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(54) Improved drilling machine

(57) This invention relates to an improved multi-purpose drilling machine of the type comprising a self-propelled vehicle to which is fitted a fifth wheel (5) that carries a support and movement unit (2) for a drilling-rod boom (4), said machine including a system of counterweights (6) mounted on said fifth wheel (5) on the opposite side of the drilling-rod boom to the axis of rotation of said fifth wheel, which said counterweights are designed to offset,

at least partly, the moment created by said drilling-rod boom on the structure of the machine.

In particular, said drilling-rod boom (4) is mounted at the end of an upright (3), which in turn is hinged to said fifth wheel (5) so that said boom (4) can be moved from a substantially vertical to a substantially horizontal position and vice versa, said fifth wheel (5) rotating around an axis parallel to the longitudinal axis of the machine.

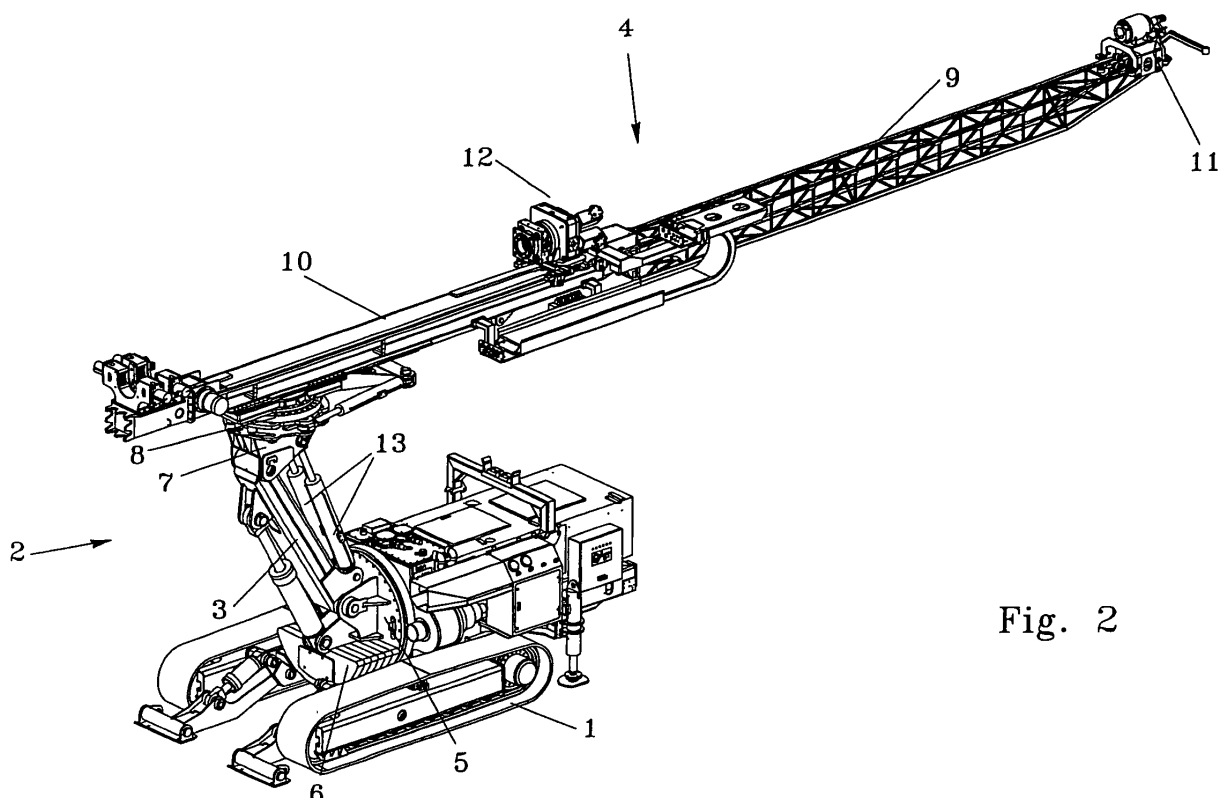


Fig. 2

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Description

[0001] This invention relates to an improved multi-purpose drilling machine.

[0002] In particular, it relates to a multi-purpose drilling machine designed to drill horizontal longitudinal holes in tunnel excavations and vertical holes for jet-grouting work, or holes with any inclination, e.g. for drainage and the like, of the type consisting of a self-propelled tracked vehicle on which is mounted a motor unit connected to a mobile upright that supports a drilling-rod boom.

