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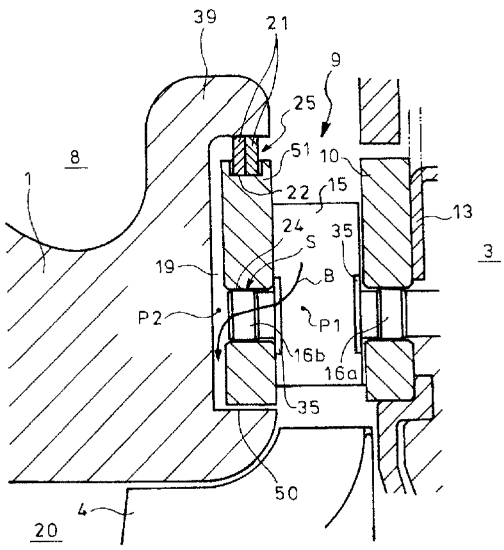
(54) ## VARIABLE GEOMETRY TURBOCHARGER

(57) An exhaust nozzle 9 has nozzle vanes 15 interposed between front and rear exhaust introduction walls 10 and 51. A space 19 is between the wall 51 and a turbine housing 1. A sealing device 25 is arranged upstream, in a direction of exhaust gas, of each through hole 24 provided in the wall 51 for penetration of a vane shaft 16a to prevent exhaust gas in a scroll passage 8 from leaking through the space 19 to a turbine impeller 4. Each of the walls 10 and 51 is disk-shaped, the turbine housing 1 being formed with a shoulder 50 to which the wall 51 is fitted with the space 19.

FIG. 2



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Description

Technical Field

[0001] The present invention relates to a variable geometry turbocharger capable of enhancing turbine efficiency and enabling a smooth operation of nozzle vanes with a simple structure.

Background Art

[0002] Fig. 1 is a longitudinal sectional view showing an overall structure of a variable geometry turbocharger to which the present invention is applied. In the turbocharger, turbine and compressor housings 1 and 2 are integrally assembled via a bearing housing 3 by fastening bolts 3a and 3b. Turbine and compressor impellers 4 and 5 disposed in the turbine and compressor housings 1 and 2, respectively, are coupled together by a turbine shaft 7 rotatably supported via a bearing 6 in the bearing housing 3.

[0003] The bearing housing 3 is provided, on its side adjacent to the turbine housing, with an exhaust nozzle 9 for guiding exhaust gas introduced into a scroll passage 8 in the turbine housing 1 to the turbine impeller 4.

[0004] The exhaust nozzle 9 comprises a front and rear exhaust introduction walls 10 and 11 adjacent to the bearing and turbine housings 3 and 1, respectively, and integrally assembled together with a required space kept therebetween by fixing members 12 provided, for example, at three circumferential positions. The front exhaust introduction wall 10 has a front surface (a surface adjacent to the bearing housing 3) to which a mounting member 13 is fixed. The mounting member 13 is pinched by the turbine and bearing housings 1 and 3 to fix the exhaust nozzle 9 in assembling of the turbine and bearing housings 1 and 3 together. In such assembling, the exhaust nozzle 9 is positioned with a positioning pin 14 relative to the bearing housing 3.

[0005] Circumferentially equidistantly disposed between the front and rear exhaust introduction walls 10 and 11 are a plurality of nozzle vanes 15 each of which is, in Fig. 1, pivotally supported at its opposite sides by vane shafts 16a and 16b coaxially fixed to the opposite sides of the vane 15 and penetrating through the exhaust introduction walls 10 and 11, respectively. In Fig. 1, reference numerals 17a, 17b, 17c and 17d denote a link-type transmission mechanism for adjusting an opening/closing angle of the nozzle vanes 15; and 18, a scroll passage formed in the compressor housing 2.

[0006] A space 19 is provided between the turbine housing 1 and the rear exhaust introduction wall 11 in the exhaust nozzle 9. The space 19, which is inherently unnecessary, is provided for absorption of any thermal deformation and any variations in accuracy since the turbine housing 1 may have heat deformation between cold and hot times and components to be assembled may have variations in accuracy.

[0007] Since the space 19 exists, exhaust gas in the scroll passage 8 may wastefully leak through the space 19 to a turbine impeller outlet 20. Thus, in order to block the space 19, it has been proposed to provide the rear exhaust introduction wall 11 with an extension 11' extending downstream, sealing piston rings 21 being arranged between an outer periphery of the extension 11' and an inner surface 1' of the turbine housing 1 facing to the extension 11' for prevention of any gas leakage and absorption of any thermal deformation (see Patent Literature 1).

[0008] As shown in Fig. 1, in Patent Literature 1, an annular groove 22 is provided on the outer periphery of the extension 11' of the rear exhaust introduction wall 11 and typically two sealing piston rings 21 are disposed in the groove 22 with their cutout portions being not overlapped with each other, thereby forming a sealing device 23. Outer peripheries of the sealing piston rings 21 are pushed against the inner surface 1' of the turbine housing 1 due to resilience of the rings 21 to prevent any gas leakage.

[0009] In the turbocharger shown in Fig. 1, the sealing device 23 is provided in various elaborate manners for prevention of gas leakage from the space 19. However, it has turned out that substantially enhancing turbine efficiency is difficult to attain and is limited even if the sealing device 23 is elaborately configured.

[0010] Thus, the inventors have variously studied and examined factors other than the gas leakage which affect turbine efficiency and found out that greater disturbance of the exhaust gas at the turbine impeller outlet 20 decreases turbine efficiency.

[0011] In the structure like the sealing device 23 in Fig. 1 with the sealing piston rings 21 arranged between the outer periphery of the extension 11' of the rear exhaust introduction wall 11 and the inner surface 1' of the turbine housing 1, pressure in the space 19 on which the pressure in the scroll passage 8 directly acts is larger than pressure in the exhaust nozzle 9, so that the exhaust gas with higher pressure in the space 19 flows downstream of the exhaust nozzle 9 through clearances between the vane shafts 16b and their through holes 24 (see Fig. 2). In this case, a clearance is present in advance between each nozzle vane 15 and the front and rear exhaust introduction walls 10 and 11 for pivotal movement of the nozzle vane 15, and the size of this clearance varies depending on the turbocharger concerned. Thus, it has been found that each vane shaft 16b of each nozzle vane 15 is pressed by the exhaust gas from the space 19 with higher pressure to move the nozzle vane 15 toward the front exhaust introduction wall 10, thereby causing a clearance between each nozzle vane 15 and the rear exhaust introduction wall 11. Thus, findings have been obtained such that the exhaust gas with higher pressure flows downstream of the exhaust nozzle 9 through the clearance between each nozzle vane 15 and the rear exhaust introduction wall 11 and significantly disturbs the exhaust gas at the turbine impeller 4 outlet, leading to degraded turbine efficiency.

