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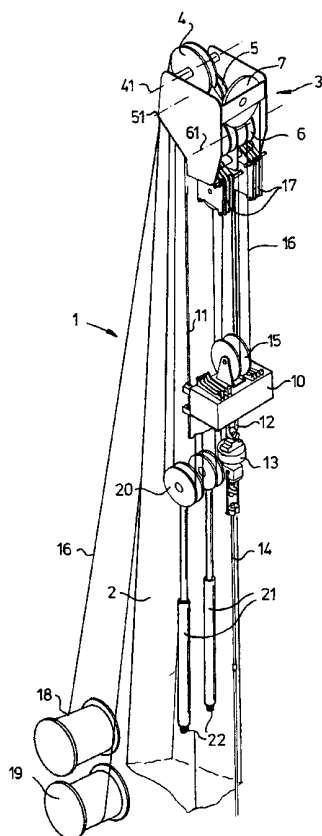
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(54) Title: HOISTING MECHANISM, WITH COMPENSATOR INSTALLED IN A HOISTING CABLE SYSTEM



(57) Abstract: The invention relates to a hoisting mechanism (1) for a vessel, comprising a mast (2) which is provided with cable blocks on the top side; a trolley (10) which is displaceably attached to the mast (2) and is provided on the top side with cable blocks and on the underside with means (12) for picking up a load; hoisting means, at least equipped with a hoisting cable (16) and a winch (18, 19), the hoisting cable (16) being guided over the cable blocks of both the mast and the trolley, and it being possible to move the trolley (10) with respect to the mast (2) with the aid of the hoisting means; and a compensator (21), in the form of a pneumatic or hydraulic cylinder, for damping movements of the vessel (70) caused by swell and wave action, in which mechanism the hoisting cable (16) is guided over cable pulleys (20) which are connected to the end of the compensator (21), in such a manner that with the aid of the compensator it is possible to exert force on the hoisting cable (16).

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

HOISTING MECHANISM, WITH COMPENSATOR INSTALLED IN A HOISTING CABLE SYSTEM

The present invention relates to a hoisting mechanism, provided with a mast which is provided with cable blocks on the top side; a trolley which is
5 displaceably attached to the mast and is provided on the top side with cable blocks and on the underside with means for picking up a load; hoisting means, at least equipped with a hoisting cable and a winch, the hoisting cable being guided over the cable blocks of both the mast and the trolley, and it being possible to move the trolley with respect to the mast with the aid of the hoisting means; and a compensator, in the form of a
10 pneumatic or hydraulic cylinder, for damping movements of the vessel caused by swell and wave action.

Hoisting mechanisms of this nature are known from the prior art. These hoisting mechanisms are used in the offshore industry as a drilling mast on drilling vessels, for example. When, in use, a drill string is attached to the underside of a
15 trolley, the compensator has to compensate for the movements of the vessel with respect to the sea bed. During drilling, the drill string itself will be at least partially positioned in the ground and will make minimal movements with respect to the ground. By contrast, the vessel does move, under the influence of the waves and the current of the water.

20 According to the prior art, the compensator is generally placed between two blocks or trolleys, which can both move with respect to the mast. The top trolley will in this case be provided with cable pulleys which can be moved with respect to the mast with the aid of a hoisting cable. The bottom trolley will be attached to the top trolley by means of the compensator. If, in this structure, forces are exerted on the bottom trolley
25 by the drill string, these forces will be only partially transmitted to the top trolley.

The compensator which is generally used has a pneumatic action. The pneumatic compensator will therefore be connected to a compressed-air system with the aid of hoses and the like. For a compensator of this nature to function correctly, a relatively large stroke volume will be required. Since the two blocks or trolleys move
30 with respect to the mast, the compensator will also be able to move with respect to the mast; this represents a drawback. This is because the connections of the compressed-air installation to the compensator must also be able to move with respect to the mast, requiring the use of flexible hoses and tubes, for example, all of which makes

connection relatively complicated and therefore expensive.

A first object of the present invention is to provide a hoisting mechanism of the type mentioned in the preamble, in which the connections of a pressure installation to the compensator can be arranged at a stationary position.

5 In the present invention, this object is achieved by the fact that the hoisting cable is guided over cable pulleys which are connected to the end of the compensator, in such a manner that with the aid of the compensator it is possible to exert force on the hoisting cable.

This means that the compensator is no longer located between the trolleys
10 which are attached to the mast, but rather the compensator acts directly on the hoisting cable. A first end of the compensator may be connected to a stationary part of the mast. At the other end, the compensator is connected to the hoisting cable via cable pulleys. Therefore, the compensator can also be used to place stress on the hoisting cable.

The advantage of these measures is firstly that the compensator may be
15 secured at a fixed position in the vicinity of the mast. The compressed-air installation may therefore be connected to the compensator at a single location, thus enabling a relatively simple and inexpensive structure to be realized.

The hoisting mechanism according to the invention can be further improved
20 by the mechanism comprising at least two compensators which are each connected, at their end, to cable pulleys.

The effect of this measure is that the device acquires greater redundancy. If
the compensator in a mechanism according to the prior art breaks down, the drilling work has to be suspended immediately. With a hoisting mechanism according to the invention which contains more than one compensator, it is possible to continue work
25 even if one of the compensators should fail. The cylinder of the compensator which fails is then placed in one of the limit positions. Fixing the compensator in place will change the damping action on the hoisting cable, but since there are still one or more compensators which remain active, the device does not have to be shut down.

According to the invention, it is advantageous if the mast is designed as a
30 casing or sleeve, and if the compensator or the compensators are located in the mast.

There is generally sufficient space available in the mast on a drilling vessel or similar vessel for the compensator to be installed. This means that the compensator itself will not require any additional space. In addition to the space-saving advantage

which this produces, it is important that the mast remains freely accessible from all sides due to the compensator being located inside the mast. The compensator therefore does not present any obstacle to feeding a tool to the mast, for example.

In the mechanisms according to the prior art, it is customary for a hoisting
5 cable to be attached at a fixed location at one end. The other end of the hoisting cable is then wound onto a winch. If this winch fails, the mechanism can no longer be used.

It is therefore advantageous if the hoisting means are provided with two winches, each end of the hoisting cable being wound onto a separate winch. By then winding the two ends onto a separate winch, it is possible to achieve the same cable
10 speed at a relatively low rotational speed of the winches. This constitutes a huge reduction in wear on the cable, with the result that the cable has to be replaced less often.

Moreover, the addition of the second winch provides redundancy in the system. Should one of the winches fail, the hoisting mechanism does not become
15 unusable, but rather it is possible to continue work using a single winch.

It is advantageous for the winches to be driven by a large number of relatively small motors.