[0003] Said machine is characterised in that it includes a particular coupling of the upright fitted with counterweights to prevent the machine from overturning when the boom is operating at the maximum distance from the centre of gravity of the machine; it is further characterised in that it includes a locking and compensation system which allows the drilling rod to be positioned precisely on the hole, even when the boom is fully extended and the considerable bending moment created can cause the structure to buckle.

[0004] To excavate a tunnel, it is usually necessary to drill a series of substantially horizontal holes a few centimetres in diameter in the face to be excavated, and insert strengthening elements that prevent the earth above from collapsing during the excavations.

[0005] According to the state of the art, drilling machines to which a drilling-rod boom is fitted are known, said boom being equipped with guides on which a rotary table runs; said boom is supported by two telescopic uprights which can rotate around the longitudinal axis of the machine, allowing holes to be drilled in the largest possible area while the machine remains in the same position.

[0006] According to the state of the art, the majority of these drilling-rod booms are rigid structures, with a fixed length, which can be up to 20-25 metres for the most common applications.

[0007] The problem presented by the systems according to the prior art is that when the uprights are positioned horizontally, ie. the drilling-rod boom is at the maximum distance from the longitudinal axis of the machine, the machine is considerably unbalanced and risks overturning.

[0008] At present, telescopic booms are used to combat this tendency to overturn; however, said booms, which rest on the ground to provide a wider support base, hamper the free movement of the uprights, which often cannot move the drilling-rod boom to ground level.

[0009] Moreover, as the uprights that support the drilling rod are relatively close together, it projects for much of its length, and as it is a fairly heavy structure, it tends to bend, causing inaccuracies in the positioning of the drill bit.

[0010] In order to eliminate the problems described above, this invention provides for the upright that supports the drilling-rod boom to be mounted on a fifth wheel that allows it to rotate around the longitudinal axis of the

machine, and for a system of counterweights to be connected to said fifth wheel to balance the moment caused by the distance of the drilling-rod boom from the centre of gravity of the machine, especially when the upright is in the horizontal position.

[0011] A second improvement relates to the way in which the drilling-rod boom is connected to the upright.

[0012] In particular, the invention comprises a drilling-rod boom support hinged at the upper end of the upright, consisting of two plates between which are inserted a series of adjustable supports that enable the inclination of one plate in relation to the other to be varied slightly, thus compensating for any bending of the projecting structure.

[0013] A fifth wheel which enables the boom to rotate in relation to the end of the upright is fitted to said support.

[0014] This invention will now be described in detail, by way of example but not of limitation, by reference to the annexed figures wherein:

- Figure 1 is a side view of the improved drilling machine;
- Figure 2 is a perspective view of the improved drilling machine;
- Figure 3 is a perspective view of the movement unit of the drilling-rod boom;
- Figure 4 is a side view of the drilling-rod boom support and its locking system;
- Figure 5 is a perspective view of the locking system of the drilling-rod boom support;

[0015] The machine moves on tracks 1 and is fitted with a movement and drilling-rod boom support unit shown as no. 2.

[0016] In particular, said unit comprises an upright 3, to the end of which is fitted boom 4, and which is hinged on the opposite side to a fifth wheel 5.

[0017] Said fifth wheel can rotate, moving the boom from a position at ground level on one side of the machine to a corresponding position on the opposite side.

[0018] A series of counterweights 6, in an eccentric position in relation to the axis of rotation of the fifth wheel, are fitted to said fifth wheel.

[0019] As said counterweights are integral with the mobile plate of the fifth wheel, whatever the position of the mobile boom the moment created by the boom is always balanced, at least partially, thus preventing the machine from overturning.

[0020] This compact, low-cost device solves the problem of overturning risk which affected the systems according to the prior art.

[0021] A support 7 is hinged to the other end of upright 3, and a second fifth wheel 8, which in turn is connected to drilling-rod boom 4, rotates on said support 7.

[0022] Said boom consists of a front part 9 and a beam 10 fixed rigidly to fifth wheel 8.

[0023] Front part 9 of the boom consists of a tubular latticework structure which is both light and rigid, thus

preventing excessive flexural stresses on fifth wheel 8 and the whole of the boom. A support-guide 11 for the drilling rod is positioned at the end of said structure.

[0024] Beam 10 which, as stated, is connected to the upright via a fifth wheel, is a rigid structure. Guides on which the carriage that carries rotary table 12 runs are fitted to said beam 10.

[0025] A pair of pistons 13 cause the support to be inclined from the upright position so as to regulate the inclination of the drilling-rod boom.