[0012] Thus, the applicant already filed an application as to a turbocharger which prevents the exhaust gas in a scroll passage 8 from leaking through the space 19 to the turbine impeller 4 and also prevents the exhaust gas with higher pressure in the space 19 from flowing downstream of the exhaust nozzle 9 through a clearance between each vane shaft 16a and its through hole 24 (see Fig. 2) and a clearance between each nozzle vane 15 and the rear exhaust introduction wall 11 (see Patent Literature 2).

Citation List

Patent Literature

[0013]

[Patent Literature 1] JP 2006-125588A
[Patent Literature 2] JP 2009-144545A

Summary of Invention

Technical Problems

[0014] According to the turbocharger of Patent Literature 2, the gas leakage to the turbine impeller 4 due to the space 19 and the disturbance of the exhaust gas at the turbine impeller 4 outlet can be prevented to effectively enhance turbine efficiency.

[0015] However, in Patent Literature 2, the front exhaust introduction wall 10 is disk-shaped as a whole whereas the rear exhaust introduction wall 11 is, just like Patent Literature 1, disk-shaped at its outer periphery and has an inner periphery with the extension 11' curved axially downstream along a contour of the turbine impeller 4. Thus, when heated by the exhaust gas at high temperatures, the disk-shaped front exhaust introduction wall 10 is deformed in its entirety only in a direction of increasing diameter. By contrast, the rear exhaust introduction wall 11 with the extension 11' is suppressed in diametral deformation of the disk-shaped outer periphery due to high stiffness strength of the extension 11' so that the disk-shaped portion is deformed to slump down against the front exhaust introduction wall 10; as a result, there is a concern that the disk-shaped portion may contact any nozzle vane 15 to block the movement of the vane 15.

[0016] The invention was made in view of the above, and has its object to provide a variable geometry turbocharger capable of preventing, with a simple structure, front and rear exhaust introduction walls from being deformed in a non-diametral direction and ensuring stable movement of the nozzle vanes.

Solution to Problems

[0017] The invention is directed to a variable geometry turbocharger with an exhaust nozzle having nozzle vanes interposed between front and rear exhaust introduction walls, a space being between said rear exhaust introduction wall and a turbine housing, a sealing device being arranged upstream, in a direction of exhaust gas, of each through hole provided in said rear exhaust introduction wall for penetration of a vane shaft to prevent exhaust gas in a scroll passage from leaking through said space to a turbine impeller, wherein each of said front and rear exhaust introduction walls is disk-shaped, said turbine housing being formed with a shoulder to which the disk-shaped rear exhaust introduction wall is fitted with said space.

[0018] In the above-mentioned variable geometry turbocharger, it is preferable that said front and rear exhaust introduction walls are equivalent in linear expansion coefficient.

[0019] In the above-mentioned variable geometry turbocharger, it is preferable that said sealing device comprises sealing piston rings or a disk spring seal.

Advantageous Effects of Invention

[0020] According to the variable geometry turbocharger of the invention, the front and rear exhaust introduction walls are disk-shaped and the disk-shaped rear exhaust introduction wall is fitted to and disposed, with the space, in the shoulder formed on the turbine housing. Thus, an excellent effect can be achieved such that, with a simple structure, the deformation of the front and rear exhaust introduction walls in a non-diametral direction can be prevented and stable movement of the nozzle vanes can be ensured.

Brief Description of Drawings

[0021]

Fig. 1 is a longitudinal sectional view showing an overall structure of a variable geometry turbocharger to which the invention is applied;

Fig. 2 is a sectional view in a vicinity of an exhaust nozzle showing an embodiment of the invention;

Fig. 3a is a sectional view showing an integrally unitized exhaust nozzle unit with the exhaust nozzle of Fig. 2;

Fig. 3b is a front view of the exhaust nozzle unit of Fig. 3a viewed from a direction of arrow III;

Fig. 4a is a sectional view showing a further embodiment of the invention with a sealing device different from that of Fig. 2;

Fig. 4b is a front view of a disk spring seal in Fig. 4a; and

Fig. 5 is a sectional view of a still further embodiment of the invention with a sealing device similar to that of Fig. 4a.

Description of Embodiments

[0022] Embodiments of the invention will be described below with reference to the attached drawings.

[0023] Fig. 2 shows an embodiment of the invention in which a disk-shaped rear exhaust introduction wall 51 is substituted for the rear exhaust introduction wall 11 with the extension 11' in the variable geometry turbocharger of Fig. 1. Thus, each of the front and rear exhaust introduction walls 10 and 51 is disk-shaped. It is preferable that the disk-shaped front and rear exhaust introduction walls 10 and 51 are made of same material or materials equivalent in linear expansion coefficient. With the rear and front exhaust introduction walls 51 and 10 set equivalent in linear expansion coefficient, the vane shafts 16a and 16b fixed to opposite sides of each nozzle vane 15 are consistently coaxially supported by the exhaust introduction walls 51 and 10.

[0024] The turbine housing 1 is formed with an extension 39 extending to a position facing to and spaced apart by a required space from the outer periphery of the rear exhaust introduction wall 51. The turbine housing 1 with the extension 39 has a front surface formed with a shoulder 50 to which the rear exhaust introduction wall 51 is fitted with the space 19 formed therebetween. For prevention of the turbine housing 1 from contacting the rear exhaust introduction wall 51, the space 19 is set in consideration of linear expansion coefficients thereof.

[0025] Further, the embodiment of Fig. 2 has a sealing device 25 for prevention of the exhaust gas in the scroll passage 8 from leaking through the space 19 between the turbine housing 1 and the rear exhaust introduction wall 51 to the turbine impeller 4, the sealing device 25 being arranged (on a side adjacent to the scroll passage 8) upstream, in a direction of exhaust gas, of each through hole 24 through which the vane shaft 16b penetrates.

[0026] The sealing device 25 of Fig. 2 comprises a groove 22 circumferentially extending on an outer periphery of the rear exhaust introduction wall 51, and sealing piston rings 21 similar to those in Fig. 1 fitted between an inner periphery of the extension 39 and the groove 22 on the outer periphery of the rear exhaust introduction wall 51. In the embodiment of Fig. 2, two sealing piston rings 21 are disposed in the groove 22.

