(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 3 263 911 A1

(12) EUROPEAN PATENT APPLICATION

published in accordance with Art. 153(4) EPC

(43) Date of publication:
03.01.2018 Bulletin 2018/01

(21) Application number: **16755427.8**

(22) Date of filing: **22.02.2016**

(51) Int Cl.:
F04D 29/42 *(2006.01)* ***F02B 39/00*** *(2006.01)*
F04D 29/62 *(2006.01)*

(86) International application number:
PCT/JP2016/055111

(87) International publication number:
WO 2016/136681 (01.09.2016 Gazette 2016/35)

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
MA MD

(30) Priority: **25.02.2015 JP 2015034671**

(71) Applicants:
- **OTICS Corporation**
  Nishio-shi, Aichi 444-0392 (JP)
- **Toyota Jidosha Kabushiki Kaisha**
  Toyota-shi, Aichi 471-8571 (JP)

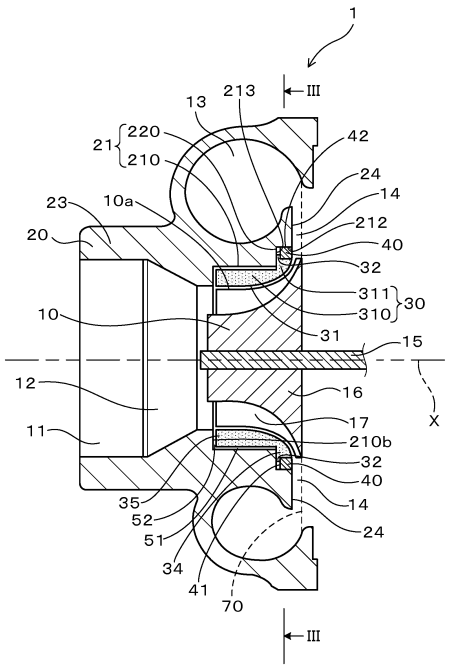
(72) Inventors:
- **SAKURAI Masahide**
  Nishio-city
  Aichi 444-0392 (JP)
- **YONEZAWA Koichi**
  Toyota-shi
  Aichi 471-8571 (JP)

(74) Representative: **Kramer Barske Schmidtchen**
Patentanwälte PartG mbB
European Patent Attorneys
Landsberger Strasse 300
80687 München (DE)

(54) COMPRESSOR HOUSING FOR SUPERCHARGER AND MANUFACTURING METHOD THEREOF

(57) To provide a compressor housing for a turbocharger, which makes it possible to prevent reduction of compression efficiency and to maintain holdability for an abradable seal, and which is advantageous in terms of cost, and a method of manufacturing the same. A compressor housing (1) for a turbocharger includes a housing body (20) to house an impeller (10), an annular abradable seal (30) to form a shroud surface (31). The abradable seal (30) includes a flange (32) that projects outwardly in a radial direction of the abradable seal, and is disposed in an inner circumferential recess (21) that is formed on an inner circumference surface of the housing body (20). In addition, the abradable seal is fixed by having the flange (32) held between a press-fitting direction forward surface (41) of a ring member (40) and a recess opposing surface (213) of the inner circumferential recess (21), which opposes the press-fitting direction forward surface (41), by press-fitting the ring member (40) into the inner circumferential recess (21).

FIG. 1



EP 3 263 911 A1

Description

TECHNICAL FIELD

[0001] The present invention relates to a compressor housing for a turbocharger and a method of manufacturing the same.

BACKGROUND ART

[0002] A compressor for use in a supercharger such as a turbocharger of an automobile includes a compressor housing that is configured to be able to house an impeller, and includes an intake port for sucking air toward the impeller, a scroll chamber for introducing air discharged by the impeller thereinto, the scroll chamber being formed in a circumferential direction at an outer circumferential side of the impeller, and a shroud surface opposed to the impeller.

[0003] With the compressor configured as above, compression efficiency of the compressor can be increased by minimizing a gap between blades of the impeller and the shroud surface of the compressor housing.

[0004] However, if the gap is decreased, there is a risk that the impeller may be damaged, for example, when the impeller blades come into contact with the shroud surface of the compressor housing due to vibrations, a runout of an impeller rotation shaft, or the like.

[0005] Thus, in one conventionally proposed structure, an abradable seal made of a resin or the like that is softer than the impeller blades is attached to a portion of the compressor housing, which forms the shroud surface (Patent Document 1).

[0006] In this case, even if the impeller blades come into contact with the shroud surface of the compressor housing due to vibrations, a runout of the impeller rotation shaft, or the like, only the abradable seal attached to the portion that forms the shroud surface is abraded, while the impeller suffers no damage, and the gap between the impeller blades and the shroud surface of the compressor housing is kept small.

PRIOR ART DOCUMENT

Patent Document

[0007] Patent Document 1: JP-A-09-170442

SUMMARY OF THE INVENTION

PROBLEM TO BE SOLVED BY THE INVENTION

[0008] However, in Patent Document 1, in order to fix the abradable seal to the shroud part, the abradable seal is expanded to a diffuser portion that is not opposed to the impeller, then, fastened and fixed thereto with a screw member through a screw hole provided in the diffuser portion. Further, a housing recess for housing a head of each screw member is provided on a diffuser surface of the abradable seal in order to avoid the head of the screw member from projecting into a fluid passage from the diffuser surface. However, the housing recess that opens to the fluid passage, affects intake air flowing through the fluid passage to thereby disturb a flow of airflow, which may reduce compression efficiency.

[0009] Also, if the housing recess has water or the like in, this may be a cause of corrosion. Thus, it is conceivable to fill the housing recess with putty or the like after placing the head of the screw member in the housing recess. However, such configuration has disadvantages such as increase of manufacturing processes and/or increase of material costs.

[0010] Also, because in order to prepare a region for fixing the screw member on the abradable seal, the abradable seal is expanded to the diffuser portion that is a region not opposed to the impeller, the abradable seal is relatively increased in size. A material for forming the abradable seal is generally more costly than a material for forming the compressor housing. Therefore, upsizing of the abradable seal is disadvantageous in terms of cost.

[0011] The present invention has been made in view of the conventional problems as mentioned above, and it is intended to provide a compressor housing for a turbocharger which makes it possible to prevent reduction of compression efficiency and to maintain holdability for the abradable seal, and which is advantageous in terms of cost, and a method of manufacturing the same.

MEANS FOR SOLVING THE PROBLEM

[0012] One aspect of the present invention provides a compressor housing for a turbocharger configured to house an impeller, the compressor housing including:

a housing body having an inner circumferential recess recessively formed on an annular inner circumference surface of the housing body along an outer circumference of the impeller;

an annular abradable seal that is disposed in the inner circumferential recess, an inner circumference surface of the abradable seal forming a shroud surface that opposes the impeller; and

a ring member that is formed in a ring shape along the inner circumferential recess and is press-fitted into the inner circumferential recess in the axial direction of the impeller.

[0013] In the compressor housing, the inner circumferential recess includes a recess press-contact surface that is formed along the press-fitting direction of the ring member, and press-contacts the radial-direction outside surface of the ring member; and a recess opposing surface that opposes a press-fitting direction forward surface of the ring member, the abradable seal includes a flange that projects outwardly in the radial direction of the abradable seal, and the flange is held between the press-fitting

direction forward surface and the recess opposing surface by press-fitting the ring member into the inner circumferential recess.

[0014] Another aspect of the present invention provides a method of manufacturing the compressor housing. The method includes the steps of:

forming an integral raw material constructed from a housing raw material to be a raw material for the housing body, and a ring-shaped raw material to be a raw material for the ring member as a single body; and

machining and dividing the integral raw material to form the housing body and the ring member.

EFFECTS OF THE INVENTION

[0015] According to the above-mentioned compressor housing for a turbocharger, because the abradable seal is fixed through the flange, there is no need for a screw member(s) for fixing the abradable seal. A housing recess as conventionally provided to keep a screw head of the screw member(s) from projecting from the diffuser surface into a fluid passage, needs not be provided. Consequently, reduction of the compression efficiency in the shroud surface of the abradable seal can be prevented without disturbing a flow of air discharged from the impeller.

[0016] Moreover, according to the compressor housing for a turbocharger, the flange of the abradable seal is held between the press-fitting direction forward surface of the ring member and the recess opposing surface of the inner circumferential recess by press-fitting the ring member into the inner circumferential recess of the housing body.

[0017] Furthermore, because there is no need to provide any housing recess on the diffuser surface as conventionally provided, there is no risk that the diffuser surface has water or the like in, which may cause corrosion. In addition, because it is not necessary to fill the housing recess with putty or the like, as conventionally done, material cost does not increase. Also, because it is not necessary to extend the abradable seal to the diffuser portion that is a region not opposed to the impeller to prepare a region for fixing a screw member(s) to the abradable seal, the abradable seal can be downsized, which is advantageous in terms of cost.

[0018] The above-mentioned method of manufacturing a compressor housing for a turbocharger makes it possible to manufacture a compressor housing that exhibits the operational effects as mentioned above. Further, an integral raw material constructed from a housing raw material to be a raw material for a housing body and a ring-shaped raw material to be a raw material for a ring member is formed in the step of forming an integral raw material, and in the step of machining and dividing the integral raw material, the integral raw material is machined, and then is divided to form the housing body and the ring member as separated bodies. That is, the ring-shaped raw material can be machined and divided simultaneously in the step of machining the housing body. In this way, the manufacturing processes can be simplified as compared to the case where both raw materials are separately prepared and machined independently.

