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

(11) **EP 4 344 780 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
03.04.2024 Bulletin 2024/14

(21) Application number: **22199073.2**

(22) Date of filing: **30.09.2022**

(51) International Patent Classification (IPC):
B02C 13/09 *(2006.01)*

(52) Cooperative Patent Classification (CPC):
B02C 13/095

(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:
KH MA MD TN

(71) Applicant: **Sandvik SRP AB**
233 81 Svedala (SE)

(72) Inventors:
- **Forsberg, Andreas**
  23381 Svedala (SE)
- **Kjaerran, Knut**
  23381 Svedala (SE)
- **Dallimore, Rowan**
  23381 Svedala (SE)

(74) Representative: **Sandvik**
Sandvik Intellectual Property AB
811 81 Sandviken (SE)

(54) A HORIZONTAL SHAFT IMPACT CRUSHER

(57) A horizontal shaft impact crusher (10) comprising a crusher housing (15) having an inlet (30) for material to be crushed, an outlet (40) for material that has been crushed, an impeller (50) mounted on a horizontal shaft (60) in the crusher housing (15) and being operative for rotating around a horizontal axis, a curtain (70,80), against which material accelerated by the impeller (50) may be crushed, pivotably mounted on a pivot shaft (90,100) between first and second pivot points (110,120,130,140) either side of the housing (15) defining a curtain shaft pivot point axis (150,160), and an impact relief system (20) for relieving impact loads on the curtain (70,80) in which the impact relief system (20) comprises a shock absorber (170) configured to be in proximity with the curtain shaft pivot point axis (150,160).

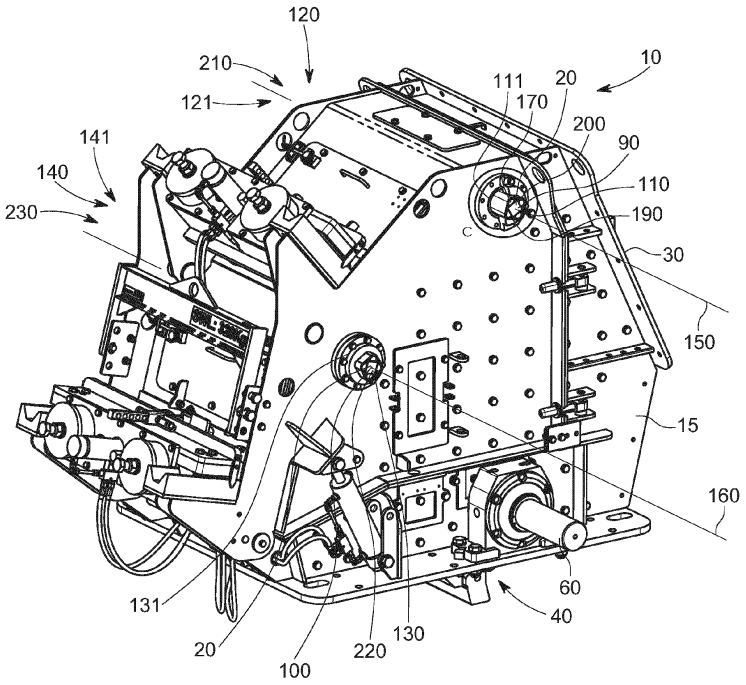

FIG. 2

EP 4 344 780 A1

Description

Field of Invention

[0001] This invention relates to a horizontal shaft impact crusher having a curtain, mounted on a pivot shaft, against which material accelerated by an impeller can be crushed in which the crusher is provided with an impact relief system at the pivot shaft for relieving impact loads on the curtain.

Background of the Invention

[0002] Horizontal shaft impact crushers are utilized in many applications for crushing hard material such as pieces of rock, ore etc. A horizontal shaft impact crusher is generally made up of a housing having an inlet for material to be crushed, an outlet for material that has been crushed, an impeller, mounted on a horizontal shaft in the crusher housing, operative for rotating around a horizontal axis, a curtain mounted between pivot points against which material accelerated by the impeller may be crushed, and an adjustment bar for adjusting the position of said curtain relative to the impeller. Pieces of rock are fed towards the impeller and are struck by beater elements mounted on the impeller. The pieces of rock are disintegrated by being struck by the beater elements and are accelerated and thrown against the curtains where further disintegration occurs.

[0003] The action of the impeller thus causes the material fed to the horizontal shaft impact crusher to move freely in a crushing chamber and to be crushed upon impact against the beater elements, against the curtains, and against other pieces of material moving around at high speed in the crushing chamber.

[0004] During crushing operations, the curtains are exposed to significant impact forces from the pieces of rock that are thrown against the curtains or from oversized material which can result in damage to the curtains and associated elements.

