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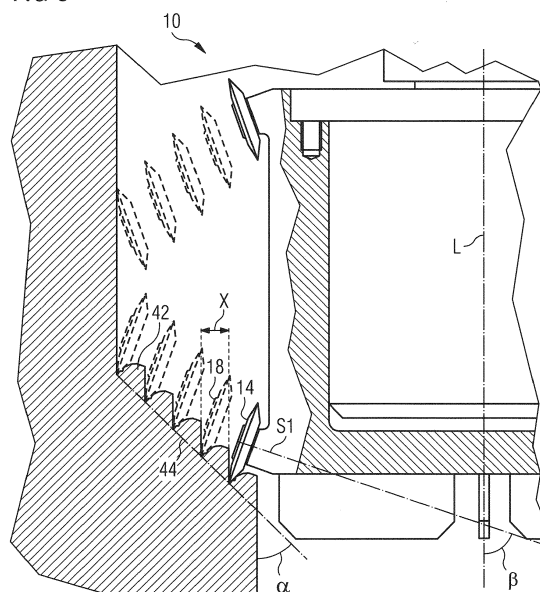
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(54) Milling device

(57) The present disclosure generally relates to a milling device (10). The milling device (10) includes a first row of cutting discs (14) mounted on a first circumference, and a second row of cutting discs (18) mounted on a second circumference. The second row of cutting discs (18) is offset from the first row of cutting discs (14) in a longitudinal direction of the milling device (10), and the second circumference is arranged relative to the first cir-

cumference such that the second row of cutting discs (18) projects at least in part radially outward from the first row of cutting discs (14). Therefore, the first and second rows of cutting discs (14, 18) cut a material to be removed at a different depth, with a predetermined distance (X) formed between the cuts in order to achieve a substantially continuous milling line.

FIG 5**EP 3 056 660 A1**

Description

Technical Field

[0001] The present disclosure relates to an apparatus for milling and/or drilling cutting of materials, in particular, to a milling device including a plurality of cutting discs.

Background

[0002] In the field of underground or open-work mining as well as in road or structural engineering, several milling systems are known for the milling of rock and other hard materials such as extraction products, tarmac, and concrete components. For such milling operations, rotary driven drums or discs including milling tools mounted at the circumference thereof in an evenly distributed manner are mainly used.

[0003] As an example, WO 2006/079536 A1 discloses a device for milling treatment. The device includes a spindle drum which is rotatably mounted on a drum support and rotatable about a drum axis. In the spindle drum, several tool spindles are supported eccentrically to the drum axis to be rotatably driveable about spindle axes. Each tool spindle carries a machining tool at its end projecting from the spindle drum.

[0004] The present disclosure is directed, at least in part, to improving or overcoming one or more aspects of prior systems.

Summary of the Disclosure

[0005] According to a first aspect of the present disclosure, a milling device for milling of materials comprises a first plurality of cutting discs mounted on a first circumference of the milling device. The first plurality of cutting discs is rotatable about a first axis defining a longitudinal direction. A second plurality of cutting discs is mounted on a second circumference of the milling device. The second plurality of cutting discs is rotatable about a second axis extending parallel to the first axis. The second plurality of cutting discs is offset from the first plurality of cutting discs in the longitudinal direction, and the second circumference is arranged relative to the first circumference such that at least one of the second plurality of cutting discs projects radially outward from the first plurality of cutting discs.

[0006] According to a second aspect of the present disclosure, a milling apparatus comprises a movable frame, at least one support mounted on the movable frame, and at least one milling device in accordance with the first aspect.

[0007] In a further aspect, a milling device for milling of materials comprises a first plurality of cutting discs mounted on a first circumference of a tool drum. A second plurality of cutting discs is mounted on a second circumference of the tool drum. The tool drum is rotatable about a tool drum axis defining a longitudinal direction. The

second plurality of cutting discs is offset from the first plurality of cutting discs in the longitudinal direction, and the second circumference is concentric with the first circumference and has a larger diameter than the first circumference.

[0008] In yet another aspect, a milling device for milling of materials comprises a first plurality of cutting discs mounted on a first circumference of a first tool drum. A second plurality of cutting discs is mounted on a second circumference of a second tool drum. The first tool drum and the second tool drum are rotatable about a common tool drum axis extending in a longitudinal direction. The second plurality of cutting discs is offset from the first plurality of cutting discs in the longitudinal direction, and the second circumference is concentric with the first circumference and has a larger diameter than the first circumference.

[0009] In another aspect, a milling device for milling of materials comprises a first plurality of cutting discs mounted on a first circumference of a first tool drum. A second plurality of cutting discs is mounted on a second circumference of a second tool drum. The first tool drum is rotatable about a first tool drum axis defining a longitudinal direction, and the second tool drum is rotatable about a second tool drum axis extending parallel to the first tool drum axis and being separated from the first tool drum axis by a distance in a transverse direction. The second plurality of cutting discs is offset from the first plurality of cutting discs in the longitudinal direction, and the second circumference has the same diameter as the first circumference.

[0010] Other features and aspects of this disclosure will be apparent from the following description and the accompanying drawings.

Brief Description of the Drawings

[0011]

Fig. 1 shows a schematic plan view of an exemplary disclosed milling apparatus;

Figs. 2A and 2B schematically show front views of the milling apparatus of Fig. 1 in different positions, respectively;

Fig. 3 schematically shows a front view of an exemplary disclosed milling device;

Fig. 4 schematically shows a front view of another exemplary disclosed milling device; and

Fig. 5 shows a milling line produced by cutting discs of an exemplary disclosed milling device.

Detailed Description

[0012] The following is a detailed description of exemplary embodiments of the present disclosure. The exemplary embodiments described therein and illustrated in the drawings are intended to teach the principles of the present disclosure, enabling those of ordinary skill in the

art to implement and use the present disclosure in many different environments and for several different applications. Therefore, the exemplary embodiments are not intended to be, and should not be considered as, a limiting description of the scope of patent protection. Rather, the scope of patent protection shall be defined by the appended claims.

