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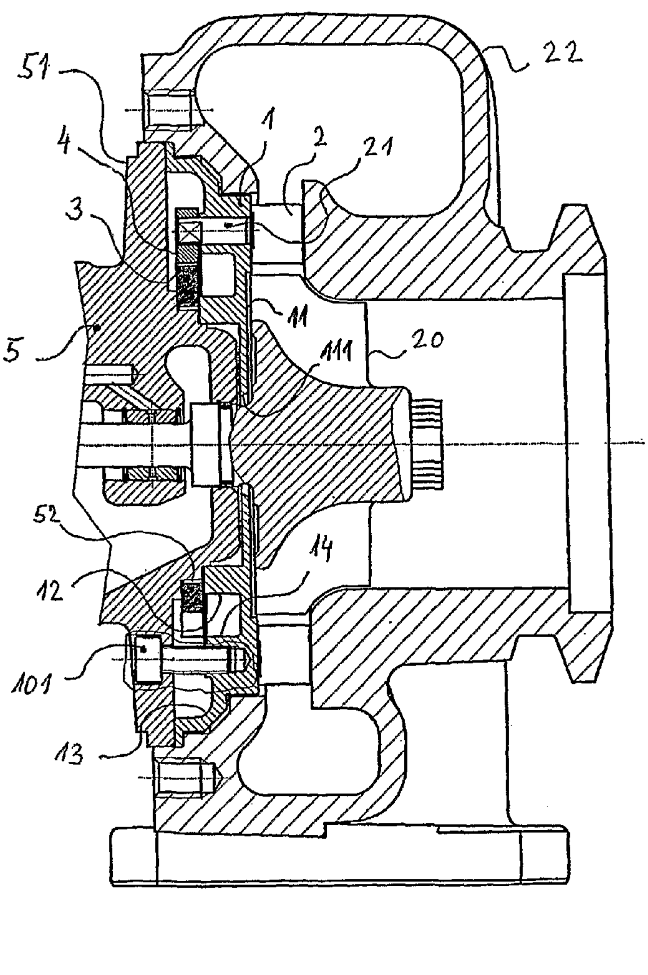
(54) Title: TURBOCHARGER WITH VARIABLE TURBINE GEOMETRY



(57) Abstract: The invention applies to the turbocharger with a variable geometry of guide blades, with a guide-blade support, located between the bearing housing and the turbine housing. The basis is that the support (1) of the guide blades (2) consists of a saucer-shaped element, with a thinned flat bottom (11) in the central area, with a central opening (111) adapted to rotor (20) shaft penetration. In the area the distance of which from the centre is 30-70% of the outer diameter of this support (1) of the guide blades (2), the support (1) is reinforced with an axial cylindrical stiffener (12), which, if assembled, reaches as far as the front of the bearing housing (5) of the turbocharger, with 0.1-0.7 mm of guaranteed play from this front. At the same time, a saucer-shaped edge (13) is located at the periphery of the support (1) of the guide blades (2), and this edge, if assembled, fits on to the edge of the bearing-housing front (5), with the bottom (11) reinforced (14) in the radial direction between the axial cylindrical stiffener (12) and the saucer-shaped edge (13) of the support (1) of the guide blades (2). The bottom has blade axial openings (112), in which the pins (21) of the guide blades (2) are embedded, with adjusting arms (4) fixed to the inside of the pins (21) of the guide blades (2).

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TURBOCHARGER WITH VARIABLE TURBINE GEOMETRY

Technical Field

The invention concerns turbochargers with a variable geometry of turbine guide blades, designed in particular for supercharging a combustion engine. The invention applies mainly to the turbine housing design and the guide-blade system mounting.