[0019] Moreover, because the housing body and the ring member are formed from the housing raw material and the ring-shaped raw material respectively, both of which are cut out from the integral raw material, the housing body and the ring member are composed of the same forming material. Thus, the housing body and the ring member have the same linear thermal expansion coefficients, accordingly, even if temperature change causes heat expansion or heat contraction in the housing body and/or the ring member, reduction of the press-contact force at a position where the radial-direction outside surface of the ring member and the recess press-contact surface of the inner circumferential recess come into press-contact with each other, can be prevented. Thus, the press-fitted state of the ring member in relation to the inner circumferential recess of the housing body can be maintained. As a result, reduction of the holdability for the abradable seal, of the inner circumferential recess of the housing body can be prevented even if any temperature change occurs.

[0020] As mentioned above, according to the present invention, it is possible to provide a compressor housing for a turbocharger which makes it possible to prevent reduction of the compression efficiency and to maintain holdability for the abradable seal, and which is advantageous in terms of cost, and a method of manufacturing the same.

BRIEF DESCRIPTION OF THE DRAWINGS

[0021]

Figure 1 is a sectional view of a turbocharger equipped with a compressor housing for a turbocharger according to Embodiment 1.

Figure 2 is a partially enlarged view of an abradable seal in Figure 1.

Figure 3 is a sectional view of the compressor housing for a turbocharger taken along the line III-III in Figure 1.

Figure 4 is a sectional view for describing a step of forming an integral raw material in a method of manufacturing the compressor housing for a turbocharger according to Embodiment 1.

Figure 5 is a sectional view for describing a step of machining and dividing the integral raw material in a method of manufacturing the compressor housing for a turbocharger according to Embodiment 1.

Figure 6 is a sectional view for describing a step of press-fitting a ring member in a method of manufacturing the compressor housing for a turbocharger according to Embodiment 1.

Figure 7 is a sectional view for describing a step of forming a shroud surface in a method of manufacturing the compressor housing for a turbocharger according to Embodiment 1.

Figure 8 is a sectional view of the compressor housing for a turbocharger after performing the step of forming a shroud surface according to Embodiment 1.

Figure 9 is a sectional view of an integral raw material according to one variation.

MODE FOR CARRYING OUT THE INVENTION

[0022] The compressor housing for a turbocharger according to the present invention can be used for a turbocharger for an automobile, and the like.

[0023] In the above-mentioned compressor housing, the ring member is preferably composed of the same forming material as the housing body. Thus, both the housing body and the ring member have the same linear thermal expansion coefficients, accordingly, even if heat expansion or heat contraction occur in the housing body and/or the ring member, reduction of the press-contact force at a position where the radial-direction outside surface of the ring member and the recess press-contact surface of the inner circumferential recess come into press-contact with each other, can be prevented. Thus, the press-fitted state of the ring member in relation to the inner circumferential recess of the housing body can be sufficiently maintained. As a result, reduction of the holdability for the abradable seal, of the inner circumferential recess of the housing body can be sufficiently prevented even if any temperature change occurs.

[0024] In the compressor housing, the flange is formed on an entire circumference of the abradable seal. In this case, the flange formed over the entire circumference of the abradable seal is held between the press-fitting direction forward surface of the ring member and the recess opposing surface of the inner circumferential recess in the housing body so as to fix the abradable seal, thereby reliably obtaining sufficient holdability for the abradable seal.

[0025] In the compressor housing, the abradable seal preferably includes the flange at a first end portion in the axial direction, and a second end portion of the abradable seal at the opposite side to the first end portion is preferably spatially apart from an opposing end surface that faces the second end portion in the inner circumferential recess. Under the condition that the second end portion is defined to be forward and the first end portion having the flange formed thereon is defined to be rearward, when the abradable seal is inserted into the inner circumferential recess with the second end portion being as a forward end, and the second end portion of the abradable seal is in contact with the opposing end surface of the inner circumferential recess, the abradable seal is prevented from expanding at the side of the second end portion and an amount of expansion at the side of the first end portion becomes large. As a result, a diffuser passage becomes narrow. However, in the above-mentioned configuration, the flange is formed at the first end portion close to the diffuser passage, and the second end portion is made spatially apart from the opposing end surface of the inner circumferential recess. Consequently, the abradable seal is allowed to expand at the side of the second end portion, so that the amount of expansion at the side of the first end portion can be made small. As a result, the diffuser passage can be prevented from being narrowed.

[0026] In the compressor housing, an outer circumference surface of the abradable seal is preferably spatially apart from an outer circumference surface of the inner circumferential recess. In this case, a space is formed between the abradable seal and the inner circumferential recess. Therefore, if the abradable seal expands, the outer circumference surface of the abradable seal expands inside of the space. Consequently, reduction of the diameter in the expanded abradable seal can be prevented. Thus, it is not necessary to set a tip clearance between the abradable seal and the impeller larger in advance in prospect of reduction of the diameter of the abradable seal due to the expansion. The tip clearance can be set to be small from the beginning. Further, when the abradable seal having the ring member attached thereto is installed on the housing body, the abradable seal can be inserted into the inner circumferential recess such that the outer circumference surface of the abradable seal is in no contact with the outer circumference surface of the inner circumferential recess, which improves assemble workability.

[0027] In the above-mentioned method of manufacturing a compressor housing for a turbocharger, the ring-shaped raw material can be formed as a single body with the housing raw material along a place for press-fitting the ring member in the step of forming an integral raw material. Thus, there is no need to prepare casting molds for the housing raw material and the ring-shaped raw material separately. It is only needed to prepare a single casting mold for forming an integral raw material constructed from a housing raw material and a ring-shaped raw material. Consequently, the molding cost can be reduced. Also, the casting cost can be reduced in the case of casting a single body as compared to the case of casting both raw materials separately.

[0028] In the method of manufacturing a compressor housing for a turbocharger, the ring-shaped raw material is formed in the step of forming an integral raw material as a single body with the housing raw material along an end portion of an intake port that is formed at an opposite side to a side on which the ring member is to be press-fitted. Also in this case, the molding cost and the casting cost can be reduced, to thereby totally reduce the manufacturing costs.

EMBODIMENTS

(Embodiment 1)

[0029] A compressor housing for a turbocharger according to the present embodiment will be described with reference to Figures 1 to 9.

[0030] A compressor housing 1 for a turbocharger according to the present embodiment (hereinafter also referred to as the "compressor housing 1") is equipped with a housing body 20, an abradable seal 30, and a ring member 40 as shown in Figure 1.

[0031] The housing body 20 is configured to be able to house an impeller 10, and includes an inner circumferential recess 21 recessively formed on an annular inner circumference surface along an outer circumference 10a of the impeller 10.

[0032] The abradable seal 30 is annularly formed and disposed in the inner circumferential recess 21, and the inner circumference surface of the abradable seal 30 forms a shroud surface 31 that opposes the impeller 10.

[0033] The ring member 40 is formed in a ring shape along the inner circumferential recess 21 of the housing body 20, and is press-fitted into the inner circumferential recess 21 in the axial direction of the impeller.

[0034] In addition, as shown in Figure 2, the inner circumferential recess 21 includes a recess press-contact surface 212 that is formed along the press-fitting direction (i.e. the axial direction X) of the ring member 40, and press-contacts a radial-direction outside surface 42 of the ring member 40; and a recess opposing surface 213 that opposes a press-fitting direction forward surface 41 of the ring member 40.

[0035] The abradable seal 30 includes a flange 32 that projects outwardly in a radial direction of the abradable seal 30, and the flange 32 is held between the press-fitting direction forward surface 41 and the recess opposing surface 213 by press-fitting the ring member 40 into the inner circumferential recess 21.

[0036] As shown in Figure 1, the compressor housing 1 forms an outer shell of a compressor (compression machine) for use in a turbocharger of an automobile.

[0037] The compressor housing 1 according to the present embodiment will be described in detail below.

[0038] The housing body 20 is made of an aluminum cast product obtained by gravity casting, and is equipped with an intake port 11, an intake passage 12, and a scroll chamber 13, as shown in Figures 1 and 2.

[0039] The intake port 11 and the intake passage 12 are defined by a cylindrical portion 23.

[0040] The scroll chamber 13 is formed on the outer circumference side of the impeller 10 in the circumferential direction to introduce air discharged from the impeller 10 thereinto.

[0041] The inner circumferential recess 21 is formed on the inner circumference surface of the housing body 20 along the outer circumference of the abradable seal 30. And, the inner circumferential recess 21 includes a first cylindrical recessed portion 210 that is recessively formed along a cylindrical abradable seal body part 310 that will be mentioned below, of the abradable seal 30, and a second cylindrical recessed portion 220 that is formed recessively further than the first recessed portion 210 along an enlarged diameter part 311. Thus, the inner circumferential recess 21 is configured to be able to have the abradable seal 30 disposed therein. The second cylindrical recessed portion 220 of the inner circumferential recess 21 includes the recess press-contact surface 212 that is formed along the press-fitting direction of the ring member 40 that will be mentioned below, and press-contacts the radial-direction outside surface 42 of the ring member 40; and the recess opposing surface 213 that extends in the radial direction in such a manner to oppose the press-fitting direction forward surface 41 that defines a press-fitting direction X forward side of the ring member 40.

