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(71) Applicant: **BORGWARNER INC.** [US/US]; Patent Department, 3850 Hamlin Road, Auburn Hills, MI 48326 (US).

(72) Inventors: **RAMB, Thomas**; Zelterstrasse 70a, 67551 Worms (DE). **METZ, Dietmar**; Hof in den Herrgottsaeckern, 67149 Meckenheim (DE). **HAIBT, Christian**; Haehnleiner Strasse 47, 64665 Alsbach-Haehnlein (DE). **NOHL, Julia**; Talstr. 3, 67891 Bruchweiler-Baerenbach (DE).

(74) Agents: **Patent Central LLC** et al.; Pendorf, Stephan, A., 1401 Hollywood Blvd., Hollywood, FL 33020 (US).

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[Continued on next page]

(54) Title: EXHAUST-GAS TURBOCHARGER

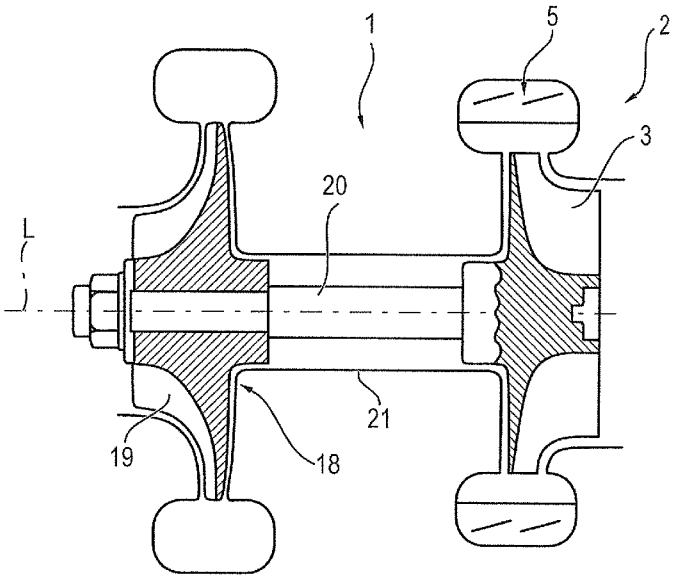

FIG. 1

(57) Abstract: The invention relates to an exhaust-gas turbocharger (1) having a turbine (2), which has a turbine wheel (3) surrounded by an intake duct (4), and having a VTG cartridge (5), which has a disk (6) and a vane bearing ring (7), which delimit the intake duct (4), and which has a plurality of vanes (8), which are arranged in the intake duct (4) and are mounted in the vane bearing ring (7) by way of rotatable vane shafts (9), which are connected to vane levers (10), the lever heads (11) of which engage into associated grooves (12) in a unison ring (13), which surrounds the vane bearing ring (7) on the outside, and which has an adjusting lever (14) which is operatively connected to an adjusting shaft (15) in order to transmit an adjusting torque to the unison ring (13), wherein the adjusting lever (14) is of planar configuration.

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Declarations under Rule 4.17:

— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*

— *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))*

— *of inventorship (Rule 4.17(iv))*

Published:

— *with international search report (Art. 21(3))*

EXHAUST-GAS TURBOCHARGER

DESCRIPTION

The invention relates to an exhaust-gas turbocharger according to the preamble of claim 1.

In the case of such an exhaust-gas turbocharger, provision is made of a variable turbine geometry (VTG), in which guide vanes are adjusted by means of a unison ring, which can be rotated by means of an adjusting shaft.

It is an object of the present invention to provide an exhaust-gas turbocharger of the type described in the preamble of claim 1, in which the bearing forces in the system of the VTG and in particular of the adjusting shaft can be reduced.

This object is achieved by the features of claim 1.

The dependent claims contain advantageous developments of the invention.

Claims 7 and 8 define a VTG cartridge according to the invention as an object which can be marketed independently.

Further details, features and advantages of the invention become apparent from the following description of exemplary embodiments with reference to the drawing, in which:

Figure 1 shows a schematically greatly simplified illustration of an exhaust-gas turbocharger according to the invention,

Figure 2 shows a perspective plan view of a first embodiment of a VTG cartridge according to the invention,

Figure 3 shows an enlarged partial view of the VTG cartridge shown in Figure 2, and

Figure 4 shows a partial side view of the VTG cartridge according to the invention.

