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(54) Method and apparatus for steering a boat, for instance when laying hoses under water.

(57) A method and an appartus for accurate steering of a boat, for instance when laying flexible conduits, tubes or hoses under water on a certain depth under the bottom of a lake by means of a propulsable boat (1) having a preferably vibratable sword (8') which after having been forced down in the bottom mud (12) cuts its way through the bottom mud while concurrently therewith laying down one or more hoses on intended depth levels, and having at least two spaced steering means (8', 23) mounted vertically movable in a guide sleeve in the boat and at least one of which, a rudder means (23), is rotatable about a vertical axis. When laying down one or more hoses (9-11) the vibrating sword (8') is pressed down to the intended depth in the bottom mud, the rotatable rudder means (23) is/are pressed down some distance in the bottom mud (12), for instance 50-100 cm, and the boat is advanced, whereby the steering means (8', 23) by a mutual rotation is steering the boat with great accuracy. The advancing of the boat can be made by means of wire winches (18) the wires (21) of which are secured at places ashore.

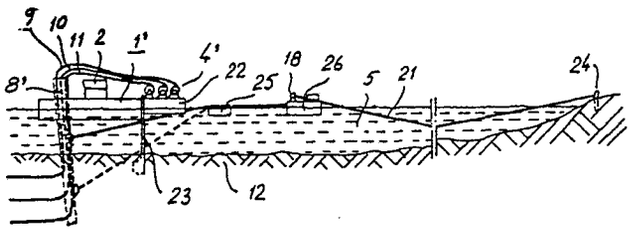

Fig. 3

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Method and apparatus for steering a boat, for instance when laying hoses under water.

The present invention generally in concerned with steering of boats, for instance when laying flexible tubes, conduits and hoses under water, and the invention is more particularly directed to laying of tubes, conduits or hoses in connection to storing or extracting of heat, for instance in heater pumps and similar apparatus.

The invention has been develloped in connection to laying of flexible hoses for heater pumps in the bottom mud of a lake, especially a shallow lake, whereby several unit lengths of hoses are to be buried parallelly, or as closely parallelly to each other as possible and preferably in several layers above each other. The invention is not restricted to this particular project, but in the following the said project will shortly be analyzed, since the project gives a clear view of the basic problems leading to the invention.

In the project above referred to it was actual to lay or bury plastic hoses to form a heat collector in the bottom mud of a shallow lake, the water depth of which was between 1.4 and 2.3 meters, whereby the hoses should be laid on three levels, viz. on about 3, 5 and 7 meters below the bottom of the lake and in unit lengths of 1000 meters. At each end the hoses were to be connected to a collection unit. The layers of hoses should be laid with the hoses of each layer spaced from each other 1.9 meters, and the total size of the heater collecter should be 230 times 1000 meters. This means that is a total length of 360 kilometers of hoses were to be laid.

The laying of hoses was intended to be made with the aid of a vibrating sword, known per se, which was to be mounted on a water boat and by means of which three hoses could be laid concurrently on about 3, 5 and 7 meters depth under the bottom of the lake, whereby the sword under vibration cuts its way through the bottom mud and lays the hoses on the intended depth levels. It was planned that the sword be mounted on a boat intended to be moved up and down the lake during the laying procedure.

One serious problem in laying the hoses is to obtain as even distribution of the hoses as possible. The boat can be driven in several different ways like by means of its own propellers, by water jet propulsion, by means of wires anchored or secured ashore or at the bottom of the lake, etc. Whichever type of propulsion is chosen it is very difficult to have the boat follow a straight line of laying of any other predetermined line of laying, and it is still more difficult to have the boat follow several parallel successive laying paths. For different reasons it may happen that the boat is drifted or steered aside of the intended path of laying. The laying follows slowly and it should be difficult or impossible to compensate actual drifting depending on actuation of wind by means of a conventional steering means. In case the rudder means or the vibrating sword happens to hit a hard object in the bottom mud and the boat therefore has to yaw it may in practice be impossible to have the boat return to the original way of transportation after the yawing movement is ended. It should be noted that in some cases it is possible to overcome obstacles in the bottom mud by just lifting the rudder means and the sword resptectively to pass over said obstacles, in other cases this is not a useful or recommendable way.

