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(54) Device for crushing a material

(57) The invention refers to a device for crushing a material, especially coal. The device of the invention solves the technical problem how to provide a compact construction of a device for crushing a material that will be devoid of projecting parts and will at the same time be safe from fire and explosion. The device for crushing a material comprises a steel housing (2), a chain conveyor (5), a crusher roller (6) with crusher blades (8), an electric motor (10), a control unit for controlling the drive of the device, and a planetary gear (22). The electric motor (10) and the planetary gear (22) are arranged in the interior of the crusher roller (6). Rotational movement is transferred from the drive shaft (11) with a pinion (12) to the sun gear (13) and from there to planetary gears (14) and further to the crusher roller with the annular gear (9) with internal toothing. The drive shaft of the electric motor is formed with weakened area (15).

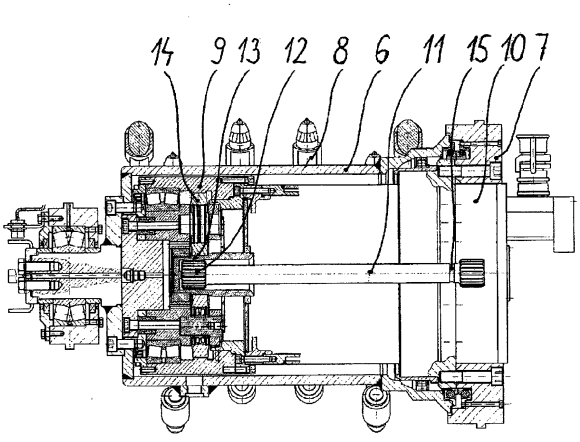


Figure 6

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Description

Field of Invention

[0001] The invention refers to a device for crushing a material, especially coal. It particularly refers to a device for crushing, in which material to be crushed is transported in a substantially horizontal direction, wherein the crushing element is a rotary roller provided with teeth.

Prior Art

[0002] Various devices for crushing materials are known from prior art. Two basic principles of crushing are known: in the first one, a material is accelerated and gets crushed when it hits against a crusher plate, in the second one, there are two plates approaching each other and thus exerting mechanical load onto the material. The plates can be straight and arranged at an angle to each other. The material is crushed when the angle between them is periodically changed. This type of crushers is called jaw crushers. Another type of crushing devices is provided with one concave plane and a conical head performing circular movement, yet not rotating. Relative movement between the planes is thus created. There are known devices with a rotor, on which impact hammers are arranged that crush material by an impact effect. There are also known devices that comprise two toothed rotors driven by huge torque and low rotation velocity. When the rotors rotate in reverse direction, the rotor teeth grab the material and exert mechanical load on it until the material is ruptured, i. e. crushed into smaller pieces. A further group of crushers comprises a rotor with teeth and a fixed crusher plate.

[0003] In known crushers, drive means with a small pulley is arranged on the housing of a crusher and connected with the two crusher rotors by a larger pulley by way of a belt. Rotary parts are protected by covers. One such device is disclosed in document GB 922 986. An advantage of such solution is the fact that no machinery breakage due to possible overload occurs. Overload may occur in a case when a harder material gets between the crusher roller and the crusher plate. In such a case the belt slips onto the pulleys. A disadvantage of such solution resides in the fact that, when the belt glides on the pulleys, heat is generated due to friction and mechanical parts get heated. Crushers are often used at a site where ore or coal is excavated, more precisely in a mine gallery, since they are used for crushing large pieces of ore or coal into smaller ones which are much easier and safer to be further manipulated and transported. Large pieces of material often fall from conveyors, get stuck on filling areas and cause congestions in transportation and damage on conveyors. In mines and coal mines methane and coal dust may be present. Overheating of mechanical parts due to friction therefore presents a potential risk to fire and explosion. A further disadvantage of known crushers is their huge dimensions owing to projecting parts, since driving means are arranged on the housing of the crusher. This poses a considerable obstacle in mines during transport and installation due to a limited space available.

Technical Problem

[0004] The technical problem is how to provide a compact construction of a device for crushing a material with small dimensions in relation to its driving power, which will not have any projecting parts and will at the same time be safe from fire and explosion and safe to work with.

