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

(11) **EP 3 184 173 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
28.06.2017 Bulletin 2017/26

(51) Int Cl.:
B02C 2/00 *(2006.01)*

(21) Application number: **16205359.9**

(22) Date of filing: **20.12.2016**

(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: **27.12.2015 JP 2015255549**

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(54) GYRATION-TYPE CRUSHER

(57) This gyration-type crusher has a concave provided inside a frame, a mantle core 12 which is rotatably arranged inside the concave, an outer peripheral surface in the shape of a truncated cone, and a mantle 13, which is mounted to the outer peripheral surface of the mantle core 12 and has an outer peripheral surface in the shape of a truncated cone. An annular member 52 is detachably provided to the outer peripheral surface of the mantle core 12, and the mantle 13 is connected to the outer peripheral surface of the annular member 52. The gyration-type crusher is capable of preventing wear of the mantle core even when the mantle and mantle cave are unevenly worn.

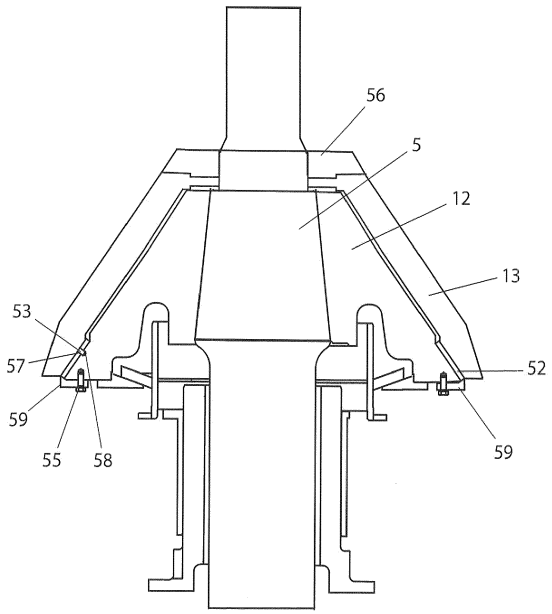

FIG. 2

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Description

Technical Field

[0001] The present invention relates to a gyration-type crusher such as a gyratory crusher, a cone crusher, or the like which comprises a mantle core with a mantle mounted to its outer surface.

Background Art

[0002] Conventionally, gyration-type crushers such as gyratory crushers, cone crushers, or the like are used to crush rocks and ore (for example, Patent literature 1, 2).

[0003] Of conventional gyration-type crushers, a cone crusher will be used as an example 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] A mantle core 12, whose outer peripheral surface forms a truncated cone, is firmly mounted to the outer surface of the main shaft 5 by shrink fitting. 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 on the inner surface of the top frame 1. A crushing chamber 16 is formed in the space which is 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 20, a bevel gear 19, and the like by means of an electric motor (not illustrated) provided below the sleeve 4, 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 of the center axis of the sleeve 4. 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 drops 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 said 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] Here, an interval is provided between the outer surface of the mantle core 12 and the inner surface of the mantle 13, and a cushioning material such as a layer of epoxy resin is provided to the interval in order to mitigate and transmit a reaction force from the object to be crushed, which is received by the mantle 13 due to the crushing of the object.

[0012] Further, a metal touch part is provided where the outer surface of the mantle core 12 and the inner surface of the mantle 13 are in direct contact with each other, in order to effectively generate a pressing force for crushing.

Related Art Literature

Patent Literature

[0013]

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

[0014] In the above-mentioned gyration-type crusher, wear of the crushing chamber 16 increases with lapse of operation time. There is more wear at the lower portion of the crushing chamber 16, where the load is larger.

[0015] As mentioned above, when the wear of the mantle 13 or the like increases, especially in the lower region of the crushing chamber 16, mantle 13 wall thickness is

reduced and deformation to an acting load is increased, and then the surface of the mantle core 12 in contact with the mantle 13 can be worn.

[0016] Since the mantle 13 directly exerts pressure on a rock, it is assumed to be replaced in a relatively short period of time due to wear, while the mantle core 12 is manufactured firmly and integrally with the main shaft 5 and assumed to operate for a relatively long period of time. The mantle core 12 is typically replaced in a factory, or the like.

[0017] Therefore, if the mantle core 12 is worn and suddenly needs to be replaced, it leads to halt of a rock crushing facility over a long period of time, and loss due to the operation halt will be large.

[0018] Further, even if the wear is known beforehand and components are prepared, since the mantle core 12 is manufactured integrally with the main shaft 5 and it is a main component of the gyration-type crusher and expensive, keeping a spare for the wear of the mantle core 12 is a big burden on the operator of a rock crushing facility.

