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(54) **CENTRIFUGAL COMPRESSOR**

(57) The present invention is intended to provide a technique in a centrifugal compressor in which the direction of protrusion of a vane blade is avoided from deviating from a specified direction as a result of a deformation of a deformation member. The present invention resides in a centrifugal compressor which includes a vane blade that is movable into and out of a diffuser passage, a space that is formed in a wall of the diffuser passage in which the vane blade is caused to be buried, and a deformation member that divides the space into a diffuser side chamber and an anti-diffuser side chamber, and deforms the volume of the anti-diffuser side chamber in a changeable manner, the deformation member causing the vane blade to move in a specified direction thereby to protrude into the diffuser passage due to a deformation thereof at the time of increasing the volume of the anti-diffuser side chamber, wherein the vane blade and the deformation member are separate bodies from each other, and only a displacement in the specified direction of a portion of the deformation member which is made into contact with the vane blade due to the deformation thereof at the time of increasing the volume of the anti-diffuser side chamber acts on the vane blade.

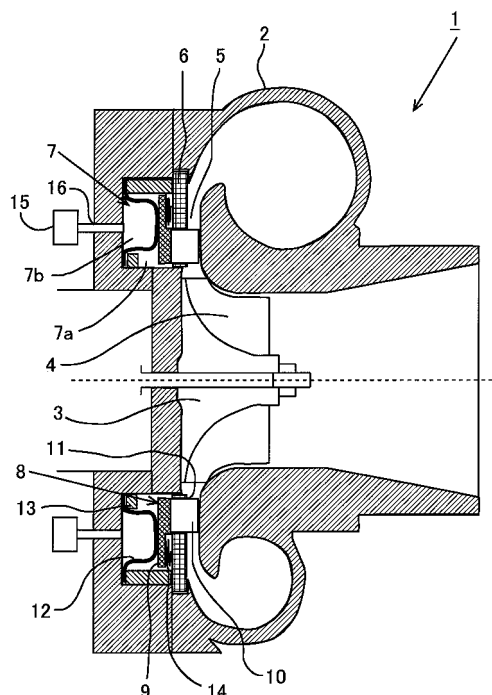


Fig.1

Description**[TECHNICAL FIELD]**

[0001] The present invention relates to a centrifugal compressor in which a vane blade is able to be moved into and out of a diffuser passage.

[BACKGROUND ART]

[0002] There has been disclosed a technique in which a vane blade is formed integrally with a diaphragm, and fluid pressure inside the diaphragm is adjusted to deform the diaphragm, so that the deformation of the diaphragm is transmitted to the vane blade, thereby causing the vane blade to move into and out of the diffuser passage (see, for example, a first patent document). With this construction, in the first patent document, when the operation flow rate of a centrifugal compressor is a small flow rate, the vane blade is caused to project into the diffuser passage, whereas when the operation flow rate of the centrifugal compressor is a large flow rate, the vane blade is caused to be buried into the side wall of the diffuser passage.

[PRIOR ART REFERENCES]**[PATENT DOCUMENTS]****[0003]**

[First patent Document] Patent Laid-Open Publication No. 2001-329996

[SUMMARY OF THE INVENTION]**[PROBLEMS TO BE SOLVED BY THE INVENTION]**

[0004] In the technique of the first patent document, the diaphragm is formed integrally with the vane blade. Therefore, when the diaphragm is not able to be deformed in an accurate manner because of variation in the thickness of the diaphragm or difference in the hardness of a part of the diaphragm from the others thereof, the direction of protrusion of the vane blade will deviate from a specified direction. When the direction of protrusion of the vane blade deviates from the specified direction, the vane blade may bite a peripheral edge portion of a slit through which the vane blade is caused to protrude into the diffuser passage. In addition, the friction at the time of the vane blade passing through the slit may become large, thus giving rise to wear of the vane blade and an increase in a driving force for operating the vane blade.

[0005] The present invention has been made in view of the above-mentioned circumstances, and has for its object to provide a technique in a centrifugal compressor in which the direction of protrusion of a vane blade is avoided from deviating from a specified direction as a

result of a deformation of a deformation member.