[0013] The present disclosure may be based at least in part on the realization that, with conventional milling devices using, for example, impact chisels as machining tools, a relatively large amount of fine dust is produced during milling. This disadvantage can be overcome at least in part by using cutting discs instead of impact chisels as the machining tools.

[0014] Further, the present disclosure may be based at least in part on the realization that, when cutting discs are arranged on an outer circumference of a tool drum to project substantially radially outward, the cutting edges of the cutting discs will cut the material in an undercutting process. This may allow for a reduction in the required power for driving the tool drum into the material to be cut.

[0015] In addition, the present disclosure may be based in part on the realization that, when a plurality of rows of circumferentially mounted cutting discs are provided in a milling device, a substantially continuous milling line can be formed by the cutting discs arranged in the plurality of rows when they are arranged in a stepwise manner with a predetermined distance between the different rows in the radial direction. In this respect, the present disclosure may be based at least in part on the realization that the predetermined distance may depend on the hardness of the material to be cut.

[0016] Also, the present disclosure may be based in part on the realization that, when a milling apparatus having a movable frame is used, a plurality of the milling devices disclosed herein may be mounted on the movable frame, each of the plurality of milling devices being adjustable with respect to its height, pivotable and/or extendable and retractable. This may allow an adjustment to different conditions at the milling site.

[0017] Referring to Figs. 1 and 2A and 2B, an exemplary embodiment of a milling apparatus 100 is shown. Fig. 1 shows a plan view of milling apparatus 100, and Figs. 2A and 2B respectively show a front view of a part of milling apparatus 100.

[0018] As shown in Fig. 1, milling apparatus 100 includes a movable frame 2 adapted to move along a rack 3 which has machine guides (not shown). Via a suitable linear drive, movable frame 2 can be moved at different speeds parallel to a material to be removed, for example, a mineral rock face or coal face or the like, but also parallel to a concrete wall or the like.

[0019] Milling apparatus 100 further comprises a first support 4 and a second support 24 formed as drum supports projecting from movable frame 2 towards the material to be removed. In the exemplary embodiment shown in Fig. 1, support 24 has the same configuration as support 4, such that only support 4 will be described

in detail.

[0020] Support 4 includes a first portion 5 mounted on movable frame 2, wherein first portion 5 is configured to be extended from and retracted towards movable frame 2 in a first direction by means of a first actuator 7, for example, a hydraulic actuator. Support 4 further includes a second portion 6 pivotably coupled to first portion 5, wherein second portion 6 is pivotable about a pivot axis P by means of a second actuator 8, for example, another hydraulic actuator. In the same manner, a second portion of support 24 may be pivoted about a pivot axis Q by a corresponding actuator. In some embodiments, further actuators (not shown) may be provided to adjust the height of supports 4 and 24, in particular, pivot axes P and Q.

[0021] At a distal end of support 4, i.e. of second portion 6, a milling device 10 is rotatably mounted on a shaft 31 attached to the distal end of support 4. In the exemplary embodiment shown in Fig. 1, milling device 10 comprises a tool drum 30 rotatably mounted on shaft 31, wherein shaft 31 extends along and defines a longitudinal direction L that is also the direction of movement of movable frame 2 on rack 3. Tool drum 30 may be driven to rotate by a suitable motor (not shown), which may be arranged inside of drum 30 or on a side of drum 30.

[0022] Milling device 10 further includes several rows of cutting discs mounted on tool drum 30. In the exemplary embodiment shown in Fig. 1, five rows of cutting discs are mounted on tool drum 30. It will be appreciated, however, that in other embodiments a different number of rows of cutting discs may be used, for example, two rows, three rows, four rows, or more than five rows of cutting discs.

[0023] A first row of cutting discs 14 is mounted on a first circumference of tool drum 30 disposed adjacent to a front of tool drum 30. The first plurality of cutting discs 14 is evenly distributed about the first circumference (see Figs. 2A and 2B) in a first plane perpendicular to the longitudinal direction of tool drum 30, and each cutting disc 14 is freely rotatably mounted on the first circumference such that a cutting edge of the same is oriented towards the material to be cut. As will be described in more detail below, each cutting disc 14 may be disposed at a given angle with respect to the longitudinal direction L.

[0024] A second plurality of cutting discs 18 is mounted on a second circumference of tool drum 30. The second circumference is arranged further toward the rear of tool drum 30 and has a greater diameter than the first circumference. The second plurality of cutting discs 18 is also evenly distributed about the second circumference in a second plane perpendicular to the longitudinal direction of tool drum 30 and mounted to be freely rotatable about tool axes that extend under the same angle with respect to the longitudinal direction L as the first plurality of cutting discs 14. In other words, the second plurality of cutting discs 18 is offset from the first plurality of cutting discs 14 in the longitudinal direction L, the first plurality of cut-

ting discs 14 and the second plurality of cutting discs 18 being arranged in different planes. As shown in Fig. 1, the second plurality of cutting discs 18 is disposed radially outward from the first plurality of cutting discs 14 when viewed in the longitudinal direction L.

[0025] A third plurality of cutting discs 40 is disposed rearward of the second plurality of cutting discs 18, on a third circumference that again has a greater diameter than the second circumference. The details of the arrangement of the third plurality of cutting discs 40 (and of fourth and fifth pluralities of cutting discs shown in Fig. 1) are substantially the same as those of the first and second pluralities of cutting discs 14, 18, such that a detailed description will be omitted.

[0026] It will be appreciated by the skilled person that milling device 10 disclosed herein may have a symmetrical configuration with respect to the longitudinal direction L. In other words, milling device 10 may be symmetrical with respect to a transverse direction extending perpendicular to the longitudinal direction L through the center of milling device 10. This will allow milling device 10 to remove material while moving in opposite directions along rack 3.

