



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
06.01.2016 Bulletin 2016/01

(51) Int Cl.:
B66C 1/16 (2006.01) **B63C 11/42 (2006.01)**
B66C 13/08 (2006.01)

(21) Application number: **15173178.3**

(22) Date of filing: **22.06.2015**

(84) Designated Contracting States:
**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB
GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO
PL PT RO RS SE SI SK SM TR**
Designated Extension States:
BA ME
Designated Validation States:
MA

(30) Priority: **20.06.2014 GB 201410993**

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(54) **AN INSTALLATION APPARATUS**

(57) A frame (10) is disclosed for use in manoeuvring a load such as a concrete mattress or the like beneath the surface of the sea or other body of water. The frame (10) comprises a plurality of thrusters (20, 36) so orientated to produce thrust in the horizontal plane. Also included is a connection means (18, 19) enabling the frame (10) to be connected to a lifting means such as a crane and which aids in maintaining the frame (10) in a hori-

zontal orientation whilst in use.

A communication or umbilical cable (22) connects the frame (10) to a control means and enables command controls and data to be sent between the control means and the frame suspension means to releasably retain a load. A release handle (60) is provided, linked to the suspension means to control release of a load.

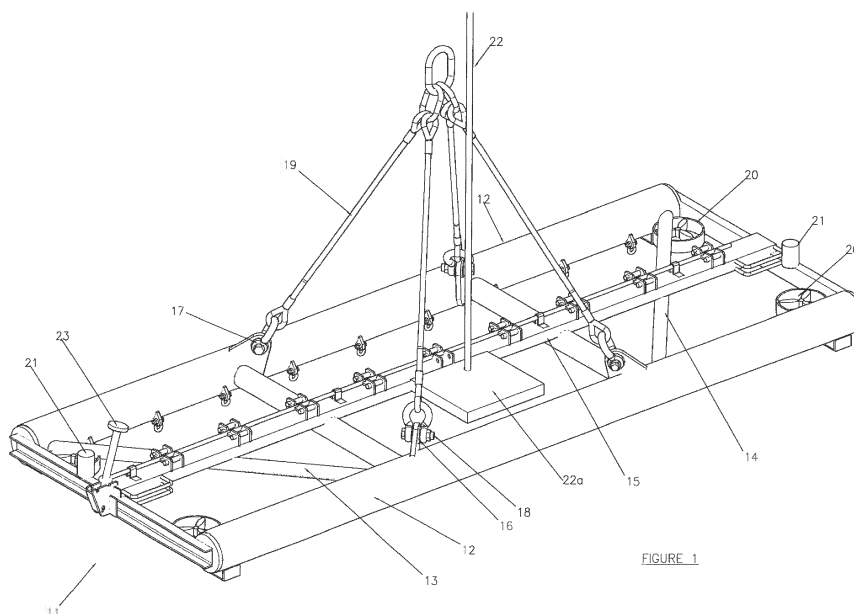


FIGURE 1

Description

Field of the Invention

[0001] The invention relates to a manoeuvrable installation apparatus for use in moving loads in a sub-sea environment. The apparatus is particularly suitable for handling structures such as concrete mattresses or the like. Further, the motion of the apparatus can be controlled remotely, including by an operator above the water surface.

Background to the Invention

[0002] In the following, the installation apparatus is described with reference to the manoeuvring of a flexible concrete mattress. Said mattresses typically comprise a plurality of concrete blocks linked to each other such that the concrete blocks can move relative to one another enabling the mattress to partially adapt to the shape which it is covering. It should be recognised however that the installation apparatus can be used with other loads.

[0003] Although frames to transport/manoeuvre mattresses are known in the sub-sea industry, they suffer from a number of disadvantages. A typical scenario involves moving mattresses from a structure such as a rig or from a boat until the mattress is in position over a cable or pipeline which it is intended the mattress protect. The mattress is then released from the frame and settled over the cable or pipeline. The frame can then be used to move further mattresses. For the greater part of the movement operation, the frame, along with a mattress is suspended from a crane. In this manner, relatively large distances can be covered. For the final, fine movements to precisely locate and align the mattress however, divers need to be on hand to guide the mattress into position and then to release the mattress from the frame. This can be a dangerous operation as there are often strong currents pushing against the mattress which itself can weigh several tonnes. Moreover, releasing the mattress is itself quite a complicated operation as several actions need to be carried out, often simultaneously. This task alone can therefore often require several divers, operating for hours at a time which is time consuming and expensive.

[0004] It will be advantageous therefore to provide a frame which addresses the above problems and whose use reduces danger to divers involved and reduces the man-hours required to carry out the operation of moving and locating a mattress. It is an object of the present invention therefore to provide such a frame.

Summary of the Invention

[0005] According to the invention there is provided a frame for use in manoeuvring a load such as a concrete mattress or the like, the frame comprising;

a plurality of thrusters so orientated to produce thrust in the horizontal plane;

connection means enabling the frame to be connected to a lifting means such as a crane and to maintain the frame in a horizontal orientation whilst in use;

a communication or umbilical cable connecting the frame to a control means and enabling command controls and data to be sent between the control means and the frame;

suspension means to releasably retain a load;

a release handle linked to the suspension means to control release of a load.

[0006] The above frame allows a load to be more safely and controllably moved to and located in the required location.

[0007] Optionally, the frame comprises a remotely operated vehicle (an ROV) module separable from a support framework, the ROV module further optionally housing the thrusters. Conveniently, the frame has negative buoyancy enabling the depth of the frame within the water to be controlled by a crane and providing 1080° movement.

[0008] Preferably, the frame houses at least one transponder to enable the location of the frame to be determined. Further preferably, two or more transponders are housed in a sufficiently spaced relationship to enable the orientation of the frame to be determined and especially preferably are housed on the framework.

[0009] The suspension means conveniently comprises a plurality of wires or strops enabling the weight of a load to be spread out. Especially conveniently, strops are utilised to reduce any damage to a load.

