

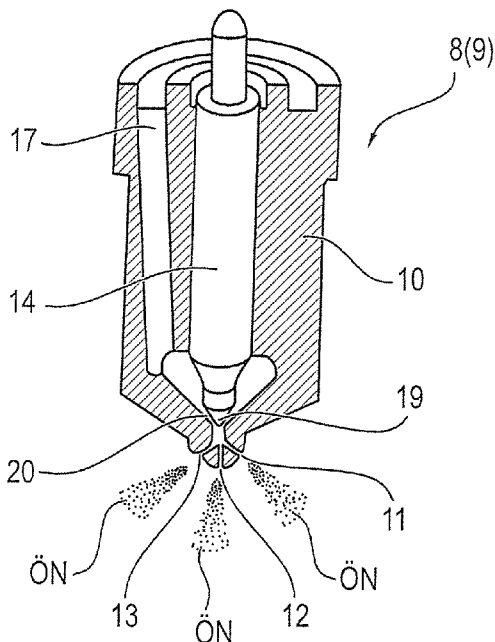


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(54) Title: EXHAUST-GAS TURBOCHARGER



**FIG. 3**

(57) Abstract: The invention relates to an exhaust-gas turbocharger (1) having a turbine wheel (2), a compressor wheel (3), a shaft (4), which bears the turbine wheel (2) and the compressor wheel (3), and having a bearing housing (5), which has a bearing arrangement (6) for the shaft (4), and which has a lubricant device (7) for the bearing arrangement (6), wherein the lubricant device (7) has at least one injection nozzle (8, 9, 8', 9'), which is arranged adjacent to the bearing arrangement (6) in the bearing housing (5) to produce a lubricant mist (ÖN).

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MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK,  
SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ,  
GW, KM, ML, MR, NE, SN, TD, TG).

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

**Declarations under Rule 4.17:**

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

**Published:**

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

## EXHAUST-GAS TURBOCHARGER

## DESCRIPTION

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

          An exhaust-gas turbocharger of the generic type has a turbine with a turbine wheel in a turbine housing, a compressor wheel in a compressor housing and a shaft, which bears the turbine wheel and the compressor wheel at its ends. The shaft is  
10 arranged in a bearing housing connected at one end to the turbine housing and at the other end to the compressor housing. The bearing housing has a bearing arrangement for the shaft and is provided with a lubricant device for the bearing arrangement. Oil is commonly used as the lubricant.

          It is an object of the present invention to provide an exhaust-gas turbocharger  
15 of the type indicated in the preamble of claim 1 which is provided with a lubricant device with little loss in friction power.

          This object is achieved by the features of claim 1.

          The dependent claims contain advantageous developments of the invention.

          Since the lubricant device is provided with at least one injection nozzle for  
20 lubricant, it is possible to nebulize the lubricant, in particular oil, and to thereby achieve optimized metering of oil in the bearing arrangement, in particular a rolling bearing arrangement.

          Lubrication with little loss in friction power can be achieved by optimized metering of lubricant of this type.

25           To this end, the injection nozzle can have one or more injection openings in a nozzle body which can be opened and closed by means of a nozzle needle.

          Alternatively, it is possible to integrate a sleeve with a sleeve body in the lubricant device as the injection nozzle, said sleeve body having an injection opening, the diameter of which is smaller than the lubricant supply opening or the lubricant  
30 supply duct.

          To produce an injection opening of this type, suitable production processes, such as laser treatment or erosion, can be used to make a blind hole in the sleeve body subsequent to the lubricant supply opening, the diameter of which blind hole is smaller than that of the lubricant supply opening, in order to make it possible to produce an

optimized diameter for the oil supply.

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

5 in which:

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

Figure 2 shows the detail E shown in Figure 1 in an enlarged illustration,

10 Figure 3 shows a schematically slightly simplified sectional illustration through an injection nozzle,

Figure 4 shows a schematically simplified sectional illustration through an alternative embodiment of an injection nozzle, and

Figure 5 shows a sectional illustration, corresponding to Figure 4, through a further embodiment of an injection nozzle.

