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(54) Method for positioning a digging tool relative to a vessel, and vessel with digging tool

(57) Method for positioning a digging tool (7;29;47) relative to a vessel comprising a hull (2), the digging tool (7;29;47) being situated at one end of an elongated element (4,6;24-26;46) connected to the hull (2;22;42) by a hinge coupling (3;23;43) and comprising, between the digging tool and the hinge coupling, at least one hinge connection (5;27,28;45), which divides the elongated element into two parts which are pivotable relative to each other and enclose an angle relative to each other, while starting from a situation in which vessel and digging tool (7;29;47) move at the same speed, an externally caused change of the speed of displacement of the vessel involves active control of the hinge connection (5;27,28;45) to move through swiveling such that the speed of the digging tool in direction of travel remains unchanged relative to said starting situation. A vessel for performing such method.

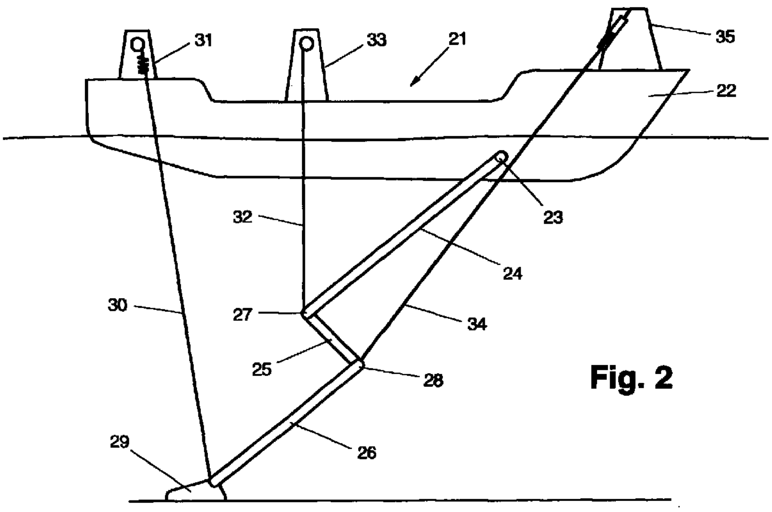

Fig. 2

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Description

[0001] The invention relates to a method for positioning a digging tool relative to a vessel comprising a hull, the digging tool being situated at one end of an elongated element, such as a suction pipe, a ladder or a similar element, said elongated element being pivotally connected to the hull by a hinge coupling whose center line extends substantially transversely to the vessel and comprising, between the digging tool and the hinge coupling, at least one hinge connection whose pivotal axis extends substantially parallel to the center line, whereby the elongated element is subdivided into at least two parts which are pivotable relative to each other and which enclose an angle relative to each other, the positioning of the digging tool being effected in that, via active control means, the angle between two parts of at least one hinge connection is changed in response to signals coming from measuring means. The invention also relates to such vessel with digging tool.

[0002] Such vessel is known from DE-A 28 18 028, where a trailing suction dredge is employed having a suction pipe ending in a draghead, via which, by means of a dredge pump, a mixture of soil and water is sucked up from a bottom under water. In order to keep the pressure of the draghead on the bottom to be processed more or less constant at seaway, i.e. during change of the position of the trailing suction dredge relative to the bottom to be processed, a passive swell compensator is utilized, which, upon a change of the distance between the draghead and the fastening point of the cable on the ship, more or less keeps the force in this cable. At seaway, the draghead-carrying part of the suction pipe is kept as much as possible at a constant angle to the bottom by the measuring means and the active control means.

[0003] If operations takes place under relatively quiet circumstances, i.e. the surface of the water in which the trailing suction dredge floats is virtually smooth without waves or swell, the speed of the draghead is substantially equal to the speed of travel of the trailing suction dredge. However, if the trailing suction dredge starts to roll, the draghead, remaining at the same level, will obtain an irregular speed, i.e. it will move faster or slower than the average speed or speed of travel of the trailing suction dredge, depending on the vertical movement of the trailing suction dredge. At heavy seaway and the low speed of travel customary for dredging, there is even the risk that the speed of the draghead momentarily becomes negative. Under those circumstances, the draghead will be pressed into the soil and substantial pressure forces are created in the suction pipe. To prevent this, and hence to prevent damage, the suction pipe may be of articulated design and at seaway, the vessel may travel with an upwardly bent suction pipe. Should the suction pipe be inclined to get stuck, the bend may rise, so that the pressure forces referred to earlier will not occur.

[0004] This manner of operating prevents damage to the equipment, but does not alter the fact that the draghead moves irregularly. The draghead alternately stands still or almost still to be jerked forwards thereafter, which leads to an irregular and, on average, very low dredging production.