[0010] Preferably, the release handle is linked to a release rod, operation of which rod simultaneously releases all of the straps or wires. Further preferably, the release rod is linked to a plurality of release pins, each accommodating a strop.

[0011] The release handle is conveniently a lever and further conveniently can be moved between an open position and a closed position. A locking mechanism yet further conveniently is provided to prevent accidental movement between the two positions. Optionally, the lever pivots between the open and the closed positions about a hinge, which hinge is moveably housed in a slot for movement along the slot, the pivoting action causing the hinge movement along the slot.

[0012] The thrusters are advantageously capable of directing water in opposite directions to each other to provide torque to the frame.

Brief Description of the Drawings

[0013] The invention is now described with reference

to the accompanying drawings which show, by way of example only, two embodiments of a frame. In the drawings;

Figure 1 is an illustration of a first embodiment of a frame;

Figure 2 is an illustration of a second embodiment of a frame ;

Figures 3 and 4a-c illustrate in more detail the ROV module of figure 2 and the operation of the thrusters;

Figures 5a, 5b are an end elevation and isometric view respectively of the framework of the second embodiment and figure 5c shows the dead-eye anchor of figure 5a in more detail;

Figures 6a, 6b are respectively a plan view and a section along A of said plan view of a framework;

Figures 7a, 7b are enlarged views of the release lever shown in figure 6a with the release pins closed;

Figure 8 shows the lever of figure 7a in plan view with the release pins open;

Figure 9 is a hydraulic ram mounting plate;

Figure 10 is a detailed view of the lever shown in detail 2 of figure 6b;

Figures 11a to 11c are further detailed views of the release lever;

Figure 12 is a section through B of support beam of the frame of figure 6a;

Figure 13 is a section through D through a support cheek plate of the frame shown in figure 6a;

Figure 14a shows a guide arrangement of the section through C of the frame shown in figure 6a and figure 14b is a side view thereof;

Figure 15 is an enlarged view of a bolt as shown in detail 1 of figure 6b;

Figure 16a, 16b illustrates the actuation of a release lever between the closed and open positions respectively; and

Figures 17a and 17b illustrate the strop-releasing mechanism in more detail.

Detailed Description of the Invention

[0014] The frame as described herein enables a load

to be manoeuvred more accurately and safely than a prior art frame. In addition, the coupling means between the frame and the load allows a load to be more easily secured and subsequently released on site. It is envisaged that the load release in particular should require, at most, only one sub-sea operative to operate. Typically, with regard to the prior art apparatus designed to carry out this task, more than one operative is required which increases the associated costs and risks.

[0015] The frame or apparatus described herein, in its most basic form, comprises a framework from which a mattress can be releasably suspended. The frame has incorporated thrusters which allow the frame and/or mattress to be manoeuvred. The thrusters can be operated remotely, with location transponders informing the controller as to the location and also, in some embodiments, the orientation of the frame.

[0016] Referring to figure 1, the apparatus, generally referenced 10, comprises a framework 11. The framework 11 is rectangular having two hollow steel tubular side frame members 12 held together and strengthened by perpendicular and diagonal cross-pieces 13, 14. Extending along the longer, central axis of the framework 11 is a parallel flanged channel (PFC) 15 which houses and supports elements of the quick release mechanism. In order to enable the framework 11 to be lifted by a crane, cheek plates 16, having eyes at 17 to receive shackles 18 and wire 19 are provided.

[0017] Thrusters 20 are mounted to the framework 11 which thrusters 20 act in the horizontal plane and can be orientated to provide torque about the suspension axis of the framework 11 or to move the apparatus horizontally. Additionally or alternatively, thrusters 20 can also be used to enable the framework 11 to hold its position in the presence of sub-sea current.

[0018] As the apparatus 10 is designed to be operated remotely when desired, transponders 21 are provided at opposite ends of the framework 11. The location signals given out by the transponders 21 not only provide the position of the apparatus 10 to the user, but also the orientation within the water. With this information, corrections can more accurately be made to said orientation which bring the framework 11 and the mattress depending therefrom into the correct alignment for the mattress to be set down. However, the apparatus is able to operate using a single transponder, although the ability to determine the orientation of the apparatus by means of the transponder information alone will not be available. Further, additional transponders, beyond the two described above can be included to give a finer determination of location and orientation and also, in the event of failure of a transponder to enable the apparatus' orientation to continue to be determined.

[0019] Information to and controls issued by an operator are transferred by means of an umbilical 22 to a control box 22a. In figure 1, a handle 23 to operate the release mechanism releasing the mattress from the apparatus 10 is shown. A quick release mechanism is de-

scribed in more detail below.

[0020] In use therefore, the framework 11 along with a mattress depending therefrom, is lowered by a crane or the like into the approximate location of a cable or pipeline to be covered by the mattress. The thrusters 20 are operated to maintain the general position and also aligning more exactly the mattress. Once the mattress is in the correct position, the mattress is released from the apparatus either manually by a diver or remotely.

[0021] In figure 2, a second embodiment of a lifting apparatus 30 is shown in which an ROV module 31 to provide control and motive power to the apparatus 30 is shown. The ROV module 31 is releasably secured to the framework 32 by means of pins 33 passing through apertures in coupling lugs 34 on the ROV module 31 and pad-eyes 35 on the framework 32. When required therefore, the ROV module 31 can be removed from the framework 32 to carry out servicing and maintenance.

[0022] Secured to the ROV module 31 are thrusters 36, which act to control the motion of the apparatus 30. A control box 37 enables a user to operate the thrusters 36 and, in an unillustrated embodiment, the mattress-release mechanism. Other elements of the framework 32 are in accordance with the first embodiment figure 1.

[0023] The ROV module 31 of figure 2 is shown in more detail in figure 3. In this figure, the umbilical 22 can be seen which links the control box 37 to the remote operator, usually above the water surface. The connection between the operator and the apparatus 30 is therefore quite robust. In order to enable the apparatus 30 or the ROV module 31 to be lifted, the ROV module 31 has pad-eyes 38 at each corner to enable shackles 39 from the lifting apparatus to be secured thereto.