[0027] A fixed portion of each of the vane shafts 16a and 16b fixed to each nozzle vane 15 for penetration through the front and rear exhaust introduction walls 10 and 51, respectively, is formed with a collar 35 for coverage of the through hole 24. Such collar 35 can suppress entering of foreign matters through the through hole 24 and movement of the exhaust gas through the through hole 24 to the space 19. Furthermore, as will be described hereinafter, pressure of the exhaust gas acting on the collar 35 can be utilized for a force sufficient for movement of the nozzle vane 15 toward the rear exhaust introduction wall 51.

[0028] Fig. 3a is a sectional view of an exhaust nozzle unit unitized to include the exhaust nozzle 9 of Fig. 2, and Fig. 3b is a front view of the exhaust nozzle unit of Fig. 3a viewed in a direction of arrow III. In the nozzle unit U, the nozzle vanes 15 with the vane shafts 16a and 16b penetrating through the through holes 24 are disposed between the disk-shaped rear exhaust introduction wall 51 with the groove 22 formed on its outer periphery and the disk-shaped front exhaust introduction wall 10. The front exhaust introduction wall 10 has a front surface (a right side surface in Fig. 3a) on which a guide ring 53 is disposed for pinching a rotary ring 52 between the guide ring 53 and the mounting member 13. The rear exhaust introduction wall 51, the front exhaust introduction wall 10, the mounting member 13 and the guide ring 53 are fastened together with the fixing members 12 provided at three positions, whereby the exhaust nozzle unit U is unitized. An end of the vane shaft 16b of each nozzle vane 15 penetrates through and is fixed to an inner end of a corresponding one of transmission links 54. The transmission link 54 has an outer end fitted into a corresponding one of engaging recesses 55 equidistantly formed as many as the number of nozzle vanes 15 on an inner periphery of the rotary ring 52. Rotary movement of the vane shaft 16b of one of the nozzle vanes 15 by the transmission mechanism constituted by the parts 17a, 17b, 17c and 17d in Fig. 1 causes pivotal movement of all the nozzle vanes 15 at the same angle through the transmission links 54 and the rotary ring 52.

[0029] With the disk-shaped rear exhaust introduction wall 51 being fitted, with the space 19, to the shoulder 50 on the front surface of the turbine housing 1 in Fig. 2, the exhaust nozzle unit U unitized as shown in Figs. 3a and 3b is assembled with a flange 13' of the mounting member 13 pinched for fastening between the turbine and bearing housings 1 and 3.

[0030] An operation of the embodiment shown in Fig. 2 is as follows.

[0031] In the variable geometry turbocharger shown in Fig. 2, the sealing piston rings 21 are disposed between the inner periphery of the extension 39 in the shoulder 50 on the front surface of the turbine housing 1 and the groove 22 formed on the outer periphery of the rear exhaust introduction wall 51 of the exhaust nozzle unit U unitized as shown in Figs. 3a and 3b, the rear exhaust introduction wall 51 being fitted to the shoulder 50. In this state, the flange 13' of the mounting member 13 is pinched between the turbine and bearing housings 1 and 3 shown in Fig. 1 and they are integrally fastened together with the fastening bolt 3a. Thus, the rear exhaust introduction wall 51 is disposed in the shoulder 50 of the turbine housing 1 with the space 19.

[0032] Each of the front and rear exhaust introduction walls 10 and 51 constituting the exhaust nozzle 9, which has the disk-shaped simple structure as described above, is freely deformed only diametrally. Thus, while a problem may occur in which the rear exhaust introduction wall 11 with the extension 11' in Fig. 1 is deformed to slump down in a non-diametral direction, such deformation can be suppressed in the structure of Fig. 2 to prevent an irrational force from acting on any of the nozzle vanes 15. Thus, the nozzle vanes 15 can always ensure a stable pivotal movement.

[0033] Also, as described above, the sealing device 25 with the sealing piston rings 21 disposed between the inner periphery of the extension 39 and the groove 22 formed on the outer periphery of the rear exhaust introduction wall 51 prevents the exhaust gas in the scroll passage 8 from leaking through the space 19 between the turbine housing 1 and the rear exhaust introduction wall 51.

[0034] Further, since the sealing device 25 is disposed (on a side adjacent to the scroll passage 8) upstream, in the direction of the exhaust gas, of the through holes 24 of the rear exhaust introduction wall 51 through which vane shafts 16b penetrate, a pressure P2 in the space 19 downstream of the sealing device 25 is low and brings about a state of P1 > P2 with respect to a pressure P1 in the exhaust nozzle 9, so that the exhaust gas in the exhaust nozzle 9 is liable to flow through the space 19 downstream of the sealing device 25 as indicated by an arrow B. The difference in pressure as P1 > P2 described above causes the nozzle vanes 15 to be pressed against the rear exhaust introduction wall 51 to deform, so that a clearance between each nozzle vane 15 and the rear exhaust introduction wall 51 becomes minimum. At this time, with the provision of the collar 35 covering the through hole 24 on the fixed portion to the nozzle vane 15 of the vane shaft 16b penetrating through the rear exhaust introduction wall 51, the pressure of the exhaust gas in the exhaust nozzle 9 acts on the collar 35 and thus the collar 35 is pressed against the rear exhaust introduction wall 51 to block the through hole 24; then, leakage of exhaust gas indicated by the arrow B is decreased and the amount of exhaust gas introduced to the turbine impeller 4 is increased, thereby enhancing efficiency of the turbine impeller 4. Note that even if no collar 35 is provided, the pressure P2 acting on the space 19 of the vane shaft 16b is lower than that of Fig. 1, and thus the nozzle vane 15 moves toward the rear exhaust introduction wall 51. However, if the collar 35 is provided as described above, the nozzle vane 15 moves more reliably to the rear exhaust introduction wall 51, which is preferable.

[0035] Fig. 4a shows a further embodiment of the invention with a sealing device 25 different from that in Fig. 2. In this sealing device 25, the shoulder 50 of the turbine housing 1 facing to a vertical surface of the rear exhaust introduction wall 51 with the space 19 has an inner periphery 26 which in turn is formed at its outer peripheral position with a shoulder 27 recessed from the inner periphery 26 further into the turbine housing 1, a ring-shaped disk spring seal 28 being arranged between the shoulder 27 and the rear surface of the rear exhaust introduction wall 51. The shoulder 27 is defined by a facing surface 27a parallel to the rear exhaust introduction wall 51 (or at a right angle to the axis of the turbine impeller 4) and an annular tapered surface 27b extending with decreased diameter from the inner periphery 26 into the turbine housing 1. Note that the bottom of the shoulder 27 may be not the tapered surface 27b but, for example, a cylindrical surface having a constant radius about the axis; even if the bottom of the shoulder 27 is cylindrical, the disk spring seal 28 can be held. However, as described above, when the bottom of the shoulder 27 is the tapered surface 27b, the disk spring seal 28 can be stably held and thus the seal effect can be enhanced; moreover, the disk spring seal 28 can be prevented from moving and falling off from the shoulder 27 during, for example, assembling of the variable geometry turbocharger.

