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(54) **GYRATION-TYPE CRUSHER**

(57) This gyration-type crusher has a main shaft (5) rotatably provided in a crushing chamber (16) inside frame (1, 2), wherein the frame has a bottom frame (2) and a top frame (1) connected to the upper portion of the bottom frame (2), wherein an annular inner peripheral surface (66), to which the lower portion of the top frame (1) is fitted, is formed in the upper portion of the bottom frame (2), wherein an annular outer peripheral surface (67), to be fitted to the annular inner peripheral surface (66) of the bottom frame (2), is formed in the lower portion of the top frame (1), and, wherein at least one of the annular inner peripheral surface (66) and the annular outer peripheral surface (67) is formed of annular member (54, 55) detachably provided to the frame (1, 2). The gyration-type crusher is capable of ensuring a normal operation state without replacing the whole frame, even when defect such as wear occurs in a connection portion of upper and bottom frames.

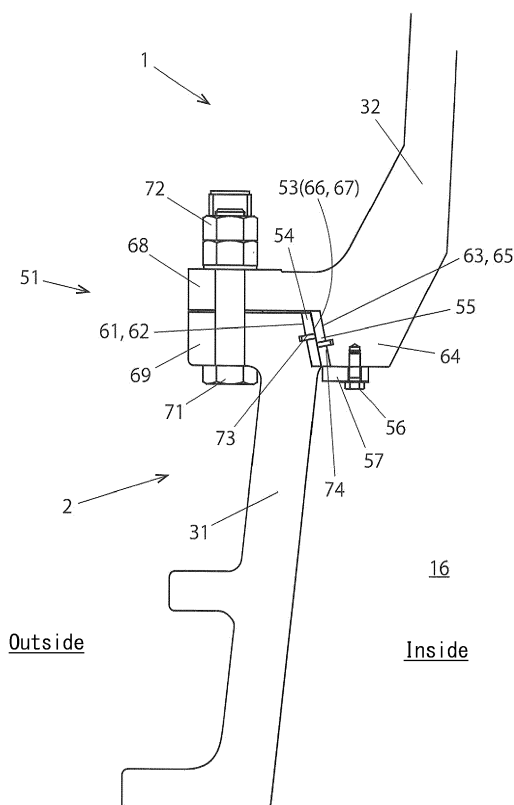


FIG. 2

Description

Technical Field

[0001] The present invention relates to a gyration-type crusher such as a gyratory crusher, a cone crusher, or the like comprising a main shaft which is rotatably provided in a crushing chamber formed inside a frame.

Background Art

[0002] Conventionally, gyration-type crushers such as gyratory crushers, cone crushers, or the like are used as crushers to crush a large raw stone (rock) (for example, Patent literature 1, 2).

[0003] Of conventional gyration-type crushers, a gyratory crusher will be exemplified in order to describe its summary and crushing principle, referring to FIG. 1.

[0004] In the conventional gyration-type crusher illustrated in FIG. 1, a main shaft 5 whose center axis is inclined relative to the center axis of the crusher is provided in the center portion of the internal space formed by a top frame 1 in the shape of a truncated inverted conical tubular body and a bottom frame 2 connected thereto.

[0005] The lower portion of the main shaft 5 is rotatably fitted and inserted into a sleeve 4 with an eccentric shaft hole 3, and the lower end of the main shaft 5 is supported by a lower bearing 6 such as a thrust bearing, or the like. The lower bearing 6 is further supported by the piston 8 of a main shaft-elevating hydraulic cylinder 7 which is connected to the lower end of the boss section 2a of the bottom frame 2.

[0006] Additionally, the upper end of the main shaft 5 is rotatably supported by an upper bearing 9 such as a sliding bearing or the like, and the upper bearing 9 is supported by a spider 11 which is connected to an annular-shaped rim 10 mounted to the upper end of the top frame 1.

[0007] The main shaft 5 configures a mantle core 12 whose outer peripheral surface forms a truncated cone. A mantle 13 which is manufactured from a wear-resistant material (for example, high-manganese cast steel) and whose outer peripheral surface forms a truncated cone is mounted to the outer surface of the mantle core 12.

[0008] Additionally, a concave 14 which is manufactured from a wear-resistant material (for example, high manganese cast steel) is provided to the inner surface of the top frame 1. A crushing chamber 16 is formed of the space formed by the concave 14 and the mantle 13 and whose vertical section forms a wedge shape.

[0009] The center axis of the main shaft 5 and the center axis of the top frame 1 intersect with each other in the upper space of the crusher, and the main shaft 5 is inclined relative to the top frame 1 on the plane surface including the center axis of the main shaft 5 and the center axis of the top frame 1. Due to this inclination between the center axes, when the main shaft 5 is rotated via a power transmission mechanism such as a pulley 22, a

horizontal shaft, a bevel gear 19, and the like by means of an electric motor (not illustrated) provided outside the machine, the main shaft 5 performs an eccentric turning motion, called precessional motion, with respect to the top frame 1, and the horizontal distance between the mantle 13 and the concave 14 varies periodically at an arbitrary position on the center axis of the top frame 1. Note that the varying period of this distance is identical to the rotation period of the main shaft.

[0010] A rock to be crushed (hereunder, referred to as "object to be crushed") is inserted from above the crusher and falls into the crushing chamber 16. In the crushing chamber 16, the interval between the concave 14 and the mantle 13 is tapered downward, and the width of the interval varies periodically according to the rotation of the main shaft 5. Thereby, the object is increasingly crushed through repeated dropping and compression, and what is crushed into pieces smaller than the narrowest interval between the concave 14 and the mantle 13 at the lower portion of the concave 14 is collected from below as a crushed product.

[0011] In such a gyratory crusher, typically, a rock whose size is about 1m to 2m is crushed into a size of about 200mm to 250mm, and therefore a large reaction force (load) accompanying the crushing acts on the mantle 13 and the concave 14.

[0012] The load acting on the concave 14 is finally supported by a frame (not illustrated) via the top frame 1 and the bottom frame 2, and for that, the top frame 1 and the bottom frame 2 need to be integrally connected so that the frames as a whole have enough rigidity and strength against the load.

[0013] Accordingly, as illustrated in FIG. 1, in the connected part 51 of the top frame 1 and the bottom frame 2, an annular recessed portion whose inner peripheral surface is an inverted truncated cone is formed in the upper portion of the bottom frame 2, and an annular projected portion whose outer peripheral surface is an inverted truncated cone is formed in the bottom portion of the top frame 1. The annular projected portion and the annular recessed portion are fitted to each other by tapered fitting. Metal touch is performed using both inverted truncated conical surfaces (inclined surface 53), so that the top frame 1 and the bottom frame 2 are firmly connected. Thereby, together the top frame 1 and the bottom frame 2 have enough rigidity and strength against the load which acts accompanying the crushing.

[0014] In order to ensure integral connection of the top frame 1 and the bottom frame 2, so that the annular projected portion and the annular recessed portion are precisely fitted to each other, and function in the portion of the frames 51 connected with tapered fitting, the top frame 1 and the bottom frame 2 are fixed by multiple bolts 52 which are arranged at regular intervals along the circumference of the outer peripheral portion of the connected part of the frames 51.

Related Art Literature

Patent Literature

[0015]

Patent Literature 1: Japanese Patent Application
Laid-open No. H08-281131 A

Patent Literature 2: Japanese Patent Application
Laid-open No. H09-52056 A

Summary of the Invention

Problem to be solved by the Invention

[0016] Since a gyration-type crusher crushes a rock as an object to be crushed by a large crushing force as described above, the mantle 13 and the concave 14 which are brought into direct contact with the rock may need to be replaced regularly or irregularly due to wear. In that case, the replacement needs to be performed with the inside of the crusher opened by removing the top frame 1, which requires release of the bolts 52, hanging up and removal of the top frame 1, unhanging and reinstallation of the top frame 1 after the repair, and fastening of the bolts 52.

[0017] However, since the bolts 52 are large and their screw portion is tens of millimeters in diameter, it is a very heavy work to remove or refasten them. Further, since the top frame 1 is large and heavy, it is also a heavy work to handle it. Especially if the annular projected portion and the annular recessed portion are not precisely fitted to each other in reinstallation, the inclined surface 53 of the annular projected portion and the annular recessed portion is worn due to sliding or the like because of the load on the top frame 1 and the bottom frame 2 during operation of the crusher, bringing about the need to replace the top frame 1 and the bottom frame 2 which are expensive and important components in the gyration-type crusher and not originally expected to be replaced.

