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(54) SYSTEM FOR THE CONTINUOUS EXCAVATION OF CUT-OFF WALLS

(57) The system is based on a shovel whose jaws (3) have a system which pushes the material towards a loading chamber (4) with no-return gates (5), wherein a pressure filter effect is produced, separating the liquids and the bentonite mud using filtering zones. The compressed material, free of liquid and mud, ascends to a continuous transporting means comprising a loading chamber (10) of variable volume, actuated by hydraulic cylinders (11'), with lower gates (12) and upper gates (12') which "pump" the material towards an evacuation pipe (13) which extends up to the surface. The system provides for the evacuation, extraction and unloading of the material to the surface, in a completely continuous way, without the need to interrupt the excavation for extraction with the jaws (3), which is what is conventionally done. In addition, the material extracted is also compacted and perfectly inert for the purposes of dumping and poses no danger from an environmental point of view.

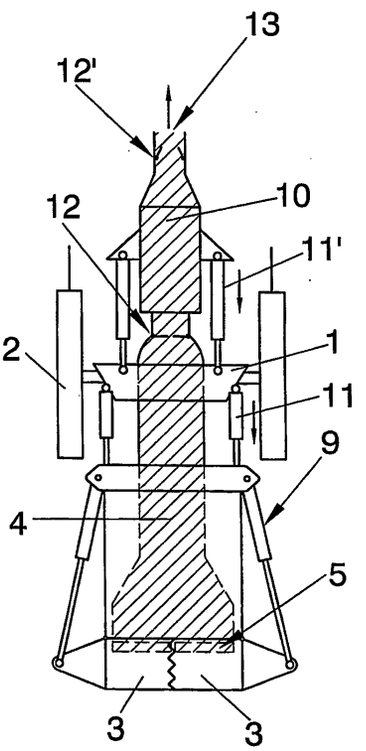

FIG. 6

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Description

OBJECT OF THE INVENTION

[0001] The present invention relates to a cut-off wall continuous excavation system, whose purpose is to excavate earth and extract it to the surface, with no interruptions in the process. The system also provides for the material extracted to be compact and free of bentonite mud used during excavation, whereon the wall or cut-off is built, in such a way that the solid material extracted and compacted is perfectly inert for the purposes of dumping and poses no danger from an environmental point of view.

BACKGROUND OF THE INVENTION

[0002] In a large majority of constructions built on subsoil, such as car parks, basements and buildings in general, a cut-off wall must first be built around the construction in order to enclose and make the construction watertight, as well as support the outside earth during construction of the new structure, and even bear some of the weight of the future construction.

[0003] Cut-off walls are usually built using diggers with shovels which excavate and extract the earth to the surface. To prevent the walls of the cut-off from giving way while being built, during excavation, the hole dug out is filled with bentonite mud, so that the earth extracted and mixed with the bentonite mud is loaded onto trucks which transport it to inert waste dumps, a process which poses various problems, the following being cited as the most important:

- the mixture of earth with bentonite mud is a more or less liquid product which, during the transportation chain, often causes spilling, resulting in contamination, a problem which is aggravated in urban settings.
- Bentonite, although a type of clay, is a contaminant. If unloaded with very high water content, it contaminates the actual subsoil by lixiviation, also potentially causing problems of stability in the slopes of the waste dump piling.
- The problems referred to in the two previous points have led some countries to introduce certain restrictions on the use of bentonite.

[0004] As far as the means or systems of cut-off wall excavation currently used are concerned, we can cite two fundamental systems, both of which are coupled to a self-propelled crane, one consisting in the traditional shovel system which excavates the earth using respective shovel jaws, which extract the material or earth together with some of the mud from perforation, making the extraction time quite considerable, and which increases with depth, since the shovel has to be removed, unloaded in the truck and repositioned in the place of excavation.

[0005] In addition to the reduced performance of the shovel system, the excavated earth carries all the contaminants present in the subsoil and which are dissolved in the water held in the earth.