[0005] A vessel used for such method may also be a cutter suction dredge provided with a digging tool in the form of a cutter head or a cutter wheel, at the end of a ladder, which inclines forwards during operation. Controlled by cables, the digging tool, during operation, makes an even swivel movement in a horizontal plane, while a forward movement is controlled by, for instance, a spud anchor with a spud anchor carriage. During swell of the cutter suction dredge, the movements thereof will be transferred to the digging tool via the pivotable ladder, which involves the danger of damage to the equipment due to the fact that the digging tool is pressed into the ground or out of the excavated groove when the cutter suction dredge moves in vertical direction because of swell. Also, the displacement of the digging tool will deviate jerkily from the above-described, intended path, which will again result in an irregular and averagely very low dredging production.

[0006] The object of the invention is to remove as much as possible the influence of the vessel movements on the speed and regularity at which the digging tool moves during travel of the vessel and thus to increase the efficiency of the dredging operations.

[0007] In accordance with the invention, with a method of the type described in the preamble, this object is realized if, starting from a situation in which vessel, elongated element and digging tool all move at the same speed in direction of travel, during an externally caused change of the speed at which the vessel moves in direction of travel, by changing the angle between two parts of at least one hinge connection, said at least one hinge connection is actively controlled to move through swiveling in such a manner that a deceleration or acceleration is thereby effected in direction of travel such that the speed of displacement of the digging tool in direction of travel remains unchanged relative to said starting situation. Due to these features, midship displacements and accelerations of the vessel, superposed on a linear speed of travel, can be actively compensated through the controlled change of the mutual position of the pivotally connected parts forming the elongated element. In order to have the digging tool describe a predetermined path at a constant speed, a similar condition will hold for the hinge connection located closest to the digging tool, while the angle which is enclosed by the pivotable part carrying the digging tool relative to the bottom to be processed can vary within certain limits without actually affecting the dredging operations. Hence, the level at which said hinge connection is located can vary, which fact is used for giving that hinge connection such a horizontal acceleration or deceleration, through active bending or stretching of the articulated, elongated element, that a horizontal deceleration or acceleration of the vessel, which can be measured and is caused by swell, can thereby be compensated, so that the hinge connection moves at a controlled horizontal speed relative to the bottom to be processed and the digging tool moves along the desired path at the desired speed, as a result of which any danger of damage to the dredging equipment, caused-by the digging tool being pressed into the ground, is of course eliminated as well.

[0008] As reference for the compensation, the speed at which the digging tool moves can be taken, which can be compared with the desired speed of displacement. In accordance with a further embodiment of the invention, however, it is preferred that the change of the speed of displacement of the vessel be measured in the direction of travel, from which measuring result a control signal is calculated for the degree to which the angle between two parts of at least one hinge connection is to be changed for keeping the speed of displacement of the digging tool in the direction of travel constant.

[0009] The enable carrying out the compensation of deviations from the desired speed of displacement as quickly and effectively as possible, according to a further embodiment of the invention, it is preferred that this be carried out by changing the angle between a rearwardly inclined part, viewed in direction of travel, and a pivotally connected part of the elongated element that is forwardly inclined in direction of travel. By choosing such arrangement, the desired acceleration or deceleration can be realized with a smaller change of the angle than in the case where parts of the hinge connection substantially extend in the same direction at a fairly obtuse angle. It is further preferred that the angle between two parts at at least one hinge connection, in the starting situation, is in the order of 90°.

[0010] The invention also relates to a vessel comprising a hull and an elongated element such as a suction pipe, a ladder or similar element, carrying a digging tool at one end thereof, which elongated element is pivotally connected to the hull by a hinge coupling whose center line extends substantially transversely to the vessel and is provided, between the digging tool and the hinge coupling, with at least one hinge connection whose pivotal axis extends substantially parallel to the center line, whereby the elongated element is subdivided into at least two parts which are pivotable relative to each other and which enclose an angle relative to each other, there being present active control means for changing the angle between two parts of at least one hinge connection and measuring means for generating signals for activating the active control means, while in accordance with the invention, the measuring means are adapted to measure a change of speed in the direction of travel and are preferably located on the hull of the vessel.

[0011] For realizing ample compensation possibilities, the elongated element is preferably provided with a part which inclines forwards, viewed in direction of travel, and a part pivotally connected thereto which inclines rearwards, viewed in direction of travel.

[0012] Depending on the construction, the active control means can act on various locations, for instance on the part of the elongated element which is pivotally connected to the hull, or to the hinge coupling between that part and the hull. In accordance with a further embodiment of the invention, however, it is preferred that the active control means on one side act on or adjacent the hinge connection located closest to the digging tool, and on the other side act on a part fixedly connected to the vessel or a part of the elongated element connected to the hull by the hinge coupling. In this manner, an extremely direct and hence efficient, active control is possible.