For example, it is possible for the winches to be equipped on either side with electric motors which engage with a pinion in a gearwheel of the winch. Firstly,
20 this has the advantage that electric motors of this nature are commercially available. Therefore, there is no need to develop a special, and therefore expensive, hoisting winch in order for the hoisting mechanism to be used. Secondly, the relatively small motors have a low internal inertia. This means that, for example when changing the direction of rotation of the winch, less energy and time is lost in this changeover.

25 In a hoisting mechanism of the type mentioned in the introduction, according to the prior art, there is a known problem in finding an optimum compromise between speed and force. The hoisting cable is guided over the cable blocks in the mast and on the trolley in such a manner that a plurality of cable sections extend between the mast and the trolley. The more wire sections there are between the mast and the trolley,
30 the higher the load which can be lifted using the hoisting mechanism will become, if the hoisting winch remains unchanged. However, it is also true that the more wire sections there are between the mast and the trolley, the lower the speed at which the trolley can be moved with respect to the mast becomes. To find a suitable compromise

between speed and lifting power, it is generally decided to provide the hoisting mechanism with winches which in relative terms are too heavy. The heavy winches are at any rate able to satisfy the requirement that the trolley should be able to move rapidly up and down. However, this also means that a considerable part of the time and
5 a considerable part of the lifting capacity are not utilized. In other words: the device is actually provided with winches which are too heavy and therefore too expensive in order to be able to achieve a sufficient speed from time to time.

Therefore, a further object of the present invention is to provide a hoisting mechanism of the type referred to in the introduction with which, on the one hand, it is
10 possible to lift a relatively heavy load and, on the other hand, it is possible to operate at a relatively high speed, while the hoisting means can be of relatively lightweight and inexpensive design.

In the present invention, this object is achieved by the fact that the hoisting cable is also guided over separate pulleys which can be attached to the mast or to the
15 trolley as desired.

The effect of this measure is that the number of wire sections between the mast and the trolley can be set as desired. If the separate pulleys are attached to the mast, a large number of wire sections will extend between the mast and the trolley, and it will be possible to lift a relatively high weight. If the separate blocks are attached to
20 the trolley, a relatively small number of wire sections will extend between the mast and the trolley, and the trolley can be moved at a relatively high speed with respect to the mast. Since the hoisting cable is guided over the pulleys, and the pulleys can be attached to the mast or the trolley as desired, the hoisting cable does not have to be reeved again. This means that the desired number of wire sections can be adjusted
25 within a relatively short time.

According to the invention, it is possible for the separate pulleys to be secured symmetrically with respect to the centre of the mast.

Consequently, the forces which are exerted on the cables are also transmitted symmetrically to a mast. This means that there are no additional flexural
30 loads exerted on the mast.

According to the invention, it is possible for the separate pulleys to be accommodated in a housing which is provided, both on the top side and the underside, with eyelets which are able to receive locking pins.

By using locking pins which are able to engage in eyelets, it is possible for the separate pulleys to be quickly and effectively attached to the mast or the trolley as desired.

It is advantageous for the locking pins to be equipped with a hydraulic
5 actuation means.

The use of a hydraulic actuation means allows the locking pins to be subjected to remote control.

In a second aspect, the present invention relates to a method for placing an object on the ground, beneath a vessel which is provided with the hoisting mechanism
10 according to the invention, the said vessel moreover being provided with a tensioner.

The method according to the present invention is characterized in that:

- the compensator is placed under a prestress which is lower than the weight of the object which is to be lowered using the hoisting mechanism,
- the object is moved downwards by paying out the hoisting cable with the aid of
15 the winch,
- the hoisting cable continues to be paid out when the object comes into contact with the ground and continues to be paid out until the compensator has approximately reached the centre position thereof,
- the object is coupled to the tensioner.

20 The procedure described above allows a heavy object to be placed on the ground beneath a vessel in a very well-controlled manner. The risk of an object, such as for example a BOP, hitting the ground with a considerable force and thus being damaged is consequently minimized.

It is advantageous if the prestress on the tensioner is between 60 and 90%
25 of the total weight of the load, preferably between 75 and 85% of that weight, and most preferably 80% of that weight.

The present invention will be described further with reference to the appended drawings, in which:

Figure 1 shows the hoisting mechanism according to the present invention;

30 Figure 2 shows the arrangement in which four separate pulleys are attached to the trolley;

Figure 3 shows the arrangement in which two separate pulleys are attached to the trolley and two separate pulleys are attached to the mast head;

Figure 4 shows the arrangement in which four separate pulleys are attached to the mast head;

Figure 5 shows a separate pulley which, on the underside and the top side, is provided with eyelets into which locking pins can be moved;

- 5 Figure 6 diagrammatically shows the path of the hoisting cable over the various pulleys, in the arrangement in which four separate pulleys are attached to the trolley; Figures 7, 8 and 9 diagrammatically show the possibility of using the hoisting mechanism according to the invention, which is attached to a vessel, to place objects on the ground beneath the vessel.

- 10 Figure 1 shows the hoisting mechanism 1 according to the present invention. The hoisting mechanism 1 comprises a mast 2. The following description will always refer to a mast, but it should be understood that any other suitable device, such as for example a tower, could also be used.

- The top side of the mast 2 is formed by a mast head 3. A large number of
15 cable pulleys is secured in the mast head 3. Firstly, two cable pulleys 4 are arranged on an axis 41. Beneath these, at the rear of the mast, four cable pulleys 5 are mounted on an axis 51. At the front side of the mast, four cable pulleys 6 are mounted on an axis 61. Moreover, a central pulley 7 is attached to the front of the mast, the axis of this pulley 7 being substantially perpendicular to the axis of the pulleys 4, 5 and 6.

- 20 The hoisting mechanism moreover comprises a trolley 10. This trolley 10 can move along a guide 11 with respect to the mast 2. On its underside, the trolley 10 is provided with a bracket or hook 12 or some other suitable means to which a load which is to be hoisted can be attached. Figure 1 shows the case in which a topdrive 13, with a drill string 14 below it, is attached to the hook 12. On the top side, the trolley 10 is
25 provided with two cable pulleys 15. The trolley 10 is connected to the mast head 3 by the cable 16 which, via a plurality of reeving arrangements, runs between the cable pulleys 15 on the trolley and the various cable pulleys in the mast head 3.

- In addition to the abovementioned cable pulleys 4, 5, 6, 7 and 15, the hoisting mechanism 1 also contains four "separate pulleys" 17. These separate pulleys
30 17 can be attached to the mast head 3 or to the trolley 10 as desired. The way in which the separate pulleys 17 are coupled to the mast head 3 or the trolley 10 is shown in detail in Figures 2, 3 and 4.

