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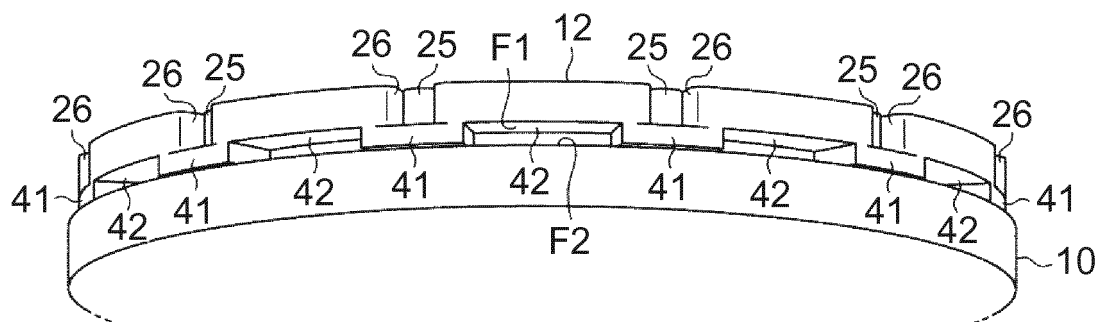
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(54) **Variable nozzle turbocharger**

(57) In a variable nozzle turbocharger, variable nozzles operate through circumferential displacement of a unison ring (12) aligned with a main plate (10) in a thickness direction thereof. A gap is formed between facing surfaces (F1, F2) of the unison ring and the main plate, and projections (41) that project from one surface (F1)

out of the facing surfaces (F1, F2) toward the other surface (F2) are provided in the gap. When the unison ring is displaced in its circumferential direction, foreign substances attached to the gap between the facing surfaces (F1, F2) are scraped out from the gap by the projections.

FIG. 4B**EP 2 871 328 A1**

Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a variable nozzle turbocharger.

2. Description of Related Art

[0002] Japanese Patent Application Publication No. 2010-180864 (JP 2010-180864 A) describes a variable nozzle turbocharger including a variable nozzle provided in an exhaust passage for blowing exhaust gas to a turbine wheel and configured such that its opening degree is changed so as to adjust a flow speed of the exhaust gas. A change operation of the opening degree of the variable nozzle is performed by rotation (circumferential displacement) of a unison ring aligned with a main plate provided in the exhaust passage, in a thickness direction of the main plate.

[0003] In the variable nozzle turbocharger, the unison ring and the main plate are exposed to the exhaust gas. Because of this, foreign substances such as soot included in the exhaust gas may be accumulated between the unison ring and the main plate. The foreign substances thus accumulated disturb the circumferential displacement of the unison ring, thereby resulting in that an appropriate operation of the variable nozzle may be disturbed by the foreign substances.

SUMMARY OF THE INVENTION

[0004] The present invention provides a variable nozzle turbocharger that is able to restrain that an appropriate operation of a variable nozzle is disturbed by foreign substances accumulated between a unison ring and a main plate.

[0005] A variable nozzle turbocharger according to a first aspect of the present invention is a variable nozzle turbocharger for changing a flow speed of exhaust gas to be blown to a turbine wheel and characterized by including a main plate, a unison ring, and variable nozzles. The unison ring is aligned with the main plate in a thickness direction of the main plate. The variable nozzles are configured such that their opening degrees are changed along with rotation of the unison ring. A first facing surface of the unison ring is opposed to a second facing surface of the main plate via a gap, and the first facing surface is provided with a plurality of first projections projecting toward the second facing surface and placed at intervals along a circumferential direction of the unison ring. According to the above configuration, when the unison ring is rotated (displaced in the circumferential direction) so as to operate the variable nozzles, foreign substances such as soot attached to the gap between the first facing surface and the second facing surface of the unison ring

and the main plate are discharged from the gap. More specifically, when the unison ring is displaced in the circumferential direction, the foreign substances attached to the gap is scraped out from the gap by the plurality of first projections projecting from the first facing surface toward the second facing surface. This accordingly makes it possible to restrain such a problem that an appropriate operation of the variable nozzles is disturbed by the foreign substances accumulated between the unison ring and the main plate.

[0006] In the variable nozzle turbocharger, the first facing surface may include a plurality of first recessed portions placed at intervals in the circumferential direction of the unison ring, and the plurality of first projections and the plurality of first recessed portions may be alternately arranged on the first facing surface along with the circumferential direction of the unison ring. According to the above configuration, the foreign substances attached to the gap can be effectively scraped out from the gap by the plurality of first projections provided between the first facing surface and the second facing surface.