[0042] The abradable seal 30 is formed of an elastically deformable material. In the present embodiment, the abradable seal 30 is made of a polyimide resin. The material for forming the abradable seal 30 is not limited to this, and available materials include Teflon (registered trademark), PPS (polyphenylene sulfide) resin, and PEEK (polyetheretherketone) resin, and the like. As shown in Figure 3, the abradable seal 30 has an annular shape, and the entire inner circumference surface forms the shroud surface 31, opposing the impeller 10 (Figure 1). Further, the abradable seal 30 includes the cylindrical abradable seal body part 310, and the enlarged diameter part 311 that is formed on the opposite side to the intake port 11 (i.e. the rearward side in the press-fitting direction to be mentioned below) with the abradable seal body part 310 in-between. The enlarged diameter part 311 is formed in the circumference direction of the abradable seal 30. The enlarged diameter part 311 includes the flange 32 that projects outwardly in the radial direction. In the present embodiment, the flange 32 is formed on the entire circumference of the enlarged diameter part 311. The abradable seal 30, as shown in Figures 1 and 2, is disposed in the inner circumferential recess 21 such that the abradable seal body part 310 is positioned in the first recessed portion 210 of the inner circumferential recess 21 and the enlarged diameter part 311 is positioned in the second recessed portion 220.

[0043] As shown in Figure 3, the ring member 40 is formed in a ring shape along the recess press-contact surface 212 of the inner circumferential recess 21, and has a substantially rectangular cross section as shown in Figures 1 and 2. The radial-direction outside surface 42 that oppose the recess press-contact surface 212 is formed over the entire outer periphery of the ring member 40 along the press-fitting direction X. And, the outer diameter of the ring member 40 is slightly larger than the inner diameter of the second recessed portion 220 of the inner circumferential recess 21. The radial-direction outside surface 42 press-contacts the recess press-contact surface 212 by press-fitting the ring member 40 into the

second recessed portion 220. On the other hand, a radial-direction inside surface 43 that is positioned on the opposite side to the radial-direction outside surface 42 of the ring member 40 press-contacts an outer circumference surface 313 of the enlarged diameter part 311 of the abradable seal 30.

[0044] As shown in Figure 2, in the state in which the ring member 40 is press-fitted into the second recessed portion 220, the press-fitting direction forward surface 41 of the ring member 40 opposes the recess opposing surface 213. And, the flange 32 of the abradable seal 30 is held between the press-fitting direction forward surface 41 and the recess opposing surface 213. Moreover, as shown in Figure 2, although the flange 32 projects outwardly in the radial direction from the enlarged diameter part 311, an outer circumference surface 32a of the flange 32, which corresponds to the outer circumference surface that opposes the recess press-contact surface 212 and the recess press-contact surface 212 are not in contact with each other. Thus, a space 50 that is surrounded by the press-fitting direction forward surface 41, the recess opposing surface 213 and the outer circumference surface 32a is formed. Furthermore, in the first recessed portion 210, because the outer diameter of the abradable seal body part 310 is smaller than the inner diameter of the first recessed portion 210, the outer circumference surface 310a of the abradable seal body part 310 is spatially apart from the outer circumference surface 210a of the first recessed portion 210. Thus, a space 51 is formed between the outer circumference surface 310a of the abradable seal body part 310 and the outer circumference surface 210a of the first recessed portion 210. Moreover, as shown in Figure 1, the abradable seal 30 has the flange 32 formed at a first end portion 34 thereof in the axial direction X. And, a second end portion 35 at an opposite side to the first end portion 34 is spatially apart from an opposing end surface 210b that faces the second end portion 35 in the inner circumferential recess 21. Thus, a space 52 is formed between the second end portion 35 and the opposing end surface 210b.

[0045] Further, as shown in Figure 1, a bearing housing or an end surface 70 of a backplate is located on the opposite side to the intake port 11 of the housing body 20. A diffuser portion 14 that serves as a fluid passage that connects the impeller 10 side to a scroll chamber 12 is formed between the end surface 70 and the housing body 20. In the housing body 20, a surface that opposes the end surface 70 forms a diffuser surface 24.

[0046] Further, as shown in Figure 1, the impeller 10 is arranged on the side of the inner circumference surface (the shroud surface 31) of the abradable seal 30 in the housing body 20 in a rotatable manner around a rotation shaft 15. In addition, the impeller 10 has a hub 16 and a plurality of blades 17 that are arranged in the circumferential direction of the hub 16 and project from the outer circumference surface thereof. The plurality of blades 17 are arranged facing the shroud surface 31 of the abradable seal 30.

[0047] In a compressor provided with the compressor housing 1 according to the present embodiment, as shown in Figure 1, intake air that is sucked from the intake port 11 through the intake passage 12, is accelerated by the blades 17 of the impeller 10 and is fed to the diffuser part 14. Then, the intake air is pressurized in the diffuser portion 14 and is fed into the scroll chamber 13.

[0048] Next, a method of manufacturing the compressor housing 1 according to the present embodiment will be explained.

[0049] For manufacturing the compressor housing 1, as shown in Figure 4, an integral raw material 60 constructed from a housing raw material 20a which will be a raw material for the housing body 20, and a ring-shaped raw material 40a which will be a raw material for the ring member 40, is firstly formed (a step S1 of forming an integral raw material).

[0050] According to the present embodiment, in the step S1 of forming an integral raw material, the integral raw material 60 was formed from an aluminum alloy by a gravity casting method. As shown in Figure 4, the intake port 11 and the intake passage 12 were formed in the integral raw material 60, and the ring-shaped raw material 40a was formed in a ring shape protrudingly toward the opposite side to the intake port 11 along a place 40b (the second recessed portion 220 in Figure 2) at which the ring member 40 would be press-fitted in the housing raw material 20a. Moreover, the scroll chamber 13 was formed in the integral raw material 60 using a core.

[0051] Next, the integral raw material 60 (Figure 4) was machined and divided to form the housing body 20 and the ring member 40 as shown in Figure 5 (a step S2 of machining and dividing the integral raw material). Specifically, in the step S2 of machining and dividing the integral raw material, the integral raw material 60 in the state shown in Figure 4 is machined cutting an inner circumferential portion 20b of a part that will be the housing raw material 20a to form the inner circumferential recess 21 (Figure 5) including the first recessed portion 210 and the second recessed portion 220, thereby forming a portion that will be the housing body 20. At the same time, a portion that will be the ring member 40 is formed by grinding a part that will be the ring-shaped raw material 40a. After that, the integral raw material 60 thus machined was divided into two components so as to prepare the housing body 20 and the ring member 40.

[0052] Subsequently, as shown in Figure 6, the ring member 40 is press-fitted into the abradable seal 30 that has been prepared in advance, and is assembled thereto. Then, the resulting assembly is press-fitted into the inner circumferential recess 21 of the housing body 20 (a step S3 of press-fitting). As shown in Figure 7, the flange 32 was held between the press-fitting direction forward surface 41 of the ring member 40 and the recess opposing surface 213 of the inner circumferential recess 21 by press-fitting the ring member 40 into the second recessed portion 220 in the inner circumferential recess 21. The outer diameter of the radial-direction outside surface 42

of the ring member 40 was slightly larger than the inner diameter of the recess press-contact surface 212 of the second recessed portion 220. In the step S3 of press-fitting, the radial-direction outside surface 42 of the ring member 40 was made press-contacted with the recess press-contact surface 212 of the second recessed portion 220 by press-fitting the ring member 40 into the second recessed portion 220. It is noted that the radial-direction inside surface 43 of the ring member 40 press-contacts the outer circumference surface 311 of the enlarged part 313 of the abradable seal 30.

[0053] Thereafter, an inner circumferential portion 30b (Figure 7) of the abradable seal 30 was cut along with the ring member 40 and the inner circumference surface of the housing body 20 to form the shroud surface 31 as shown in Figure 8 (a step S4 of forming a shroud surface). Thus, a continuously smooth surface that continues from the intake port 11 to the diffuser surface 24 through the intake passage 12 and the shroud surface 31 was formed. In this way, the compressor housing 1 was completed.

[0054] Next, the operational effects of the compressor housing 1 for a turbocharger according to the present embodiment will be described in detail. In the compressor housing 1 according to the present embodiment, because the abradable seal 30 is fixed through the flange 32, there is no need for a screw member(s) for fixing the abradable seal 30. Thus, a housing recess as conventionally provided to keep a screw head of the screw member(s) from projecting from the diffuser surface 24 into a fluid passage, needs not be provided. Consequently, reduction of the compression efficiency in the shroud surface 31 of the abradable seal 30 can be prevented without disturbing a flow of air discharged from the impeller 10.

[0055] Moreover, the flange 32 of the abradable seal 30 is held between the press-fitting direction forward surface 41 of the ring member 40 and the recess opposing surface 213 of the inner circumferential recess 21 by press-fitting the ring member 40 into the inner circumferential recess 21 of the housing body 20. Thus, the abradable seal 30 is fixed to the inner circumferential recess 21 of the housing body 20.