[0005] Accordingly, horizontal impact crushers can be provided with impact relief systems to mitigate the impact forces. The known impact relief systems are typically made up of shock absorbers which absorb impact forces at the curtains by being disposed generally perpendicular to the curtains towards the rear of the crusher. However, this configuration inhibits access to the crusher for servicing which is generally performed via the rear of the crusher. In addition, by being oriented generally perpendicular to the curtains, the known impact relief systems occupy considerable space and increase the crusher footprint required to open and close the crusher housing.

[0006] An object of the invention is to overcome at least some of the problems of the prior art.

Summary of the Invention

[0007] According to the invention there is provided a horizontal shaft impact crusher comprising:

a crusher housing having an inlet for material to be crushed;
an outlet for material that has been crushed;
an impeller mounted on a horizontal shaft in the crusher housing and being operative for rotating around a horizontal axis;
a curtain, against which material accelerated by the impeller may be crushed, pivotably mounted on a pivot shaft between first and second pivot points either side of the housing defining a curtain shaft pivot point axis, and
an impact relief system for relieving impact loads on the curtain
wherein impact relief system comprises

a shock absorber configured to be in proximity with the curtain shaft pivot point axis. By locating an impact relief system in the form of a shock absorber in proximity with the curtain pivot point axis increases the space available in the impact crusher for servicing operations and reduces the overall crusher footprint required when opening and closing the crusher housing.

[0008] In one embodiment, the shock absorber is configured to be in line or contiguous with the pivot point axis. This configuration optimises the available space in the impact crusher and minimises the required crusher footprint.

[0009] In any embodiment, the shock absorber is configured to be in contact with the pivot shaft. Impact pressures on the pivot shaft are therefore resisted effectively.

[0010] In one embodiment, the shock absorber is in contact with the pivot shaft towards a free end of the pivot shaft. The impact relief system can therefore be easily incorporated into the crusher.

[0011] Suitably, the free end of the pivot shaft extends beyond the crusher housing. This provides ease of access to the pivot shaft for the impact relief system.

[0012] In one embodiment, the shock absorber is fixed to the crusher via a shock absorber mounting to resist movement of the pivot shaft under impact loads. The shock absorber mounting therefore supports the shock absorber in place on the crusher.

[0013] In any embodiment, the shock absorber mounting is fixed to the crusher housing. The crusher housing therefore holds the shock absorber mounting in place.

[0014] In one embodiment, the shock absorber mounting comprises a shock absorber housing surrounding the shock absorber. The shock absorber is therefore contained within the shock absorber housing.

[0015] Suitably, the shock absorber housing is fixed to the crusher housing at a fixed ring secured to the housing. The fixed ring and the shock absorber housing are therefore maintained in a stationary position in use.

[0016] In one embodiment, the shock absorber housing has a non-circular cross-sectional shape. The non-circular cross-sectional shape therefore resists rotational

movement in the fixed ring.

[0017] In any embodiment, the pivot shaft free end of the pivot shaft has a non-circular cross-sectional shape. The pivot shaft free end therefore complements the shock absorber housing.

[0018] In any embodiment, the shock absorber comprises a spring. A spring shock absorber is highly effective at resisting impacts.

[0019] In one embodiment, the spring comprises a torsion spring. A torsion spring is a compact spring and assists in minimising the space occupied by the impact relief system.

[0020] Suitably, the torsion spring is a rubber torsion spring. Rubber is a particularly suitable material for a torsion spring.

[0021] In one embodiment, the torsion spring is configured to surround the pivot shaft. By surrounding the pivot shaft, the torsion spring assists in resisting impact loads from all directions.

Brief Description of the Drawings

[0022] The invention will now be described, by way of example only, with reference to the accompanying drawings in which:

Figure 1 is a partially cut away side view through a horizontal shaft impact crusher of the invention with a shock absorber type first impact relief system mounted in proximity with the curtain shaft pivot point axis at the free ends of the pivot shaft of a first upper curtain of the crusher and a second shock absorber impact relief system mounted in proximity with the curtain shaft pivot point axis at the free ends of the pivot shaft of a second lower curtain of the crusher;

Figure 2 is a perspective view from above and one side of the horizontal shaft impact crusher of Figure 1 with a shock absorber type impact relief system at the pivot shaft of the first upper curtain partially cutaway at its outer fixed ring to more clearly show the shock absorber housing;

Figure 3 is an enlarged side view of a shock absorber type impact relief system at the first upper curtain of the horizontal shaft impact crusher of Figure 1, and

Figure 4 is an enlarged perspective view from above and one side of partially cutaway shock absorber type impact relief system at the first upper curtain of the horizontal shaft impact crusher of Figure 2.