[0007] In the variable nozzle turbocharger, the second facing surface may include a plurality of second recessed portions placed at intervals in the circumferential direction of the unison ring, and the plurality of second recessed portions may be opposed to the plurality of first recessed portions provided on the first facing surface. According to the above configuration, a distance between the facing surfaces F1, F2 of the unison ring and the main plate is increased due to the recessed portions thus opposed to each other, such that the gap between the facing surfaces F1, F2 can be widened, thereby resulting in that the foreign substances are hard to be accumulated in the gap.

[0008] In the variable nozzle turbocharger, the second facing surface may include a plurality of second recessed portions placed at intervals in the circumferential direction of the unison ring, and may include a plurality of second projections placed at intervals in the circumferential direction of the unison ring, the plurality of second projections and the plurality of second recessed portions may be alternately arranged on the second facing surface along with the circumferential direction of the unison ring, the plurality of first projections provided on the first facing surface may be inserted into the plurality of second recessed portions, and the plurality of second projections may be inserted into the plurality of first recessed portions. According to the above configuration, the foreign substances attached to the gap between the first facing surface and the second facing surface of the unison ring and the main plate can be scraped out from the gap by the first projections provided on the first facing surface and the second projections provided on the second facing surface, along with the circumferential displacement of the unison ring.

[0009] In the variable nozzle turbocharger, the number and position of the plurality of first projections may be set such that the first projections is displaced over the whole

circumferential direction of the unison ring in the gap between the first facing surface and the second facing surface, through the circumferential displacement of the unison ring over a whole displacement range of the unison ring to operate the variable nozzles. According to the above configuration, when the unison ring is displaced in the circumferential direction over the whole displacement range to operate the variable nozzles, the foreign substances attached to the gap between the first facing surface and the second facing surface can be scraped out from the gap by the projections.

[0010] In the variable nozzle turbocharger, the number and position of the plurality of first projections may be set such that the plurality of first projections and the plurality of second projections are displaced over the whole circumferential direction of the unison ring in the gap between the first facing surface and the second facing surface, through the circumferential displacement of the unison ring over the whole displacement range of the unison ring to operate the variable nozzles.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] Features, advantages, and technical and industrial significance of exemplary embodiments of the invention will be described below with reference to the accompanying drawings, in which like numerals denote like elements, and wherein:

FIG. 1 is a schematic drawing illustrating a variable nozzle turbocharger and an engine according to one embodiment of the present invention;

FIG. 2 is a front view illustrating a variable nozzle unit of the turbocharger according to the above embodiment;

FIG. 3 is an enlarged sectional view illustrating an attachment form of the variable nozzle unit according to the above embodiment;

FIG. 4A is a side view illustrating a unison ring and a main plate according to the above embodiment;

FIG. 4B is a perspective view illustrating the unison ring and the main plate according to the above embodiment;

FIG. 5 is a side view illustrating another examples of the unison ring and the main plate according to the above embodiment; and

FIG. 6 is a side view illustrating another example of the unison ring and the main plate according to the above embodiment.

DETAILED DESCRIPTION OF EMBODIMENTS

[0012] One embodiment of a variable nozzle turbocharger is described below with reference to FIGS. 1 to 4. As illustrated in FIG. 1, an upstream portion of an intake path 2 and a downstream portion of an exhaust pipe 3 in an engine 1 are connected to a variable nozzle turbocharger 4. The turbocharger 4 includes a compressor

wheel 5 and a turbine wheel 6. The compressor wheel 5 sends air to a downstream side of the intake path 2. The turbine wheel 6 is rotated based on blowing of exhaust gas passing through the exhaust pipe 3. When the turbine wheel 6 is rotated, the compressor wheel 5 is rotated integrally with the turbine wheel 6, thereby increasing an air intake amount of the engine 1 and improving an output of the engine 1.

[0013] In the turbocharger 4, a variable nozzle unit 7 is attached onto an exhaust passage 8 for blowing exhaust gas to the turbine wheel 6. The variable nozzle unit 7 is driven by an actuator 9 so as to increase and decrease an exhaust-gas flow area of the exhaust passage 8. Hereby, a flow speed of the exhaust gas to be blown to the turbine wheel 6 is variable. Since the flow speed of the exhaust gas to be blown to the turbine wheel 6 is variable as such, a rotation speed of the turbocharger 4 is changed, such that a boost pressure (intake pressure) of the engine 1 is adjusted. More specifically, when the exhaust-gas flow area of the exhaust passage 8 is decreased, the flow speed of the exhaust gas to be blown to the turbine wheel 6 becomes faster and the rotation speed of the turbocharger 4 is increased, thereby increasing the boost pressure of the engine 1. In the meantime, when the exhaust-gas flow area of the exhaust passage 8 is increased, the flow speed of the exhaust gas to be blown to the turbine wheel 6 becomes slower and the rotation speed of the turbocharger 4 is decreased, thereby decreasing the boost pressure of the engine 1.