[0024] As with the frameworks 32 and 11, the body of the ROV module 31 is formed from steel circular hollow section tubes 12a. Overall therefore, the apparatus 10 and 30 have negative buoyancy and the depth of an apparatus is controlled by the crane. This is in contrast to prior art ROVs which are neutrally buoyant allowing full 1080° movement.

[0025] When it is necessary to move the apparatus 30, the thrusters 36 can be operated in a number of different ways as shown in figures 4a - 4c. The thrusters are mounted at 45° to the main axis of the frame or ROV. Further, the thrusters 36 are capable of creating water flow in two directions, depending on which way the propeller 40 is allowed to turn. In figure 4a, all the thrusters 36 act to force water in the same general direction as shown by the arrows. The ROV module 31 (and hence the apparatus 30) is moved in the direction indicated 'forward'.

[0026] In figure 4b, the thrusters 36 again act to move the water in the same direction, but in this case, the water acts to cause sideways motion of the ROV module 31. Finally in figure 4c, only two of the thrusters 36, diagonally opposite each other are operated, resulting in torque about the suspension axis of the ROV module 31. Combining the above motion therefore results in the ability to

accurately deliver the load to its correct position.

[0027] Turning now to the attachment and release of a load, in the form of a mattress, reference is made to the remaining figures 5 to 17. For convenience and ease of illustration the thrusters, the umbilical, along with any ROV module have been omitted from the figures.

[0028] In figures 5a and 5b, a concrete mattress 50 is shown suspended from a framework 51. The mattress 50 comprises a plurality of concrete blocks, flexibly linked together. Loops formed of, for example rope, cast into the outer edge of each outer block, are present to provide secure lifting points on the mattress 50. The mattress 50 is therefore releasably secured to the framework 51 by means of strops 52. Each strop 52 is secured at a first end to a dead-eye anchor 53 fixed to a frame member 12 (see figure 1). Each dead-eye anchor 53 has a removable pin 54 passing there through (see figure 5c). When necessary therefore, to replace a strop 52, the pin 54 can be removed, the strop 52 taken off and a new strop 52 placed in the anchor 53 and secured in position by the pin 54 passing through a loop in the strop 52.

[0029] The strop 52 passes from the anchor 53, through a loop 55 and the mattress 50 and back over the frame member 12 to be secured at a second end to the centre frame 56 by a sliding-pin release mechanism set out below in more detail. The strops 52 therefore combine together to support the weight of the mattress 50.

[0030] The release mechanism enables all the strops 52 to be freed simultaneously allowing the mattress 50 to settle freely in position. Prior art apparatus have required the manual release of multiple securing means. This is not only time consuming, often entailing several operatives working together, but can also lead to an uneven release of the mattress 50. The release mechanism of the present invention can be operated by one person, either manually or remotely. This can be achieved for example by moving the release handle such as a lever 60 between a first strop-retaining position (figure 7) and a second strop-releasing position (figure 8).

[0031] The release mechanism lies above the well of the upturned- U-shaped (or parallel flange channel (PFC)) centre frame 56. The release lever 60 is pivotally mounted and operatively connected to a link rod 70 by means of a hydraulic ram 71. The link rod 70 is in its turn coupled to sliding release pins 72, 73 (see figures 14a and 17 a - c) about which a strop 52 is looped. Opening of the release pins 72, 73 releases one end of the strop 52 which allows the strop 52 to be pulled through the loop 55 on the mattress 50, so releasing the mattress 50 from the framework 51.

[0032] As can be seen in figure 17a, the link rod 70 is welded to the release pin 72, 73 by a welded bar 74. Each of the pins 72, 73 is housed within guide plates 75, 76 (shown for convenience on one side only).

[0033] When the mattress 50 is to be released therefore, the release lever 60 is moved between the closed position 60a to the open position 60b. Acting through the hydraulic ram 71, the lever 60 moves the link rod 70 in

the direction indicated by the arrow A (figures 6b, 17a). The release pins 72, 73 are therefore moved to the stop-releasing position shown in figure 17c. The framework 51 can then be lifted clear. When another mattress 50 is to be carried by the framework 51, the strops of that mattress are simply put into position and the lever 60 moved to the closed position 60a, passing the release pins 72, 73 through the loop in the strop, thereby securing the strop 52 and the mattress 50 to the framework 51.

[0034] In one embodiment of the invention, not illustrated, sufficient of a release pin 72 is left between the guide plates 75, 76 to enable all the strops to be positioned by one person prior to the release pins 72, 73 being simultaneously closed. Alternatively, the lever 60 can be provided with an intermediate positioning setting to enable partial retraction of the pins 72, 73.