15 Figure 1 shows an exhaust-gas turbocharger 1 having a turbine and a compressor. The turbine is in this case symbolized by the turbine wheel 2, with the turbine housing, which surrounds the turbine wheel 2, having been omitted so as to simplify the illustration of Figure 1.

20 The turbine wheel 2 is in this case fastened to one end of a shaft 4, whereas a compressor wheel 3 is fastened to the other end of the shaft 4; the compressor wheel 3 is part of a compressor, the compressor housing of which, like the turbine housing, is not shown, however, since the illustration of this housing is not required for explaining the principles of the present invention.

25 As is further shown in Figure 1, a bearing housing 5 is provided, as is customary, between the turbine wheel 2 and the compressor wheel 3 for mounting the shaft 4. The bearing housing 5 has a bearing arrangement 6 for mounting the shaft 4. In the example shown in Figure 1, the bearing arrangement 6 is formed as a rolling bearing arrangement having two rolling bearings 6A and 6B. As Figure 1 shows, the rolling bearings 6A and 6B are arranged spaced apart from one another along the  
30 longitudinal extent of the shaft 4.

The exhaust-gas turbocharger 1 furthermore has a lubricant device 7, with oil preferably being used as the lubricant. The lubricant device 7 has a lubricant inlet 18, which, as is also evident from the enlarged illustration of the detail E in Figure 2, leads

to two injection nozzles 8 and 9, which are arranged adjacent to the respectively assigned rolling bearings 6A and 6B in the bearing housing 5. According to the invention, however, the provision of one injection nozzle 8 or 9 already constitutes an optimization measure for improving lubrication.

5 Figure 3 shows an example of an embodiment of such an injection nozzle 8 or 9. The injection nozzle 8 has a nozzle body 10, in which a lubricant inlet 17 is arranged. An injection needle 14 is provided centrally in the nozzle body 10 and can be displaced by way of an actuator (not shown in more detail in Figure 3) in the longitudinal direction in the nozzle body 10 in order to open and to close, in the  
10 example, three injection openings 11, 12 and 13. In this case, to open and close the injection openings 11 to 13, a tip 19 of the nozzle needle 14 is lifted from a sealing seat 20, or set down thereon for closing. The oil mists to be produced are symbolized by the three dotted areas ÖN. Figure 3 in this respect represents a particularly preferred embodiment of the injection nozzle 8 or 9, since a plurality of injection openings are  
15 provided. In principle, an embodiment with a single injection opening or else a greater number of injection openings is also conceivable.

Figure 4 shows an alternative embodiment of the injection nozzle, this being denoted in Figure 4 by the reference signs 8' and 9'. This injection nozzle 8' represents a simplified embodiment, in which a lubricant supply opening or a lubricant supply  
20 duct 15 is provided in the nozzle body 10' and issues into a blind hole 16, the diameter  $D_{16}$  of which is smaller than the diameter  $D_{15}$ , as a result of which an oil mist can also be produced when lubricant is pressed into the lubricant supply duct 15 and ejected through the injection opening 16.

Figure 5 shows a further embodiment of an injection nozzle 21 according to the  
25 invention. The injection nozzle 21 has a nozzle body 22, which is connected to an oil inlet 28 via a shut-off member, which comprises a sealing seat 23, a closing element 24 and a spring element 25 which pretensions the closing element 24 in the sealing direction. This shut-off member is preferably in the form of a non-return valve.

The nozzle body 22 furthermore has an injection opening 27 and a bypass duct  
30 26 reaching through the entire nozzle body 22, as is evident from Figure 5.

The bypass duct 26 is constantly open so as to allow the passage of a volumetric flow of oil at low rotational speeds. At relatively high rotational speeds, the thermal output to be dissipated is also higher given a corresponding load. Therefore, it

is provided according to the invention that, above a certain selectable pressure, the injection nozzle 21 opens as the main nozzle, which is kept closed at low pressures by means of the above-described closing element 24.

