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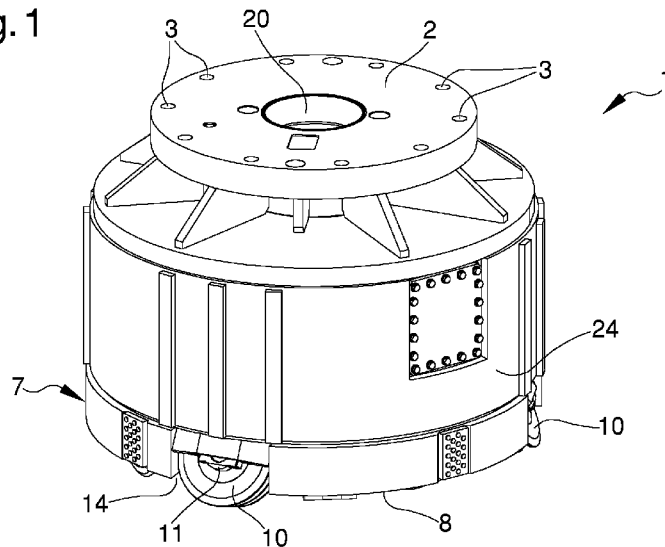
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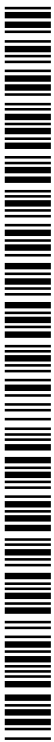
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(54) Title: EXCAVATING HEAD

Fig. 1



(57) Abstract: The excavating head (1) comprises: an attachment element (2) to a driving machine to place the head (1) in rotation; a plate-shaped body (7) having a first main face (8) and a second main face (9), the first main face (8) being facing to the excavation front and the second main face (9) being opposite to the first main face (8) and connected to the attachment element (2); at least an excavation tool (10) associated with the plate-shaped body (7) so as to protrude at least in part from the first main face (8); and suction means (13) of the excavated material associated with said plate-shaped body (7) and comprising: a plurality of through openings (14, 15) and crossing the plate-shaped body (7) between the first main face (8) and the second main face (9); and a hood-shaped element (17) having a suction mouth (18) adjacent to the second main face (9) and surrounding the through openings (14, 15).



## **EXCAVATING HEAD**

### Technical Field

The present invention relates to an excavating head.

### Background Art

5 With reference to the sector of the construction of large works such as tunnels, bridges, dams, aqueducts, foundation pits and the like, excavating heads are known designed to work in a descending direction below the level of seas or rivers, or in terrestrial conditions in the presence of water tables.

These excavating heads operate in the presence of water in the excavated soil  
10 and, for this reason, are also called "heads for wet excavations".

The heads of known type are usually operated in rotation by means of a driving machine, which makes them rotate around a vertical axis gradually as the excavation progresses in depth.

In detail, heads are in use having a plate-shaped body with an upper face with a  
15 plurality of excavation tools arranged staggered with respect to the latter and a side opening crossed by a suction pipe able to aspirate the excavated material.

However, the heads of known type have some drawbacks among which must be included the fact that the suction pipe allows to remove small amounts of excavated material.

20 Another drawback is represented by the fact that the heads of known type have reduced productivity due to the low removal speed of the excavated material that greatly affects the overall excavation speed, leading to long working times.

### Description of the Invention

The main aim of the present invention is to devise an excavating head which  
25 allows removing large amounts of excavated material.

Another object of the present invention is to devise an excavating head which allows increasing the removal speed of the excavated material, considerably reducing working times and increasing the overall productivity of the head itself.

30 Another object of the present invention is to devise an excavating head which allows to overcome the mentioned drawbacks of the prior art within the ambit of a simple, rational, easy, effective to use and affordable solution.

The above mentioned objects are achieved by the present excavating head having the characteristics of claim 1.

#### Brief Description of the Drawings

Other characteristics and advantages of the present invention will become better  
5 evident from the description of a preferred, but not exclusive, embodiment of an excavating head, illustrated by way of an indicative, but non-limiting example in the accompanying drawings, wherein:

Figure 1 is an axonometric view of the head according to the invention;

Figure 2 is an axonometric view from another angle of the head according to the  
10 invention;

Figure 3 is a front sectional view of the head according to the invention.

#### Embodiments of the Invention

With particular reference to such figures, reference number 1 globally indicates an excavating head.

