

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
22 November 2007 (22.11.2007)

PCT

(10) International Publication Number
WO 2007/133984 A1

(51) International Patent Classification:
F01D 25/24 (2006.01)

(21) International Application Number:

PCT/US2007/068319

(22) International Filing Date: 7 May 2007 (07.05.2007)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
11/429,817 8 May 2006 (08.05.2006) US

(71) Applicant (for all designated States except US): **HONEYWELL INTERNATIONAL INC.** [US/US]; Law Department AB/2B, 101 Columbia Road, Morristown, NJ 07962 (US).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **MARTIN, Steven P.** [US/US]; 2042 Dacian Drive, Walnut, California 91789 (US). **MEADE, Christopher O.** [US/US]; 1907 Voorhees,

Redondo Beach, California 90278 (US). **MCGRAW, Andrew F.** [US/US]; 1654 Centinela Avenue, Los Angeles, California 90025 (US).

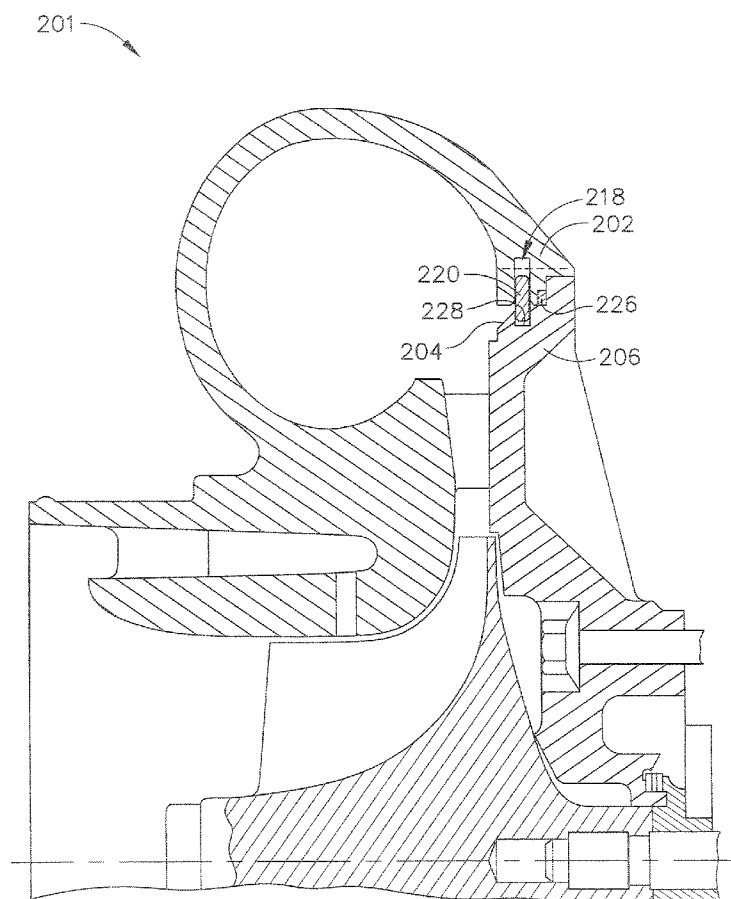
(74) Agent: **CHESS, Deborah**; Honeywell International Inc., Law Department AB/2B, 101 Columbia Road, Morristown, New Jersey 07962 (US).

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM),

[Continued on next page]

(54) Title: COMPRESSOR STAGE ASSEMBLY LOCK



(57) Abstract: The present invention relates to a turbocharger assembly lock comprising a retaining ring partially disposed in a circumferential groove of a first turbocharger stage component and partially in a circumferential groove of a second turbocharger stage component so that the turbocharger stages are securely attached to each other.

WO 2007/133984 A1



European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, MT, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments*

Published:

— *with international search report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

COMPRESSOR STAGE ASSEMBLY LOCK

CROSS-REFERENCES TO RELATED APPLICATIONS

[0001] Not Applicable.

BACKGROUND OF THE INVENTION

Field of the Invention (Technical Field):

[0002] The present invention relates to turbocharger compressor assemblies, particularly to means for attaching one turbocharger stage component, such as a compressor assembly, to another stage component, such as a second compressor assembly or a turbocharger center housing rotating assembly.

Description of Related Art:

[0003] Note that where the following discussion refers to a number of publications by author(s) and year of publication, because of recent publication dates certain publications are not to be considered as prior art vis-a-vis the present invention. Discussion of such publications herein is given for more complete background and is not to be construed as an admission that such publications are prior art for patentability determination purposes.

[0004] Turbochargers for pressurizing or boosting the intake air stream into an internal combustion engine include several stage components such as an exhaust gas turbine through which the engine's exhaust gas is routed so that the exhaust gas turbine spins within the turbocharger housing. Typically, the exhaust gas turbine is connected via a shaft in a center housing rotating assembly ("CHRA") to a radial air compressor impeller disposed within a compressor housing so that as the exhaust gas turbine turns, the compressor impeller also turns within the compressor housing and causes intake air to axially enter the compressor housing, go past the impeller, then

change direction past a diffuser before entering a compressor housing volute. After the intake air is pressurized or boosted, it exits the turbocharger to be mixed with fuel that is then sent to the engine combustion chamber.