The basis of the invention therefore was the problem of providing a method and an appartus useful in laying of flexible tubes, conduits or hoses from a boat thereby having said boat as closely as possible follow a straight path or any other predetermined path and to make it possible to move the boat in several parallel paths up and down or in several parallel paths when driving the boat is successive paths following each other in the same direction of movement.

According to the invention this problem has been solved in that the boat, in addition to the vibratable sword, is equipped with at least one rudder means having a steering function, whereby said rubber means in use is -(are) lowered until the rudder means has at least partly entered the bottom mud, whereupon the rubber means is during the movement of the boat adjusted or rotated respectively so that the rudder in combination with the sword steers the boat along a predetermined path, and whereby the hose or conduit or several hoses or conduits are, during the movement of the boat, laid on different levels above each other on the intended depths in the bottom mud. The boat is then moved up and down, or in one and the same direction, thereby laying several hoses or conduits parallelly with each other.

By starting from a carefully adjusted position or line and by directing the boat along land based navigation points it is very well possible to have the boat follow a carefully planned path of laying after the said rudder means of the boat has been correctly adjusted, and after such necessary deviations from the planned path that may occur when yawing past any obstacle in the bottom mud, to return to the planned path as soon as said obstacle has been left behind.

In a modified embodiment of the invention the boat is formed with two rudders mounted spaced from each other, preferably one rudder at the stem and the other rudder at the stern.

The rudder means may be knife like rudder disks which can be raised and lowered and which are also rotatably mounted in the boat, whereby said rudders can be moved down some distance, for instande 50 -100 cm, in the bottom mud, and which steer the boat from a position at the stem or from a position at the stern of the boat or both from stem and stern. Alternatively the rudder means can be runners which dig themselves down a slight distance in the bottom mud, or rolls or wheels which at least with their lower halves cut themselves through the bottom mud. The rudder means is (are) preferably mounted in guide tubes in the boat and so that it (they) can be rotated about its -(their) vertical axis thereby steering the boat.

Since the rudder means may provide a very careful steering of the boat the propulsion of the boat can be provided as simple as possble without any other demands on steering than is made by the above mentioned rudder means. The propulsion of the boat may for instance be made by means of a wire and a simple winch from a land based wire fastener or from two opposite land or lake bottom based wire fasteners, or by means of first winch at the stem and a second winch at the stern of the boat.

In an alternative embodiment of the invention the boat is equipped with two vibratable swords provided aside of each other speced by the same distance as the intended distance between two adjacent hoses, in the above related case a distance of 190 cm, whereby two parallel series of hoses can be laid at the same time, and whereby the accuracy in the mutual distance between said hoses is exact.

Since the sword places the hoses on the intended depths in the bottom mud and the bottom mud normally refilles the path provided by the sword with the hoses immediately after it has passed there is normally no need for any activity for refilling material above the hoses or to press the hoses down in the bottom mud and to secure the hoses in their positions as being laid down.

In the attached drawings some embodiments of apparatus for laying hoses at the bottom of a lake are illustrated diagrammatically. Figure 1 shows a side view of a boat for laying three layers of hoses, whereby the boat is adapted to be steered in accordance with the invention, and figure 2 is a view from above of the same boat. Figure 3 is a side view of a more complete system for laying hoses according to the invention, and figure 4 i a side view of a modified boat used in the system according to figure 3.

The basic difference between figures 1-2 and 3-4 respectively is that the first embodiment of the boat is formed with two steering rudders, whereas the second embodiment of the boat is formed with only one steering rudder. Actual cases have proved that both types of boat are quite useful and give a surprisingly accurate result.

The boat 1 shown in figures 1 and 2 of the drawings comprises a boat body 2 and at one end thereof two outer pontoons 3 adapted to carry diagrammatically indicated drums 4 with hoses to become laid in the bottom mud of the lake 5 in which the boat is moved. One end of the boat has a recess making the boat fork-like. Between the fork branches 6 and 7 a vibratable laying sword 8 of a type known per se is mounted so that it can be lowered and raised. In the illustrated case the sword has inner guides for three hoses 9, 10 and 11 which leave the sword on different depth levels of the sword. The sword is mounted so that it can be lowered down to the intended depth of the bottom mud 12, preferably so that the hoses 9, 10 and 11 leave the sword on 3, 5 and 7 meters depth level. The illustrated sword 8 is of a known vibratory type which can cut itself a passage through the bottom mud. At each end the boat according to this embodiment is formed with a rudder means 13 and 14 each mounted in a vertical guide sleeve 15 and 16 resp. so that they can be lowered and raised. The rudder means also are rotatable about a vertical axis, and they provide the actual steering means for the boat. The rudders may be formed as knife-like bars, or they may be formed as runners which cut themselves down a slight distance in the bottom mud, or they may be rolls or wheels which cut down to at least haft their height in the bottom mud, or which may in some cases roll on the bottom surface of the lake.