The advantage of the presence of the separate pulleys 17 is that the number

of wire sections of the cable 16 which extend between the mast head 3 and the trolley 10 can be varied as desired. If the separate pulleys 17 are attached to the mast head 3, a limited number of wire sections will extend in the direction of the trolley 10. This means that, on the one hand, a relatively limited weight can be lifted using the hoisting mechanism but, on the other hand, the trolley 10 can be moved relatively quickly towards the mast head 3. If the separate pulleys 17 are attached to the trolley 10, a relatively large number of wire sections will extend from the mast head 3 towards the trolley 10. This means that a relatively large weight can be lifted using the trolley 10, but this trolley 10 will be moved at a relatively low speed with respect to the mast head 3. By distributing the number of separate pulleys 17 as desired between the mast head 3 and the trolley 10, it is possible to adjust both the weight which is to be lifted using the hoisting mechanism and the speed at which the trolley 10 can be moved with respect to the mast head 3.

In the prior art, it is known to be a problem that a hoisting mechanism often has to be equipped with a drive which in relative terms is too large, in order to achieve a workable compromise between the maximum lifting capacity and a minimum hoisting speed which has to be reached. The present invention solves this problem by means of the "separate pulleys".

In the hoisting mechanism 1 shown in Figure 1, the cable 16 extends from a first hoisting winch 18 towards the mast head 3. The hoisting winch is also known as a "drawwork". The hoisting cable 16 is then guided back to a second hoisting winch 19. In the prior art, it is customary for an end section of the hoisting cable 16 to be fixed to a stationary point, the other end being wound onto a hoisting winch. By using two hoisting winches 18, 19, as in the hoisting mechanism 1, it is possible to achieve a number of advantages. To achieve a specified speed of the trolley with respect to the mast head 3, the rotational speed of the hoisting winches 18 and 19 can be half the level of that which would be used if there were only one hoisting winch. The effect which can be achieved by maintaining a relatively low speed of the winches 18, 19 is that there will be little wear in the cable 16. If, in use, one of the two hoisting winches were to fail, it is possible to continue to operate using another hoisting winch. In the prior art, the failure of a hoisting winch immediately means that the hoisting mechanism can no longer be used. The hoisting winches 18, 19 are preferably driven by electric motors, on which there is a gearwheel, engaging in a pinion. In each hoisting winch, it is

possible, for example, for each side of the hoisting winch 18, 19 to be provided with four such motors. This means that each hoisting winch is driven by eight electric motors. This has the first advantage that the electric motors which are to be used can be kept relatively small. This means that these motors do not have to be specifically
5 designed for hoisting purposes, but rather will be commercially available. Secondly, the use of the relatively small motors means that the internal inertia in the motors is kept at a low level, with the result that when the direction of rotation of the winches 18, 19 is changed over, the internal inertia of the drive members themselves will not cause any problems.

10 In Figure 1, in addition to the cable pulleys mentioned above, there is also a first set of two cable pulleys 20 and a second set of two cable pulleys 20 connected to the top side of two compensators 21. At the bottom, the compensators 21 are connected to the mast 2 at the connection point 22. The hoisting mechanism 1 according to the present invention can be used to good effect for numerous hoisting activities. The
15 hoisting mechanism 1 is particularly advantageous if it is used for drilling work from a vessel. The reason for this is that it must be possible to exert a very high hoisting force in particular when carrying out drilling work of this nature, in some parts of the drilling process, and that in other parts of the drilling process the speed at which the trolley is able to move with respect to the mast is the most important factor. In hoisting
20 mechanisms which are used on drilling vessels of this nature, it is customary to place a compensator in the mechanism. This compensator is generally arranged on the underside of the trolley 10. Then, a device is placed on the underside of the compensator, to which device the topdrive of a drill string, for example, can be coupled. As a result of the compensator being attached in this way, the compensator
25 will move with respect to the mast. To achieve good performance, the compensator must be connected to feed means for compressed air. If the compensator moves with respect to a mast, this compressed-air installation has to be coupled to the compensator in a complex and therefore relatively expensive manner, for example with the aid of flexible hoses and the like.

30 According to the invention, it is now selected to arrange the compensators 21 inside the mast 2, with the underside 22 of the compensators attached to a stationary point of the mast 2. The position of the underside of the compensators with respect to the mast is therefore always the same. This means that the installation for supplying

compressed air can always be coupled to the compensators 21 at the same location. This ensures that the coupling between the compressed-air installation and the compensators can be many times simpler than in the prior art. The specific possibilities for the compensators arranged in the mast will be explained with reference to Figures 7, 8 and 9.

The arrangement shown intentionally depicts two compensators 21 in the mast. The mechanism 1 can function excellently with only one compensator 21, but the addition of at least a second compensator is advantageous. Should one of the two compensators refuse to function or break down, it is still possible to continue to operate using the mechanism. It is possible that the damping of the hoisting cable may no longer be ideal, but the presence of the second compensator which is still functioning means that there is at any rate still some degree of damping. In the prior art, failure of the compensator means that the hoisting mechanism has to be immediately shut down. The invention prevents this problem.

Figure 2 shows the arrangement in which four separate pulleys 17 are attached to the trolley 10. It can be seen in Figure 2 that four pulleys 17 are attached to the trolley 10. Therefore, twelve wire sections extend between the trolley 10 and the mast head 3.

Figure 3 shows the arrangement in which two separate pulleys 17 are attached to the mast head 3, and two separate pulleys 17 are attached to the trolley 10. In this arrangement, eight wire sections will extend between the mast head 3 and the trolley 10.

Figure 4 shows the arrangement in which four separate pulleys 17 are attached to the mast head 3. This means that only three wire sections will extend between the mast head 3 and the trolley 10. As will be understood, in the configuration shown in Figure 2, it will be possible to lift the highest weight, since in that case twelve wire sections extend between the mast head 3 and the trolley 10. In the configuration shown in Figure 4, only a relatively low weight can be lifted, since only four wire sections extend between mast head 3 and the trolley 10. However, the trolley 10 can be moved at a relatively high speed with respect to the mast 3.

In Figures 2, 3 and 4, it can be seen that exactly the same number of separate pulleys 17 are attached to the mast head 3 on the left-hand side of the mast 2 as on the right-hand side. This means that the forces exerted by the cable 16 on the

mast will be symmetrically distributed. Moreover, the figures indicate that both the mast head 3 and the trolley 10 are provided with attachment means for the separate pulleys 17. These attachment means comprise, for example, a U-shaped attachment section 51 which is provided on either side with movable locking pins 52. This is
5 illustrated in detail in Figure 5.