[0019] Thus, there is a problem that, when a mantle is damaged due to partial wear or the like, it leads to a large loss due to a long-term operation halt of a crusher, and increase of burden by keeping a spare.

[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 whose mantle core itself does not need to be replaced even when the mantle core is worn.

Means for Solving the Problem

[0021] In order to solve the above-mentioned problem, a gyration-type crusher according to a first aspect of the present invention comprises: a concave provided inside a frame; a mantle core which is rotatably arranged inside the concave with an outer peripheral surface in the shape of a truncated cone; and a mantle which is mounted to the outer peripheral surface of the mantle core with an outer peripheral surface in the shape of a truncated cone e, wherein an annular member is detachably provided to the outer peripheral surface of the mantle core, and wherein the mantle is connected to the outer peripheral surface of the annular member.

[0022] A second aspect of the present invention is that, in the first aspect, the annular member is connected to a lower portion of the mantle core, and above the annular member, a cushioning member is provided in a space between the outer peripheral surface of the mantle core and an inner peripheral surface of the mantle.

[0023] A third aspect of the present invention is that, in the first or second aspect, the inner peripheral surface of the annular member and the outer peripheral surface of the mantle core are connected by shrink fitting.

[0024] A fourth aspect of the present invention is that, a through hole or a recessed portion is formed in at least one place where the inner peripheral surface of the annular member and the outer peripheral surface of the mantle core are in contact, and a fixing member for preventing rotation of the annular member relative to the mantle core is inserted into the through hole or the recessed portion.

Effect of the Invention

[0025] According to the present invention, a gyration-type crusher whose mantle core itself does not need to be replaced even when the mantle core is worn can be provided.

Brief Description of Drawings

[0026]

FIG. 1 schematically illustrates the structure of a conventional cone crusher.

FIG. 2 is a longitudinal section view schematically illustrating the main part of a gyration-type crusher according to one embodiment of the present invention.

FIG. 3 is a disassembled perspective view illustrating the connecting structure of the mantle and the mantle core of the gyration-type crusher in FIG. 2.

FIG. 4 is a longitudinal section view schematically illustrating the main part of a gyration-type crusher according to another embodiment of the present invention.

FIG. 5 is a disassembled perspective view illustrating the connecting structure of the mantle and the mantle core of the gyration-type crusher in FIG. 4.

Embodiment of the Invention

[0027] Hereunder, a gyration-type crusher according to one embodiment of the present invention will be described referring to the drawings.

[0028] As illustrated in FIG. 2 and FIG. 3, a mantle core 12 in the shape of a truncated conical tube is mounted to a main shaft 5 by fitting its inner peripheral surface to the outer peripheral surface of the main shaft 5 by shrink fitting.

[0029] Additionally, in this embodiment, an annular member 52 in the shape of a truncated conical tube is mounted to the lower portion of the outer peripheral surface of the mantle core 12. This annular member 52 is mounted by fitting its inner peripheral surface to the outer peripheral surface of the mantle core 12 by shrink fitting.

[0030] Note that the lower end portion of the annular member 52 may be supported by a pressing member 59 which is mounted to the bottom surface of the mantle core 12. Note that the pressing member 59 may be configured to support either all or part of the circumference of annular member 52.

[0031] Further, a mantle 13 in the shape of a truncated conical tube is fitted to the outer peripheral surface of the

annular member 52 by taper fitting. Note that the mantle 13 is also connected to the mantle core 12 by a nut 56 in the upper portion.

[0032] In the gyration-type crusher, since load typically becomes largest at the lower portion of the mantle 13 as mentioned above, the mantle 13 is brought into metal touch with the mantle core 12 via the annular member 52 at the lower portion.

[0033] A part above the annular member 52 in the space between the outer peripheral surface of the mantle core 12 and the inner peripheral surface of the mantle 13 is filled with a cushioning material such as epoxy resin or the like, which mitigates and transmits a load acting on the mantle 13 to the mantle core 12.

[0034] Since the mantle 13 performs crushing in direct contact with an object to be crushed such as a rock, it is manufactured from a wear-resistant material such as a high-manganese cast steel as mentioned above, and since the mantle 13 is worn due to crushing, it is replaced after a relatively short operation time. On the other hand, since the mantle core 12 is also manufactured from alloy steel equivalent to manganese steel and is hardly worn, it is used over a long period of time. Therefore, when the mantle 13 is replaced due to wear or the like, a main shaft assembly including the mantle core 12 is reused.

[0035] As a result of the outer peripheral surface of the mantle 13 becoming thin due to wear, the annular member 52 could be deformed into an elliptical shape due to a load on the mantle or the like, and an outer force could be exerted in a direction that the annular member 52 rotates relative to the mantle core 12.