[0056] Furthermore, because there is no need to provide any housing recess on the diffuser surface 24 as conventionally provided, there is no risk that the diffuser surface 24 has water or the like, which may cause corrosion. In addition, because it is not necessary to fill the housing recess with putty or the like as conventionally done, material cost does not increase. Also, because it is not necessary to expand the abradable seal 30 to the diffuser surface 24 that is a region not opposed to the impeller 10 in order to prepare a region for fixing a screw member(s) to the abradable seal 30, the abradable seal 30 can be downsized, which is advantageous in terms of cost.

[0057] Furthermore, the ring member 40 is composed of the same forming material as the housing member 20. Thus, both the housing body 20 and the ring member 40 have the same linear thermal expansion coefficients, accordingly, even if heat expansion or heat contraction occur in the housing body 20 and/or the ring member 40, reduction of the press-contact force at a position where the radial-direction outside surface 42 of the ring member 40 and the recess press-contact surface 212 of the inner circumferential recess 21 come into press-contact with each other, can be prevented. Thus, the press-fitted state of the ring member 40 in relation to the inner circumferential recess 21 of the housing body 20 can be maintained. As a result, reduction of the holdability for the abradable seal 30, of the inner circumferential recess 21 of the housing body 20 can be sufficiently prevented even if any temperature change occurs.

[0058] Furthermore, the flange 32 is formed on an entire circumference of the abradable seal 30. The flange 32 formed over the entire circumference of the abradable seal 30 is held between the press-fitting direction forward surface 41 of the ring member 40 and the recess opposing surface 213 of the inner circumferential recess 21 so as to fix the abradable seal, thereby reliably obtaining sufficient holdability for the abradable seal 30.

[0059] Furthermore, the ring member 40 is formed along the recess press-contact surface 212 of the second recessed portion 220 in the inner circumferential recess 21, the radial-direction outside surface 42 of the ring member 40 is formed on the entire circumference of the ring member 40. Consequently, a position where the recess press-contact surface 212 and the radial-direction outside surface 42 come into press-contact with each other can be obtained widely, so that the ring member 40 can be reliably fixed to the housing body 20.

[0060] In the present embodiment, the sectional shape of the ring member 40 is designed to be substantially rectangular. However, the sectional shape is not limited to this, and can be determined as appropriate in view of formability of the ring member 40, easiness of press-fitting into the inner circumferential recess 21, required holdability for the abradable seal 30, manufacturing cost, and so on.

[0061] In the present embodiment, the flange 32 is protrudingly formed outward in the radial direction on the entire circumference of the abradable seal 30. However, the flange 32 is not limited to this configuration. The flange 32 may be formed on part of the outer circumference of the abradable seal 30. A position to form the flange 32 can be determined as appropriate in view of formability of the abradable seal 30, manufacturing costs, required holdability for the abradable seal 30, and so on.

[0062] In the present embodiment, the abradable seal 30 includes the flange 32 at the first end portion 34 in the axial direction, and the second end portion 35 of the abradable seal 30 at the opposite side to the first end portion 34 is spatially apart from the opposing end surface 210b that faces the second end portion 35 in the inner circumferential recess 21. Under the condition that the second end portion 35 is defined to be forward and the first end portion 34 having the flange 32 formed thereon

is defined to be rearward, when the abradable seal 30 is inserted into the inner circumferential recess 21 with the second end portion 35 being as a forward end, and the second end portion 35 of the abradable seal 30 is in contact with the opposing end surface 210b of the inner circumferential recess 21, the abradable seal 30 is prevented from expanding at the side of the second end portion 35. Consequently, the diffuser passage 14 becomes narrow. However, in the present embodiment, the flange 32 is formed at the first end portion 34 close to the diffuser passage 14, and the second end portion 35 is made spatially apart from the opposing end surface 210b of the inner circumferential recess 21. Thus, the abradable seal 30 is allowed to expand at the side of the second end portion 35, so that the amount of expansion at the side of the first end portion 34 can be made small. As a result, the diffuser passage 14 can be prevented from being narrowed.

[0063] In the present embodiment, the outer circumference surface 310a of the abradable seal 30 is spatially apart from the outer circumference surface 210a. Thus, the space 51 is formed between the abradable seal 30 and the inner circumferential recess 21. And, if the abradable seal 30 expands, the outer circumference surface 310a of the abradable seal 30 expands inside of the space 51. Consequently, reduction of diameter in the expanded abradable seal 30 can be prevented. Thus, it is not necessary to set a tip clearance between the abradable seal 30 and the impeller 10 larger in advance in prospect of the reduction of diameter due to the expansion of the abradable seal 30. The tip clearance can be set to be small from the beginning. Further, when the abradable seal 30 having the ring member 40 attached thereto is installed on the housing body 20, it is possible to insert the abradable seal 30 into the inner circumferential recess 21 such that the outer circumference surface 310a of the abradable seal 30 is in no contact with the outer circumference surface 210a of the inner circumferential recess 21, which improves assemble workability.

[0064] Moreover, according to the method of manufacturing the compressor housing 1 for a turbocharger in the present embodiment, it is possible to manufacture the compressor housing 1 that exhibits the above-mentioned operational effects. Specifically, in the step S1 of forming an integral raw material, the integral raw material 60 constructed from the housing raw material 20a which will be a raw material for the housing body 20, and the ring-shaped raw material 40a which will be a raw material for the ring member 40, is formed, and in the step S2 of machining and dividing the integral raw material, the integral raw material 60 is machined and divided to form the housing body 20 and the ring member 40. In short, the ring member 40 is formed by machining and dividing in the step to process the housing body 20 by machining (the step S2 of machining and dividing the integral raw material). In this way, the manufacturing processes can be simplified as compared to the case where both raw materials 20a and 40b are separately prepared and machined independently.

[0065] Furthermore, because the housing body 20 and the ring member 40 are formed from the housing raw material 20a and the ring-shaped raw material 40a respectively, both of which are cut out from the integral raw material 60, the housing body 20 and the ring member 40 are composed of the same forming material. Thus, the housing body 20 and the ring member 40 have the same linear thermal expansion coefficients, accordingly, even if temperature change causes heat expansion or heat contraction in the housing body 20 and/or the ring member 40, reduction of the press-contact force at a position where the radial-direction outside surface 42 of the ring member 40 and the recess press-contact surface 212 of the inner circumferential recess 21 come into press-contact with each other, can be prevented. Thus, the press-fitted state of the ring member 40 in relation to the inner circumferential recess 21 of the housing body 20 can be maintained. As a result, reduction of the holdability for the abradable seal 30, of the inner circumferential recess 21 of the housing body 20 can be prevented even if any temperature change occurs.

[0066] Furthermore, in the method of manufacturing the compressor housing 1 for a turbocharger, the ring-shaped raw material 40a is formed in the step S1 of forming an integral raw material, as a single body with the housing raw material 20a along a place in which the ring member 40 is to be press-fitted. Thus, there is no need to prepare casting molds for the housing raw material 20a and the ring-shaped raw material 40a separately. It is only needed to prepare a single casting mold for forming the integral raw material 60 constructed from the housing raw material 20a and the ring-shaped raw material 40a. Consequently, the molding cost can be reduced. Also, the casting cost can be reduced in the case of casting a single body compared to the case of casting both raw materials separately. Consequently, the manufacturing cost can be reduced.

[0067] According to the present embodiment, in the step S1 of forming an integral raw material, the ring-shaped raw material 40a was formed in the housing raw material 20a at the opposite side to the intake port 11 along a place 40b in which the ring member 40 is to be press-fitted. Besides this, the following configuration can also be adopted. Specifically, as shown in Figure 9, in the step S1 of forming an integral raw material, the ring-shaped raw material 40a may be formed in the housing raw material 20a along an end portion 11a of the intake port 11 so as to protrude toward the opposite side to the side on which the ring member is to be press-fitted, as a single body with the housing raw material 20a. Also in this case, because it is only needed to prepare a single casting mold for forming the integral raw material constructed from both raw materials in the same way as mentioned above, the molding cost and the casting cost can be reduced, thereby exhibiting the operational effects of reducing the manufacturing cost.

[0068] In the present embodiment, the integral raw material 60 is formed by gravity casting in the step S1 of forming an integral raw material. However, the forming method is not limited to this. The integral raw material 60 may be formed by a die-casting method or other conventional methods. When the die-casting method is adopted, the integral raw material 60 is divided into plural pieces as appropriate to eliminate any undercut.

[0069] As mentioned above, according to the present embodiment, it is possible to provide the compressor housing 1 for a turbocharger which makes it possible to prevent reduction of the compression efficiency and to maintain holdability for the abradable seal, and which is advantageous in terms of cost, and the method of manufacturing the same.

Claims

1. A compressor housing for a turbocharger configured to house an impeller, the compressor housing comprising:

a housing body having an inner circumferential recess recessively formed on an annular inner circumference surface thereof along an outer circumference of the impeller;
an annular abradable seal that is disposed in the inner circumferential recess, an inner circumference surface of the abradable seal forming a shroud surface that opposes the impeller; and
a ring member that is formed in a ring shape along the inner circumferential recess and is press-fitted into the inner circumferential recess in an axial direction of the impeller; wherein
the inner circumferential recess includes a recess press-contact surface that is formed along a press-fitting direction of the ring member, and press-contacts a radial-direction outside surface of the ring member; and a recess opposing surface that opposes a press-fitting direction forward surface of the ring member,
the abradable seal includes a flange that projects outwardly in a radial direction of the abradable seal, and
the flange is held between the press-fitting direction forward surface and the recess opposing surface by press-fitting the ring member into the inner circumferential recess.