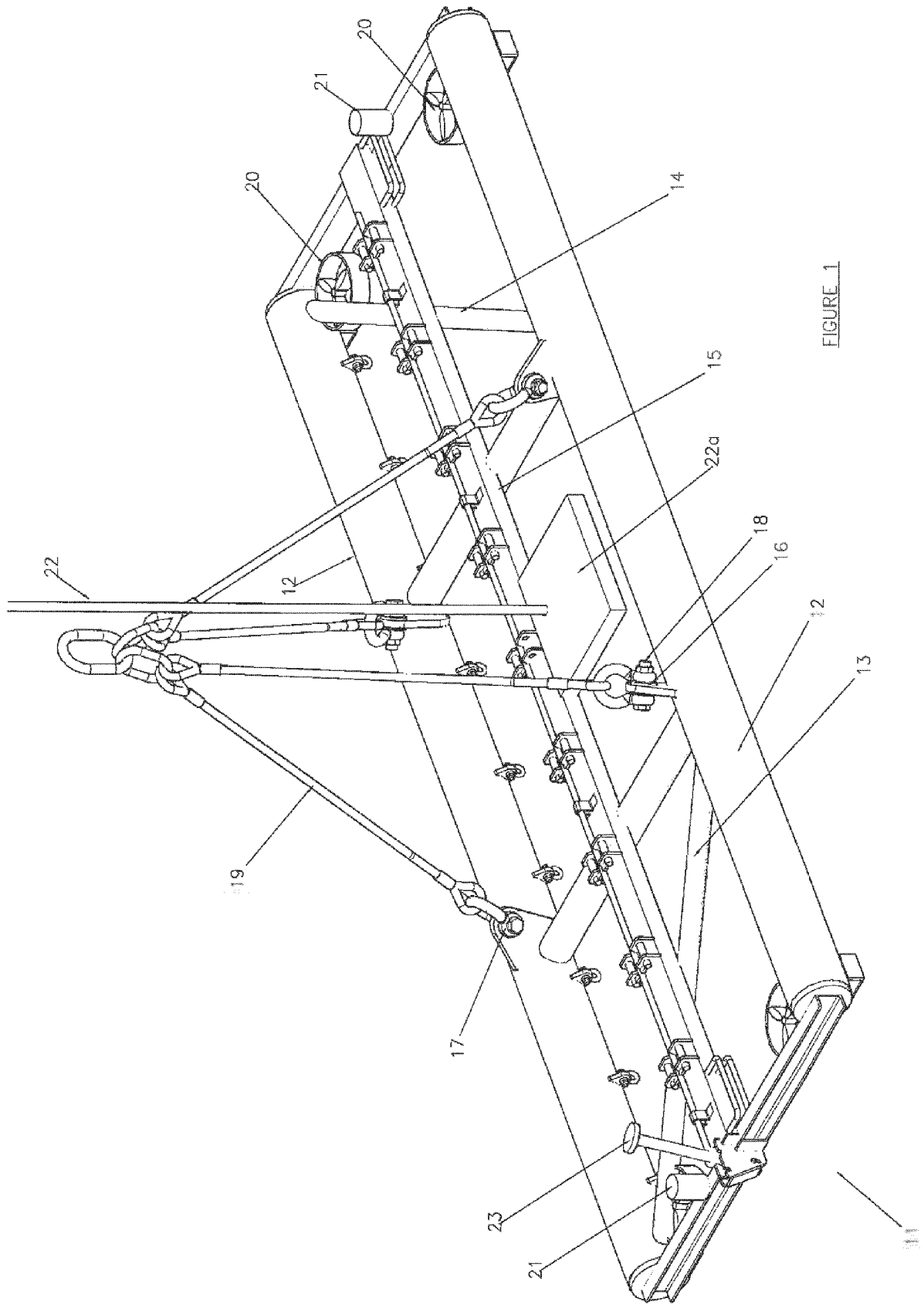
[0035] To ensure that the release lever 60 does not accidentally slip between the open and closed positions 60b, 60a, a locking mechanism is provided as shown particularly in figures 16a, 16b. In figure 16a, the lever 60 is in the closed position such that the release pins 72, 73 retain the second end of the strop 52. As the lever 60 is pulled the link rod 70 is pulled by approximately 120mm in the same direction as the lever 60 movement, thus moving the release pins 72, 73 and releasing the second end of the strop 52. As the lever 60 is pulled, a locking pin 77 eventually reaches the slot 78, approximately 25mm in depth. At the same time as the slot 78 is reached, the hinge 79 about which the lever 60 pivots, drops under the weight of the lever 60, into a hinge slot 80. The lever 60 is thus prevented from accidentally slipping to the closed position and potentially fouling the mattress-release operation. In order to close the release pins 72, 73 the lever is lifted out of the slot 78. Particularly, when the ROV is in operation in the water, this would not be a simple task given the ease with which the ROV itself would be lifted.

[0036] The mattress release mechanism can alternatively be operated from the surface using a hydraulic release kit. Before initial deployment a water fed hydraulic cylinder ram is mounted between the lever and the hydraulic cylinder bracket. The cylinder ram is then connected to a hydraulic power pack remotely by a hydraulic hose. The frame is then deployed subsea carrying a mattress as described above with the cylinder ram in the closed position. The power pack remains on the deck of the vessel. When the frame with its load is in position the power pack is turned on by the remote operator. This causes the cylinder ram to move to the open position forcing the quick release mechanism open and deploying the mattress. When the frame is recovered to the surface the ram can be manually closed along with the quick release mechanism as previously described. The advantages of this hydraulic system allow the frame with the ROV module mounted to be operated from the safety of the deck remotely without having to have a diver or work-class ROV in the water at the same time.

Claims

1. A frame (10) for use in manoeuvring a load such as a concrete mattress or the like, the frame (10) comprising;
 - a plurality of thrusters (20, 36) so orientated to produce thrust in the horizontal plane;
 - connection means (18, 19) enabling the frame (10) to be connected to a lifting means such as a crane and to maintain the frame (10) in a horizontal orientation whilst in use;
 - a communication or umbilical cable (22) connecting the frame (10) to a control means and enabling command controls and data to be sent between the control means and the frame;
 - suspension means to releasably retain a load;
 - a release handle (60) linked to the suspension means to control release of a load.
2. A frame according to Claim 1, wherein the frame comprises a remotely operated vehicle (an ROV) module (31) separable from a support framework.
3. A frame according to Claim 2, wherein the ROV module (31) houses the thrusters.
4. A frame according to any preceding claim, wherein the frame has negative buoyancy.
5. A frame according to any preceding claim, wherein the frame houses at least one transponder (21) to enable the location of the frame (10) to be determined.
6. A frame according to Claim 5, wherein two or more transponders are housed in a sufficiently spaced relationship to enable the orientation of the frame to be determined.
7. A frame according to Claim 5 or Claim 6, wherein the or each transponder is housed on the frame.
8. A frame according to any preceding claim, wherein the suspension means comprises a plurality of wires or strops enabling the weight of a load to be spread out.
9. A frame according to any preceding claim, wherein the release handle is linked to a release rod (70), operation of which rod (70) simultaneously releases all of the strops or wires.
10. A frame according to Claim 9, wherein the release rod is linked to a plurality of release pins (72, 73), each accommodating a strop.
11. A frame according to any preceding claim, wherein the release handle is a lever.