[0018] Further, the work of removing and reinstalling the top frame 1 above is usually performed by an inexperienced worker of a stone-crushing/crushing plant or the like in a site such as a stone-crushing plant where a hoisting facility, and repair/ inspection facility are usually less adequate compared to a manufacturing factory. Additionally, the work tends to be performed in a short time in order to minimize loss due to ceased operation of the stone-crushing/crushing plant. Therefore, the annular projected portion and the annular recessed portion are often fitted improperly, especially when reinstalling the top frame 1.

[0019] However, there is a problem that, the annular projected portion and the annular recessed portion are fitted improperly when reinstalling the top frame 1, damage such as wear occurs in the fitted portion of the annular projected portion and the annular recessed portion due to the influence of a crushing load as mentioned above,

and finally the top frame 1 and the bottom frame 2 which are expensive components and not expected to be replaced need to be replaced, leading to ceased operation of the crusher for a long period of time.

5 **[0020]** The present invention was made considering the above-mentioned problem of the related art, and its object is to provide a gyration-type crusher capable of ensuring a normal operation state without replacing the top frame and/or the bottom frame as a whole, which are
10 expensive and important components in the gyration-type crusher, even when damage such as wear occurs due to faulty removal and reinstallation of the top frame by an inexperienced worker and defects such as wear occur in the connected part of the upper and bottom
15 frames with the lapse of operation time of the crusher

Means for solving the problem

[0021] In order to solve the above-mentioned problem,
20 a gyration-type crusher according to a first aspect of the present invention comprises: a frame inside which a crushing chamber is formed; and a main shaft rotatably provided in the crushing chamber, wherein the frame has a bottom frame and a top frame connected to the upper
25 portion of the bottom frame, wherein an annular inner peripheral surface, to which the lower portion of the top frame is fitted, is formed in the upper portion of the bottom frame, wherein an annular outer peripheral surface to be fitted to the annular inner peripheral surface of the bottom frame is formed in the lower portion of the top frame, and,
30 wherein at least one of the annular inner peripheral surface and the annular outer peripheral surface is formed of an annular member detachably provided to the frame.

[0022] A second aspect of the present invention is that,
35 in the first aspect, the annular inner peripheral surface and the annular outer peripheral surface are each formed in an inverted truncated conical shape.

[0023] The third aspect of the present invention is that, in the first or second aspect, the annular members include
40 the first annular member, detachably provided to the upper portion of the bottom frame, and the second annular member, detachably provided to the lower portion of the top frame, wherein the inner peripheral surface of the first annular member includes the annular inner peripheral surface, and wherein the outer peripheral surface of the second annular member includes the annular outer
45 peripheral surface.

[0024] A fourth aspect of the present invention is that, in the third aspect, the outer peripheral surface of the first
50 annular member is formed in an inverted truncated conical shape.

[0025] A fifth aspect of the present invention is that, in the third or fourth aspect, the inner peripheral surface of the second annular member is formed in an inverted truncated
55 conical shape.

[0026] A sixth aspect of the present invention is that, in the third aspect, the outer peripheral surface of the first annular member is formed in a cylindrical shape.

[0027] A seventh aspect of the present invention is that, in the third or fourth aspect, the inner peripheral surface of the second annular member is formed in a cylindrical shape.

[0028] A eighth aspect of the present invention further comprises, in any one of the first to seventh aspects, a rotation preventing mechanism for preventing rotation of the annular member relative to the frame.

Effect of the Invention

[0029] According to the present invention, there is provided a gyration-type crusher capable of ensuring a normal operation state without needing to replace the top frame and/or the bottom frame, which are expensive and important components in the gyration-type crusher, even when a defect such as wear occurs in the connected part of the top frame and the bottom frame.

Brief Description of Drawings

[0030]

FIG. 1 is a longitudinal section view schematically illustrating the structure of a conventional gyratory crusher.

FIG. 2 is a longitudinal section view illustrating the structure of the connected part of the frames in a gyration-type crusher according to the first embodiment of the present invention.

FIG. 3 is a disassembled view illustrating the connected part of the frames illustrated in FIG. 2.

FIG. 4 is a longitudinal section view illustrating the structure of a connected part of the frames in a gyration-type crusher according to the second embodiment of the present invention.

FIG. 5 is a disassembled view illustrating the connected part of the frames illustrated in FIG. 4.

FIG. 6 is a longitudinal section view illustrating the structure of the connected part of the frames in an example 1 of a gyration-type crusher according to the third embodiment of the present invention.

FIG. 7 is a longitudinal section view illustrating the structure of the connected part of the frames in an example 2 of the gyration-type crusher according to the third embodiment of the present invention.

Embodiment of the Invention

[0031] Hereunder, a gyration-type crusher according to each embodiment of the present invention will be described referring to the drawings. Note that, although the description below is for a gyratory crusher, the present invention can be applied to all gyration-type crushers, including a cone crusher and the like.

<First embodiment>

[0032] A gyration-type crusher according to the first embodiment of the present invention will be described referring to FIG. 2 and FIG. 3.

[0033] As illustrated in FIG. 2 and FIG. 3, a bottom frame 2 has a bottom frame body 31 and a detachable first annular member 54 on the inner peripheral surface of the upper portion of the bottom frame body 31. The bottom frame body 31 has, on the inner peripheral surface of the upper portion, an inner peripheral surface (hereunder, referred to as "bottom frame upper inner peripheral surface") 61 where an inverted truncated conical surface, whose center axis is almost identical to the center axis of the bottom frame body 31, is formed.

[0034] In the first annular member 54, an inverted truncated conical surface to be fitted to the bottom frame upper inner peripheral surface 61 is formed on its outer peripheral surface 62, and an inverted truncated conical surface whose center axis is almost identical to the center axis of the bottom frame body 31 is formed on its inner peripheral surface 66. The inner peripheral surface 66 is a tapered fitting (inclined fitting) surface to be fitted to the outer peripheral surface 67 of the second annular member 55, which will be described later.

[0035] The first annular member 54 is mounted to the bottom frame body 31 by hanging the first annular member 54 above the bottom frame body 31 and fitting the outer peripheral surface 62 of the first annular member 54 to the bottom frame upper inner peripheral surface 61.

[0036] The top frame 1 has top frame body 32 and a detachable second annular member 55 in the bottom portion of the top frame body 32. In the bottom portion of the top frame body 32, an annular projected portion 64 is formed, which has an outer peripheral surface (hereunder, referred to as "top frame bottom outer peripheral surface") 63 where an inverted truncated conical surface, whose center axis is almost identical to the center axis of the top frame body 32, is formed.

[0037] The second annular member 55 is provided on the outer peripheral surface of the annular projected portion 64, and the second annular member 55 has an inverted truncated conical tubular shape whose center axis is almost identical to the center axis of the top frame body 32. In the second annular member 55, an inverted truncated conical surface to be fitted to the top frame bottom outer peripheral surface 63 is formed on its inner peripheral surface 65, and an inverted truncated conical surface, whose center axis is almost identical to the center axis of the top frame body 32, is formed on its outer peripheral surface 67. The outer peripheral surface 67 is a tapered fitting (inclined fitting) surface to be fitted to the inner peripheral surface 66 of the first annular member 54.

[0038] The second annular member 55 is lifted from below the top frame 1 and mounted to the top frame body 32 by fitting the inner peripheral surface 65 of the second annular member 55 to the top frame bottom outer peripheral surface 63.

eral surface 63.

[0039] Additionally, the top frame 1 has a support plate 57 and a pushing bolt 56 under the annular projected portion 64 in the bottom portion of the top frame body 32 to prevent the second annular member 55 from falling from the top frame body 32.

[0040] The inner peripheral surface 66 of the first annular member 54 and the outer peripheral surface 67 of the second annular member 55 form a tapered fitting (inclined fitting) surface 53 to connect the top frame 1 to the bottom frame 2. The top frame 1 is connected to the bottom frame 2 by hanging the top frame 1, where the second annular member 55 is mounted to the top frame body 32, to the bottom frame 2, where the first annular member 54 is mounted to the bottom frame body 32, so as to fit the outer peripheral surface 67 of the second annular member 55 to the inner peripheral surface 66 of the first annular member 54.