Figure 5 shows a separate pulley 17. The separate pulley 17 comprises an outer casing which is composed of two plates 53. These plates 53 are provided, on both the top side and the underside, with eyelets 54 which are able to receive locking pins 52. These locking pins move through eyelets 55 which are formed in, for example, a U-
10 shaped attachment member 51. This attachment member 51 may be attached to both the trolley and a mast head.

In use, the trolley 10 will be raised to a position which is as close as possible to the mast head 3. This position is also known as two-blocks. Then, either the locking pins 52 associated with the trolley 10 or the locking pins 52 associated with the
15 mast head 3 will be moved into the eyelets 54 of the plates 53. In this way, it is possible to select which separate pulleys 17 are coupled to the mast head 3 and which pulleys 17 are coupled to the trolley 10.

Figure 6 shows the path of the cable 16 from the hoisting winch 18, over the successive cable pulleys, towards the hoisting winch 19. Figure 6 shows the
20 arrangement in which the four separate pulleys 17 are substantially in line with the two pulleys 15 which are fixedly attached to the trolley. This means that in the arrangement shown in Figure 6 twelve wire sections will extend between the mast head 3 and the trolley 10.

As stated above, the hoisting mechanism 1 according to the invention can
25 be used to good effect on drilling vessels. A known problem on drilling vessels according to the prior art is that of positioning heavy objects on the bed of, for example, the sea. Figure 7 shows the situation in which a blow-out preventer (BOP) 71 is placed on a so-called baseplate or template 72, below the drilling vessel 70 (diagrammatically depicted). Since the drilling vessel 70 will never be completely
30 stationary with respect to the sea bed 73, owing to the waves and the swell, there is a risk when placing the BOP 71 on the template 72, that the swell of the vessel 70 will cause the BOP to be placed on the template 72 at an uncontrolled speed. This could damage the BOP 71.

Figure 7 shows the situation in which the BOP 71, on the drill string 14 with a riser 77 around it, is being moved towards the template 72. In this case, a pressure of approximately 80% of the total weight of the riser and the BOP is being applied to the compensators 21. Since this pressure is insufficient to bear the weight of the riser and the BOP, this means that the compensators are in their limit position. The compensators will nevertheless exert a force on the cable 16. The BOP 71 is moved downwards as a result of the cable 16 being paid out from either the winch 18 or the winch 19, or both. As can be seen in Figure 7, a riser tensioner 75 is also present in the vessel 70. This riser tensioner 75 is connected to the riser ring 78 on the top side of the riser. While the cable 16 is being paid out downwards in order to move the BOP 71 towards the template 72, this riser tensioner 75 as yet has no function.

Figure 8 shows the situation in which the BOP 71 has just come into contact with the template 72. This means that from that moment paying out the cable 16 would cause the compensators 21 to retract inside the mast. The cable 16 is then paid out until the tensioner 75 is approximately in the central position thereof. This means that the cable continues to be paid out until the cylinders of the compensators 21 are in the central position.

When this position has been reached, the riser tensioner 75 is brought further into position. This means that from this moment a considerable part of the weight of the BOP and the riser will be supported by the riser tensioner 75. The cable continues to be paid out until the compensators 21 are in their limit position. From that moment, the winch is not paid out further. Due to the level of 80% of the weight of the riser and the BOP which has previously been established in the compensators 21, this force will continue to be present on the cable.

The method shown in Figures 7-9 allows the BOP to be placed onto the template 72 in a very controlled manner.

Claims

1. Hoisting mechanism (1) for a vessel, comprising a mast (2) which is provided with cable blocks on the top side; a trolley (10) which is displaceably attached
5 to the mast (2) and is provided on the top side with cable blocks and on the underside with means (12) for picking up a load; hoisting means, at least equipped with a hoisting cable (16) and a winch (18, 19), the hoisting cable (16) being guided over the cable blocks of both the mast and the trolley, and it being possible to move the trolley (10) with respect to the mast (2) with the aid of the hoisting means; and a compensator (21),
10 in the form of a pneumatic or hydraulic cylinder, for damping movements of the vessel (70) caused by swell and wave action, characterized in that the hoisting cable (16) is guided over cable pulleys (20) which are connected to the end of the compensator (21), in such a manner that with the aid of the compensator it is possible to exert force on the hoisting cable (16).
- 15 2. Hoisting mechanism (1) according to Claim 1, characterized in that the device comprises at least two compensators (21) which are each connected, at their end, to cable pulleys (20).
3. Hoisting mechanism (1) according to Claim 1 or 2, characterized in that the mast is designed as a casing or sleeve, and in that the compensator or the compensators
20 (21) are located in the mast (2).
4. Hoisting mechanism (1) according to one of the preceding claims, characterized in that the hoisting means are provided with two winches (18, 19), each end of the hoisting cable (16) being wound onto a separate winch (18, 19).
5. Hoisting mechanism (1) according to Claim 4, characterized in that the
25 winches (18, 19) are driven by a large number of relatively small motors.
6. Hoisting mechanism (1) according to one of the preceding claims, characterized in that the hoisting cable is also guided over separate pulleys (17) which can be attached to the mast (2) or to the trolley (10) as desired.
7. Hoisting mechanism (1) according to Claim 6, characterized in that the
30 separate pulleys (17) are attached symmetrically with respect to the centre of the mast (2).
8. Hoisting mechanism (1) according to Claim 6 or 7, characterized in that the separate pulleys (17) are accommodated in a housing (53) which is provided, on both

the top side and the underside, with eyelets (54) which are able to receive locking pins (52).