Background Art

There are currently various known turbocharger-housing designs, relating mainly to various arrangements of the variable guide-blades in the housing. As far as the blade arrangement, blade-drive mechanism and blade-tilting synchronisation are concerned, there are basically two main known types of design. One is based on blades tilting by means of a shaft, which also serves as a bearing axis and a rotation axis of these blades. The movement of all blades is synchronised by a ring, mounted in turbocharger's main body, and this ring is tilted by means of a lever or a pull-rod connected to the drive mechanism outside the housing. The other design is based on blades tilting directly by the ring, located at the sides of the blades, and the ring is linked with the blades by protrusions on the blades that fit in the recesses or groves in the ring, or vice versa. Both these designs have their pros and cons. A synchronisation ring located outside the blade area is thus protected against high temperatures but there is an increased likelihood of choking up the ring with carbon. The opposite is true about a ring located at the blades. As far as the turbocharger housing is concerned, one of important factors is to attain good thermal insulation between the blade and turbine area and the area of bearings in which the common shaft of the turbine and the blower is located and where the heat input must be reduced to prevent overheating of both the bearing and the oil that is passing through. Designs according to files US 4643640, US 4654941 US 4659295, and US 4804316, with a metal shield integrated in the turbocharger housing, located flush with and behind the shaft entry into the bearing area, are available examples of increasing this insulation. However, even this thermal shielding may be insufficient under extreme load. Another known adjustment to reduce the danger of mutual deformations and possible jamming is to achieve the blade rotation and tilting by interconnecting the blade ring and the mechanism. Examples of other similar designs of the bearing housing, its wall, and supplementary parts adjusted to allow mounting the guide blades are those according to the US 4679984 and US 4770603 files.

All these designs are always based on a compromise between the aforementioned requirements and the requirement of a simple design, if possible, which involves easy mounting. One of the disadvantages of the current solutions appears to be in particular the relatively complicated shape of the front of the bearing housing, often the insufficient thermal shielding of the bearing area and many times also the relatively large overall dimensions of the turbocharger, in particular with regard to the dimensions of the area where the blade-control system and the synchronisation ring are located.

Disclosure of Invention

All aspects of these disadvantages are reduced and a compact overall shape and good thermal insulation of turbocharger's bearing area are achieved, while keeping the housing design and mounting relatively simple, in turbocharger with a variable guide-blade geometry, with a guide-blade support located between the bearing housing and the turbine housing, according to the presented invention, which is based on the saucer-shaped guide-blade support, with a thinned flat bottom in the central area, with a central hole adapted to rotor shaft penetration. In the area the distance of which from the centre is 30-70% of the outer diameter of this guide-blade support, the support is reinforced with an axial cylindrical stiffener, which, when assembled, reaches as far as the front of turbocharger's bearing housing, with 0.1-0.7 mm of guaranteed play from this front. Also, at the periphery of the guide-blade support there is a saucer-shaped edge, which, if assembled, fits on to the edge of the bearing housing front, with the bottom reinforced in the radial direction between the axial cylindrical stiffener and the saucer-shaped edge of the guide-blade support. The bottom has blade axial holes, with the pins of the guide-blades fitted into these holes, while adjusting arms are fixed to the inside of the guide-blade pins. The guide-blade support can be conveniently centred against the bearing housing using the inner surface of the bottom's cylindrical support. Another benefit can be achieved by directing the adjusting arms of the guide-blades towards the centre of the guide-blade support, with the heads of the adjusting arms fitted into the outer adjusting openings of the adjusting ring, fixed in a radial direction to the cylindrical surface on the front of the bearing housing, and arranged in the axial direction between the radial front surface of the bearing housing and the opposite radial front surface of the axial cylindrical stiffener of the guide-blade support. A functional benefit is achieved if the inner surface of the adjusting ring fits on to the outer cylindrical surface on the bearing housing by means of relief grooves. Another benefit stems from the location of the axial opening at the edge of the peripheral collar of the bearing housing, in which the control pin of the adjusting ring is fitted, with an adjusting-ring control arm located on the inside of this pin, the head of this control arm fitted into the control opening on the adjusting-ring surface, and a pull-rod lever located on the outside of the pin. As far as the control of the adjusting ring is concerned, a benefit can be achieved by directing the adjusting-ring control arm towards the turbocharger axis while the pull-rod lever is directed from the turbocharger axis. To make sure that the pull-rod lever reliably abuts, a stop-fork should be located near the axial opening at the edge of the bearing housing collar, with the arms of this fork projecting axially along both sides of the pull-rod lever. For statically defined mounting of the support on the bearing housing and to prevent undesirable stress, the system of the bearing housing, guide-blade support and rotor housing should be designed in such a way that the outer diameters of the bearing housing collar and of the saucer-shaped edge of the guide-blade support fitted on to the collar are flush mounted against the inner diameter through these outer diameters of the slid-on inner cylindrical surface of the turbine housing with a guaranteed play. Of these two plays, the play between the outer diameter of the saucer-shaped edge of the guide-blade support and the inner diameter of the opposite inner cylindrical surface of the turbine housing is greater than the other. A last but not least benefit is achieved if axial threaded holes are available in the bottom reinforcement area of the guide-blade support, with the screws fixing the guide-blade support to the bearing housing collar screwed in these holes, while the rotor housing is fixed to the bearing housing collar with a flange, which projects beyond the bearing housing collar.