[0005] Turbocharger stage components are typically attached to each other via clamp plates, bolts, etc. For example, compressor housings are typically attached to the CHRA via clamp plates and bolts. Such an assembly requires several separate turbocharger parts and the consequent attention to assembly torques required for all fasteners. Therefore, there exists a potential for poor quality assembly as a result of the application of improper torque on the assembly fasteners. There are also greater turbocharger assembly costs as a result of using clamp plates and bolts and greater manufacturing costs associated with threaded holes.

[0006] Therefore, there is a need for an inexpensive and precise means to assemble turbocharger stages to each other. Unlike bolts and other fasteners requiring specific assembly torques, the use of snap rings typical in many applications today, including "horse shoe" shaped snap rings, can be simpler and less expensive to utilize if properly applied in the assembly of turbocharger systems.

BRIEF SUMMARY OF THE INVENTION

[0007] The present invention provides a turbocharger stage assembly lock to mate a first turbocharger stage to a second turbocharger stage through the use of a retaining ring partially disposed within a circumferential groove in the first turbocharger stage and partially within a circumferential groove in the second turbocharger stage.

[0008] Therefore, an embodiment of the present invention comprises a turbocharger assembly comprising a first turbocharger stage having a ring groove, a retaining ring disposed in the ring groove, said retaining ring having an adjustable circumference, and a second turbocharger stage adjacent to the first turbocharger stage, said second turbocharger stage having a mating groove

within which the retaining ring is fitted to mate the ring groove and the mating groove and thus secure the first turbocharger stage to the second turbocharger stage.

Another embodiment of the present invention comprises a method for attaching turbocharger stages to each other, the method comprising disposing a ring groove in a first turbocharger stage, disposing a retaining ring having an adjustable circumference in the ring groove, disposing a mating groove in a second turbocharger stage, bringing the first turbocharger stage and the second turbocharger stage together and simultaneously changing the circumference of the retaining ring, and allowing the retaining ring to resume its original circumference, when the ring groove and the mating groove come together, by snapping into position so that the retaining ring resides partially in the ring groove and partially in the mating groove, thus attaching the first turbocharger stage to the second turbocharger stage.

[0009] An object of the present invention is to provide an effective and simplified means to attach a first turbocharger stage component to a second turbocharger stage component.

[0010] An advantage of the present invention is that assembly and parts costs are minimized.

[0011] Other objects, advantages and novel features, and further scope of applicability of the present invention will be set forth in part in the detailed description to follow, taken in conjunction with the accompanying drawings, and in part will become apparent to those skilled in the art upon examination of the following or may be learned by practice of the invention. The objects and advantages of the invention may be realized and attained by means of the instrumentalities and combinations particularly pointed out in the appended claims.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

[0012] The accompanying drawings, which are incorporated into, and form a part of, the specification, illustrate one or more embodiments of the present invention and, together with the description,

serve to explain the principles of the invention. The drawings are only for the purpose of illustrating one or more preferred embodiments of the invention and are not to be construed as limiting the invention. In the drawings:

[0013] Fig. 1 is a cross section view of a turbocharger of the prior art;

[0014] Fig. 2 is a close-up cross section view of an embodiment of the present invention showing a turbocharger compressor housing comprising a retaining ring used to secure the compressor housing to a backplate;

[0015] Fig. 3 is a close-up cross section view of an embodiment of the present invention showing a turbocharger backplate comprising a retaining ring used to secure a turbocharger compressor to the backplate;

[0016] Fig. 4A is a cross section view of an embodiment of the present invention showing a two-stage compressor assembly wherein two compressors are attached using a retaining ring; and

[0017] Fig. 4B is a close-up view of the embodiment of Fig. 4.

DETAILED DESCRIPTION OF THE INVENTION

[0018] The present invention provides a turbocharger assembly lock comprising a retaining ring and circumferential grooves for attaching turbocharger stages (i.e., stage components) such as, but not limited to, a compressor, a turbine, and/or a center housing rotating assembly to each other. Thus, the present invention comprises a retaining ring and grooves disposed in the turbocharger stages for attaching the turbocharger stages to each other. For example, an embodiment of the present invention comprises a retaining ring to attach a compressor stage to a center housing rotating assembly ("CHRA"). Also, the retaining ring of the present invention is applicable to

single stage compressors and two stage compressor assemblies. As used in the specification and claims herein, the terms “a”, “an”, and “the” mean one or more.