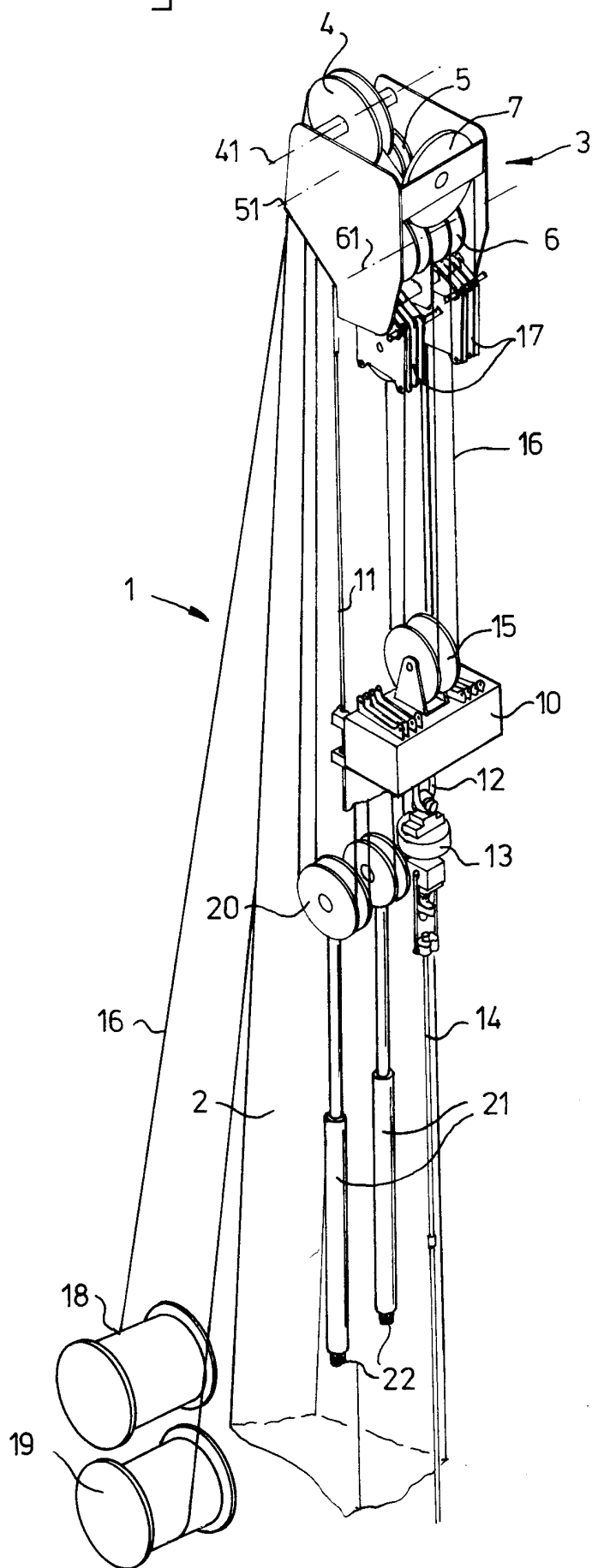
9. Hoisting mechanism (1) according to one of Claims 6, 7 or 8, characterized in that the locking pins (52) are equipped with a hydraulic actuation means.

5 10. Method for placing an object on the ground, below a vessel which is provided with the hoisting mechanism according to one of the preceding claims, the said vessel also being provided with a tensioner (75), characterized in that:

- the compensator (21) is placed under a prestress which is lower than the weight of the object which is to be lowered using the hoisting mechanism,
- 10 - the object is moved downwards by paying out the hoisting cable (16) with the aid of the winch (18, 19),
- the hoisting cable (16) continues to be paid out when the object comes into contact with the ground (72, 73) and continues to be paid out until the compensator (21) has approximately reached the centre position thereof,
- 15 - the object is coupled to the tensioner (75).

11. Method according to Claim 10, characterized in that the prestress on the tensioner is between 60 and 90% of the total weight of the load, preferably between 75 and 85% of that weight, and most preferably 80% of that weight.