15 The head 1, in particular, allows performing wet excavations.

In the context of this treatise by "wet excavations" are meant excavations that take place below the level of seas or rivers, or in terrestrial conditions in the presence of water tables.

The head 1 comprises an attachment element 2 to a driving machine to place the  
20 head itself in rotation.

With reference to the particular embodiment shown in the illustrations, the attachment element 2 is a flange with bolting holes 3.

The flange 2 can be coupled to a corresponding flanged plate 4 equipping the driving machine.

25 The placing in rotation takes place around a main axis 5 of the head 1, which also identifies the direction of excavation 6.

Advantageously, the main axis 5 is vertical and the direction of excavation 6 is downwards.

Furthermore, it is specified that in the present treatise expressions such as  
30 "high", "low", "upper", "lower", "above", "below" and the like, are to be deemed with reference to an operative configuration wherein the head 1 is used for downward vertical excavations.

It cannot however be ruled out that the direction of excavation 6 can be horizontal, in which case the head 1 is used in an operative configuration wherein the main axis 5 is horizontal.

The head 1 comprises a plate-shaped body 7 having a first main face 8 and a  
5 second main face 9.

With reference to the particular embodiment shown in the illustrations, the plate-shaped body 7 is a substantially circular plate coaxial to the main axis 5.

Advantageously, the first main face 8 is facing to the excavation front and the second main face 9 is opposite to the first main face 8 and is connected to the  
10 attachment element 2.

In the context of this treatise by "excavation front" is meant the margin defined by the material to be excavated, along the direction of excavation 6.

In the operative configuration, shown in the illustrations, wherein the main axis 5 is vertical, the plate-shaped body 7 is substantially horizontal and the first  
15 main face 8 is lower than the second main face 9.

The head 1 comprises at least an excavation tool 10 associated with the plate-shaped body 7 so as to protrude at least in part from the first main face 8.

Advantageously, the plate-shaped body 7 comprises a plurality of tools 10.

The tools 10 have variable shape and size according to the type and dimensions  
20 of the excavation.

With reference to the particular embodiment shown in the illustrations, the tools 10 are composed of a substantially cylindrical or frusto-conical body having a sharp or abrasive outer surface.

Conveniently, the tools 10 are mounted idle on the plate-shaped body 7.

25 In the present case, each tool 10 is associated with the plate-shaped body 7 by means of axial pins 11 separate and parallel to each other which allow its free rotation around a central axis of symmetry of the tool 10.

With reference to the particular embodiment shown in the illustrations, the tools 10 are arranged asymmetrically with respect to the main axis 5 and have axes of  
30 rotation with different inclinations according to their position on the plate-shaped body 7.

For example, the tools 10 arranged in the proximity of the main axis 5 have the

axis of rotation substantially coplanar to the first main face 8, whereas the tools 10 arranged peripherally to the plate-shaped body 7 have the axis of rotation inclined with respect the first main face 8, i.e. arranged neither vertically nor horizontally.

- 5 Advantageously, the tools 10 define an excavation plane 12 tangent to the tools themselves.

The excavation plane 12, in practice, consists in an imaginary plane which, in the operative configuration of the head 1, is substantially horizontal and tangent to the lower part of each tool 10.

- 10 The head 1 comprises suction means 13 of the excavated material associated with the plate-shaped body 7.

The suction means 13 comprise a plurality of through openings 14, 15 and crossing the plate-shaped body 7 between the first main face 8 and the second main face 9.

- 15 Conveniently, the tools 10 are at least partially housed within at least one of the through openings 14, 15.

In particular, each tool 10 is at least partially housed within one and only one corresponding through opening 14, 15 and emerges (i.e. protrudes) from the first main face 8 for at least one-twentieth of its volume.

- 20 Advantageously, the axial pins 11 of the tools 10 are arranged inside the through openings 14, 15 and the material excavated by the tools 10 is able to cross the plate-shaped body 7, passing in the space defined between the tools 10 and the inner walls of the through openings 14, 15.

Not all through openings 14, 15 house a tool 10.

- 25 With reference to the particular embodiment shown in the illustrations, in fact, the through openings 14, 15 comprise a plurality of first through openings 14, accommodating at least partially the tools 10, and at least a second through opening 15, clear of the tools 10.

- 30 The second through opening 15 has a projecting edge 16 protruding from the first main face 8.

Conveniently, the projecting edge 16 extends from the first main face 8 to a distance very close to the excavation plane 12.

