



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
07.09.2016 Bulletin 2016/36

(51) Int Cl.:
E02B 3/12 (2006.01) **B66B 1/00 (2006.01)**
E02B 5/02 (2006.01)

(21) Application number: **16158568.2**

(22) Date of filing: **03.03.2016**

(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 MD

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(30) Priority: **05.03.2015 NL 2014401**

(54) **DEVICE AND METHOD FOR ARRANGING A PROTECTIVE MATERIAL MAT ON A BOTTOM UNDER WATER**

(57) Described is a device for arranging a protective material mat on a bottom under water. The device comprises a floating support body for a manipulating tool and for a guide construction for the material mat, wherein the manipulating tool is configured to pick up, carry under-water and unroll a material mat roll on the bottom from a

starting position, and wherein the guide construction comprises a guide frame and an engaging means for a side edge of the material mat movable along the guide frame into the starting position. Also described is a method for arranging the protective material mat.

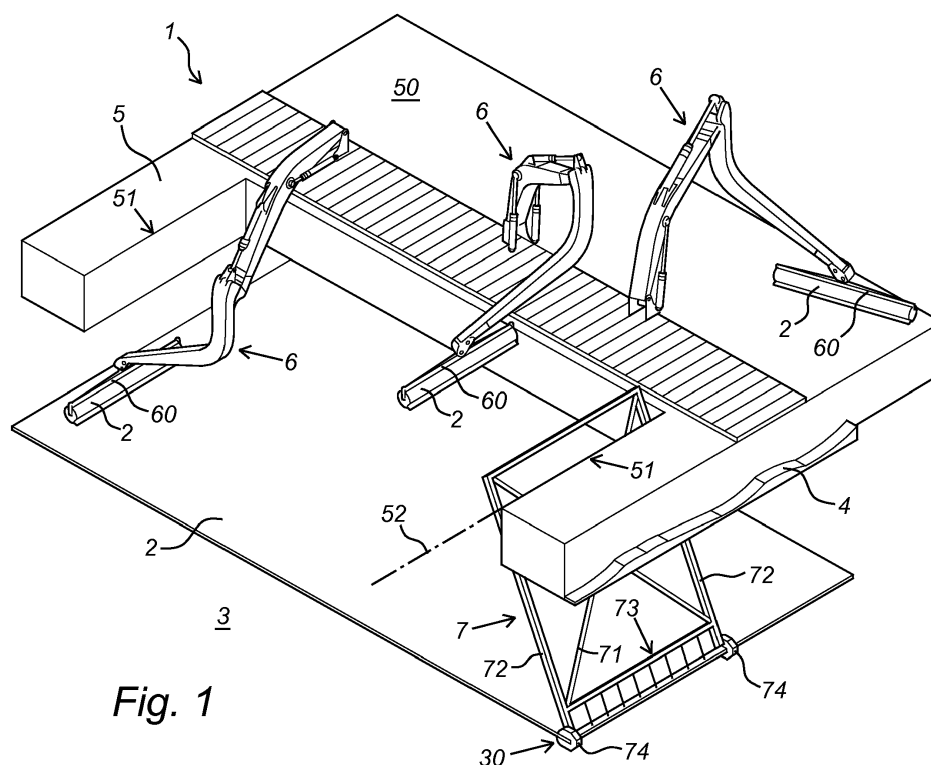


Fig. 1

Description

TECHNICAL FIELD OF THE INVENTION

[0001] The invention relates to a device for arranging a protective material mat on a bottom lying at least partially under water. The invention also relates to a method for arranging a protective material mat on a bottom under water wherein use is made of the invented device.

BACKGROUND OF THE INVENTION

[0002] Arranging a protective material mat on a bottom under water may for instance be necessary in the context of widening and/or deepening a channel. During such operations the existing watertight bottom layer is often removed. Water from the channel can hereby penetrate into the ground and adversely affect the groundwater level. Such an effect - generally a raising - of the groundwater level is undesirable as it can have adverse consequences for the ecology of the area, but also for agriculture and the stability of nearby embankments and water barriers. Seepage of water out of the channel into the ground moreover lowers the water level in the channel, which can make navigation through the channel more difficult or even impossible. For the above stated reasons it is important during widening and/or deepening of a channel to arrange a new protective layer as quickly as possible on the bottom, which new layer must in any case partially restore the watertightness and provide further protection against erosion and other instabilities. In addition, there is often lack of space in channels, and the devices utilized for arranging a protective layer must operate efficiently in order to impede shipping traffic as little as possible.