[MEANS FOR SOLVING THE PROBLEMS]

[0006] In the present invention, the following construction is adopted. That is, the present invention resides in a centrifugal compressor which is provided with:

a vane blade that is movable into and out of a diffuser passage;

a space that is formed in a wall of the diffuser passage in which said vane blade is caused to be buried; and

a deformation member that divides said space into a diffuser side chamber and an anti-diffuser side chamber, and deforms to change the volume of said anti-diffuser side chamber, said deformation member causing said vane blade to move in a specified direction thereby to protrude into said diffuser passage due to a deformation thereof at the time of increasing the volume of said anti-diffuser side chamber;

wherein said vane blade and said deformation member are separate bodies from each other, and only a displacement in the specified direction of a portion of said deformation member which is made into contact with said vane blade due to the deformation thereof at the time of increasing the volume of said anti-diffuser side chamber acts on said vane blade.

[0007] In the deformation of the deformation member at the time of increasing the volume of the anti-diffuser side chamber, a portion of the deformation member, being in contact with the vane blade, is not only displaced in the specified direction to cause the vane blade to protrude into the diffuser passage, but also can be displaced in a direction other than the specified direction, too. At this time, when the portion of the deformation member, which is in contact with the vane blade, is formed integrally with the vane blade, the vane blade may also move not in the specified direction but in the direction other than the specified direction, in accordance with the deformation of the deformation member.

[0008] However, in the present invention, the vane blade and the deformation member are separate bodies from each other. For this reason, the displacement in the direction other than the specified direction of the portion of the deformation member in contact with the vane blade only causes the portion of the deformation member in contact with the vane blade to move with respect to the vane blade, but does not act on the vane blade, thus making it difficult for the vane blade to move in a direction other than the specified direction. On the other hand, only a displacement in the specified direction of the portion of the deformation member in contact with the vane blade acts on the vane blade, thereby causing the vane blade to move in the specified direction. Accordingly, it is possible to avoid the direction of protrusion of the vane blade

from deviating from the specified direction as a result of the deformation of the deformation member.

[0009] As a result, it is possible to avoid the direction of protrusion of the vane blade from deviating from the specified direction, thus avoiding the vane blade from biting a peripheral edge portion of a slit through which the vane blade is caused to protrude into the diffuser passage. In addition, it is also possible to avoid friction at the time of the vane blade passing through the slit from becoming large, thereby avoiding the occurrence of wear of the vane blade and an increase in a driving force for operating the vane blade.

[0010] Provision may further be made for:

an urging member that urges said vane blade in a manner such that said vane blade is caused to be buried into said diffuser passage wall; and a stopper that positions said vane blade against the urging of said urging member when an amount of protrusion into said diffuser passage of said vane blade is equal to or less than a predetermined amount;

wherein said deformation member is able to be moved away from said vane blade that is positioned by said stopper, by decreasing the volume of said anti-diffuser side chamber.

[0011] Here, the predetermined amount is an amount which, when the amount of protrusion is equal to or less than that amount, can deal with a case where the operation flow rate of the centrifugal compressor is a large flow rate.

[0012] According to this, in cases where the amount of protrusion of the vane blade into the diffuser passage is equal to or less than the predetermined amount, the deformation member can be caused to separate from the vane blade positioned by the stopper. As a result of this, it is possible to avoid heat transfer from the vane blade to the deformation member. Accordingly, it is possible to suppress the deformation member from being thermally deteriorated resulting from the heat transfer from the vane blade.

[0013] In cases where the centrifugal compressor operates so as to make air to be supplied at a high flow rate and at a high supercharging pressure, the volume of said anti-diffuser side chamber may be made small until said deformation member and said vane blade positioned by said stopper are separated from each other.

[0014] In cases where the centrifugal compressor operates to make air to be supplied at a high flow rate and at a high supercharging pressure, the air flowing through the diffuser passages becomes a high temperature, and the vane blade, which has been caused to be buried into the diffuser passage wall, is similarly at a high temperature. In this case, the volume of the anti-diffuser side chamber is made small until the deformation member and the vane blade positioned by the stopper are separated from each other, so the deformation member and

the vane blade are separated or away from each other, thus making it possible to avoid the heat transfer from the vane blade of the high temperature to the deformation member. Accordingly, in cases where the centrifugal compressor operates to make air to be supplied at a high flow rate and at a high supercharging pressure, it is possible to suppress the deformation member from being thermally deteriorated resulting from the heat transfer from the vane blade of the high temperature.

[EFFECT OF THE INVENTION]

[0015] According to the present invention, in a centrifugal compressor, it is possible to avoid the direction of protrusion of a vane blade from deviating from a specified direction as a result of a deformation of a deformation member.

[BRIEF DESCRIPTION OF THE DRAWINGS]

[0016]

[Fig. 1] is a view showing the schematic construction of a centrifugal compressor according to a first embodiment of the present invention.