[0006] Another excavation system is the one known as hydrofraise, which is a hydraulic system involving perforation rather than excavation, so that the earth is reduced by being broken down mechanically into smaller sizes which are mixed with the bentonite mud for hydraulic transportation to the surface. The mixture with the bentonite mud is even higher than with the traditional shovel, as is the mixture of contaminants in the earth, with an increased cleaning effect caused by greater disintegration of the materials and the transportation system itself to the surface.

[0007] The first shovel system referred to is hydraulic or mechanical and is the one most widely used today, while the hydrofraise system is more frequently used for rocky or hard formations.

[0008] In accordance with what is presented above, most conventional excavation systems use up a lot of time raising the shovel to the surface, loading it in the lorry and taking it back down again to the point of excavation, wasting a lot of time which, logically, increases with the depth of the cut-off wall and results in low performance.

DESCRIPTION OF THE INVENTION

[0009] The system recommended here has been designed to resolve the abovementioned problems, and to provide a series of benefits which will be set out during the present description.

[0010] More specifically, the system of the invention is based on extracting the material, compact and free of bentonite mud, and even free of some of the water contained in the earth, thereby making transportation and dumping easier, without contaminants and added liquids, and reducing the amount of residues originating from the bentonite mud by an estimated 10%.

[0011] The consumption of bentonite and water used to make the mud is also reduced, with an estimated saving of 10%, so that for a piece of machinery excavating approximately 25 m^3/hour and working an average of 1,500 hours per year, for example, would imply an annual saving of 3,750 m^3 of water and more than 150 tonnes of bentonite.

[0012] Another important advantage is the extraction of earth without the need to move the shovel to the surface,

significantly increasing performance.

[0013] More specifically, the system of the invention is based on the use of a shovel with jaws, but with certain added innovations that consist in providing in the jaws a means of loading, which transfer the earth from inside the jaws to a loading chamber.

[0014] In accordance with another characteristic of the invention, in addition to the aforementioned loading chamber, a pressure filter chamber has been provided wherein the earth is compressed with the material excavated and extracted (preferably using a system of hydraulic presses) using filtering zones to separate solid material from liquid, such as water, bentonite and other elements in suspension, so that the earth or material is compact and ready for extraction and transportation.

[0015] Another characteristic of the invention consists in the fact that the outlet of the pressure filter chamber is part of a subsystem for moving the compressed material to the surface.

[0016] This system, in accordance with a first embodiment of the invention, comprises a constant-circuit vertical transporter, which may be in the form of a tubular belt, a system of buckets, etc., in all cases, being used for the continuous movement of the solid and compressed material extracted, without having to move the shovel up to the surface, unload it on a truck and return it to the place of work, etc.

[0017] In accordance with a second variant of the embodiment of this transportation subsystem, the aforementioned pressure filter chamber is provided in a loading chamber with no-return gates, so that via a vertical movement of the jaws, the earth can be introduced into said chamber where, by the effect of the pressure, and given its configuration with filtering zones, the ascending liquid is eliminated and the earth compacted, ready for transportation.

[0018] Simultaneously, with the vertical movement of the jaws, via the effect of cylinders, the loading chamber is also expanded via cylinders, to receive the earth extracted from the jaws, mainly due to the existence in said chamber of a lower entry gate which is open at that moment, and an exit gate which is closed, the position of said gates being reversed once the loading chamber is full and producing a compression in said chamber via a reduction in the latter's volume, moving the material to an upper evacuation pipe which extends up to the surface.

DESCRIPTION OF THE DRAWINGS

[0019] In order to accompany the description given and provide a better understanding of the characteristics of the invention, in accordance with a preferred example of practical embodiment thereof, an illustrative and non-restrictive set of drawings is provided as an integral part of said description, representing the following:

Figure 1	Shows a diagrammatic representation of the cut-off wall continuous excavation system object of the present invention, in a compressed position and in accordance with the first variant of embodiment of the transportation subsystem.
Figure 2	Shows a similar representation to that in Figure 1, at the end of the loading phase.
Figures 3, 4, 5 and 6	Show representations in accordance with the second variant of embodiment of the transportation subsystem, corresponding respectively to the excavation start-up position, the start-up position for extracting the earth from the jaws to the external transportation system and the final extraction phase and transportation phase from the shovel to the outside.