[0036] Accordingly, in this embodiment, a rotation-preventing pin 53 is driven into a pin insertion recessed portion 58 of the mantle core 12 through a pin insertion hole 57 which penetrates through the outer surface of the annular member 52 in order to prevent the rotation of the annular member 52 relative to the mantle core 12. A sectional shape of the pin 53 is a polygon such as a substantially circular shape, a rectangular shape, and the like. A shearing stress is acted on the pin 53 mainly due to the rotation of the mantle 13 for crushing. Since a large cross-sectional area is desirable in order to reduce the shearing stress, it is preferable that the cross section of the pin 53 is a polygonal cross section such as a rectangular shape or the like.

[0037] Note that it is preferable to fix portions with the pin 53 at regular intervals along the circumference. However, since it becomes difficult to secure accuracy of positioning or the like when the fixed portions are increased, the number of fixed portions is preferably around two or three, for example.

[0038] The mantle core 12, the annular member 52, the mantle 13, and the like are configured as illustrated in FIG. 3. Note that, in FIG. 3, components other than the mantle core 12, the annular member 52, the mantle 13, and the like are not illustrated.

[0039] Since the annular member 52 has a truncated conical tube shape which expands downwardly, it is mounted from above the mantle core 12. The mantle core 12 also has a truncated conical tube shape, and the inner peripheral surface of the annular member 52 and the outer peripheral surface of the mantle core 12, where they fit each other, have an almost identical shape. Therefore, the annular member 52 can be loaded and supported on the outer peripheral surface at the lower portion of the mantle core 12.

[0040] When loading the annular member 52 onto the mantle core 12, positioning of the pin insertion hole 57 of the annular member 52 and the pin insertion recessed portion 58 of the mantle core 12 is performed, and after that, the pin 53 in inserted into the pin insertion hole 57 and the pin insertion recessed portion 58. After that, the mantle 13 is fitted to the mantle core 12 from above.

[0041] As mentioned above, in this embodiment, all of the annular member 52 and the mantle 13 can be assembled to the mantle core 12 from above the mantle core 12.

[0042] Next, in the gyration-type crusher according to this embodiment, a method of removing the annular member 52 from the mantle core 12 will be described.

[0043] Generally, shrink fitting is performed, for example, to fit the annular member 52, heated by a heater or the like, and to achieve a firm and tight connection using heat shrink when returned to normal temperature. Accordingly, when the annular member 52 is removed from the mantle core 12, conversely, the annular member 52 is expanded by heating it with a heater or the like so as to release the tight connection, and it is removed from the mantle core 12.

[0044] In another way, for example, the annular member 52 is cut with a cutter or the like so as to be removed from the mantle core 12. Since a tensile force acts on the circumference of the annular member 52 due to the shrink fitting, the annular member 52 can easily be removed by releasing the tensile force with cutting , which is effective especially when the annular member 52 is stuck or difficult to remove from the mantle core 12 in the above-mentioned method.

[0045] Next, the gyration-type crusher according to another embodiment of the present invention will be described referring to the drawings.

[0046] Note that, hereunder, mainly matters different from the above-mentioned embodiment will be described, and matters which are not referred to are the same as the above-mentioned embodiment unless they are inconsistent with the description below.

[0047] As illustrated in FIG. 4 and FIG. 5, in this embodiment, an annular member 62 in the shape of a truncated conical tube is mounted to the lower portion of the outer peripheral surface of the mantle core 12 with its inner peripheral surface fitted to the outer peripheral surface of the mantle core 12 by shrink fitting. Further, the mantle 13 in the shape of a truncated conical tube is fittedly mounted to the outer peripheral surface of the annular member 62 by shrink fitting.

[0048] Additionally, in this embodiment, in order to pre-

vent the annular member 62 from sliding relative to the mantle core 12 because of deformation into an elliptical shape due to wear of the outer peripheral surface of the mantle 13, load on the mantle 13, or the like, a recessed portion is formed in a position where the outer peripheral surface of the mantle core 12 and the inner peripheral surface of the annular member 62 are opposed to each other, and a key 63 for stopping rotation is driven there from below the annular member 62. A sectional shape of the key 63 is a substantially rectangular shape, or another polygonal shape.

[0049] Note that, in this embodiment, thickness of the annular member 62 is kept thicker than the annular member 52 in the above-mentioned embodiment (FIG. 2, FIG. 3) so that the key structure can be prevented from rotating. Consequently, in this embodiment, rotation prevention performance is increased..

[0050] The mantle core 12, the annular member 62, the mantle 13, and the like are configured as illustrated in FIG. 5. Note that, in FIG. 5, components other than the mantle core 12, the annular member 52, the mantle 13, and the like are not illustrated.