[Fig. 2] is views showing a protruded state and a buried state of a vane blade according to the first embodiment.

[Fig. 3] is a view showing a problem of a conventional vane blade.

[Fig. 4] is a view showing a feature of the vane blade according to the first embodiment.

[BEST MODE FOR CARRYING OUT THE INVENTION]

[0017] Hereinafter, a specific embodiment of the present invention will be described.

<First Embodiment>

(Construction of a Centrifugal Compressor)

[0018] Fig. 1 is a view showing the schematic construction of a centrifugal compressor according to a first embodiment of the present invention. The centrifugal compressor 1 shown in Fig. 1 is provided with a scroll casing 2, and it has an impeller 3 arranged in an axial center inside the scroll casing 2. Air as a gas, which has flowed into the centrifugal compressor 1, is guided to flow into a diffuser passage 5 formed on an outer peripheral side of the impeller 3 by means of vanes 4 which are arranged in a circumferential direction of the impeller 3 at equal intervals.

[0019] The diffuser passage 5 is sandwiched or enclosed by diffuser passage walls, which are part of the scroll casing 2. One of the diffuser passage walls on a left-hand side of Fig. 1 is composed of a plate-shaped diffuser plate 6, and is formed separately from a casing

main body. Space 7, which can be covered with the diffuser plate 6, is formed in the one diffuser passage wall (hereinafter referred to as the diffuser passage wall) on which the diffuser plate 6 is arranged. The space 7 is of a hollow cylindrical shape, and can receive a vane blade 8 which is movable into and out of the interior of the diffuser passage 5.

[0020] The vane blade 8 is provided with an annular disk 9, and a plurality of blade portions 10 which have their one ends fixed to the disk 9 and are arranged in a circumferential direction at intervals. The diffuser plate 6 is formed with slits 11 into which the blade portions 10 of the vane blade 8 are inserted, respectively. With this construction, when the disk 9 of the vane blade 8 is brought close to the diffuser plate 6, the blade portions 10 of the vane blade 8 protrude from the slits 11, respectively, into the diffuser passage 5. On the other hand, when the disk 9 of the vane blade 8 is moved away from the diffuser plate 6 (the diffuser passage 5), the blade portions 10 are received in the space 7 while being guided by the slits 11, respectively, so that the vane blade 8 is buried or drawn in the diffuser passage wall.

[0021] In the space 7 where the vane blade 8 is received, there is arranged a diaphragm 12, as a deformation member, which serves to divide the space 7 into a diffuser side chamber 7a and an anti-diffuser side chamber 7b, and to deform to change the volume of the anti-diffuser side chamber 7b. The diaphragm 12 is of an annular shape which can swell or expand in the direction of the diffuser side chamber 7a, and is composed of a rubber-like elastic body so as to be elastically deformable, and has an outer edge and an inner edge both fixedly secured to the wall of the space 7 in an airtight manner. The diaphragm 12 can push the disk 9 of the vane blade 8 toward the side of the diffuser passage 5 by being swelled or expanded in a manner such that the anti-diffuser side chamber 7b is made larger. The diaphragm 12 and the disk 9 are different bodies from each other. If the diaphragm 12 has not been deformed to swell, the diaphragm 12 and the disk 9 are separated or away from each other. In other words, the diaphragm 12 is able to be moved away from the disk 9 of the vane blade 8 that is positioned by stoppers 13, by decreasing the volume of the anti-diffuser side chamber 7b.

[0022] In the diffuser side chamber 7a in the space 7, there is arranged a compression spring 14, as an urging member, which serves to urge the disk 9 of the vane blade 8 so as to cause the vane blade 8 to be buried in the diffuser passage wall. The compression spring 14 is compressed inside the diffuser side chamber 7a, and urges the disk 9 in a direction opposite to the direction of the diffuser passage 5.

[0023] In a position in which the compression spring 14 in the diffuser side chamber 7a urges the disk 9 of the vane blade 8 thereby to cause the vane blade 8 to be buried in the diffuser passage wall, there is arranged a stopper 13 which serves to position the disk 9 of the vane blade 8 against the urging of the compression spring 14.

If the disk 9 abuts against the stoppers 13 in a state urged by the compression springs 14, respectively, so that there will be no action due to the swelling or expanding deformation of the diaphragms 12, the vane blade 8 can be maintained in a state in which it is caused to be buried in the diffuser passage 5.