For advancing the boat there is a wire winch 17 and 18 at each end of the boat. The end of each wire is intended to be fixed mounted ashore or to be anchored at the bottom of the lake at a point far from the boat. Preferably the boat is equipped with a suitable directing means of a known type, so that it is possible to direct and steer the boat into an exactly or nearly exactly intended position and advancing path for laying layers of hoses in several rows aside of each other.

When using the boat illustrated in figures 1 and 2 the hose drums are mounted at suitable places of the boat and are over the vibrating sword 8 laid down on their respective depth levels. The hoses are connected to a diagrammatically illustrated collection conduit 19 and the boat is directed into a ccrrect position for laying the first row of hoses. The sword is connected for vibration and is lowered to such depth that the hoses 9, 10 and 11 are located on their intended depth levels and the rudder means is (are) lowered to such depth in the bottom mud, that the expected good steering property is obtained. Normally a suitable depth is 50-100 cm. The wires 20 and 21 of the winches 17 and 18, which are fixed to a point ashore or at the bottom of the lake, are stretched and the boat is pulled forward in that one winch, for instance, the winch 18 winds its wires 21 at the same time as the winch 17 unwinds a corresponding length of its wire 20. By rotating the rudders 13 and 14 the position and the line of movement may be corrected upon need, and the boat can yaw with the aid of the rudders in case the sword 8 hits a hard object in the bottom mud. When the boat has reached the end of the first path of laying hoses said hoses are connected to a second (not shown) collection conduit, the sword 8 and the rudders 13 and 14 are retracted, the boat is moved transversally a distance corresponding to the intended offset distance between parallel rows of hoses, in the actual case a distance of 1.9 meters. Then a new set of hoses is connected to the collection conduit, the sword 8 and the rudders 13, 14 are forced down in the bottom mud, and the next row of hoses are laid down like the former row of hoses and parallelly to said former row. The laying of hoses can be made by moving the boat up and down the lake or in that the boat moves backwards to the initial position starting a new path of laying. Before the laying of the second and every successive path the boat is offset a distance of 1.9 meters and is directed to correct position for laying parallel rows of hoses.

Figure 3 shows a more complete system for laying hoses comprising a boat 1' connected to a separate hose raft 22 for three hose drums 4'. In this embodiment there is only one rudder 23 mounted at the stem of the boat, and the sword 8' is mounted at the stern. The sword 8'and the single rudder 23 provide the necessary two reference points for correctly directing the boat. For advancing the boat the propulsion wire 21 is at one end fixed at a point 24 ashore and with the opposite end mounted in the sword at a point adjacent the bottom of the lake (marked with full lines in figures 3 and 4). It may, however by advategeous to connect the wire to the sword at a point which at general depth of the sea is located below the bottom level (marked with dotted lines in figures 3 and 4). Thereby the wire will at least partly cut a way for the sword 8' through the bottom mud and the risk that the boat dips at the stem is eliminated. The wire extends over one or more support rafts 25 to a winch raft 26 having a winch which is advancing the boat.

As shown in figure 4 the sword 8' can be mounted in a guide 26 which is rotatable about a horizontal pin 27 and in which the sword can be lowered and raised and can be rotated from a vertical position as shown with the full lines to a horizontal position above the boat as shown with the dotted lines.

As previously mentioned the boat can be equipped with two vibratable laying swords mounted on a distance from each other corresponding to the intended distance between rows of hoses, in the above cited case a distance of 1.9 meters, whereby two rows of hoses can be laid down at the same time and exactly spaced from each other.

