(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
14 August 2014 (14.08.2014)

WIPO | PCT

(10) International Publication Number
WO 2014/123720 A1

(51) International Patent Classification:
F01D 25/24 (2006.01) *F02B 39/00* (2006.01)

(21) International Application Number:
PCT/US2014/013321

(22) International Filing Date:
28 January 2014 (28.01.2014)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
10 2013 002 299.1
8 February 2013 (08.02.2013) DE

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

(72) Inventors: **JUNG, Martin**; Luise-michel-str. 1b, 67292 Kirchheimbolanden (DE). **GUGAU, Marc**; Schulstr. 11, 55546 Freilaubersheim (DE).

(74) Agents: **PENDORF, Stephan, A.** et al.; Patent Central LLC, 1401 Hollywood Boulevard, Hollywood, FL 33020-5237 (US).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, 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, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, 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, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV,

[Continued on next page]

(54) Title: EXHAUST-GAS TURBOCHARGER AND METHOD FOR PRODUCING A FLOW HOUSING OF AN EXHAUST-GAS TURBOCHARGER

(57) Abstract: The invention relates to an exhaust-gas turbocharger (1) having a turbine housing (2) which has a turbine spiral (16); having a compressor housing (3) which has a compressor spiral (17), wherein an internal flow-guiding spiral surface (18 or 19 respectively) of the turbine spiral (16) and/or of the compressor spiral (17) is machined in a material-removing process.

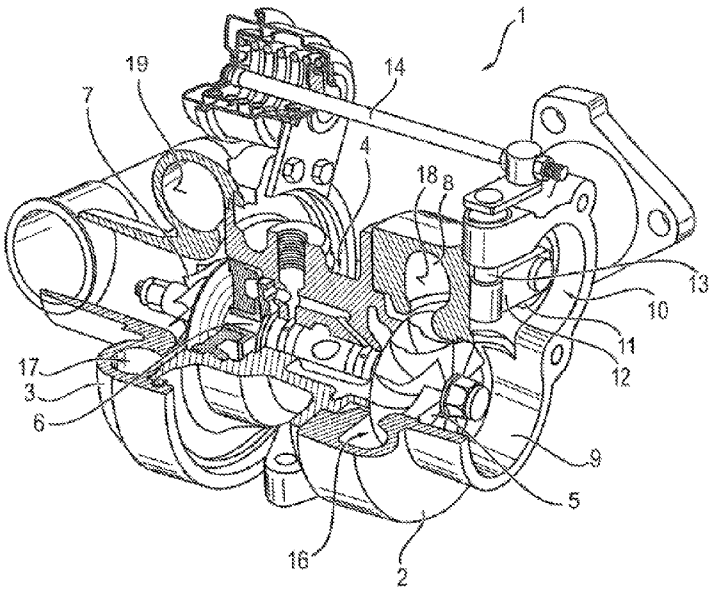

FIG. 1

WO 2014/123720 A1

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).

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 AND METHOD FOR PRODUCING A FLOW HOUSING OF AN EXHAUST-GAS TURBOCHARGER

DESCRIPTION

The invention relates to an exhaust-gas turbocharger according to the preamble of claim 1 and to a method for producing a flow housing of an exhaust-gas turbocharger, as per claim 4.

The flow housings of an exhaust-gas turbocharger are the compressor housing and the turbine housing. Said flow housings are normally produced as cast parts and respectively comprise a compressor spiral and turbine spiral which surround the compressor wheel and the turbine wheel respectively and end at a tongue.

In already-known exhaust-gas turbochargers, reworking of the internal flow-guiding spiral surface of the compressor housing or turbine housing is performed by turning only in exceptional cases, if the compressor wheel or the turbine wheel are damaged, the aim of said reworking being to increase the distance between the tongue and the wheel.

It is an object of the present invention to provide an exhaust-gas turbocharger of the type specified in the preamble of claim 1, the efficiency of which can be increased.

This object is achieved by the features of claim 1.