5 If the injection nozzle 21 is connected to an adjustable oil pump (not shown in more detail in Figure 5), the injection nozzle 21 opens above a selectable pressure. This pressure is to be stipulated in such a way that the injection nozzle 21 or the shut-off member 23, 24, 25 thereof conceivably also opens earlier than is necessary for dissipating a thermal output which is present, because the characteristics and the setting parameters of adjustable oil pumps are not always known.

10 In addition to the above written disclosure of the invention, reference is hereby explicitly made to the illustrative presentation thereof in Figures 1 to 5.

List of reference signs

	1	Exhaust-gas turbocharger
	2	Turbine wheel
	3	Compressor wheel
5	4	Shaft
	5	Bearing housing
	6	Bearing arrangement
	6A, 6B	Rolling bearing
	7	Lubricant device
10	8, 9, 8', 9'	Injection nozzle
	10, 10'	Nozzle body
	11, 12, 13, 16	Injection opening
	17	Lubricant inlet/oil inlet
	18	Lubricant supply opening of the lubricant device 7
15	19	Tip of the nozzle needle 14
	20	Sealing seat
	21	Injection nozzle
	22	Nozzle body
	23	Sealing seat
20	24	Closing element
	25	Pretensioning element/spring element
	26	Bypass duct
	27	Injection opening
	28	Oil supply
25	E	Detail
	ÖN	Oil mist

## CLAIMS

1. An exhaust-gas turbocharger (1)
- having a turbine wheel (2);
  - 5 - having a compressor wheel (3);
  - having a shaft (4), which bears the turbine wheel (2) and the compressor wheel (3); and
  - having a bearing housing (5),
  - which has a bearing arrangement (6) for the shaft (4), and
  - 10 • which has a lubricant device (7) for the bearing arrangement (6),
- wherein
- the lubricant device (7) has at least one injection nozzle (8, 9; 8', 9'), which is arranged adjacent to the bearing arrangement (6) in the bearing housing (5) to produce a lubricant mist (ÖN).
- 15
2. The exhaust-gas turbocharger as claimed in claim 1, wherein the injection nozzle (8, 9) has a nozzle body (10) with at least one injection opening (11, 12, 13), which can be opened and closed by means of a nozzle needle (14).
- 20
3. The exhaust-gas turbocharger as claimed in claim 2, wherein the nozzle needle (14) is arranged such that it can be displaced longitudinally by means of an actuator in the nozzle body (10).
4. The exhaust-gas turbocharger as claimed in claim 1, wherein the injection nozzle (8', 9') has a nozzle body (10') with an injection opening (16), the diameter ( $D_{16}$ ) of which is smaller than a diameter ( $D_{15}$ ) of a lubricant supply duct (15).
- 25
5. The exhaust-gas turbocharger as claimed in one of claims 1 to 4, wherein the bearing arrangement (6) is formed as a rolling bearing arrangement (6A, 6B).
- 30
6. The exhaust-gas turbocharger as claimed in claim 5, wherein the rolling

bearing arrangement (6) has two rolling bearings (6A, 6B) arranged spaced apart from one another.

7. The exhaust-gas turbocharger as claimed in claim 6, wherein each  
5 rolling bearing (6A, 6B) is assigned an injection nozzle (8 or 9).