[0019] Therefore, although the description and figures depict, for illustrative purposes, the attachment of a compressor stage to another turbocharger stage, it is understood that the attachment/assembly of other turbocharger stage components utilizing the present invention is within the scope of the invention

[0020] Turning to the figures, Fig. 1 shows a turbocharger assembly **100** of the prior art wherein turbine **110** is attached to CHRA **150**, and compressor **101** is attached to CHRA **150** via the attachment of compressor housing **102** secured to backplate **106** using bolt **108** and clamp plate **109**.

[0021] In all embodiments of the present invention, bolt **108** and clamp plate **109** of Fig. 1 are replaced by a retaining ring which is a snap ring that, in accordance with the present invention, comprises an opening or break in its circumferential structure so that its circumference can be expanded by being forced open or compressed by being forced closed, followed by a return to its original shape upon release of the pressure forcing it open or closed. Therefore, the retaining ring comprises a variably adjustable circumference. The retaining ring is disposed into a circumferential recess groove, referred to herein as a “ring groove”, of a first turbocharger stage. A second turbocharger stage also comprises a circumferential recess groove, referred to herein as a “mating groove”. Upon mating of the turbocharger stages, the retaining ring resides partially in the ring groove and partially in the mating groove. As used in the specification and claims herein, the term “groove” denotes or means a groove having a bottom, two generally opposing sides, and an open face opposite the bottom.

[0022] An embodiment of the present invention is illustrated in Fig. 2 wherein housing **202** of compressor **201** (the first compressor stage) comprises ring groove **218** (for consistency herein,

the first compressor stage is that which comprises a ring groove) into which retaining ring **220** is disposed prior to assembly of housing **202** onto backplate **206**. Backplate **206** (a part of the second compressor stage, the CHRA) comprises mating groove **228**. For assembly, compressor housing **202** and backplate **206** are brought together (for example, compressor housing **202** is moved onto backplate **206**) so that retaining ring **220** is forced open. The increase in the circumference of retaining ring **220** is accommodated by ring groove **218**, which is of sufficient depth to accommodate the expansion of retaining ring **220**. As shown in the figures, the retaining ring is disposed so that its circumference is oriented along a plane substantially perpendicular to the center, longitudinal axis of a given turbocharger stage, although the orientation may vary depending on the application. Preferably, circumferential chamfer or bevel **204** is provided to aid in the expansion of retaining ring **220**. Retaining ring **220** then slides onto backplate **206** until it reaches mating groove **228** whereupon retaining ring **220** snaps back to its original shape/circumferential dimension so that it resides within both ring groove **218** and mating groove **228** to secure housing **202** to backplate **206**. Therefore, retaining ring **220** mates ring groove **218** and mating groove **228**, thus mating the first turbocharger stage to the second turbocharger stage.

[0023] In another embodiment, shown in Fig. 3, the position of the ring groove is the reverse of that shown in Fig. 2 but otherwise is similar in concept to that shown in Fig. 2. In this embodiment, backplate **306** (of the first compressor stage) comprises backplate ring groove **328** into which retaining ring **320** is disposed prior to assembly of housing **302** of compressor **301** onto backplate **306**. Compressor **301** (i.e., the second compressor stage) comprises mating groove **318**. For assembly, compressor housing **302** is pushed onto backplate **306** so that retaining ring **320** is forced closed, to decrease its circumference, and the change in circumference is accommodated further by ring groove **328**. Preferably, circumferential chamfer or bevel **304** is provided to aid in the compression of retaining ring **320** as the two turbocharger stage components are moved together. Retaining ring **320** then slides along housing **302** until it reaches mating groove **318** whereupon retaining ring **320** snaps back to its original shape.

[0024] In the embodiment shown in Figs. 4A and 4B (Fig. 4B being a close-up view of the area designated "B" in Fig. 4A), two-stage compressor assembly **400** is shown wherein first compressor **401** (low pressure compressor) is attached to second compressor **402** (high pressure compressor) in accordance with the same concept described above with respect to Figs. 2 and 3. In Figs. 4A and 4B, housing **411** of compressor **401** comprises ring groove **428** into which ring **420** is disposed prior to assembly of compressor **401** to compressor **402**. Housing **412** of compressor **402** comprises mating groove **418**. As compressor **401** and compressor **402** are brought together, retaining ring **420** is compressed to lessen its circumference until it reaches mating groove **418** whereupon retaining ring **420** snaps back to its original shape/circumference. Preferably, circumferential chamfer or bevel **404** is provided to aid in the compression of retaining ring **420** as the two turbocharger compressor housings are moved together. As with regard to Fig. 2 *vis-à-vis* Fig. 3, the orientation of the grooves can be the reverse of that shown in Figs. 4A and 4B.

[0025] Preferably, a leak prevention seal and/or loading component, such as O-ring **226** and O-ring **326** shown in Fig. 2 and Fig. 3, respectively, and O-ring seal **426** with seal plate **436** shown in Fig. 4B, is/are disposed at a juncture of the first turbocharger stage and the second turbocharger stage to seal the respective compressor stage from leakage and/or to function as a spring or loading component. Alternatively, the sealing/loading component can comprise a spring-like device such as, but not limited to, a Belleville spring (or washer) or other component known in the art to carry out the sealing and/or loading function. Also, an orientation component such as, but not limited to, a pin (not shown) may be provided to assure proper orientation of the turbocharger stage components to each other.