By virtue of the internal flow-guiding spiral surface of the compressor spiral and/or of the turbine spiral being machined for example by milling, the original tolerance range of the tongue spacing is reduced by approximately 80%. Here, by contrast to reworking by turning, it is advantageously the case that no imperfections are generated. The narrower (milling) tolerance range is in this case shifted into the minus range of the original (casting position) tolerance range. The efficiency of the exhaust-gas turbocharger is thus increased.

The dependent claims contain advantageous further developments of the exhaust-gas turbocharger according to the invention.

Tests carried out within the context of the invention have shown that the internal flow-guiding spiral surface has a coarse influence on the performance of the turbine or of the compressor owing to its roughness generated by the casting process. Here, it is in particular the final circumferential quarter of the compressor spiral and/or of the turbine spiral that is of crucial significance. It is therefore preferable for said

final circumferential quarter to be subjected to a material-removing machining process, in particular a milling machining process, wherein it is basically also possible for the compressor spiral and/or the turbine spiral to be subjected to such machining over its entire length.

Said material-removing machining, in particular the milling machining, yields the already-discussed increase in efficiency, and additionally a reduction in efficiency variance, by providing an improved surface condition.

Further tests carried out within the context of the invention have shown that the tongue spacing between the tongue and wheel of the turbine and/or of the compressor has a decisive influence on the following:

a) the flow housing performance, the throughput and the efficiency; and

b) the HCF excitation of the turbine wheel and/or compressor wheel, wherein a smaller spacing leads to a more intense excitation.

The tongue spacing is set according to the invention based on the compromise between the two stated conditions a) and b). In practice however, said tongue spacing is not fixed but rather varies owing to the casting position tolerances in the flow housing. This means that:

In particular, the turbine performance and the HCF excitation of the turbine wheel fluctuate with the tolerance range of the tongue spacing, and superposed with the surface quality of the spiral (of the flow duct).

In particular, if the final circumferential quarter of the spiral is now milled, the tolerance range is reduced by 80%, and the surface quality is much higher than without milling machining. This yields the following advantages:

– The differences in efficiency of the individual series-produced flow housings are reduced by 80% as regards influences arising from the tongue spacing. At the same time, the series HCF performance is maintained.

– The average efficiency of the turbine and/or of the compressor in the series-produced turbine and/or series-produced compressor can be increased:

- if, for example, a turbine housing lies in the middle/upper casting tolerance range, this reduces the efficiency;
- if the milling tolerance is placed into the lower casting tolerance range, this increases the exhaust-gas turbocharger efficiency in the series process, without the original series HCF limit being undershot. That is to say, the increase in

performance is greater the smaller the flow housing is.

– If the tongue is milled, the surface quality is simultaneously also increased, because significant imperfections can be milled away. The HCF strength is thus increased significantly. However, if only the original series HCF strength is required, it is possible according to the invention to correspondingly reduce the tongue spacing. A reduction of the tongue spacing by for example 2.5% results in a 1% increase in efficiency.

Claims 8 to 14 define a method according to the invention for producing a flow housing of an exhaust-gas turbocharger. According thereto, the flow housing is firstly cast, and material-removing machining, in particular milling machining, of the internal flow-guiding spiral surfaces is subsequently performed.

In accordance with the results of the tests carried out according to the invention, material-removing machining, in particular milling machining, is performed in particular on the final circumferential quarter up to the end of the tongue of the respective spiral of the flow housing.

It is preferably possible for a disk milling cutter to be used for carrying out the milling process.

Furthermore, in relation to known flow housings, it is possible for the lateral connection radii of the tongue to be enlarged and for the tongue to be formed with a machining allowance.

The flow housing may either be in the form of a compressor housing or in the form of a turbine housing. In the case of an exhaust-gas turbocharger according to the invention, however, it is possible, as defined in claim 1, for milling machining to be performed either only on the compressor housing or only on the turbine housing or on both flow housings.

The method according to the invention can basically be implemented as follows:

A) Emergency remedy in ongoing series production in the event of individual blade damage (HCF performance): The previous approach of turning machining of the tongue generates both an imperfection at the machining engagement location and also a greater efficiency loss, because in the case of turning machining, the tongue radius can only be kept constant. The efficiency loss will be noticeably lower with the implementation of the method according to the invention, which

provides milling machining, for example, than with the previously known turning. Furthermore, in the case of milling, no imperfection is generated, which likewise has a positive effect on efficiency.