2. The compressor housing according to claim 1, wherein the ring member is composed of a material identical to that of the housing body.

3. The compressor housing according to claim 1 or 2, wherein the flange is formed on an entire circumference of the abradable seal.

4. The compressor housing according to any one of claims 1 to 3, wherein the flange is provided at a first end portion of the abradable seal in an axial direction, and a second end portion of the abradable seal at an opposite side to the first end portion is spatially apart from an opposing end surface that faces the second end portion in the inner circumferential recess.

5. The compressor housing according to any one of claims 1 to 4, wherein an outer circumference surface of the abradable seal is spatially apart from an outer circumference surface of the inner circumferential recess.

6. A method of manufacturing the compressor housing according to Claim 1, the method comprising the steps of:

forming an integral raw material constructed from a housing raw material to be a raw material for the housing body, and a ring-shaped raw material to be a raw material for the ring member as a single body; and
machining and dividing the integral raw material to form the housing body and the ring member.

7. The method of manufacturing the compressor housing according to Claim 6, wherein in the step of forming an integral raw material, the ring-shaped raw material is formed as a single body with the housing raw material along a place for press-fitting the ring member.

8. The method of manufacturing the compressor housing according to Claim 6, wherein in the step of forming an integral raw material, the ring-shaped raw material is formed as a single body with the housing raw material along an end portion of an intake port that is formed at an opposite side to a side on which the ring member is to be press-fitted.

FIG. 1

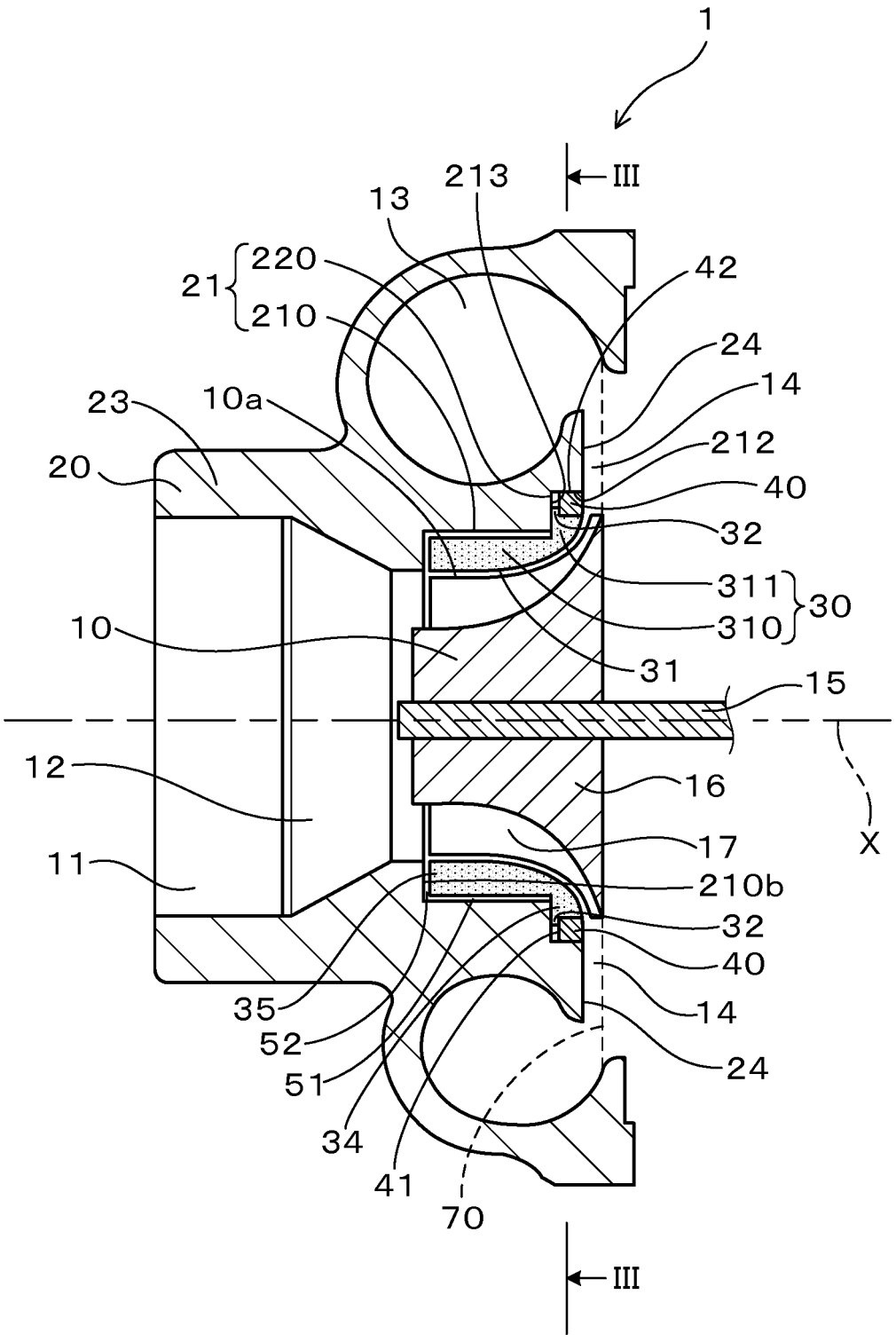

1
III
213
13
21
220
210
42
24
14
23
10a
212
20
40
32
311
30
310
10
31
15
12
16
X
17
11
210b
32
40
14
35
52
24
51
34
41
70
III

FIG. 2

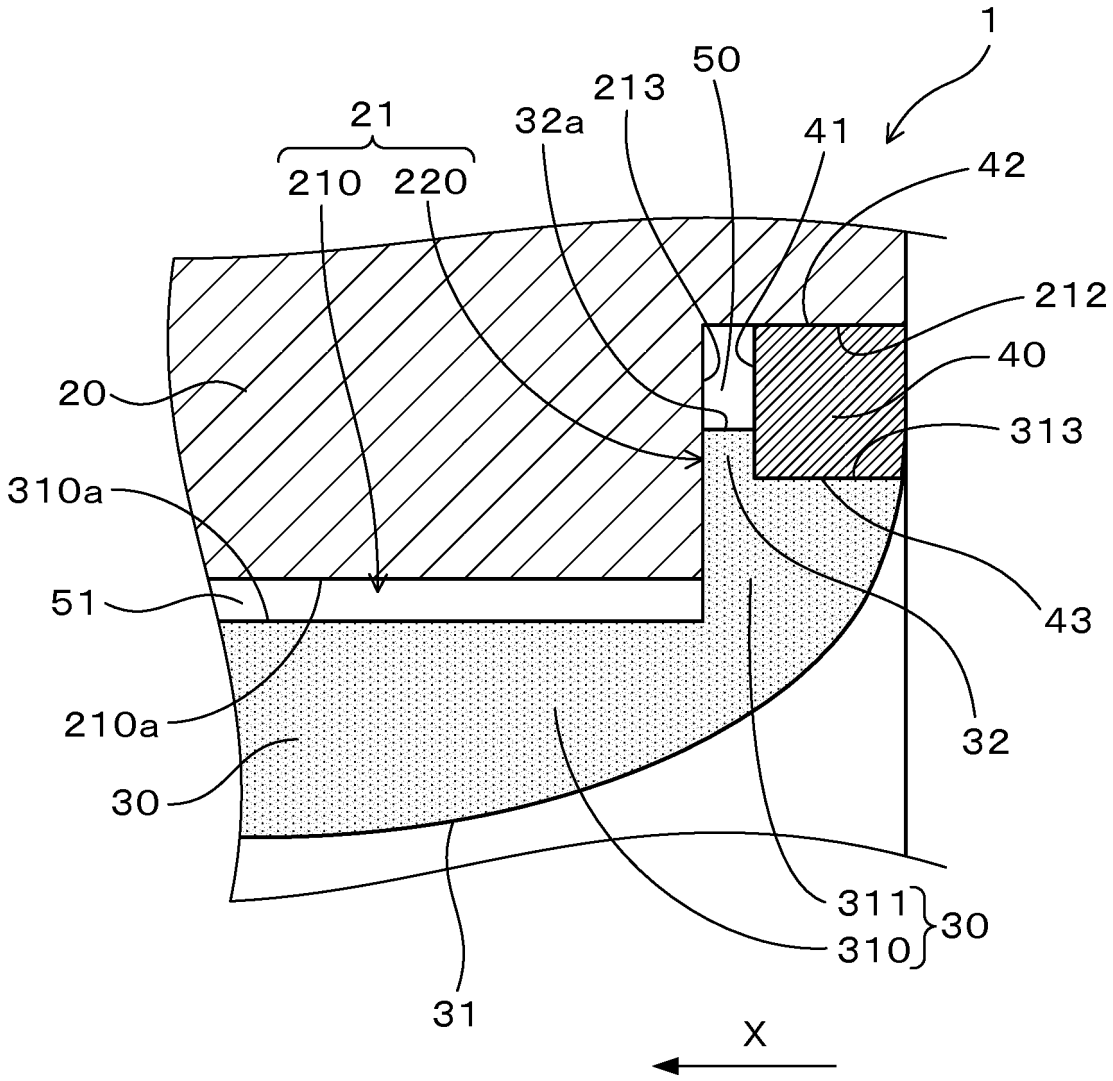

1
50
213
21
32a
41
42
210
220
212
40
20
313
310a
51
43
210a
32
30
311
30
310
31
X