[0041] After that, a top frame side flange 68 formed in the bottom outer peripheral portion of the top frame body 32 and a bottom frame side flange 69 formed in the upper outer peripheral portion of the bottom frame body 31 are fastened by a bolt 71 and a nut 72 so that the top frame 1 and the bottom frame 2 are fixed.

[0042] In order to prevent the bottom frame upper inner peripheral surface 61 from being worn due to sliding of the outer peripheral surface 62 of the first annular member 54 and the bottom frame upper inner peripheral surface 61, the bottom frame 2 has a pin 73 for inhibiting relative motions between them. The pin 73 is driven into a hole bored in the bottom frame body 31 through a through hole formed in the inner peripheral surface of the first annular member 54, so as to fix the first annular member 54 to the bottom frame body 31.

[0043] Similarly, in order to prevent the top frame bottom outer peripheral surface 63 from being worn due to sliding of the inner peripheral surface 65 of the second annular member 55 and the top frame bottom outer peripheral surface 63, the top frame 1 has a pin 74 for restraining relative motions between them. The pin 74 is driven into a hole bored in the top frame body 32 through a through hole formed in the outer peripheral surface of the second annular member 55, so as to fix the second annular member 55 to the top frame body 32.

[0044] The connected part of the frames 51 is configured as described above, wherein the inner peripheral surface 66 of the first annular member 54 in the bottom frame 2 and the outer peripheral surface 67 of the second annular member 55 in the top frame 1 are the tapered fitting surface 53, and the first annular member 54 and the second annular member 55 can be removed for replacement from the bottom frame body 31 and the top frame body 32, respectively. Therefore, even when the tapered fitting surface (the inner peripheral surface 66 of the first annular member 54 and/or the outer peripheral surface 67 of the second annular member 55) is worn or deformed due to failure to connect the top frame 1 to the bottom frame 2, or the like, the whole bottom frame 2

including the bottom frame body 31 and/or the whole top frame 1 including the top frame body 32 do not need to be replaced.

[0045] Accordingly, when the taper fitting surface (the inner peripheral surface 66 of the first annular member 54 and/or the outer peripheral surface 67 of the second annular member 55) is worn, it is sufficient to repair or replace only the first annular member 54 and/or the second annular member 55, and therefore replacement work is easy and rest time of the facility can be shorter.

[0046] Further, stocking the top frame 1 and/or the bottom frame 2, which are expensive main components of the gyration-type crusher, as spares in preparation for wear of the tapered fitting surface is a heavy burden on stone-crushing business/crushing business operators, while stocking the first annular member 54 and the second annular member 55 as spares is less of a burden.

[0047] Note that, in the bottom frame 2 and the top frame 1, the inner peripheral surface 66 of the first annular member 54 and the outer peripheral surface 67 of the second annular member 55, each forming an inverted truncated conus, are fitted to each other, and further the bottom frame side flange 69 and the top frame side flange 68 are fastened to the bolt 71 and the nut 72 so as to give a tension force. Thereby, the second annular member 55 strongly bites into the first annular member 54, making the connection of the top frame 1 and the bottom frame 2 stronger, and together the top frame 1 and the bottom frame 2 form an integral structure.

[0048] Therefore, in order to secure an appropriate biting amount without limiting the biting amount of the second annular member 55 into the first annular member 54, a predetermined interval is provided between the upper surface of the bottom frame side flange 69 and the bottom surface of the top frame side flange 68.

[0049] Additionally, if the inner peripheral surface 66 of the first annular member 54 and the outer peripheral surface 67 of the second annular member 55 slide when the upper surface of the bottom frame side flange 69 and the bottom surface of the top frame side flange 68 are in contact with each other, sliding will also occur between the upper surface of the bottom frame side flange 69 and the bottom surface of the top frame side flange 68, which are integrated with them respectively, creating a risk of wear. To prevent wear on the upper surface of the bottom frame side flange 69 and the bottom surface of the top frame side flange 68, it is effective to provide a predetermined interval between the upper surface of the bottom frame side flange 69 and the top frame side flange 68.

[0050] Further, the inner peripheral surface 66 of the first annular member 54 and the outer peripheral surface 67 of the second annular member 55 form a tapered fitting surface, so when these surfaces are worn, the top frame 1 lowers according to the amount of wear due to the weight of the top frame 1 and the tension of the bolt 71. However, if the upper surface of the bottom frame side flange 69 and the bottom surface of the top frame side flange 68 are in contact with each other, the lowering is

inhibited and the connection of the top frame 1 and the bottom frame 2 becomes weaker. Therefore, in order to maintain the connection between the top frame 1 and the bottom frame 2, it is effective to provide a predetermined interval between the upper surface of the bottom frame side flange 69 and the bottom surface of the top frame side flange 68.

<Second embodiment>

[0051] Next, a gyration-type crusher according to the second embodiment of the present invention will be described referring to FIG. 4 and FIG. 5.

[0052] Note that, hereunder, mainly matters different from the above-mentioned first embodiment will be described, and matters which are not described are the same as the first embodiment unless they are inconsistent with the description below.

[0053] As illustrated in FIG. 4 and FIG. 5, the bottom frame 2 has a bottom frame body 31 and a detachable first annular member 81 on the inner peripheral surface in the upper portion of the bottom frame body 31. The bottom frame body 31 has, on the inner peripheral surface of the upper portion, an surface (hereunder, referred to as "bottom frame upper inner peripheral surface") 83 where a cylindrical surface, whose center axis is almost identical to the center axis of the bottom frame body 31, is formed. The first annular member 81 has an annular shape whose center axis is almost identical to the center axis of the bottom frame body 31, and a cylindrical surface to be fitted to the bottom frame upper inner peripheral surface 83 is formed on its outer peripheral surface 85, and an inverted truncated conical surface whose center axis is almost identical to the center axis of the bottom frame body 31 is formed on its inner peripheral surface 86. The inner peripheral surface 86 of the first annular member 81 is a tapered fitting (inclined fitting) surface to be fitted to the outer peripheral surface 87 of a second annular member 82, which will be described later.

[0054] The first annular member 81 is mounted to the bottom frame body 31 by hanging the first annular member 81 above the bottom frame body 31 and fitting the outer peripheral surface 85 of the first annular member 81 to the bottom frame upper inner peripheral surface 83.

[0055] The top frame 1 has the top frame body 32 and a detachable second annular member 82 in the bottom portion of the top frame body 32. In the bottom portion of the top frame body 32, an annular projected portion 89 is formed, which has an outer peripheral surface (hereunder, referred to as "top frame bottom outer peripheral surface") 84 where a cylindrical surface, whose center axis is almost identical to the center axis of the top frame body 32, is formed.

[0056] The second annular member 82 is provided on the outer peripheral surface of the annular projected portion 89, and the second annular member 82 has an annular shape whose center axis is almost identical to the

center axis of the top frame body 32. In the second annular member 82, a cylindrical surface to be fitted to the top frame bottom outer peripheral surface 84 is formed on its inner peripheral surface 88, and an inverted truncated conical surface, whose center axis is almost identical to the center axis of the top frame body 32, is formed on its outer peripheral surface 87. The outer peripheral surface 87 of the second annular member 82 is a tapered fitting (inclined fitting) surface to be fitted to the inner peripheral surface 86 of the first annular member 81.

[0057] The second annular member 82 is lifted from below the top frame 1 and mounted to the top frame body 32 by fitting the inner peripheral surface 88 of the second annular member 82 to the top frame bottom outer peripheral surface 84.

[0058] Additionally, the top frame 1 has a support plate 57 and a pushing bolt 56 under the annular projected portion 89 in the bottom portion of the top frame body 32, to prevent the second annular member 82 from falling from the top frame body 32.

[0059] The inner peripheral surface 86 of the first annular member 81 and the outer peripheral surface 87 of the second annular member 82 form a tapered fitting (inclined fitting) surface 53 to connect the top frame 1 to the bottom frame 2. The top frame 1 is connected to the bottom frame 2 by hanging the top frame 1, where the second annular member 82 is mounted to the top frame body 32, to the bottom frame 2, where the first annular member 81 is mounted to the bottom frame body 31, so as to fit the outer peripheral surface 87 of the second annular member 82 to the inner peripheral surface 86 of the first annular member 81.

[0060] After that, the top frame side flange 68 formed in the bottom outer peripheral portion of the top frame body 32 and the bottom frame side flange 69 formed in the upper outer peripheral portion of the bottom frame body 31 are fastened by a bolt 71 and a nut 72 so that the top frame 1 and the bottom frame 2 are fixed.