B) Improvement in efficiency in new housing constructions: The spiral is preferably structurally adapted such that, in its final quarter, its cross-sectional width is less than or equal to the turbine wheel inlet width or diffuser outlet width, and in which the cross-sectional depth decreases to approximately zero.

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

Figure 1 shows a perspective sectional illustration of one possible embodiment of an exhaust-gas turbocharger according to the invention;

Figure 2 shows one possible embodiment of a flow housing according to the invention of the exhaust-gas turbocharger, said flow housing being a turbine housing in the example illustrated;

Figure 3 shows a sectional illustration through an embodiment of a turbine housing according to the invention;

Figure 4 shows a sectional illustration, corresponding to figure 3, of a further embodiment of the turbine housing according to the invention; and

Figure 5 shows graphs illustrating tolerance ranges for the tongue spacing without milling (casting) and with milling machining.

Figure 1 illustrates an exhaust-gas turbocharger 1 according to the invention which has a turbine housing 2 and a compressor housing 3.

The turbine housing 2 has a turbine spiral 16 which is the flow duct which surrounds a turbine wheel 5 which is arranged in the turbine housing 2.

Correspondingly, the compressor housing 3 has a compressor spiral 17 which is the flow duct which surrounds a compressor wheel 7 of the compressor housing 3.

The turbine spiral 16 has an internal spiral surface 18, and the compressor spiral 17 has an internal spiral surface 19, which according to the invention is subjected, for example, to milling machining. As explained in the introduction, it is possible according to the invention for either both spiral surfaces 18 and 19 or in each case only one of said spiral surfaces 18 or 19 to be subjected to milling machining, wherein a milled turbine-side internal flow-guiding spiral surface 18 is preferred.

Figure 1 shows merely an exemplary embodiment of an exhaust-gas turbocharger 1 which may be designed according to the invention. It is self-evident that, in principle, any other conceivable embodiments of such exhaust-gas turbochargers may conceivably be provided so as to be configured according to the invention. Since the further elements of the exhaust-gas turbocharger 1 that are visible in Figure 1, and which are denoted by the reference numerals 8 to 15, are not required for the explanation of the principles of the present invention, said elements are merely listed in the following list of reference numerals.

Figure 2 shows one conceivable embodiment of a turbine housing 2 as a representative of a flow housing of an exhaust-gas turbocharger 1. Also with regard to the embodiment of the turbine housing 2 shown in Figure 2, it is pointed out that this is merely an exemplary embodiment, and any other design of a turbine housing 2 may likewise have the features according to the invention. Furthermore, it is pointed out that the features that are explained below and visible in Figure 2 also apply in principle to the compressor housing 3 of the exhaust-gas turbocharger 1.

Figure 2 illustrates again that the turbine housing 2 has a turbine spiral 16 with an internal flow-guiding spiral surface 18, which leads from a housing inlet 8 to the end 21 of a tongue 22. According to the invention, said internal flow-guiding spiral surface 18 is subjected, for example, to milling machining, wherein in particular the final circumferential quarter 20 to the end 21 of the tongue 22 is subjected to milling machining, because said final circumferential quarter 20 has a particularly crucial influence on the increase in efficiency.

As is also shown in Figure 2, the tongue 22 may, in the region of the end 21 of the tongue, comprise lateral connection radii R_1 and R_2 which are of enlarged form in relation to standard housings. This yields a reduced risk of cracking.

Furthermore, it is possible according to the invention for a thickening 24 of the tongue 22 to be provided in the final circumferential quarter 20 for the material-removing machining, in particular in the case of new constructions.

The resulting tongue spacing Z is also plotted in Figure 2.

Finally, Figure 2 shows, by means of the arrow PF, that the path of the milling axis is oriented to the profile of the tongue 22 and the A/R profile thereof.

Figure 3 shows a cross-sectional area, that can be realized for example by means of milling machining, in the final circumferential quarter of 20 of the spiral 16

and/or 17. The A/R profile over the circumference of the spiral continues to correspond to the conventional construction and is controlled only by means of the engagement of the milling cutter. The milling regions in the case of a new construction of said type are indicated by the six points P.

