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(54) **A CAVITY WEAR PLATE FOR A ROTOR OF A VERTICAL SHAFT IMPACTOR (VSI) CRUSHER**

(57) A cavity wear plate (40, 42, 44) configured for mounting to a vertical rotor wall (22, 2426) of a rotor (1) of a VSI-crusher is described. The cavity wear plate is to protect a cavity (50, 52, 54) of the vertical rotor wall (22, 24, 26). The cavity wear plate comprises cemented carbides. A rotor (1) of a VSI crusher comprising one or more cavity wear plates (40, 42, 44) according to invention is also described.

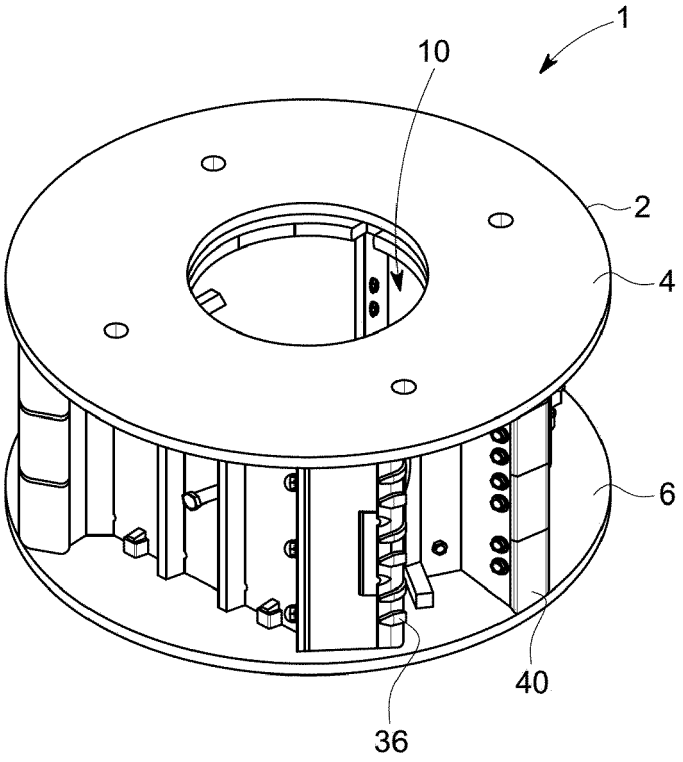

FIG. 1

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Description

Field of Invention

[0001] This invention generally relates to a cavity wear plate for a rotor of a vertical shaft impactor (VSI) crusher. The invention also relates to a rotor of a vertical shaft impact crusher comprising the cavity wear plate.

Background of the invention

[0002] Vertical shaft impact (VSI) crushers find widespread use for crushing a variety of hard materials, such as rock, ore, demolished constructional materials and the like. Typically, a VSI crusher comprises a housing that accommodates a horizontally aligned rotor mounted at a generally vertically extending main shaft. The rotor is provided with a top aperture through which material to be crushed is fed under gravity from an elevated position. The centrifugal forces of the spinning rotor eject the material outwards against a wall of compacted feed material (the stone bed) which also protects the walls of the rotor such that on impact the feed material is crushed to a desired size.

[0003] The rotor commonly comprises a horizontal upper disc and a horizontal lower disc provided with a centrally located distributor plate to protect the lower disc and distribute the material outwards for crushing. The upper and lower discs are connected and axially separated by a plurality of upstanding rotor wall sections. A top aperture is formed within the upper disc such that feed material flows downwardly towards the lower disc between the wall sections and is then ejected at high speed from the distributor plate.

[0004] The upper disc and lower discs are provided with wear plates (or wear parts) to protect the discs with the wear plates on the lower disc being radially mounted between the distributor plate and the wall sections and being secured at the walls sections with wear plate fixings such as wedges and the like. The wear plates, and in particular the lower wear plates, are therefore subjected to substantial abrasive wear which significantly reduces their operational lifetime resulting in the need for regular replacement of the wear plates at service intervals. It is not uncommon to have over 40 wear resistant components, or wear parts, protecting the rotor body. Many of these are what are referred to in the industry as rotor tips or cavity wear plates. The rotor tips are often placed at the exit of the outlet ports of the rotor body. It is usually these wear parts which experience the greatest wear and tear.

[0005] Wear parts for rotor tips made from cemented carbide are described in KR20080005195U and EP0187252.

[0006] Conventional cavity wear plates are described in EP2142300 (Figures 7a and 7b). These plates are commonly made from high chromium white iron.

[0007] An object of the invention is to rotors for VSI crushers with improved wear capacity.

Summary of the Invention

[0008] According to the invention there is provided a cavity wear plate configured for mounting to a vertical rotor wall of a rotor of a VSI-crusher to protect a cavity of the vertical rotor wall, characterized in that the cavity wear plate comprises cemented carbides.