[0027] As shown in Fig. 2A, supports 4, 24 are configured such that, in a first position, supports 4, 24 may extend substantially parallel to each other, for example, horizontally. In some embodiments, supports 4, 24 may be pivoted towards frame 2 to extend at an angle of less than 90° with respect to the longitudinal direction, depending on the direction of movement of frame 2 on rack 3. First support 4 may be retracted, and second support 24 may be extended, such that milling device 10 mounted on first support 4 cuts a first layer of the material to be removed, and another milling device configured substantially the same as milling device 10 and mounted on support 24 cuts a second, deeper layer of the material to be removed, as also shown in Fig. 1.

[0028] Fig. 2B shows a second position of supports 4, 24. In the second position shown in Fig. 2B, supports 4, 24 are extended by the same amount and arranged at the same height, such that pivot axes P and Q coincide, but are pivoted by different amounts, respectively. Accordingly, as shown in Fig. 2B, a larger area of material in the height direction may be processed by the milling devices mounted on supports 4 and 24, respectively.

[0029] As also shown in Fig. 2A and Fig. 2B, in the exemplary embodiment of milling device 10, the cutting discs are arranged on milling device 10 in such a manner that the cutting discs of one row are offset from the cutting discs of an adjacent row in the circumferential direction. For example, as shown in Figs. 2A and 2B, the cutting discs of the second plurality of cutting discs 18 are offset from the cutting discs of the first plurality of cutting discs 14 in the circumferential direction such that, when milling device 10 (i.e. tool drum 30 as shown in Fig. 1) rotates, each cutting disc 18 comes into contact with the material to be removed at a position that is offset from the position of contact of the neighboring cutting disc 14 in a projection

on a plane perpendicular to the longitudinal direction L. The same applies to the third to fifth pluralities of cutting discs shown in Figs. 2A and 2B. Accordingly, a fixed phase relation (i.e. a fixed angular offset) exists between two adjacent rows of cutting discs.

[0030] As shown in Figs. 2A and 2B, the several rows of cutting discs may be distributed along their respective circumferences such that together the cutting discs of all rows are evenly distributed about the circumference of milling device 10. In other words, with respect to the cutting discs of one row, for example, cutting discs 14, the cutting discs of all other rows, for example, cutting discs 18, may be disposed between the cutting discs of the one row when viewed in the longitudinal direction. It will be readily appreciated that, for example, when only two rows of cutting discs are provided, each cutting disc 18 of the second plurality of cutting discs will be disposed substantially in the middle between adjacent cutting discs 14 of the first plurality of cutting discs. For the sake of simplicity, the following description of different implementations of milling device 10 will be given with respect to an example where only two rows of cutting discs are provided, i.e. the first plurality of cutting discs 14 and the second plurality of cutting discs 18. However, appropriate modifications for the cases where more than two rows of cutting discs are provided will be immediately obvious to the skilled person from the following description and the attached figures.

[0031] Fig. 3 shows a first exemplary embodiment of milling device 10 having a first plurality of cutting discs 14 and a second plurality of cutting discs 18. As shown in Fig. 3, cutting discs 14 and 18 are mounted on a first circumference 16 and a second circumference 20, respectively, of tool drum 30. In the example shown in Fig. 3, first circumference 16 is formed on a first outer circumferential surface of tool drum 30 having a first diameter D1, and second circumference 20 is formed on an outer circumferential surface of tool drum 30 having a second diameter D2 that is greater than the first diameter D1. Accordingly, a step portion 33 may be formed between first circumference 16 and second circumference 20.

[0032] Each of the first plurality of cutting discs 14 is mounted in a mounting recess 26 formed in first circumference 16, and is freely rotatable about a first tool axis S1. Although first tool axis S1 is shown in Fig. 3 as extending substantially in the radial direction, it will be appreciated that in a practical implementation first tool axis S1 may extend at an angle with respect to the longitudinal direction L. This will be described in more detail below. The first plurality of cutting discs 14 rotates about a first axis A formed at the center of first circumference 16. Likewise, each of the second plurality of cutting discs 18 is mounted on second circumference 20 in corresponding mounting recesses 28, and is freely rotatable about a second tool axis S2. Second tool axis S2 may extend at substantially the same angle with respect to the longitudinal direction L as first tool axis S1. The second plurality of cutting discs 18 rotates about a second axis B formed

at the center of second circumference 20. In the example shown in Fig. 3, first axis A and second axis B are col-linear, i.e., coincide with each other, and correspond to an axis of shaft 31 of tool drum 30 (see Fig. 1).

[0033] Each cutting disc 14, 18 is formed in a substantially plate-like shape, a plane surface of the plate-like shape facing, at an angle, towards a wall of material to be cut, and edges of the plate-like shape engaging with the material to be cut as milling device 10 is moved in the longitudinal direction L. It will be readily appreciated that rotation of the first and second pluralities of cutting discs 14, 18 about first axis A and second axis B will result in the edges of the cutting discs rolling off on the material to be cut. Accordingly, the contact point of each cutting disc 14, 18 will define a circular cutting line when viewed in the longitudinal direction L. As shown in Fig. 3, edges of the first plurality of cutting discs 14 define a first cutting line 17, and edges of the second plurality of cutting discs 18 define a second cutting line 19. First cutting line 17 and second cutting line 19 are separated by a distance X in the radial direction due to the stepwise arrangement of the first plurality of cutting discs 14 and the second plurality of cutting discs 18.

[0034] In the example shown in Fig. 3, first circumference 16 and second circumference 20 are formed on an outer circumferential surface of a single tool drum 30. However, in other embodiments similar to the embodiment shown in Fig. 3, first circumference 16 and second circumference 20 may be formed on separate tool drums. For example, tool drum 30 may be a first tool drum, and a second tool drum 32 may be provided separately from first tool drum 30 (see also Fig. 4). In this case, first tool drum 30 is rotatable about tool drum shaft 31, and second tool drum 32 is rotatable about a second tool drum shaft, the second tool drum shaft defining the second axis B about which the second plurality of cutting discs 18 rotates. In some embodiments, first tool drum 30 and second tool drum 32 may be mounted on a common shaft, for example, shaft 31. As will be appreciated, first tool drum 30 and second tool drum 32 may have different diameters, thereby defining first circumference 16 and second circumference 20 having diameters D1 and D2, respectively. First and second tool drums 30, 32 may be coupled to each other in a form-fitting or force-fitting manner. It will be appreciated that different numbers of tool drums may be provided, corresponding to the number of rows of cutting discs. As mentioned above, all tool drums may be mounted on a single shaft, or each tool drum may be mounted on a separate shaft, the separate shafts being mechanically coupled to each other to result in a synchronous rotation of the pluralities of cutting discs about their respective axes.