Figure 4 shows a turbine housing with material removal regions P' in the case of an emergency remedy as explained above.

Finally, figure 5 shows graphs illustrating tolerance ranges for the tongue section without milling (casting) and with milling machining.

Here, the curve K1 shows the tolerance range with milling machining, wherein the tongue spacing is reduced.

The curve K2 shows the tolerance range in the case of milling machining without a reduced tongue spacing, and the curve K3 shows the tolerance range without machining (for example in the case of the casting position tolerances in the case of steel casting). It must also be pointed out that the term "HCF configuration" is to be understood to mean a configuration which places the emphasis on a high one-time load, that is to say does not focus on load alternation. The abbreviation "HCF" refers here to "High Cycle Fatigue".

The expression "A/R profile" is to be understood to mean an area profile of a spiral which is characterized as a dimensionless ratio of cross-sectional area at a certain circumferential point and the associated centroid radius.

In addition to the above written description of the invention, reference is hereby explicitly made, for additional disclosure thereof, to the diagrammatic illustration of the invention in figures 1 to 5.

List of reference signs

1	Exhaust-gas turbocharger
2	Turbine housing
3	Compressor housing
4	Bearing housing
5	Turbine wheel
6	Shaft
7	Compressor wheel
8	Turbine housing inlet
9	Turbine housing outlet
10	Flap arrangement
11	Flap plate
12	Flap lever/spindle
13	Flap shaft
14	Control rod
15	Actuator
16	Turbine spiral
17	Compressor spiral
18	Internal spiral surface of the turbine housing 2
19	Internal spiral surface of the compressor housing 3
20	Final circumferential quarter
21	End of the tongue
22	Tongue
23	Region of the rectangular shape in the final circumferential quarter 20
24	Thickening

CLAIMS

1. An exhaust-gas turbocharger (1)

– having a turbine housing (2) which has a turbine spiral (16);

– having a compressor housing (3) which has a compressor spiral (17),

wherein

– at least a part of the internal flow-guiding spiral surface (18 or 19 respectively) of the turbine spiral (16) and/or of the compressor spiral (17) is machined in a material-removing process.

2. The exhaust-gas turbocharger as claimed in claim 1, wherein the internal flow-guiding spiral surface (18 or 19 respectively) is machined in a material-removing process in the final circumferential quarter (20) of the turbine spiral (16) and/or of the compressor spiral (17) in the tongue region (22), in particular at the end (21) of the tongue.

3. The exhaust-gas turbocharger as claimed in claim 1, wherein at least a part of the internal flow-guiding spiral surface (18 or 19 respectively) of the turbine spiral (16) and/or of the compressor spiral (17) is machined by milling.

4. The exhaust-gas turbocharger as claimed in claim 3, wherein the internal flow-guiding spiral surface (18 or 19 respectively) of the turbine spiral (16) and/or of the compressor spiral (17) is machined by milling in the final circumferential quarter (20) in the tongue region (22), in particular at the end (21) of the tongue.

5. The exhaust-gas turbocharger as claimed in claim 1, wherein at least a part of the internal flow-guiding spiral surface (18 or 19 respectively) of the turbine spiral (16) and/or of the compressor spiral (17) is machined by interpolation turning.

6. The exhaust-gas turbocharger as claimed in claim 5, wherein the internal flow-guiding spiral surface (18 or 19 respectively) is machined by interpolation turning in the final circumferential quarter (20) of the turbine spiral (16) and/or of the compressor spiral (17) in the tongue region (22), in particular at the end (21) of the tongue.

7. The exhaust-gas turbocharger as claimed in claim 1, wherein the cross-sectional width at at least a part of the internal flow-guiding spiral surface (18 or 19 respectively) of the turbine spiral (16) and/or of the compressor spiral (17) is enlarged no further proceeding from the turbine wheel inlet or diffuser outlet respectively.