[0013] For actively displacing the hinge connection in order to effect a compensation, use can be made of means which define that displacement entirely, for which purpose the active control means may be provided with an actively controllable hydraulic cylinder engaging the elongated element on or adjacent the hinge connection located closest to the digging tool. Because the actively controllable hinge connection can move along specific paths only, due to its arrangement in the articulated, elongated element, and is subject to gravity, due to its floating arrangement between the vessel and the digging tool, means that are only capable of imposing an upward displacement may also be opted for. To that end, in accordance with a further embodiment of the invention, active control means may be opted for, provided with an actively controllable winch with a cable of which one end engages the elongated element at or adjacent the hinge connection located closest to the digging tool. In that case, controlled displacement of the hinge connection is effected by hauling in or veering out the winch cable.

[0014] If the vessel is a trailing suction dredge, in accordance with a further embodiment of the invention, it is preferred that the elongated element be a suction pipe which, as digging tool, carries a draghead, while during operation, the part of the suction pipe which connects to the draghead inclines rearwards, viewed in direction of travel, and the part of the suction pipe which pivotally connects to said rearwardly inclining part inclines substantially forwards. If the vessel is a cutter suction dredge, similar advantages can be achieved if, in accordance with a further embodiment of the invention, the elongated element is a ladder which, as digging tool, carries a cutter head or cutter wheel, while during use, the part of the ladder which connects to the cutter head or the cutter wheel inclines forwards, viewed in direction of travel, and the part of the ladder which pivotally connects to said forwardly inclined part inclines substantially rearwards.

[0015] The flexibility of the system for effecting a compensation according to the invention can be further increased, if in accordance with a further embodiment, there are provided in the elongated element a first hinge connection and a second hinge connection, spaced from said first hinge connection, whereby the elongated element is subdivided into a first, a second and a third part, which parts are pivotable relative to each other, the first part being connected, by the hinge coupling, to the hull and, by the first hinge connection, to the second part forming an intermediate part, and coupled by the second hinge connection to the third part, which further carries the digging tool.

[0016] A hinge connection in a suction pipe can be realized in a simple yet effective manner if in accordance with a further embodiment of the invention, there are provided two 90° bends, each having at least one end face, an end face of one bend being pivotally connected, fasewise, to an end face of the other bend. During the fitting of two hinge connections in the suction pipe, an intermediate part can readily be formed by fixedly connecting a first pair of bends to a second pair of bends.

[0017] Hereinafter, the vessel according to the invention will be specified exclusively by way of example and with reference to exemplary embodiments schematically shown in the drawings. In these drawings:

Fig. 1 is a side elevation of a first embodiment of the vessel according to the invention;
Fig. 2 is a side elevation of a second embodiment of the vessel according to the invention;
Fig. 3 is a side elevation of a third embodiment of the vessel according to the invention;
Fig. 4 shows a suction pipe in top plan view; and
Fig. 5 is a side elevation of a fourth embodiment of the vessel according to the invention.

[0018] Fig. 1 shows a trailing suction dredge 1 having a hull 2 to which a first end of a first suction pipe part 4 is pivotally connected by means of a hinge coupling 3. The second end of the first suction pipe part 4 is pivotally connected, by a hinge connection 5, to a first end of a second suction pipe part 6 whose other end carries a draghead 7 contacting a bottom 8 under water, the water surface of which is designated by reference numeral 9.

[0019] Positioned on the afterdeck of the trailing suction dredge 1 is a well-known, passive swell compensator 10 having a trestle 11 which supports a winch 12 with a cable 13. The free end of the cable 13 is connected to the draghead 7 or to the second suction pipe part 6 in the proximity thereof. In a known manner, the winch 12 is designed so that it causes the draghead 7 to press on the bottom 8 with a constant force.

[0020] Positioned on the foredeck of the trailing suction dredge 1 is an active displacement compensator 14 provided with a trestle 15 supporting an active compensation unit 16, whose first part is attached to the trestle 15 and whose second part, actively displaceable relative to the first part, is attached to one end of a cable 17 whose other end is connected to the suction pipe construction at or adjacent the hinge connection 5. Said active compensation unit 16 can, for instance, be a piston-cylinder unit or a winch.