[0026] The present invention reduces the number of turbocharger parts and costs by eliminating the typical clamp plates and clamp bolts. Additional cost reduction can be realized because neither threaded holes nor the assembly of clamp plates and bolts are required when the present

invention is applied, thus reducing machining and turbocharger assembly time (i.e., assembly cycle time). Further, the quality of turbocharger assembly is improved because fastener assembly torques are not required as a result of implementation of the present invention.

[0027] The present invention also provides for a tamper resistant assembly of turbocharger stages.

Tamper resistance is sometimes desirable as when emission control requirements are imposed given that a turbocharger is typically an integral part of an internal combustion engine's emission control system.

[0028] The preceding examples can be repeated with similar success by substituting the generically or specifically described components, mechanisms, materials, and/or operating conditions of this invention for those used in the preceding examples.

[0029] Although the invention has been described in detail with particular reference to these preferred embodiments, other embodiments can achieve the same results. Variations and modifications of the present invention will be obvious to those skilled in the art and it is intended to cover in the appended claims all such modifications and equivalents. The entire disclosures of all references, applications, patents, and publications cited above are hereby incorporated by reference.

CLAIMS

What is claimed is:

1. A turbocharger assembly comprising:
 - a first turbocharger stage having a ring groove;
 - a retaining ring disposed in said ring groove, said retaining ring having an adjustable circumference; and
 - a second turbocharger stage adjacent to said first turbocharger stage, said second turbocharger stage having a mating groove within which said retaining ring is fitted to mate said ring groove and said mating groove and secure said first turbocharger stage to said second turbocharger stage.
2. The assembly of claim 1 further comprising a loading component at a juncture of said first turbocharger stage and said second turbocharger stage.
3. The assembly of claim 1 wherein said second turbocharger stage further comprises a circumferential bevel to facilitate a variation in a circumference of said retaining ring as said first turbocharger stage is moved toward said second turbocharger stage.
4. The assembly of claim 1 wherein said first turbocharger stage comprises a compressor.
5. The assembly of claim 1 wherein said second turbocharger stage comprises a compressor.
6. The assembly of claim 1 wherein said first turbocharger stage comprises a turbocharger center housing rotating assembly.

7. The assembly of claim 1 wherein said second turbocharger stage comprises a turbocharger center housing rotating assembly.

8. The assembly of claim 1 wherein said first turbocharger stage comprises a turbocharger turbine.

9. The assembly of claim 1 wherein said second turbocharger stage comprises a turbocharger turbine.

10. A method for attaching turbocharger stages to each other, the method comprising:
disposing a ring groove in a first turbocharger stage;
disposing a retaining ring having an adjustable circumference in the ring groove;
disposing a mating groove in a second turbocharger stage;
bringing the first turbocharger stage and the second turbocharger stage together and simultaneously changing the circumference of the retaining ring, and allowing the retaining ring to resume its original circumference, when the ring groove and the mating groove come together, by snapping into position so that the retaining ring resides partially in the ring groove and partially in the mating groove, thus attaching the first turbocharger stage to the second turbocharger stage.