Detailed Description of the Invention

[0023] Figures 1 and 2 show a horizontal shaft impact crusher 10 provided with impact relief systems 20 of the invention.

[0024] As shown in the drawings, the horizontal shaft impact crusher 10 comprises a housing 15 having an inlet 30 for receiving material to be crushed, an outlet 40 for material that has been crushed and an impeller 50 within the housing 15. A crusher motor, not illustrated for reasons of maintaining clarity of illustration, is operative for rotating a horizontal shaft 60 on which the impeller 50 is mounted. As an alternative to the impeller 50 being fixed to the shaft 60, the impeller 50 may rotate around the shaft 60. In either case, the impeller 50 is operative for rotating around a horizontal axis, coinciding with the centre of the horizontal shaft 60.

[0025] Internally, the housing 15 is provided with a plurality of wear protection plates 16 that are operative for protecting the walls of the housing 15 from abrasion and from impact by the material to be crushed. Furthermore, the housing 15 comprises a bearing 61 for the horizontal shaft 60. A lower feed plate (not shown) and an upper feed plate (not shown) are arranged at the inlet 30. The feed plates are operative for providing the material fed to the crusher 10 with a suitable direction with respect to the impeller 50.

[0026] As shown particularly in Figure 1, the housing 15 houses a first upper curtain 70, and a second lower curtain 80. Each curtain 70,80 comprises at least one wear plate 73,83 against which material may be crushed.

[0027] The illustrated impeller 50 has four beater elements 51, each such beater element 51 having a bent shape, as shown particularly in Figure 1. The area formed between the impeller 50 and the first and second curtains 70,80 can be called a crushing chamber 11 of the crusher 10.

[0028] An upper end 71 of the first curtain 70 is mounted on a horizontal first pivot shaft 90 extending between first and second oppositely disposed pivot points 110,120 defined by respective openings 111,121 in the housing 15 so that the first pivot shaft 90 is suspended in the housing 15 and can pivot or rotate about a longitudinal and horizontal curtain shaft pivot point axis 150 defined between the pivot points 110,120. Similarly, an upper end 81 of the lower curtain 80 is mounted on a horizontal second pivot shaft 100 extending between first and second pivot points 130,140 defined by respective openings 131,141 so that the second pivot shaft 100 is also suspended in the housing 15 and can pivot or rotate about a longitudinal and horizontal curtain shaft pivot point axis 160 defined between the pivot points 130,140.

[0029] Material to be crushed first reaches the first curtain 70, being located upstream of the second curtain 80 as seen with respect to the direction of travel of the material. By means of the feed plates the material is directed towards the impeller 50 rotating at, typically, 400-850 rpm. When the material is hit by the beater elements 51 it is crushed and accelerated against the wear plates 73 of the first curtain 70 where further crushing occurs. The material bounces back from the first curtain 70 and is crushed further against material travelling in the opposite direction and, again, against the beater elements 51. When the material has been crushed to a sufficiently

small size it moves further down the crusher chamber 11 and is accelerated, by means of the beater elements 51, towards the wear plates 83 of the second curtain 80, being located downstream of the first curtain 70. Hence, the material moves freely around in the crushing chamber 11 and is crushed against the beater elements 51, against the wear plates 73,83 respectively of the curtains 70,80 and against other pieces of material circling around, at a high velocity, in the crusher 10.

[0030] It will be appreciated that the curtains 70,80 are subjected to significant impact forces during crushing operations. Accordingly, as shall be explained in more detail below, an impact relief system 20 is provided in proximity with the pivot point axes 150,160 to mitigate impact forces on the upper and lower curtains 70,80. The impact relief system 20 is made up of a shock absorber 170 such as a spring or springs 180 (hereinafter referred to as a spring 180) disposed in line (i.e. parallel) or contiguous with the pivot point axes 150,160 e.g. the spring 180 can be made up of a body 190 disposed in line with the pivot point axes 150,160.

[0031] In the present embodiment, the first pivot shaft 90 extends beyond the openings 111,121 in the housing 15 to define first and second free ends 200,210 of the first pivot shaft 90 and an impact relief system 20 is provided at both the first free end 200 and the second free end 210. Similarly, the second pivot shaft 100 extends beyond openings 121,131 in the housing 15 to define first and second free ends 220,230 of the second pivot shaft 100 and an impact relief system 20 is provided at the first free end 220 and the second free end 230. However, in other embodiments, an impact relief system 20 can be provided at either free end 200,210 and 220,230 of the pivot shafts 90,100 respectively as required.