[0009] In any embodiment, the cavity wear plate comprises a wear body having a top surface, a bottom surface, an external wear surface, an internal surface, in which the wear body is substantially L-shaped when viewed in transverse cross-section and comprises a radially inward section and a radially outward section that is generally substantially orthogonal to the radially inward section.

[0010] In any embodiment, the cavity wear plate is configured for mounting to a vertical rotor wall of a rotor such that, in use, the radially inward section is disposed generally radially with respect to the rotor and the radially outward section is disposed generally circumferentially with respect to the rotor.

[0011] In any embodiment, the external wear surface of the radially inward section is curved outwardly when viewed in transverse cross-section.

[0012] In any embodiment, the internal surface of the wear body comprises an elongated recess for mounting the wear body to a vertical rotor wall.

[0013] In any embodiment, the elongated recess extends longitudinally along the internal surface of the wear body.

[0014] In any embodiment, the cavity wear plate comprises cemented carbides and nodular iron.

[0015] In any embodiment, the cavity wear plate consists essentially of cemented carbides and nodular iron.

[0016] In any embodiment, the cavity wear plate is of modular construction and comprises a plurality of cavity wear plate parts configured to fit together.

[0017] In any embodiment, the cavity wear plate parts comprise an upper cavity wear plate part, an intermediate cavity wear plate part, and a lower cavity wear plate part.

[0018] In any embodiment, each of the cavity wear plate parts comprises an elongated recess for mounting the wear body to a vertical rotor wall.

[0019] In any embodiment, the cavity wear plate comprises a plate body section and a peripheral wear section disposed on an external wear side of the plate body.

[0020] In any embodiment, the plate body comprises a metal (e.g, iron) and the peripheral wear section comprises a metal (e.g, iron) and the cemented carbides.

[0021] In another aspect, the invention provides a rotor of a VSI crusher, wherein the rotor comprises:

a horizontal upper disc;
a horizontal lower disc;
a vertical rotor wall connecting the horizontal upper disc and the horizontal lower disc; and

a cavity wear plate according to the invention mounted to a vertical rotor wall to protect a cavity of a vertical rotor wall.

[0022] In any embodiment, a cavity wear plate according to the invention is mounted to each vertical rotor wall to protect a cavity of each vertical rotor wall.

[0023] In any embodiment, the or each cavity wear plate abuts a full length of a second trailing edge of each vertical rotor wall.

[0024] In another aspect, the invention provides a VSI crusher comprising a rotor according to the invention.

Brief Description of the Drawings

[0025] The invention will now be described, by way of example only, with reference to the accompanying drawings in which:

Figure 1 is a perspective view from above of a rotor of a VSI crusher according to the invention.

Figure 2 is a side elevational view of part of the rotor of Figure 1 showing wear tips located at the first trailing edge of a wall segment and three cavity wear plates located at the second trailing edge of an adjacent wall segment.

Figure 3 is a cut through plan view from above of a rotor according to the invention with the horizontal upper disc having top wear plates removed for clarity.

Figure 4 is the same view as Figure 3 but showing the rotor in operation.

Figure 5A is an illustration of the front of a cavity wear plate of the invention in three spaced apart sections in a spaced apart configuration.

Figure 5B is an illustration of the rear of a cavity wear plate of Figure 5A.

Figure 6A is an illustration of the front of a cavity wear plate of the invention in three sections joined together.

Figure 6B is an illustration of the rear of a cavity wear plate of Figure 6A.

Figure 7 is a detailed view of part of a vertical rotor wall with a cavity wear plate of the invention mounted to the vertical rotor wall.

Detailed Description of the Invention

[0026] All publications, patents, patent applications and other references mentioned herein are hereby incorporated by reference in their entireties for all purposes as if each individual publication, patent or patent application were specifically and individually indicated to be incorporated by reference and the content thereof recited in full.

[0027] Where used herein and unless specifically indicated otherwise, the following terms are intended to have the following meanings in addition to any broader (or narrower) meanings the terms might enjoy in the art: Unless otherwise required by context, the use herein of the singular is to be read to include the plural and *vice versa.* The term "a" or "an" used in relation to an entity is to be read to refer to one or more of that entity. As such, the terms "a" (or "an"), "one or more," and "at least one" are used interchangeably herein.

[0028] As used herein, the term "comprise," or variations thereof such as "comprises" or "comprising," are to be read to indicate the inclusion of any recited integer (e.g. a feature, element, characteristic, property, method/process step or limitation) or group of integers (e.g. features, element, characteristics, properties, method/process steps or limitations) but not the exclusion of any other integer or group of integers. Thus, as used herein the term "comprising" is inclusive or open-ended and does not exclude additional, unrecited integers or method/process steps.