Solution to the Technical Problem

[0005] The technical problem is solved by a device for crushing a material comprising:

- steel housing with a material inlet opening and a material outlet opening,
- chain conveyor arranged through said steel housing provided to supply large pieces of material into the device for crushing a material and to convey away crushed pieces of material from the device for crushing a material,
- hollow crusher roller that is pivotably supported by bearings in the steel housing and closed at one side in a fixed manner and at the other by a detachable cover, and provided at its external circumference with a plurality of crushing blades for crushing the material,
- electric motor arranged in the interior of the crusher roller and detachably fastened on the cover of the crusher roller and having a drive shaft with a pinion,
- planetary gear that engages with the pinion, wherein the planetary gear further comprises:
  - annular gear with internal toothing that is separately connected with the crusher roller,
  - sun gear that engages with its internal toothing with the pinion,
  - plurality of planetary gears, preferably four planetary gears, which are arranged on a support of planetary gears and engage on the one hand with the sun gear and with the annular gear with internal toothing of the crusher roller on the other,
- control unit for controlling the drive of the device for crushing a material.

[0006] Rotational movement is transferred from the drive shaft with a pinion to the sun gear and from there to planetary gears and further to the crusher roller with the annular gear with internal toothing.

[0007] The control unit comprises a relay circuit and at least one temperature sensor that electrically protect the electric motor against overheating in case of overload.

The temperature sensor disconnects the drive electric motor at a pre-determined temperature by means of the relay circuit. Said at least one temperature sensor is arranged in a head of electric winding of the electric motor and/or in a bearing casing of the drive and/or output shaft of the electric motor and/or in a water cooled casing of the electric motor.

[0008] Apart from electric protection of the device for crushing a material mechanical protection of the device is foreseen as well. Mechanical protection protects the device in case of pulse overload The drive shaft of the electric motor is formed with weakened area, such that it gets ruptured in case of overload and the crusher roller immediately loses driving power. Potential destruction of other constructional parts of the device for crushing a material is herewith prevented. Overload occurs when a material of higher hardness gets under the crusher blades and impulse occurs.

[0009] The control unit further comprises at least one sensor for detecting rotation of the crusher roller. In case the drive shaft gets ruptured, the sensor disconnects the electric motor.

[0010] In case of rupture of the drive shaft, the cover closing one of the sides of the crusher roller is dismounted together with the electric motor and the drive shaft. The ruptured drive shaft is replaced by a new one and mounted back into the crusher roller.

[0011] The device for crushing a material further comprises:

- a water supply pipe with at least one sprayer nozzle for spraying water, the nozzle being arranged over the crusher roller and foreseen for cooling crusher blades and reducing dusting while material is crushed,
- screen elements, especially chains, arranged in the area of the inlet opening of the housing and/or outlet opening of the housing that prevent the material from falling from the housing into the ambient of the device for crushing a material upon crushing.

[0012] The crusher blades are equally distributed on the external surface of the crusher roller alternately in a plurality of first V-shaped rows that comprises at least 3, preferably 5 crusher blades, and a plurality of second V-shaped rows that comprise at least 2, preferably 4 crusher blades, wherein the crusher blades of the second row are arranged such that, when viewed in axial direction of the crusher roller, they are arranged substantially on one half of the axial distance of two adjacent crusher blades of the first row.

[0013] Without circumventing the essence of the invention, the device of the invention can be adapted to be suitable for crushing other materials, such as stone, concrete, constructional waste material, wood etc. by adequately selecting drive power, gear ratio of gears, shapes of the crusher blades and their arrangement on the outer cover of the crusher roller; the device can also be used in other environments, such as stone quarries, construction sites, etc.

[0014] Advantages of the device for crushing a material over known devices of this type are a compact geometry of the device devoid of projecting parts, smaller dimensions of the device, smaller device weight, better and easier mobility of the device, good protection of the rotary parts of the device and thus reliable operation of the device, simple assembly and disassembly and maintenance of constructional parts of the drive of the device for crushing a material, electric and mechanical protection of the device against overload, and fire and explosion safe design of the drive of the device.

Figure 1: Device for crushing a material in lateral view
Figure 2: Device for crushing a material in front view
Figure 3: Device for crushing a material in cross-section
Figure 4: Planetary gear in cross-section
Figure 5: Planetary gear in front view
Figure 6: Crusher roller in cross-section
Figure 7: Outer cover of the crusher roller with crusher blades arranged

[0015] The invention will be described in more detail in the continuation by way of an embodiment.