[0032] Figures 3 and 4 show enlarged views of the impact relief system 20 of Figures 1 and 2 at the free end 200 of the pivot shaft 90 - the impact relief system 20 at the opposite free end 210 of the pivot shaft 90 being identical in configuration. Similarly, impact relief systems 20 provided at the free ends 220,230 of the pivot shaft 100 are identical in construction to the impact relief system 20 described in more detail below.

[0033] As shown in the drawings, the impact relief system 20 is configured to be in line or contiguous with the pivot point axis 150 and is in the form of a shock absorber 170 in contact with the pivot shaft 90 towards the free end 200 of the pivot shaft 90 which extends beyond the crusher housing 15. The impact relief system 20 is generally made up of a shock absorber 170 in the form of a spring 180 which surrounds the pivot shaft 90. The spring 180 can be a torsion spring 270 such as rubber torsion spring 270. As indicated above, the longitudinal axis of the torsion spring 270 is in line and contiguous with the pivot point axis 150 of the pivot shaft 90 and is fixed to the crusher 10 via a shock absorber mounting 240 which is fixed to the crusher housing 15. The shock absorber mounting 240 together with the torsion spring 270 resist movement of the pivot shaft 90 under impact loads.

[0034] The shock absorber mounting 240 is made up of a tubular shock absorber housing 250 having a crusher housing end 251 surrounding the pivot shaft opening 111 in the housing 15 and an opposite open end 252. In the present embodiment, the shock absorber housing 250 is shaped and configured to have a non-circular cross-section and more particularly a rectangular cross-section such as a square cross-section as shown in the drawings. Similarly, the free end 200 of the pivot shaft 90 is sized, shaped and configured to have a rectangular shape, such as a square shape as shown in the drawings, which is offset with respect to the rectangular shape of the outer shock absorber housing 240 to define elongate channels 280 around the pivot shaft 90 to accommodate the torsion spring 270.

[0035] The shock absorber mounting 240 is further made up of an outer fixed annular ring 290 surrounding the shock absorber housing 250 and extending between the shock absorber housing 250 and the housing 15 to prevent rotational movement of the shock absorber housing 250 so that the shock absorber housing 250 remains static. The annular ring 290 is provided with a rectangular central opening 291 sized and shaped to receive the shock absorber housing 250 in a complementary fit. The annular ring 290 is fixed to the housing 15 via bolts 292 inserted in an outer flange 293 of the annular ring 290.

[0036] In use, the torsion spring 270 relieves impact loads on the pivot shaft 90 and the hence the upper curtain 70 by resisting rotational movement of the pivot shaft 90. In addition, resistance to rotational movement of the pivot shaft 90 is reinforced by the shock absorber housing 250 being maintained in a fixed stationary position by the outer fixed annular ring 290 while resistance to movement of the pivot shaft 90 and the upper curtain 70 is optimised by locating the torsion spring 270 in proximity to the curtain shaft pivot point axis 150. This configuration results in the space available in the impact crusher for servicing operations being significantly increased and, at the same time, the overall crusher footprint required when opening and closing the crusher housing being significantly reduced.

Claims

1. A horizontal shaft impact crusher (10) comprising:

a crusher housing (15) having an inlet (30) for material to be crushed;
an outlet (40) for material that has been crushed;
an impeller (50) mounted on a horizontal shaft (60) in the crusher housing (15) and being operative for rotating around a horizontal axis;
a curtain (70,80), against which material accelerated by the impeller (50) may be crushed, pivotably mounted on a pivot shaft (90,100) between first and second pivot points (110,120,130,140) either side of the housing

(15) defining a curtain shaft pivot point axis (150,160), and
an impact relief system (20) for relieving impact loads on the curtain (70,80)
wherein impact relief system (20) comprises a shock absorber (170) configured to be in proximity with the curtain shaft pivot point axis (150,160).

2. A horizontal shaft impact crusher (10) as claimed in Claim 1 wherein the shock absorber (170) is configured to be in line or contiguous with the pivot point axis (150,160).

3. A horizontal shaft impact crusher (10) as claimed in Claim 1 or Claim 2 wherein the shock absorber (170) is configured to be in contact with the pivot shaft (90,100).

4. A horizontal shaft impact crusher (10) as claimed in Claim 3 wherein the shock absorber (170) is in contact with the pivot shaft (90,100) towards a free end (200,210,220,230) of the pivot shaft (90,100).

5. A horizontal shaft impact crusher (10) as claimed in Claim 4 wherein the free end (200,210,220,230) of the pivot shaft (90,100) extends beyond the crusher housing (15).

6. A horizontal shaft impact crusher (10) as claimed in any of Claims 1 to 5 wherein the shock absorber (170) is fixed to the crusher (10) via a shock absorber mounting (240) to resist movement of the pivot shaft (90,100) under impact loads.