1/5

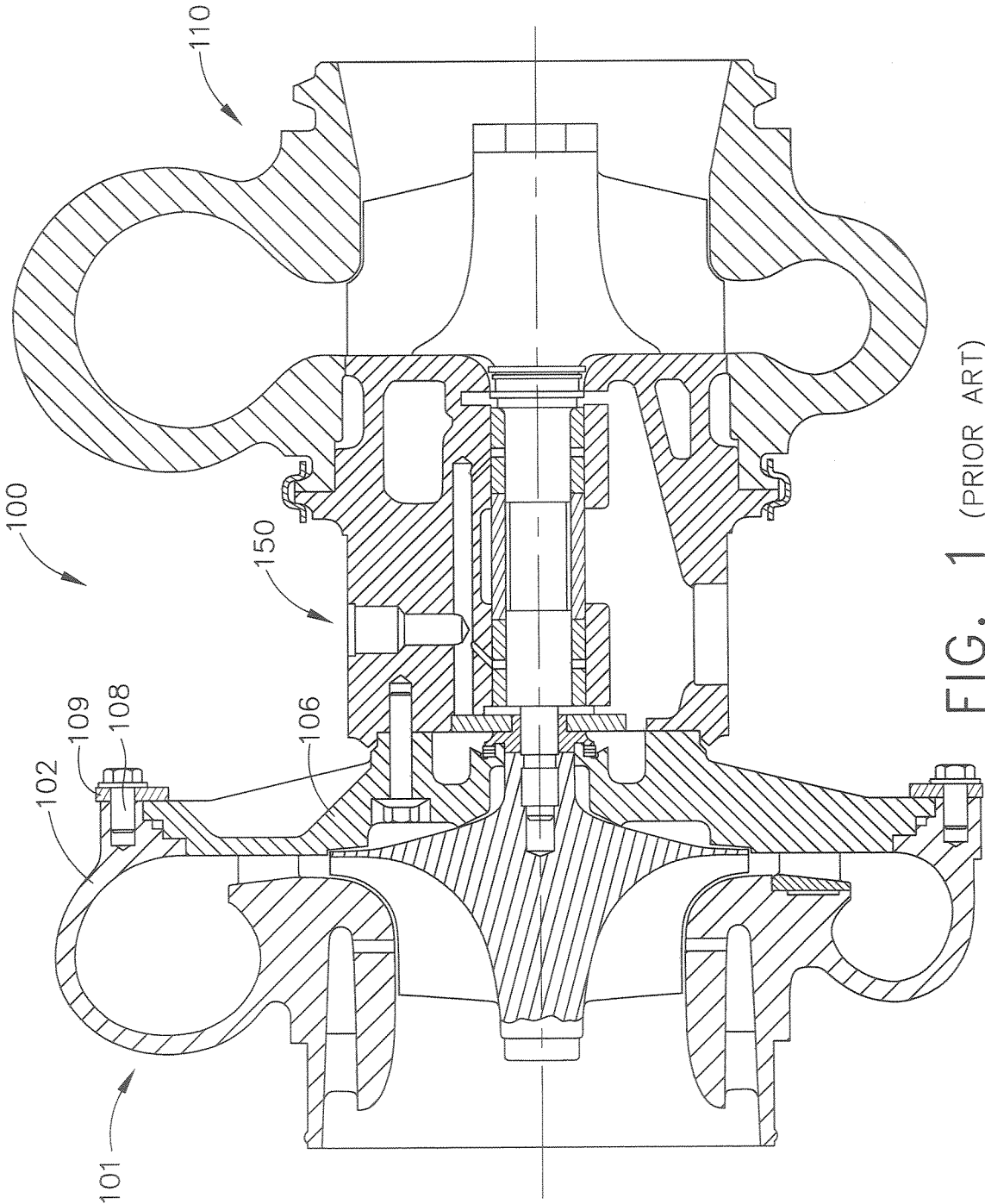


FIG. 1 (PRIOR ART)