[0036] The disk spring seal 28 has a cutout 38 having a width of the order of 0.2 to 0.8 mm formed by cutting out a part on its perimeter as indicted by two-dot chain lines in Fig. 4b. The disk spring seal 28 is bent to the facing surface 27a and then is bent outward at a position near an inner peripheral edge 29 to provide a straight portion 30 abutting on the facing surface 27a; the straight portion 30 is followed by bent toward the rear exhaust introduction wall 51 to provide a substantially S-shaped portion. Provision of such substantially S-shape portion makes it easy to press-fit the inner peripheral edge 29 of the disk spring seal 28 to the tapered surface 27b and makes difficult removal of the press-fitted inner circumferential edge 29 out of the shoulder 27 because of the shape of the tapered surface 27b. Furthermore, the disk spring seal 28 has an outer peripheral edge 31 with a tilt portion 32 tiltingly extending from the straight portion 30 to the rear exhaust introduction wall 51. An outer periphery of the tilt portion 32 forms a curved portion 33 abutting on the rear exhaust introduction wall 51 and is then curved in a direction away therefrom. Thus, the disk spring seal 28 has an approximately frustoconical shape with the inner and outer peripheral edges 29 and 31 being axially shifted in position. The disk spring seal 28 in the frustoconical shape is formed with such an axial height that the curved portion 33 is pressed against the rear surface of the rear exhaust introduction wall 51 with a predetermined force when the inner peripheral edge 29 is fitted to the tapered surface 27b with the straight portion 30 abutting on the facing surface 27a.

[0037] In Fig. 4a, the disk spring seal 28 to be fitted to the tapered surface 27b of the shoulder 27 has the axial height in the frustoconical shape between the straight portion 30 and the curved portion 33 higher than a distance between the facing surface 27a and the rear surface of the rear exhaust introduction wall 51, so that the straight portion 30 and the curved portion 33 of the outer peripheral edge 31 of the disk spring seal 28 are pressed against the facing surface 27a and the rear surface of the rear exhaust introduction wall 51, respectively, when the variable geometry turbocharger is assembled. Thus, the sealing device 25 with the disk spring seal 28 can prevent the exhaust gas in the scroll passage 8 from leaking through the space 19 between the turbine housing 1 and the rear exhaust introduction wall 51.

[0038] Also in the embodiment in Fig. 4a, each of the front and rear exhaust introduction walls 10 and 51 constituting the exhaust nozzle 9, which has the disk-shaped simple structure, is freely deformed only diametrally. Thus, deformation in a non-diametral direction is suppressed to prevent an irrational force from acting on any of the nozzle vanes 15. Thus, the nozzle vanes 15 can always ensure a stable pivotal movement.

[0039] Fig. 5 shows a still further embodiment similar to the sealing device 25 shown in Fig. 4a. In this sealing device 25, the shoulder of the turbine housing 1 facing to the vertical surface of the rear exhaust introduction wall 51 with the space 19 has the inner periphery 26 which in turn is formed at its outer peripheral position with a shoulder 36 deeper than the shoulder 27 in Fig. 4a, a ring-shaped disk spring seal 37 being arranged between the shoulder 36 and the rear surface of the rear exhaust introduction wall 51. The shoulder 37 is defined by a cutting surface 36a formed facing to the rear exhaust introduction wall 51 and a cylindrical surface 36b parallel to the axis of the turbine shaft 7.

[0040] The disk spring seal 37 has a cutout 38 having a width of the order of 0.2 to 0.8 mm formed by cutting out a part on its perimeter as indicated by two-dot chain lines in Fig. 4b. As shown in Fig. 5, the inner peripheral edge 29 is bent in a direction away from the rear exhaust introduction wall 51 and is fitted movably and closely to the cylindrical surface 36b. Further, the disk spring seal has a frustoconical shape with its diameter divergent from the fitted portion to the rear exhaust introduction wall 51, with the curved portion 33 formed on the outer peripheral edge 31 abutting on the rear surface of the rear exhaust introduction wall 51.

[0041] The disk spring seal 37 placed on and fitted to the cylindrical surface 36b of the shoulder 36 in Fig. 5 moves along the cylindrical surface 36b by the pressure of the exhaust gas in the scroll passage 8 (a differentiation in pressure between the scroll passage 8 and the space 19), so that the curved portion 33 of the outer peripheral edge 31 is automatically pressed against the rear surface of the rear exhaust introduction wall 51. The disk spring seal 37 is configured in advance such that, at this time, its diameter is reduced to cause the cutout portion 38 shown in Fig. 4b to disappear, with opposite ends defining the same in contact with each other. Also in the embodiment of Fig. 5, the sealing device 25 with the disk spring seal 37 can prevent the exhaust gas in the scroll passage 8 from leaking through the space 19 between the turbine housing 1 and the rear exhaust introduction wall 51.

[0042] Also in the embodiment in Fig. 5, each of the front and rear exhaust introduction walls 10 and 51 constituting the exhaust nozzle 9, which has the disk-shaped simple structure, is freely deformed only diametrally. Thus, deformation in a non-diametral direction is suppressed to prevent an irrational force from acting on any of the nozzle vanes 15. Thus, the nozzle vanes 15 can always ensure a stable pivotal movement.

[0043] It is to be understood that the invention is not limited to the embodiments mentioned above and, as a matter of course, can be variously modified within a range not deviating from the gist of the invention.

Industrial Applicability

[0044] According to a variable geometry turbocharger of the invention, each of front and rear exhaust introduction walls is disk-shaped and a turbine housing is formed with a shoulder to which a disk-shaped rear exhaust introduction wall is fitted with a space. Thus, deformation of an exhaust nozzle is suppressed to enable a smooth operation of nozzle vanes.