[0061] In order to prevent the bottom frame upper inner peripheral surface 83 from being worn due to sliding between the outer peripheral surface 85 of the first annular member 81 and the bottom frame upper inner peripheral surface 83, the bottom frame 2 has a key 58 for inhibiting relative motions between them. In the upper inner peripheral portion of the bottom frame body 31 and in the upper outer peripheral portion of the first annular member 81, a key groove is formed in a corresponding position in one or several places on the circumference. After aligning the position of the corresponding key groove while fitting the outer peripheral surface 85 of the first annular member 81 to the bottom frame upper inner peripheral surface 83 of the bottom frame body 31, the key 58 is driven into the key groove from above so as to fix the first annular member 81 to the bottom frame body 31.

[0062] Similarly, in order to prevent the top frame bottom outer peripheral surface 84 from being worn due to sliding between the inner peripheral surface 88 of the second annular member 82 and the top frame bottom

outer peripheral surface 84, the top frame 1 has a key 59 for inhibiting relative motions between them. In the lower outer peripheral portion of the annular projected portion 89 of the top frame body 32 and in the lower outer peripheral portion of the second annular member 82, a key groove is formed in a corresponding position in one or several places on the circumference. After aligning the position of the corresponding key groove while fitting the inner peripheral surface 88 of the second annular member 82 to the top frame bottom outer peripheral surface 84 of the top frame body 32, the key 59 is driven into the key groove from below so as to fix the second annular member 82 to the top frame body 31.

[0063] Note that, the support plate 57 for preventing the second annular member 82 from falling from the top frame body 32, or the like may be in either an annular shape continued in the circumference direction, or in a configuration where small plates are discontinuously placed at semi-regular intervals in the circumference direction. In the configuration of the annular shape, a notch for key driving is formed in the location where the key 59 is driven into, and in the configuration where small plates are placed discontinuously, the key groove is placed in a region where no plate is present. Thereby, the work for driving the key 59 can be performed after taking measures to prevent the second annular member 82 from falling by means of the support plate 57, making the work easier.

[0064] Since the connected part of the frames 51 is configured as above, even when the connection of the top frame 1 to the bottom frame 2 is faulty, mainly only the inner peripheral surface 86 of the first annular member 81 and the outer peripheral surface 87 of the second annular member 82 are worn due to sliding, and the bottom frame body 31 and the top frame body 32 are not worn. Therefore, the same effect as the first embodiment can be achieved in the second embodiment as well.

[0065] Note that, as a fixing mechanism for preventing sliding between the first annular member and the bottom frame body, and between the second annular member and the top frame body, the second embodiment, where a large sectional area can be ensured in response to shearing, has a greater fixing effect.

<Third embodiment>

[0066] Next, a gyration-type crusher according to the third embodiment of the present invention will be described referring to FIG. 6 and FIG. 7.

[0067] In the above-mentioned first embodiment and second embodiment, both the bottom frame 2 and the top frame 1 are provided with the detachable first annular member and second annular member respectively so that, even when the tapered fitting surface is worn or deformed, only the first annular member and/or the second annular member which are worn or deformed need to be repaired or replaced, eliminating the need to repair or replace the whole bottom frame and/or top frame.

[0068] In contrast, in the third embodiment, only one of the bottom frame 2 and the top frame 1 is provided with the detachable annular member (first annular member in the case of the bottom frame, second annular member in the case of the top frame), so that the inner peripheral surface (in the case of the first annular member) or the outer peripheral surface (in the case of the second annular member) of the annular member, and the bottom outer peripheral surface of the top frame which is not provided with the annular member or the upper inner peripheral surface of the bottom frame, are configured so as to form the tapered fitting surface.

[0069] In this third embodiment, in order that the inner peripheral surface of the bottom frame body 31 and the outer peripheral surface of the top frame body 32 form the tapered fitting surface, and the inner peripheral surface of the bottom frame body 31 and the outer peripheral surface of the top frame body 32 are not worn or deformed due to sliding or the like, the annular member is preferably made from the same material as the bottom frame body 31 or the top frame body 32, or it may be made from a harder or softer material.

[0070] The third embodiment will describe examples for each part where the annular member is provided. Note that, hereunder, mainly matters different from the first embodiment and the second embodiment will be described, and matters which are not described are the same as the first embodiment or the second embodiment unless they are inconsistent with the description below.

(i) Example 1

[0071] The example 1 is configured so that only the bottom frame 2 is provided with the annular member. FIG. 6 is a longitudinal section view illustrating the structure of the connected part of the frames according to example 1. The configuration of the bottom frame 2 in example 1 is basically the same as that of the first embodiment.

[0072] The bottom frame 2 has the bottom frame body 31 and the detachable first annular member 54 on the inner peripheral surface in the upper portion of the bottom frame body 31. The bottom frame body 31 has, on the inner peripheral surface in the upper portion, the bottom frame upper inner peripheral surface 61, where an inverted truncated conical surface, whose center axis is almost identical to the center axis of the bottom frame body 31, is formed. In the first annular member 54, an inverted truncated conical surface to be fitted to the bottom frame upper inner peripheral surface 61 is formed on its outer peripheral surface 62, and an inverted truncated conical surface, whose center axis is almost identical to the center axis of the bottom frame body 31, is formed on its inner peripheral surface 66. The inner peripheral surface 66 is a tapered fitting (inclined fitting) surface to be fitted to the outer peripheral surface 92 of an annular projected portion 92 in the bottom portion of the top frame body 32, which will be described later.

[0073] Unlike the first embodiment, the top frame 1 does not have the detachable second annular member 55. In the bottom portion of the top frame body 32, the annular projected portion 91, which has the outer peripheral surface 92 to be fitted to the inner peripheral surface 66 of the first annular member 54, is formed, the outer peripheral surface 92 being an inverted truncated conical surface whose center axis is almost identical to the center axis of the top frame body 32.

[0074] The inner peripheral surface 66 of the first annular member 54 and the outer peripheral surface 92 of the annular projected portion 91 of the top frame 1 form a tapered fitting surface to connect the top frame 1 and the bottom frame 2. The top frame 1 is connected to the bottom frame 2 by hanging the top frame 1 to the bottom frame 2 where the first annular member 54 is mounted to the bottom frame body 32 so as to fit the outer peripheral surface 92 of the annular projected portion 91 to the inner peripheral surface 66 of the first annular member 54.

[0075] After that, the top frame side flange 68 formed in the bottom outer peripheral portion of the top frame body 32, and the bottom frame side flange 69 formed in the upper outer peripheral portion of the bottom frame body 31, are fastened by a bolt 71 and a nut 72, so that the top frame 1 and the bottom frame 2 are fixed.

[0076] Note that, the shape of the first annular member provided to the bottom frame 2 may be the shape of the annular member 81 in the second embodiment instead of the annular member 54 in the first embodiment. In that case, the shape of the upper inner peripheral surface of the bottom frame 2 is also changed, according to the shape of the annular member 81, to the shape of the bottom frame upper inner peripheral surface 83 in the second embodiment instead of the bottom frame upper inner peripheral surface 61 in the first embodiment.

[0077] Additionally, although the first annular member may be fixed to the bottom frame body 31 by means of the pin 73 or the key 58 as in the first embodiment 1 or the second embodiment 2, a configuration which does not use a pin or a key may be employed since the first annular member 54 is manufactured from material which does not cause wear or the like to the bottom frame body 31.

(ii) Example 2

[0078] Example 2 is configured so that only the top frame 1 is provided with the annular member. FIG. 7 is a longitudinal section view illustrating the structure of the connected part of the frames according to example 2.

[0079] The configuration of the top frame 1 in example 2 is basically the same as that of the first embodiment.

[0080] The top frame 1 has the top frame body 32 and the detachable second annular member 55 in the bottom portion of the top frame body 32. In the bottom portion of the top frame body 32, the annular projected portion 64, which has the top frame bottom outer peripheral sur-

face 63, is formed where the inverted truncated conical surface, whose center axis is almost identical to the center axis of the top frame body 32, is formed.

[0081] The second annular member 55 is provided on the outer peripheral surface of the annular projected portion. The second annular member 55 has an inverted truncated conical tuber shape, whose center axis is almost identical to the center axis of the top frame body 32. In the second annular member 55, the inverted truncated conical surface to be fitted to the top frame bottom outer peripheral surface 63 is formed on its inner peripheral surface 65, and an inverted truncated conical surface, whose center axis is almost identical to the center axis of the top frame body 32, is formed on its outer peripheral surface 67. The outer peripheral surface 67 of the second annular member 55 is a tapered fitting (inclined fitting) surface to be fitted to the upper inner peripheral surface 93 of the bottom frame body 31, which will be described later.