PREFERRED EMBODIMENT OF THE INVENTION

[0020] In the light of the figures described, specifically Figures 1 and 2, it can be seen how the cut-off wall continuous excavation system object of the invention is based on the use of a conventional shovel, but which has a series of improvements and innovations which enable extraction of the earth which is compressed and free of bentonite mud, without having to raise the shovel to the surface.

[0021] More specifically, the shovel whereon the excavation system is based, has a support structure (1) which is accompanied by guiding elements (2), all of this, as is conventional, having jaws (3), whose function is to excavate the earth, and which may have any geometry suitable for it to efficiently achieve the desired function.

[0022] From this basic structure, and already in accordance with the invention, the inside of the jaws (3) has a fork-shape or loading chamber (4) with no-return gates (5).

[0023] Additionally, and via the vertical movement of the jaws (3), the earth is compressed in the loading chamber (4) and is forced to enter the pressure filter chamber (6) where, due to the effect of pressure and given its innovative configuration with filtering walls, the ascending liquid (water, bentonite and other elements in suspension) is eliminated, thus making the earth compact and ready for extraction and transportation.

[0024] During the descent phase of the jaws (3), the no-return gates (5) prevent the earth in the loading chamber (4) and the pressure filter chamber (6) from descending, allowing the jaws to open for another excavation and unloading cycle.

[0025] Repetition of these cycles pushes the compressed material towards the exit zone (7), from which the material, itself compressed, is fed to a transportation system (8) used to raise the compressed material to the surface, with the special characteristic that such transportation means is made up by a constant-circuit vertical transporter, such as a tubular belt, a system of buckets, etc.

[0026] The vertical movement of the jaws (3) is produced via the action of the hydraulic cylinders (9).

[0027] In accordance with the variant of embodiment shown in Figures 3 to 6, there is a second loading chamber (10) above the loading chamber (4), which receives the material when the jaws (3) are raised by the effect of the cylinders (11), through a lower pair of gates (12), said loading chamber (10) of the transportation subsystem also having a second pair of gates (12'), situated higher up and through which said chamber (10) connects to an evacuation pipe (13) which goes up to the surface of the ground and which can even reach the vehicle for loading the extracted material.

[0028] More specifically, when the jaws (3) are raised by the effect of the cylinders (11), the loading chamber (10) expands via the effect of the cylinders (11'), to receive the earth extracted from said jaws, with the lower gates (12) open and the upper gates closed, as shown in Figure 3.

[0029] Once the loading chamber (10) of the transportation subsystem is full, the exit gates (12') open and the entry gates (12) close, the cylinders (11') reverse the direction wherein they are acting, producing a compression in said chamber (10) and the earth is consequently projected or pumped towards the outside through the evacuation pipe (13).

[0030] During the descent phase of the jaws, the no-return gates (5) prevent the earth present in the loading chamber (4) from descending, allowing said jaws to open for another excavation and reloading cycle, while the lower gates (12) of the chamber (10) in the transportation subsystem, close, preventing the evacuation tube (8) from unloading.

[0031] Repetition of these cycles pushes the compressed material towards the surface.

[0032] In this way, a suction-pressure effect is achieved from the loading chamber (4) to the evacuation pipe (13), through said intermediate chamber (10) of the transportation subsystem.

[0033] In all cases, the earth is extracted, compressed and free of bentonite mud, and even free of some of the water in the earth, facilitating transportation of this earth from the extracted material and the dumping thereof without contaminants or added liquids.

[0034] There is also a reduction in the amount of residues from the bentonite mud, estimated at approximately 10%, meaning a saving in the amount of water and bentonite used to produce the mud, which may also be estimated at 10%.

[0035] Another fundamental advantage is that the earth is extracted without the need to move the shovel to the surface, as mentioned earlier, considerably increasing performance, since consideration should be given to the fact that cut-off walls with a depth of more than 50 metres are often built.

[0036] It should also be pointed out that unloading of the material or other solid and compressed earth at the surface, becomes an inert element with a low capacity for contamination, i.e. it poses no danger from an environmental point of view.