This is what a variable guide-blade geometry turbocharger is based on, with a simple and sturdy design and compact dimensions at the same time. What is more, there are even heat distribution and mainly acceptable differences in temperature, time and place, good thermal protection of the bearing housing, which, in this design, is covered by the guide-blade support virtually throughout its front, as well as the thermal protection of the entire guide-blade tilting mechanism.

Brief Description of Drawings

The presented invention is described in detail below and explained using an example. Drawings are enclosed, with fig.1 showing the longitudinal vertical section of the turbine and part of the bearing housing, fig.2 showing in detail the longitudinal vertical section of the fixation of the adjusting-ring control pin with a pull-rod lever and adjusting-ring control arm, fig.3 showing the front of the adjusting ring, and fig.4 showing the front of the guide-blade support from the inside. Fig.5 shows the bearing housing – a view of the collar through the housing, fig.6 shows the bearing housing – a view from the rotor, fig.7 and fig.8 show the side view and the top view of the stop-fork.

Description of the Preferred Embodiment

The turbocharger design in this example consists of a bearing housing, a blower, which is not shown here, and a turbine shown here, which includes a guide-blade support, located between the bearing housing and the turbine housing. An important fact is that the support 1 of guide blades 2 consists of a saucer-shaped element, with a thinned flat bottom 11 in the central area, with a central opening 111 adapted to rotor 20 shaft penetration. In the spot located in the distance of 45% of the outer diameter of this support 1 of guide blades 2 from the centre, the support 1 is reinforced by an axial cylindrical stiffener 12, which, when assembled, reaches as far as the front of turbocharger's bearing housing 5, with a guaranteed play of 0.3 mm from this front. A saucer-shaped edge 13 is located on the support 1, at the periphery of the support 1 of the guide blades 2, and this edge, if assembled, fits on to the edge of the bearing-housing front 5, with the bottom 11 reinforced 14 in the radial direction between the axial cylindrical stiffener 12 and the saucer-shaped edge 13 of the support 1 of the guide blades 2. The bottom has blade axial holes 112, with the pins 21 of the guide blades 2 fitted into these holes, while adjusting arms 4 are fixed to the inside of the pins 21 of the guide blades 2. The support 1 of the guide blades 2 is conveniently centred there against the bearing housing 5 by the inner surface of the cylindrical support 12 of the bottom 11. In this example, the adjusting arms 4 of the guide blades 2 are directed to the centre of the support 1 of the guide blades 2, and the heads of the adjusting arms 4 are fitted into the outer adjusting openings 31 of the adjusting arm 3, located in the radial direction on the cylindrical surface on the front of the bearing housing 5, and arranged in the axial direction between the radial front surface of the bearing housing 5 and the opposite radial front surface of the axial cylindrical stiffener 12 of the support 1 of the guide blades 2. The inner surface of the adjusting ring 3 in this design fits on to the outer cylindrical surface on the bearing housing 5 by means of relief grooves 52. As for the control of the adjusting ring of the external controller, which is not shown here, an axial opening 511 is located at the edge of the peripheral collar 51 of the bearing housing 5 in this example. The pin 8 of the adjusting ring 3 control is embedded in this opening, and the control arm 7 of the adjusting ring 3 is located on the inside of this pin 8. In this example, the pin 8 at the edge of the collar 51 is fixed using an insert 6 of the collar 51 of the bearing housing 5, pressed in this collar 51. An axial opening 511 is located in this insert 6, which, when pressed in, is actually part of the collar 51. The head of the control arm 7 fits into the control opening 32 on the surface of the adjusting ring 3 and, at the same time, the lever 10 of the pull-rod 15 is located on the outside of the pin 8. This pull-rod leads to the controller, which is not shown here, and this controller is designed, in this example, as a pneumatic membrane drive or an electric servo-drive. As far as the arrangement of the adjusting-ring controls is concerned, the control arm 7 of the adjusting ring 3 is directed to the axis of the turbocharger 20, while the lever 10 of the pull-rod 15 is directed from the axis of the turbocharger 20. A stop-fork 9 is mounted at the axial opening 511, at the edge of the collar 51 of the bearing housing 5, with the arms of this fork axially projecting along both sides of the lever 10 of the pull-rod 15. An adjusting stop-joint can always be located in the arms of the stop-fork 9. As for the mechanism of the entire turbocharger, the system of the bearing housing 5, the support 1 of the guide blades 2 and the housing 22 of the rotor 20 is designed in such a way that the outer diameters of the collar 51 of the bearing-housing 5 and of the saucer-shaped edge 13 of the support 1 of the guide blades 2 fitted on to the collar are flush mounted against the inner diameter through these outer diameters of the slid-on inner cylindrical surface of the housing 22 of the turbine 20 with a guaranteed play. Of these two plays, the play between the outer diameter of the saucer-shaped edge 13 of the support 1 of the guide blades 2 and the inner diameter of the opposite inner cylindrical surface of the housing 22 of the turbine 20 is greater than the other. In this example, the lesser play is 0.1 mm and the greater play is 0.5 mm. In this example, turbine components are assembled in such a way that axial threaded holes 113 are located in the reinforcement area 14 of the bottom 11 of the support 1 of the guide blades 2. Screws 101 fixing the support 1 of the guide blades 2 to the collar 51 of the bearing housing 5 are screwed in these holes. The housing 22 of the rotor 20 is fixed to the collar 51 of the bearing housing 5 with a flange, which is not shown here, and which projects beyond the collar 51 of the bearing housing 5 and is fixed with screws, which are not shown here either, embedded in housing's threaded holes 221, located in the axial direction at the periphery of the turbine housing 22. A few flanges as fitting pieces can be used instead of a single flange that covers the entire periphery.