[0024] The centrifugal compressor 1 of this embodiment is provided with a fluid pressure adjusting mechanism 15 which serves to apply fluid pressure to the anti-diffuser side chamber 7b. Between the fluid pressure adjusting mechanism 15 and the anti-diffuser side chamber 7b, there is arranged a fluid passage 16 which circulates or supply fluid from the fluid pressure adjusting mechanism 15 to the anti-diffuser side chamber 7b.

(Operation of the Centrifugal Compressor)

[0025] Fig. 2 is views showing a protruded state and a buried state of the vane blade according to this embodiment, wherein Fig. 2A shows the protruded state in which the vane blade has been protruded into the diffuser passage, and Fig. 2B shows the buried state in which the vane blade has been buried in the diffuser passage wall.

[0026] In cases where the centrifugal compressor 1 operates so as to cause air to be supplied at a low flow rate and at a low supercharging pressure, the fluid pressure adjusting mechanism 15 causes fluid to flow into the anti-diffuser side chamber 7b thereby to pressurize the anti-diffuser side chamber 7b, so that the diaphragm 12 is caused to perform swelling deformation, thus increasing the volume of the anti-diffuser side chamber 7b. As a result of this, the diaphragm 12 is displaced to push the disk 9 of the vane blade 8, so the disk 9 is moved in the specified direction of an illustrated arrow A to cause the blade portions 10 of the vane blade 8 to protrude into the diffuser passage 5, whereby the blade portions 10 of the vane blade 8 are protruded from the slits 11, respectively, into the diffuser passage 5, as shown in Fig. 2(a).

[0027] Fig. 3 is a view showing a problem of a conventional vane blade. Here, in the swelling deformation of a diaphragm at the time of increasing the volume of an anti-diffuser side chamber, a portion of the diaphragm, being in contact with a disk of the vane blade, is not only displaced in a specified direction to cause the disk of the vane blade to protrude into a diffuser passage, but also can be displaced in a direction other than the specified direction, too. At this time, if the portion of the diaphragm in contact with the disk of the vane blade as shown in a region C of Fig. 3 is formed integrally with the vane blade, the vane blade may not move in the specified direction shown by a broken line arrow, in accordance with the swelling deformation of the diaphragm as shown by an arrow B, but may move in a direction other than the specified direction, as shown in the arrow B. If so, the direction of protrusion of the blade portions of the vane blade may deviate from the specified direction, and the blade portions of the vane blade may bite peripheral edge portions of slits to stop moving. In addition, even if the blade por-

tions of the vane blade do not bite, they may be rubbed against the peripheral edge portions of the slits, and friction at that time may become large, thus giving rise to an increase in wear of the blade portions of the vane blade or an increase in the driving forces of a fluid pressure adjusting mechanism.

[0028] Fig. 4 is a view showing a feature of the vane blade according to this first embodiment. In this embodiment, the vane blade 8 and a diaphragm 12 are different or separate bodies from each other, and in a portion shown in a region D of Fig. 4, the diaphragm 12 is only in contact with the disk 9 of the vane blade 8. For this reason, even in cases where the diaphragm 12 is deformed in a direction of the arrow B other than the specified direction, such a displacement in a direction other than the specified direction of the portion of the diaphragm 12 in contact with the vane blade 8 only causes the portion of the diaphragm 12 in contact with the disk 9 of the vane blade 8 to move in position (shift in position) with respect to the vane blade 8, but does not act on the vane blade 8, thus making it difficult for the vane blade 8 to move in a direction other than the specified direction. On the other hand, only a displacement in the specified direction of the portion of the diaphragm 12 in contact with the disk 9 of the vane blade 8 acts on the vane blade 8, so that the vane blade 8 is caused to move in the specified direction of the illustrated arrow A. Accordingly, in the present embodiment, it is possible to avoid the direction of protrusion of a blade portion 10 of the vane blade 8 from deviating from the specified direction as a result of the deformation of the diaphragm 12.

[0029] As a result, it is possible to avoid the direction of protrusion of the blade portions 10 of the vane blade 8 from deviating from the specified direction, thus avoiding the blade portions 10 of the vane blade 8 from biting the peripheral edge portions of the slits 11 to stop moving. In addition, it is also possible to avoid the blade portions 10 of the vane blade 8 from being rubbed against the peripheral edge portions of the slits 11 at the time of the blade portions 10 passing through the slits 11, respectively, and hence, friction at that time from becoming large, thereby avoiding the occurrence of wear of the blade portions 10 of the vane blade 8 and an increase in the driving forces of the fluid pressure adjusting mechanism 15.