[0037] It should also be pointed out that extraction of the excavated material to the surface is done in a continuous way, without the need to move the shovel out of the excavation, resulting in a significant increase in productivity.

Claims

1. Cut-off wall continuous excavation system which, based on the use of a shovel with corresponding jaws for excavating and extracting material, and a structure for holding and guiding the elements forming the shovel array, **characterized in that** on the inside of the shovel is a loading chamber (4), which receives the extracted material, fed by the shovel jaws (3), the jaws-loading chamber unit being hermetically sealable, there being, in addition to the loading chamber, a pressure filter chamber (6), wherein, via the vertical movement of the jaws, the material is compacted and separated from the liquid components (water, bentonite and others in suspension), through filtered zones provided in the pressure filter chamber (6).

2. Cut-off wall continuous excavation system, according to claim 1, **characterized in that** the jaws (3) of the shovel, and the loading chamber (4), are actuated via hydraulic cylinders (9).

3. Cut-off wall continuous excavation system, according to the previous claims, **characterized in that** the loading chamber (4) has no-return gates (5).

4. Cut-off wall continuous excavation system, according to claim 1, **characterized in that** there are means for transporting the compressed material at the exit of the pressure filter chamber (6).

5. Cut-off wall continuous excavation system, according to claim 4, **characterized in that** the aforementioned means for transporting the earth to the outside comprise a constant-circuit vertical transporter, which can be formed by a

tubular belt, a system of buckets or similar.

6. Cut-off wall continuous excavation system, according to claim 4, **characterized in that** the means for transporting the earth to the outside consist in a chamber (10), which is expandable via the use of cylinders (11'), which have entry and exit gates (12-12') in their ends, so that during the filling phase of said chamber (10) and when the latter is in an extended position, the lower gates (12) are open and the upper gates (12') are closed, while in the unloading phase, wherein the chamber (10) is contracted, the lower gates (12) are closed and the upper gates (12') are open, said transportation chamber (10) opening into an evacuation pipe (13) which extends up to the surface.

Amended claims under Art. 19.1 PCT

1. Cut-off wall continuous excavation system which, based on the use of a shovel with corresponding jaws for excavating and extracting material, and a structure for holding and guiding the elements forming the shovel array, is **characterized in that** on the inside of the shovel is a loading chamber (4), which receives the extracted material, after which a pressure filter chamber (6) has been provided, wherein, via the vertical movement of the jaws, the material is compacted and separated from the liquid components (water, bentonite and others in suspension), through filtered zones provided in the chamber(4).

2. Cut-off wall continuous excavation system, according to claim 1, **characterized in that** the jaws (3) of the shovel, and the loading chamber (4), are actuated via hydraulic cylinders (9).

3. Cut-off wall continuous excavation system, according to the previous claims, **characterized in that** the loading chamber (4) includes no-return gates (5).

4. Cut-off wall continuous excavation system, according to claim 1, **characterized in that** there are means for transporting the compressed material at the exit of the pressure filter chamber (6).

5. Cut-off wall continuous excavation system, according to claim 4, **characterized in that** said means for transporting the earth to the outside comprise a constant-circuit vertical transporter, which can be formed by a tubular belt, a system of buckets or similar.

6. Cut-off wall continuous excavation system, according to claim 4, **characterized in that** the means for transporting the earth to the outside consist in a chamber (10), which is expandable via the use of cylinders (11'), which have entry and exit gates (12-12') in their ends, so that during the filling phase of said chamber (10) and when the latter is in an extended position, the lower gates (12) are open and the upper gates (12') are closed, while in the unloading phase, wherein the chamber (10) is contracted, the lower gates (12) are closed and the upper gates (12') are open, said transportation chamber (10) opening into an evacuation pipe (13) which extends up to the surface.