7. A horizontal shaft impact crusher (10) as claimed in Claim 6 wherein the shock absorber mounting (240) is fixed to the crusher housing (15).

8. A horizontal shaft impact crusher (10) as claimed in Claim 6 or Claim 7 wherein the shock absorber mounting (240) comprises a shock absorber housing (250) surrounding the shock absorber (170).

9. A horizontal shaft impact crusher (10) as claimed in Claim 8 wherein the shock absorber housing (250) is fixed to the crusher housing (15) at a fixed ring (290) secured to the housing 15.

10. A horizontal impact crusher (10) as claimed in Claim 8 or Claim 9 wherein the shock absorber housing has a non-circular cross-sectional shape.

11. A horizontal shaft impact crusher (10) as claimed in any of Claims 4 to 10 wherein the pivot shaft free end (200,210,220,230) of the pivot shaft (90,100) has a non-circular cross-sectional shape.

12. A horizontal shaft impact crusher (10) as claimed in any of Claims 1 to 11 wherein the shock absorber (170) comprises a spring (180).

13. A horizontal shaft impact crusher (10) as claimed in Claim 12 wherein the spring comprises a torsion spring (270).

14. A horizontal shaft impact crusher (10) as claimed in Claim 13 wherein the torsion spring is a rubber torsion spring (270).

15. A horizontal shaft impact crusher (10) as claimed in Claim 13 or Claim 14 wherein the torsion spring (270) is configured to surround the pivot shaft (90,100).

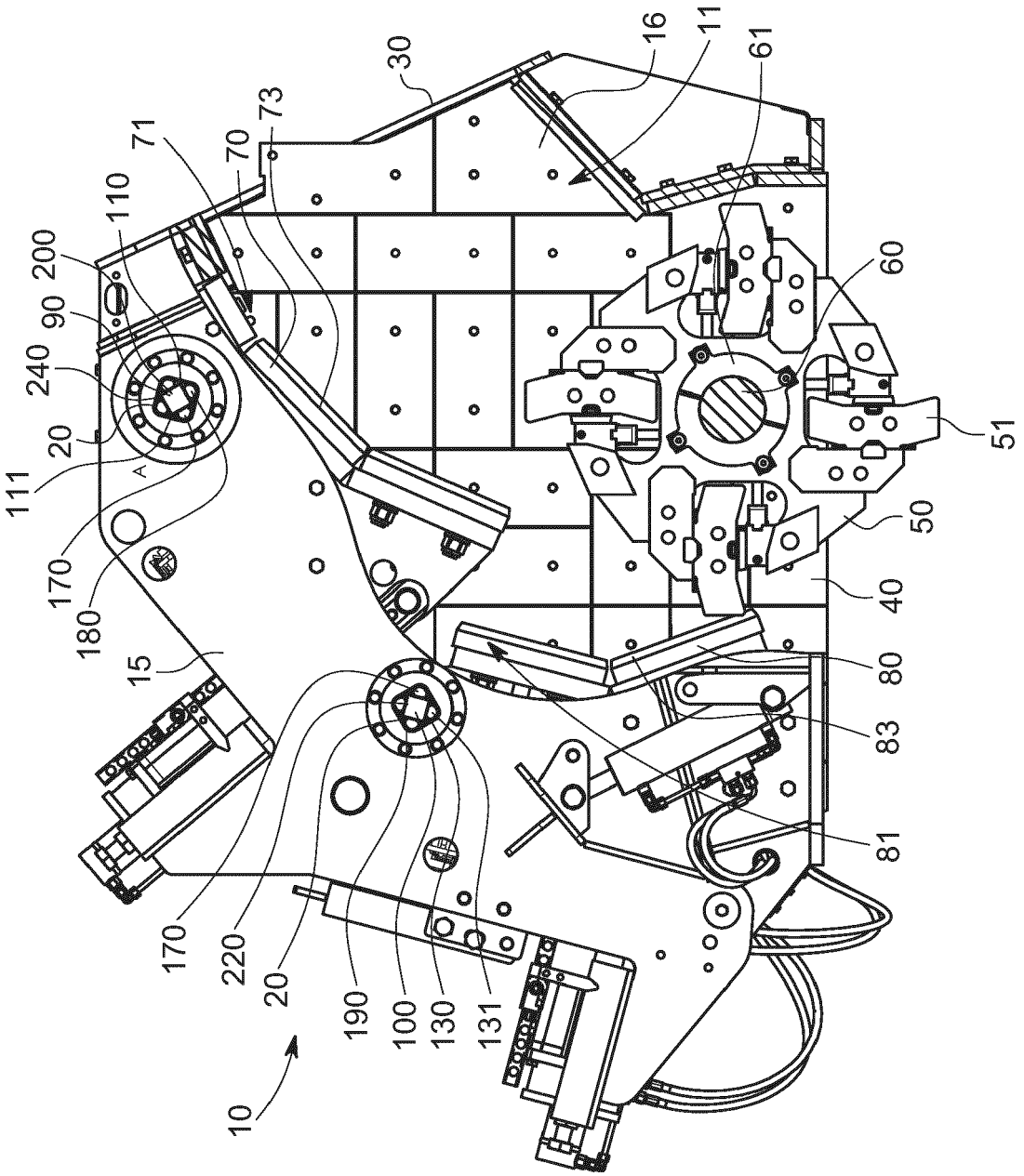
30
16
11
61
73
71
70
110
200
90
240
20
111
170
180
15
60
51
50
40
80
83
81
170
220
20
190
100
130
131
10