8. A method for producing a flow housing (2; 3) of an exhaust-gas turbocharger (1), having the following method steps:

– casting the flow housing (2; 3); and

– machining at least a part of the internal flow-guiding spiral surface (18 or 19 respectively) of the flow housing (2; 3) in a material-removing process.

9. The method as claimed in claim 8, wherein the internal flow-guiding spiral surface (18 or 19 respectively) is machined in a material-removing process in the final circumferential quarter (20) of the turbine spiral (16) and/or of the compressor spiral (17) in the tongue region (22), in particular at the end (21) of a tongue.

10. The method as claimed in either of claims 8 and 9, wherein the turbine spiral (16) and/or the compressor spiral (17) are, in the final circumferential quarter (20), designed such that the cross-sectional width is enlarged no further proceeding from the turbine wheel inlet or diffuser outlet respectively.

11. The method as claimed in one of claims 8 to 10, wherein lateral connection radii (R_1; R_2) of the tongue (22) are of enlarged form at the end (21) of the tongue.

12. The method as claimed in one of claims 8 to 11, wherein the tongue (22) is at least partially thickened in the final circumferential quarter (20).

13. The method as claimed in one of claims 8 to 10, wherein the milling machining is performed by means of a disk milling cutter.

14. The method as claimed in one of claims 8 to 10, wherein the flow housing is in the form of a turbine housing (2) and/or a compressor housing (3).