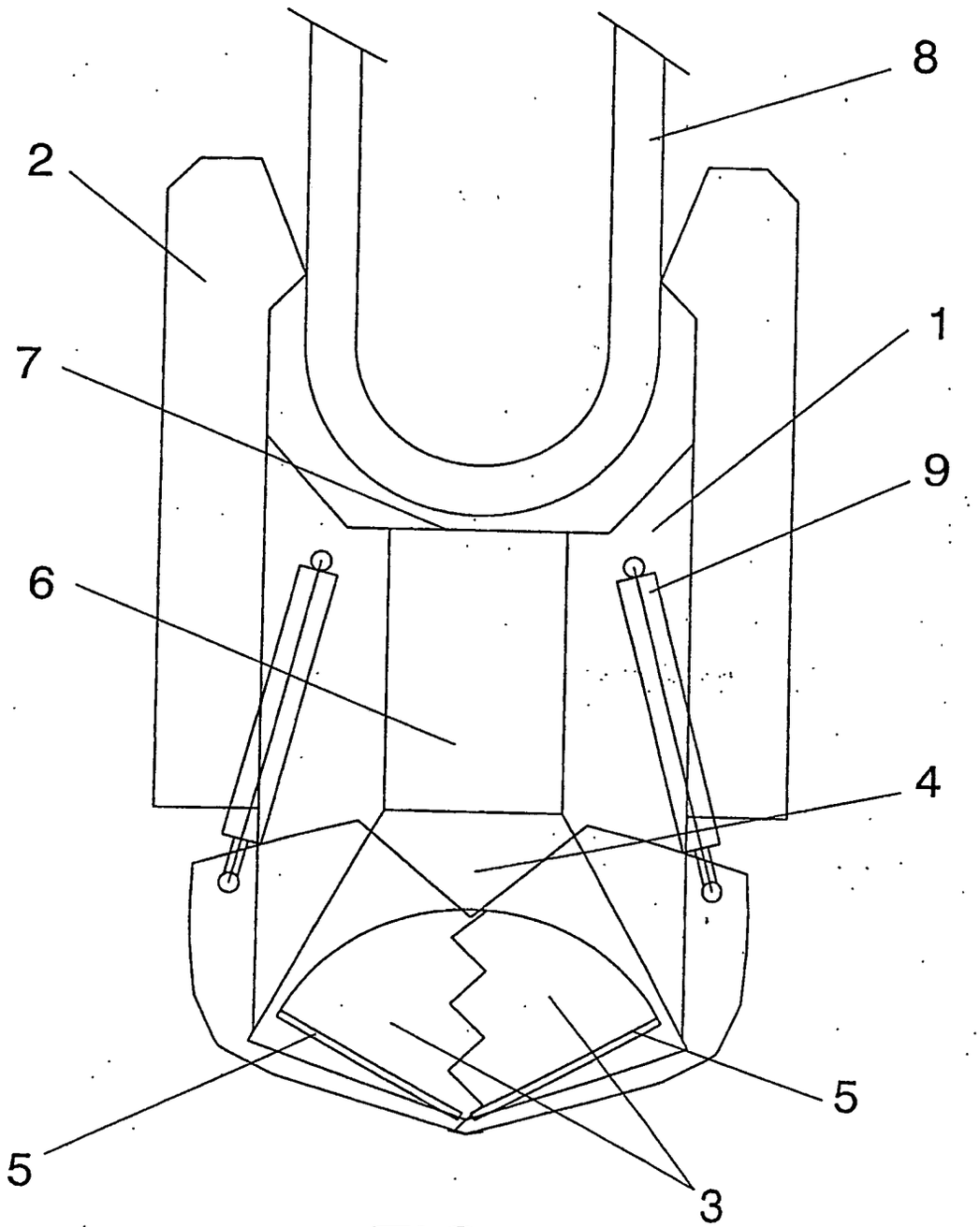

FIG. 1

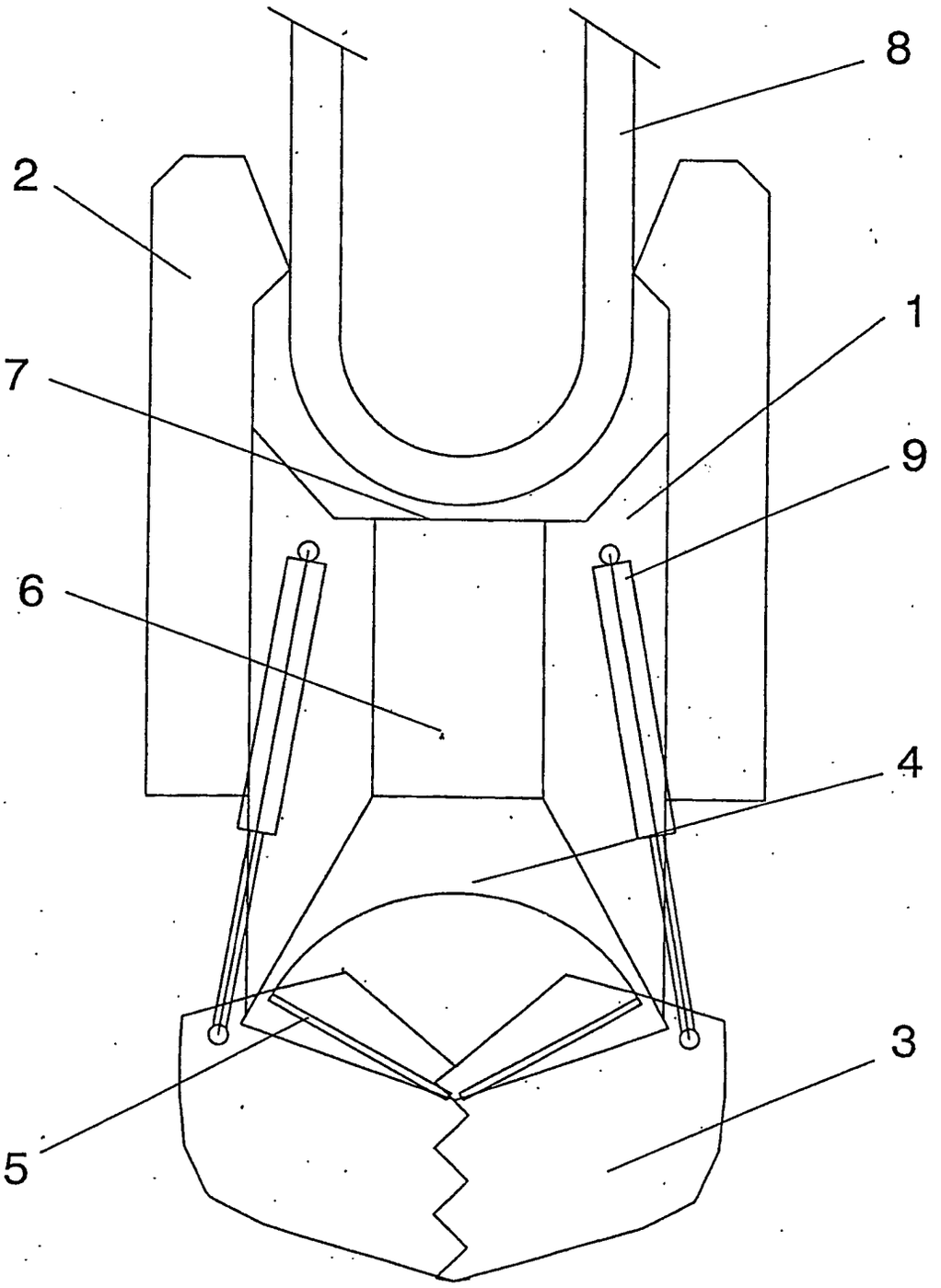

FIG. 2

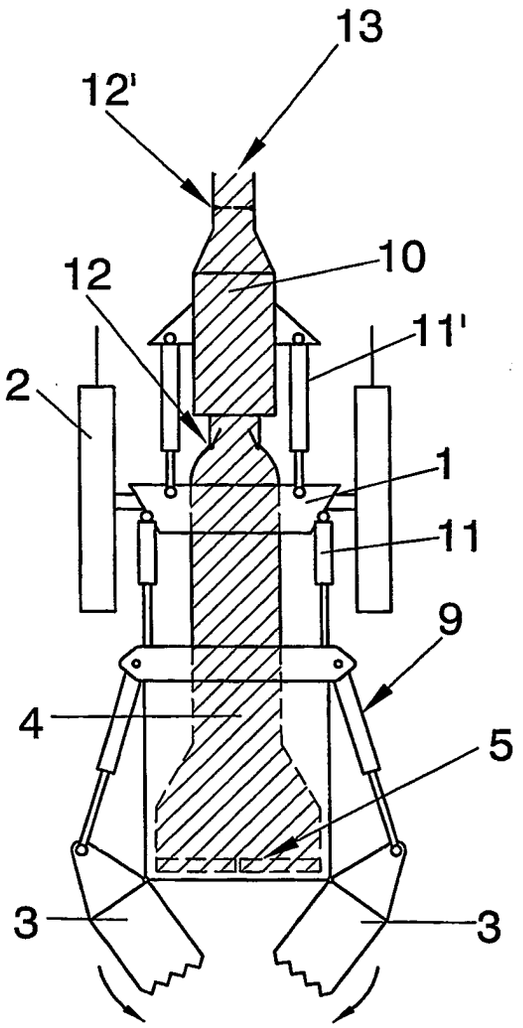

FIG. 3

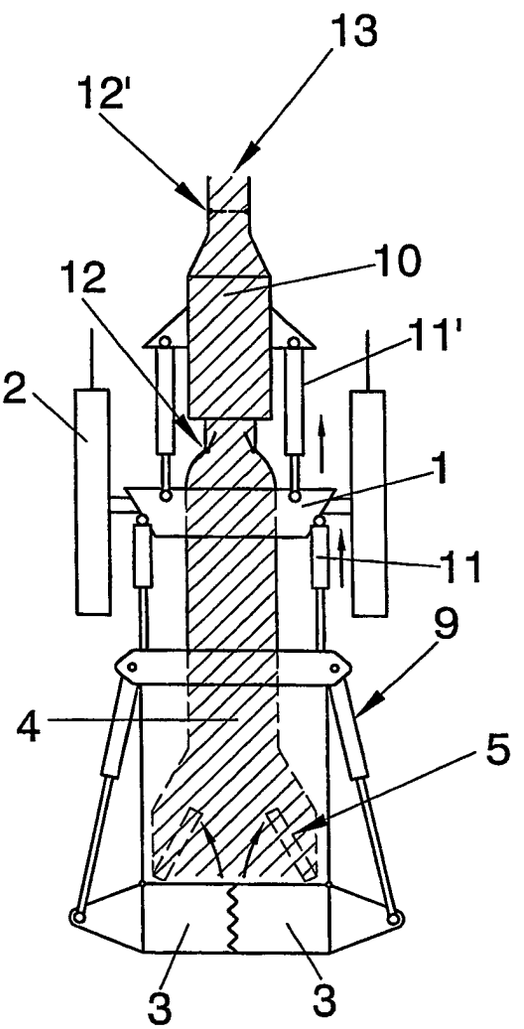

FIG. 4

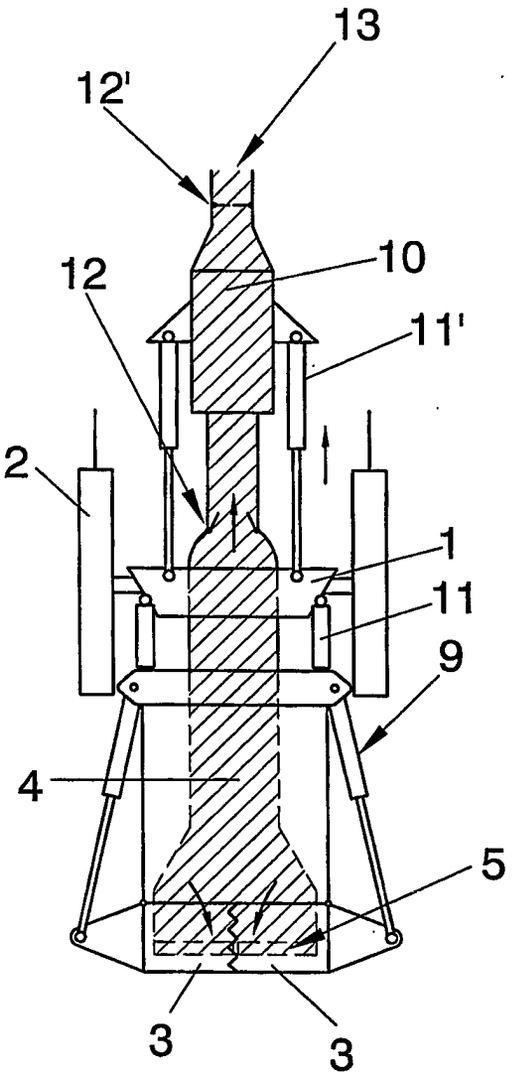

FIG. 5

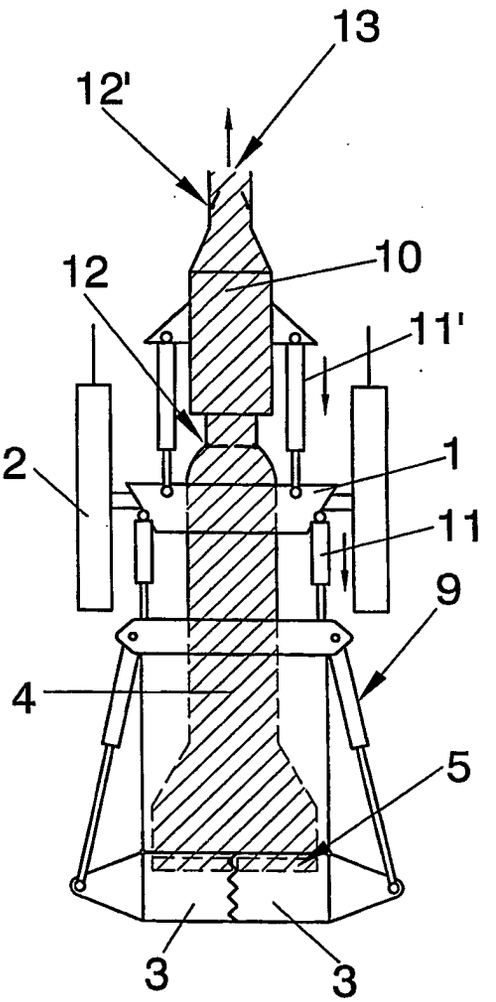

FIG. 6

INTERNATIONAL SEARCH REPORT

International application No.
PCT/ ES 2003/000640

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 E02F 3/44, E02D 17/13