It is easy to understand how the presence of the projecting edge 16 allows to aspirate the excavated material through the second through opening 15, going to withdraw directly in the proximity of the excavation front, and, therefore, to increase the flow rate of the material excavated at inlet, thus obtaining greater excavation speed.

The suction means 13 also comprise a hood-shaped element 17 having a suction mouth 18 adjacent to the second main face 9 and surrounding the through openings 14, 15.

Advantageously, the hood-shaped element 17 has a substantially frusto-conical shape wherein the suction mouth 18 defines the larger base of the truncated cone and is substantially circular.

The suction mouth 18 has a diameter more or less equal to the diameter of the plate-shaped body 7 and, therefore, surrounds and covers all through openings 14, 15 formed on the plate-shaped body itself.

The hood-shaped element 17 also comprises an outlet section 19 of the excavated material having a smaller surface extension than the suction mouth 18.

The suction mouth 18 is also circular and defines the smaller base of the truncated cone.

Preferably, the hood-shaped element 17, the suction mouth 18 and the outlet section 19 are coaxial to the main axis 5.

In addition, the suction means 13 comprise a suction tubular length 20 of the excavated material associated with the outlet section 19.

With reference to the particular embodiment shown in the illustrations, the suction tubular length 20 is associated on the top with the suction mouth 18.

The suction tubular length 20 of the head 1 is in fluid connection with a conveying tube 21 equipping the driving machine.

The conveying tube 21 is associated with the flanged plate 4 and permits to send the material from depth to the surface.

The suction means 13 comprise at least an air forced introduction pipe 22 in the suction tubular length 20 able to generate a suction force of the excavated material.

Advantageously, the suction means 13 comprise a plurality of air forced introduction pipes 22 arranged around the suction tubular length 20.

The forced introduction pipes 22 communicate on the top, i.e. at inlet, with blowing tubes 23 equipping the driving machine and on the bottom, i.e. at  
5 output, with the suction tubular length 20.

The pressurized air is introduced inside the suction tubular length 20, thus creating a differential pressure which causes the excavated material to lift inside the suction tubular length itself, this phenomenon being known to the person skilled in the art as reverse circulation (RCD).

10 With reference to the particular embodiment shown in the illustrations, the plate-shaped body 7 has a lateral perimeter of circular shape from which extends a shell 24 of substantially cylindrical shape, able to laterally protect the hood-shaped element 17.

Advantageously, the head 1 comprises control means 25 of the inclination of the  
15 plate-shaped body 7.

Said control means 25 are able to allow the control of the inclination of the plate-shaped body 7, during the excavation operations.

In this regard, the control means 25 comprise an oscillometer accommodated in the space between the hood-shaped element 17 and the shell 24.

20 It cannot however be ruled out that the head 1 can comprise other monitoring devices of the excavation conditions, such as e.g. a thermometer, a hygrometer, or the like.

The operation of the present invention is as follows.

The head 1 is made to rotate by the operation of the driving machine.

25 The tools 10 are operated in rotation by means of the pressure of the head 1 against the excavation front.

Simultaneously the excavated material passes through the through openings 14, 15 and is suctioned by the hood-shaped element 17 along the suction tubular length 20, and then is made to exit through the conveying tube 21.

30 It has in practice been ascertained how the described invention achieves the intended objects.

In particular, the fact is underlined that the particular solution of providing a

hood-shaped element cooperating with a plurality of through openings formed through the plate-shaped body, permits increasing the amount of material removed in the unit of time and greatly increases the productivity of the excavating head.

**CLAIMS**

- 1) Excavating head (1) comprising:
- at least an attachment element (2) to a driving machine to place said head (1) in rotation;
- 5 - at least a plate-shaped body (7) having at least a first main face (8) and at least a second main face (9), said first main face (8) being facing to the excavation front and said second main face (9) being opposite to said first main face (8) and connected to said attachment element (2);
- at least an excavation tool (10) associated with said plate-shaped body (7) so as to protrude at least in part from said first main face (8); and
- 10 - suction means (13) of the excavated material associated with said plate-shaped body (7);
- characterized by the fact that said suction means (13) comprise:
- a plurality of through openings (14, 15) and crossing said plate-shaped body
- 15 (7) between said first main face (8) and said second main face (9); and
- at least a hood-shaped element (17) having a suction mouth (18) adjacent to said second main face (9) and surrounding said through openings (14, 15).
- 2) Head (1) according to claim 1, characterized by the fact that said tool (10) is housed at least in part within at least one of said through openings (14, 15).
- 20 3) Head (1) according to claim 2, characterized by the fact that said tool (10) housed at least in part within at least one of said openings (14, 15) emerges from said first main face (8) for at least one-twentieth of its volume.
- 4) Head (1) according to one or more of the preceding claims, characterized by the fact that it comprises a plurality of said tools (10) each of which is housed at
- 25 least in part within one of said through openings (14, 15).
- 5) Head (1) according to claim 4, characterized by the fact that said through openings (14, 15) comprise a plurality of first through openings (14) accommodating at least partially said tools (10) and at least a second through opening (15) clear of said tools (10).
- 30 6) Head (1) according to claim 5, characterized by the fact that said second through opening (15) has a projecting edge (16) from said first main face (8).
- 7) Head (1) according to one or more of the preceding claims, characterized by