12. A frame according to Claim 11, wherein the lever can be moved between an open position and a closed position.
13. A frame according to Claim 12, wherein a locking mechanism is provided to prevent accidental movement between the two positions. 5
14. A frame according to Claim 11 - 13, wherein the lever pivots between the open and the closed positions about a hinge (79), which hinge (79) is moveably housed in a slot (80) for movement along the slot (80), the pivoting action causing the hinge (79) movement along the slot (80). 10
15. A frame according to any preceding claim, wherein the thrusters are capable of directing water in opposite directions to each other to provide torque to the frame. 15
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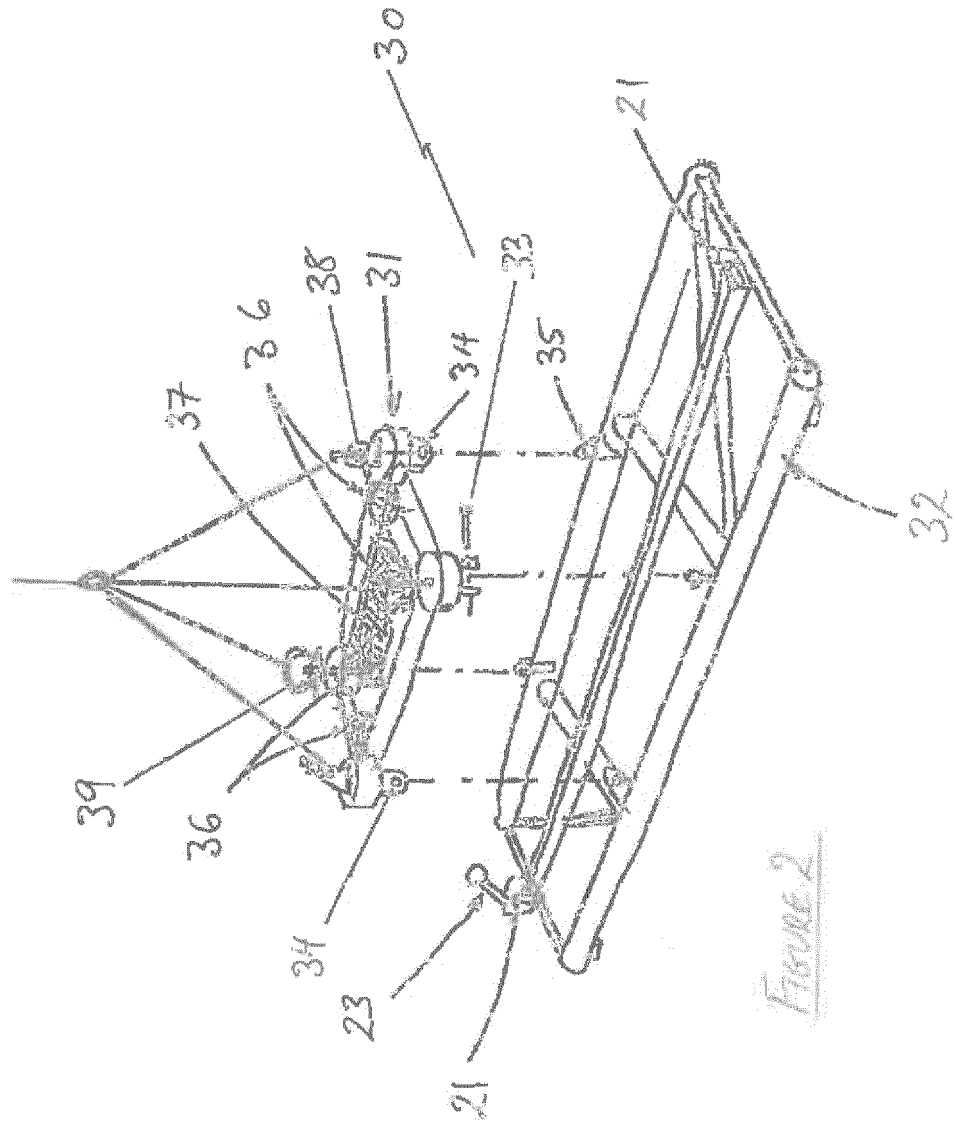
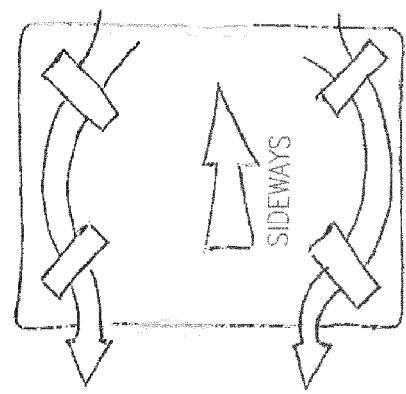
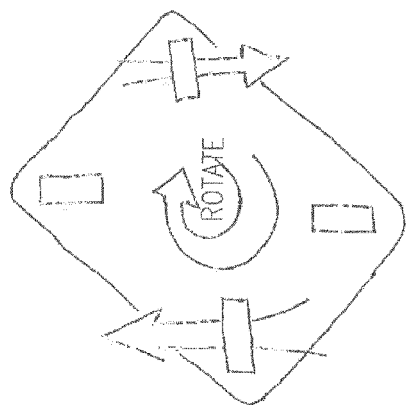
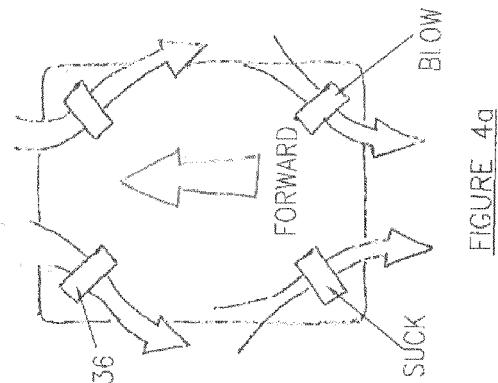
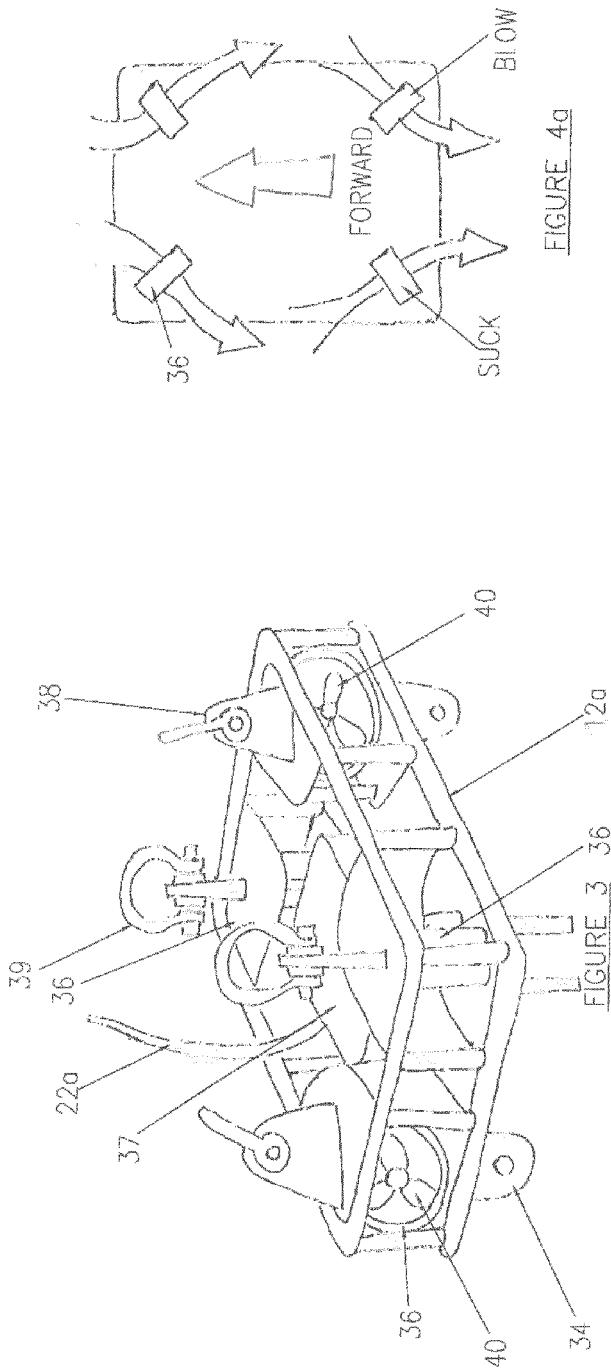
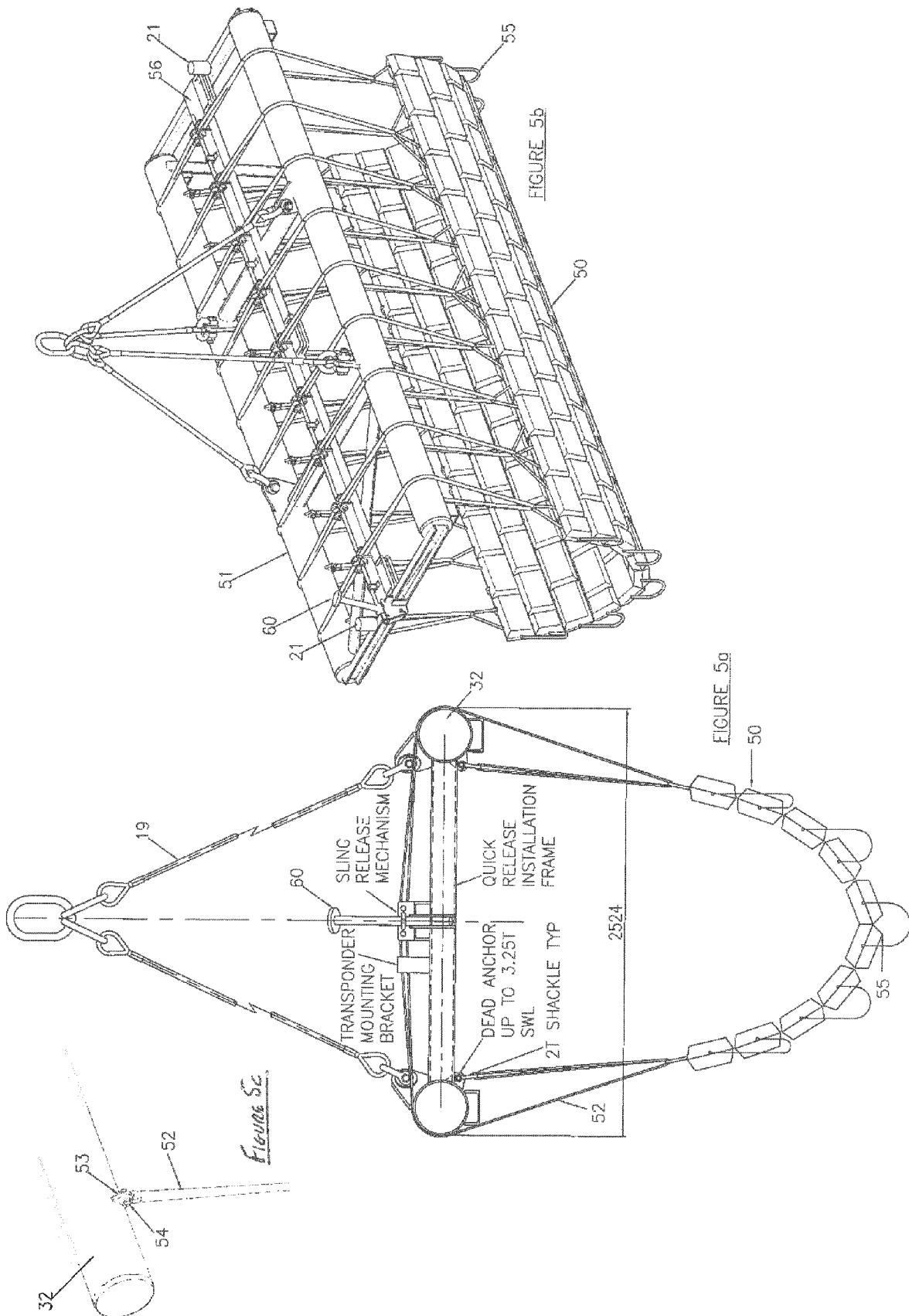
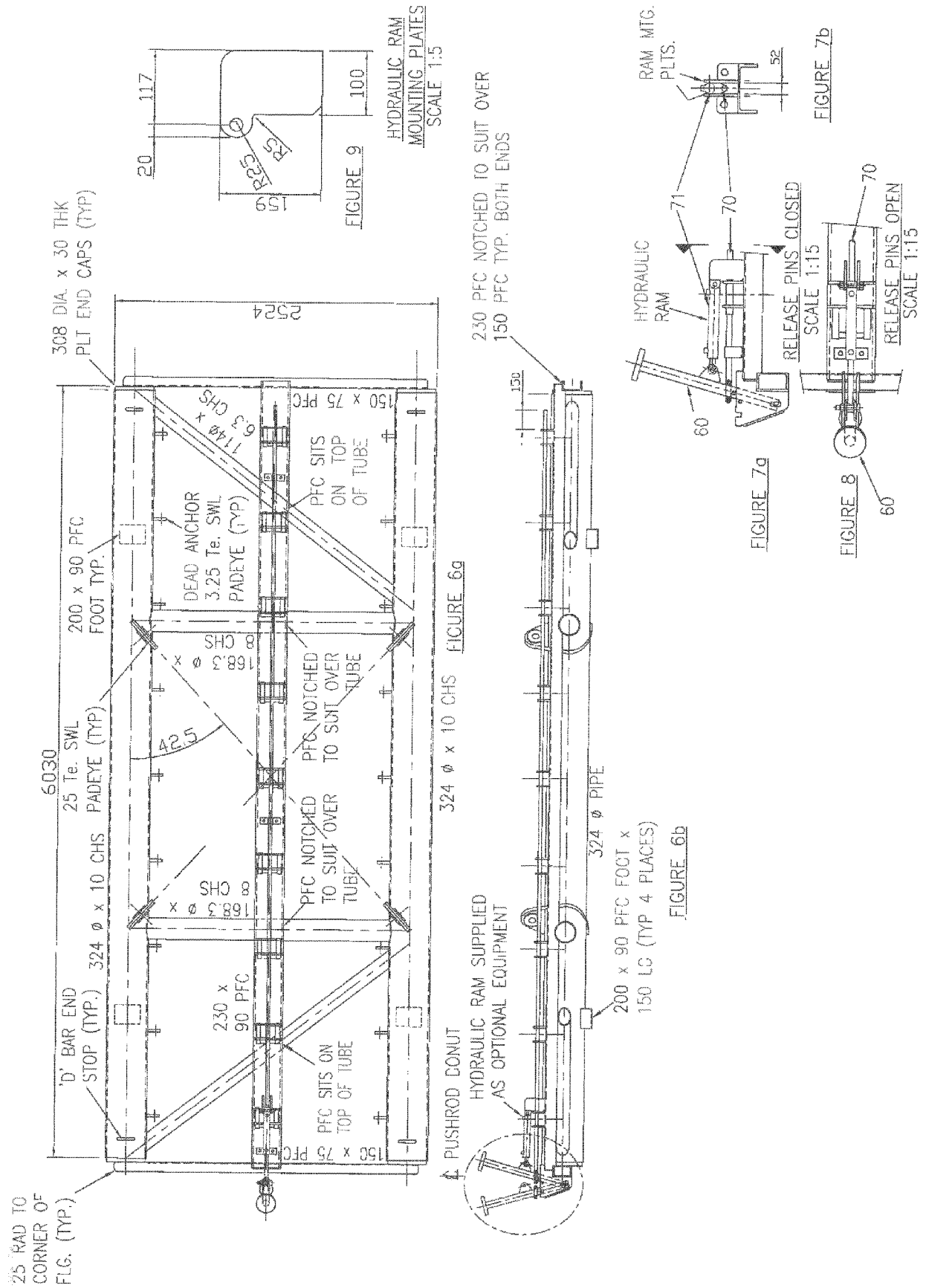