FIG. 3

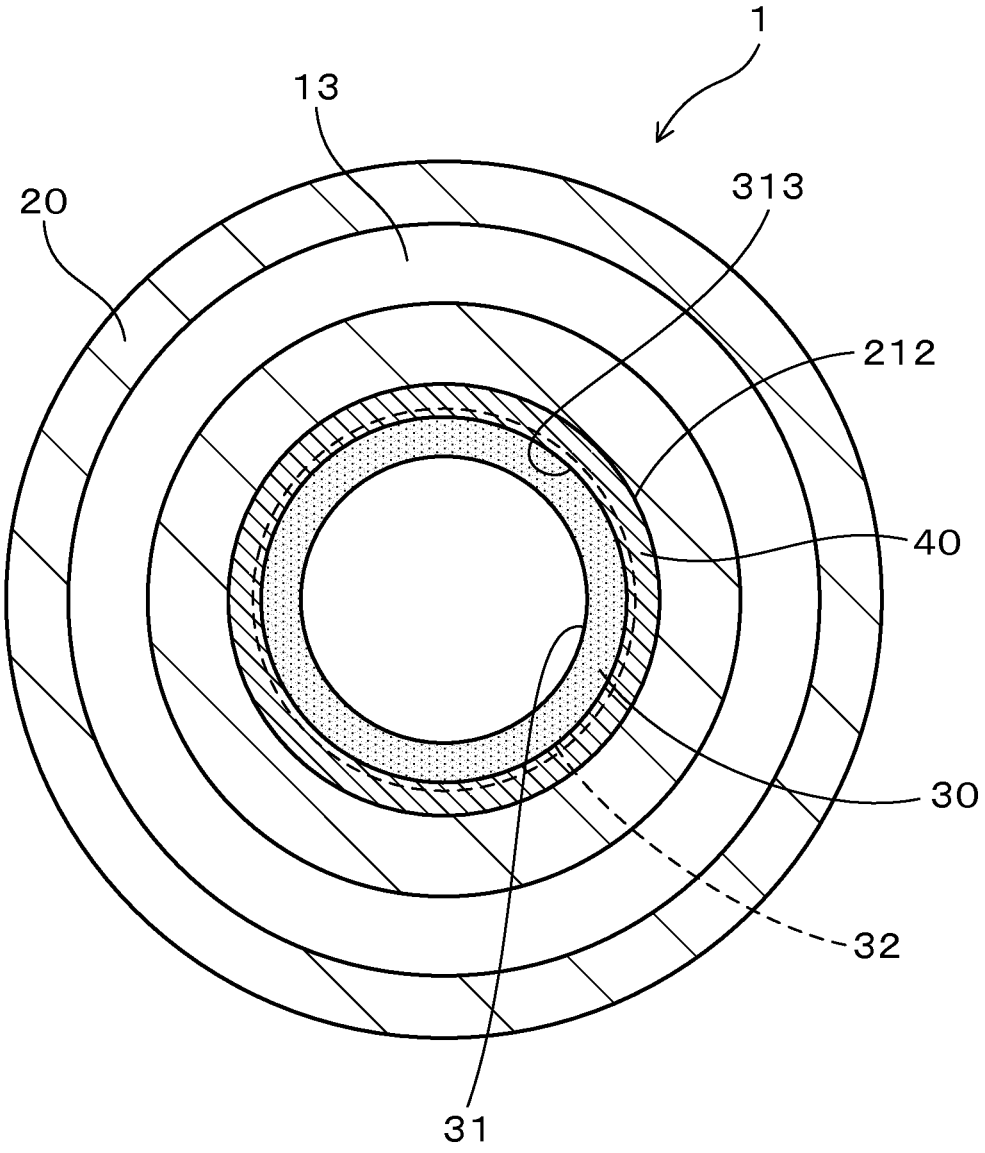


FIG. 4

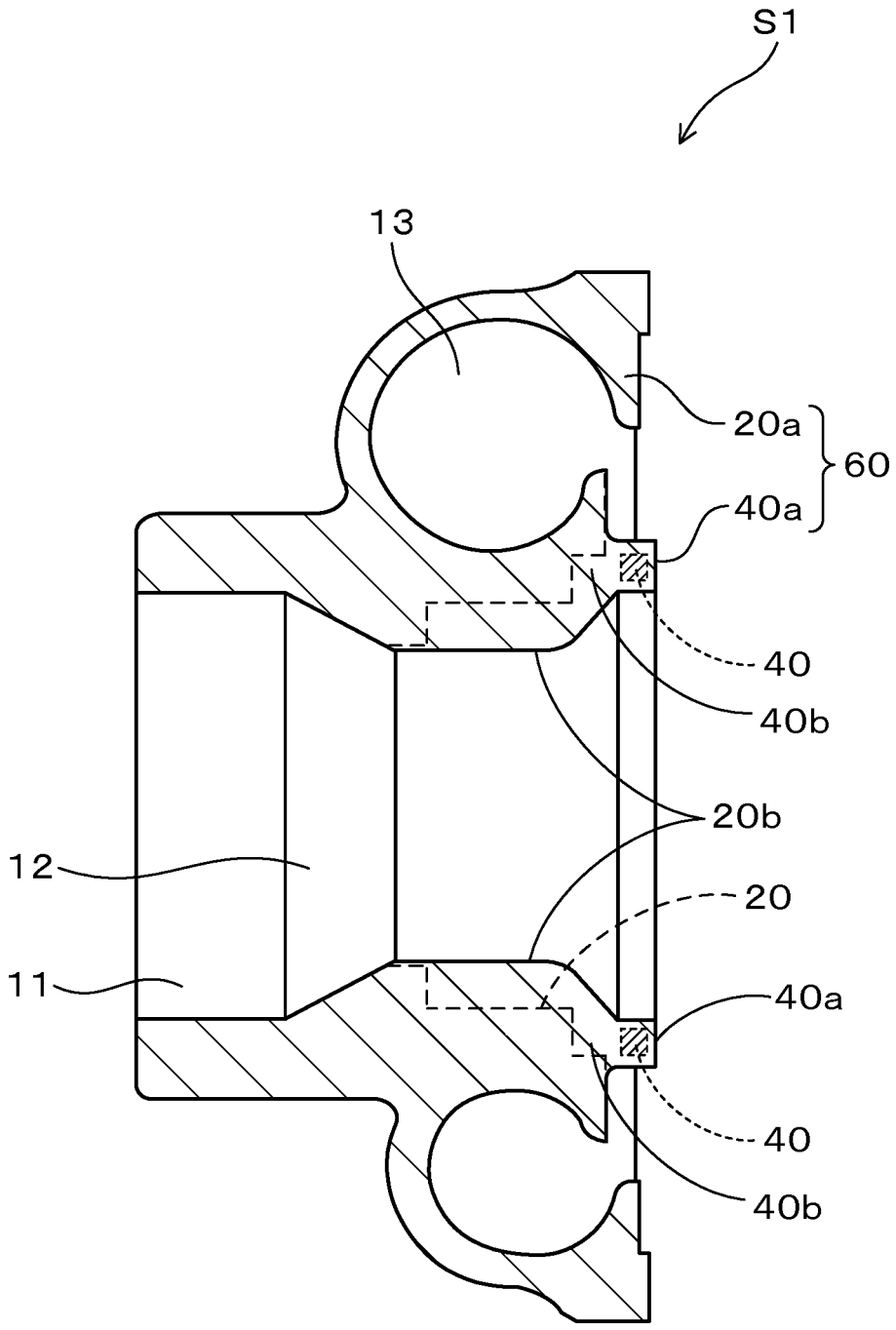


FIG. 5

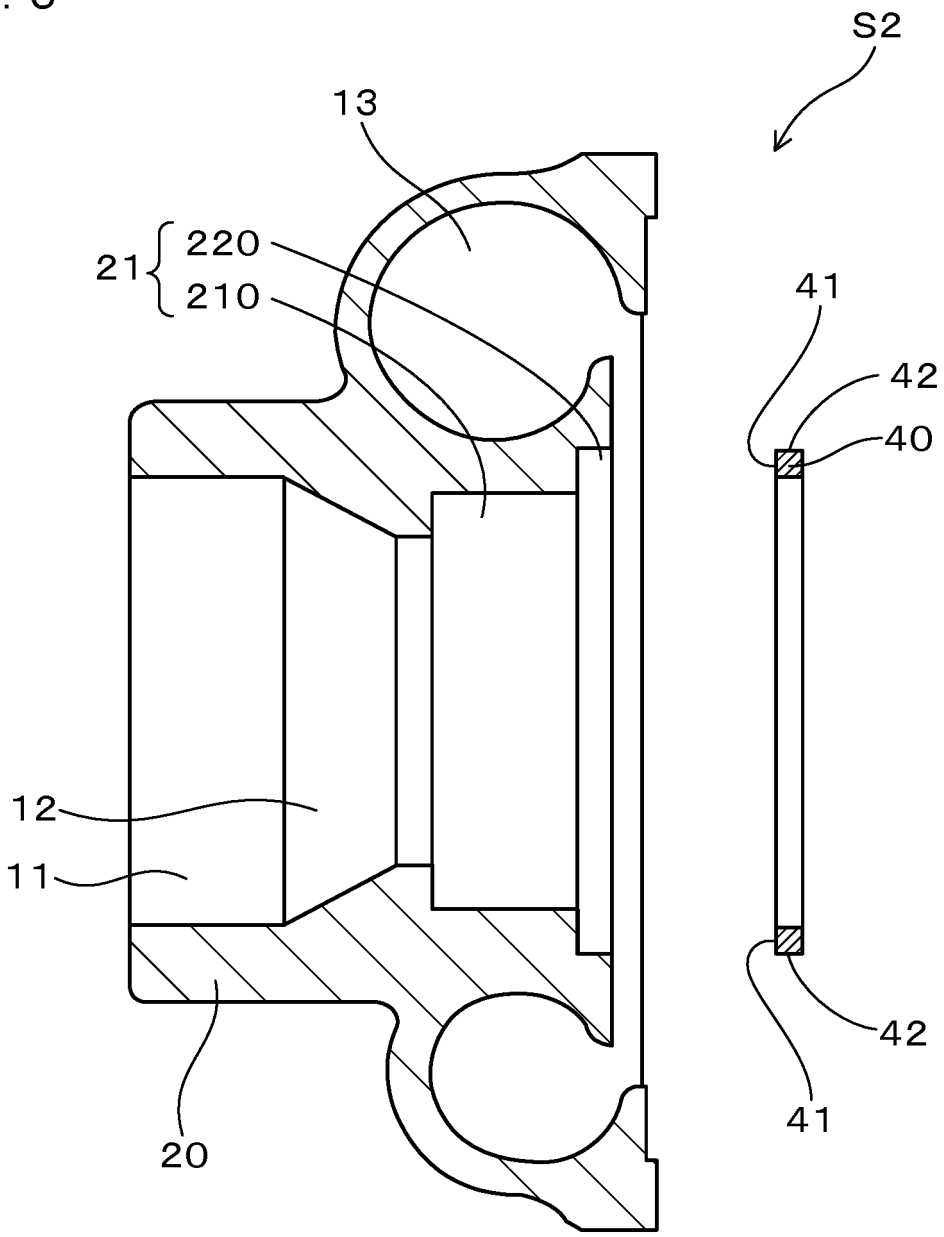


FIG. 6

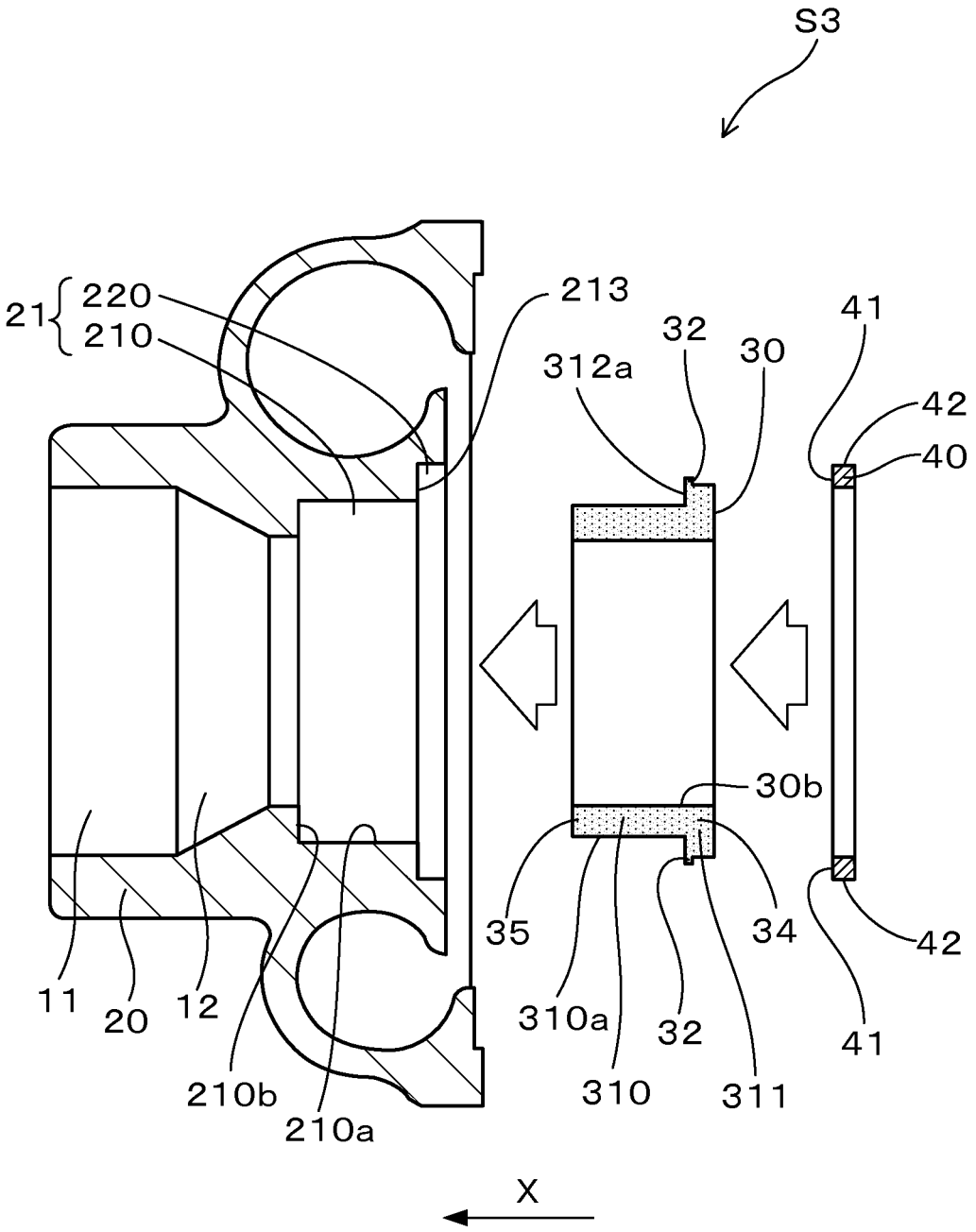

S3
21
220
210
213