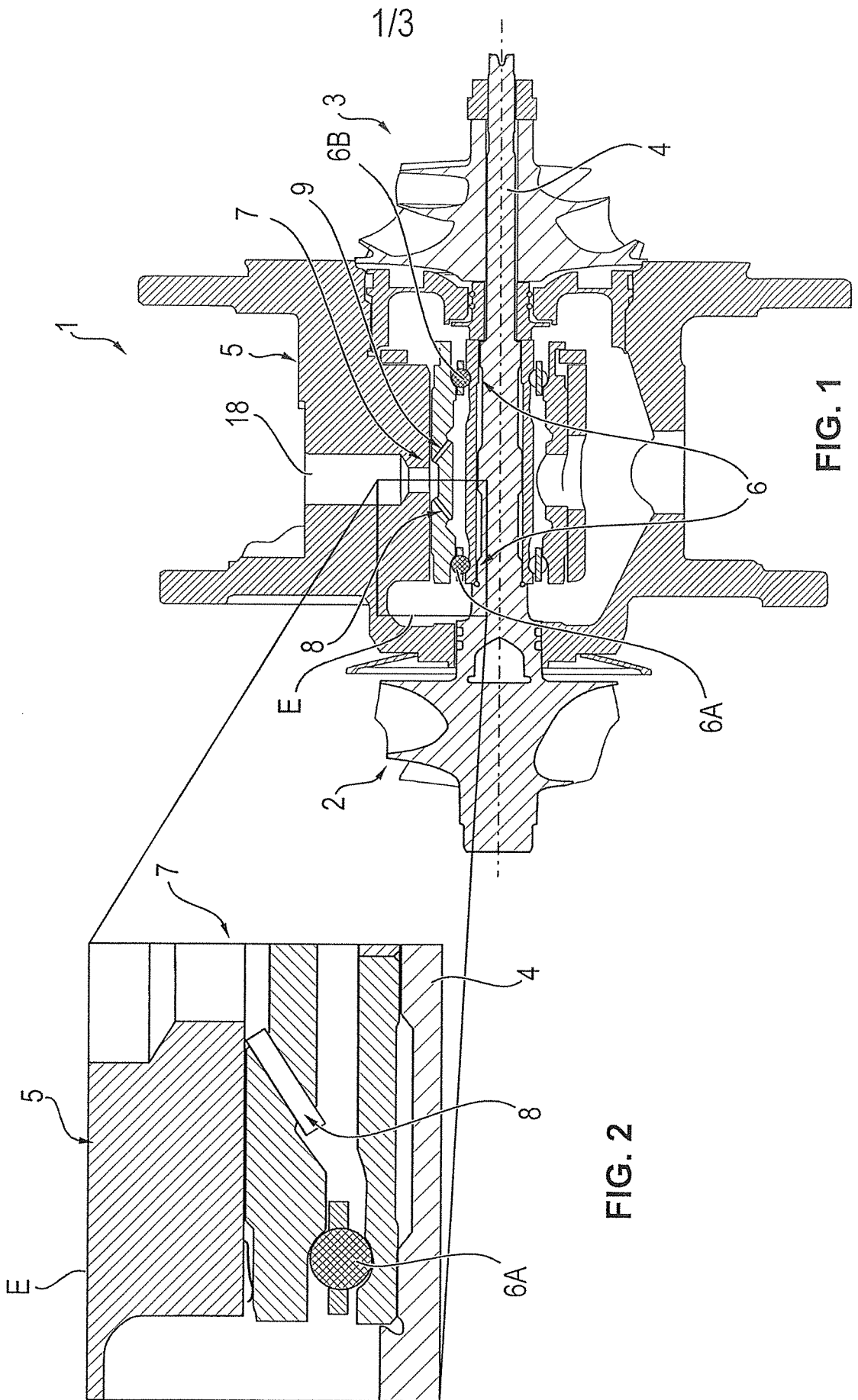
8. The exhaust-gas turbocharger as claimed in claim 1, wherein the  
injection nozzle (21) has an injection opening (27) which can be opened depending on  
a selectable pressure.

10

9. The exhaust-gas turbocharger as claimed in claim 8, wherein the  
injection nozzle (21) has a nozzle body (22), in which provision is made of a  
constantly open bypass duct (26).

15

10. The exhaust-gas turbocharger as claimed in claim 8 or 9, wherein a shut-  
off member for opening and closing the injection opening (27) is provided in the  
nozzle body (22) and has a sealing seat (23) and a pretensioned closing element (24)  
which are arranged subsequent to an oil supply (28) in the nozzle body (22).