[0030] On the other hand, in cases where the centrifugal compressor 1 operates so as to make air to be supplied at a high flow rate and at a high supercharging pressure, the fluid pressure adjusting mechanism 15 suck fluid from the anti-diffuser side chamber 7b thereby to reduce the pressure in the anti-diffuser side chamber 7b, so that the diaphragm 12 is caused to perform deflating or retracting deformation, thus decreasing the volume of the anti-diffuser side chamber 7b. As a result of this, a force from the diaphragm 12 to cause the vane blade 8 to move in the specified direction to protrude into the diffuser passage 5 stop acting thereon. Then, the disk 9 is urged by means of the compression springs 14 to abut

against the stoppers 13 to be positioned thereby, so that the blade portions 10 of the vane blade 8 are respectively buried in the diffuser passage wall, as shown in Fig. 2B.

[0031] At this time, the fluid pressure adjusting mechanism 15 operates to make small the volume of the anti-diffuser side chamber 7b until it separates the diaphragm 12 from the disk 9 of the vane blade 8 positioned by the stoppers 13, so that the diaphragm 12 takes a steady shape which is not deformed. For this reason, as shown in Fig. 2B, the diaphragm 12 and the disk 9 of the vane blade 8 positioned by the stoppers 13 are separated or away from each other. Here, in cases where the centrifugal compressor 1 is operated to make air to be supplied at a high flow rate and at a high supercharging pressure, the air flowing through the diffuser passage 5 becomes a high temperature of about 180 degrees C, and the vane blade 8, which has been buried in the diffuser passage wall, is similarly at a high temperature through the action of the air which flows in from the slits 11. In this case, because the volume of the anti-diffuser side chamber 7b is made small by means of the fluid pressure adjusting mechanism 15 until the diaphragm 12 is separated or away from the disk 9 of the vane blade 8 positioned by the stoppers 13, the diaphragm 12 and the disk 9 of the vane blade 8 are separated or away from each other, thus making it possible to avoid heat transfer from the vane blade 8 of the high temperature to the diaphragm 12. Accordingly, in cases where the centrifugal compressor 1 operates so as to make air to be supplied at a high flow rate and at a high supercharging pressure, it is possible to suppress the diaphragm 12, which is rubber-like elastic body, from being thermally deteriorated resulting from the heat transfer from the vane blade 8 of the high temperature, thereby making it possible to improve the endurance reliability of the diaphragm 12.

[0032] The centrifugal compressor according to the present invention is not limited to the above-mentioned embodiment, but can be subjected to various changes and modifications within the scope not departing from the gist of the present invention. For example, as the deformation members, there may be used bellows, besides the diaphragms, and as a material therefor, there may also be used resin, metal or the like, besides a rubber-like elastic material. In addition, at the time when the diaphragm is separated or away from the disk of the vane blade positioned by the stoppers, the volume of the anti-diffuser side chamber can be made small by continuously reducing fluid pressure by means of the fluid pressure adjusting mechanism. The driving force to cause the diaphragm to deform may not be adjusted by fluid pressure supplied by means of the fluid pressure adjusting mechanism. As the urging members, besides the compression springs, there may be used rubber-like elastic bodies, elastic bodies using resin, or the like, in addition to tension springs. As the case where the stoppers position the vane blade against the urging of the compression springs, there may not only be a case where the vane blade is in a position in which it is buried in the diffuser passage

wall, but also a case where the amount of protrusion of the vane blade into the diffuser passage is equal to or less than a predetermined amount. Here, the predetermined amount is an amount which, when the amount of protrusion is equal to or less than that amount, can deal with a case where the operation flow rate of the centrifugal compressor is a large flow rate.

[EXPLANATION OF REFERENCE NUMERALS AND CHARACTERS]

[0033]

- 1: centrifugal compressor
- 2: scroll casing
- 3: impeller
- 4: vanes
- 5: diffuser passage
- 6: diffuser plate
- 7: space
- 7a: diffuser side chamber
- 7b: anti-diffuser side chamber
- 8: vane blade
- 9: disk
- 10: blade portions
- 11: slits
- 12: diaphragm
- 13: stoppers
- 14: compression springs
- 15: fluid pressure adjusting mechanism
- 16: flow passage

Claims

1. A centrifugal compressor comprising:

a vane blade that is movable into and out of a diffuser passage;
 a space that is formed in a wall of the diffuser passage to allow said vane blade to be buried therein; and
 a deformation member that divides said space into a diffuser side chamber and an anti-diffuser side chamber, and deforms to change the volume of said anti-diffuser side chamber, said deformation member causing said vane blade to move in a specified direction thereby to protrude into said diffuser passage due to a deformation thereof at the time of increasing the volume of said anti-diffuser side chamber;
 wherein said vane blade and said deformation member are separate bodies from each other, and only a displacement in the specified direction of a portion of said deformation member which is made into contact with said vane blade due to the deformation thereof at the time of increasing the volume of said anti-diffuser side

chamber acts on said vane blade.