[0035] In case first circumference 16 and second circumference 20 are formed on different tool drums 30 and 32, in other exemplary embodiments, first axis A and second axis B may be offset from each other, i.e., may be spaced apart from each other. One such exemplary embodiment is shown in Fig. 4.

[0036] As shown in Fig. 4, second axis B is spaced apart from first axis A in a transverse direction T, for example, in the horizontal direction. In the embodiment shown in Fig. 4, first circumference 16 and second circumference 20 have the same diameters D1 and D2. In other words, first tool drum 30 and second tool drum 32 may have the same configuration, in particular, the same diameter. As shown in Fig. 4, cutting lines 17 and 19 of cutting discs 14 and 18 are also offset from each other, corresponding to the offset between first axis A and second axis B. As a consequence, a maximum distance between first cutting line 17 and second cutting line 19 is an amount X that corresponds to the offset between first axis A and second axis B. In the embodiment shown in Fig. 4, milling device 10 is configured to cut the material to be removed at a position that substantially corresponds to a left half of tool drums 30, 32, where some of the second plurality of cutting discs 18 are disposed radially outward from the first plurality of cutting discs 14 when viewed in the longitudinal direction. As mentioned above, the offset between first cutting line 17 and second cutting line 19 may be at a maximum in a first radial direction R, for example, the horizontal direction as shown in Fig. 4.

[0037] It will be readily appreciated that, in the exemplary embodiment shown in Fig. 4, tool drums 30, 32 are mounted on separate shafts, the separate shafts being mechanically coupled to each other, for example, via a cardan joint.

[0038] It will further be appreciated that in embodiments where first axis A and second axis B are offset from each other, as shown in the example in Fig. 4, more than two tool drums may be provided, each tool drum having a circumference on which a plurality of cutting discs are mounted. Each plurality of cutting discs may be evenly distributed about the respective circumference. Further, the different pluralities of cutting discs may be offset from each other when viewed in the longitudinal direction, similar to what is shown in Figs. 2A and 2B. It will also be appreciated that, when more than two tool drums are provided, the offsets between the shafts of adjacent tool drums may be the same for all tool drums. In other words, the axes about which the pluralities of cutting discs rotate may be evenly spaced a first direction, for example, the horizontal direction as shown in Fig. 4.

Industrial Applicability

[0039] In the following, the operation of exemplary disclosed milling device 10 will be described with reference to Figs. 1 to 5. It should be appreciated that the effects described below may be achieved by any embodiment of milling device 10 described herein, regardless of whether the pluralities of cutting discs are mounted on a single tool drum or whether they are mounted on separate tool drums. Further, it will be appreciated that the described effects can be achieved regardless of whether the exemplary configuration shown in Fig. 3 or the ex-

emplary configuration shown in Fig. 4 is used, and independent from the number of rows of cutting discs.

[0040] As shown in detail in Fig. 5, the plurality of rows of cutting discs are arranged on milling device 10 to be offset with respect to each other in the longitudinal direction L. The first plurality of cutting discs 14 disposed adjacent to the front of milling device 10 is disposed on a circumference of milling device 10 having a first diameter, and a diameter of the circumference of each subsequent row of cutting discs increases towards the rear of milling device 10.

[0041] As also shown in Fig. 5, the plurality of cutting discs are offset by a distance X in the transverse direction. As used herein, the term "offset X" is intended to describe the offset between cutting lines 17 and 19 of adjacent pluralities of cutting discs, for example, cutting discs 14 and 18 in case cutting lines 17 and 19 are arranged concentrically (see Fig. 3), and also the maximum offset in the direction of the offset between first axis A and second axis B in case cutting lines 17 and 19 are not arranged concentrically (see Fig. 4).

[0042] As shown in Fig. 5, each cutting disc is mounted on milling device 10 to face toward the material to be removed, with a tool axis, for example, tool axis S1 of cutting disc 14, extending at an angle β with respect to the longitudinal direction L, i.e., the direction of movement of milling device 10. In some embodiments, the angle β may be between around 45° and around 80°, in particular, between around 50° and around 70°.

[0043] As shown in Fig. 5, the cutting edges of each cutting disc roll off on the material to be removed and penetrate the same. Thereby, cutting chips 42 are separated from the material to be removed as milling device 10 moves along the longitudinal direction L. The offset X and, optionally, the angle β are chosen such that the portions at which cutting chips 42 are separated form a substantially continuous milling line 44 that extends at an angle α with respect to the longitudinal direction L. The angle α may be between around 20° and around 45°. The offset X and, optionally, the angle β may be chosen depending on the material to be removed. For example, the offset X may be between around 10 mm and around 50 mm for hard materials, or between around 50 mm and around 150 mm for soft materials.

[0044] The exemplary milling device disclosed herein may be applicable in road milling applications, and mining applications. A milling machine which may be configured as, for example, a road mill, a continuous miner, a surface miner, or a shearer loader may comprise milling device 10 for milling coal, concrete, tarmac, and/or other extraction products and materials.

[0045] Although an exemplary embodiment has been described herein, wherein milling apparatus 100 includes two milling devices mounted on respective supports 4, 24, in other embodiments, milling apparatus 100 may include only a single milling device 10, or may include more than two milling devices 10, for example, three or more milling devices 10.

[0046] Although the preferred embodiments of this invention have been described herein, improvements and modifications may be incorporated without departing from the scope of the following claims.