In case the sword 8 meets any hard object in the bottom mud the front rudder is to be lifted or rotated and, in case of two rudders then possibly also the rear rudder is to be lifted or rotated, so as to get free of the obstacle or so that the entire boat yaws past the said har object, and after having passed the obstacle the rudder or rudders are to be rotated back so that the boat re-enters its planned path of movement, whereby the hose or hoses only provide a curve round the obstacle, whereas they otherwise extend along the planned paths parallelly to each other.

It should be pointed out that the apparatus according to the invention can be used with only one rudder means whereby the sword acts at a second necessary reference point for directint and steering the boat. In case the boat should be be moved along a straight line with the swword lifted from the bottom mud it is considered necessary to use two rudder means, preferably on at the stem and one at the stern.

Claims

1. Method for accurate steering of a boat, for instance for laying of flexible tubes or hoses (9, 10, 11) under the bottom (12) of a lake by means of a propulsable boat (1), **characterized** in that a steering means (8, 13, 14; 8', 23) on at least two spaced locations of the boat (1) are lowered until said steering means have somewhat entered the bottom mud (12), whereupon at least one (13, 14; 23) of said steering means, during the advancing of the boat (1), is set or rotated respectively so as to steer the boat (1) under cooperation of said at least two steering means and along a predetermined path, and during the advancing the boat (1) one or more conduits or hoses (9, 10, 11) are laid down in the bottom mud (12), preferably by means of a vibratable laying sword (8; 8') moved through the bottom mud.

2. Method according to claim 1, **characterized** in that the starting ends and the final ends of the conduits or hoses (9, 10, 11) are connected to collection conduits (19) at the beginning and at the end of the hose path, and in that the boat, before the second and any successive path of conduits or hoses are laid, is side offset a distance corresponding to the intended distance to the adjacent path of hoses, and in that the second and any successive path of hoses are laid parallelly to the first path.

3. Method according to claims 1 or 2, **characterized**in that the rudder means (13, 14; 23) is/are rotated in case the vibrating sword (8) hits any hard object in the bottom mud - (12), so that the sword (8) is yawing past the the obstacle, and in that the rudder means is then rotated back to its initial position, so that the boat reenters its normal pach of movement.

4. Method according to claim 1, 2 or 3, **characterized**in that the boat is driven by means of a propeller, by water jets or by means of a wire winch (17, 18) provided at one or at both ends of the boat and the wire ends of which are anchored in a point ashore or at the bottom of the lake.

5. Method according to claim 4, **characterized** in that the wire (21) is connected to the sword (8') at a point which is at normal depth of the lake located under the bottom level, whereby the wire (21) is at least partly cutting a path for the sword through the bottom mud.

6. Apparatus for executing the method according to any of the preceding claims, **characterized** in that it comprises a boat (1) having one or more vibratable swords (8; 8') for laying of one or more flexible conduits or hoses (9, 10, 11) on intended depth levels in the bottom mud (12) of a lake and having at least two cooperationg steering means (13, 14; 8', 23), at least one (13, 14; 23) of which is mounted in a guide sleeve (15, 16) of the boat (1) and is adapted for being lowered to a certain depth in the bottom mud (12), and in which the steering means (13, 14; 8', 23) for enabling a careful steering of the boat are located cpaced from each other, preferably at or adjacent the stem and the stern of the boat.

7. Apparatus according to claims 6, **characterized** in that the steering means comprises one rotatable and vertically movable rudder (23) at the stem of the boat and a vertically movable sword (8') at the stern of the boat, or vice versa.

8. Apparatus according to claim 6, **characterized** in that the steering means comprises two rotatable and vertically movable rudders (13, 14), one provided at the stem and the other provided at the stern of the boat (1), or vice versa, and in which the laying sword (8) or swords are provided in between said rudders (13, 14).

9. Apparatus according to claims 6-8, **characterized** in that the rudder means (13, 14; 23) is/are mounted for being lowered and raised and rotated about a vertical axis in its/their guide sleeves (15, 16) of the boat, so that the boat can be steered with great accuracy by rotating any of the rudder means (23) or both rudder means (13, 14).

10. Apparatus according to any of claims 6-9, **characterized** in that the rudder means (13, 14) is/are in the form of flat knife-like rudders, rotatable wheels or rolls or runners.