32
312a
30
41
42
40
30b
35
34
42
41
11
20
12
210b
210a
310a
32
310
311
X

FIG. 7

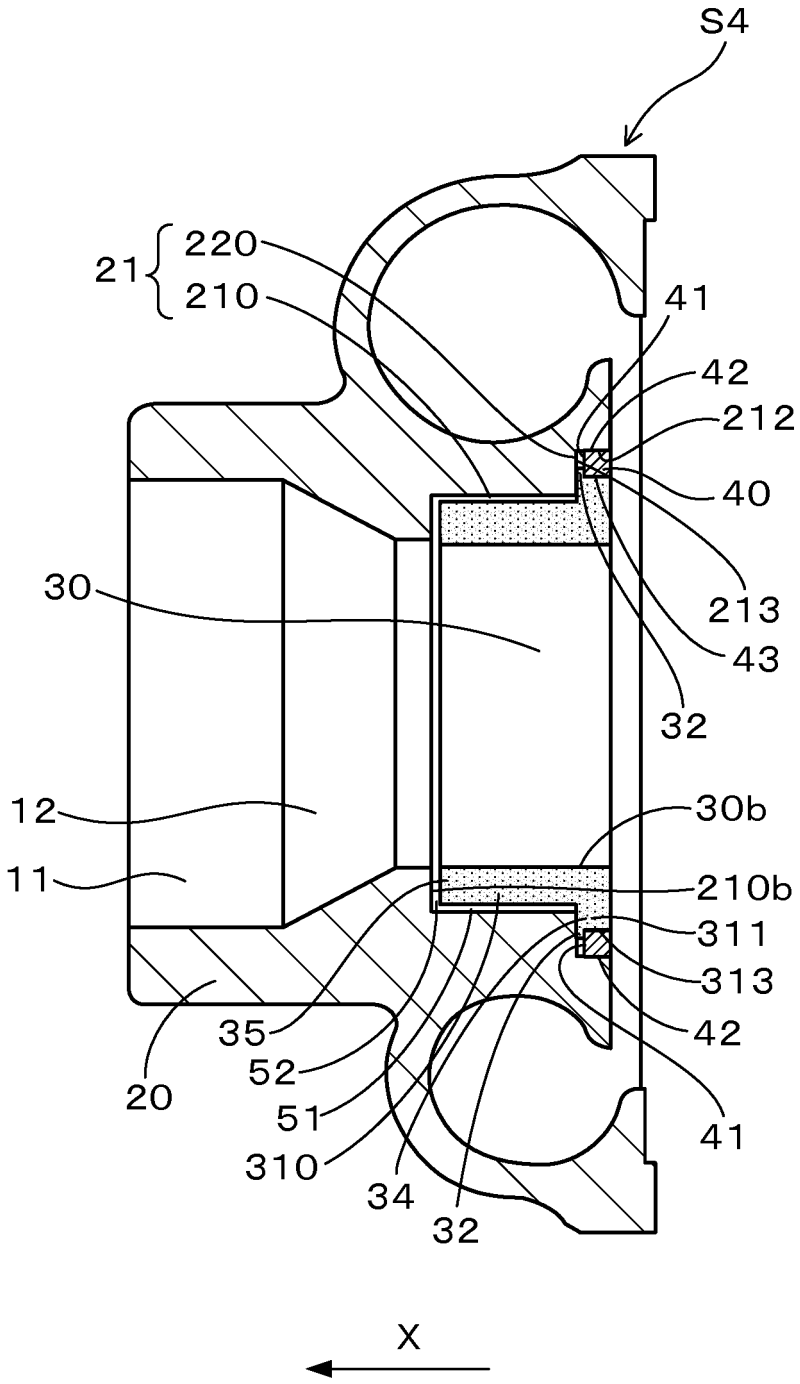

S4
21
220
210
41
42
212
40
213
43
32
30
12
11
30b
210b
311
313
42
41
35
52
51
310
34
32
20
X