[0026] As shown in figure 4, support 7 consists of a lower plate 14 and an upper plate 15 integral with fifth wheel 8.

[0027] The problem that affects the systems according to the prior art is that in view of its considerable length, the drilling-rod boom is subjected to flexural stresses that cause high deflection at the drilling rod bit, leading to imprecision in the positioning of the rod.

[0028] In order to eliminate said problem, this innovation provides for the drilling-rod boom to consist partly of a latticework structure which, being both lighter and more rigid than the structure according to the prior art, considerably reduces bending of the boom.

[0029] Moreover, as the unit comprising support 7, plates 14 and 15 and fifth wheel 8 is the only constraint that supports the boom, it is the element subjected to the maximum bending moment formed by the distributed weight of the boom and the reactions to which the tool is subjected during operations.

[0030] In some cases, this stress can be so intense as to cause bending of the plates and consequent buckling of the support, as said element is fairly elastic.

[0031] Upper plate 15 is parallel to plate 14 when the support is not under load. However, when it is under load, said upper plate tends to tilt by a few degrees in relation to the lower plate, causing a significant movement at the end of the drilling-rod boom.

[0032] To solve this problem, the present invention provides for an adjustable locking device 16 to be inserted between the two plates in such a way that when tightened, said device prevents any relative movement between the two plates.

[0033] As shown in figure 5, said device 16 consists of one or more plates 17 to which one or more perforated threaded pins 18 are welded.

[0034] Sleeves 19, also threaded internally, are screwed to said pins.

[0035] When the boom has been positioned in the desired operating position the device is inserted between the two plates and regulated, so that by screwing sleeves 19 to a greater or lesser extent on threaded pins 18 the length of said elements inserted between the two plates is adjusted, and said plates thus return to a parallel position.

[0036] Next, bolts 20 passing through sleeves 19 and threaded pins 18 are inserted into holes in support plates 7 to lock the assembly and make the support unit more rigid.

[0037] This locking system guarantees that the distance between the two plates of the fifth wheel will remain unchanged, so that they do not move closer together or further apart, thus eliminating the above-mentioned problem of inaccurate tool positioning.

[0038] The result is a multi-purpose drilling machine which simultaneously presents two advantages, namely greater stability than known machines and a more rigid structure.

[0039] An expert in the field could devise various modifications and variations, all of which should be deemed to fall within the ambit of this invention as defined in the appended claims.

Claims

1. Multi-purpose drilling machine of the type comprising a self-propelled vehicle to which is fitted a fifth wheel (5) that carries a support and movement unit (2) for a drilling-rod boom (4), **characterised in that** it includes a system of counterweights (6) mounted on said fifth wheel (5) on the opposite side of the drilling-rod boom to the axis of rotation of said fifth wheel, which said counterweights are designed to offset, at least partly, the moment created by said drilling-rod boom on the structure of the machine.
2. Multi-purpose drilling machine of the type comprising a self-propelled vehicle to which is fitted a fifth wheel that supports a drilling-rod boom, as claimed in claim 1, **characterised in that** said drilling-rod boom (4) is mounted at the end of an upright (3), which in turn is hinged to said fifth wheel (5) so that said boom (4) can be moved from a substantially vertical to a substantially horizontal position and vice versa.
3. Multi-purpose drilling machine as claimed in claim 2, **characterised in that** said fifth wheel (5) rotates around an axis parallel to the longitudinal axis of the machine.
4. Multi-purpose drilling machine as claimed in any of the preceding claims, **characterised in that** said drilling-rod boom (4) is mounted on said upright (3) via a support (7) consisting of two plates (14, 15) with adjustable supports (18, 19) inserted between them.
5. Multi-purpose drilling machine as claimed in the preceding claim, **characterised in that** said adjustable supports are constituted by a plate (17) to which are welded one or more threaded pins (18), to each of which is screwed an adjustable sleeve (19), so that the length of said supports, and consequently the distance between said plates (14, 15), can be varied by screwing in said sleeves to a greater or lesser extent.

6. Multi-purpose drilling machine as claimed in claim 5, **characterised in that** said pins (18) contain holes to allow the insertion of bolts (20) that secure the supports to the plates.