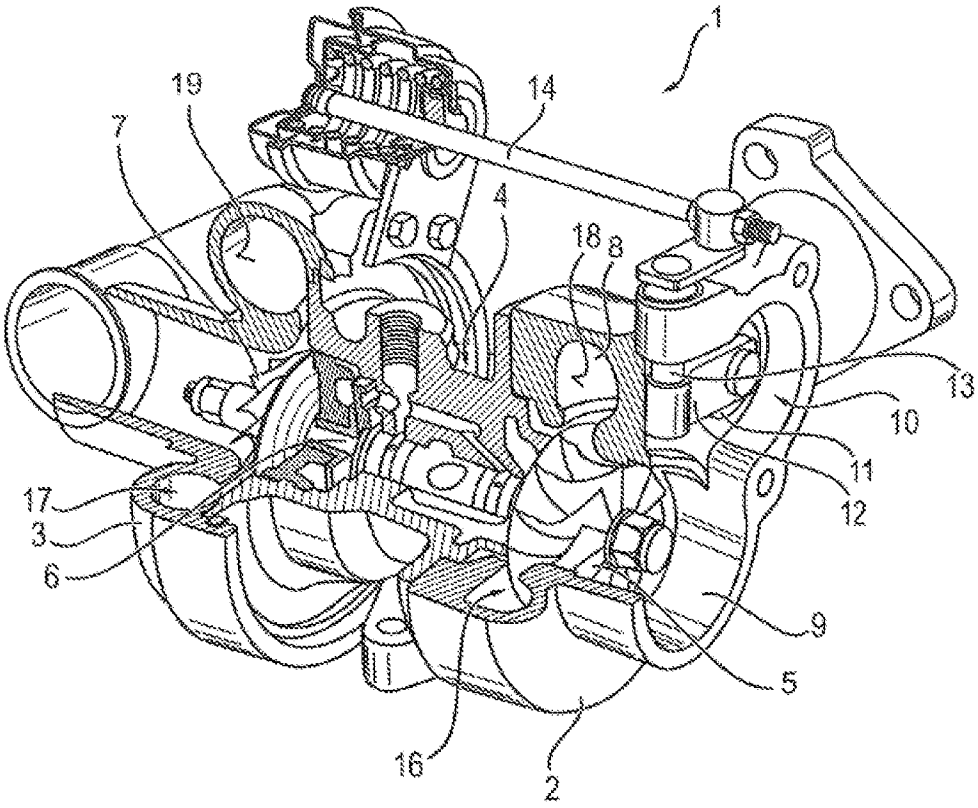

FIG. 1

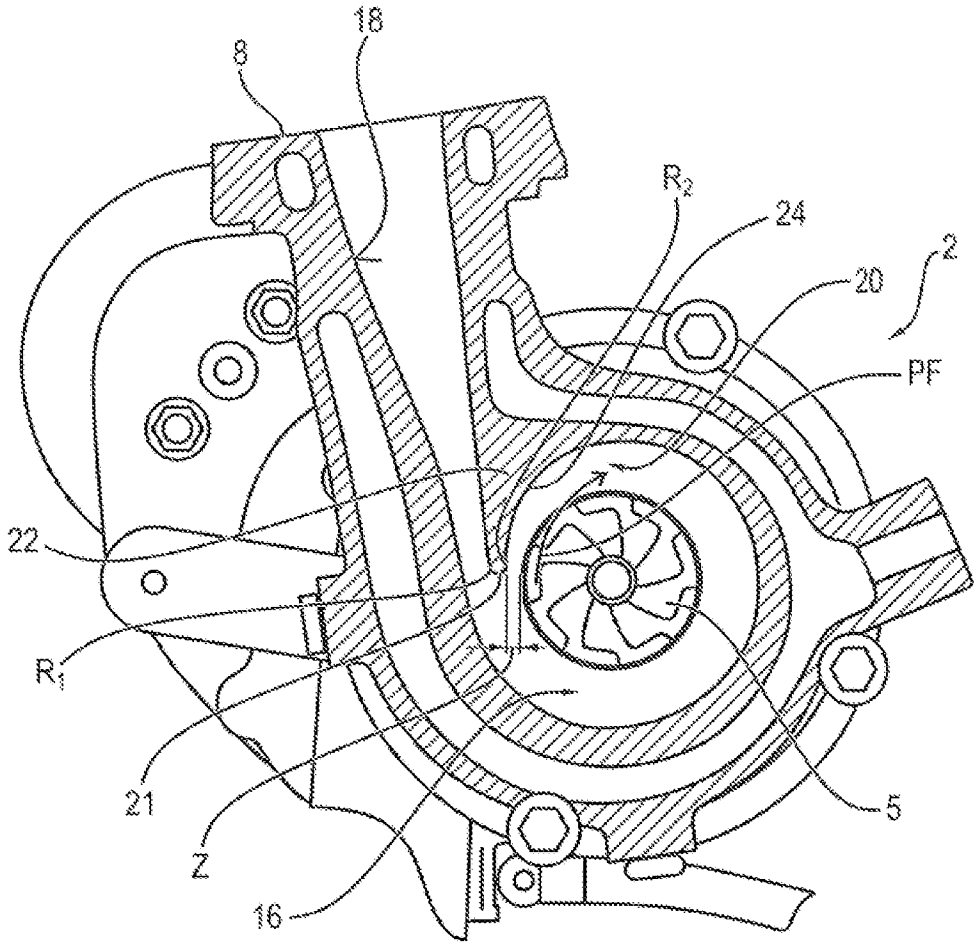

FIG. 2

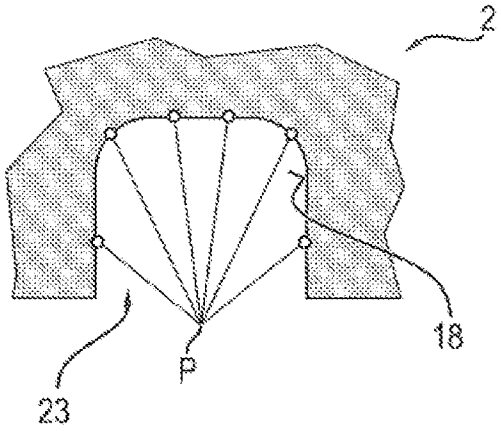

FIG. 3

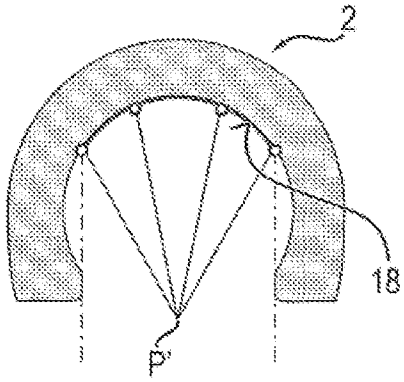

FIG. 4

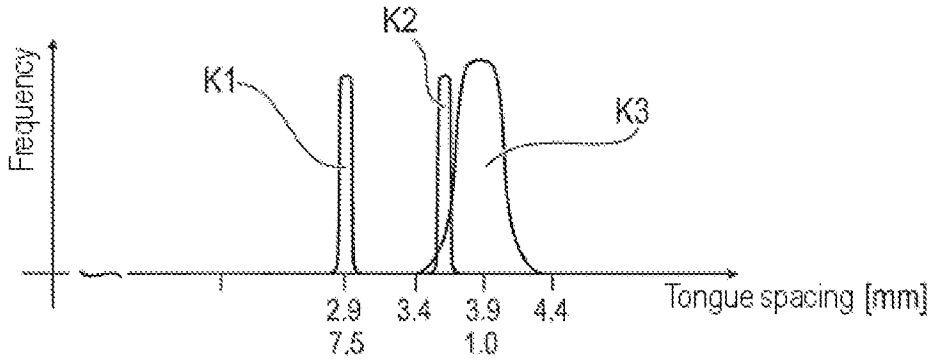

FIG. 5

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2014/013321

A. CLASSIFICATION OF SUBJECT MATTER

F01D 25/24(2006.01)i, F02B 39/00(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)
F01D 25/24; F04B 47/08; F04B 35/00; B23B 27/00; F03B 11/00; F02C 6/12; F04D 29/44; B23P 15/00; 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, turbine, compressor, housing, spiral, surface, machining, material-removing process, and milling

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2012-0288367 A1 (BOENING et al.) 15 November 2012 See paragraphs [0019],[0044]-[0046] and figures 1,5.	1-10
Y	US 2006-0013707 A1 (OKLEJAS et al.) 19 January 2006 See abstract, paragraphs [0051]-[0054], and figures 1,3-4,8-9,14,20.	1-10
A	US 2011-0158796 A1 (ALBRECHT et al.) 30 June 2011 See paragraphs [0035]-[0042] and figures 1-5.	1-10
A	US 2006-0110249 A1 (WILLIAMS et al.) 25 May 2006 See paragraphs [0016]-[0020] and figures 1-5.	1-10
A	US 2008-0209905 A1 (PETITJEAN et al.) 04 September 2008 See paragraphs [0047],[0063] and figures 2,7.	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 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 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	Date of mailing of the international search report