the fact that said hood-shaped element (17) has a substantially frusto-conical shape.

8) Head (1) according to one or more of the preceding claims, characterized by the fact that said hood-shaped element (17) comprises an outlet section (19) of  
5 said excavated material having a surface extension smaller than said suction mouth (18), and by the fact that said suction means (13) comprise a suction tubular length (20) of said excavated material associated with said outlet section (19).

9) Head (1) according to claim 8, characterized by the fact that said suction  
10 means (13) comprise at least an air forced introduction pipe (22) in said suction tubular length (20) able to generate a suction force of said excavated material.

10) Head (1) according to claim 9, characterized by the fact that said suction means (13) comprise a plurality of said air forced introduction pipes (22) arranged around said suction tubular length (20).

15 11) Head (1) according to one or more of the preceding claims, characterized by the fact that said plate-shaped body (7) has a lateral perimeter of circular shape from which extends a shell (24) of a substantially cylindrical shape for the lateral protection of said hood-shaped element (17).

12) Head (1) according to one or more of the preceding claims, characterized by  
20 the fact that it comprises control means (25) of the inclination of said plate-shaped body (7).

13) Head (1) according to claims 11 and 12, characterized by the fact that said control means (25) comprise an oscillometer accommodated in the space between said hood-shaped element (17) and said shell (24).