[0021] Starting from a constant speed of travel of the trailing suction dredge 1 and a smooth water surface 9, in the situation shown in Fig. 1, the draghead 7 will be pulled along at the constant speed of travel. In the event of swell, a change will occur in that situation, because the hinge coupling 3 will then, inter alia, move up and down. This may be understood most readily if one thinks away the first suction pipe part 4 and causes the hinge coupling 3 to coincide with the hinge connection 5. Upon upward movement of the hinge coupling 3, the suction pipe part 6, pivotable relative to the draghead 7, will assume a steeper position, as a result of which the draghead 7 will move rightwards relative to the hinge coupling 3 in Fig. 1, which speed of displacement is superposed upon the speed of travel, so that the draghead 7 will move faster with a corresponding reduction of the suction efficiency. If the hinge coupling 3 lowers, the draghead 7 is moved rearwards relative to the hinge coupling 3, and, accordingly, starts to move less fast relative to the bottom. If the speed of the rearward displacement exceeds the speed of travel, this may even entail the danger of the draghead 7 being pressed into the bottom, which may lead to damage to the suction equipment. Swell means, inter alia, alternate upward and downward movement of the hinge coupling 3 and hence alternate acceleration and deceleration of the draghead 7, which irregular speed pattern has an extremely disadvantageous effect on the dredging production.

[0022] However, by giving the suction pipe an articulated design, through the hinge connection 5, as shown in Fig. 1, and by imposing an actively controlled displacement on that hinge connection 5, the speed at which the draghead 7 moves can be kept constant, also during swell of the trailing suction dredge 1. This can be effected as follows.

[0023] If the hinge coupling 3 moves up relative to the bottom 8 due to swell, the passive swell compensator 10, as described hereinabove, will maintain the desired contact between the bottom 8 and the draghead 7 while changing the incline of the second suction pipe part 6. At the same time, by an acceleration sensor not shown, the acceleration of hinge coupling 3 in the direction of travel is determined and transmitted to a calculating unit, not shown either, which determines the distance through which the draghead 7, as a result of that acceleration, would move additionally in the direction of travel and which, on the basis thereof, controls the active displacement compensator 14 in such a manner that it causes the hinge connection 5 to swivel rearwards through such an angle that the draghead 7 is not subjected to an additional displacement and hence keeps moving at a constant or substantially constant speed. If the hinge coupling 3 lowers relative to the bottom 8, which would prompt the draghead 7 to decelerate, this is compensated by causing the hinge connection 5 to swivel forwards through the angle required therefor.

[0024] It is observed that a number of standard provisions of a trailing suction dredge which are usually present and well-known per se, are not shown. As such, inter alia a suction pump and hoisting trestles with winches and cables for hauling the suction pipe parts on board can be mentioned. Further, the trailing suction dredge may comprise a hold with bottom discharge flaps, the sucked-up dredging material being dumped into the hold, after which the heavier material can settle and the excess transport water can flow off overboard. Also in respect of the vessels shown in the other Figures, parts which are usually present but which are not necessary for the explanation of the invention have been left out.

[0025] Fig. 2 shows a trailing suction dredge 21 having a hull 22 to which a three-part suction pipe is pivotally attached by means of a hinge coupling 23 and which is composed of a first suction pipe part 24, a second suction pipe part 25 and a third suction pipe part 26, the first and second suction pipe parts being coupled via a first hinge connection 27 and the second and third suction pipe parts-being coupled by a second hinge connection 28. A draghead 29 is hinged to the third suction pipe part 27 and, via a cable 30, to a passive swell compensator 31. Further, the first suction pipe part 24 is kept at a substantially constant angle to the trailing suction dredge 21 by suspending the first hinge connection 27 from a trestle 33 via a cable 32. The second hinge connection 28 is connected, via a cable 34, to an active displacement compensator 35. Because the first suction pipe part 24 maintains a substantially equal position relative to the hinge coupling 23 during swell, the displacement compensation which can be realized by the first hinge connection 27, the second suction pipe part 25, the second hinge connection 28 and the third suction pipe part 26, is in fact comparable with the displacement compensation as realized by the hinge coupling 3, the first suction pipe part 4, the hinge connection 5 and the second suction pipe part 6 of the trailing suction dredge 1 according to Fig. 1 as described hereinabove. The suction pipe construction according to Fig. 2 is particularly preferred if the dredging operations are carried out in deep water.

[0026] Fig. 3 shows a trailing suction dredge having a three-part suction pipe which is substantially identical to that of Fig. 2; hence, similar parts are designated by the same reference numerals. Fig. 3 differs in its construction of the active displacement compensator, here referred to by reference numeral 36 and consisting of a piston-cylinder unit which is pivotally coupled to the first suction pipe part 24 on one side and to the second hinge connection 28 on the other. From the foregoing, it will be understood that in this embodiment, during swell, the desired compensation is effected through extension or retraction of the piston-cylinder unit 36.