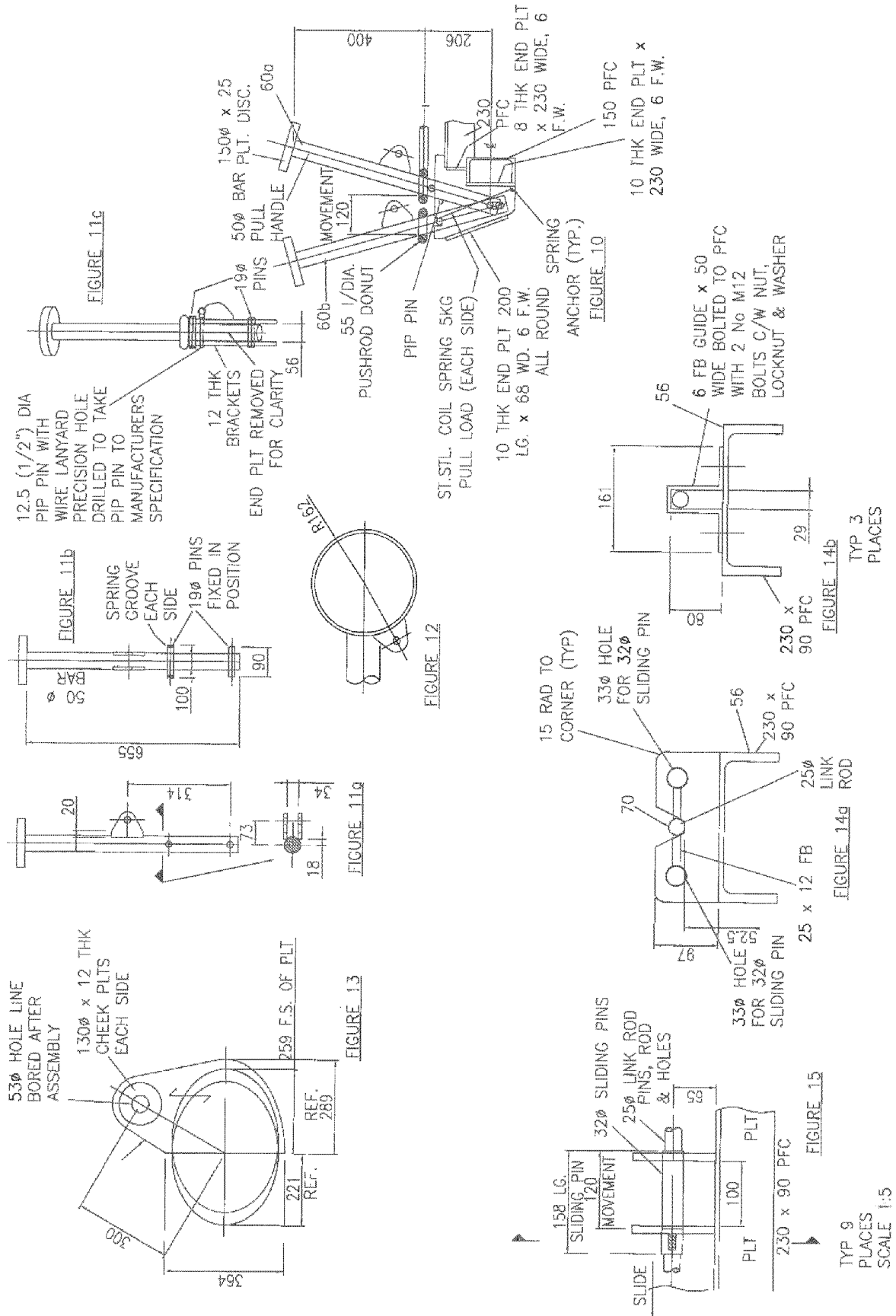
Figure 2

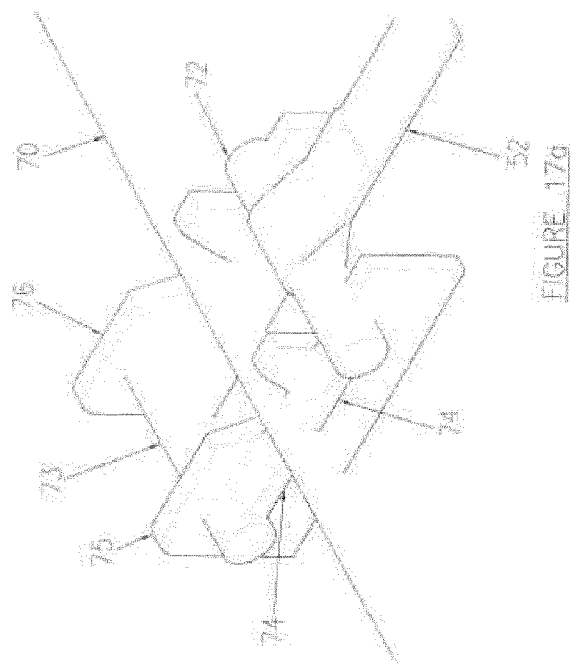
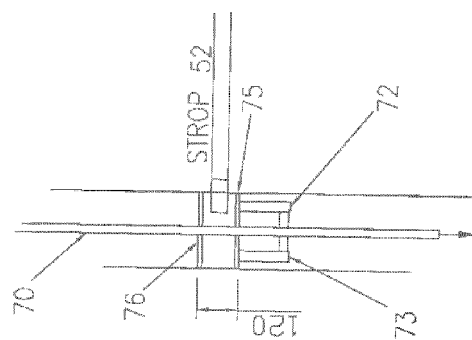
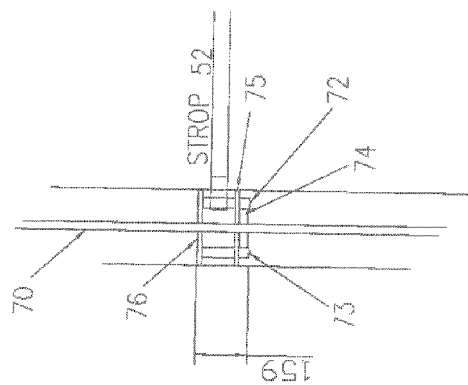
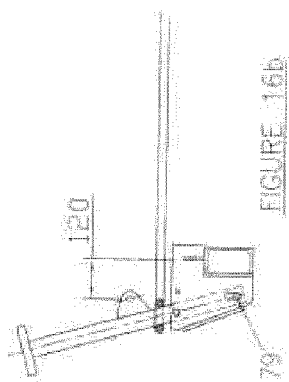
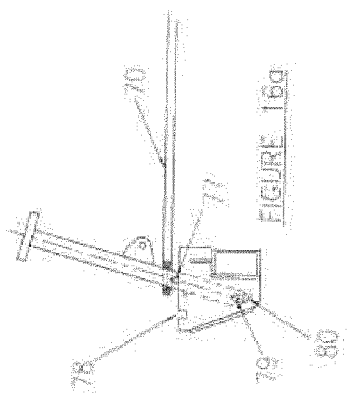


ALL 4
THRUSTERS BLOW
WATER IN SAME
DIRECTION FRAME
MOVES
'SIDEWAYS'











EUROPEAN SEARCH REPORT

Application Number
EP 15 17 3178

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 2 December 2015	Examiner Verheul, Omiros
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**ANNEX TO THE EUROPEAN SEARCH REPORT
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The members are as contained in the European Patent Office EDP file on
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02-12-2015

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