[0014] FIG. 2 illustrates a detailed structure of the variable nozzle unit 7. As illustrated in the figure, the variable nozzle unit 7 is configured such that a plurality of variable nozzles 11 is assembled to a ring-shaped main plate 10 at regular intervals in a circumferential direction of the main plate 10. The variable nozzles 11 each include a nozzle pin 23, a nozzle vane 24 (illustrated in a broken line), and an arm 25. The nozzle pin 23 penetrates through the main plate 10 in a thickness direction thereof (a direction perpendicular to a plane of paper). The nozzle vane 24 is fixed to one end of the nozzle pin 23. The arm 25 is fixed to the other end of the nozzle pin 23. A plate-shaped unison ring 12 placed on the same axis as a center line of the main plate 10 and aligned with the main plate 10 in the thickness direction is assembled to the variable nozzle unit 7. The unison ring 12 is displaceable relative to the main plate 10 around the axis (in a circumferential direction). On an inner peripheral surface of the unison ring 12, a plurality of accommodation portions 26 into which respective ends of the arms 25 of the variable nozzles 11 are inserted is placed at regular intervals along the circumferential direction. Further, a notch portion 16 into which an engagement pin 18 for engaging the actuator 9 (see FIG. 1) with the unison ring 12 is inserted is also formed on the inner peripheral surface of the unison ring 12.

[0015] When a driving force of the actuator 9 is applied to the unison ring 12 via the engagement pin 18, the unison ring 12 is rotated (displaced in the circumferential

direction). As a result, the arms 25 of the variable nozzles 11 are pushed by the unison ring 12 so as to pivot the nozzle pins 23 around their axes, and along with the pivoting of the nozzle pins 23, the nozzle vanes 24 pivot around the nozzle pins 23 at the same time and in the same direction. The nozzle vanes 24 (the variable nozzles 11) perform an opening-closing operation based on such pivoting of the nozzle vanes 24. Based on the opening-closing operation (an opening-degree change operation), a size of a gap between adjacent nozzle vanes 24, that is, the exhaust-gas flow area of the exhaust passage 8 (FIG. 1) for blowing exhaust gas to the turbine wheel 6 is changed. Due to the change of the exhaust-gas flow area of the exhaust passage 8, the flow speed of the exhaust gas to be blown to the turbine wheel 6 is variable. A notch portion 17 into which a stopper 19 fixed to the main plate 10 is inserted is also formed on the inner peripheral surface of the unison ring 12 illustrated in FIG. 2. Due to the notch portion 17 and the stopper 19, the circumferential displacement of the unison ring 12 is regulated within a predetermined range.

[0016] FIG. 3 illustrates an attachment state of the variable nozzle unit 7 on the exhaust passage 8 of the turbocharger 4. As can be seen from the figure, the nozzle vanes 24 of the variable nozzles 11 are sandwiched between the main plate 10 of the variable nozzle unit 7 and a side plate 27 aligned therewith in the thickness direction of the main plate 10 (a right-left direction in the view). Note that a distance between the main plate 10 and the side plate 27 is maintained, by a plurality of spacer pins 30 (only one spacer pin 30 is illustrated in FIG. 3) fixed therebetween, to a distance where the nozzle vanes 24 can be provided between the main plate 10 and the side plate 27. The unison ring 12 of the variable nozzle unit 7 is placed on that side of the main plate 10 which is opposite to the side plate 27.

[0017] Since the variable nozzle unit 7 is provided on the exhaust passage 8 of the turbocharger 4, the unison ring 12 and the main plate 10 are exposed to the exhaust gas. Because of this, foreign substances such as soot included in the exhaust gas may be accumulated between the unison ring 12 and the main plate 10, which may result in that the foreign substances disturb an appropriate operation of the variable nozzles 11. The following describes a structure to deal with such a problem, more specifically.

[0018] As illustrated in FIGS. 4A and 4B, a gap is formed between that first facing surface F1 of the unison ring 12 which is opposed to the main plate 10 and that second facing surface F2 of the main plate 10 which is opposed to the unison ring 12. That is, the facing surface F1 of the unison ring 12 is opposed to the facing surface F2 of main plate 10 via the gap. The gap makes it difficult for the foreign substances to be accumulated between the facing surfaces F1, F2. That is, since a relatively large gap can be secured between the main plate 10 and the unison ring 12, even if foreign substances enter into the gap, the foreign substances are hard to be accumulated

therein. Further, projections 41 that project from one surface F1 out of the facing surfaces F1, F2, toward the other surface F2 out of the facing surfaces F1, F2 are provided in the gap. More specifically, a plurality of recessed portions 42 is formed on that surface F1 which is one of the facing surfaces F1, F2 and is provided closer to the unison ring 12, at given intervals in the circumferential direction of the unison ring 12. The projections 41 are provided between the plurality of recessed portions 42 on the surface F1.