Claims

1. A milling device (10) for milling of materials, comprising:
 - a first plurality of cutting discs (14) mounted on a first circumference (16) of the milling device (10), the first plurality of cutting discs (14) being rotatable about a first axis (A) defining a longitudinal direction (L); and
 - a second plurality of cutting discs (18) mounted on a second circumference (20) of the milling device (10), the second plurality of cutting discs (18) being rotatable about a second axis (B) extending parallel to the first axis (A), wherein the second plurality of cutting discs (18) is offset from the first plurality of cutting discs (14) in the longitudinal direction (L), and the second circumference (20) is arranged relative to the first circumference (16) such that at least one of the second plurality of cutting discs (18) projects radially outward from the first plurality of cutting discs (14).
2. The milling device of claim 1, wherein the first axis (A) and the second axis (B) are collinear, and the second circumference (20) has a greater diameter than the first circumference (16).
3. The milling device of claim 1, wherein the first axis (A) and the second axis (B) are spaced apart from each other in a transverse direction (T).
4. The milling device of claim 3, wherein the first circumference (16) and the second circumference (20) have the same diameter (D1, D2).
5. The milling device of claim 2, wherein the first plurality of cutting discs (14) and the second plurality of cutting discs (18) are provided on a first tool drum (30) of the milling device (10), the first tool drum (30) being rotatable about a first tool drum shaft (31) defining the first axis (A) and the second axis (B).
6. The milling device of claim 5, wherein the first circumference (16) and the second circumference (20) are formed at a step portion (33) in an outer circumferential surface of the first tool drum (30).
7. The milling device of any one of claims 2 to 4, wherein the first plurality of cutting discs (14) is provided on a first tool drum (30) of the milling device (10), the

- first tool drum (30) being rotatable about a first tool drum shaft (31) defining the first axis (A), and the second plurality of cutting discs (18) is provided on a second tool drum (32) of the milling device (10), the second tool drum (32) being rotatable about a second tool drum shaft defining the second axis (B).
8. The milling device of claim 7, wherein the first tool drum shaft (31) and the second tool drum shaft are mechanically coupled to each other, for example, via a cardan joint.
9. The milling device of any one of claims 1 to 8, wherein the first plurality of cutting discs (14) and the second plurality of cutting discs (18) are adapted to rotate about the first axis (A) and the second axis (B), respectively, at the same rotational speed, the second plurality of cutting discs (14) being offset from the first plurality of cutting discs (14) in the circumferential direction.
10. The milling device of any one of claims 1 to 9, wherein each of the first plurality of cutting discs (14) and the second plurality of cutting discs (18) is mounted to be freely rotatably about a tool axis (S1, S2) extending at a predetermined angle (β) with respect to the longitudinal direction (L), the angle (β) being the same for all of the first plurality of cutting discs (14) and/or all of the second plurality of cutting discs (18), for example, between around 45° and around 80°, in particular, between around 50° and around 70°.
11. The milling device of any one of claims 1 to 10, wherein cutting edges of the first plurality of cutting discs (14) define a first cutting line (17) when viewed in the longitudinal direction (L), and cutting edges of the second plurality of cutting discs (18) define a second cutting line (19) when viewed in the longitudinal direction (L), the first cutting line (17) and the second cutting line (19) having a predetermined distance (X) from each other at least in a first radial direction (R), for example, between around 10 mm and around 50 mm, or between around 50 mm and around 150 mm.
12. The milling device of any one of claims 1 to 11, further comprising at least a third plurality of cutting discs (40), the third plurality of cutting discs (40) being mounted on a third circumference of the milling device (10) and being rotatable about a third axis extending parallel to the first axis (A) and the second axis (B), the third plurality of cutting discs (40) being offset from the second plurality of cutting discs (18) in the longitudinal direction (L), and the third circumference being arranged relative to the second circumference such that at least one of the third plurality of cutting discs (40) projects radially outward from the second plurality of cutting discs (18).
13. A milling apparatus (100) comprising:
a movable frame (2);
at least one support (4) mounted on the movable frame (2); and
at least one milling device (10) of any one of claims 1 to 12 mounted on the at least one support (4).
14. The milling apparatus of claim 13, further comprising a linear drive for moving the movable frame (2) in the longitudinal direction.
15. The milling apparatus of claim 14, further comprising at least one of:
a first actuator (7) configured to extend and retract the at least one support (4) in a first direction; and
a second actuator (8) configured to pivot the at least one support (4) around a pivot axis (P) extending parallel to the longitudinal direction (L).