[0016] A device 1 for crushing a material that comprises:

- a steel housing 2 with a material inlet opening 3 and a material outlet opening 4,
- a chain conveyor 5 arranged through said steel housing 2 provided to supply large pieces of material into the device for crushing a material and to convey away crushed pieces of material from the device for crushing a material,
- a hollow crusher roller 6 that is pivotably supported by bearings in the steel housing 2 and closed at one side in a fixed manner and at the other by a detachable cover 7, and provided at its external circumference with a plurality of crushing blades 8 for crushing the material,
- electric motor 10 arranged in the interior of the crusher roller and detachably fastened on the cover 7 of the crusher roller and having a drive shaft 11 with a pinion 12,
- a planetary gear 22 that engages with the pinion 12, wherein the planetary gear 22 further comprises:
  - an annular gear 9 with internal toothing that is separately connected with the crusher roller 6,
  - a sun gear 13 that engages with its internal toothing with the pinion 12,
  - a plurality of planetary gears 14, preferably four planetary gears, which are arranged on a support 19 of planetary gears and engage on the one hand with the sun gear 12 and with the annular gear 9 with internal toothing of the crusher

roller on the other,

- a control unit for controlling the drive of the device for crushing a material.

[0017] In the embodiment, the pinion has 18 teeth, the sun gear is provided with internal toothing with 18 teeth and with external toothing with 33 teeth, the planetary gears have 53 teeth and the annular gear with internal toothing has 144 teeth.

[0018] The control unit comprises a relay circuit and at least one temperature sensor. Said at least one temperature sensor is arranged in a head of electric winding of the electric motor and/or in a bearing casing of the drive and/or output shaft of the electric motor and/or in a water cooled casing of the electric motor. In the embodiment, a thermistor with positive temperature coefficient (PTC) is selected as a temperature sensor.

[0019] The drive shaft of the electric motor is formed with weakened area 15, such that it gets ruptured in case of overload and the crusher roller immediately loses driving power.

[0020] The drive unit further comprises at least one sensor for detecting rotation of the crusher roller. In case the drive shaft gets ruptured, the sensor disconnects the electric motor. The sensor for detecting rotation of the crusher roller can be an pulse sensor.

[0021] In case of rupture of the drive shaft 11, the cover 7 closing one of the sides of the crusher roller 6 is dismounted together with the electric motor 10 and the drive shaft 11. The ruptured drive shaft is replaced by a new one and mounted back into the crusher roller.

[0022] The device for crushing a material further comprises:

- a water supply pipe 16 with at least one sprayer nozzle 17 for spraying water, the nozzle being arranged over the crusher roller 6 and foreseen for cooling crusher blades 8 and reducing dusting while material is crushed,
- screen elements 18, especially chains, arranged in the area of the inlet opening 3 of the housing and/or outlet opening 4 of the housing that prevent the material from falling from the housing 2 into the ambient of the device for crushing a material upon crushing.

[0023] The crusher blades are equally distributed on the external surface of the crusher roller alternately in a plurality of first V-shaped rows 20 that comprises 5 crusher blades, and a plurality of second V-shaped rows 21 that comprises 4 crusher blades, wherein the crusher blades of the second row are arranged such that, when viewed in axial direction of the crusher roller, they are arranged substantially on one half of the axial distance of two adjacent crusher blades of the first row.

[0024] Without circumventing the essence of the invention, the device of the invention can be adapted to be suitable for crushing other materials, such as stone, concrete, constructional waste material, wood etc. by adequately selecting drive power, gear ratio of gears, shapes of the crusher blades and their arrangement on the outer cover of the crusher roller; the device can also be used in other environments, such as stone quarries, construction sites, etc.

Claims

1. A device (1) for crushing a material, especially coal, comprising:

   - a steel housing (2) with a material inlet opening (3) and a material outlet opening (4),
   - chain conveyor (5) arranged through said steel housing (2) provided to supply large pieces of material into the device for crushing a material and to convey away crushed pieces of material from the device for crushing a material,
   - a hollow crusher roller (6) that is pivotably supported by bearings in the steel housing (2) and closed at one side in a fixed manner and at the other by a detachable cover (7), and provided at its external circumference with a plurality of crushing blades (8) for crushing the material,
   - an electric motor (10) having a drive shaft (11) with a pinion (12) and
   - a control unit for controlling the drive of the device for crushing a material, **characterized in that** it further comprises
   - a planetary gear (22) that engages with the pinion (12), wherein the electric motor (10) detachably fastened on the cover (7) of the crusher roller and the planetary gear (22) are arranged in the interior of the crusher roller (6).