[0019] The number and position of the projections 41 are set such that the projections 41 are displaced over the whole circumferential direction in the gap between the facing surfaces F1, F2 of the unison ring 12 and the main plate 10, through the displacement of the unison ring 12 over a whole displacement range in the circumferential direction to operate the variable nozzles 11 (see FIG. 2). In the unison ring 12, the accommodation portions 26 into which the respective ends of the arms 25 of the variable nozzles 11 are inserted are formed in positions corresponding to the projections 41 thus set.

[0020] The following describes an operation of the variable nozzle turbocharger 4. In the turbocharger 4, when the unison ring 12 is displaced in the circumferential direction to operate the variable nozzles 11, the foreign substances such as soot attached to the gap between the facing surfaces F1, F2 of the unison ring 12 and the main plate 10 are scraped out from the gap by the projections 41 that project from the one surface F1 out of the facing surfaces F1, F2 toward the other surface F2 out of the facing surfaces F1, F2. That is, when the projections 41 are displaced in the circumferential direction integrally with the unison ring 12, the foreign substances attached to the gap between the facing surfaces F1, F2 are pushed by the projections 41, such that the foreign substances are discharged (scraped) out of the gap. Accordingly, accumulation of the foreign substances between the unison ring 12 and the main plate 10 is restrained. As a result, it is possible to restrain such a problem that the foreign substances disturb the circumferential displacement of the unison ring 12 or the pivoting of nozzle pins 23 around their axes, that is, it is possible to restrain such a problem that an appropriate opening-closing operation of the variable nozzles 11 is disturbed by the foreign substances.

[0021] According to the above embodiment described above, it is possible to obtain the following effects. In the turbocharger 4, when the unison ring 12 is displaced in the circumferential direction to operate the variable nozzles 11, the foreign substances such as soot attached to the gap between the facing surfaces F1, F2 of the unison ring 12 and the main plate 10 are scraped out from the gap by the projections 41 that project from the one surface F1 out of the facing surfaces F1, F2 toward the other surface F2 out of the facing surfaces F1, F2. Accordingly, it is possible to restrain accumulation of the foreign substances between the unison ring 12 and the main plate 10, thereby making it possible to restrain such a problem

that an appropriate operation of the variable nozzles 11 is disturbed by the foreign substances.

[0022] The projections 41 are provided between the plurality of recessed portions 42 formed on the one surface F1 out of the facing surfaces F1, F2 of the unison ring 12 and the main plate 10, at given intervals in the circumferential direction of the unison ring 12. In view of this, when the unison ring 12 is displaced in the circumferential direction, the foreign substances attached to the gap between the facing surfaces F1, F2 can be effectively scraped out from the gap by the plurality of projections 41 provided between the facing surfaces F1, F2.

[0023] The number and position of the projections 41 are set such that the projections 41 are displaced over the whole circumferential direction in the gap between the facing surfaces F1, F2 of the unison ring 12 and the main plate 10, through the displacement of the unison ring 12 over the whole displacement range in the circumferential direction to operate the variable nozzles 11. Accordingly, when the unison ring 12 is displaced over the whole displacement range in the circumferential direction, the foreign substances attached to the gap between the facing surfaces F1, F2 can be more surely scraped out from the gap by the projections 41.

[0024] The above embodiment can be modified as follows, for example. The number and position of the projections 41 are set such that the projections 41 are displaced over the whole circumferential direction in the gap between the facing surfaces F1, F2 of the unison ring 12 and the main plate 10, through the displacement of the unison ring 12 over the whole displacement range in the circumferential direction. However, the number and position of the projections 41 may not necessarily be set in this way.

[0025] It is not necessary to provide the plurality of projections 41. The one surface F1 out of the facing surfaces F1, F2 may be set on the main plate 10, and the other surface F2 out of the facing surfaces F1, F2 may be set on the unison ring 12. In this case, the projections 41 project from the surface F1 of the main plate 10 toward the surface F2 of the unison ring 12.