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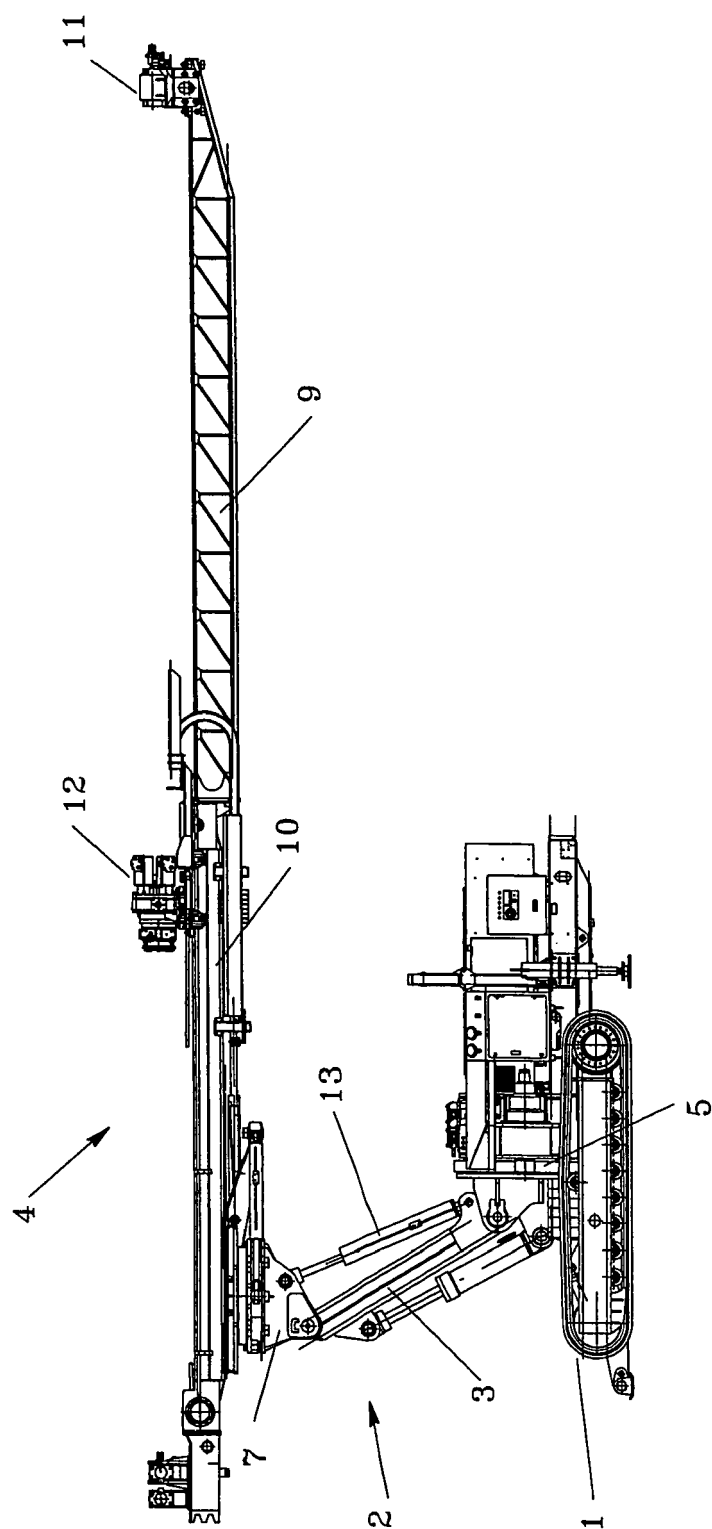