Fig. 1

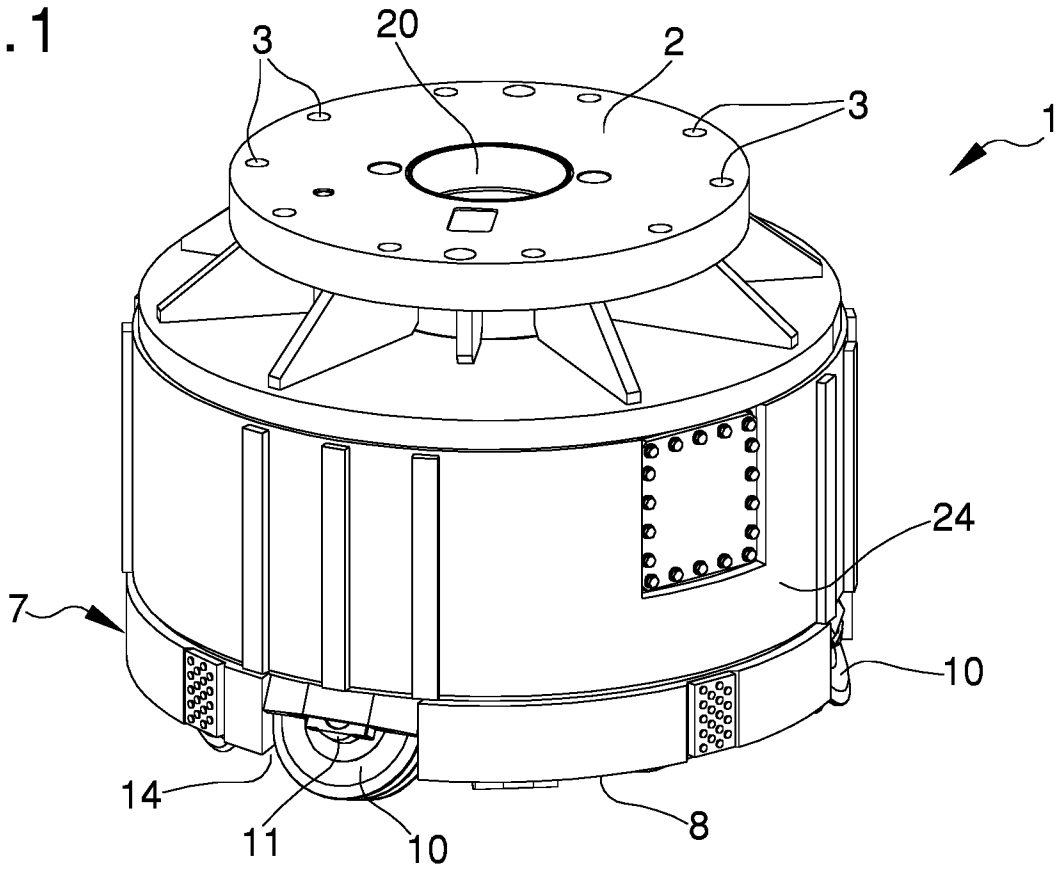
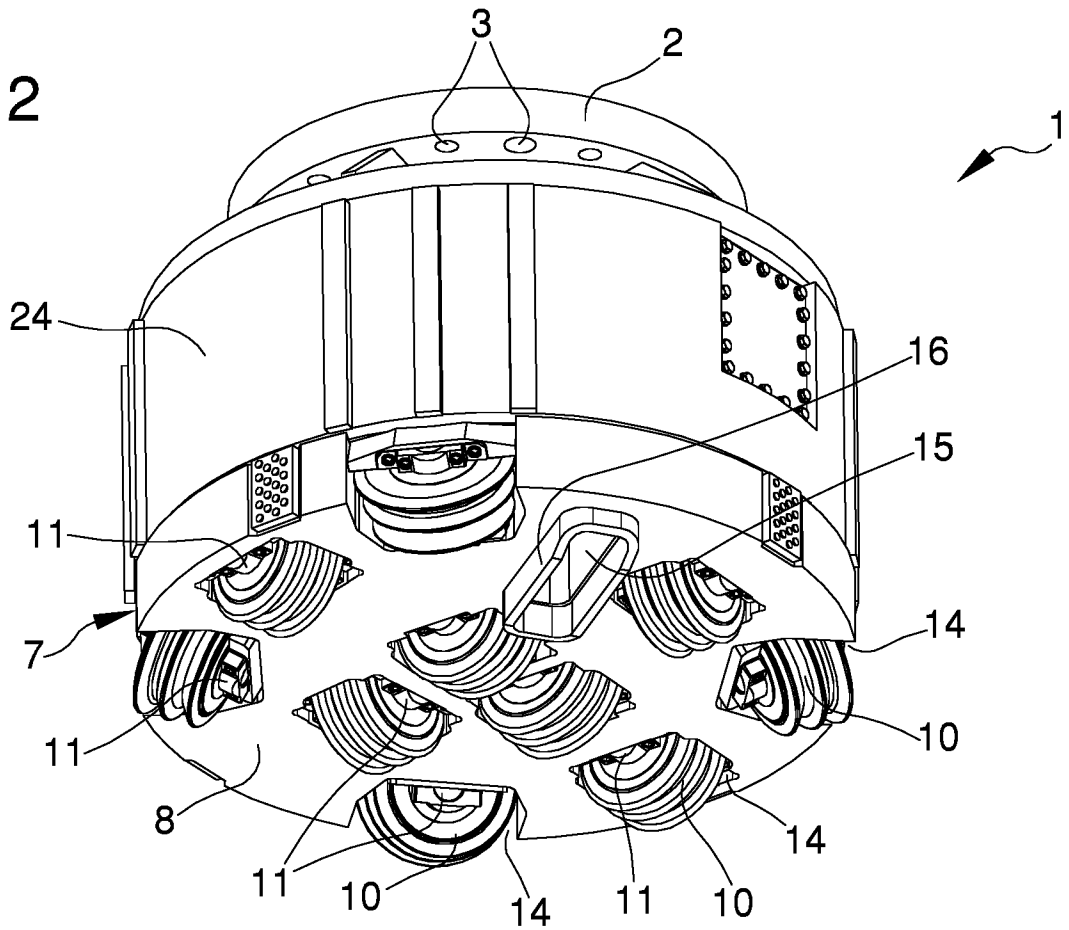