[0027] Fig. 4 shows, in top plan view, a possible embodiment of the three-part suction pipe in Fig. 3 in an extended position. Fig. 4 demonstrates that the two ends of both the first suction pipe part 24 and the second suction pipe part 25 end in 90° bends, albeit that the bends in the first suction pipe part 24 are oppositely directed and the bends in the second suction pipe part 25 are oriented in the same direction. Further, the upper end of the third suction pipe part 26, pivotally carrying the draghead 29 at its lower end, ends in such bend as well, which bend, like the other bends, may be formed by attaching a 90° bend to a straight pipe part. In this manner, the hinge connections 27 and 28 and the hinge coupling 23 can be constructed as line hinges in a relatively simple manner.

[0028] Fig. 5 shows a cutter suction dredge 41 with a hull 42 to which a first ladder part 44 is pivotally attached via a hinge coupling 43, which ladder part 44 is further connected, via a hinge connection 45, to a second ladder part 46 carrying a cutter head 47 at its end. The digging depth of the cutter head 47 relative to the hull 42 is determined by a cable 48 coming from a winch 50 arranged in a trestle 49. Alternatively, the position of the cutter head 47 may also be determined by a passive swell compensator and a support plate pressing onto the bottom behind the cutter head. The cutter head 47 further comprises threads extending above and below the plane of the drawing and capable of causing the cutter head 47 to make a uniform horizontal swivel movement. The forward movement of the cutter head 47 is controlled by a spud anchor 51 and a spud anchor carriage 52, said spud anchor carriage 52 being capable of swiveling around the spud anchor and shifting relative to the hull 42.

[0029] In known constructions, the second ladder part 46 is connected to the hull 42 so as to be directly pivotable, so that, during swell, the cutter head 47 is pulled back relative to its set position when the hinge coupling 43 is moved up and is pushed forwards when it is moved down. To compensate this movement, the second ladder part 46 is coupled to the hull 42 via the first ladder part so as to be double-pivotable and an active displacement compensator in the form of a piston-cylinder unit 53 acts on the hinge connection 45 between the first and the second ladder part. In this manner, a threatening displacement of the cutter head 47 can be compensated in the above-described manner through extension or retraction of the piston-cylinder unit 53.

[0030] It is readily understood that within the framework of the invention as laid down in the appended claims, many further modifications and variants are possible. Thus, with an active displacement compensator utilizing a cable and gravity, a second cable may be provided for realizing the displacement in a controlled and less gravity-dependent manner by having the second cable engage from a trestle which, relative to the trestle of the first cable, is located on the other side of the hinge connection. Further, the active compensation of the positional change of the parts of the elongated element relative to each other may also be directly effected by a motor. Also, more than two hinge connections may be present and more than one hinge connection may be actively controlled with mutual coordination for the desired displacement compensation. Further, the hinge coupling according to Fig. 4 is exclusively intended as an example; any other hinge connection may likewise be applied.

Claims

1. A method for positioning a digging tool relative to a vessel comprising a hull, the digging tool being situated at one end of an elongated element, such as a suction pipe, a ladder or a similar element, said elongated element being pivotally connected to the hull by a hinge coupling whose center line extends substantially transversely to the vessel and comprising, between the digging tool and the hinge coupling, at least one hinge connection whose pivotal axis extends substantially parallel to the center line, whereby the elongated element is subdivided into at least two parts which are pivotable relative to each other and enclose an angle relative to each other, the positioning of the digging tool being effected in that, via active control means, the angle between two parts of at least one hinge connection is changed in response to signals coming from measuring means, **characterized in that**, starting from a situation in which vessel, elongated element and digging tool all move at the same speed in direction of travel, during an externally caused change of the speed of displacement of the vessel in direction of travel, with a change of the angle between two parts of at least one hinge connection, said at least one hinge connection is actively controlled to move through swiveling in such a manner that a deceleration or acceleration is thereby effected in direction of travel such that the speed of displacement of the digging tool in direction of travel remains unchanged relative to said starting situation.

2. A method according to claim 1, characterized in that the change of the speed of displacement of the vessel in the direction of travel is measured, from which measuring result a control signal is calculated for the extent to which the angle between two parts of at least one hinge connection should be changed for keeping the speed of displacement of the digging tool in the direction of travel constant.

3. A method according to claim 1 or 2, characterized in that the compensation of an acceleration or deceleration of the digging tool threatening by a change of the speed of displacement is performed by changing the angle between a rearwardly inclined part, viewed in direction of travel, and a pivotally connected part of the elongated element that is forwardly inclined in direction of travel.

4. A method according to claim 3, characterized in that the angle between two parts at at least one hinge connection in the starting situation is in the order of 90°.