[0029] As used herein, the term "VSI crusher" or "vertical shaft impactor crusher" refers to a crusher of the type having a housing that accommodates a horizontally aligned rotor mounted at a generally vertically extending main shaft. The rotor is provided with a top aperture through which material to be crushed is fed under gravity from an elevated position. The centrifugal forces of the spinning rotor eject the material outwards against a wall of compacted feed material (the stone bed) which also protects the walls of the rotor such that on impact the feed material is crushed to a desired size. The upper disc and lower discs are provided with wear plates (also referred to herein as wear parts) to protect the discs with the wear plates on the lower disc being radially mounted between the distributor plate and the wall sections and being secured at the wall sections with wear plate fixings such as wedges and the like. The wear plates, and in particular the lower wear plates, are therefore subjected to substantial abrasive wear which significantly reduces their operational lifetime resulting in the need for regular replacement of the wear plates at service intervals. It is not uncommon to have over 40 wear resistant components, or wear parts, protecting the rotor body, including wear tips and cavity wear parts/plates. The wear tips are often placed at the exit of the outlet ports of the rotor body. It is usually these wear parts which experience the greatest wear and tear.

[0030] As used herein, the term "Cavity wear plate" or "cavity wear part" refers to a wear part for protecting a rotor of a VSI crusher that is mounted to a vertical wall of the rotor and functions to protect cavities in the rotor defined by the shape of the vertical rotor walls. Such cav-

ities are illustrated in Figure 4 (50, 52, 54).

[0031] As used herein, "cemented carbide" refers to a class of hard composite materials used extensively as cutting tools that consist of fine particles of carbide cemented into a composite by a binder metal. Cemented carbides commonly use tungsten carbide (WC), titanium carbide (TiC), silicon carbide (SiC), boron carbide (BC), or tantalum carbide (TaC) as the aggregate. The composite may include additional materials, such as iron. The composite sold under the tradename HX900 contains tungsten carbide and nodular iron. In any embodiment, the cemented carbide comprises a mix of different grades of carbides (granules). As used herein, this form of cemented carbide is referred to herein as "cemented carbides". Cemented carbides and composites formed from cemented carbides are described in US4119459 and US3790353.

Exemplification

[0032] The invention will now be described with reference to specific Examples. These are merely exemplary and for illustrative purposes only: they are not intended to be limiting in any way to the scope of the monopoly claimed or to the invention described. These examples constitute the best mode currently contemplated for practicing the invention.

[0033] Fig. 1 shows a rotor 1 for use in a Vertical Shaft Impact Crusher, i.e., a VSI-crusher. The rotor 1 has a roof in the form of a horizontal upper disc 2 having a top wear plate 4, and a floor in the form of a horizontal lower disc 6. The lower disc 6 has a hub 8 (Fig. 2), which is welded to the disc 6. The hub 8 is to be connected to a shaft (not shown) for rotating the rotor 1 inside the housing of a VSI-crusher. The upper disc 2 has a central aperture 10 through which material to be crushed can be fed into the rotor 1. The upper disc 2 is protected from rocks impacting the rotor 1 from above by the top wear plate 4.

[0034] As is better shown in Fig. 3 the lower disc 6 is protected from wear by three lower wear plates 12, 14 and 16. A distributor plate 18 is fastened to the centre of the lower disc 6. The distributor plate 18 distributes the material that is fed via the aperture 10 in the upper disc 2 and protects the lower disc 6 from wear and impact damages caused by the material fed via the aperture 10.

[0035] The upper and lower discs 2, 6 are separated by and held together by a vertical rotor wall which is separated into three wall segments 22, 24 and 26. The gaps between the wall segments 22, 24, 26 define outflow openings 28, 30, 32, through which material may be ejected against a housing wall. At each outflow opening 28, 30, 32 the respective wall segment 22, 24, 26 is protected from wear by a wear tip 34, 36, 38 located at a first trailing edge 27A of the respective wall segment 22, 24, 26. Each wear tip 34, 36, 38 is mounted in a tip holder. Each wall segment 22, 24, 26 is provided with a cavity wear plate 40, 42, 44 at a second trailing edge 27B of the wall segments 22, 24, 26, which will be described in more detail below. The cavity wear plates protect the rotor 1 and in particular the wear tips 34, 36, 38 from material rebounding from the housing wall and from ejected material and airborne fine dust spinning around the rotor 1.