Reference Signs List

[0045]

1	turbine housing
3	bearing housing
4	turbine impeller
8	scroll passage
9	exhaust nozzle
10	front exhaust introduction wall
11'	disk-shaped rear exhaust introduction wall
15	nozzle vane
16a, 16b	vane shaft
19	space
21	sealing piston ring
24	through hole
25	sealing device
28	disk spring seal
50	shoulder

Claims

1. A variable geometry turbocharger with an exhaust nozzle having nozzle vanes interposed between front and rear exhaust introduction walls, a space being between said rear exhaust introduction wall and a turbine housing, a sealing device being arranged upstream, in a direction of exhaust gas, of each through hole provided in said rear exhaust introduction wall for penetration of a vane shaft to prevent exhaust gas in a scroll passage from leaking through said space to a turbine impeller, wherein each of said front and rear exhaust introduction walls is disk-shaped, said turbine housing being formed with a shoulder to which the disk-shaped rear exhaust introduction wall is fitted with said space.

2. The variable geometry turbocharger as claimed in claim 1, wherein said front and rear exhaust introduction walls are equivalent in linear expansion coefficient.

3. The variable geometry turbocharger as claimed in

claim 1, wherein said sealing device comprises sealing piston rings.

4. The variable geometry turbocharger as claimed in claim 1, wherein said sealing device comprises a disk spring seal.

FIG. 1

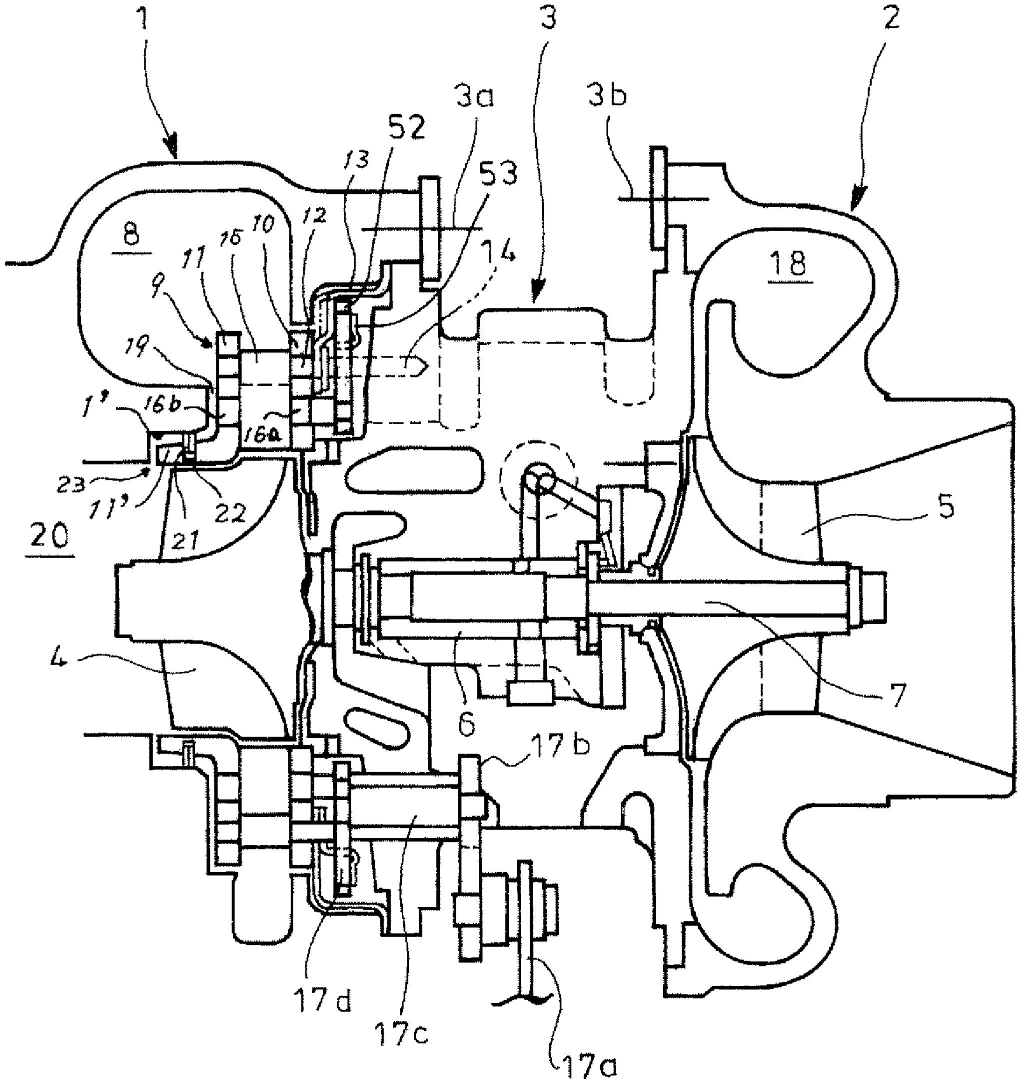
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FIG. 2