FIG. 1

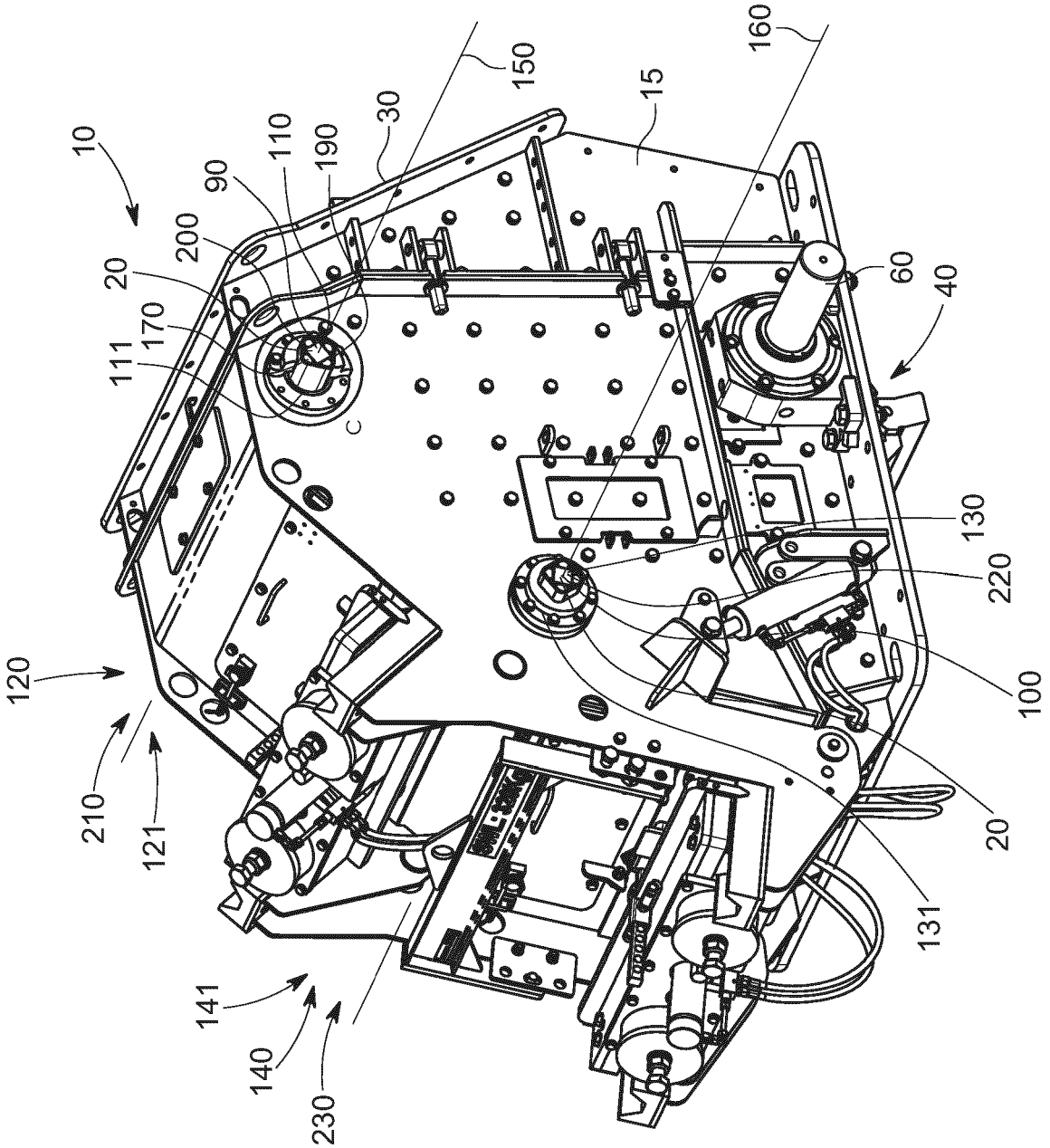
10
20
200
90
110
190
30
150
15
160
60
40
111
170
C
130
220
100
120
210
121
20
131
141
140
230