The equipment works as an ordinary turbocharger. However, it features a more compact and stiffer design, and improved thermal protection of sensitive components of the turbine.

Industrial Applicability

The equipment according to this invention can be used for supercharging combustion engines, mainly vehicle engines.

CLAIMS

1. The turbocharger with a variable geometry of guide blades, with a guide-blade support, fixed between the bearing housing and the turbine housing, characterized in that the support (1) of the guide blades (2) consists of a saucer-shaped element, with a thinned flat bottom in the central area (11), with a central hole (111) adapted to rotor (20) shaft penetration; in the area the distance of which from the centre is 30-70% of the outer diameter of this support (1) of the guide blades (2), the support (1) is reinforced with an axial cylindrical stiffener (12), which, when assembled, reaches as far as the front of the turbocharger bearing housing (5), with a guaranteed play of 0.1-0.7 mm from this front. At the periphery of the support (1) of the guide blades (2) there is a saucer-shaped edge (13), which, if assembled, fits on to the edge of the front of the bearing housing (5), with the bottom (11) reinforced (14) in the radial direction between the axial cylindrical stiffener (12) and the saucer-shaped edge (13) of the support (1) of the guide blades (2). The bottom has blade axial holes (112), with the pins (21) of the guide blades (2) fitted into these holes, while adjusting arms (4) are fixed to the inside of the pins (21) of the guide blades (2).

2. The turbocharger, of claim 1, characterized in that the support (1) of the guide blades (2) is centred against the bearing housing (5) by the inner surface of the cylindrical support (12) of the bottom (11).

3. The turbocharger, of claim 1 and 2, characterized in that the adjusting arms (4) of the guide blades (2) are directed to the centre of the support (1) of the guide blades (2), with the heads of the adjusting arms (4) fitted into the outer adjusting openings (31) of the adjusting ring (3), mounted in the radial direction on the cylindrical surface on the front of the bearing housing (5), and arranged in the axial direction between the radial front surface of the

bearing housing (5) and the opposite radial front surface of the axial cylindrical stiffener (12) of the support (1) of the guide blades (2).

4. The turbocharger, of claim 1 to 3, characterized in that the inner surface of the adjusting ring (3) fits on to the outer cylindrical surface on the bearing housing (5) by means of relief grooves (52).

5. The turbocharger, of claim 1 to 4, characterized in that an axial opening (511) is located at the edge of the peripheral collar (51) of the bearing housing (5); a pin (8) of the of the adjusting ring (3) control is embedded in this opening, with a control arm (7) of the adjusting ring (3) fixed to the inside of this pin (8), with the head of this control arm (7) fitted into the control opening (32) on the surface of the adjusting ring (3), with a lever (10) of the pull-rod (15) fixed to the outside of the pin (8).

6. The turbocharger, of claim 1 to 5, characterized in that the control arm (7) of the adjusting ring (3) is directed to the turbocharger (20) axis, while the lever (10) of the pull-rod (15) is directed from the turbocharger (20) axis.

7. The turbocharger, of claim 1 to 6, characterized in that a stop-fork (9) is fixed near the axial opening (511) at the edge of the collar (51) of the bearing housing (5), with the fork arms projecting axially along both sides of the lever (10) of the pull-rod (15).