Fig. 1

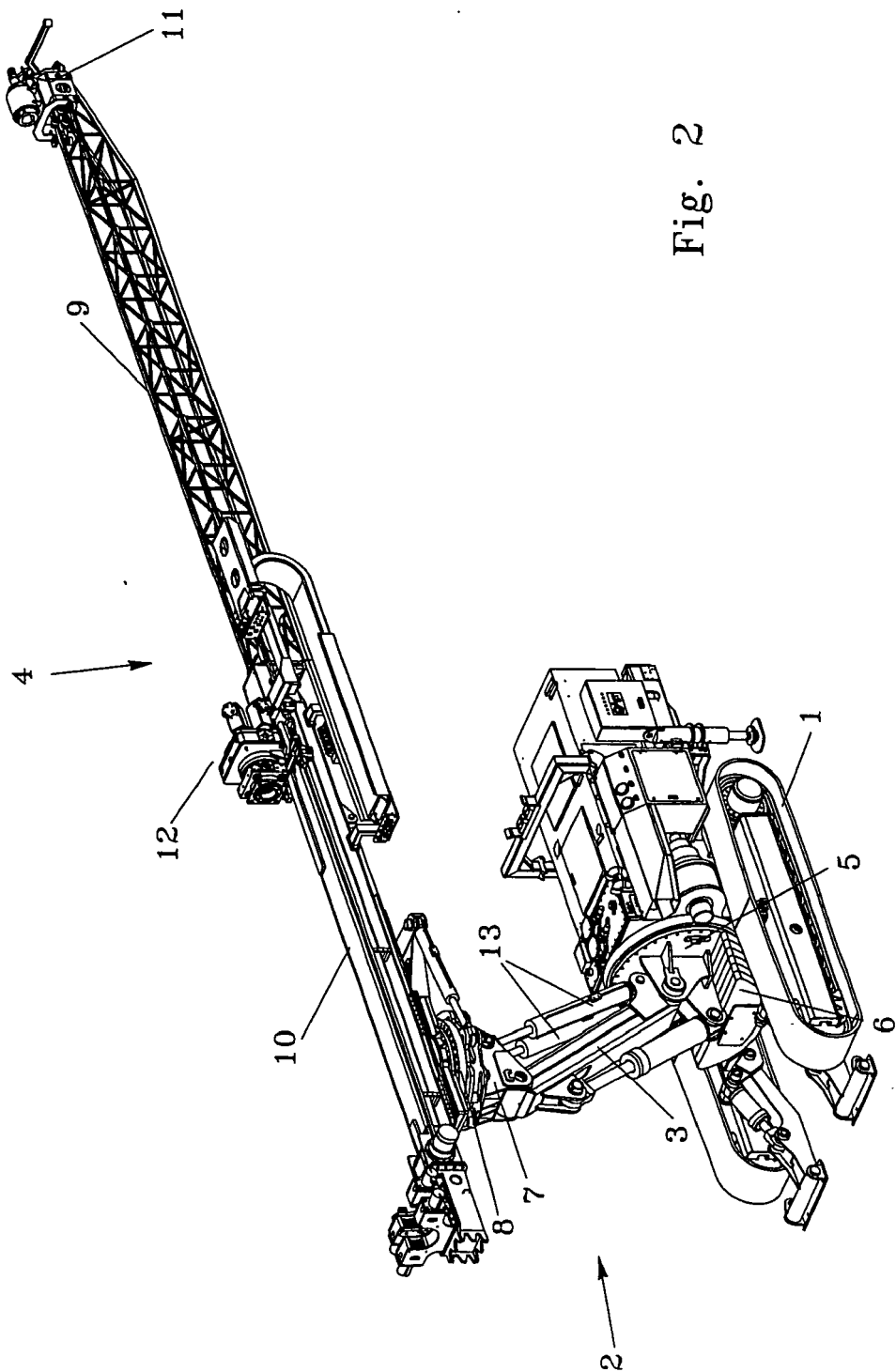


Fig. 2

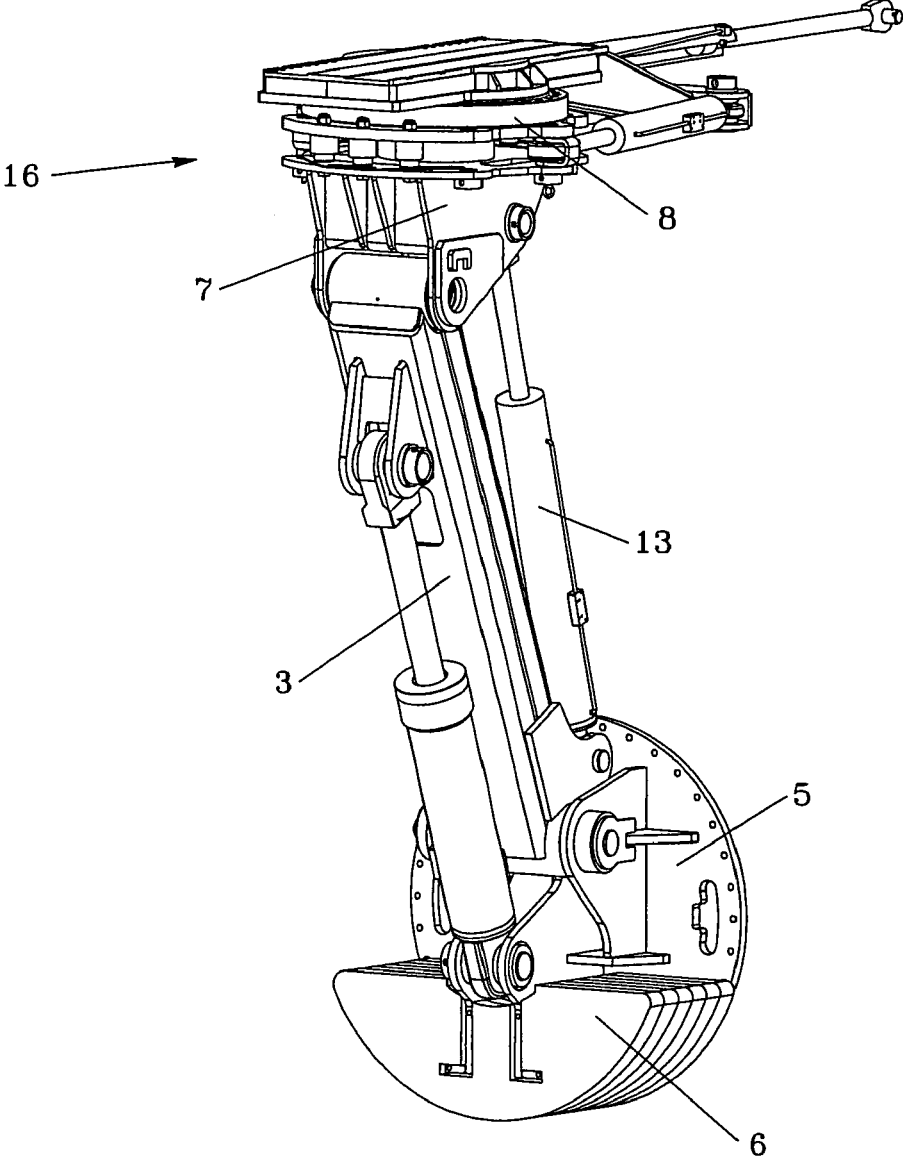


Fig. 3

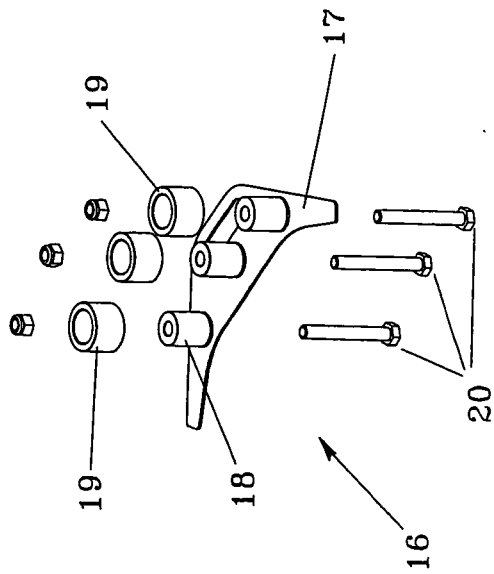


Fig. 5

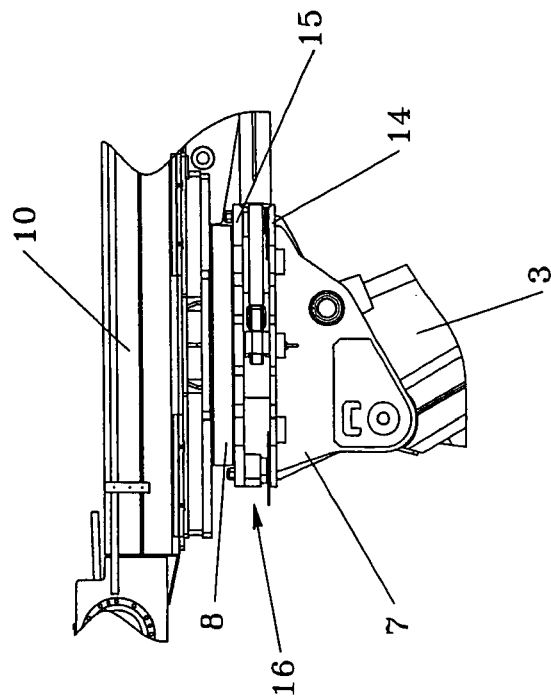


Fig. 4



European Patent
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EUROPEAN SEARCH REPORT

Application Number
EP 07 00 6009

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			TECHNICAL FIELDS SEARCHED (IPC)
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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 3 July 2007	Examiner Manolache, Iustin
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			

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EPO FORM 1503 03 82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
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EP 07 00 6009

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
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