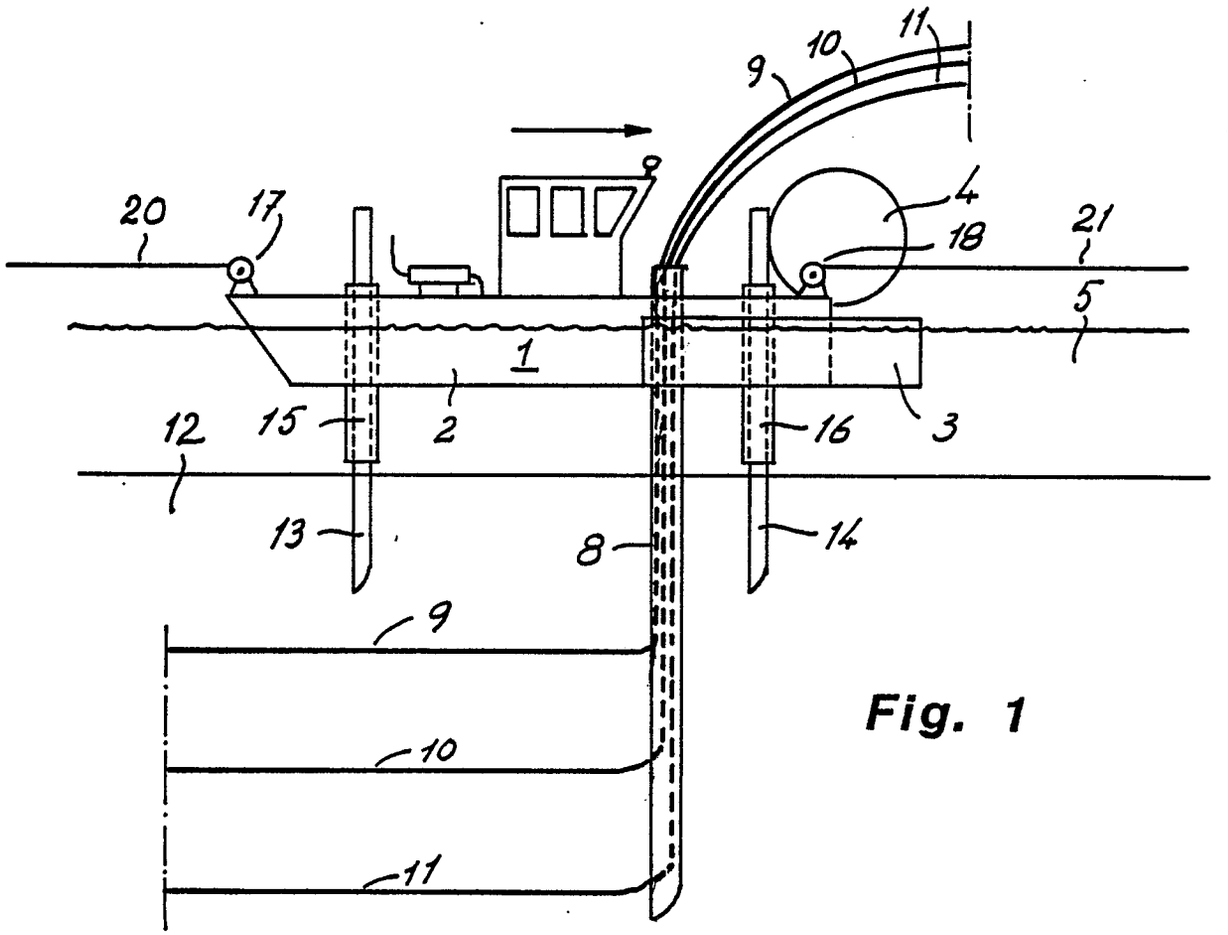
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Fig. 1