[0036] Fig. 4 illustrates the rotor 1 as seen from above and in operation. The upper disc 2 and the top wear plate 4 are not shown in Fig. 4 for reasons of clarity. The arrow R indicates the rotational direction of the rotor 1 during operation of the VSI-crusher. During operation of the rotor 1 a bed of material 46 is built up inside the rotor 1 against each of the three wall segments 22, 24, 26. In Fig. 4, only the bed 46 located adjacent to the wall segment 26 is shown. The bed 46, which consists of material that has been fed to the rotor 1 and then has been trapped inside it, extends from a rear support plate 48 to the wear tip 38. The bed 46 protects the vertical wall segment 26 and the wear tip 38 from wear and provides a proper direction to the ejected material. The arrow A describes a typical passage of a piece of rock fed to the rotor 1 via the central aperture 10 and ejected via the outflow opening 30.

[0037] In operation the rotor 1 will have a function that resembles that of a centrifugal pump. The rotor 1 "pumps" rock and high-pressure dust laden air through the outflow openings 28, 30, 32, in a direction which is indicated by the arrow A of Fig. 4. Horizontal low pressure air streams are formed on either side of the high-pressure dust laden air. It would seem, from practical experiences, that dust is "sucked" into these low-pressure air streams. The horizontal dust laden low pressure air streams, which are indicated by dashed arrows LP in Fig. 4, are thus drawn towards the rotor 1, due to the outflow of high-pressure air and rock along the arrow A. Due to the rotation of the rotor 1, such horizontal dust laden low pressure air streams LP are laminated around the rotor 1. It is clear from Fig. 4 that the flow direction of the low-pressure air streams LP is opposite to the direction R of the rotation of the rotor 1. The dust laden low-pressure air streams spin around the rotor 1 and causes wear on the wall segments 22, 24, 26, the lower disc 6 the cavity wear plates 40, 42, 44, the tip holders holding the wear tips 34, 36, 38, etc. The dust laden low-pressure air streams may even flow into cavities 50, 52, 54 formed in the vertical rotor wall. Such a dust laden low pressure air stream flowing into the cavity 50 is denoted CA in Fig. 4. As will be described hereinafter cavity wear plates are provided which serve to minimize the wear caused by such dust laden low-pressure air streams LP and CA.

[0038] Figures 5A, 5B, 6A, 6B and 7 show a cavity wear plate 40 formed in three separate parts 40A, 40B and 40C configured to fit together when mounted to the second trailing edge 27B (Figure 7) of a wall segment to form the elongated assembled cavity wear plate shown in Figures 6A and 6B. The plate 40 (and each plate section), when viewed in transverse cross section comprises a substantially L-shaped wear body having a radially inward section 60 and a radially outward section 61 that is

orthogonal to the radially inward section. The plate has an inner surface 62 including an L-shaped section 63 dimensioned to abut the second trailing edge 27B of the wall segment, and an elongated recess 64 that extends longitudinally along the inner surface 62 and that upon assembly functions as a coupling means for coupling the cavity wear plate to the wall segment. The plate also has an external wear surface 67 which is located at the opposite side of the wear body to the elongated recess 64 and includes a first wear surface 68 that is generally curved and disposed on the radially inward section 60 of the plate and a second wear surface 69 disposed on the radially outward section 61 of the plate. When mounted to a vertical wall segment, the first wear surface 68 is disposed generally radially with respect to the rotor 1 and the second wear surface 69 is disposed generally circumferentially with respect to the rotor 1. The first and second wear surfaces 68, 69 are adapted for contacting abrasive particles and dust contained in the dust laden low pressure air streams LP circulating around the rotor 1, as illustrated in Fig. 4. In particular, the first and second wear surfaces 68, 69 are adapted for contacting dust laden low-pressure air streams denoted CA in Fig. 4 and flowing into the cavity.

[0039] Figure 7 shows a cavity wear plate 40 attached to a second trailing edge 27B of the wall segment 22. The elongated recess 64 of plate 40 has a proximal part 65 and a distal section 66 that is wider than the proximal part. The cavity wear plate 40 is mounted to the wall segment 22 by means of a bolt 70 having a shaft 71 that extends through a hole in the wall segment 22 and a bolt head 72 dimensioned to slot into the distal section 66 of the elongated recess 64. Mounting of the cavity wear plate 40 involves removing the horizontal upper disc 2 and top wear plate 4 to expose the vertical wall segments, threading the shafts 71 of three mounting bolts through the apertures of each wall segment, attaching the bolt heads 72 to distal ends of the shafts 71 and then slotting the cavity wear plate parts 40A, 40B and 40C in sequence on to the bolt heads until the cavity wear plate parts abut to form a single cavity wear plate 40 mounted to the second trailing edge 27B of the wall segment 22. The bolts can then be tightened to tightly couple the cavity wear part to the wall segment.

[0040] As illustrated in Figure 7, the cavity wear plate parts 40A, 40B and 40C each comprise a plate body 80 formed of nodular iron and a peripheral wear region 81 that defines the first and second wear surfaces 68, 69 and is formed from nodular iron and cemented carbides. The peripheral wear region 81 extends to a depth of about 5 to 30 mm. The plate body and peripheral wear regions form a uniform plate part that is formed by casting. This construction while preferred, is not essential.