[0082] Unlike the first embodiment, The bottom frame 1 does not have the detachable first annular member 54. In the upper portion of the bottom frame body 31, the inner peripheral portion 93 is formed, which is to be fitted to the outer peripheral surface 67 of the second annular member 55, the inner peripheral surface 93 being an inverted truncated conical surface whose center axis is almost identical to the center axis of the bottom frame body 31. The inner peripheral surface 93 of the bottom frame body 31 is a tapered fitting surface to be fitted to the outer peripheral surface 67 of the second annular member 55.

[0083] The inner peripheral surface 93 of the bottom frame body 31 and the outer peripheral surface 67 of the second annular member 55 form a tapered fitting surface to connecting the top frame 1 and the bottom frame 2. The top frame 1 is connected to the bottom frame 2 by hanging the top frame 1, to which the second annular member 55 is mounted, to the bottom frame 2, so as to fit the outer peripheral surface 67 of the second annular member 55 to the upper inner peripheral surface 93 of the bottom frame body 31.

[0084] After that, the top frame side flange 68 formed in the bottom outer peripheral portion of the top frame body 32 and the bottom frame side flange 69 formed in the upper outer peripheral portion of the bottom frame body 31 are fastened by a bolt 71 and a nut 72 so that the top frame 1 and the bottom frame 2 are fixed.

[0085] Note that, the shape of the second annular member provided to the top frame 1 may be the shape of the second annular member 82 in the second embodiment instead of the shape of the second annular member 55 in the first embodiment. In that case, the shape of the top frame bottom outer peripheral surface 63 is changed, according to the shape of the second annular member 82, to the shape of the top frame bottom outer peripheral surface 84 in the second embodiment.

[0086] Additionally, although the first annular member may be fixed to the top frame body 32 by means of the pin 74 or the key 59 as in the first embodiment 1 or the

second embodiment 2, a configuration which does not use a pin or a key may be employed since the second annular member 55 is manufactured from material which does not cause wear or the like to the top frame body 32.

[0087] Note that each embodiment above may be properly combined or modified.

[0088] For example, the configuration where the bottom frame is provided with the first annular member as in the first embodiment, and the top frame is provided with the second annular member as in the second embodiment; or a configuration where the bottom frame is provided with the first annular member as in the second embodiment, and the top frame is provided with the first annular member as in the first embodiment, may be employed.

Description of Reference Numerals

[0089]

1 ...	top frame
2 ...	bottom frame
5 ...	main shaft
12 ...	mantle core
13 ...	mantle
14 ...	concave
16 ...	crushing chamber
31 ...	bottom frame body
32 ...	top frame body
51 ...	connected part of frames
52 ...	bolt
53 ...	tapered fitting (inclined fitting) surface
54 ...	first annular member
55 ...	second annular member
56 ...	pushing bolt
57 ...	support plate
58, 59 ...	key
61 ...	bottom frame upper inner peripheral surface
62 ...	outer peripheral surface of first annular member 54
63 ...	top frame bottom outer peripheral surface
64 ...	annular projected portion
65 ...	inner peripheral surface of second annular member 55
66 ...	inner peripheral surface of first annular member 54
67 ...	outer peripheral surface of second annular member 55
68 ...	top frame side flange
69 ...	bottom frame side flange
71 ...	bolt
72 ...	nut
73, 74 ...	pin
81 ...	first annular member
82 ...	second annular member
83 ...	bottom frame upper inner peripheral surface
84 ...	top frame bottom outer peripheral surface
85 ...	outer peripheral surface of first annular

	member 81
86 ...	inner peripheral surface of first annular member 81
87 ...	outer peripheral surface of second annular member 82
88 ...	inner peripheral surface of second annular member 82
89 ...	annular projected portion
91 ...	annular projected portion
92 ...	outer peripheral surface of annular projected portion
91 93 ...	inner peripheral surface of upper portion of bottom frame body

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Claims

1. A gyration-type crusher comprising:

20	a frame inside which a crushing chamber is formed; and
	a main shaft rotatably provided in the crushing chamber,
	wherein the frame has a bottom frame and a top frame connected to an upper portion of the bottom frame,
25	wherein an annular inner peripheral surface, to which a lower portion of the top frame is fitted, is formed in the upper portion of the bottom frame,
30	wherein an annular outer peripheral surface to be fitted to the annular inner peripheral surface of the bottom frame is formed in the lower portion of the top frame, and,
35	wherein at least one of the annular inner peripheral surface and the annular outer peripheral surface is formed of an annular member detachably provided to the frame.

40	2. The gyration-type crusher according to claim 1, wherein the annular inner peripheral surface and the annular outer peripheral surface are each formed in an inverted truncated conical surface shape.
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45	3. The gyration-type crusher according to claim 1 or 2, wherein the annular member includes a first annular member detachably provided to the upper portion of the bottom frame, and a second annular member detachably provided to the lower portion of the top frame,
50	wherein an inner peripheral surface of the first annular member includes the annular inner peripheral surface, and
55	wherein an outer peripheral surface of the second annular member includes the annular outer peripheral surface.

4. The gyration-type crusher according to claim 3,

wherein an outer peripheral surface of the first annular member is formed in an inverted truncated conical surface shape.

5. The gyration-type crusher according to claim 3 or 4, 5
wherein an inner peripheral surface of the second annular member is formed in an inverted truncated conical surface shape.
6. The gyration-type crusher according to claim 3, 10
wherein the outer peripheral surface of the first annular member is formed in a cylindrical surface shape.
7. The gyration-type crusher according to claim 3 or 4, 15
wherein the inner peripheral surface of the second annular member is formed in a cylindrical surface shape.
8. The gyration-type crusher according to any one of 20
claims 1 to claim 7 further comprising a rotation preventing mechanism for preventing a rotation of the annular member relative to the frame.

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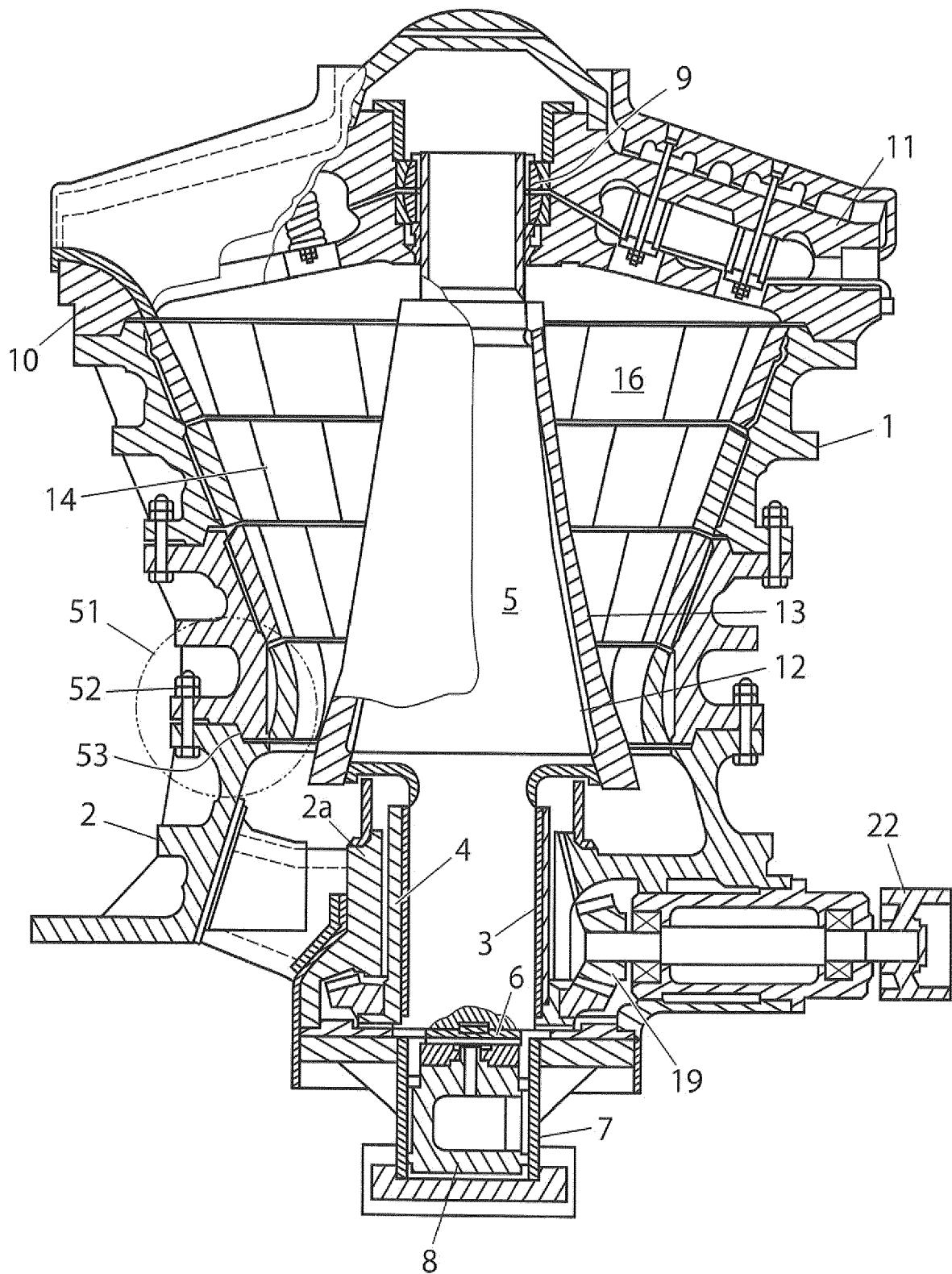