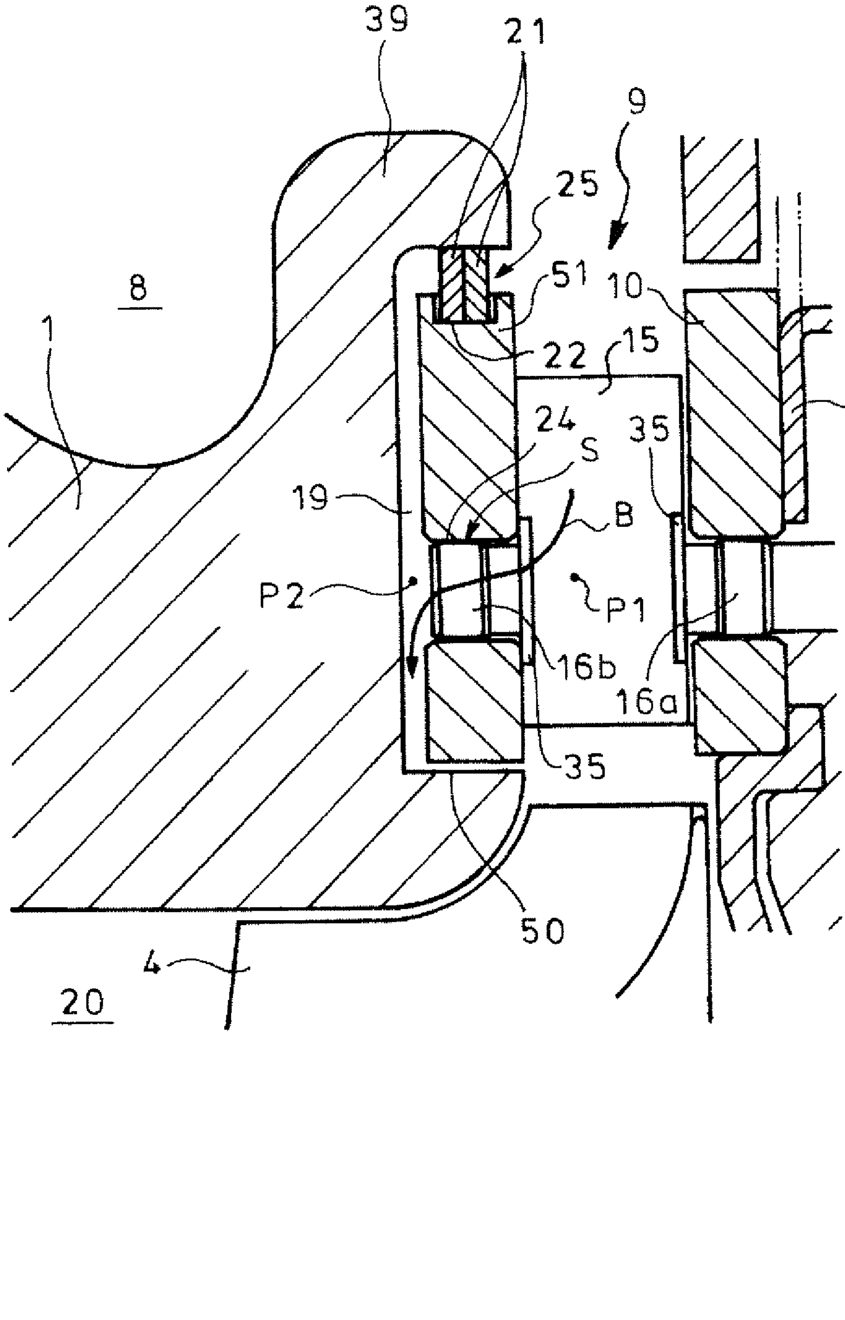

FIG. 3a

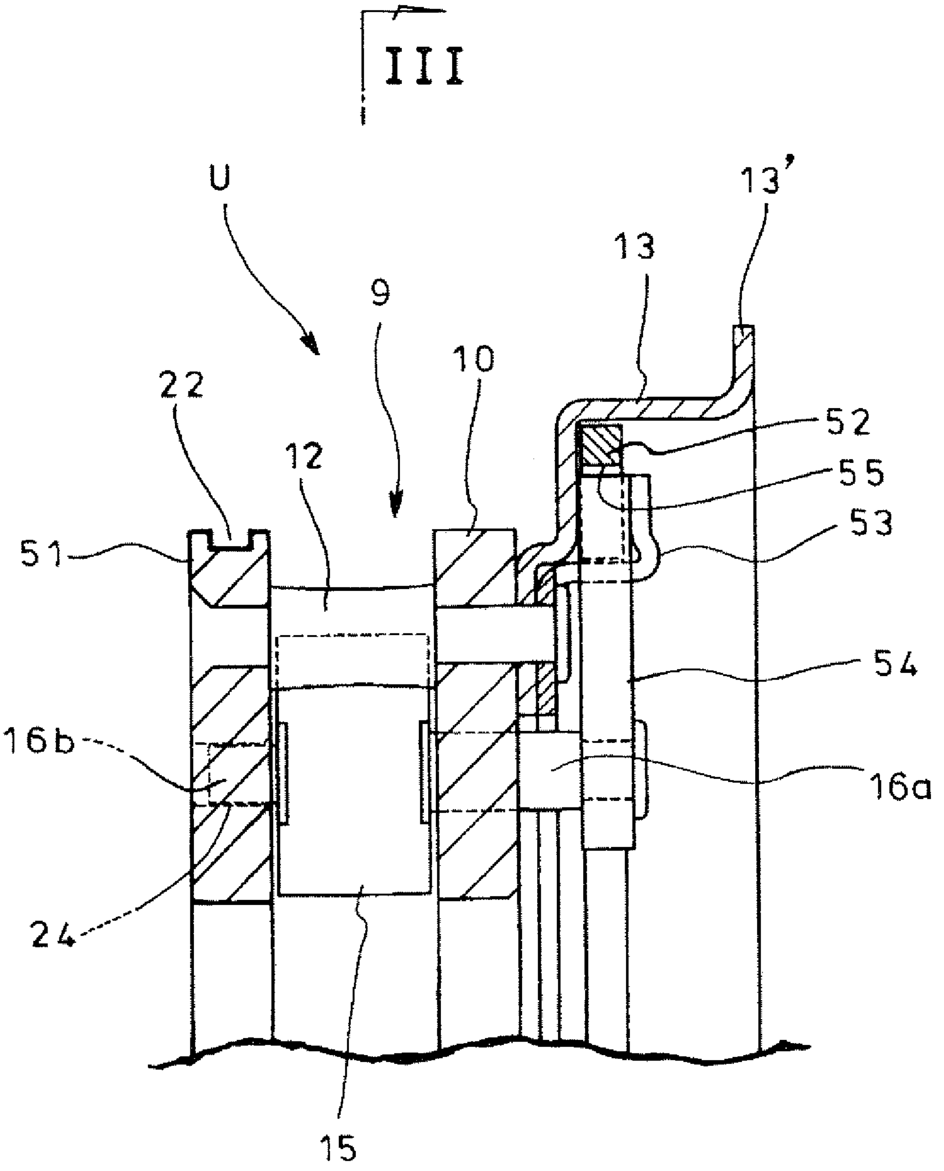

FIG. 3b

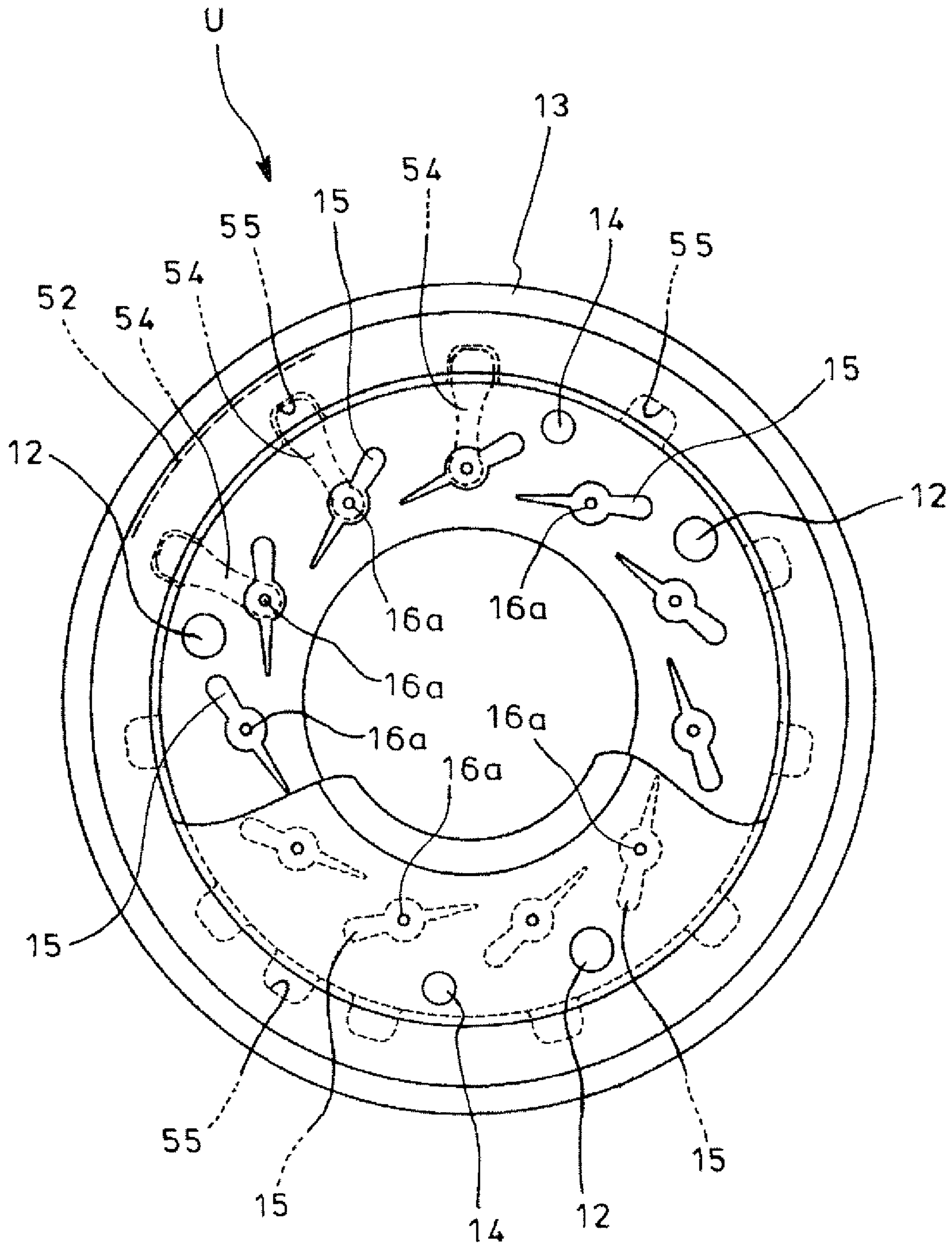