8. The turbocharger, of claim 1 to 7, characterized in that the system of the bearing housing (5), the support (1) of the guide blades (2) and the housing (22) of the rotor (20) is designed in such a way that the outer diameters of the collar (51) of the bearing housing (5) and the saucer-shaped edge (13) of the support (1) of the guide blades (2) fitted on to the collar are flush mounted against the inner diameter through these outer diameters of the slid-on inner cylindrical surface of the housing (22) of the turbine (20) with

a guaranteed play. Of these two plays, the play between the outer diameter of the saucer-shaped edge (13) of the support (1) of the guide blades (2) and the inner diameter of the opposite inner cylindrical surface of the housing (22) of the turbine (20) is greater than the other.

9. The turbocharger, of claim 1 to 8, characterized in that axial threaded holes (113) are located in the reinforced area (14) of the bottom (11) of the support (1) of the guide blades (2), with screws (101) embedded in these holes to fix the support (1) of the guide blades (2) to the collar (51) of the bearing housing (5), while the housing (22) of the rotor (20) is fixed to the collar (51) of the bearing housing (5) with at least one flange, which projects beyond the collar (51) of the bearing housing (5).

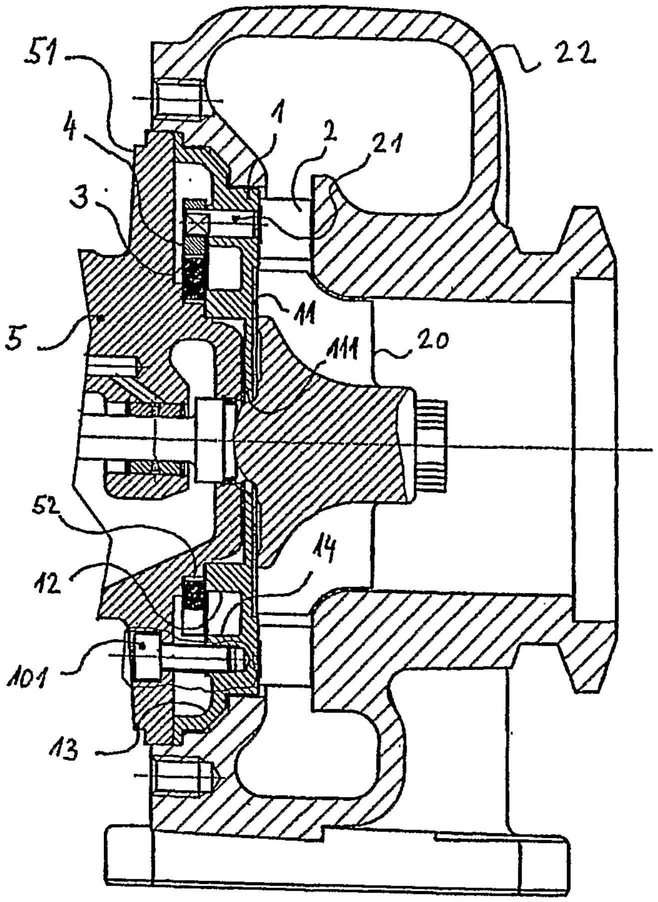