FIG 1

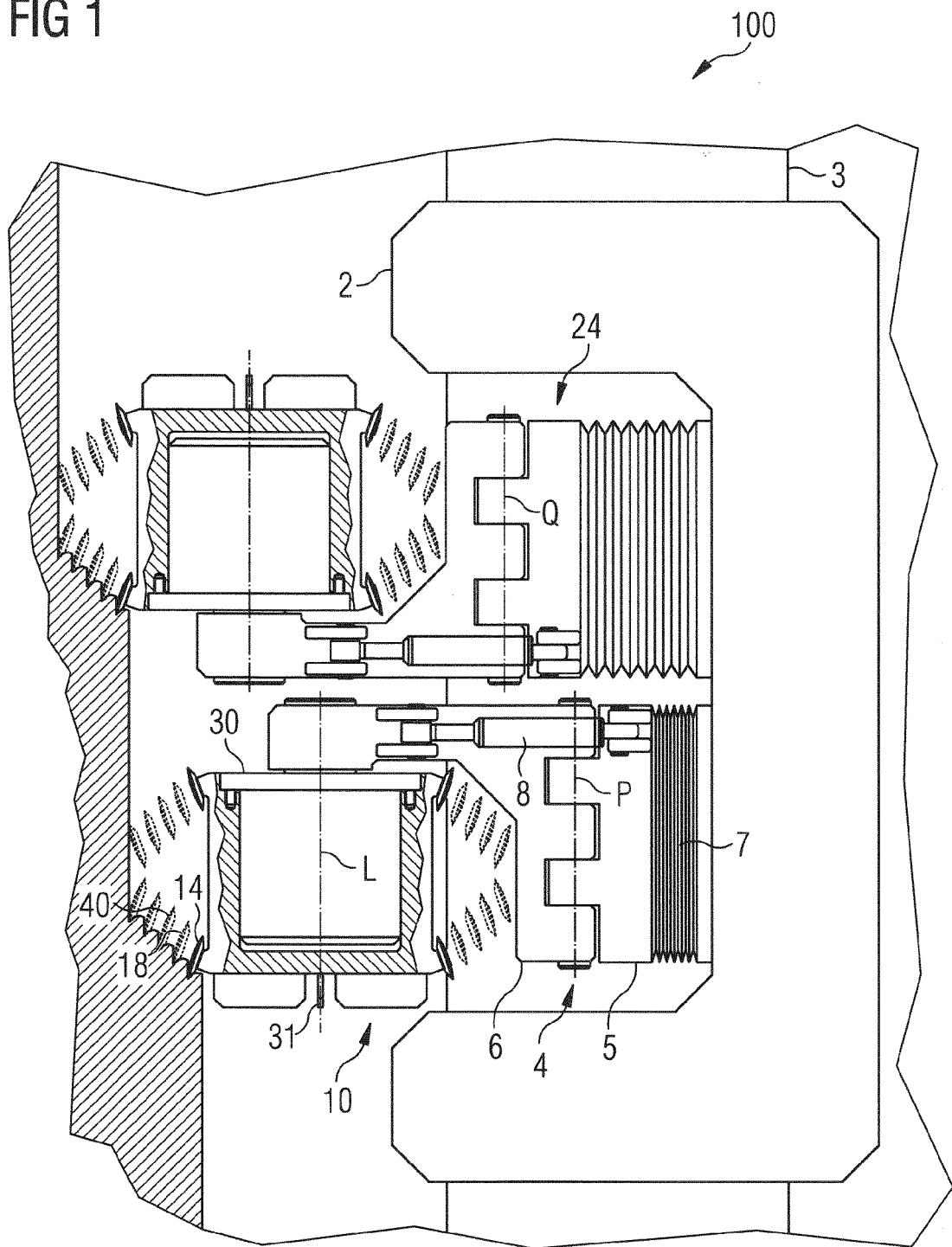


FIG 2A

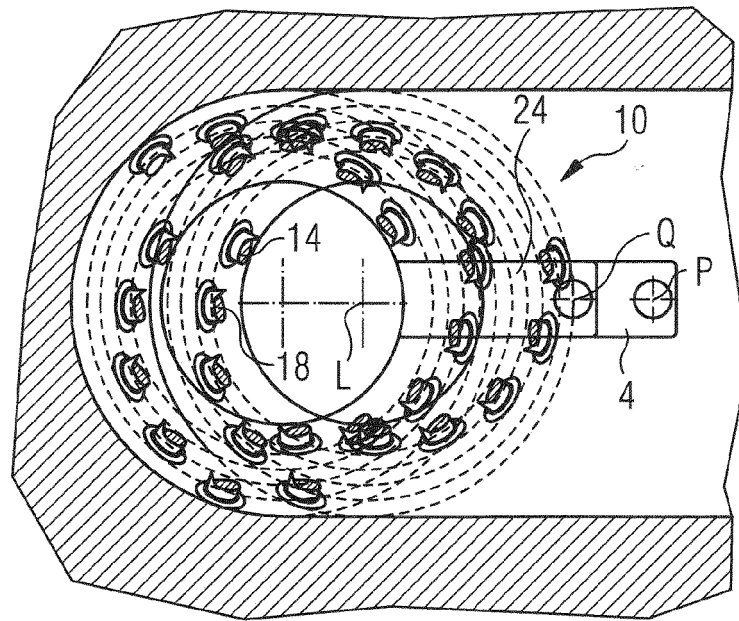


FIG 2B

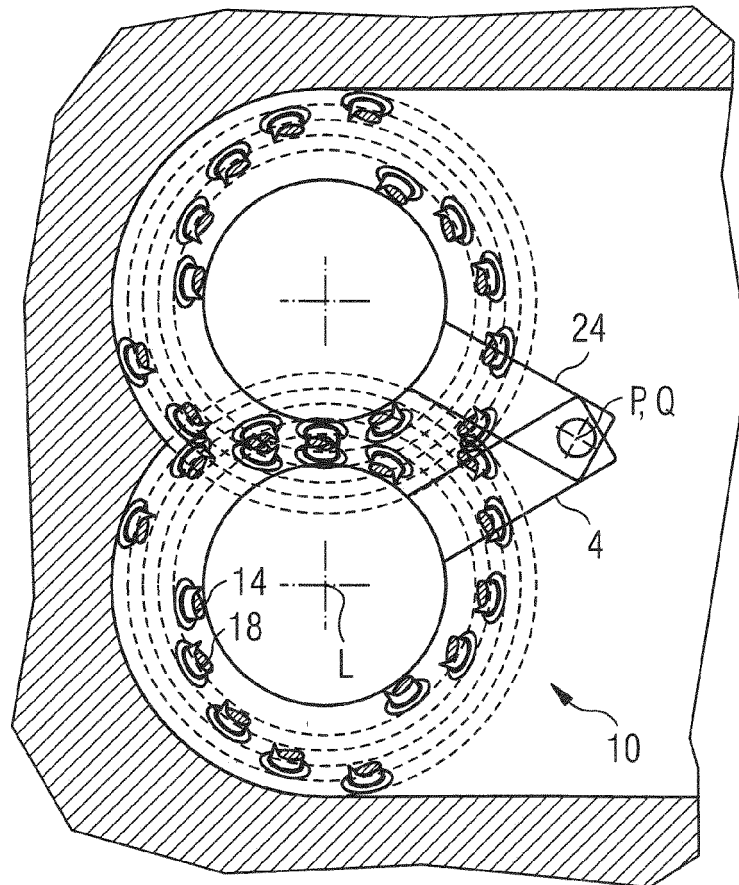


FIG 3

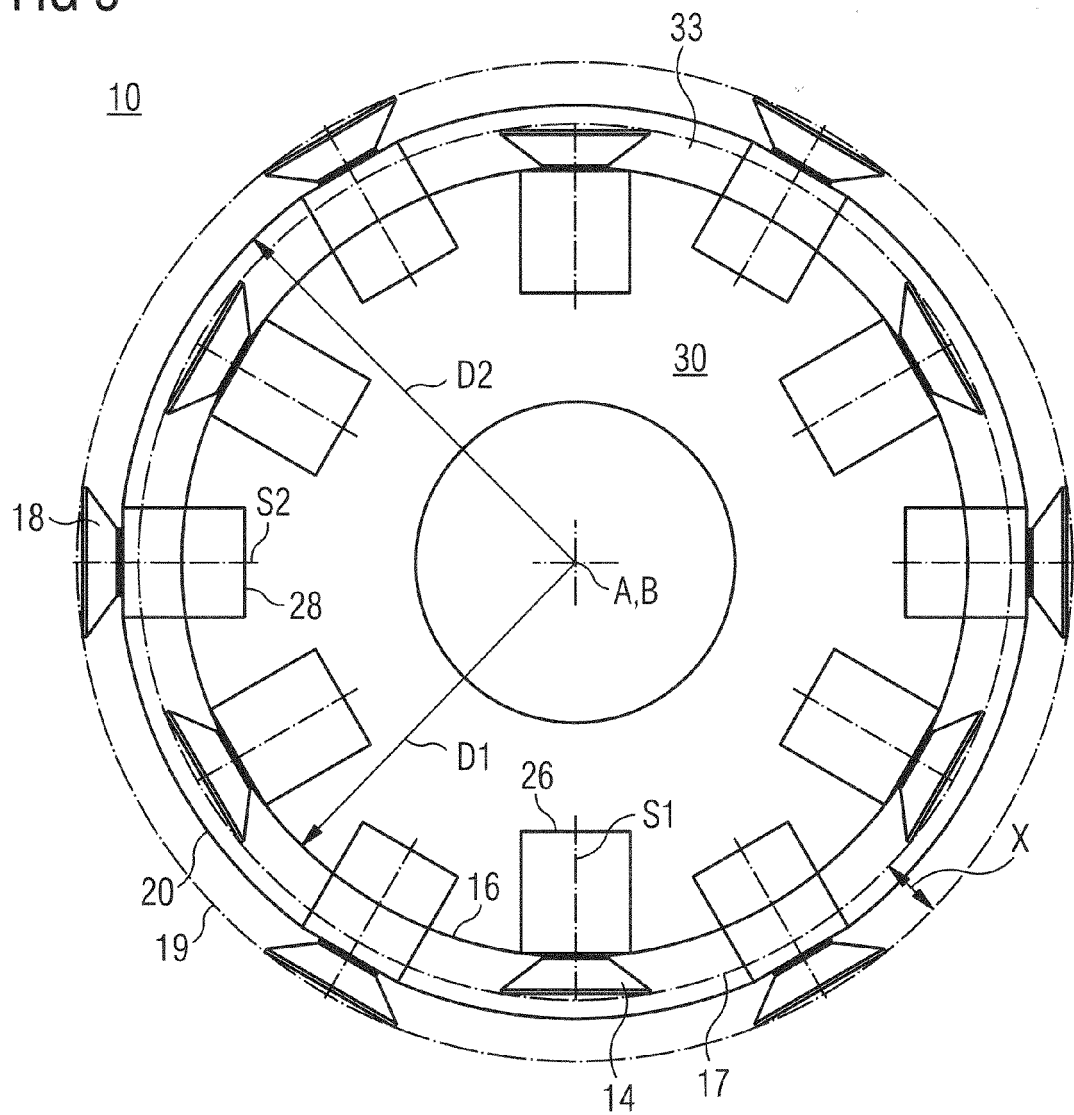