[0051] In this embodiment, the annular member 62 is mounted to the mantle core 12 from below the mantle core 12. After fitting the annular member 62 to the mantle core 12, the key 63 for rotation prevention is driven from below into the recessed portion formed in the position where the outer peripheral surface of the mantle core 12 and the inner peripheral surface of the annular member 62 are opposed to each other.

[0052] When fitting the annular member 62 to the mantle core 12, they are positioned so that the outer peripheral surface of the mantle core 12 and the inner peripheral surface of the annular member 62 are opposed to each other, forming a recessed portion..

[0053] After that, to prevent rotation, a pressing member 64 for supporting the annular member 62 and the key 63 may be fixed to the bottom surface of the mantle core 12 with bolts 65.

[0054] Note that the number of portions fixed with the key 63 is the same as that in the above-mentioned embodiment (FIG. 2, FIG. 3).

[0055] In this embodiment, the annular member 62, the key 63, and the pressing member 64 are mounted from below the mantle core 12, and the mantle 13 is mounted to the mantle core 12 from above the mantle core 12.

[0056] Note that, however, by bringing the fitting surface of the outer peripheral surface of the mantle core 12 and the inner peripheral surface of the annular member 62 into a truncated conical surface expanding downward, the annular member 62 can be loaded to the mantle core 12 from above and the weight of the annular member 62 can be supported by the lower portion of the outer peripheral surface of the mantle core 12, as in the above-mentioned embodiment (FIG. 2, FIG. 3).

[0057] This structure enables the annular member 62 to be fitted to the mantle core 12 by hanging it down from above. Additionally, since the basic function of the pressing member 64 is to contract to prevent the falling of the key 63 in this structure, burden on the pressing member 64 is reduced, and assembly of the mantle 13, including the annular member 62, to the mantle core 12 becomes easier.

[0058] As mentioned above, in the gyration-type crusher according to each embodiment above, the detachable annular member 52, 62 is provided to the outer peripheral surface of the mantle core 12 and the mantle 13 is connected to the outer peripheral surface of said annular member 52, 62, so that only damaged or worn parts can be replaced, thereby enabling replacement and repair to be performed very easily and in a short time.

[0059] Further, the annular member 52, 62 is provided to the mantle 13 and the lower portion of the mantle core 12 where, in the gyration-type crusher, load is the largest and damage and wear are most likely to occur, and a cushioning member is provided to other parts, thereby preventing damage and wear of the mantle core 12.

[0060] Additionally, the annular member 52, 62 and the mantle core 12 can be surely connected tightly by connecting the inner peripheral surface of the annular member 52, 62 and the outer peripheral surface of the mantle core 12 by shrink fitting, and the annular member 52, 62 can be easily removed from the mantle core 12 by the heating with a heater or the like or cutting of the annular member 52, 62.

[0061] Further, the connection of the mantle core 12 and the annular member 52, 62 can be further reinforced by forming a hole and a recessed portion in the annular member 52, 62 and the mantle core 12 as mentioned above and fitting a fixing member thereto. Even when the tight connection of the annular member 52, 62 and the mantle core 12 becomes weaker, the annular member 52, 62 can be prevented from rotating. Thereby, wear of the mantle core 12 or the like due to the rotation of the annular member 52, 62 can be prevented.

Description of Reference Numerals

[0062]

1	top frame
2	bottom frame
3	eccentric shaft hole
4	sleeve
5	main shaft
6	lower bearing
7	hydraulic cylinder
8	piston
9	upper bearing
12	mantle core
13	mantle
14	concave
16	crushing chamber
19	bevel gear
22	pulley

52, 62 annular member
53 pin
55, 65 bolt
57 pin insertion hole
58 pin insertion recessed portion
59, 64 pressing member
63 key (fixing member)

Claims

1. A gyration-type crusher comprising:

a concave provided inside a frame;
a mantle core which is rotatably arranged inside the concave and has an outer peripheral surface in a shape of a truncated conical surface; and
a mantle which is mounted to the outer peripheral surface of the mantle core and has an outer peripheral surface in a shape of a truncated conical surface,
wherein an annular member is detachably provided to the outer peripheral surface of the mantle core,
and wherein the mantle is connected to an outer peripheral surface of the annular member.

2. The gyration-type crusher according to claim 1,
wherein the annular member is connected to a lower portion of the mantle core, and
wherein, above the annular member, a cushioning member is provided in a space between the outer peripheral surface of the mantle core and an inner peripheral surface of the mantle.

3. The gyration-type crusher according to claim 1 or 2,
wherein an inner peripheral surface of the annular member and the outer peripheral surface of the mantle core are connected by shrink fitting.

4. The gyration-type crusher according to any one of claims 1 to 3,
wherein a through hole or a recessed portion is formed in at least one place where an inner peripheral surface of the annular member and the outer peripheral surface of the mantle core are in contact, and
wherein a fixing member for preventing a rotation of the annular member relative to the mantle core is inserted into the through hole or the recessed portion.