09 May 2014 (09.05.2014)	**09 May 2014 (09.05.2014)**

Name and mailing address of the ISA/KR
International Application Division
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
SONG, Ho Keun
Telephone No. +82-42-481-5580

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2014/013321

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.: 11-14
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 fees, this Authority did not invite payment of any additional fees.

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/US2014/013321

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2012-0288367 A1	15/11/2012	CN 102639879 A	15/08/2012
		CN 102792030 A	21/11/2012
		DE 102009053106 A1	19/05/2011
		EP 2499379 A2	19/09/2012
		US 2012-0321455 A1	20/12/2012
		WO 2011-058101 A2	19/05/2011
		WO 2011-058101 A3	21/07/2011
		WO 2011-058104 A2	19/05/2011
		WO 2011-058104 A3	21/07/2011
US 2006-0013707 A1	19/01/2006	EP 1766235 A2	28/03/2007
		EP 1766235 A4	16/05/2012
		US 8579603 B2	12/11/2013
		WO 2006-017338 A2	16/02/2006
		WO 2006-017338 A3	07/05/2009
US 2011-0158796 A1	30/06/2011	CN 102105698 A	22/06/2011
		CN 102105698 B	01/01/2014
		DE 102008025249 A1	03/12/2009
		EP 2304247 A1	06/04/2011
		US 8105025 B2	31/01/2012
		WO 2009-144102 A1	03/12/2009
		WO 2009-149798 A1	17/12/2009
US 2006-0110249 A1	25/05/2006	US 7179051 B2	20/02/2007
US 2008-0209905 A1	04/09/2008	DE 602004014034 D1	03/07/2008
		EP 1743089 A1	17/01/2007
		EP 1743089 B1	21/05/2008
		US 8250760 B2	28/08/2012
		WO 2005-106212 A1	10/11/2005