[0026] As illustrated in FIG. 5, not only the recessed portions 42 are formed on the one surface F1 out of the facing surfaces F1, F2 of the unison ring 12 and the main plate 10, but also a plurality of recessed portions 43 may be formed on the other surface F2 at given intervals in the circumferential direction of the unison ring 12, such that the recessed portions 43 are opposed to the recessed portions 42. In this case, the distance between the facing surfaces F1, F2 of the unison ring 12 and the main plate 10 is increased due to the recessed portions 42, 43 opposed to each other as such, such that the gap between the facing surfaces F1, F2 can be widened, thereby resulting in that the foreign substances are hard to be accumulated in the gap.

[0027] As illustrated in FIG. 6, the plurality of recessed portions 43 is formed on the other surface F2 out of the facing surfaces F1, F2 of the unison ring 12 and the main

plate 10, and projections 44 are provided between the recessed portions 43. Then, the projections 41 formed on the one surface F1 may be inserted into the recessed portions 43 formed on the other surface F2, and the projections 44 formed on the other surface F2 may be inserted into the recessed portions 42 formed on the one surface F1. In this case, the foreign substances attached to the gap between the facing surface F1, F2 of the unison ring 12 and the main plate 10 can be scraped out from the gap by the projections 41 formed on the one surface F1 and the projections 44 formed on the other surface F2, along with the circumferential displacement of the unison ring 12.

Claims

1. A variable nozzle turbocharger for changing a flow speed of exhaust gas to be blown to a turbine wheel (6), the variable nozzle turbocharger **characterized by** comprising:

a main plate (10);

a unison ring (12) aligned with the main plate in a thickness direction of the main plate; and variable nozzles (11) configured such that their opening degrees are changed along with rotation of the unison ring, wherein:

a first facing surface (F1) of the unison ring is opposed to a second facing surface (F2) of the main plate via a gap; and the first facing surface is provided with a plurality of first projections (41) projecting toward the second facing surface and placed at intervals along a circumferential direction of the unison ring.

2. The variable nozzle turbocharger according to claim 1, wherein the first facing surface includes a plurality of first recessed portions (42) placed at intervals in the circumferential direction of the unison ring, and the plurality of first projections and the plurality of first recessed portions are alternately arranged on the first facing surface along with the circumferential direction of the unison ring.
3. The variable nozzle turbocharger according to claim 2, wherein the second facing surface includes a plurality of second recessed portions (43) placed at intervals in the circumferential direction of the unison ring, and the plurality of second recessed portions is opposed to the plurality of first recessed portions provided on the first facing surface.
4. The variable nozzle turbocharger according to claim

2, wherein:

the second facing surface includes a plurality of second recessed portions (43) placed at intervals in the circumferential direction of the unison ring, and includes a plurality of second projections (44) placed at intervals in the circumferential direction of the unison ring;
 the plurality of second projections and the plurality of second recessed portions are alternately arranged on the second facing surface along with the circumferential direction of the unison ring;
 the plurality of first projections provided on the first facing surface is inserted into the plurality of second recessed portions; and
 the plurality of second projections is inserted into the plurality of first recessed portions.

5. The variable nozzle turbocharger according to claim 2 or 3, wherein:

the number and position of the plurality of first projections are set such that the plurality of first projections is displaced over the whole circumferential direction of the unison ring in the gap between the first facing surface and the second facing surface, through the circumferential displacement of the unison ring over a whole displacement range of the unison ring to operate the variable nozzles.

6. The variable nozzle turbocharger according to claim 4, wherein:

the number and position of the plurality of first projections are set such that the plurality of first projections and the plurality of second projections are displaced over the whole circumferential direction of the unison ring in the gap between the first facing surface and the second facing surface, through the circumferential displacement of the unison ring over a whole displacement range of the unison ring to operate the variable nozzles.