2. Device (1) for crushing a material according to claim 1 **characterized in that** the planetary gear (22) further comprises:

   - an annular gear (9) with internal toothing that is separately connected with the crusher roller (6),
   - a sun gear (13) that engages with its internal toothing with the pinion (12),
   - a plurality of planetary gears (14), preferably four planetary gears, which are arranged on a support (19) of planetary gears and engage on the one hand with the sun gear (12) and with the annular gear (9) with internal toothing of the crusher roller on the other.

3. Device (1) for crushing a material according to claims 1 and 2 **characterized in that** the drive shaft (11) of the electric motor is formed with weakened area (15).

4. Device (1) for crushing a material according to any

of preceding claims **characterized in that** the control unit comprises a relay circuit and at least one temperature sensor.

5. Device (1) for crushing a material according to claim 4 **characterized in that** said at least one temperature sensor is arranged in a head of electric winding of the electric motor (10) and/or in a bearing casing of the drive and/or output shaft of the electric motor (10) and/or in a water cooled casing of the electric motor (10).

6. Device (1) for crushing a material according to any of preceding claims **characterized in that** the control unit comprises at least one sensor for detecting rotation of the crusher roller.

7. Device (1) for crushing a material according to claim 6 **characterized in that** the sensor for detecting rotation of the crusher roller is a pulse sensor.

8. Device (1) for crushing a material according to any of preceding claims **characterized in that** it further comprises:

- a water supply pipe (16) with at least one sprayer nozzle (17) for spraying water, the nozzle being arranged over the crusher roller (6), for cooling crusher blades (8) and reducing dusting while material is crushed.

9. Device (1) for crushing a material according to any of preceding claims **characterized in that** it further comprises:

- screen elements (18), especially chains, arranged in the area of the inlet opening (3) of the housing and/or outlet opening (4) of the housing that prevent the material from falling from the housing (2) into the ambient of the device for crushing a material upon crushing.

10. Device (1) for crushing a material according to any of preceding claims **characterized in that** the crusher blades (8) are equally distributed on the external surface of the crusher roller (6) alternately in a plurality of first V-shaped rows (20) that comprises at least 3, preferably 5 crusher blades, and a plurality of second V-shaped rows (21) that comprises at least 2, preferably 4 crusher blades, wherein the crusher blades of the second row (21) are arranged such that, when viewed in axial direction of the crusher roller, they are arranged substantially on one half of the axial distance of two adjacent crusher blades of the first row (20).