Equivalents

[0041] The foregoing description details presently preferred embodiments of the present invention. Numerous modifications and variations in practice thereof are expected to occur to those skilled in the art upon consideration of these descriptions. Those modifications and variations are intended to be encompassed within the claims appended hereto.

Claims

1. A cavity wear plate (40, 42, 44) configured for mounting to a vertical rotor wall (22, 24, 26) of a rotor (1) of a VSI-crusher to protect a cavity (50, 52, 54) of the vertical rotor wall (22, 24, 26), **characterized in that** the cavity wear plate comprises cemented carbides.

2. A cavity wear plate (40, 42, 44) according to Claim 1, comprising a wear body having a top surface, a bottom surface, an external wear surface (67), an internal surface (62), in which the wear body is substantially L-shaped when viewed in transverse cross-section and comprises a radially inward section (60) and a radially outward section (61) that is substantially orthogonal to the radially inward section.

3. A cavity wear plate (40, 42, 44) according to Claim 2, configured for mounting to a vertical rotor wall (22, 24, 26) of a rotor (1) such that, in use, the radially inward section (60) is disposed generally radially with respect to the rotor (1) and the radially outward section (61) is disposed generally circumferentially with respect to the rotor (1).

4. A cavity wear plate (40, 42, 44) according to Claim 2 or 3, in which the external wear surface of the radially inward section (60) is curved outwardly when viewed in transverse cross-section.

5. A cavity wear plate (40, 42, 44) according to Claim 2 or 4, in which the internal surface (62) of the wear body comprises an elongated recess (64) for mounting the wear body to a vertical rotor wall (22, 24, 26).

6. A cavity wear plate (40, 42, 44) according to Claim 5, in which the elongated recess (64) extends longitudinally along the internal surface (62) of the wear body

7. A cavity wear plate (40, 42, 44) according to any preceding Claim, in which the cavity wear plate comprises cemented carbides and nodular iron.

8. A cavity wear plate (40, 42, 44) according to any preceding Claim, in which the cavity wear plate consists essentially of cemented carbides and nodular iron.

9. A cavity wear plate (40, 42, 44) according to any preceding Claim, in which the cavity wear plate is of modular construction and comprises a plurality of cavity wear plate parts (40A, 40B, 40C) configured to fit together.

10. A cavity wear plate (40, 42, 44) according to Claim 9, in which the cavity wear plate parts (40A, 40B, 40C) comprise an upper cavity wear plate part (40A), an intermediate cavity wear plate part (40B), and a lower cavity wear plate part (40C).

11. A cavity wear plate (40, 42, 44) according to Claim 9 or 10, in which each of the cavity wear plate parts (40A, 40B, 40C) comprises an elongated recess (64) for mounting the wear body to a vertical rotor wall (22, 24, 26).

12. A cavity wear plate (40, 42, 44) according to any preceding Claim, comprising a plate body (80) and a peripheral wear region (81) disposed on an external wear side of the plate body, in which the plate body comprises iron and the peripheral wear region (81) comprises iron and the cemented carbides.

13. A rotor (1) of a VSI crusher, wherein the rotor comprises:

a horizontal upper disc (2);
a horizontal lower disk (6);
a vertical rotor wall (22, 24, 26) connecting the horizontal upper disc and the horizontal lower disc; and
a cavity wear plate (40, 42, 44) according to any preceding Claim mounted to a vertical rotor wall (22, 24, 26) to protect a cavity (50, 52, 54) of a vertical rotor wall (22, 24, 26).

14. A rotor (1) according to Claim 13, comprising a cavity wear plate (40, 42, 44) mounted to each vertical rotor wall (22, 24, 26) to protect a cavity (50, 52, 54) of each vertical rotor wall (22, 24, 26).

15. A rotor (1) according to Claim 12 or 13, in which the or each cavity wear plate (40, 42, 44) abuts a full length of a second trailing edge (27B) of each vertical rotor wall (22, 24, 26).