FIG. 8

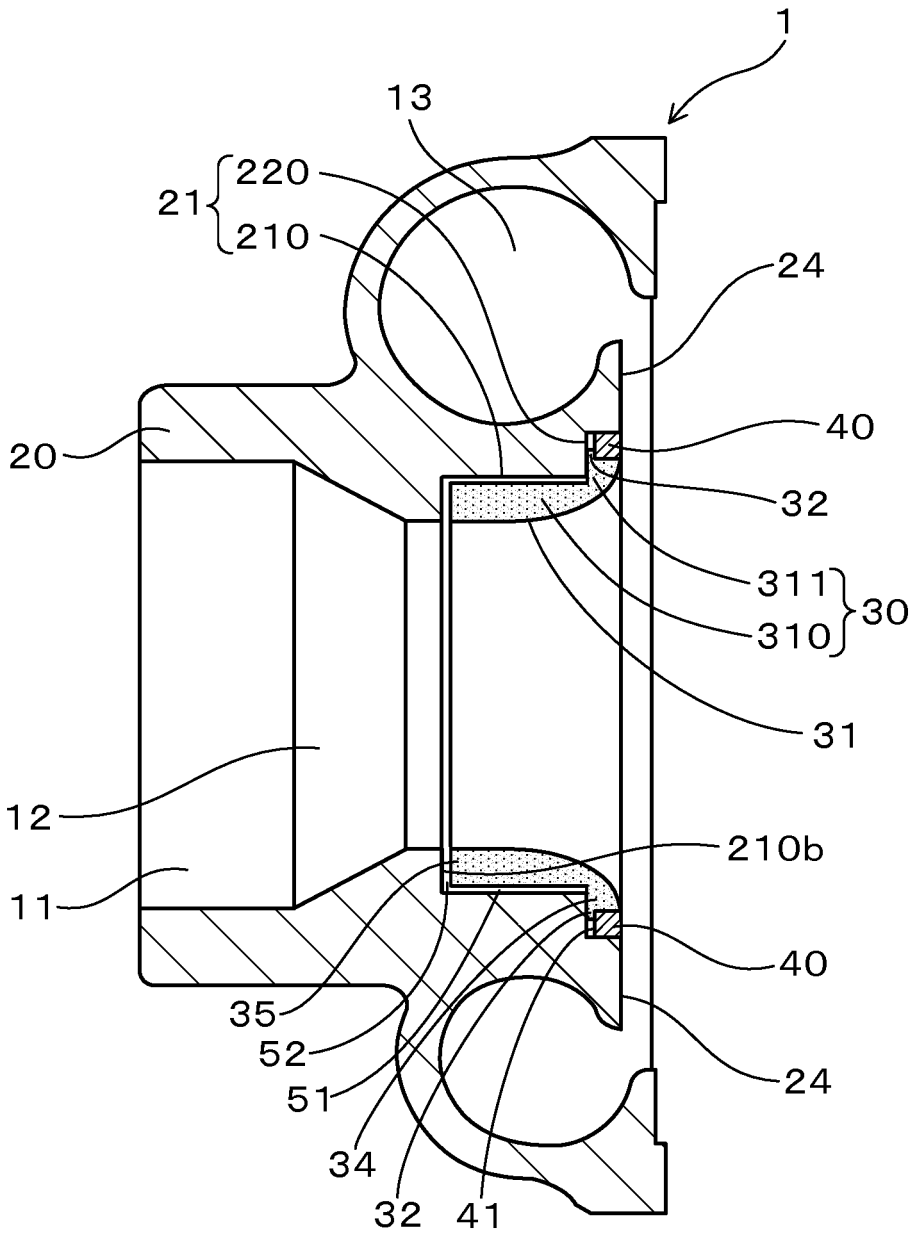
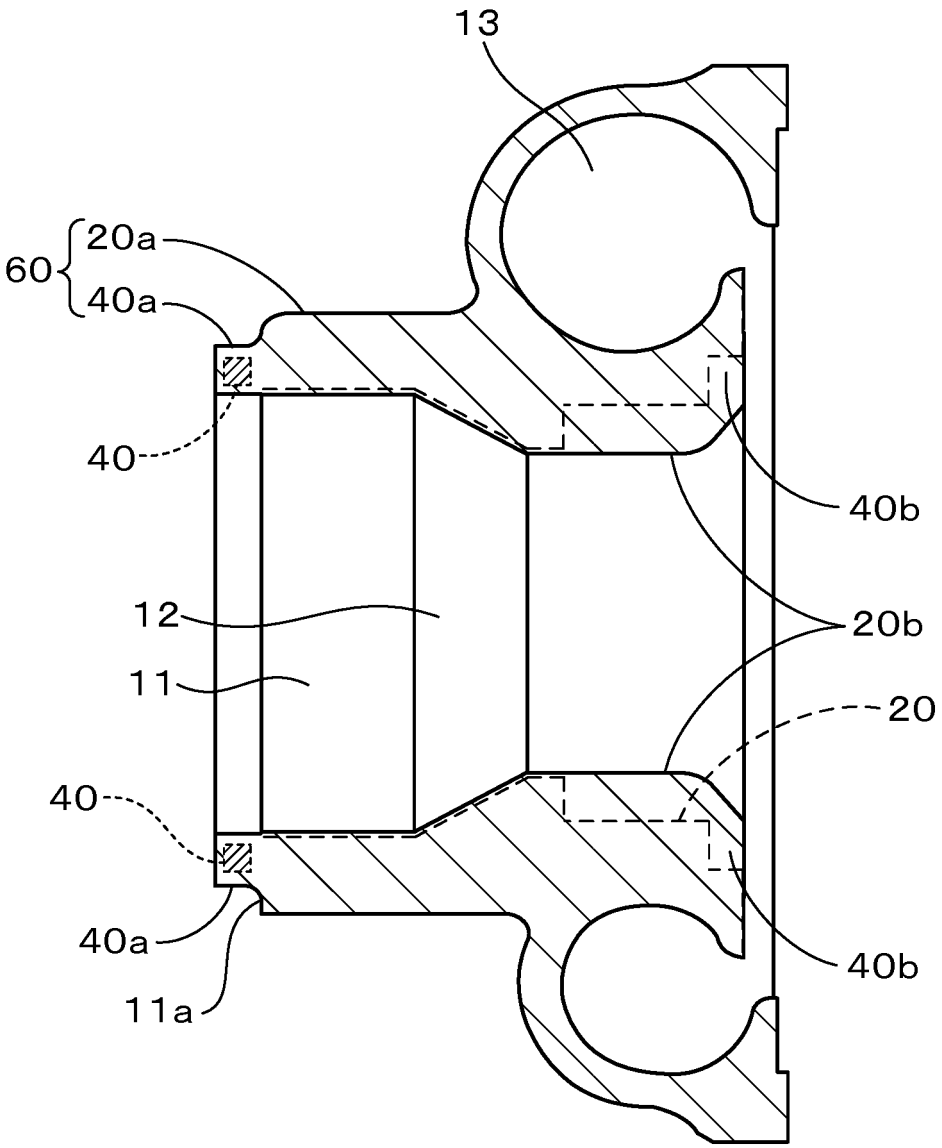

1
13
21
220
210
24
40
20
32
311
310
30
31
12
210b
11
40
35
52
51
24
34
32
41

FIG. 9



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2016/055111

A. CLASSIFICATION OF SUBJECT MATTER
F04D29/42(2006.01)i, *F02B39/00*(2006.01)i, *F04D29/62*(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)
F04D29/42, F02B39/00, F04D29/62

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 1996-2016
Kokai Jitsuyo Shinan Koho 1971-2016 Toroku Jitsuyo Shinan Koho 1994-2016

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	WO 98/048157 A1 (Kyoritsu Corp.), 29 October 1998 (29.10.1998), description, page 8, line 26 to page 9, line 21; fig. 6 to 9 & JP 3639846 B2	1-8
A	JP 2011-117433 A (Toyota Motor Corp.), 16 June 2011 (16.06.2011), paragraphs [0148] to [0156]; fig. 10 (Family: none)	1-8

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

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
10 May 2016 (10.05.16)	24 May 2016 (24.05.16)
Name and mailing address of the ISA/ Japan Patent Office 3-4-3,Kasumigaseki,Chiyoda-ku, Tokyo 100-8915,Japan	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2016/055111

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 9-170442 A (Hitachi, Ltd.), 30 June 1997 (30.06.1997), paragraphs [0016], [0040] to [0042]; fig. 1 to 3 & US 5785493 A column 3, lines 34 to 47; column 5, lines 38 to 63; fig. 1 to 3	1-8

Form PCT/ISA/210 (continuation of second sheet) (January 2015)

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- JP 9170442 A **[0007]**