FIG 4

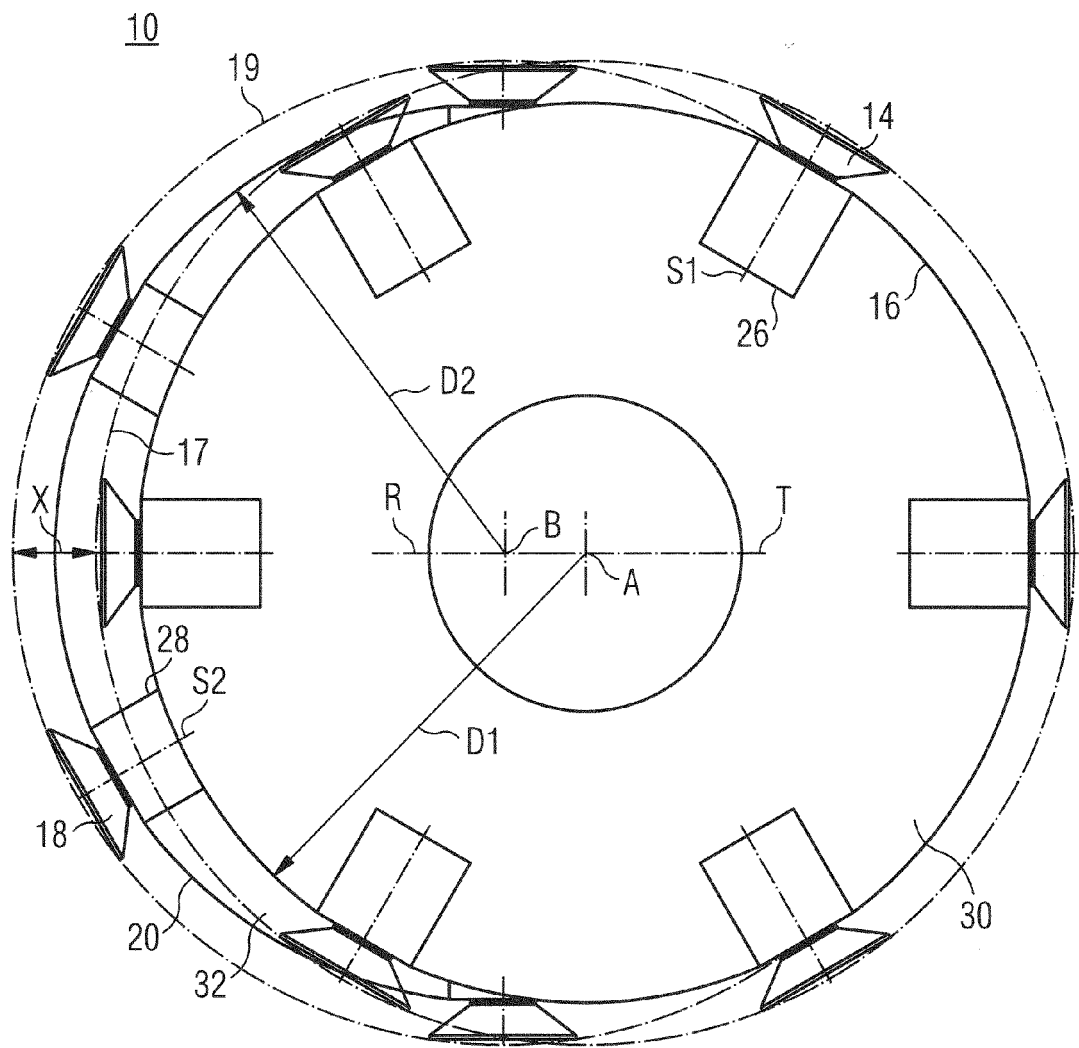
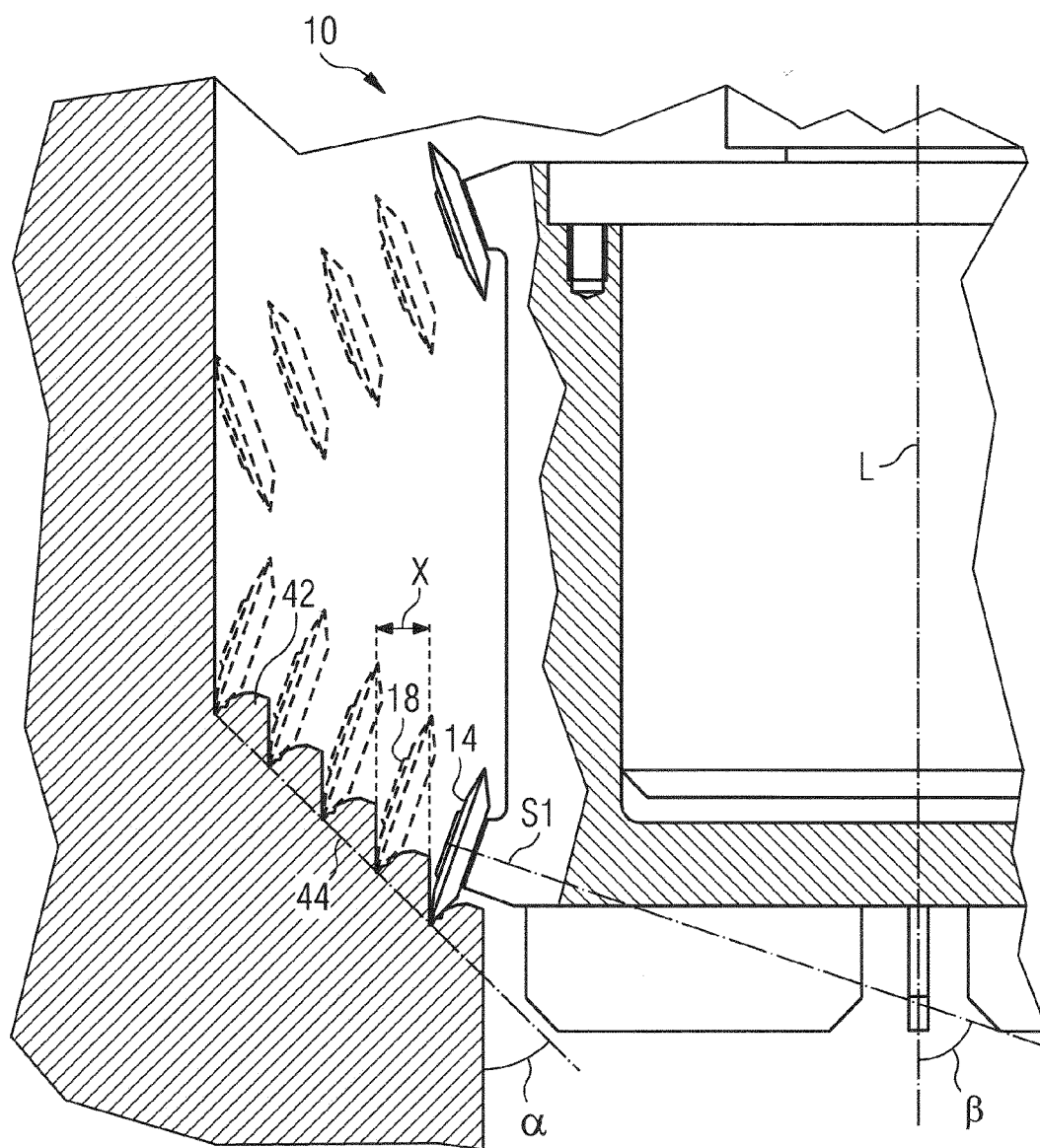


FIG 5





EUROPEAN SEARCH REPORT

 Application Number
 EP 15 15 5049

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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Y	* paragraph [0026] - paragraph [0027]; figures 2,5 *	2	
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