2/5

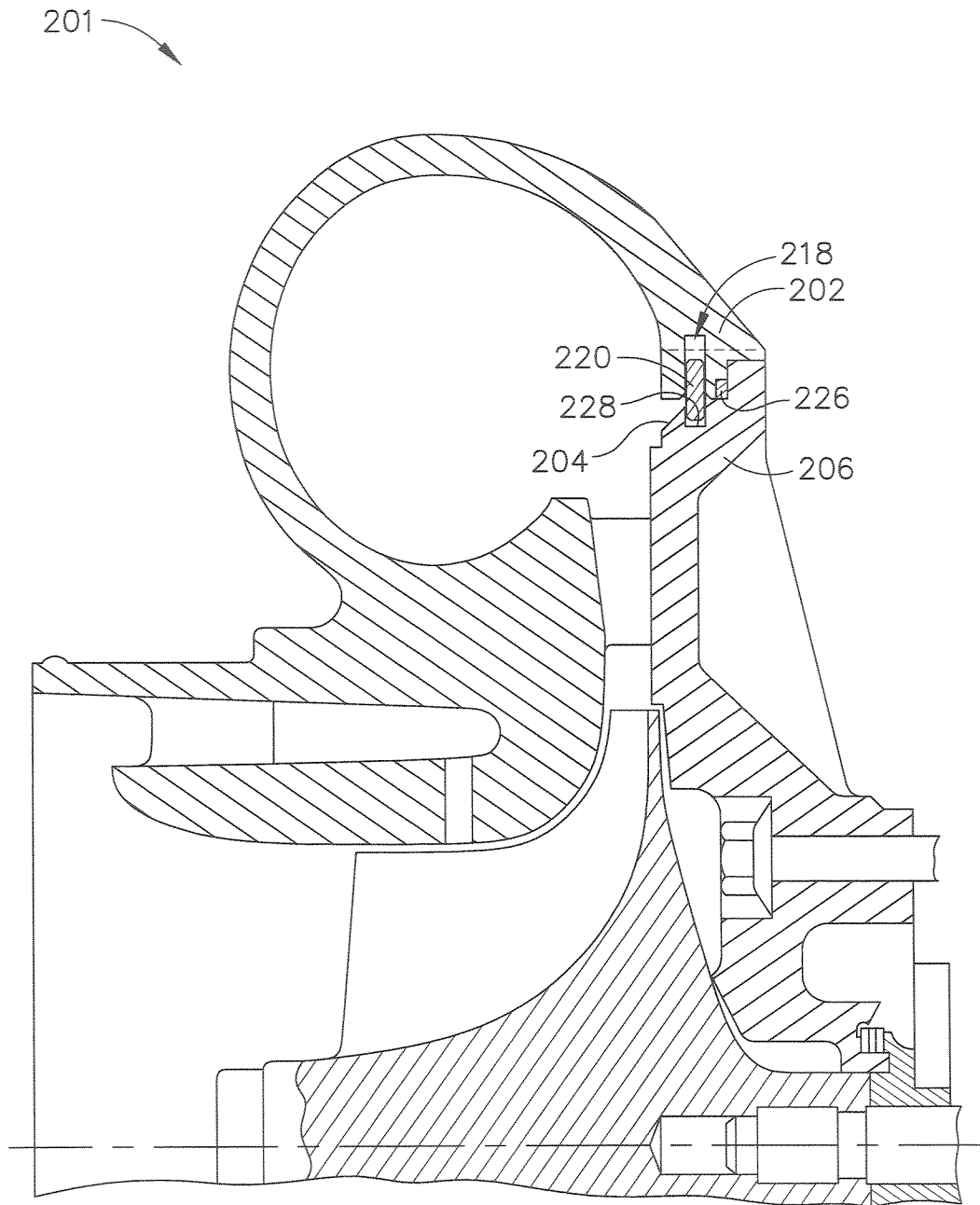


FIG. 2

3/5

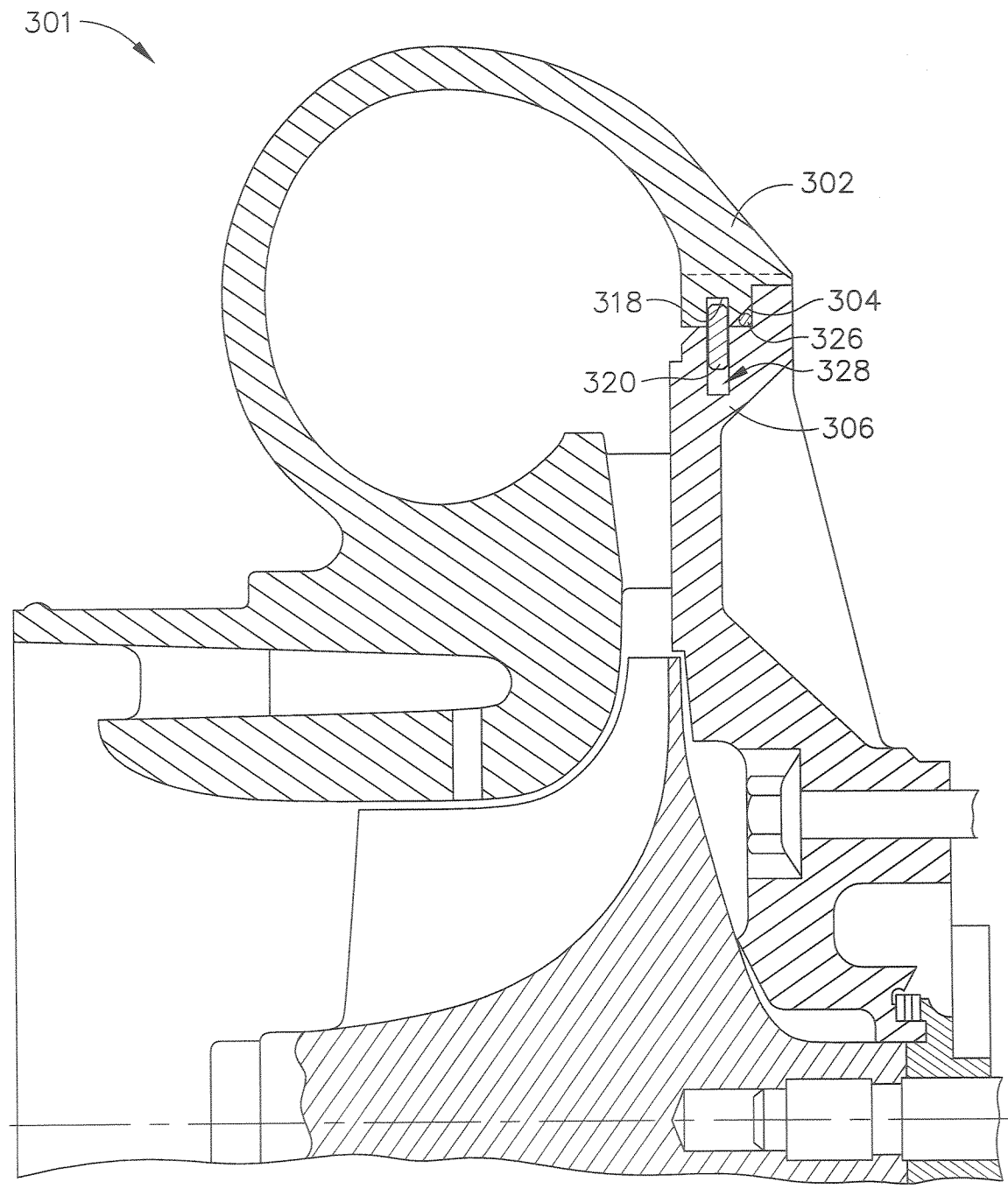


FIG. 3

4/5

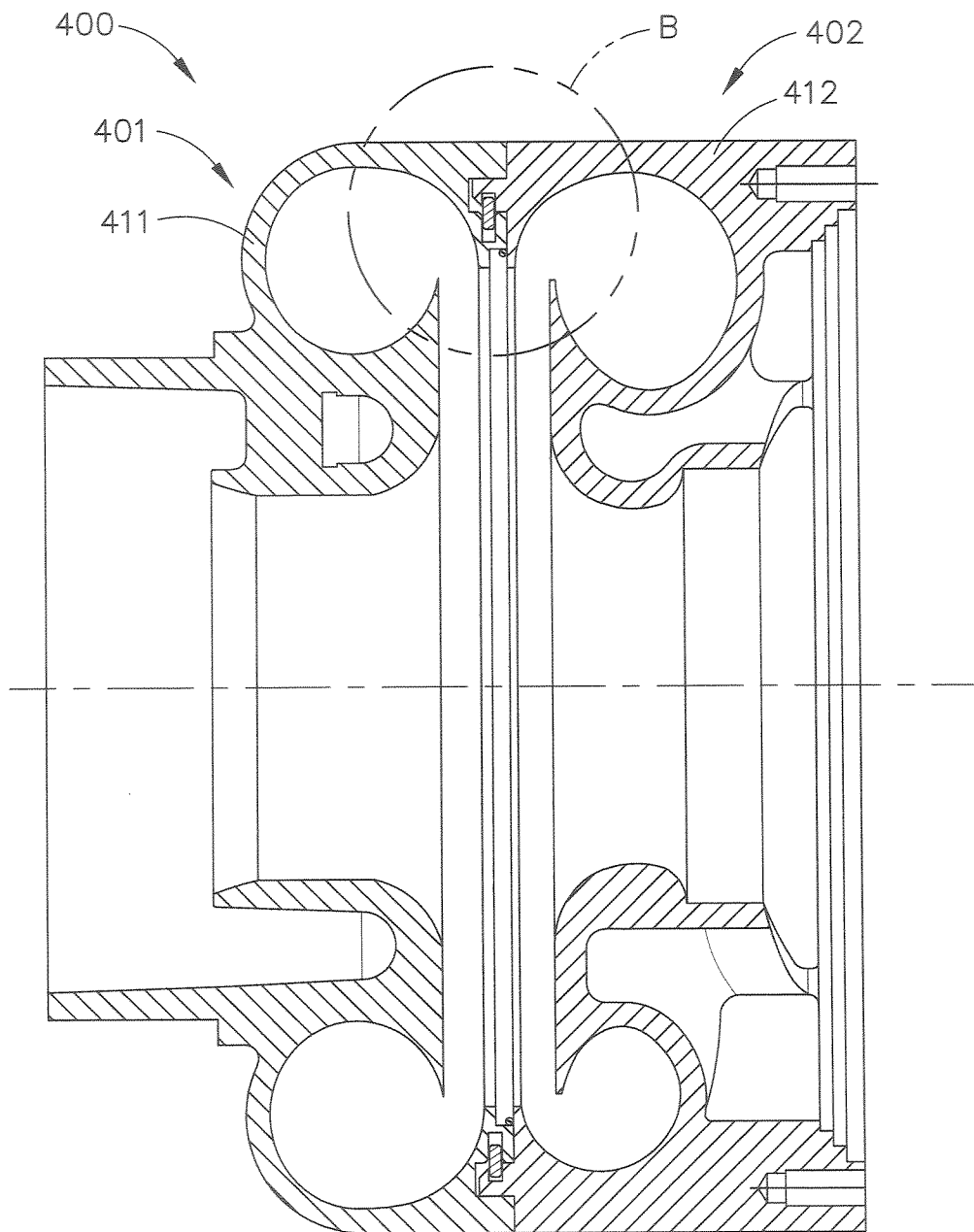


FIG. 4A

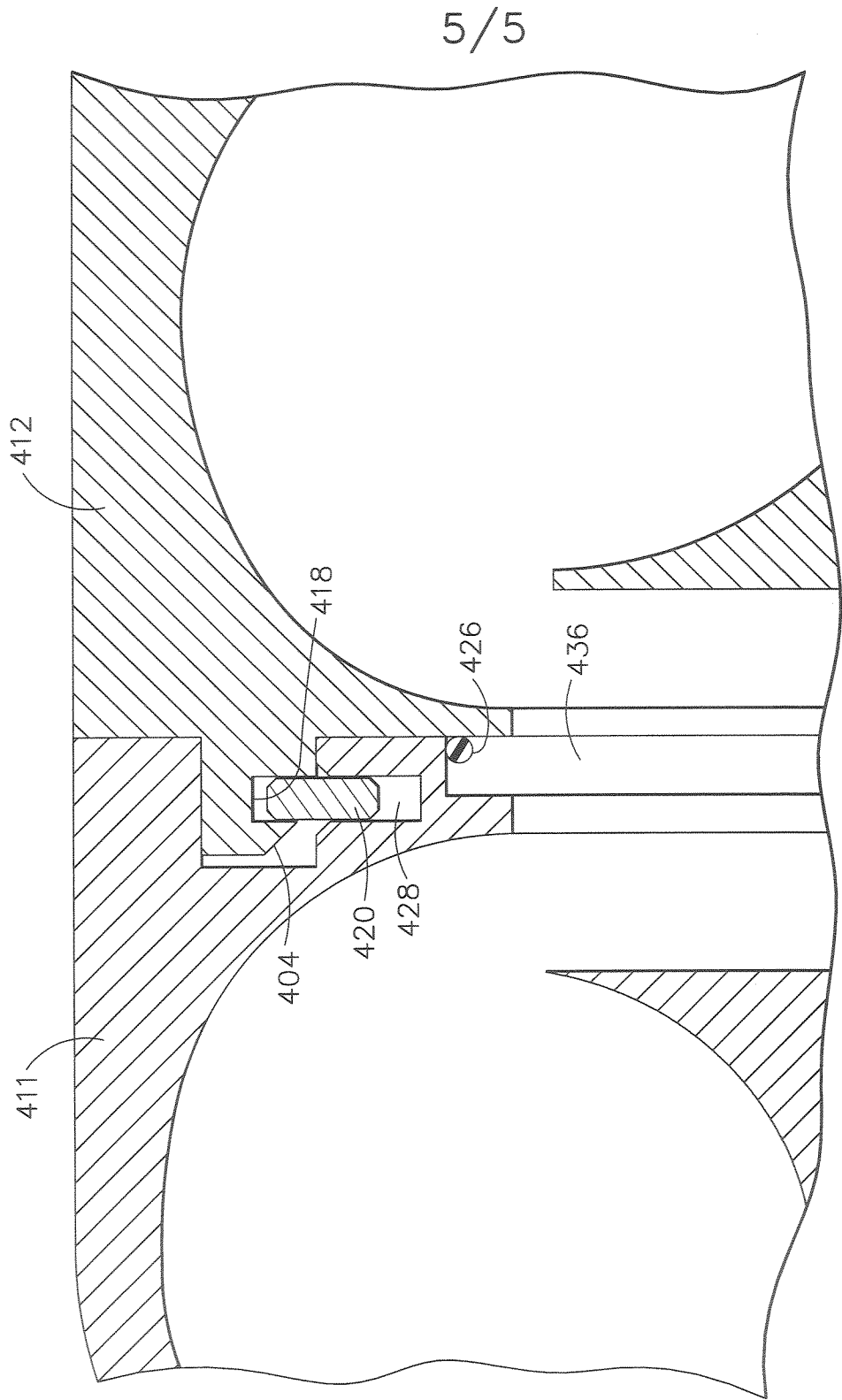


FIG. 4B

INTERNATIONAL SEARCH REPORT

International application No

PCT/US2007/068319

A. CLASSIFICATION OF SUBJECT MATTER
INV. F01D25/24

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 F02B

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.
Y	US 4 447 750 A (HOWLETT JAMES F [US] ET AL) 8 May 1984 (1984-05-08) column 3, line 19 - line 59; figure 3	1-10
Y	US 6 032 466 A (WOOLLENWEBER WILLIAM E [US] ET AL) 7 March 2000 (2000-03-07) figure 1	1-10
Y	US 4 383 799 A (OKANO HIROSHI [JP] ET AL) 17 May 1983 (1983-05-17) abstract; figure 6	1-10
Y	US 5 025 629 A (WOOLLENWEBER WILLIAM E) 25 June 1991 (1991-06-25) figures 7,8	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

E earlier document 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 another 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

4 October 2007

Date of mailing of the international search report

11/10/2007

Name and mailing address of the ISA/

European Patent Office, P.B. 5618 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer

Yates, John

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2007/068319

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	GB 2 271 814 A (LEAVESLEY MALCOLM GEORGE [GB]) 27 April 1994 (1994-04-27) items 67 & 70, figures 1,8 -----	1-10
A	US 4 741 225 A (HALL III ARTHUR [US] ET AL) 3 May 1988 (1988-05-03) abstract -----	1-10

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2007/068319

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 4447750	A	08-05-1984	NONE	
US 6032466	A	07-03-2000	NONE	
US 4383799	A	17-05-1983	JP 1427975 C	25-02-1988
			JP 56141022 A	04-11-1981
			JP 62037216 B	11-08-1987
US 5025629	A	25-06-1991	NONE	
GB 2271814	A	27-04-1994	NONE	
US 4741225	A	03-05-1988	NONE	