fig-1 1/7



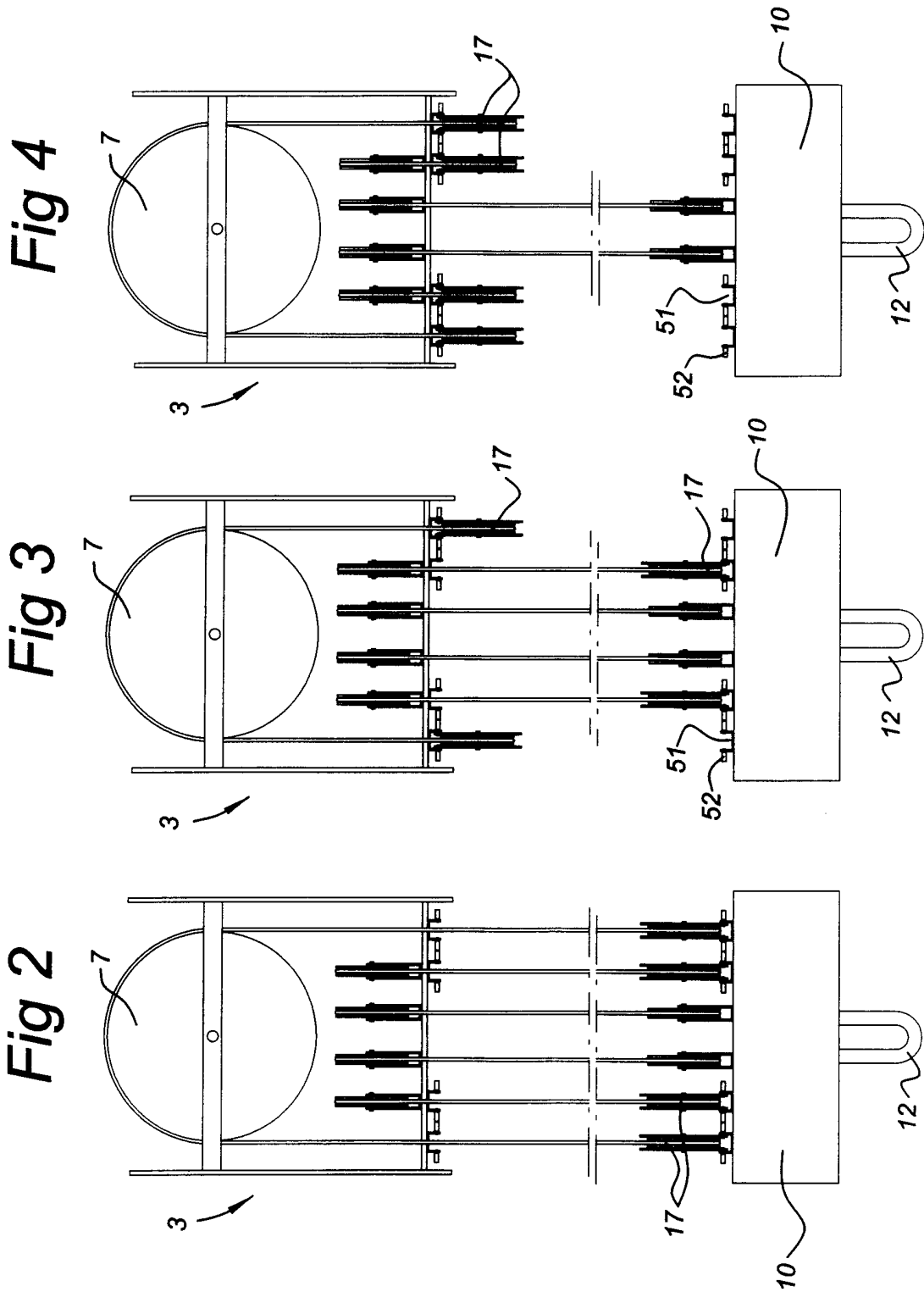


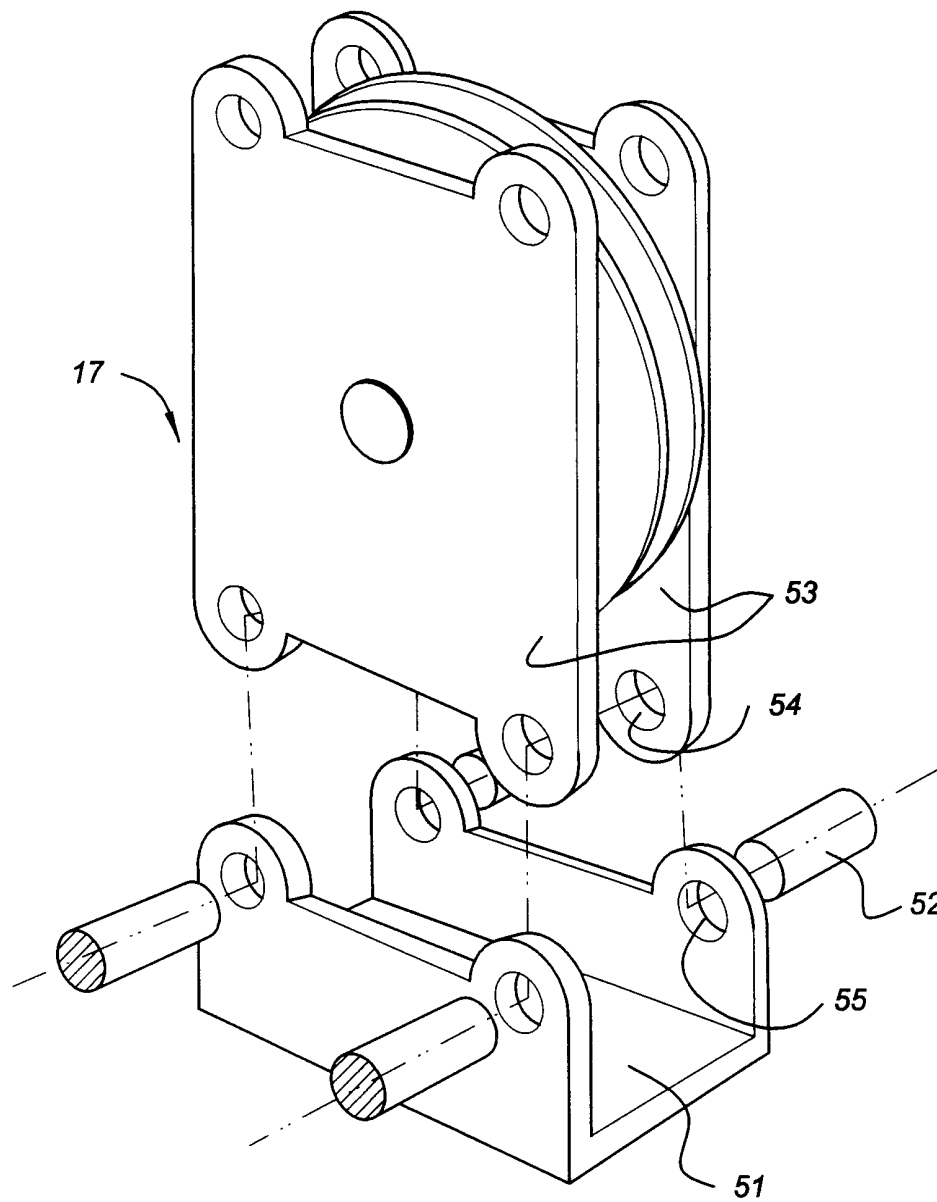