5. A vessel comprising a hull and an elongated element such as a suction pipe, a ladder or similar element, carrying a digging tool at one end thereof, said elongated element being pivotally connected to the hull by a hinge coupling whose center line extends substantially transversely to the vessel and provided, between the digging tool and the hinge coupling, with at least one hinge connection whose pivotal axis extends substantially parallel to the center line, whereby the elongated element is subdivided into at least two parts which are pivotable relative to each other and enclose an angle relative to each other, there being present active control means for changing the angle between two parts of at least one hinge connection and measuring means for generating signals for activating the active control means, characterized in that the measuring means are adapted to measure a change of speed in the direction of travel.

6. A vessel according to claim 5, characterized in that the measuring means are located on the hull of the vessel.

7. A vessel according to claim 5 or 6, characterized in that the elongated element comprises a part which inclines forwards, viewed in direction of travel, and a part which is pivotally connected thereto and inclines rearwards, viewed in direction of travel.

8. A vessel according to any one of claims 5-7, characterized in that the active control means on one side act on or adjacent the hinge connection located closest to the digging tool and on the other side act on a part fixedly connected to the vessel or a part of the elongated element connected to the hull by the hinge coupling.

9. A vessel according to any one of claims 5-8, characterized in that the active control means comprise an actively controllable winch with a cable of which one end engages the elongated element on or adjacent the hinge connection located closest to the digging tool.

10. A vessel according to any one of claims 5-8, characterized in that the active control means comprise

an actively controllable hydraulic cylinder which engages the elongated element on or adjacent the hinge connection located closest to the digging tool.

11. A vessel according to any one of claims 5-10, characterized in that the elongated element is a suction pipe consisting of at least two parts, which suction pipe carries, as digging tool, a draghead at the end of one of the parts, while during operation, the part of the suction pipe ending at the draghead inclines rearwards, viewed in direction of travel, and the part of the suction pipe connecting thereto, via the hinge connection, inclines substantially forwards, viewed in direction of travel.

12. A vessel according to claim 11, characterized in that a hinge connection in a suction pipe comprises two 90° bends, each having at least one end face, an end face of one bend being pivotally connected, facewise, to an end face of the other bend.

13. A vessel according to any one of claims 5-10, characterized in that the elongated element is a ladder carrying, as digging tool, a cutter head or cutter wheel, while during operation, the part of the ladder carrying the cutter head or the cutter wheel inclines forwards, viewed in direction of travel, and the part of the ladder which connects thereto via the hinge connection inclines substantially rearwards, viewed in direction of travel.

14. A vessel according to any one of claims 5-13, characterized in that in the elongated element, there are provided a first hinge connection and a second hinge connection, spaced from said first hinge connection, whereby the elongated-element is subdivided into a first, second and third part, the first part being connected by the hinge coupling to the hull and by a first hinge connection to the second part forming an intermediate piece and coupled by a second hinge connection to the third part, further carrying the digging tool.

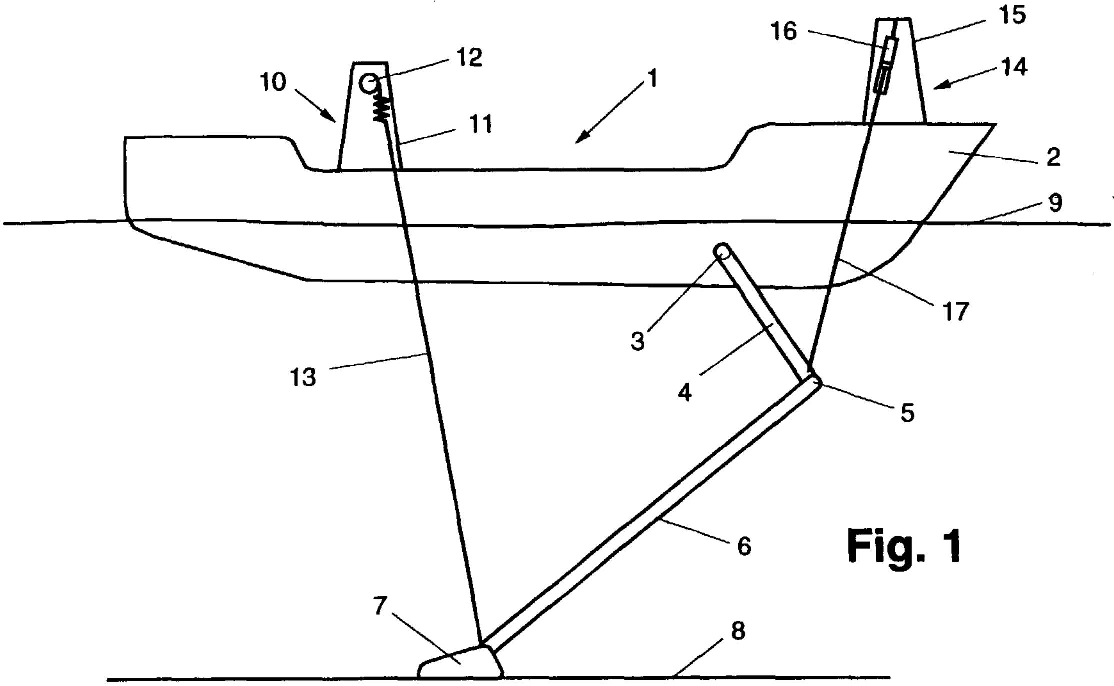
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Fig. 1