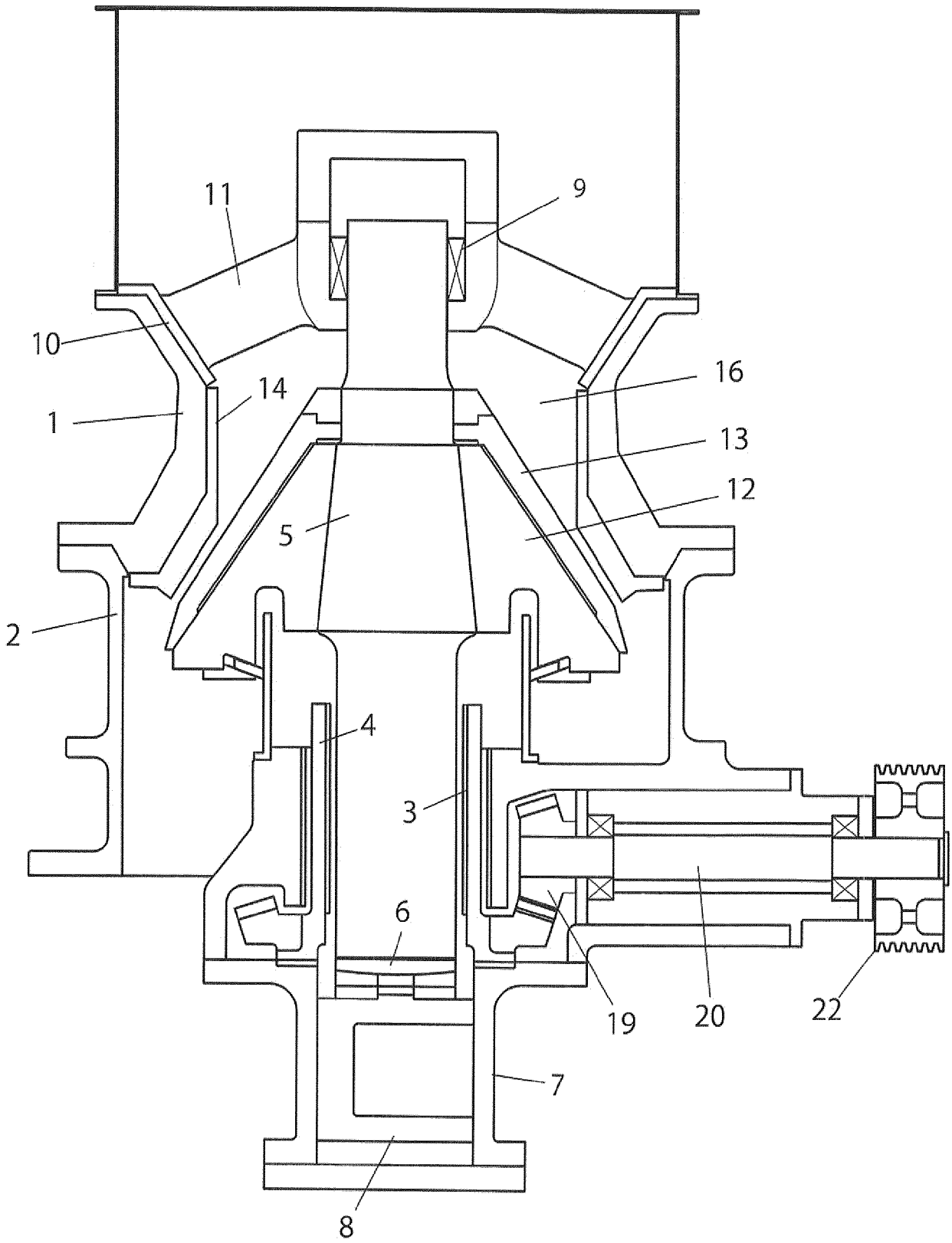

FIG. 1

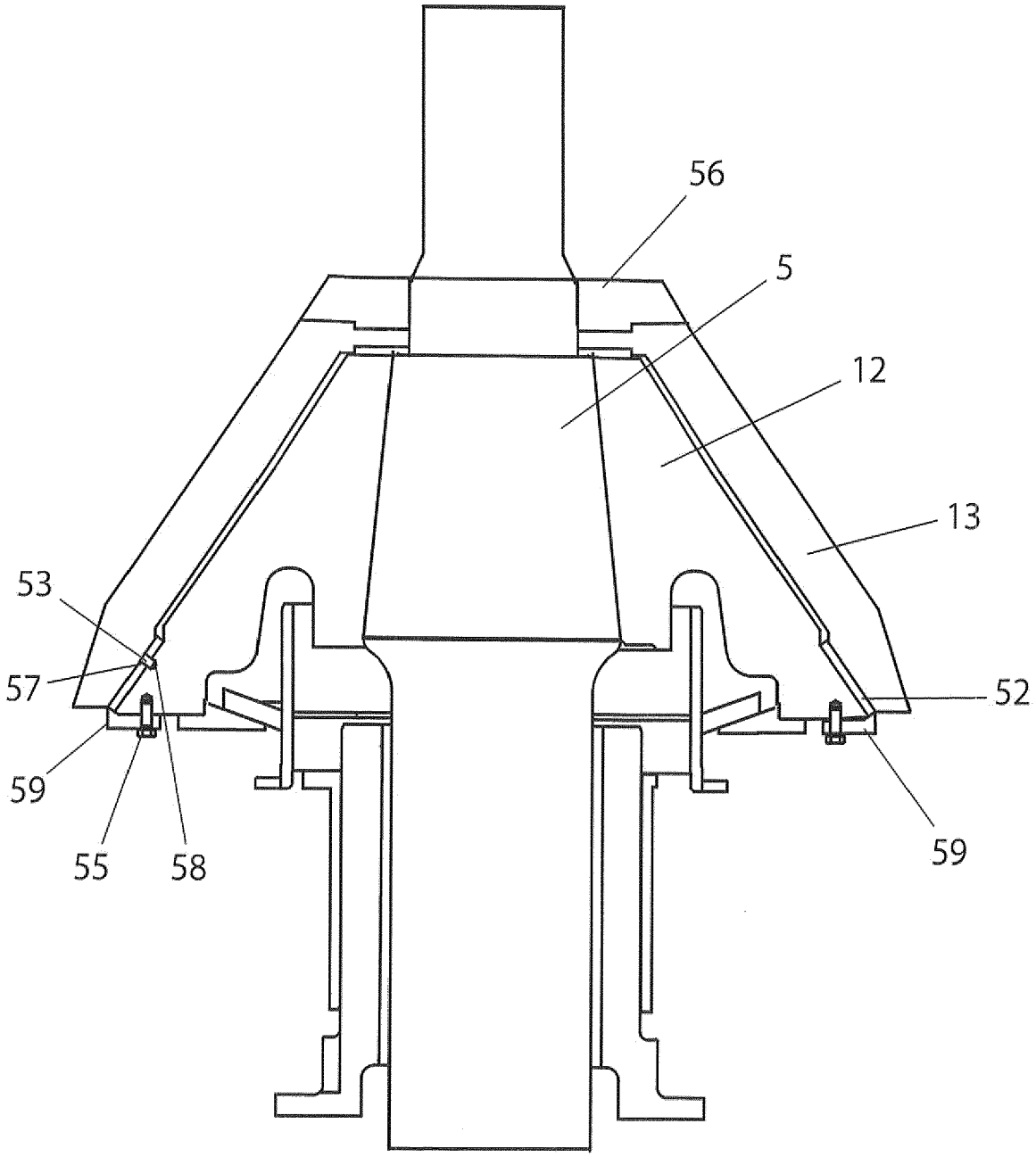

FIG. 2

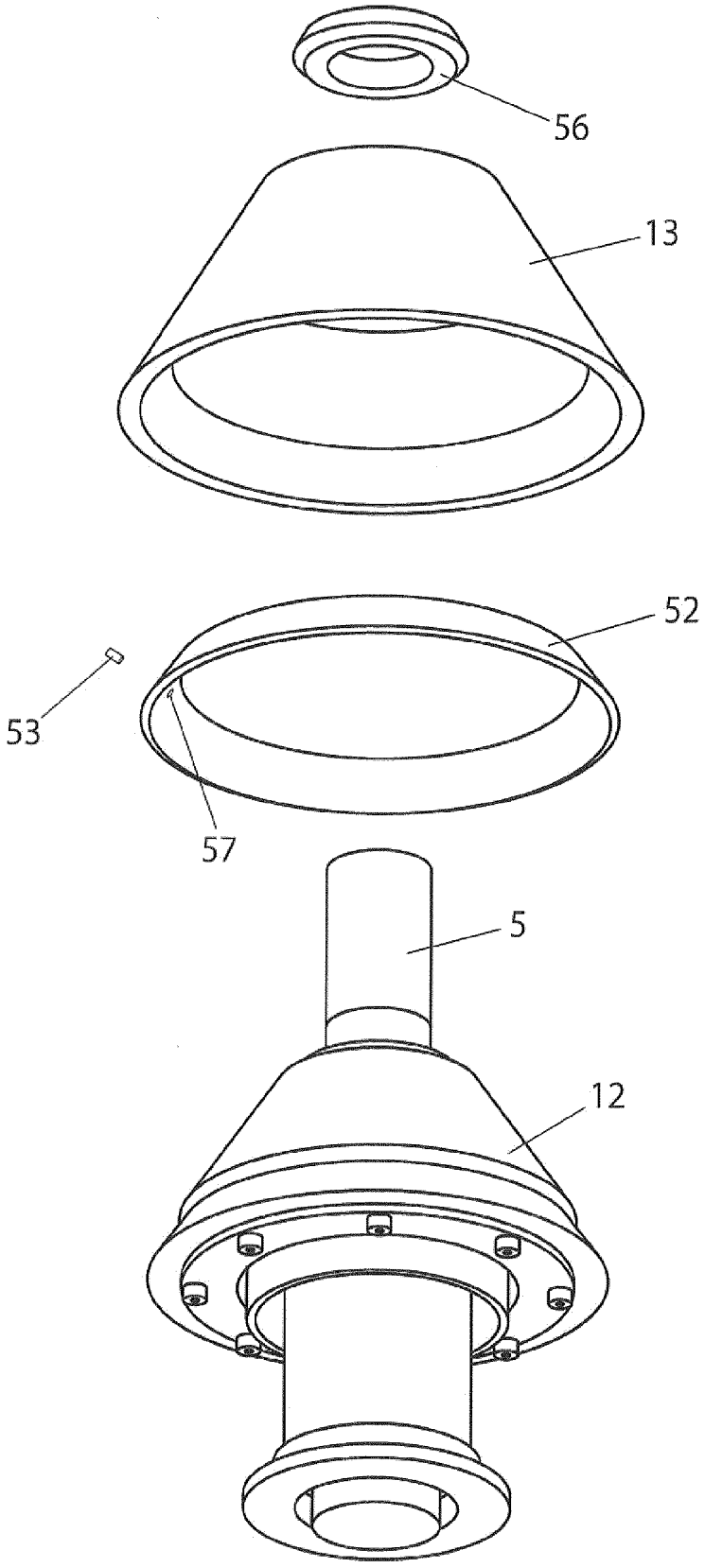

FIG. 3