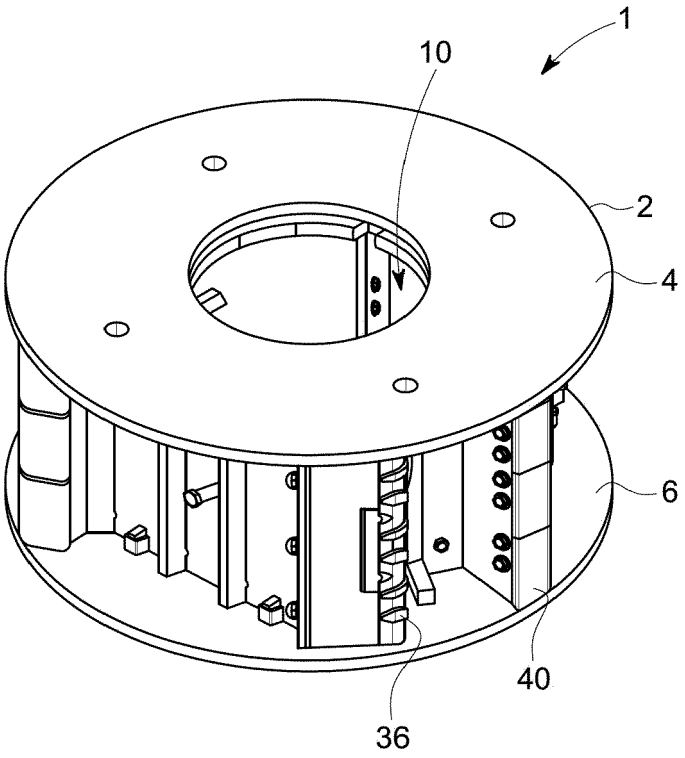


FIG. 1

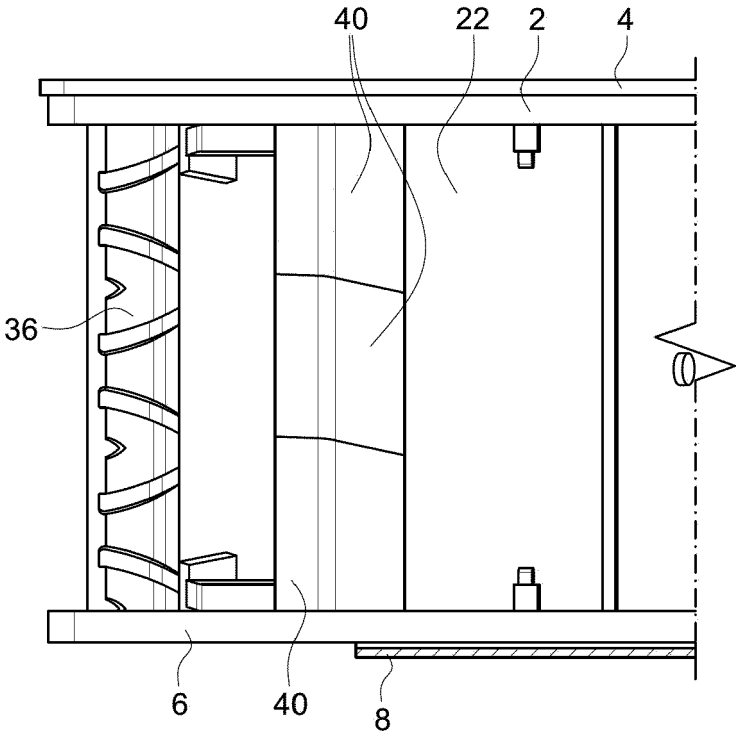
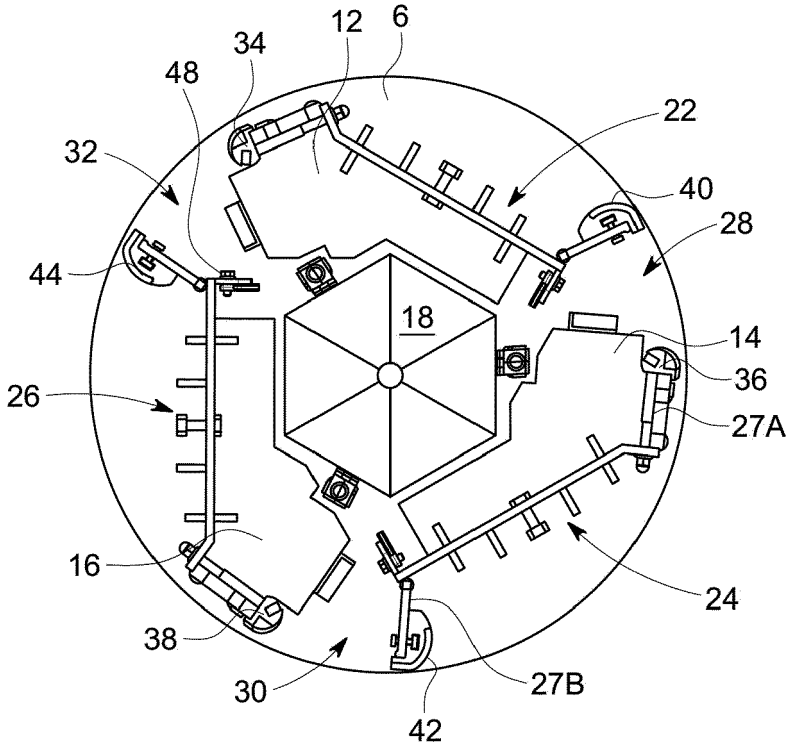