2. The centrifugal compressor as set forth in claim 1, further comprising:

an urging member that urges said vane blade in a manner such that said vane blade is caused to be buried into said diffuser passage wall; and a stopper that positions said vane blade against the urging of said urging member when an amount of protrusion into said diffuser passage of said vane blade is equal to or less than a predetermined amount;
 wherein said deformation member is able to be moved away from said vane blade that is positioned by said stopper, by decreasing the volume of said anti-diffuser side chamber.

3. The centrifugal compressor as set forth in claim 2, wherein

in cases where the centrifugal compressor operates so as to make air to be supplied at a high flow rate and at a high supercharging pressure, the volume of said anti-diffuser side chamber is made small until said deformation member and said vane blade positioned by said stopper are separated from each other.

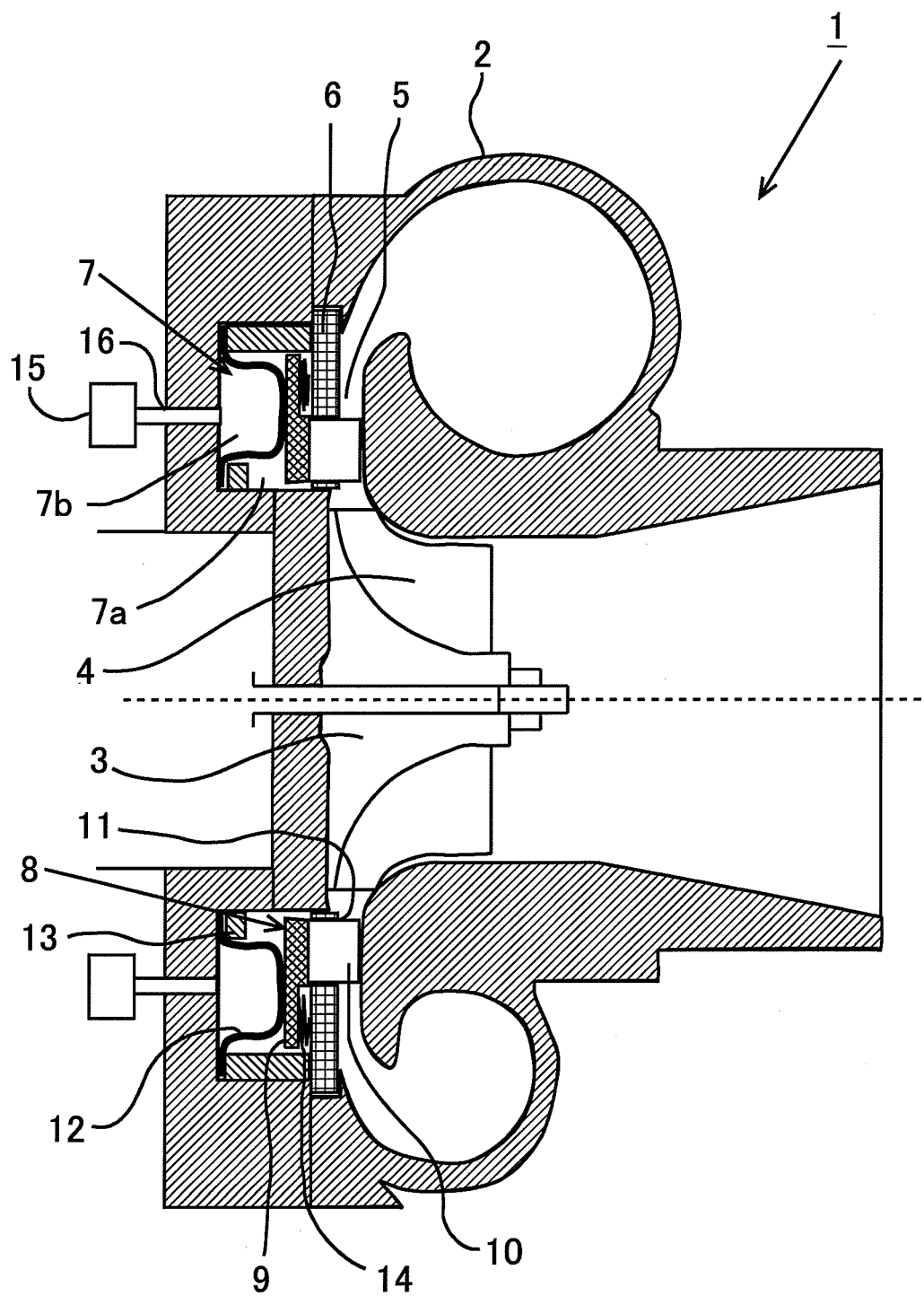


Fig. 1

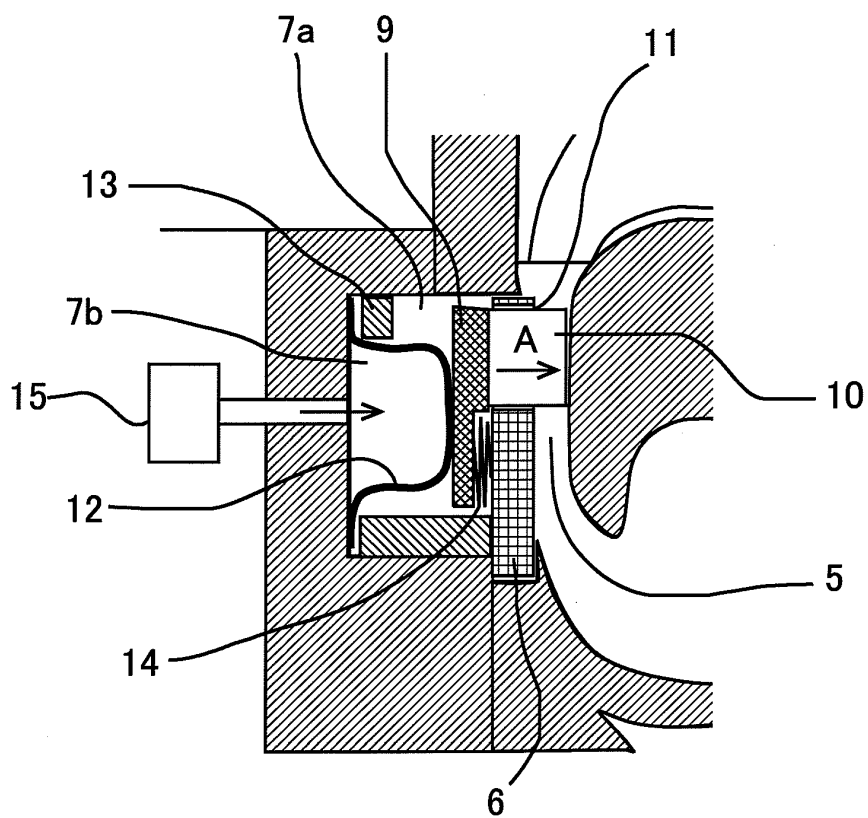


Fig.2A

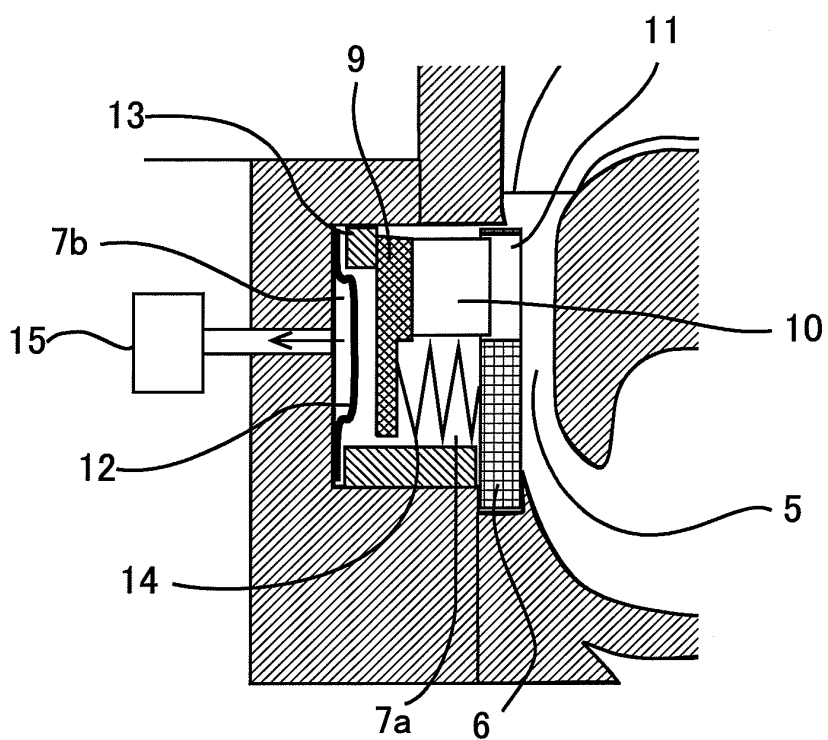


Fig.2B

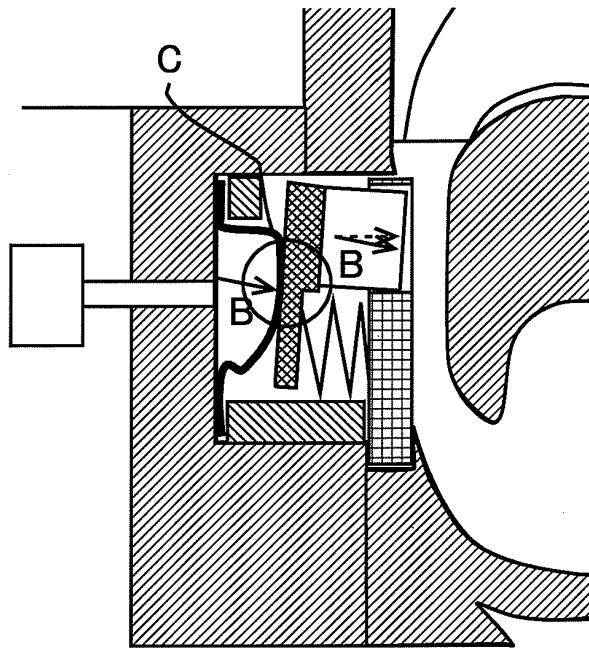


Fig.3

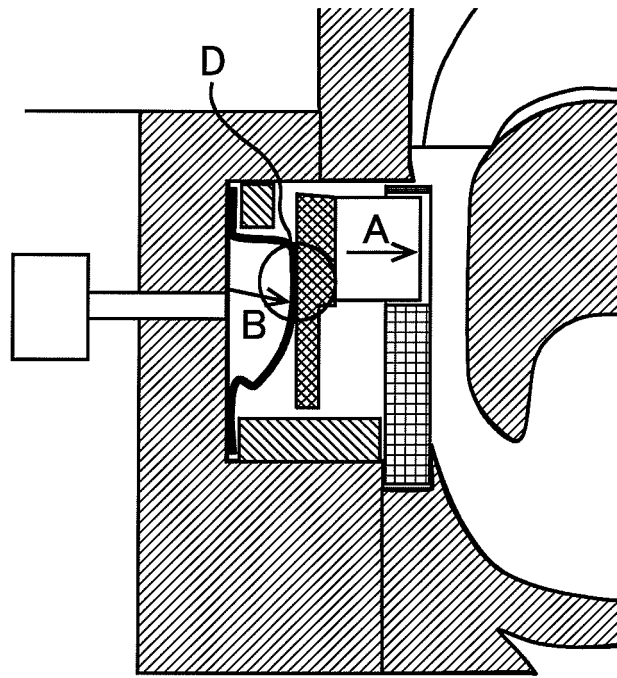


Fig.4

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2010/056595

A. CLASSIFICATION OF SUBJECT MATTER <i>F04D29/46(2006.01) i, F04D29/44(2006.01) i</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) <i>F04D29/46, F04D29/44</i>		
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 1996-2010 Kokai Jitsuyo Shinan Koho 1971-2010 Toroku Jitsuyo Shinan Koho 1994-2010		
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.
A	JP 2001-329996 A (Ishikawajima-Harima Heavy Industries Co., Ltd.), 30 November 2001 (30.11.2001), entire text; all drawings (Family: none)	1-3
A	JP 2003-184795 A (Ishikawajima-Harima Heavy Industries Co., Ltd.), 03 July 2003 (03.07.2003), paragraph [0034] (Family: none)	1
<input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C. <input type="checkbox"/> 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 02 July, 2010 (02.07.10)		Date of mailing of the international search report 13 July, 2010 (13.07.10)
Name and mailing address of the ISA/ Japanese Patent Office		Authorized officer
Facsimile No.		Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2010/056595

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2002-276545 A (Toyota Industries Corp.), 25 September 2002 (25.09.2002), paragraph [0048] & US 2002/0094279 A1 & EP 1223342 A1 & DE 60206975 T & BR 200120 A & KR 10-2002-0061097 A & CN 1364983 A	1

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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