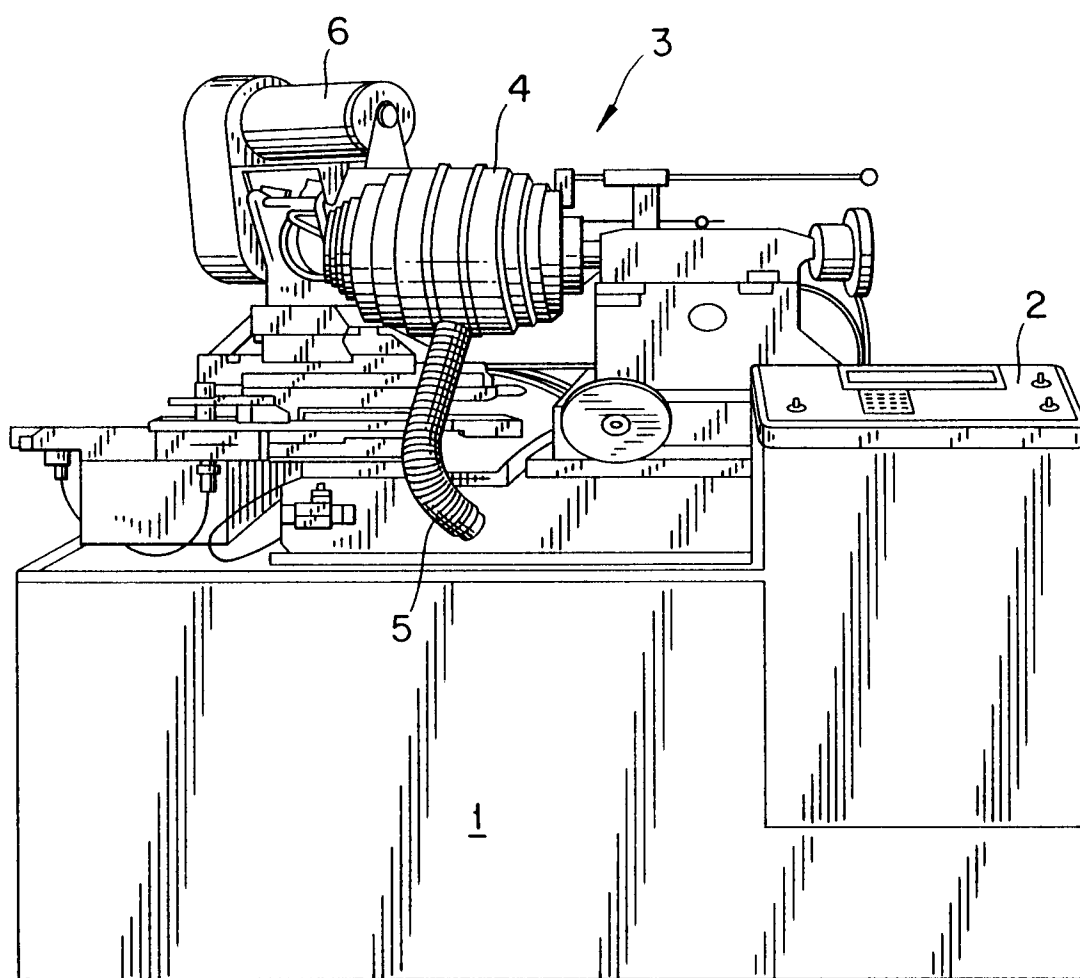


Fig. 2

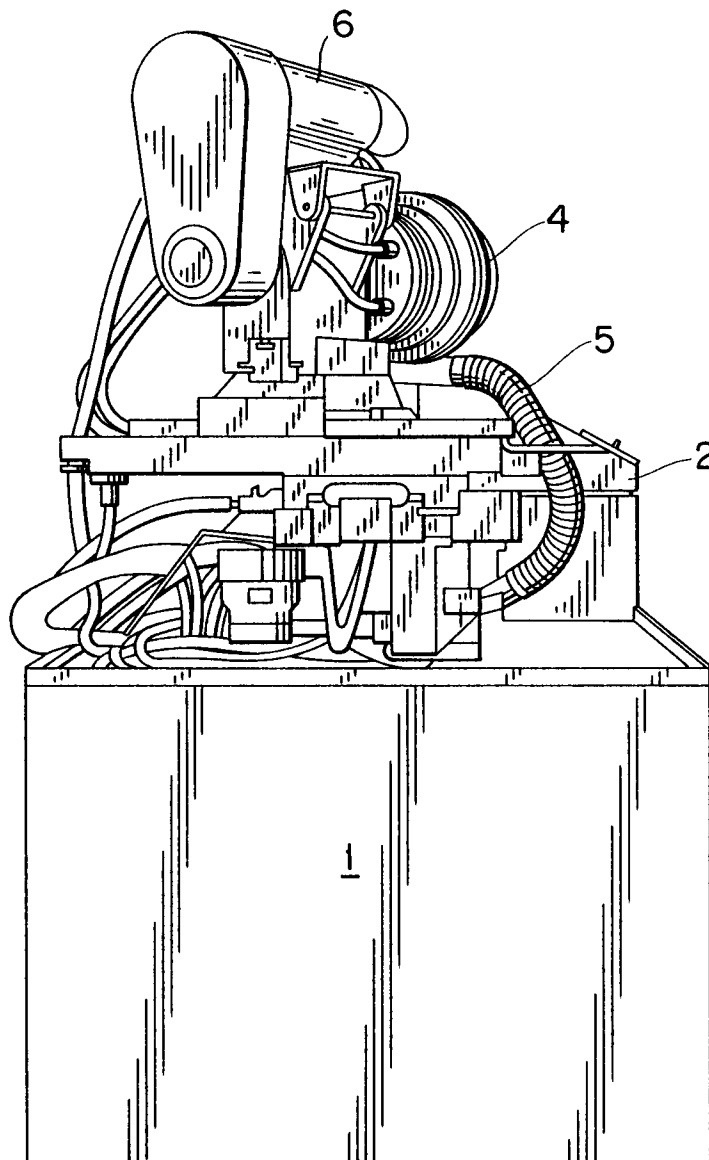