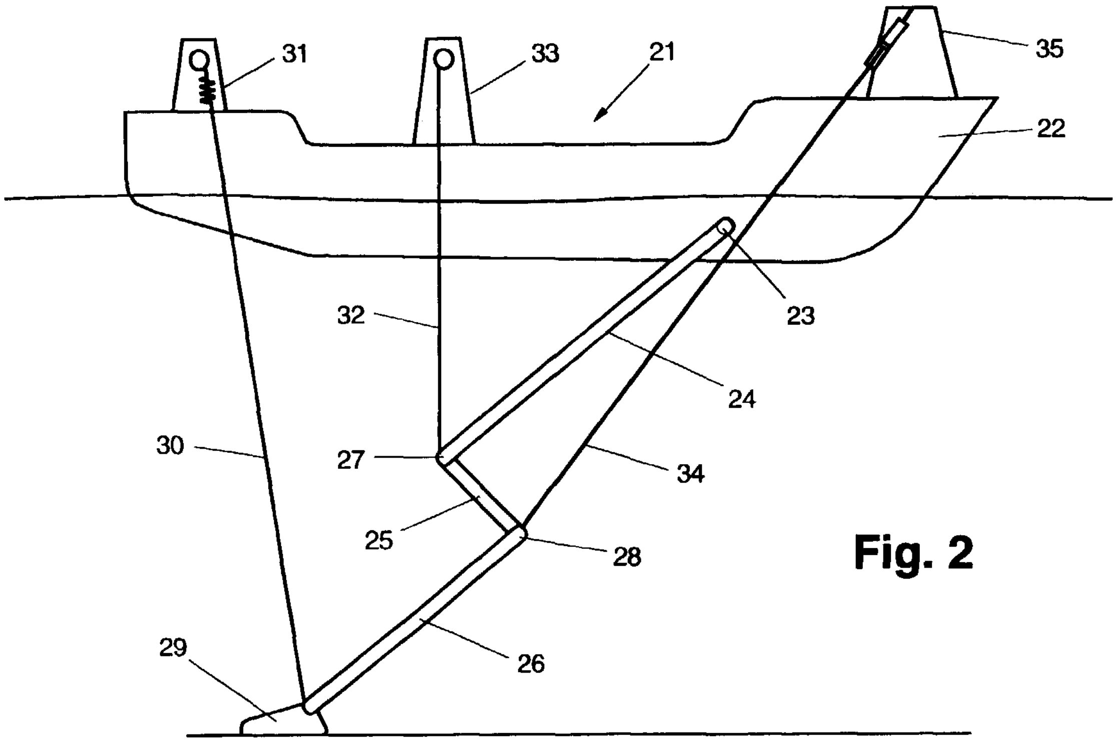
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Fig. 2