Figure 1 shows a schematically greatly simplified basic illustration of an exhaust-gas turbocharger 1 according to the invention, which has a charger axis of rotation L.

The exhaust-gas turbocharger 1 also has a turbine 2, which comprises a turbine wheel 3 surrounded by an intake duct 4, which is provided with a so-called VTG cartridge 5. This VTG cartridge 5 will be described in detail hereinbelow with reference to Figures 2 to 4.

The exhaust-gas turbocharger 1 also of course has all the other common parts of an exhaust-gas turbocharger, such as a rotor 20, which is mounted rotatably in a

bearing housing 21 and which bears the turbine wheel 3 at one end and a compressor wheel 19 of a compressor 18 at the other end. These parts are likewise shown only in schematically greatly simplified form in Figure 1, since they are not of importance for explaining the principles of the present invention.

The VTG cartridge, which, as mentioned, will be explained in detail hereinbelow with reference to Figures 2 to 4, is likewise shown in greatly schematically simplified form.

A VTG cartridge is understood to mean a structural unit which, between a vane bearing ring 7 and a disk 6, delimits an intake duct 4 for the passage of exhaust gases to the turbine wheel 3. Furthermore, a VTG cartridge 5 of this type has a plurality of vanes, which are arranged in the intake duct 4 and of which Figures 2 and 4 show one vane designated 8 as a representative example of all vanes bearing the corresponding reference numeral. The vanes 8 can be moved rotatably in the vane bearing ring 7 between a closed and an open position. For this purpose, the vanes 8 have vane shafts 9 each having an axis of rotation. The vane shafts 9 in turn are connected to vane levers 10, of which two vane levers are denoted in each case in Figure 2 with the reference numeral 10. As Figure 2 shows, the embodiment shown there has ten such, preferably cranked vane levers, in each case of identical design, and correspondingly ten vanes 8.

Each vane lever 10 has a lever head 11, which engages into an associated groove 12 in a unison ring 13. Figure 2 shows in this respect that the unison ring 13 surrounds the vane bearing ring 7 on the outside, i.e. along the outer circumference thereof.

For radially mounting the unison ring 13, provision is made of a radial bearing, which according to the invention is formed by the vane levers 10. For this purpose, the vane levers 10 are formed as rolling levers, the lever heads 11 of which are supported in the grooves 12 in the unison ring 13. Figures 2 and 4 show that the grooves 12 are arranged in a plane that is offset with respect to the bearing plane of the vane levers 10 on the vane bearing ring 7, which is the reason for the cranked configuration of the vane levers 10 in this embodiment.

As can be seen when Figures 2 to 4 are viewed in combination, the exhaust-gas turbocharger 1 according to the invention, or the VTG cartridge 5 according to the invention, also has an adjusting lever 14, which is operatively connected to an adjusting shaft 15 (which can be seen in Figure 3) for transmitting an adjusting torque

to the unison ring 13. The adjusting shaft 15 can be actuated by means of a suitable actuator which is known per se and is not shown in detail in Figures 2 to 4, since it is not necessary for the purposes of explaining the principles of the present invention.

However, Figures 2 to 4 do illustrate that the adjusting lever 14 is of planar configuration. Here, the adjusting lever 14 has a first end region 14A, which in the assembled state is adjacent to the adjusting lever 13 and which has a groove 16 that engages around a positioning pin 17. The positioning pin 17 is fixed on the unison ring 13, preferably is welded onto the unison ring 13.

As can also be seen from Figures 2 to 4, the groove 16 is open on one side, which results in a fork-like structure of the first end region 14A, as can be seen in particular from the illustration presented in Figure 3.

The adjusting lever 14 also has a second end region 14B, which is arranged adjacent to the vane bearing ring 7, in particular above the vane bearing ring 7, and is provided with a recess 17 in which the adjusting shaft 15 is fixed. In Figure 2, only the recess 17 can be seen, whereas Figure 3 shows a schematically simplified representation of the arrangement of the adjusting shaft 15 in the recess 17. The adjusting shaft 15 may for example be welded in the recess 17.

In addition to the above written disclosure, reference is hereby explicitly made to the illustrative representation of the invention in Figures 1 to 4 to supplement the disclosure of the invention.