FIG. 1

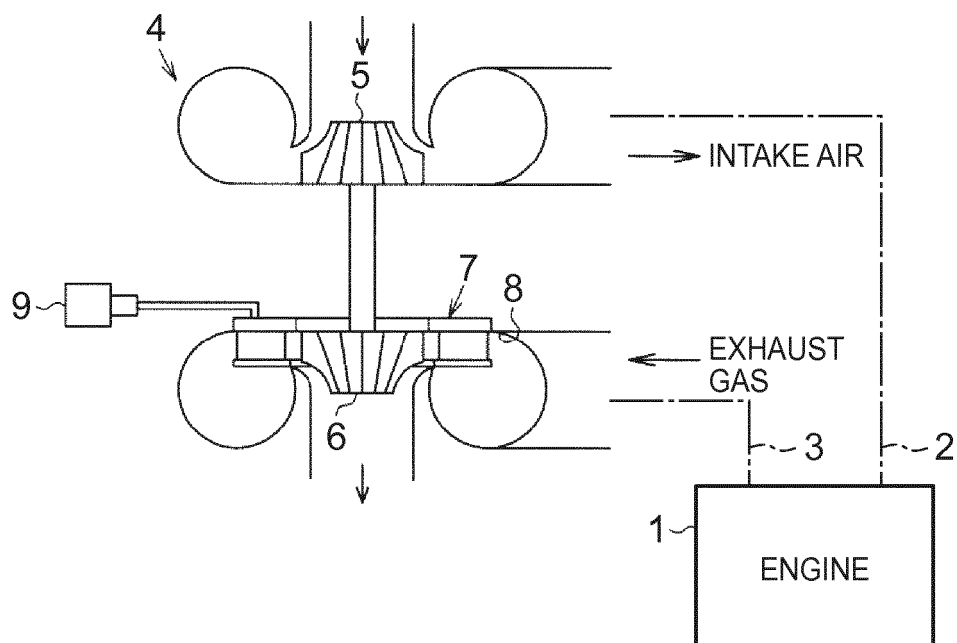


FIG. 2

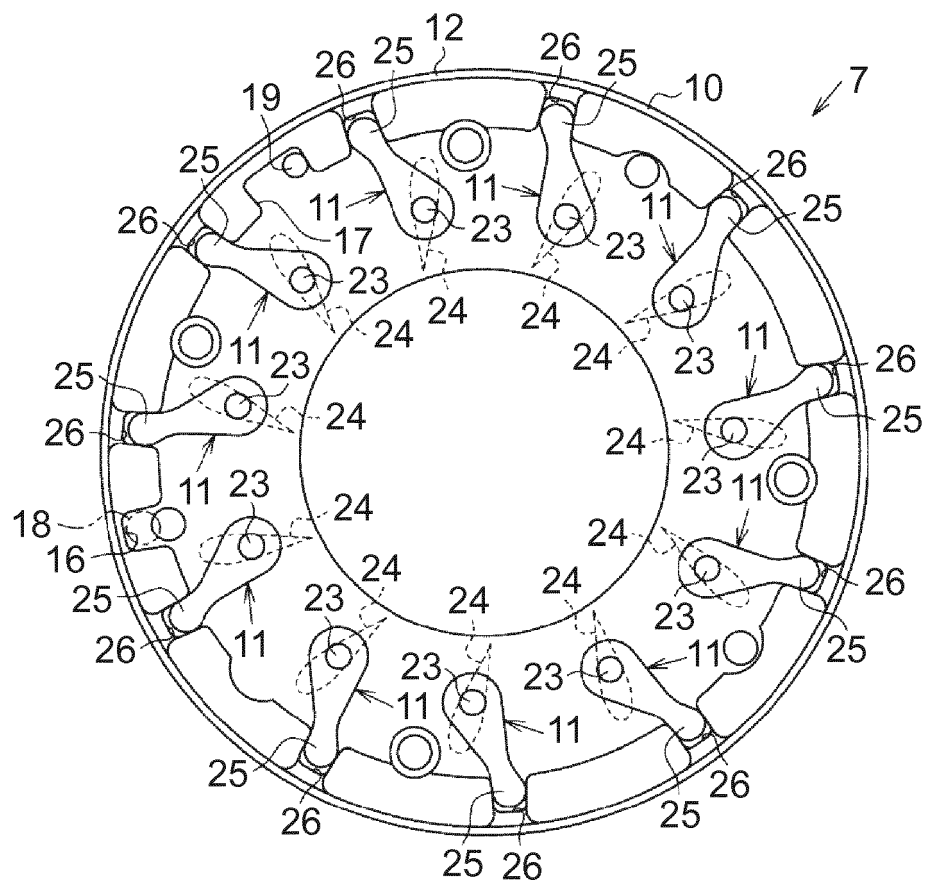


FIG. 3

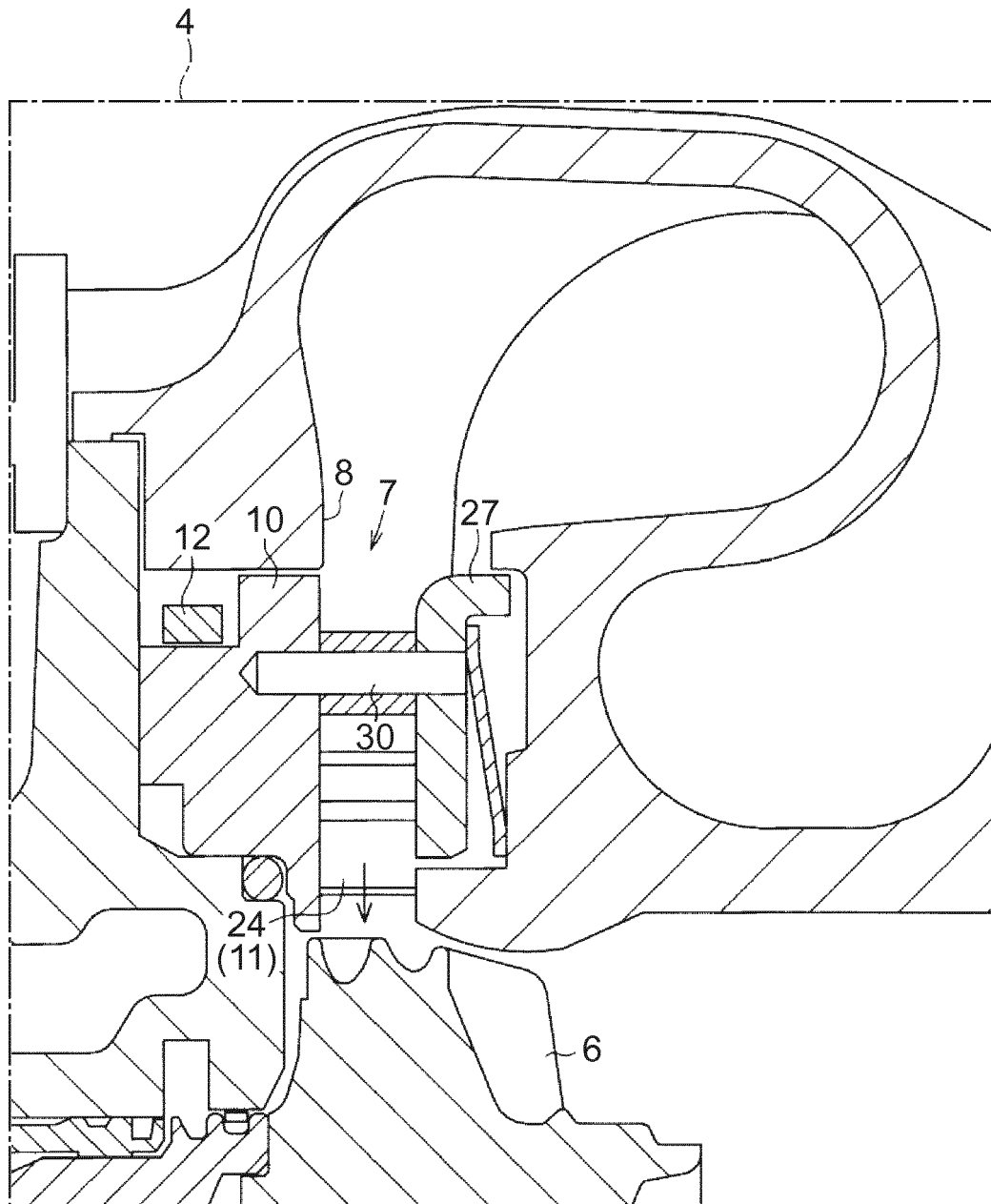


FIG. 4A

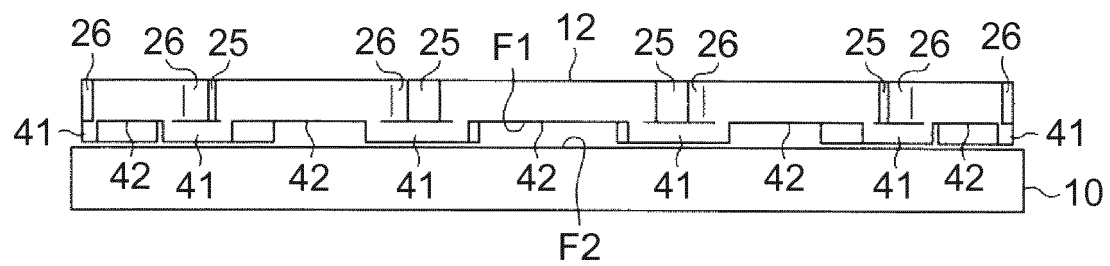


FIG. 4B

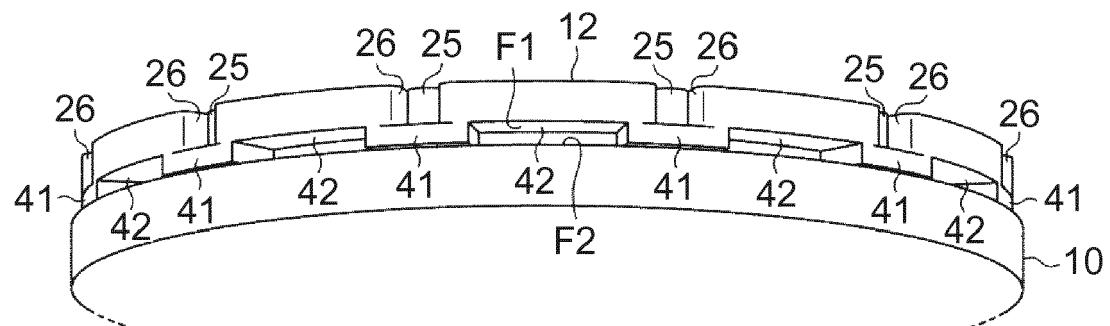


FIG. 5

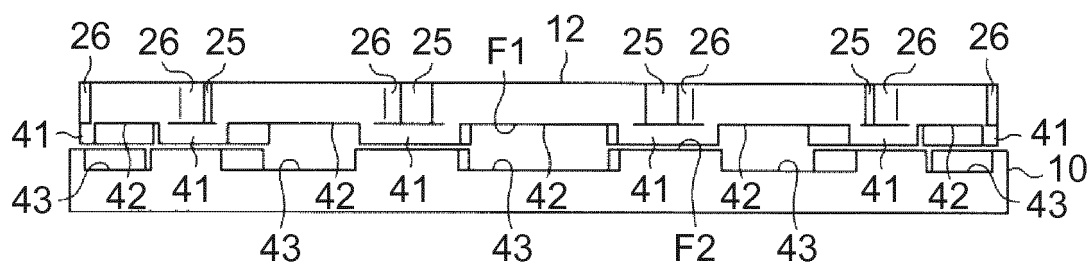
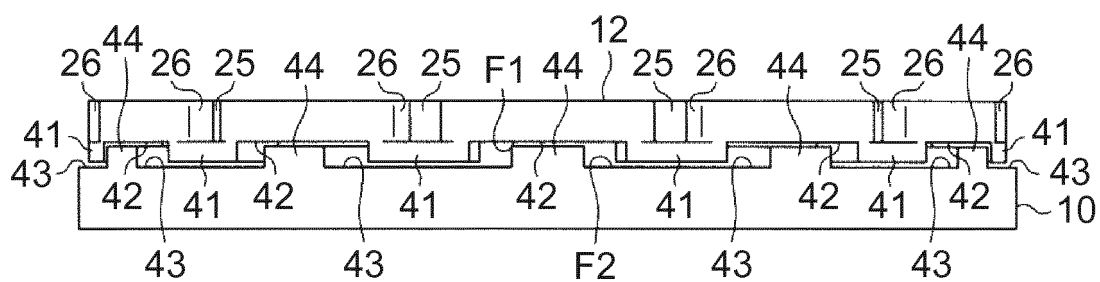


FIG. 6





EUROPEAN SEARCH REPORT

Application Number
EP 14 19 2318

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2002/098081 A1 (ERTL STEFAN [DE] ET AL) 25 July 2002 (2002-07-25) * figures *	1-6	INV. F01D17/16