FIG. 2


12
6
34
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22
32
40
28
44
18
14
36
26
27A
16
24
38
27B
30
42

FIG. 3

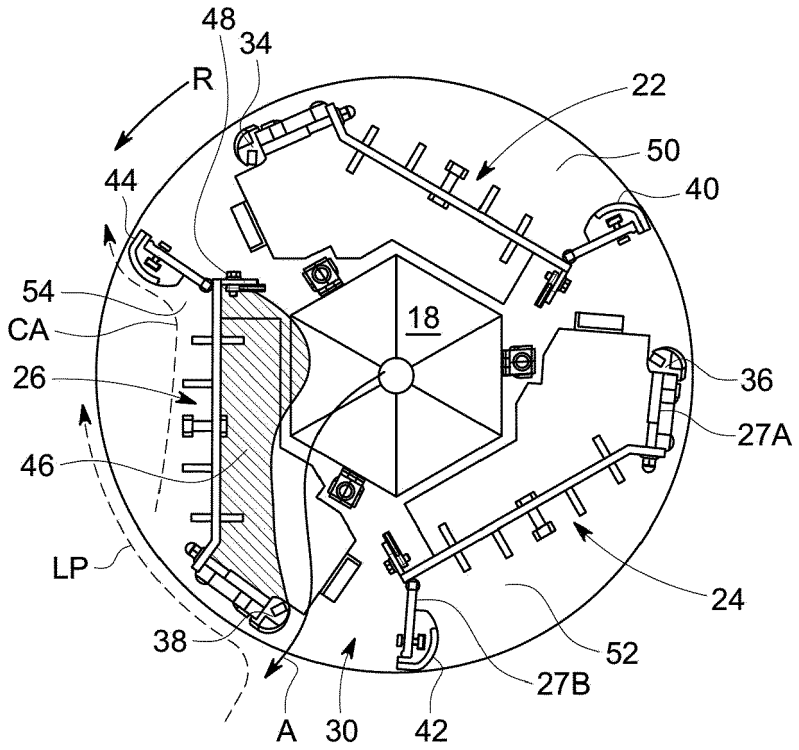
48
34
R
22
50
44
40
54
18
CA
36
26
27A
46
LP
24
38
52
27B
A
30
42

FIG. 4

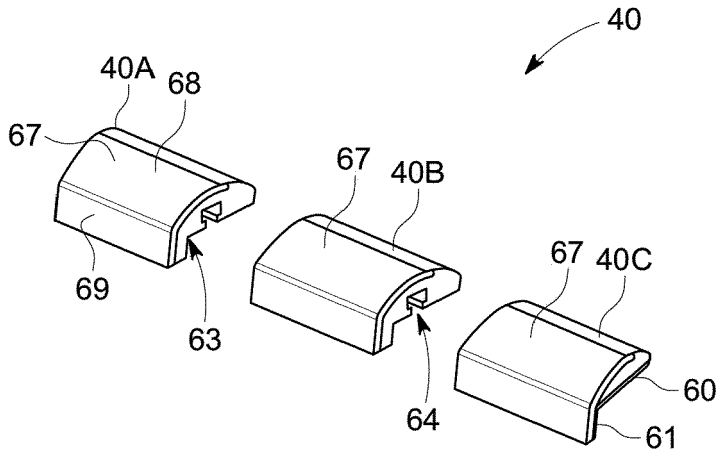
40
40A
68
67
67
40B
67
40C
69
63
64
60
61