LIST OF REFERENCE SIGNS

1	Exhaust-gas turbocharger
2	Turbine
3	Turbine wheel
4	Intake duct
5	VTG cartridge
6	Disk
7	Vane bearing ring
8	Vanes
9	Vane shafts
10	Vane levers
11	Lever heads
12	Grooves
13	Unison ring
14	Adjusting lever
14A, 14B	End regions of the unison ring
15	Adjusting shaft
16	Groove
17	Positioning pin
L	Charger longitudinal axis

CLAIMS

1. An exhaust-gas turbocharger (1)

- having a turbine (2),
  - which has a turbine wheel (3) surrounded by an intake duct (4), and
- having a VTG cartridge (5),
  - which has a disk (6) and a vane bearing ring (7), which delimit the intake duct (4), and
  - which has a plurality of vanes (8), which are arranged in the intake duct (4) and mounted in the vane bearing ring (7) by way of rotatable vane shafts (9), which are connected to vane levers (10), the lever heads (11) of which engage into associated grooves (12) in a unison ring (13), which surrounds the vane bearing ring (7) on the outside, and
  - which has an adjusting lever (14) which is operatively connected to an adjusting shaft (15) in order to transmit an adjusting torque to the unison ring (13), wherein
- the adjusting lever (14) is of planar configuration.

2. The exhaust-gas turbocharger as claimed in claim 1, wherein the adjusting lever (14), in a first end region (14A) adjacent to the unison ring (13), has a groove (16) which engages around a positioning pin (17) that is fixed on the unison ring (13).

3. The exhaust-gas turbocharger as claimed in claim 2, wherein the groove (16) is open on one side.

4. The exhaust-gas turbocharger as claimed in one of claims 1 to 3, wherein the adjusting lever (14) has a second end region (14B) which is adjacent to the vane bearing ring (7) and is provided with a recess (17) in which the adjusting shaft (15) is fixed.

5. The exhaust-gas turbocharger as claimed in one of claims 1 to 4, wherein the positioning pin (17) is welded to the unison ring (13).

6. The exhaust-gas turbocharger as claimed in one of claims 1 to 4, wherein the vane levers (6) are cranked.

7. A VTG cartridge (5) of an exhaust-gas turbocharger (1),

- having a disk (6) and a vane bearing ring (7), which delimit an intake duct (4),
- having a plurality of vanes (8), which are arranged in the intake duct (4) and mounted in the vane bearing ring (7) by way of rotatable vane shafts (9), which are connected to vane levers (10), the lever heads (11) of which engage into associated grooves (12) in a unison ring (13), which surrounds the vane bearing ring (7) on the outside, and
- having an adjusting lever (14) which is operatively connected to an adjusting shaft (15) in order to transmit an adjusting torque to the unison ring (13),

wherein

- the adjusting lever (14) is of planar configuration.