Fig.1

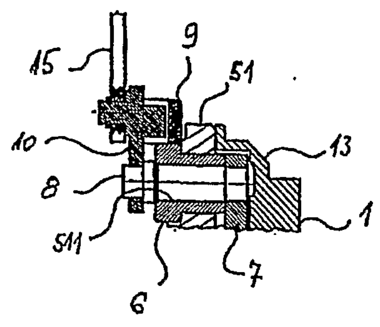

Fig.2

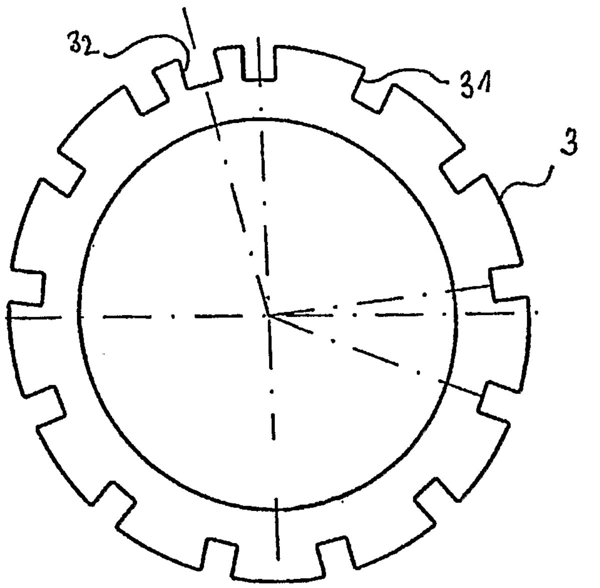

Fig.3

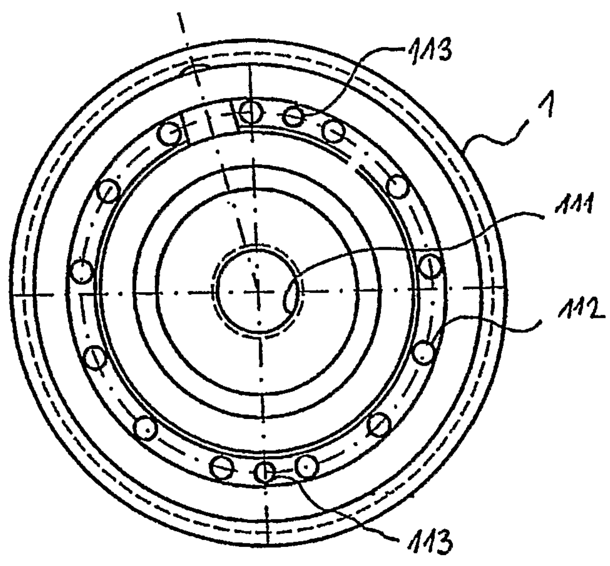

Fig.4

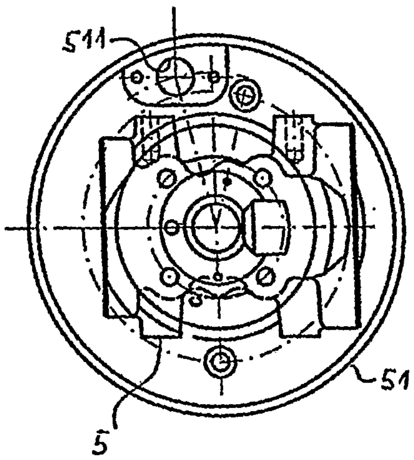

Fig.5

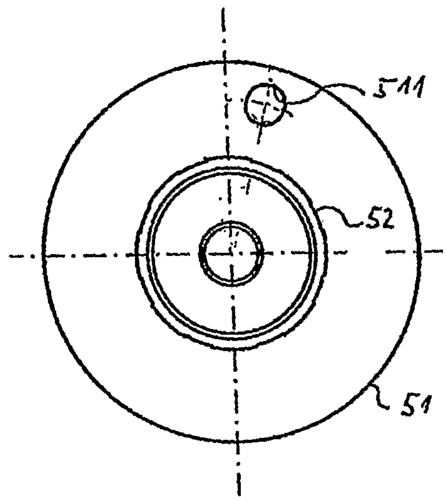

Fig.6

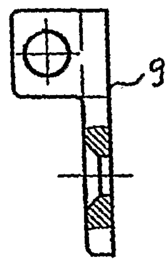

Fig.7

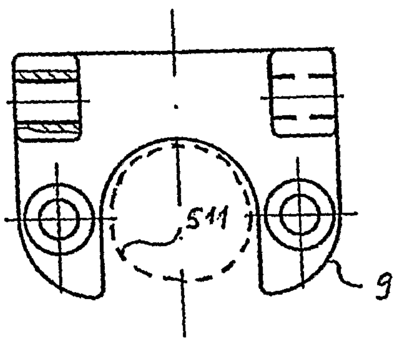

Fig.8

INTERNATIONAL SEARCH REPORT

International Application No
PCT/CZ2005/000061

A. CLASSIFICATION OF SUBJECT MATTER
F01D17/16

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)
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)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0 111 781 A (OSBORN, NORBERT L) 27 June 1984 (1984-06-27) column 8, line 9 - column 9, line 25 figures	1-9
A	WO 2004/035991 A (MITSUBISHI HEAVY INDUSTRIES, LTD; SHIRAISHI, TAKASHI; JINNAI, YASUAKI;) 29 April 2004 (2004-04-29) page 18 - page 19 page 21 page 23 figures	1-4
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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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INTERNATIONAL SEARCH REPORT

International Application No
PCT/CZ2005/000061

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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INTERNATIONAL SEARCH REPORT

Information on patent family members

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