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FIG. 4a

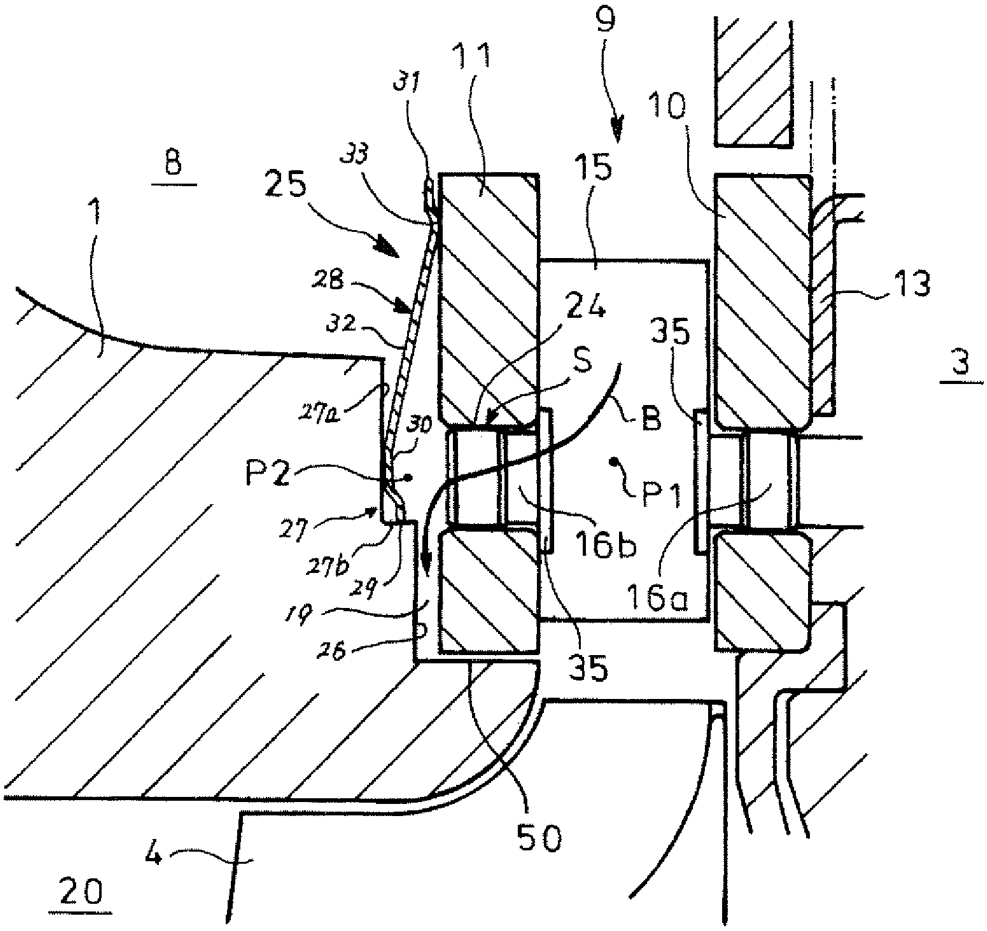
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FIG. 4b