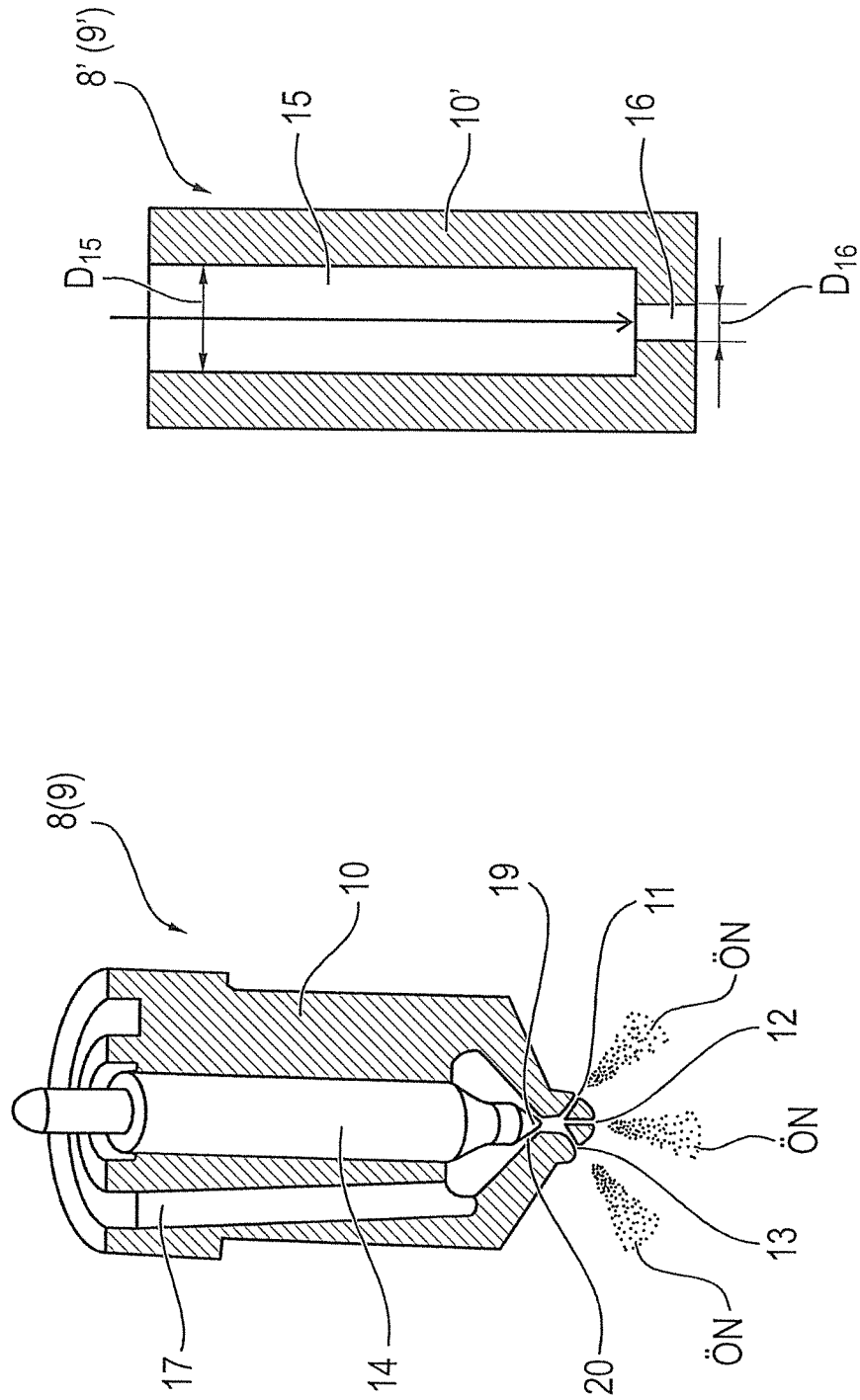


FIG. 4

FIG. 3

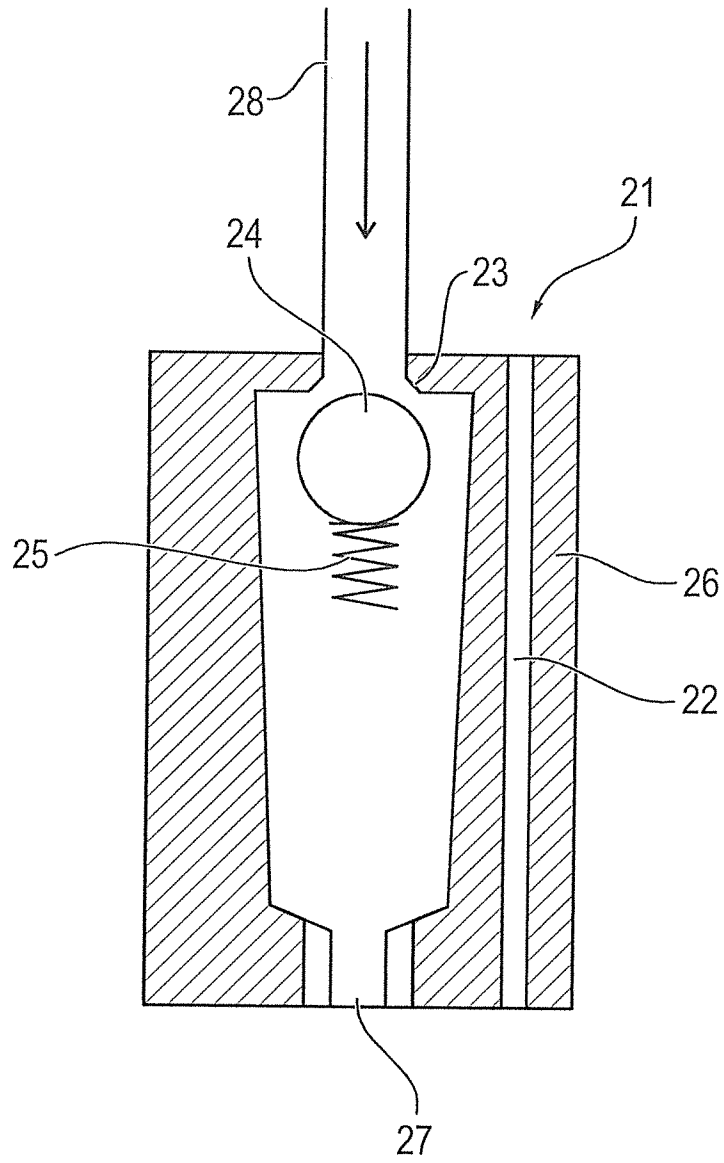


FIG. 5

## INTERNATIONAL SEARCH REPORT

International application No.  
**PCT/US2014/031715****A. CLASSIFICATION OF SUBJECT MATTER****F02B 39/14(2006.01)i, F02B 37/00(2006.01)i, F01M 7/00(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 39/14; F04B 17/00; F01D 25/20; F04D 29/059; F16C 19/30; H02K 7/18; F02B 33/00; F01D 25/18; F02C 7/06; F02B 37/00; F01M 7/00

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) &amp; Keywords: turbocharger, turbine, compressor, bearing, lubricant and nozzle

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4,541,784 A (HORLER, HANSULRICH) 17 September 1985 See column 1 line 12 - column 2 line 28, column 3 lines 55-59; claim 1 and figure 1.	1,4-7
Y		2-3,8-9
A		10
Y	US 5,045,711 A (SWEARINGEN, JUDSON S.) 03 September 1991 See column 2 lines 10-26; claim 1.	2-3,8-9
A	US 2011-0158803 A1 (SEBALD et al.) 30 June 2011 See paragraphs [0005]-[0010]; and claim 14.	1-10
A	US 2002-0095935 A1 (KAPICH, DAVORIN D.) 25 July 2002 See paragraph [0006]; and figure 1.	1-10
A	US 2008-0127627 A1 (JEWESS et al.) 05 June 2008 See paragraph [0005]; and claim 1.	1-10

 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

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"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

"&amp;" document member of the same patent family

Date of the actual completion of the international search

16 July 2014 (16.07.2014)

Date of mailing of the international search report

**17 July 2014 (17.07.2014)**

Name and mailing address of the ISA/KR

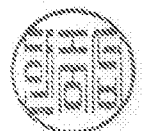
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**INTERNATIONAL SEARCH REPORT**

Information on patent family members

International application No.

**PCT/US2014/031715**

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