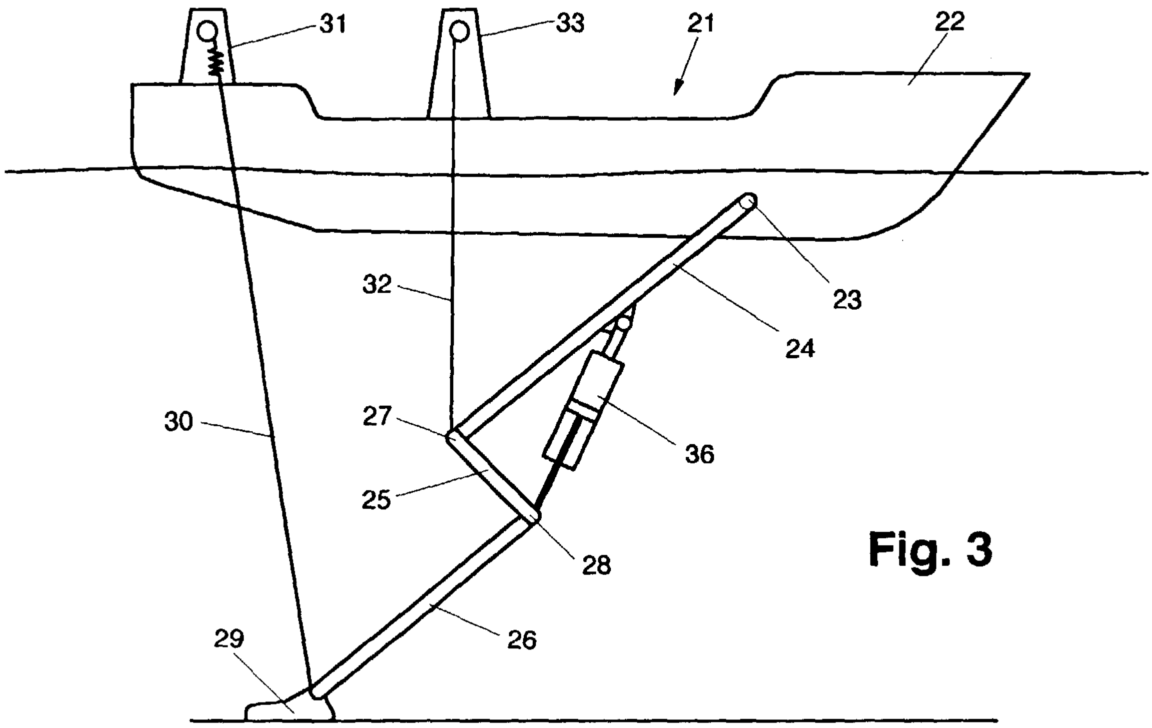

Fig. 3

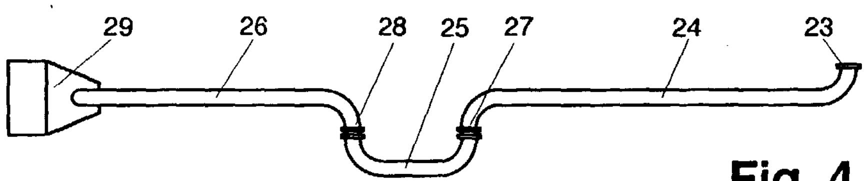

Fig. 4

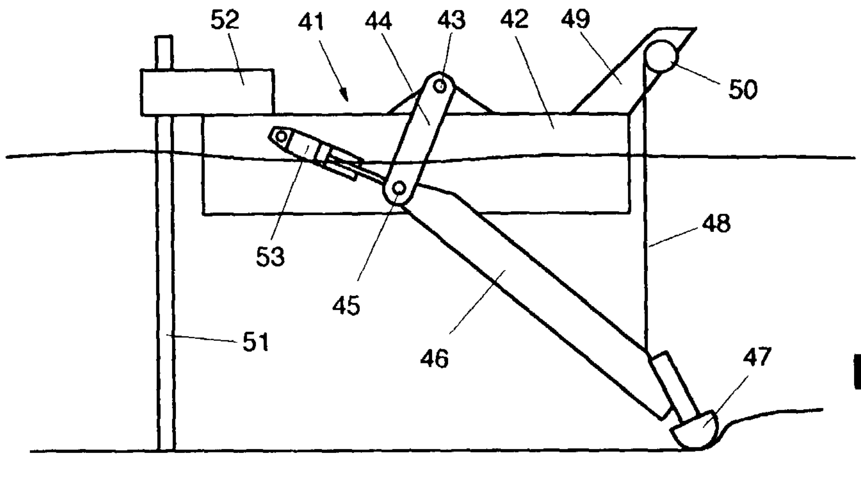

Fig. 5

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 00 20 1049

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.7)
A	NL 7 901 450 A (REBA BV) 26 August 1980 (1980-08-26) * page 1, line 19 - line 28 * * page 4, line 30 - page 5, line 28 * * figure 2 *	1,3,5, 8-10	E02F3/90 E02F9/06
A	US 3 826 023 A (DE KONING J ET AL) 30 July 1974 (1974-07-30) * figures 2,3 * * column 2, line 1 - column 3, line 18 *	1,3,5, 8-10	
A	EP 0 009 516 A (BALLAST NEDAM GROEP NV;AMSTERDAM BALLAST BAGGER) 16 April 1980 (1980-04-16) * page 4 - page 8 * * figures *	1,3,5, 7-10	
A	NL 8 101 895 A (HOLLANDSCH AANNEMERSBEDRIJF ZA) 16 November 1982 (1982-11-16) * page 3, line 11 - line 26 * * figure *	1,5	TECHNICAL FIELDS SEARCHED (Int.Cl.7)
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	31 May 2000	Guthmuller, J

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EUROPEAN SEARCH REPORT

Application Number
EP 00 20 1049

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
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