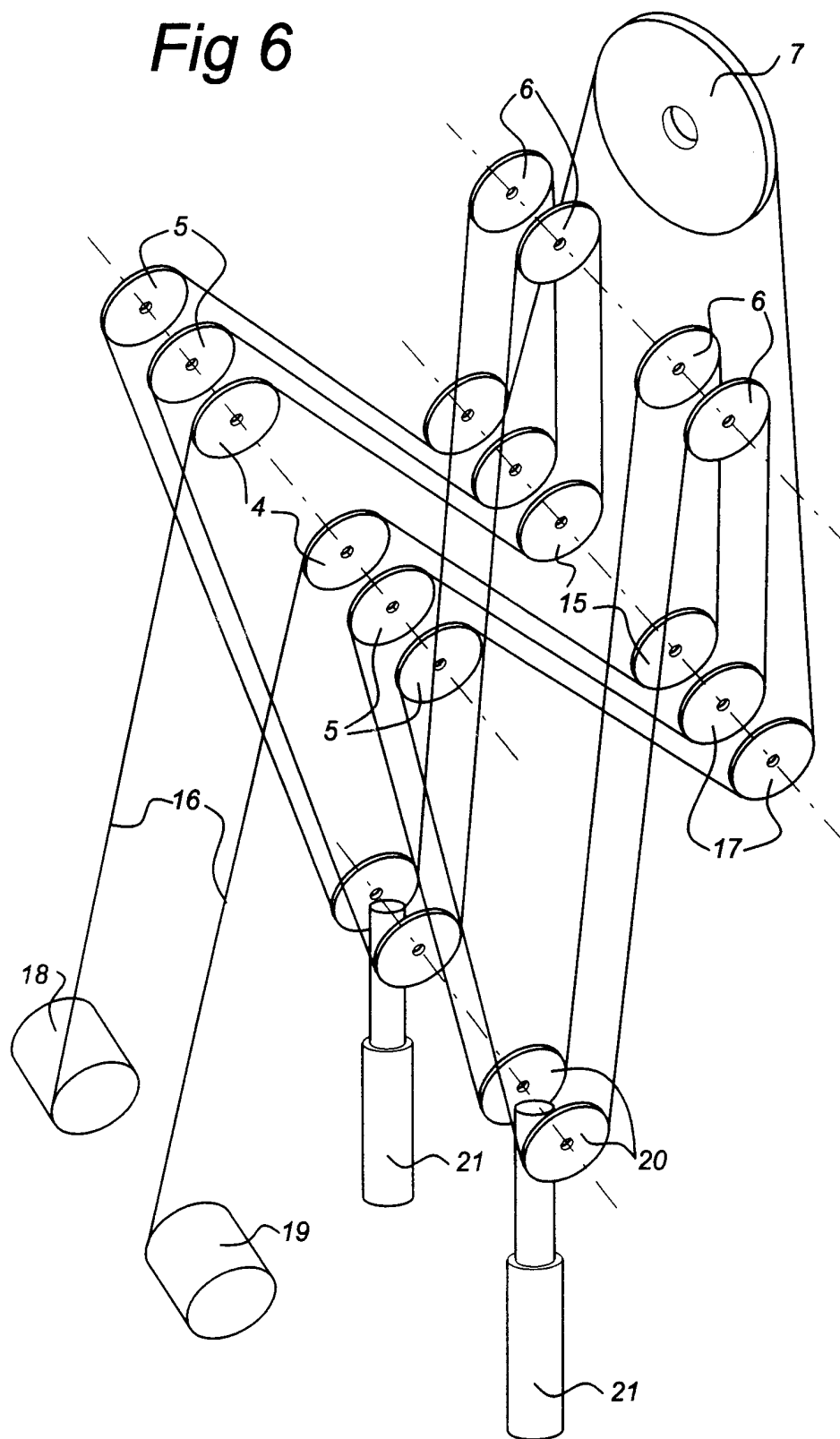
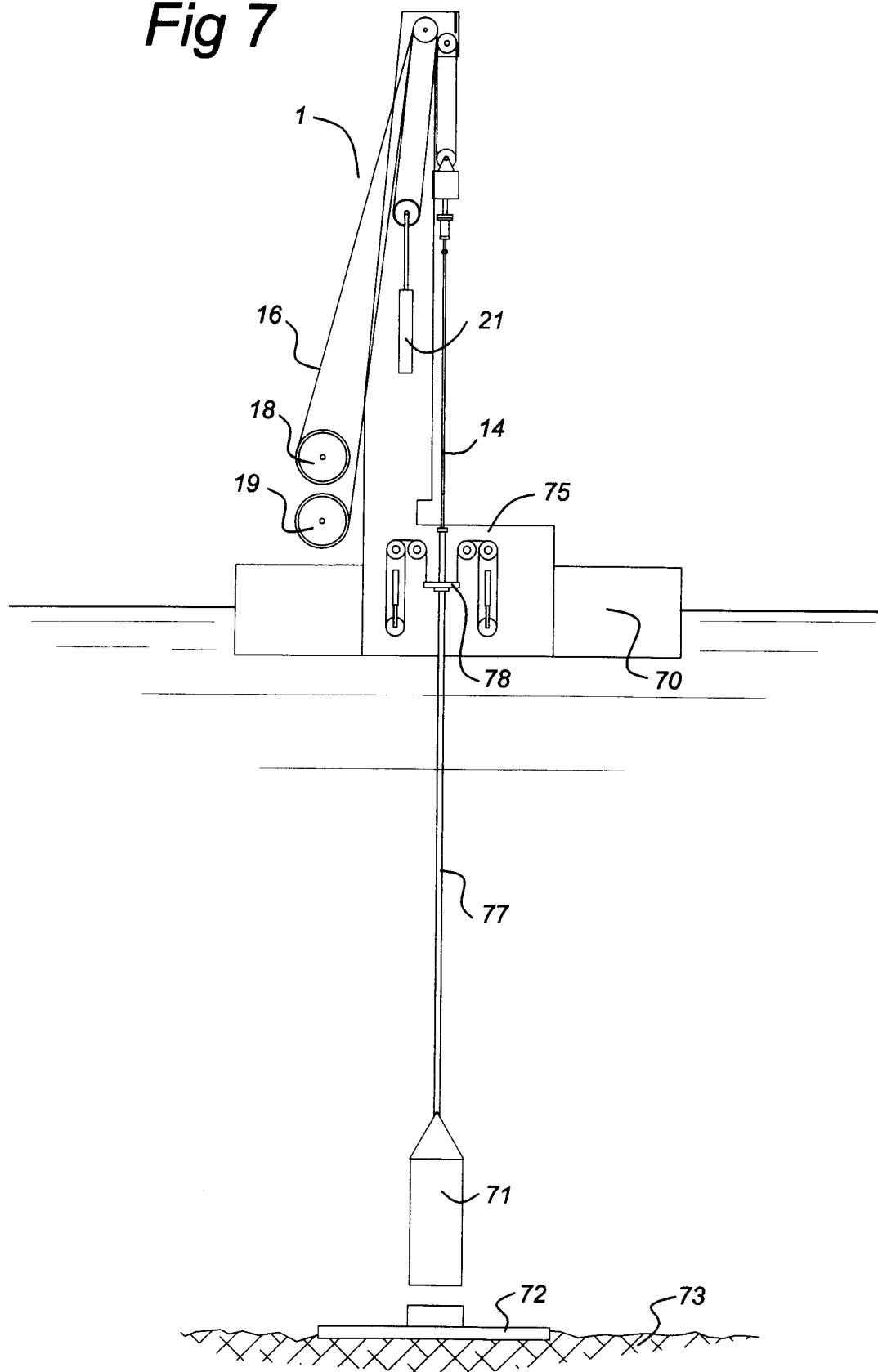
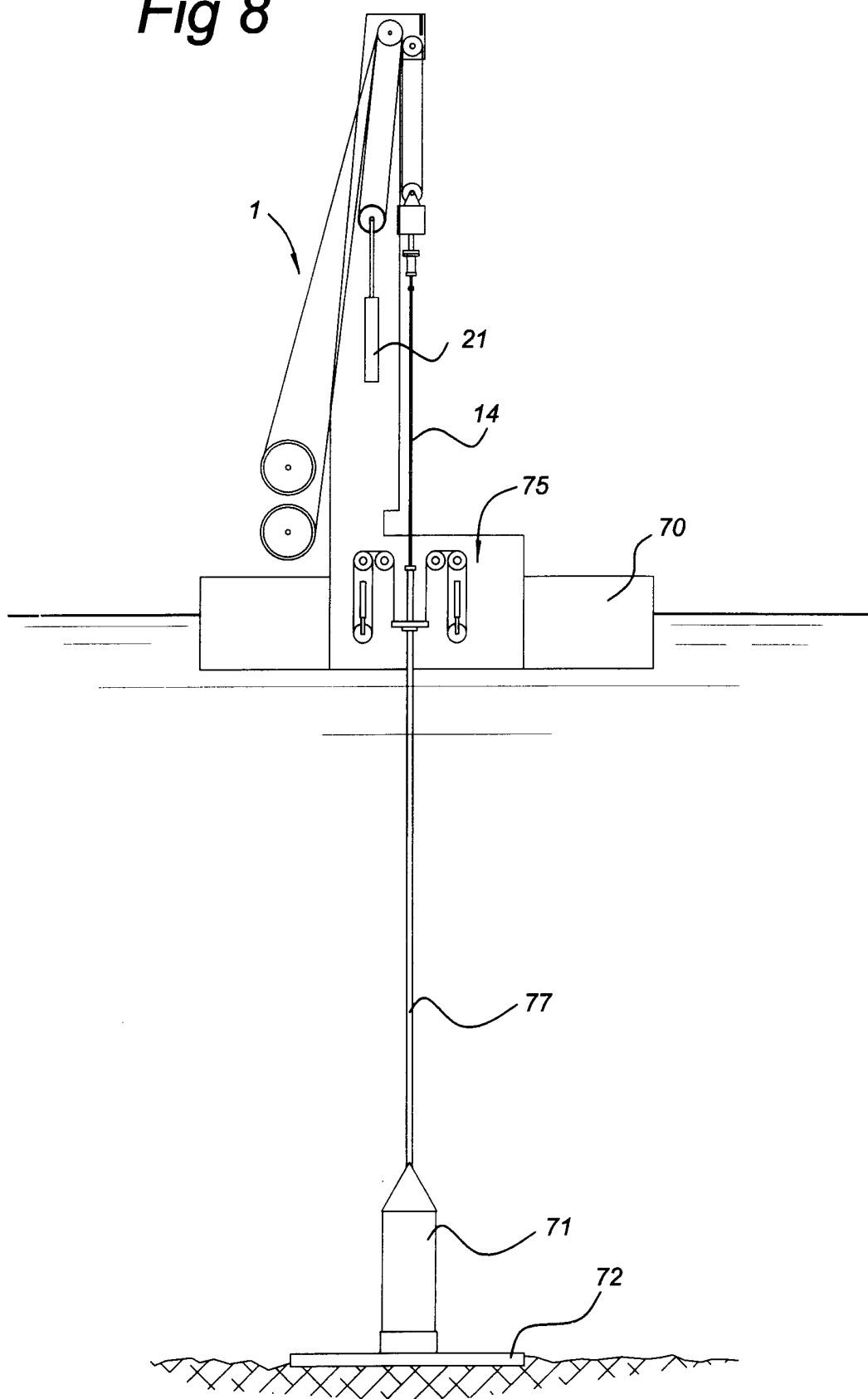
Fig 5