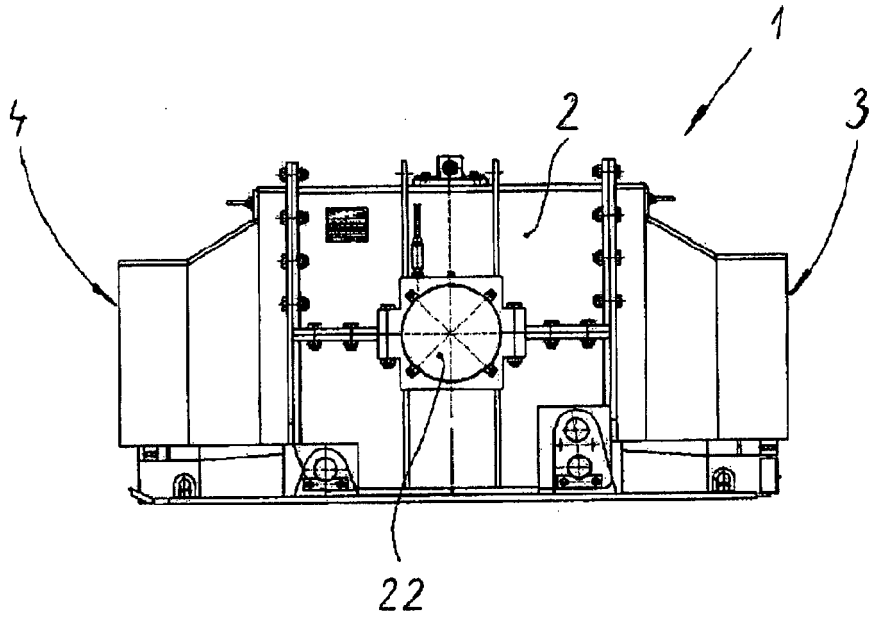


Figure 1

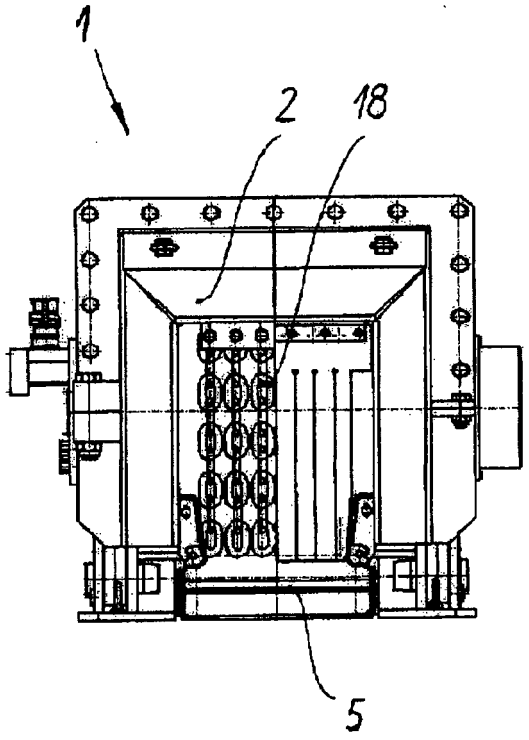


Figure 2

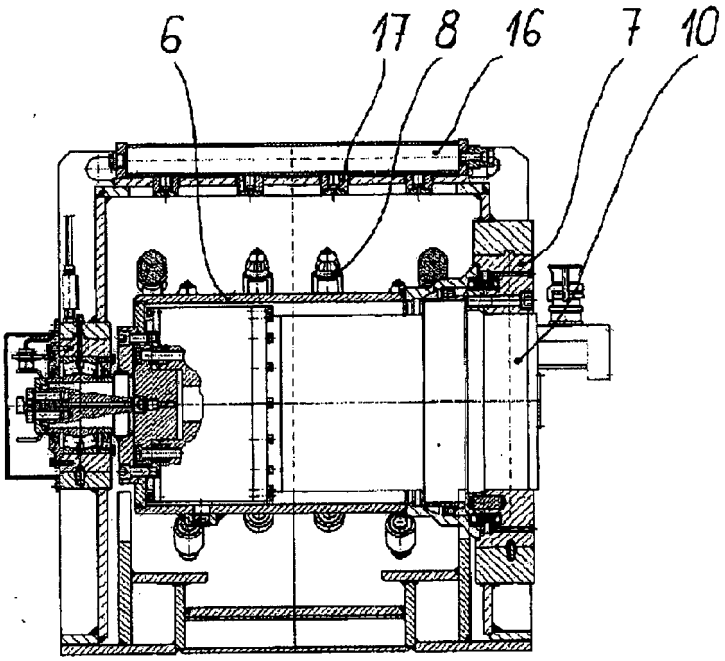


Figure 3

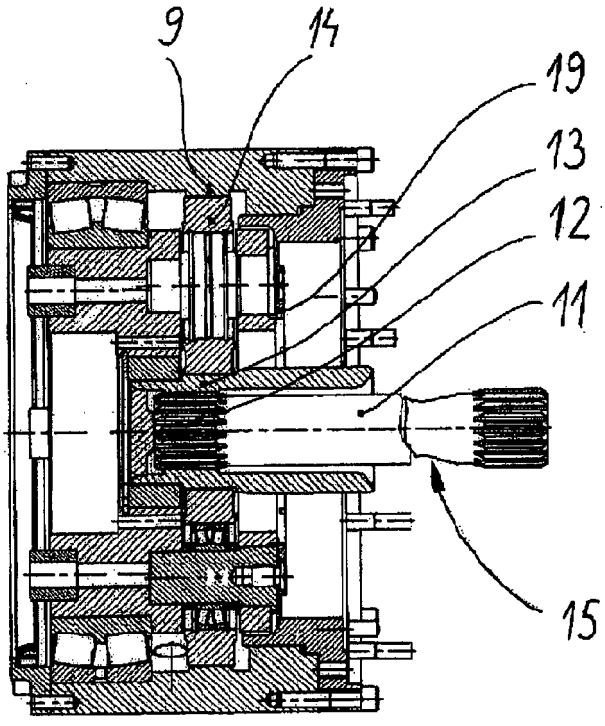


Figure 4

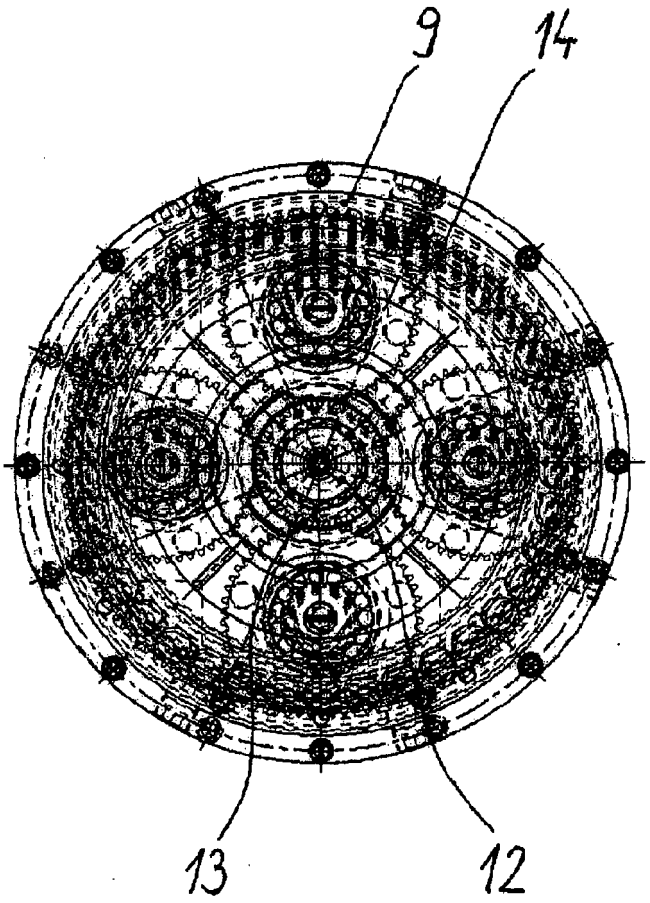


Figure 5

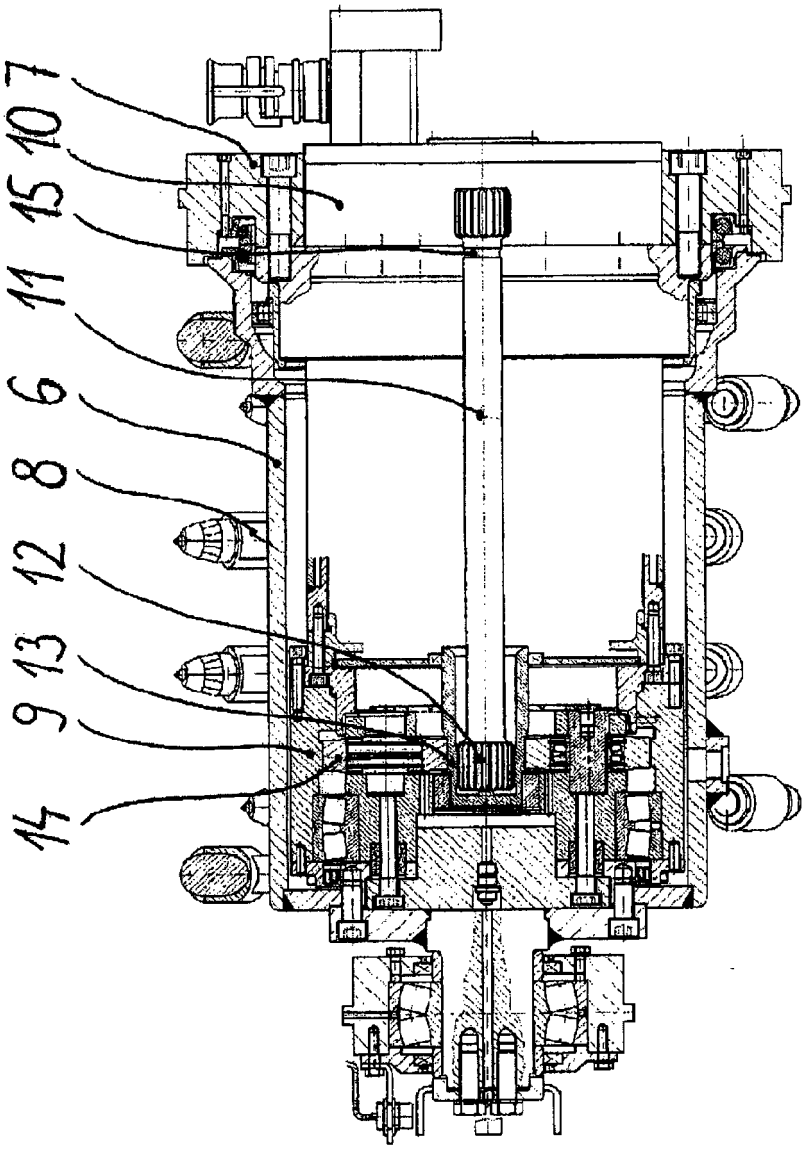


Figure 6

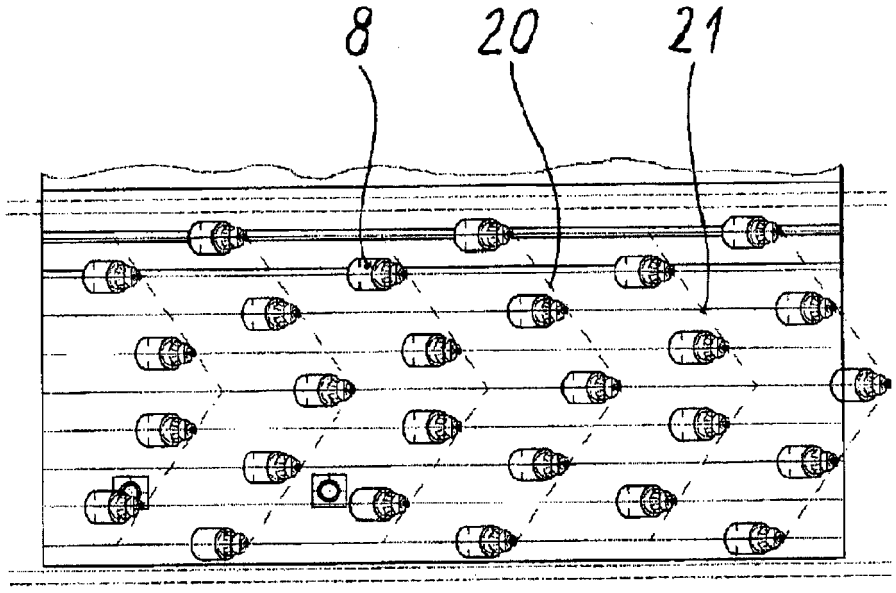


Figure 7

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EUROPEAN SEARCH REPORT

Application Number
EP 14 00 0980

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	WO 92/16296 A1 (GUNDLACH T J CO [US]) 1 October 1992 (1992-10-01) * abstract; claims 1-12; figures 2,5 * * page 2, line 8 - line 11 * * page 3, line 26 - line 27 * * page 6, line 18 - line 35 *	1-10	INV. B02C4/10 B02C4/30 B02C4/42
Y	GB 1 059 694 A (MINING ENGINEERING COMPANY MEC) 22 February 1967 (1967-02-22) * abstract; figures 6,7 * * page 1, line 8 - line 9 *	1-10	
A	US 4 103 832 A (BRAUN ERNST ET AL) 1 August 1978 (1978-08-01) * abstract; figures 1,2 *	1-10	
A	DE 20 2008 017994 U1 (MAAG GEAR AG [CH]) 24 March 2011 (2011-03-24) * abstract; figures 1-5 *	1-10	
			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	17 June 2014	Ciotta, Fausto

CATEGORY OF CITED DOCUMENTS

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17-06-2014

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 9216296 A1	01-10-1992	AU 641861 B2	30-09-1993
		AU 1549292 A	21-10-1992
		US 5249750 A	05-10-1993
		WO 9216296 A1	01-10-1992
GB 1059694 A	22-02-1967	NONE	
US 4103832 A	01-08-1978	DE 2623304 B1	11-08-1977
		FR 2352590 A1	23-12-1977
		GB 1525198 A	20-09-1978
		PL 198261 A1	30-01-1978
		US 4103832 A	01-08-1978
DE 202008017994 U1	24-03-2011	NONE	

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Patent documents cited in the description

- GB 922986 A **[0003]**