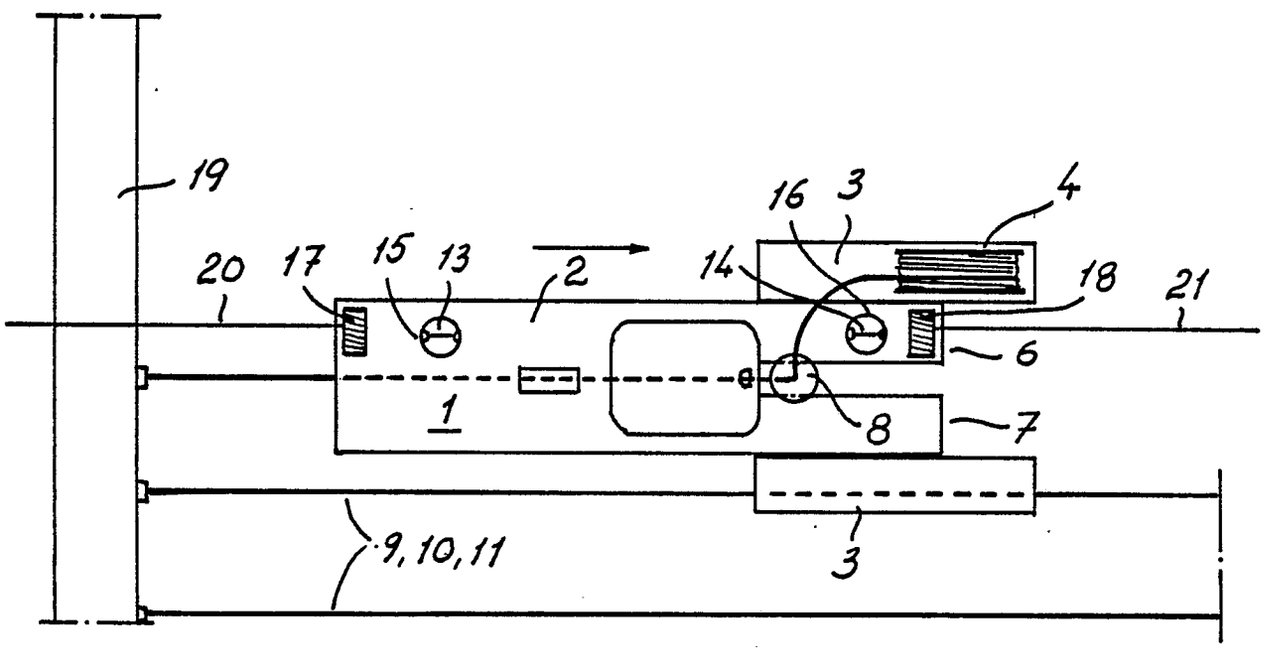
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Fig. 2