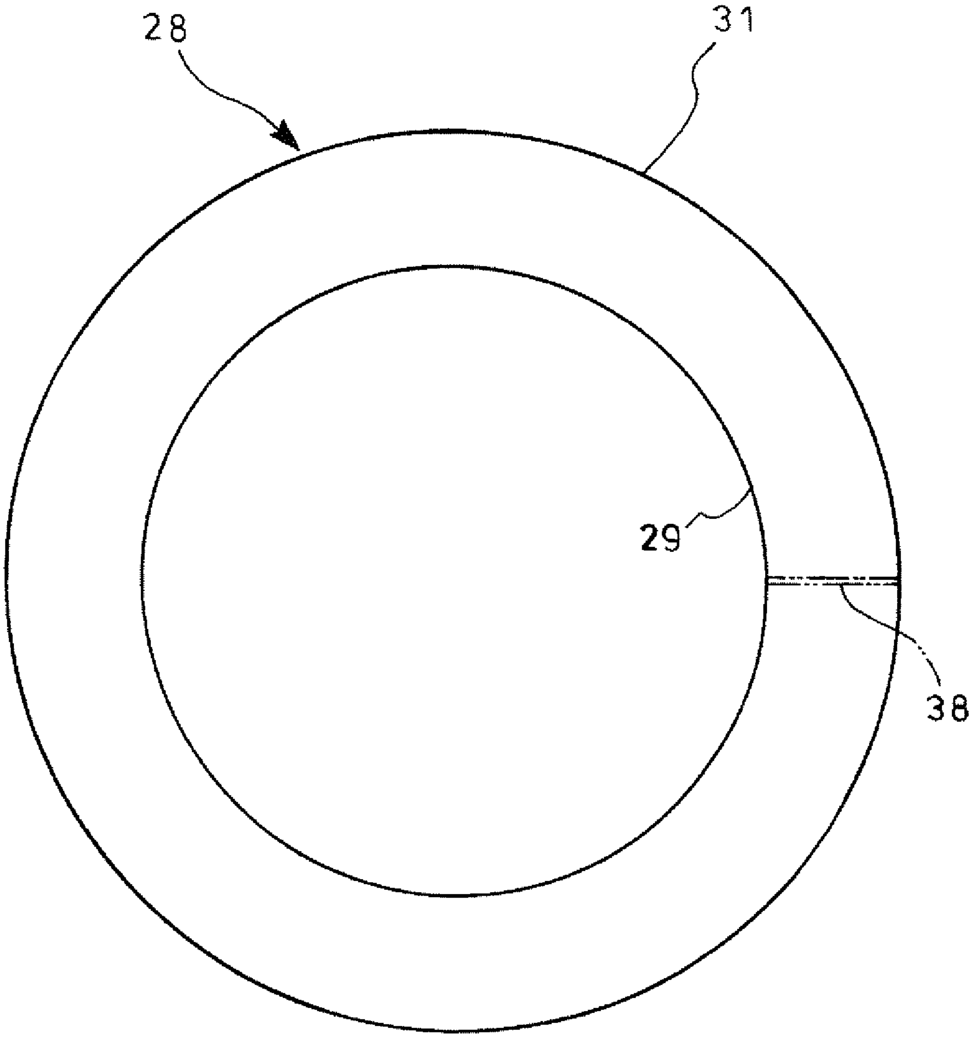
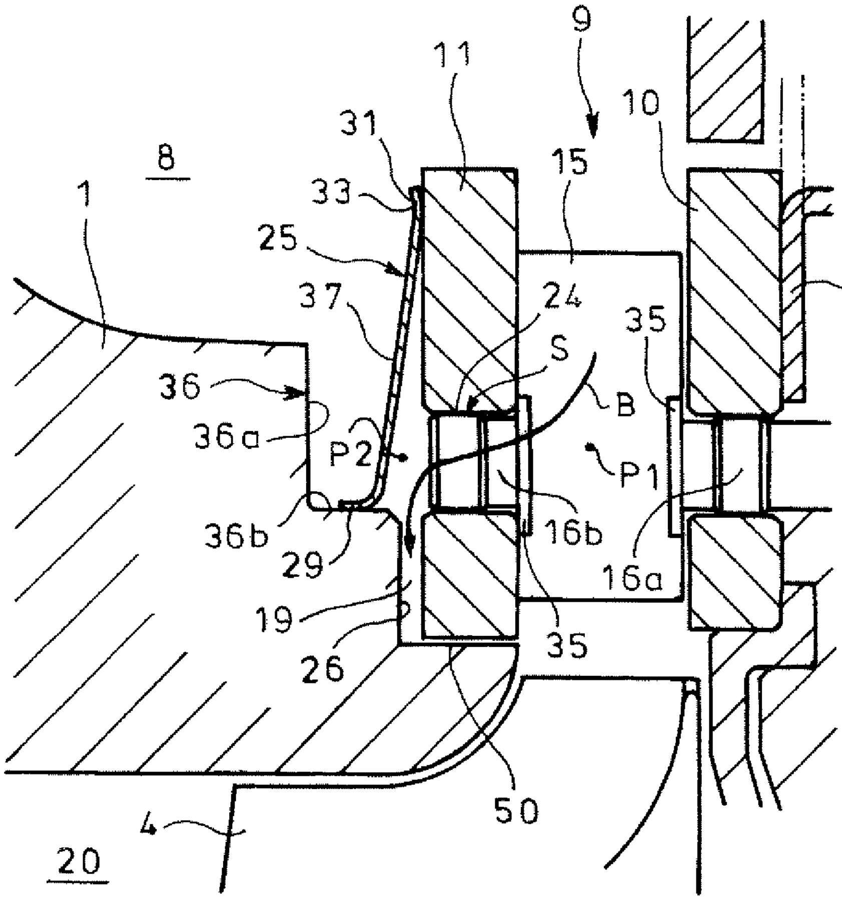


FIG. 5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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2011/001071

A. CLASSIFICATION OF SUBJECT MATTER
F02B37/24(2006.01)i, *F02B39/00*(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)
F02B37/24, F02B39/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho	1922-1996	Jitsuyo Shinan Toroku Koho	1996-2011
Kokai Jitsuyo Shinan Koho	1971-2011	Toroku Jitsuyo Shinan Koho	1994-2011

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2005-163783 A (BorgWarner Inc.), 23 June 2005 (23.06.2005), entire text; all drawings & US 2006-034684 A1 & EP 1536103 A1	1-4
Y	JP 2003-519309 A (Allied-Signal Inc.), 17 June 2003 (17.06.2003), paragraphs [0016], [0017]; fig. 4a & US 6145313 A & EP 1187980 A & WO 01/014707 A1 & DE 60021886 T & AU 5620500 A & BR 11749 A & AT 301774 A	1-4
Y	JP 2010-024915 A (IHI Corp.), 04 February 2010 (04.02.2010), paragraph [0055]; fig. 11 (Family: none)	1-4

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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01 April, 2011 (01.04.11)	12 April, 2011 (12.04.11)

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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2009-144545 A (IHI Corp.), 02 July 2009 (02.07.2009), paragraphs [0009], [0028] & US 2010-0247296 A1 & EP 2226484 A1 & WO 2009/075058 A1 & KR 2010-0087375 A	3-4

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Patent documents cited in the description

- JP 2006125588 A **[0013]**
- JP 2009144545 A **[0013]**