FIG. 2

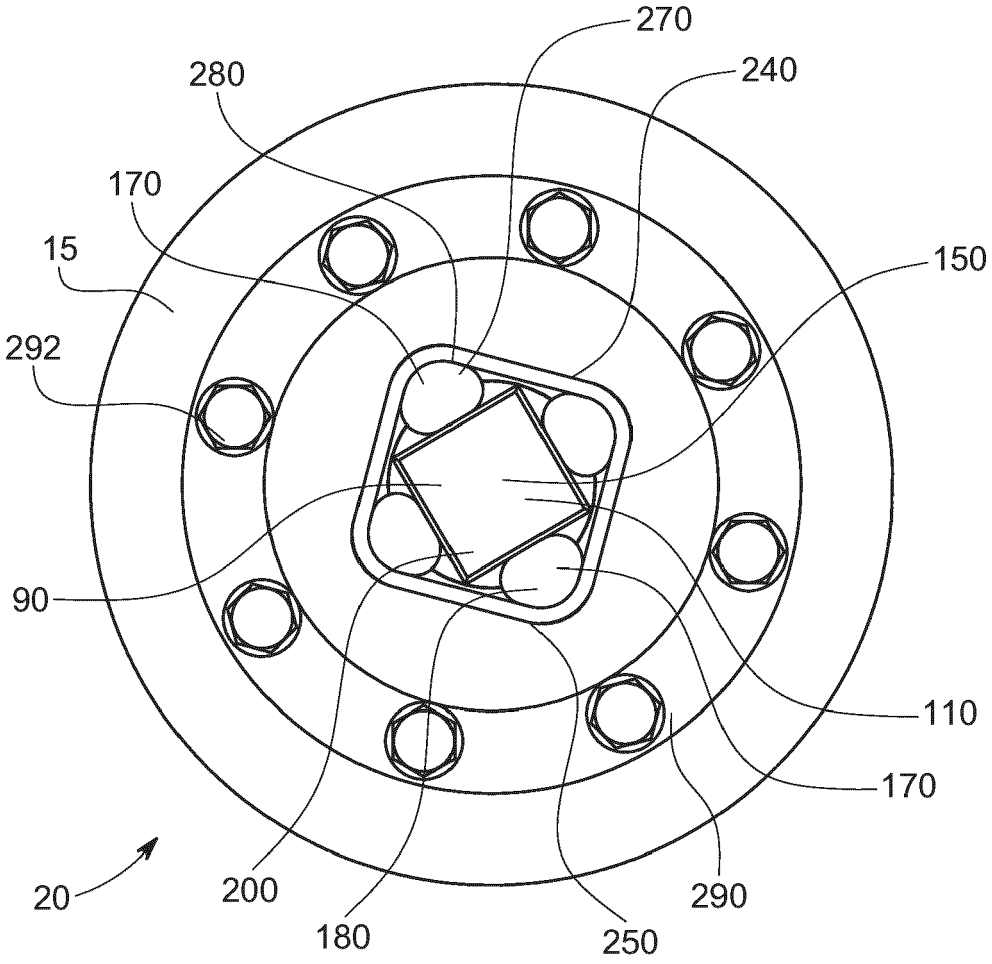

FIG. 3

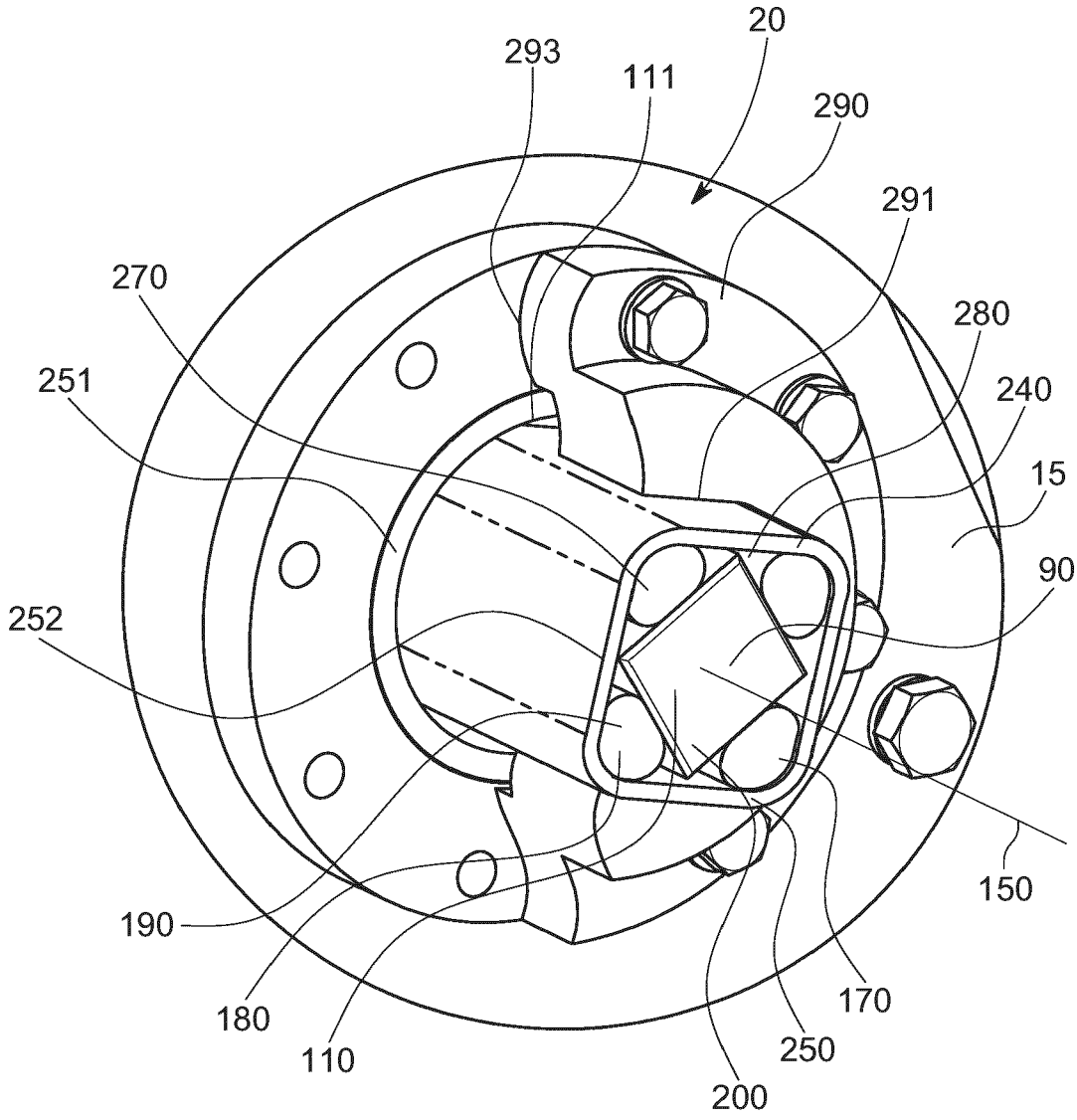
20
293
111
290
291
270
280
251
240
15
90
252
150
190
180
110
200
250
170

FIG. 4

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 22 19 9073

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	CN 113 617 463 A (ZHEJIANG MINE MACHINERY CO LTD; UNIV QUZHOU) 9 November 2021 (2021-11-09)	1,6-10, 12	INV. B02C13/09
A	* abstract; figures *	2-5,11, 13-15	
X	US 2022/203374 A1 (ADCOCK JARED [US] ET AL) 30 June 2022 (2022-06-30)	1,6-10, 12	
A	* paragraph [0017]; figures *	2-5,11, 13-15	
X	EP 1 240 946 A2 (HAZEMAG & EPR GMBH [DE]) 18 September 2002 (2002-09-18)	1,6-10, 12	
A	* paragraph [0013]; figure 2 *	2-5,11, 13-15	
X	GB 2 455 203 A (TEREX PEGSON LTD [GB]) 3 June 2009 (2009-06-03)	1,6-10, 12	
A	* abstract; figure 1 *	2-5,11, 13-15	

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	14 March 2023	von Mittelstaedt, A

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 22 19 9073

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

14-03-2023

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
CN 113617463 A	09-11-2021	NONE	
US 2022203374 A1	30-06-2022	NONE	
EP 1240946 A2	18-09-2002	AU 2319402 A	19-09-2002
		DE 10112959 A1	02-10-2002
		EP 1240946 A2	18-09-2002
		MX PA02002721 A	12-11-2004
		US 2002139880 A1	03-10-2002
		ZA 200202052 B	04-10-2002
GB 2455203 A	03-06-2009	DE 102008044195 A1	10-06-2009
		GB 2455203 A	03-06-2009
		US 2009140089 A1	04-06-2009

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82