Fig. 3

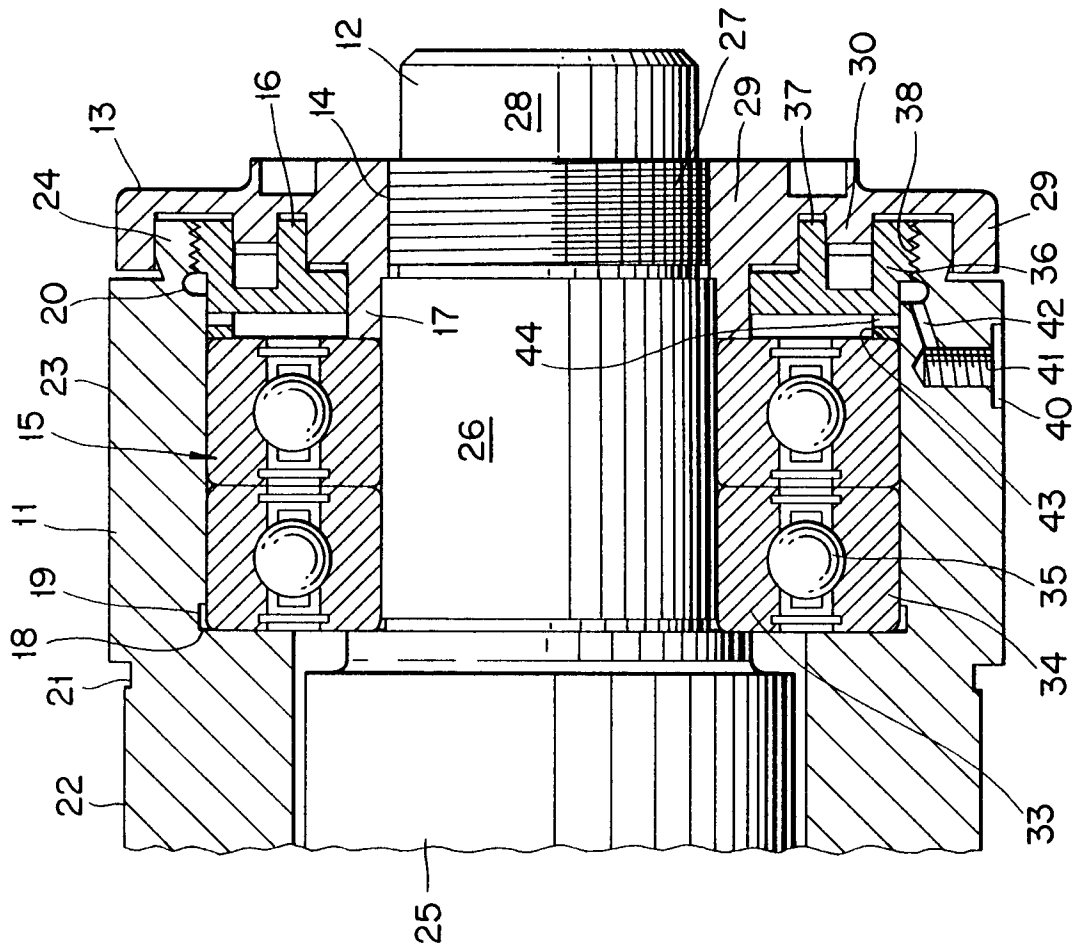


Fig. 4