8. The VTG cartridge as claimed in claim 7, characterized by one of claims 2 to 6.

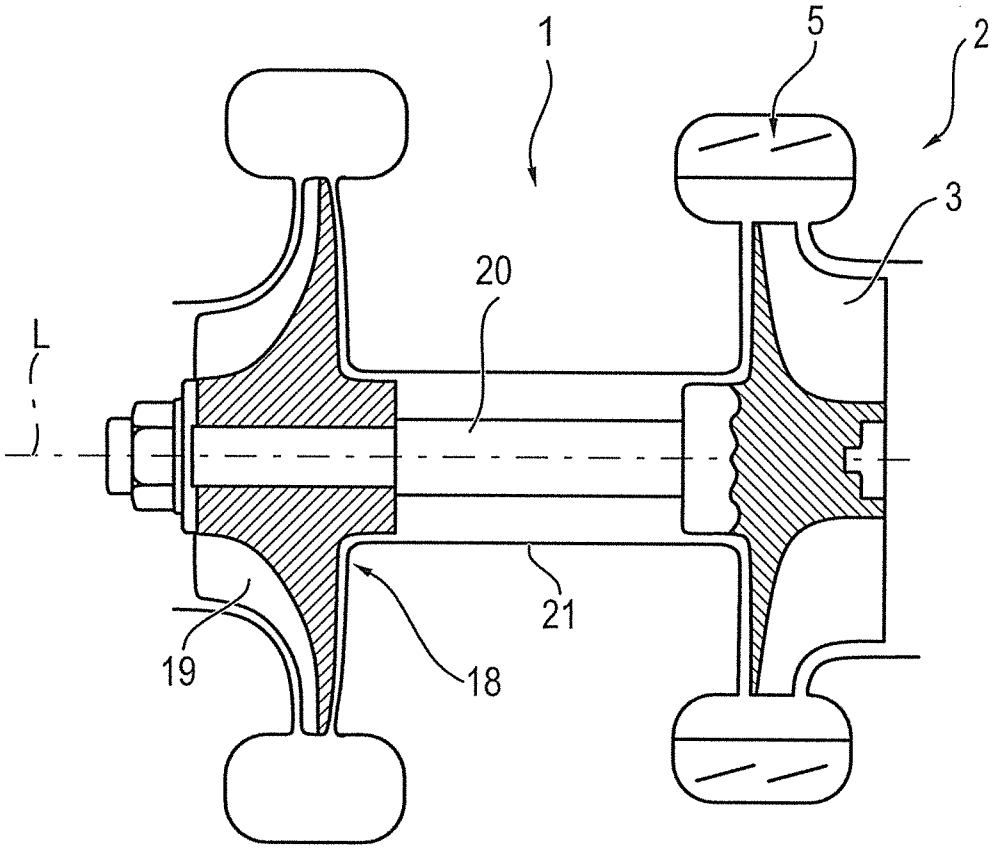

FIG. 1

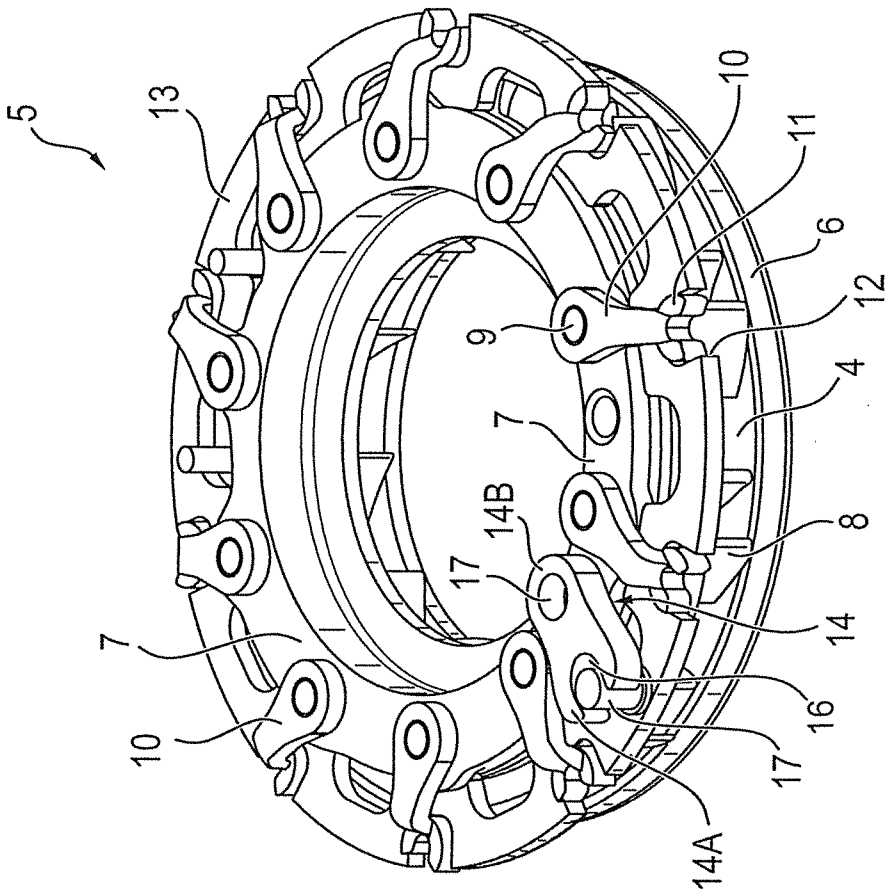

FIG. 2

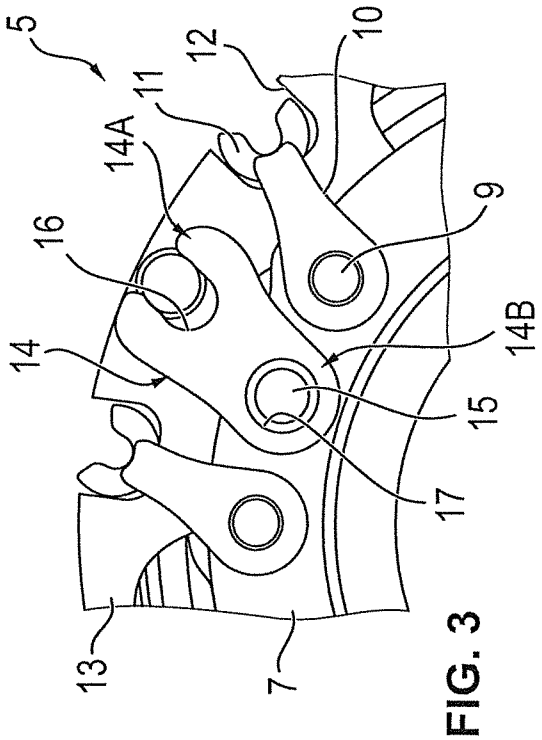

FIG. 3

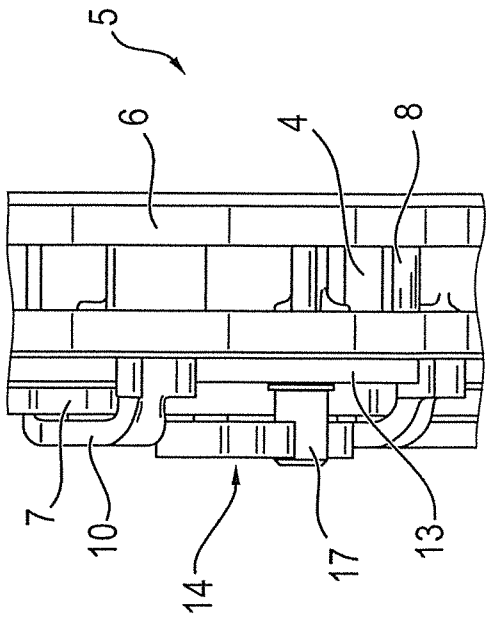

FIG. 4

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2013/037328

A. CLASSIFICATION OF SUBJECT MATTER

F02B 37/12(2006.01)i, F02B 37/22(2006.01)i, F02B 37/24(2006.01)i, F02B 39/00(2006.01)i, F02D 23/00(2006.01)i

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)
F02B 37/12; F02B 39/16; F02B 37/24; F01D 17/16; F04D 15/00; F02B 37/22; F01D 17/00; F02D 23/00; F02B 39/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Korean utility models and applications for utility models
Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
eKOMPASS(KIPO internal) & Keywords: turbocharger, variable geometry, VGT, unison ring and lever

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 2009-180111 A (TOYOTA INDUSTRIES CORP. et al.) 13 August 2009 See abstract; paragraphs 12,16-23,28-31 and figures 1-4.	1,4,7
Y		2,3
Y	JP 2008-075635 A (IHI CORP.) 03 April 2008 See abstract; paragraphs 26-28 and figures 1,2.	2,3
A	WO 2010-120028 A1 (KEYYANG PRECISION CO., LTD.) 21 October 2010 See abstract; paragraphs 42-52 and figures 1,11.	1-4,7
A	US 2009-0123272 A1 (LOVE et al.) 14 May 2009 See abstract; paragraphs 21-25 and figures 3,4.	1-4,7
A	US 2009-0301083 A1 (RAYNER et al.) 10 December 2009 See abstract; paragraphs 20-23 and figure 2.	1-4,7

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

☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents,such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
25 July 2013 (25.07.2013)	**29 July 2013 (29.07.2013)**

Name and mailing address of the ISA/KR
Korean Intellectual Property Office
189 Cheongsa-ro, Seo-gu, Daejeon Metropolitan City, 302-701, Republic of Korea
Facsimile No. +82-42-472-7140

Authorized officer
AHN Jae Yul
Telephone No. +82-42-481-8525

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2013/037328

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☒ Claims Nos.: 5,6,8
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required addtional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/US2013/037328

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 2009-180111 A	13/08/2009	None	
JP 2008-075635 A	03/04/2008	JP 4905021 B2	28/03/2012
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