FIG. 1

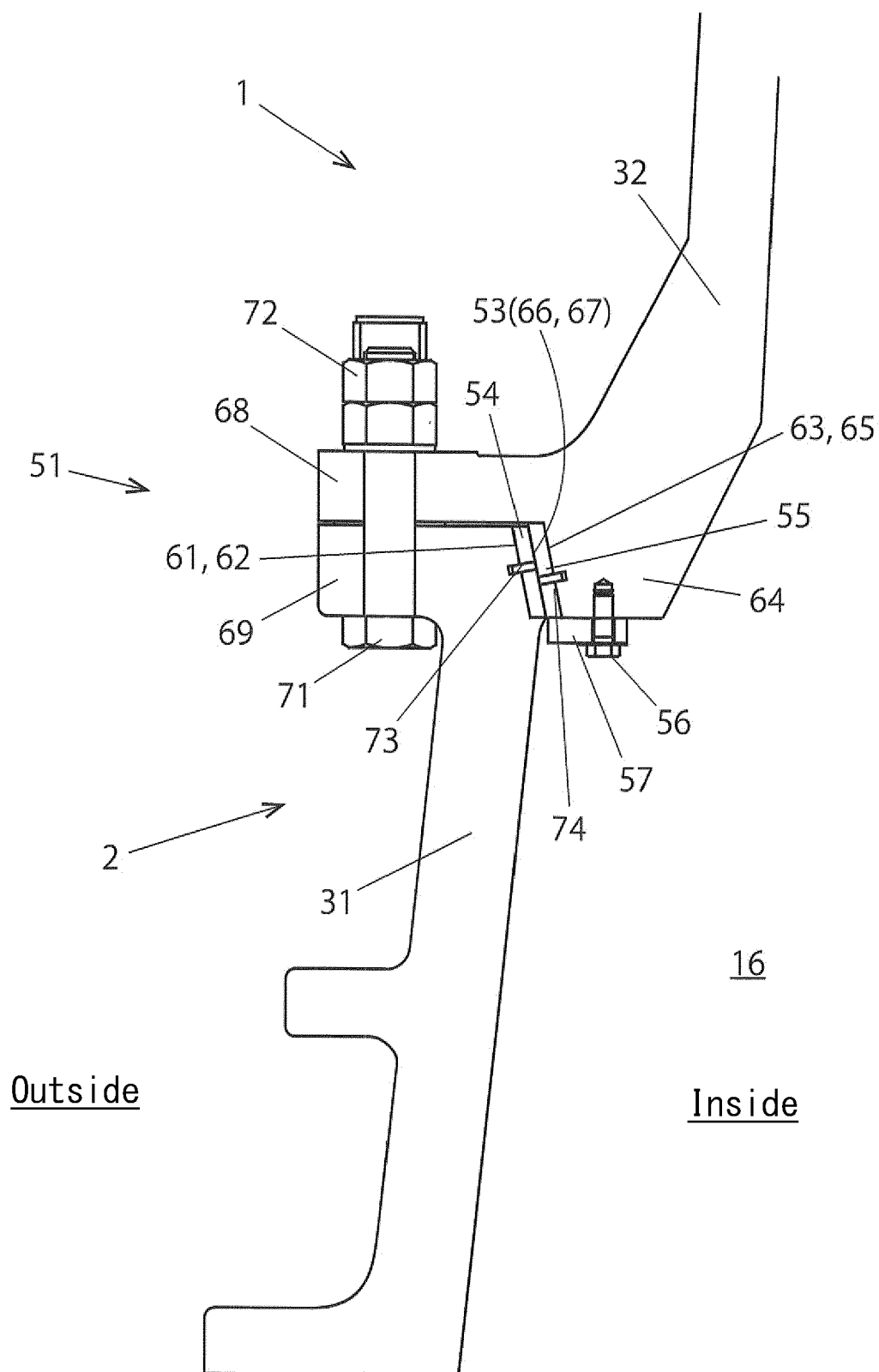
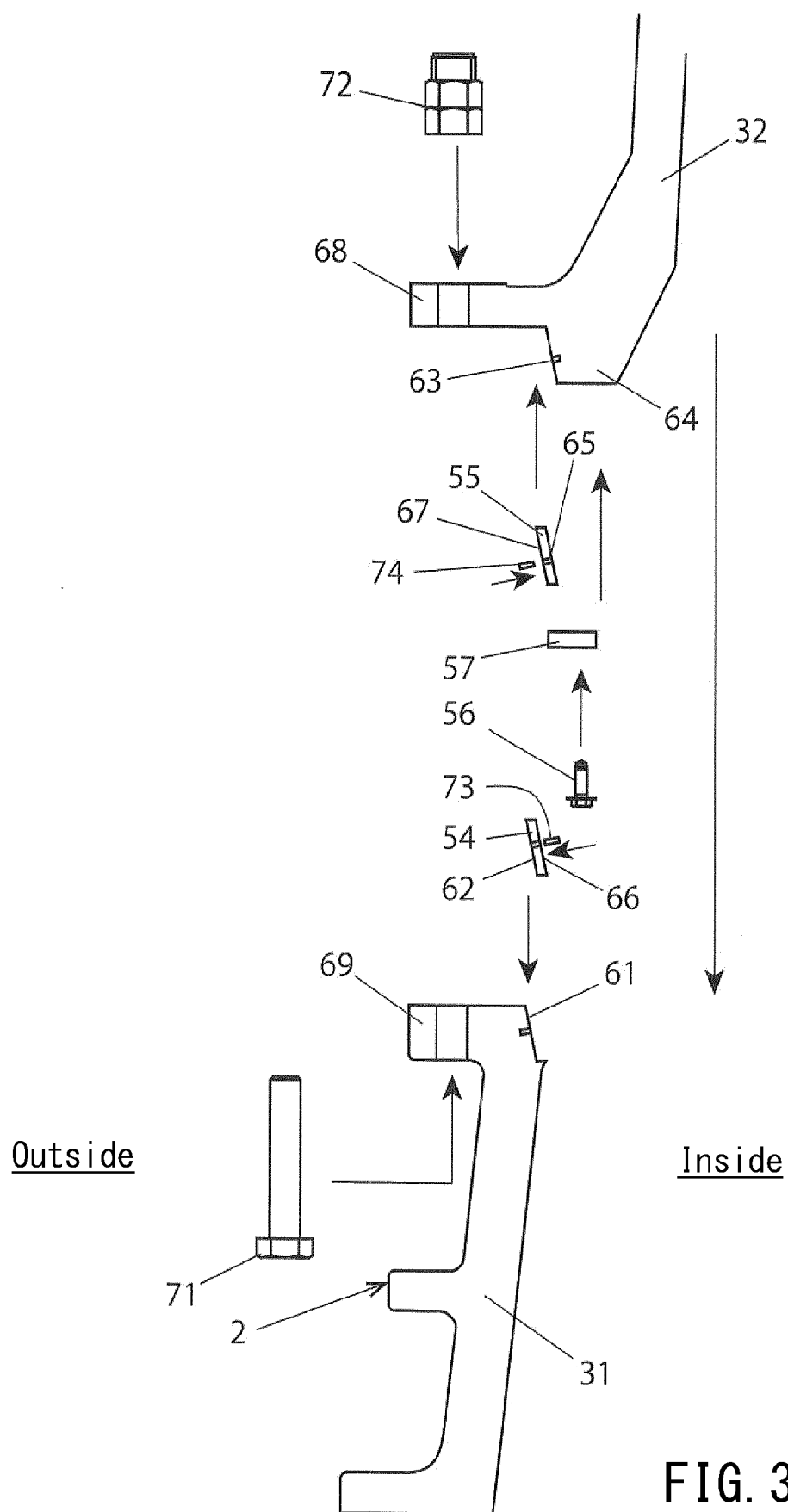
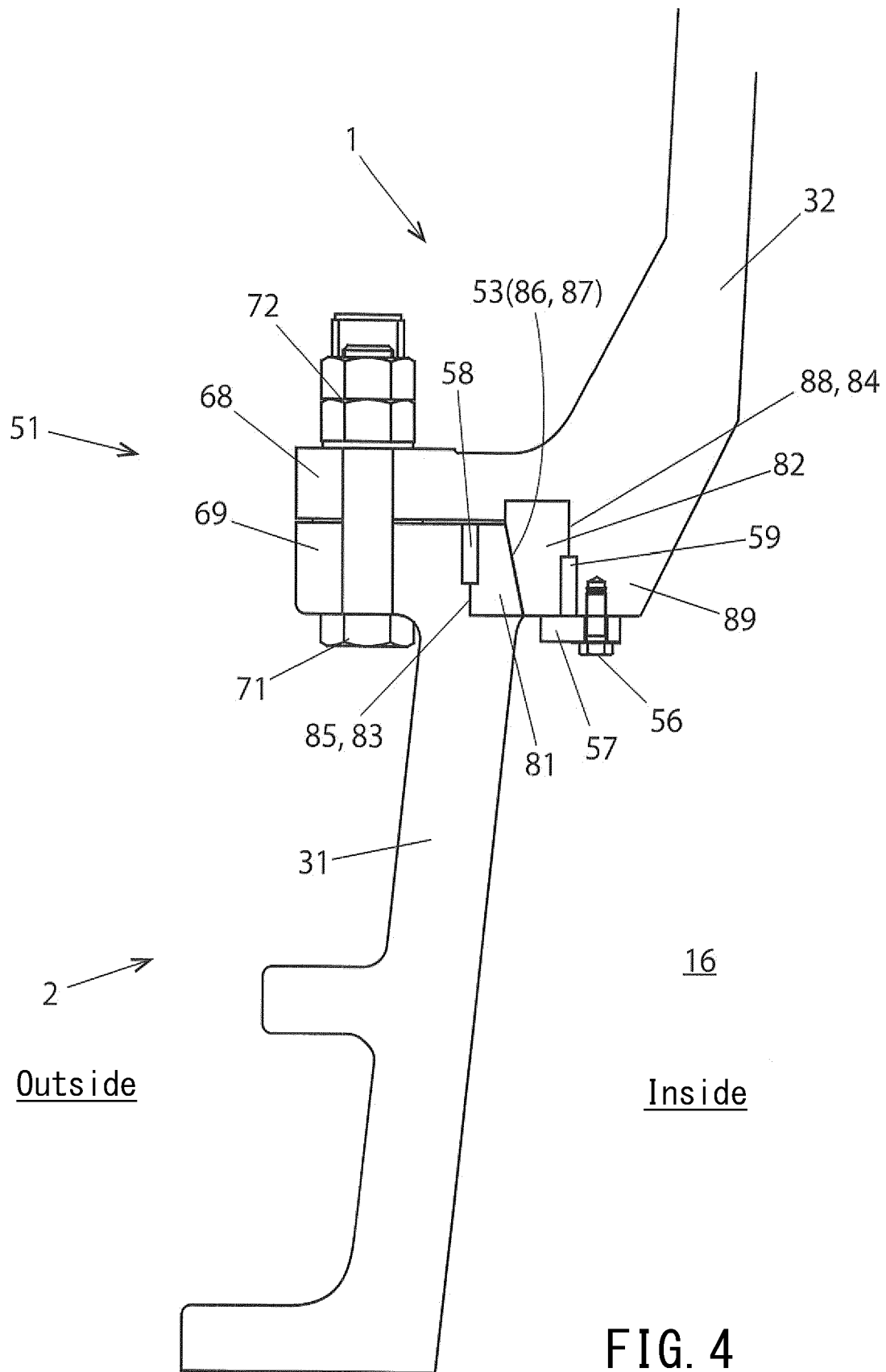