Fig. 2



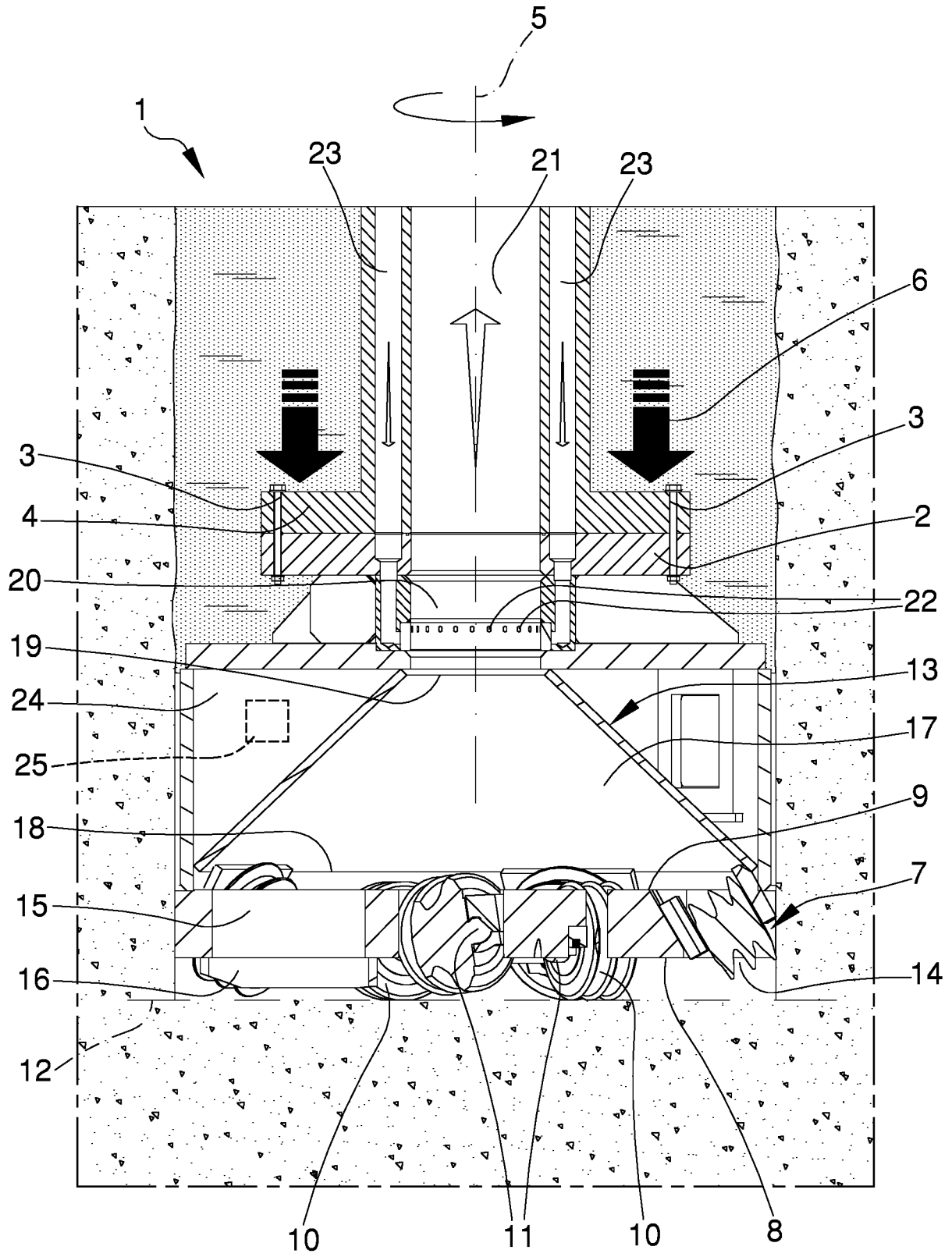


Fig. 3

**INTERNATIONAL SEARCH REPORT**

International application No  
PCT/IB2016/051387

A. CLASSIFICATION OF SUBJECT MATTER  
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ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)  
E21B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

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Y	US 3 967 463 A (GRANDORI CARLO) 6 July 1976 (1976-07-06) column 4, line 24 - column 6, line 65; figures 1-3	1-13
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Further documents are listed in the continuation of Box C.  See patent family annex.

\* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search  7 June 2016	Date of mailing of the international search report  17/06/2016
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Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer  Manolache, Iustin
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## INTERNATIONAL SEARCH REPORT

International application No

PCT/IB2016/051387

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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Information on patent family members

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