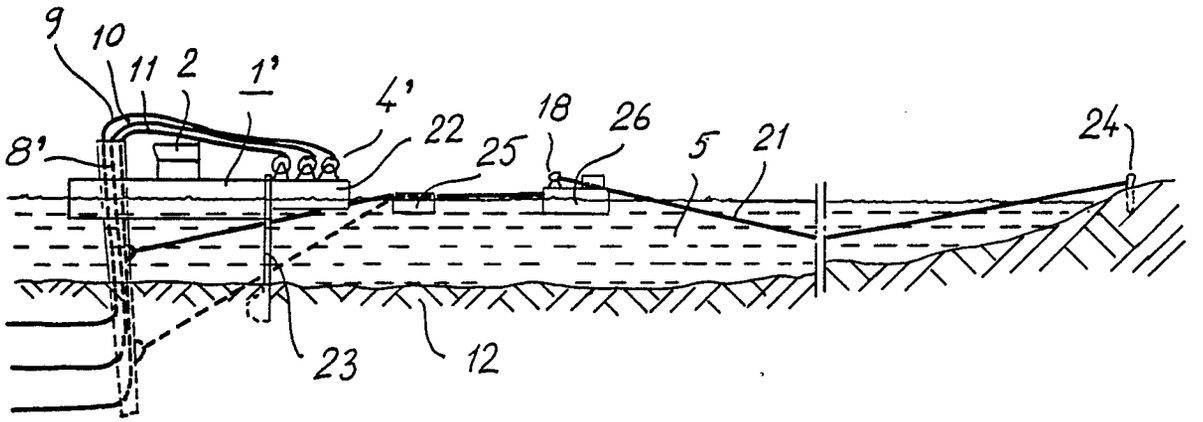

Fig. 3

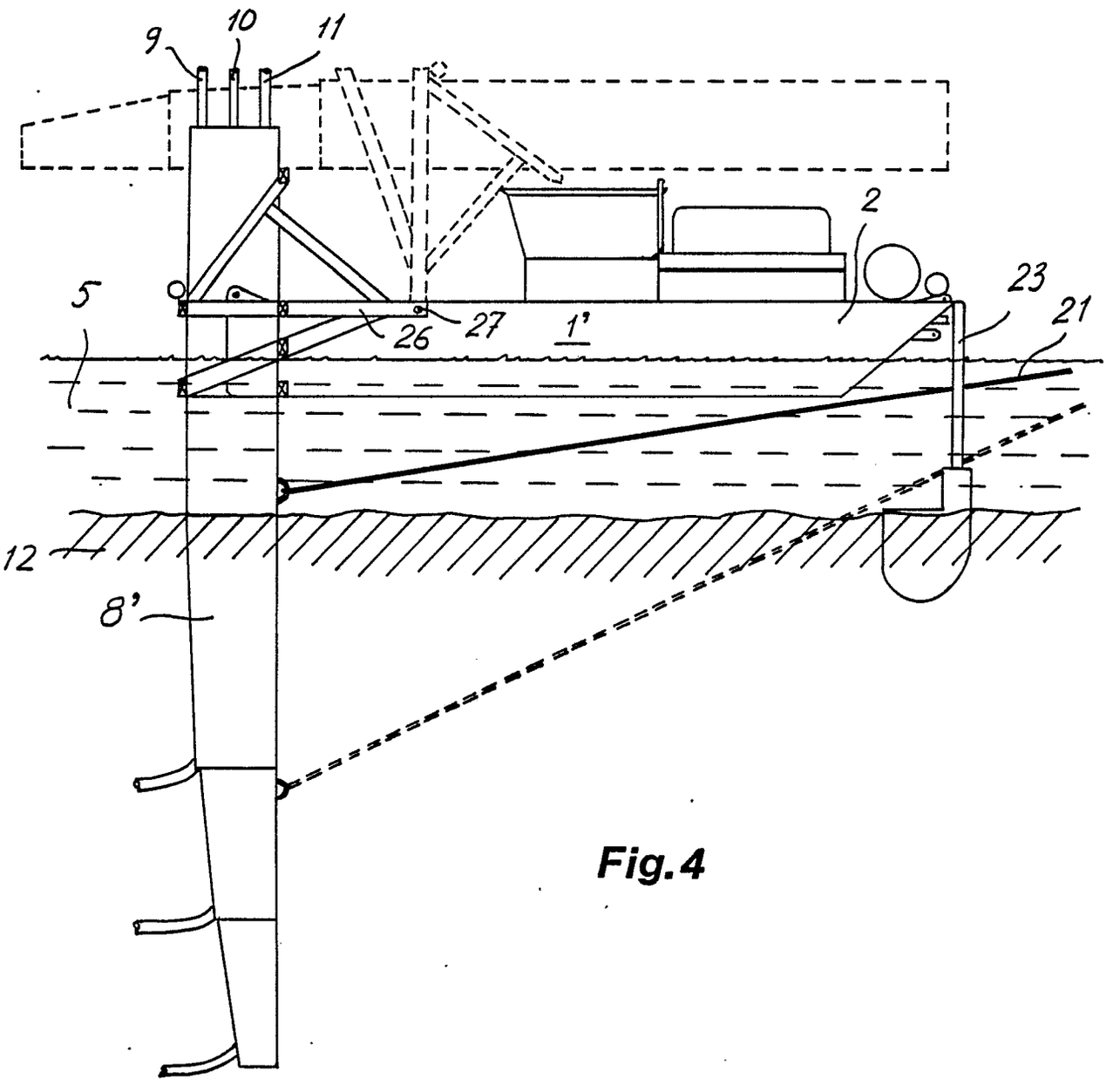

Fig.4

European Patent Office

EUROPEAN SEARCH REPORT

Application number

EP 86 85 0087

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
A	BE-A- 518 688 (A. LUITING) * Claims 1-4; figure *	1,4	E 02 F 5/10 E 02 F 9/06
A	US-A-4 399 623 (NEUMANN) * Abstract; figures 1-4 *	1,6-9	
A	US-A-3 222 876 (R.J. HARMSTORF) * Figures 1-6 *	1	
A	US-A-4 463 509 (LEONARD)		
A	US-A-3 777 372 (J.B. LAARMAN)		

TECHNICAL FIELDS SEARCHED (Int. Cl.4)

E 02 F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	20-06-1986	ANGIUS P.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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