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)

IPC 7 E02F, E02D

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)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	PATENT ABTRACTS OF JAPAN, Vol. 1995, Nº 64 31.05.1995 & JP 7026580 A (KOJIMAGUMI) 27.01.1995. **the abstract, figures**	1-4
Y	PATENT ABTRACTS OF JAPAN, Vol. 007, Nº 291 (M-265) 27.12.1983 & JP 58164831 A (KOJIMAGUMI) 29.09.1983. **the abstract, figures**	1-4
Y	ES 2160081 A1 (HERRERO) 16.10.2001. **the abstract, figures**	1-4
A	PATENT ABTRACTS OF JAPAN, Vol. 005, Nº 068 (M-067) 08.05.1981 & JP 56020243 A (KAJIMA CO.) 25.02.1981. **the abstract, figures**	1-4, 6
A	GB 323407 A (ROTINOFF) 02.01.1930. **The whole document**	1,4,5

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
10 February 2004 (10.02.04)	15 MAR 2004 15.03.04
Name and mailing address of the ISA/ **S.P.T.O.** Facsimile No.	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International Application No
PCT/ ES 2003/000640

Patent document cited in search report	Publication date	Patent familiy member(s)	Publication date
JP 7026580 A	27.01.1995	NONE	
JP 58164831 A	29.09.1983	NONE	
ES 2160081 A1	16.10.2001	EP 1111139 A BR 0002489 A US 6446364 B	27.06.2001 11.09.2001 10.09.2002
JP 56020243 A	25.02.1981	NONE	
GB 323407 A	02.01.1930	NONE	

Form PCT/ISA/210 (patent family annex) (July 1992)