X	US 2010/215482 A1 (PRANG ANDREAS [DE] ET AL) 26 August 2010 (2010-08-26) * paragraph [0023]; figure 2 *	1-6	
X	JP 2012 140894 A (TOYOTA MOTOR CORP) 26 July 2012 (2012-07-26) * figure 1 *	1-6	
X	US 2011/182717 A1 (TRIES TIMO [DE] ET AL) 28 July 2011 (2011-07-28) * figures 4,8 *	1-6	
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (IPC) F01D
Place of search Munich		Date of completion of the search 20 March 2015	Examiner Rolé, Florian
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ON EUROPEAN PATENT APPLICATION NO.**

EP 14 19 2318

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2002098081 A1	25-07-2002	DE 10104176 A1	25-07-2002
		EP 1227221 A2	31-07-2002
		US 2002098081 A1	25-07-2002

US 2010215482 A1	26-08-2010	DE 102009008531 A1	12-08-2010
		EP 2226474 A2	08-09-2010
		US 2010215482 A1	26-08-2010

JP 2012140894 A	26-07-2012	JP 5605218 B2	15-10-2014
		JP 2012140894 A	26-07-2012

US 2011182717 A1	28-07-2011	CN 101405479 A	08-04-2009
		EP 1999343 A1	10-12-2008
		JP 2009531587 A	03-09-2009
		KR 20090007728 A	20-01-2009
		US 2011182717 A1	28-07-2011
		WO 2007112910 A1	11-10-2007

EPO FORM P0459

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2010180864 A [0002]