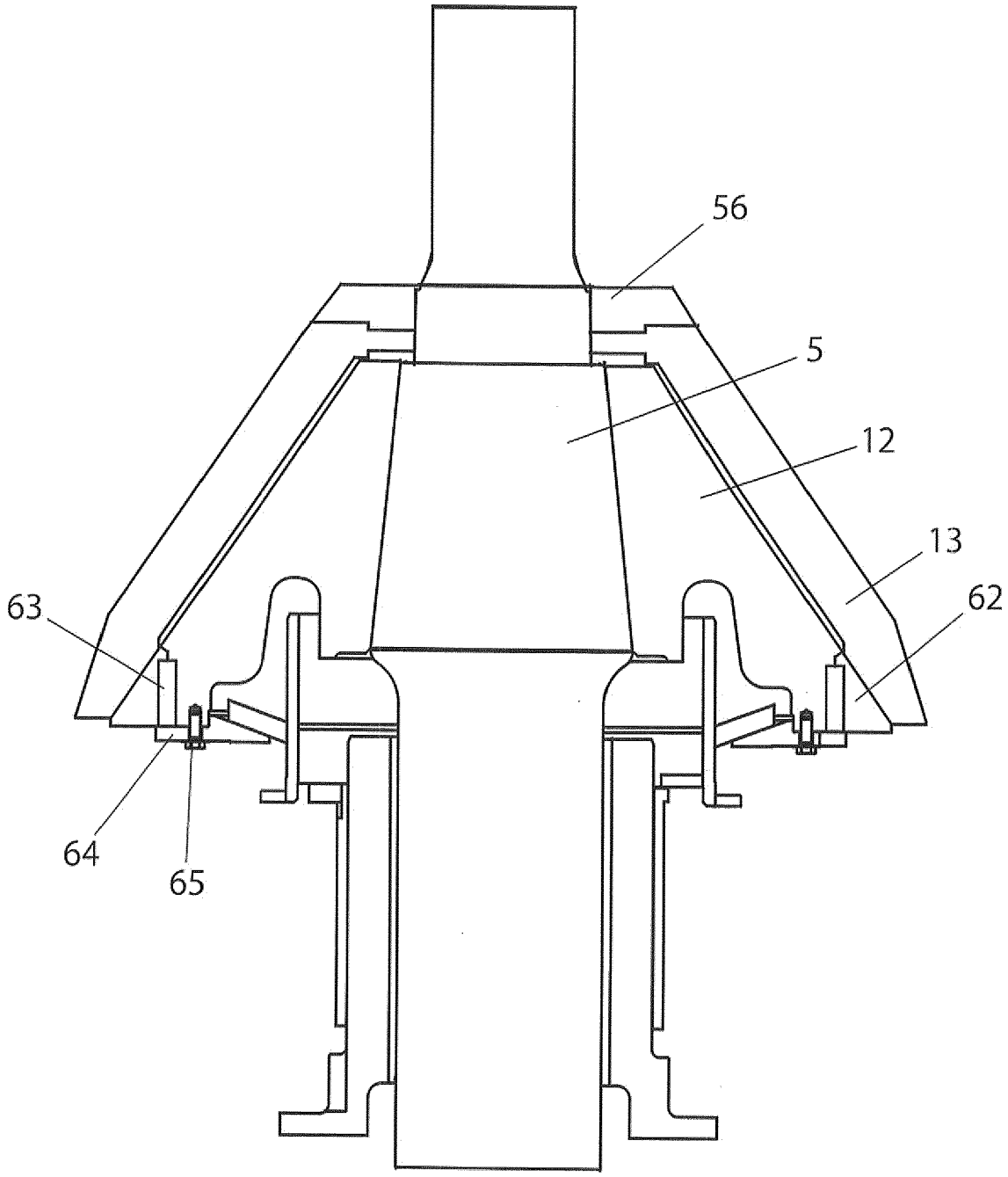

FIG. 4

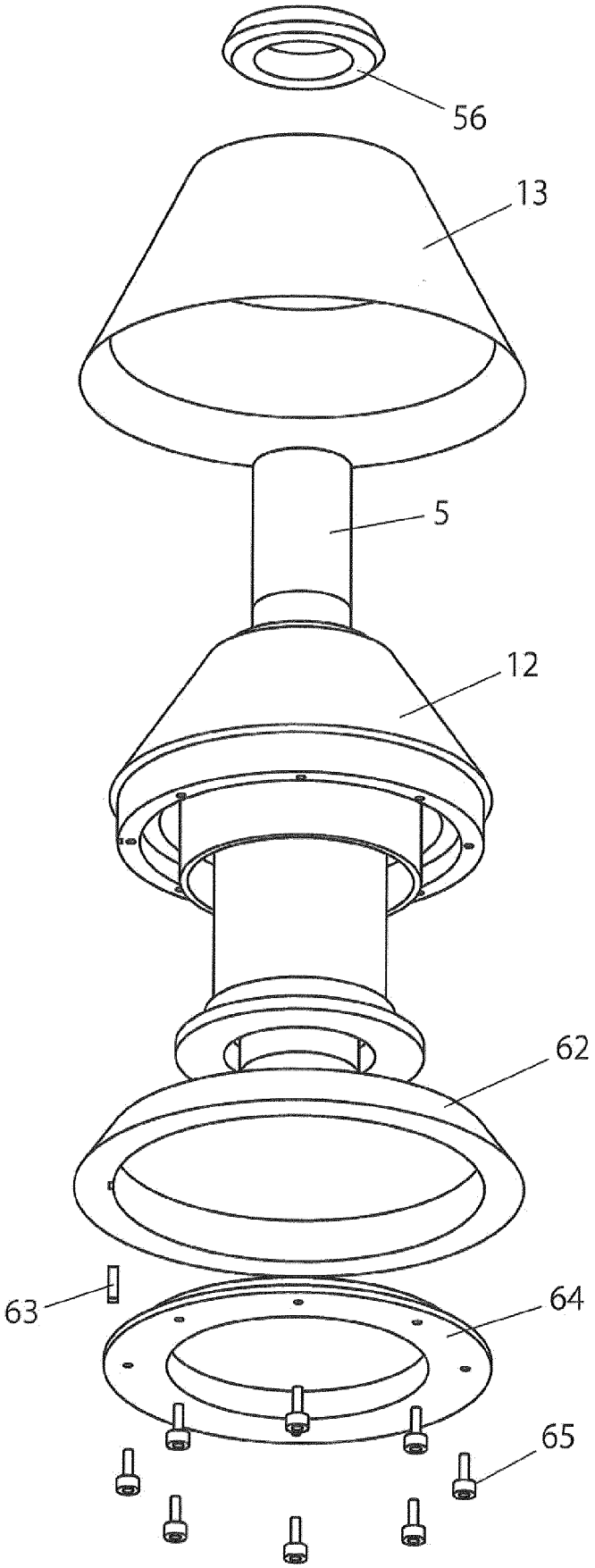

FIG. 5

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EUROPEAN SEARCH REPORT

Application Number
EP 16 20 5359

DOCUMENTS CONSIDERED TO BE RELEVANT

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TECHNICAL FIELDS SEARCHED (IPC)

B02C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	31 March 2017	Iuliano, Emanuela

CATEGORY OF CITED DOCUMENTS

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