FIG. 2





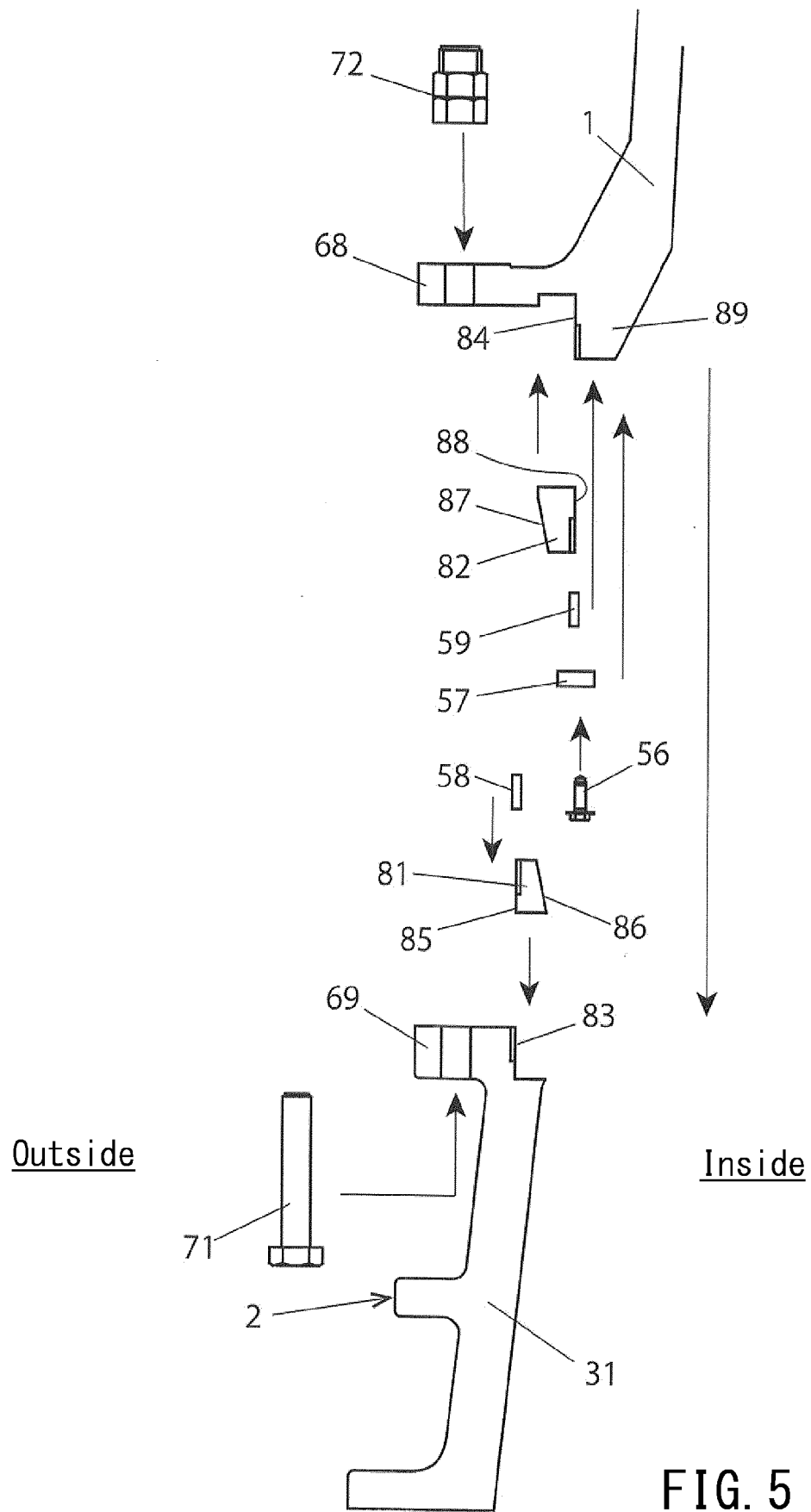


FIG. 5

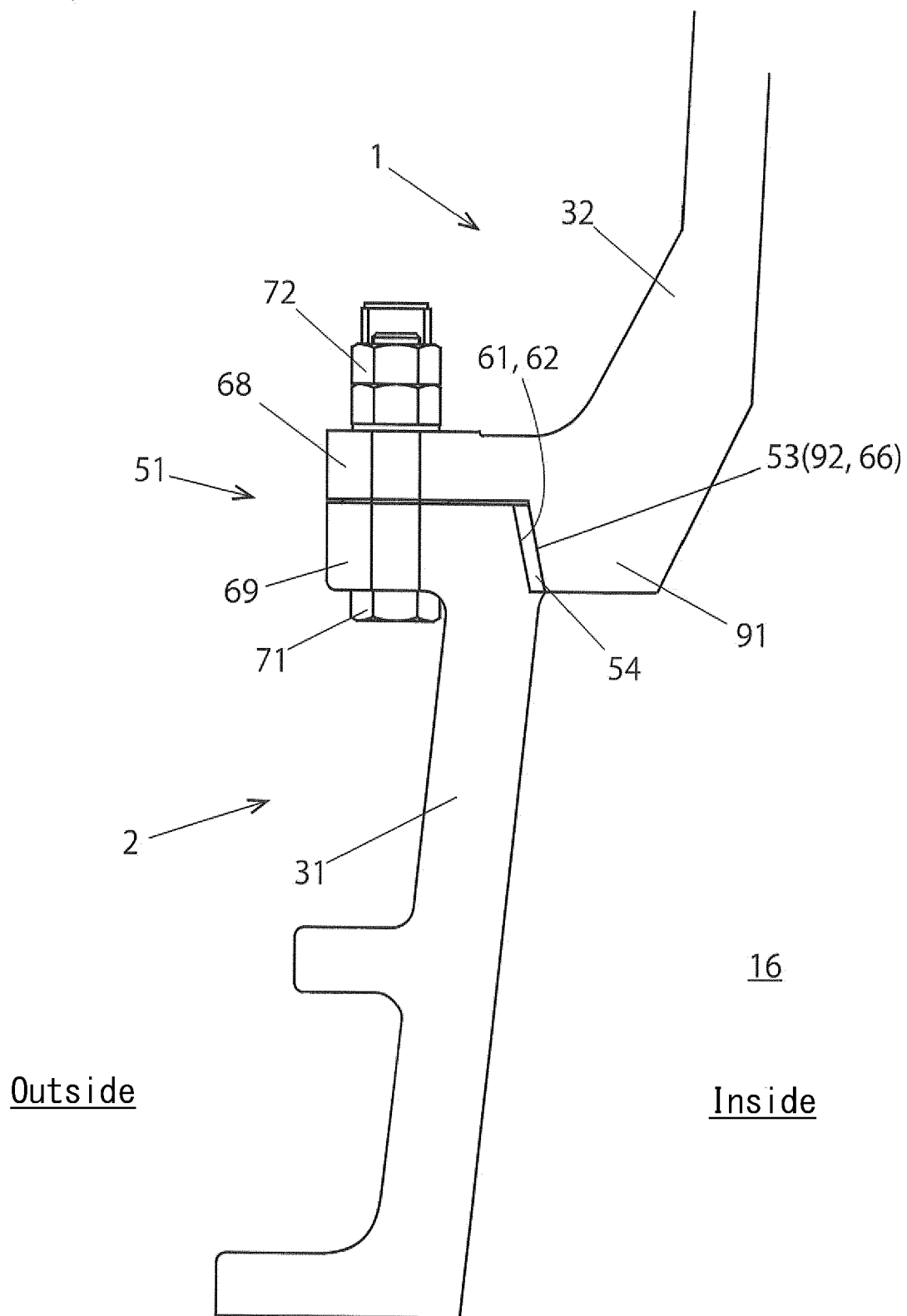


FIG. 6

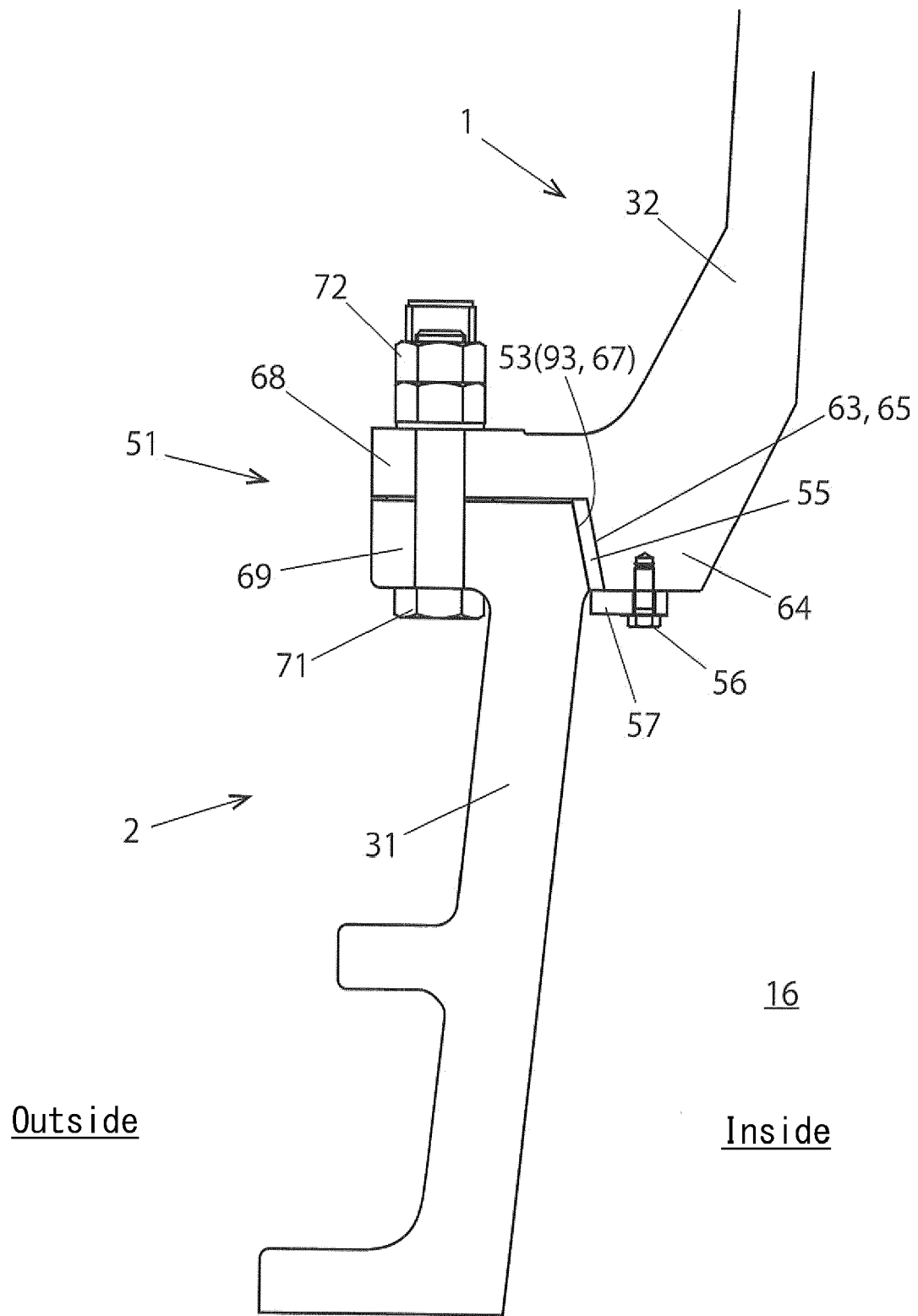


FIG. 7



EUROPEAN SEARCH REPORT

Application Number
EP 16 20 5385

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Y	* column 2, line 18 - column 3, line 14; figures 1-3 *	4-7	
	* column 3, line 36 - column 4, line 32 *		
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	* column 1, lines 10-31 *		
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			B02C
Place of search		Date of completion of the search	Examiner
Munich		29 March 2017	Iuliano, Emanuela
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