FIG. 5A

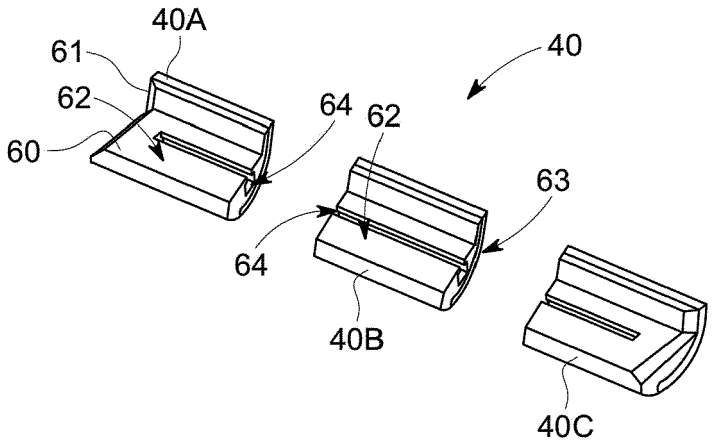
40A
61
62
60
64
62
40
63
64
40B
40C

FIG. 5B

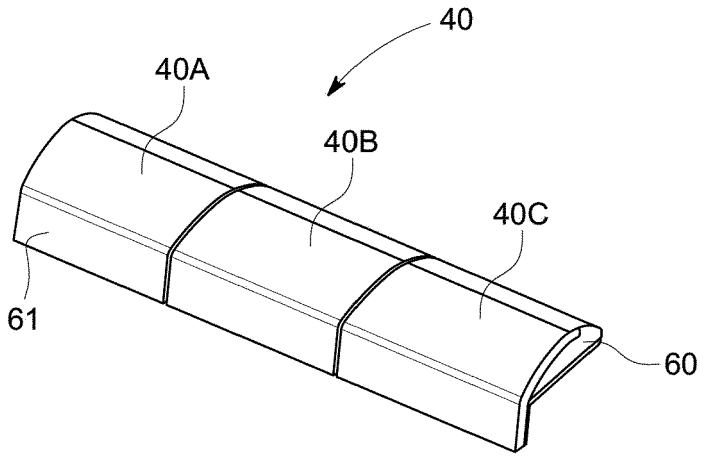

FIG. 6A

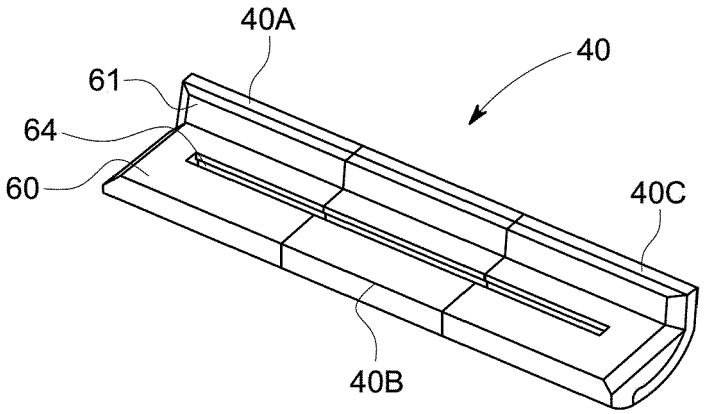

FIG. 6B

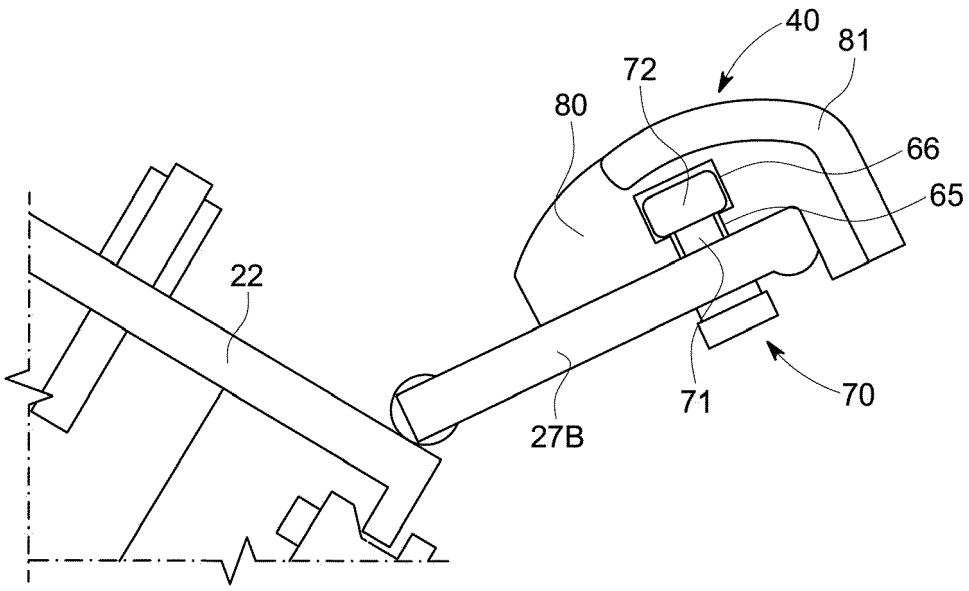

FIG. 7

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EUROPEAN SEARCH REPORT

Application Number
EP 22 20 9820

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
Y A	EP 1 545 782 B1 (SANDVIK INTELLECTUAL PROPERTY [SE]) 12 August 2009 (2009-08-12) * paragraphs [0008] - [0020], [0023] - [0035]; figures 1-4 *	1-7, 12-15 8-11	INV. B02C13/18
Y A	US 2005/017110 A1 (JOHNSON LOUIS WEIN [US] ET AL) 27 January 2005 (2005-01-27) * paragraphs [0003], [0029], [0030]; figures 1,22,24,25 *	1-7, 12-15 8-11	
			TECHNICAL FIELDS SEARCHED (IPC)
			B02C C22C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	15 May 2023	Iuliano, Emanuela

CATEGORY OF CITED DOCUMENTS

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