Fig 6

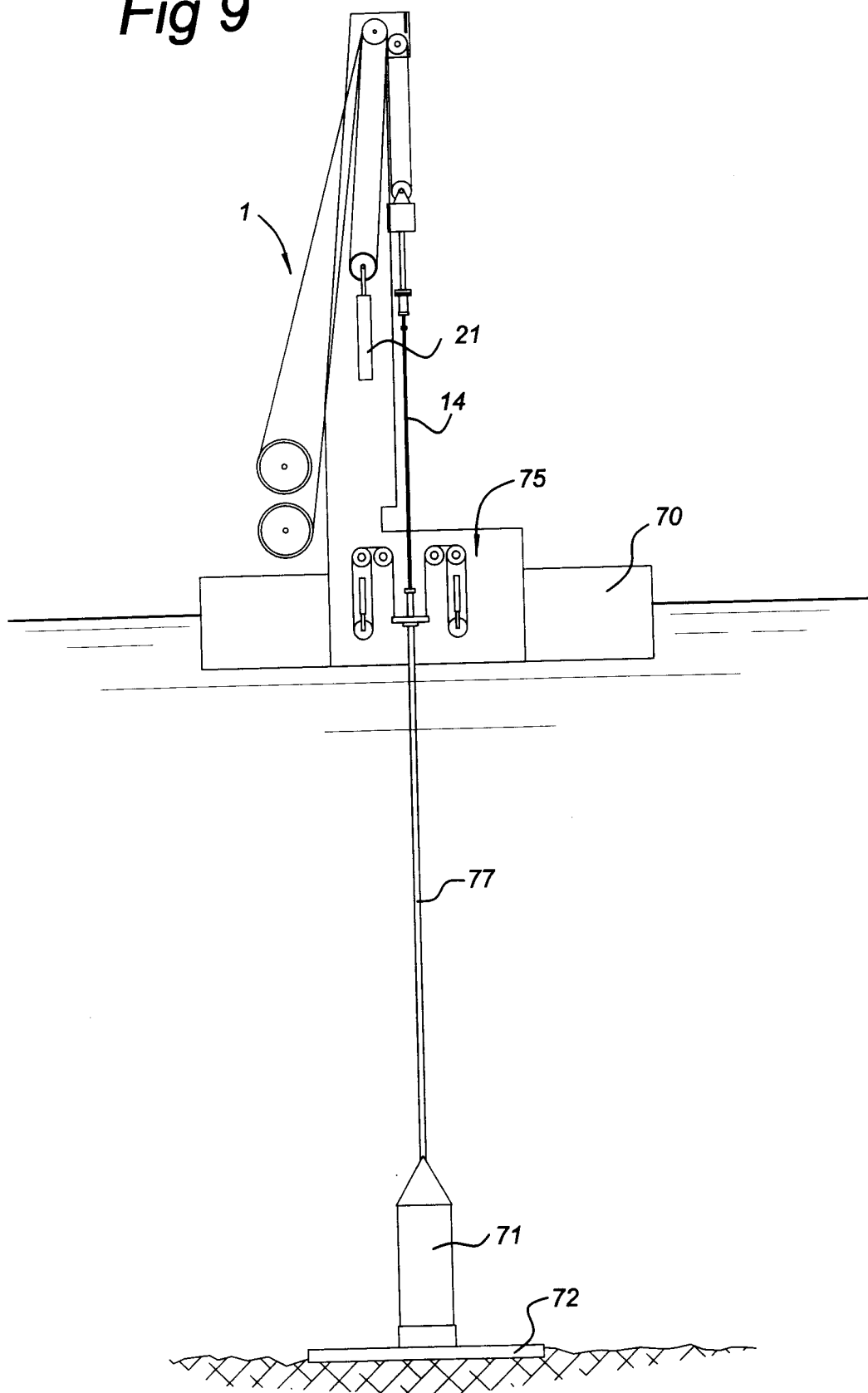
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Fig 7

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Fig 8

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Fig 9

INTERNATIONAL SEARCH REPORT

International Application No

PCT/NL 99/00649

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 E21B19/09 B66C13/02

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 E21B B66C

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 practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category ²	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 3 791 628 A (MC LELLAND J ET AL) 12 February 1974 (1974-02-12) claim 1 ---	1
A	GB 2 168 944 A (INST FRANCAIS DU PETROL) 2 July 1986 (1986-07-02) claim 1 ---	1
A	US 4 620 692 A (FOREMAN FRED R ET AL) 4 November 1986 (1986-11-04) claim 1; figure 4 ---	1
A	US 4 576 517 A (MCCANN JAMES ET AL) 18 March 1986 (1986-03-18) claim 1 ---	1
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☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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Date of the actual completion of the international search

16 June 2000

Date of mailing of the international search report

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INTERNATIONAL SEARCH REPORT

International Application No

PCT/NL 99/00649

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 3 902 319 A (OLMSTED PETER B) 2 September 1975 (1975-09-02) claim 1 -----	1

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Information on patent family members

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