[0003] The new protective layer can be realized in many ways. A known method comprises of arranging a protective material mat, for instance a geotextile or bentonite mat, on a bottom under water. The bentonite mats in particular are suitable for forming a watertight protective layer. A known method comprises of unrolling the bentonite mats from the waterside in a direction running transversely of the navigation direction in the channel. This method is time-consuming however, and it has moreover been found that it is difficult to obtain the desired watertightness.

SUMMARY OF THE INVENTION

[0004] The invention has for its object to provide an improved device and method for arranging a protective material mat on a bottom under water.

[0005] Provided for this purpose is a device as according to claim 1. Particularly provided is a device for arranging a protective material mat on a bottom under water which comprises a floating support body for a manipulating tool and for a guide construction for the material mat, wherein the manipulating tool is configured to pick up, carry underwater and unroll a material mat roll on the

bottom from a starting position, and wherein the guide construction comprises a guide frame and an engaging means for a side edge of the material mat movable along the guide frame into the starting position.

[0006] Using the invented device a protective layer can be formed in efficient and accurate manner on an underwater excavated bottom. The guide construction provides for an accurate positioning of a side edge of a material mat for placing before this material mat is unrolled onto the bottom using the manipulating tool. Carrying out the positioning of a material mat side edge from the floating support body with the guide construction mounted on the floating support body achieves an accuracy which cannot be achieved with the known method, even with the use of divers.

[0007] The floating support body can comprise any floating device but is preferably a pontoon provided with a number of spud poles. Such a pontoon is brought into a desired position in the channel and temporarily fixed by lowering the spud poles against or into the bottom. Because the position of the pontoon can be accurately determined, for instance with a global positioning system (GPS), the position of the guide frame connected to the pontoon is also fixed, and so also the starting position. A material mat can in this way be precisely positioned on the bottom.

[0008] A preferably applied embodiment of the invention provides a device, wherein this further comprises a pouring device for arranging pouring material on a material mat unrolled onto the bottom, wherein the pouring device comprises a throughfeed unit for the pouring material with an inlet along which the material is received and an outlet along which the material is deposited onto the material mat, wherein the outlet of the throughfeed unit is movable relative to the support body. The pouring device is preferably provided on the floating support body and ensures that pouring material, such as for instance gravel, is subsequently poured onto a material mat unrolled onto the bottom with the manipulating tool. This practically immediate pouring onto the material mat ensures that this mat cannot shift relative to other, already unrolled mats. It has been found that an even greater watertightness can in this way be guaranteed.

[0009] According to another embodiment there are further advantages to providing a device wherein the manipulating tool is movable in a plane of the support body. A plane of the support body is formed for instance by a work deck of the support body on which the manipulating tool, the guide construction and/or the pouring device are placed. The present embodiment provides a movable connection of the manipulating tool to for instance the work deck of the support body. Such a connection can for instance comprise a pair of rails over which the manipulating tool provided with wheels can be displaced. In another useful embodiment the pouring device as well as the manipulating tool is also movable in a plane of the support body.

[0010] Another embodiment of the invention provides

a device wherein the floating support body has a direction of forward movement and the manipulating tool and/or the outlet of the throughfeed unit is movable in a direction running transversely of the direction of forward movement. In some cases the direction of forward movement of the support body substantially corresponds to the direction of navigation in the channel. In such a case the material mats are unrolled substantially transversely of the direction of navigation in the channel, and the pouring material is likewise poured substantially transversely of the direction of navigation onto a placed material mat.

[0011] According to the invention the material mats are unrolled from the support body onto the bottom by the manipulating tool. It is useful here for the support body to be provided with an opening or moon pool which provides access to a water mass located under the support body and along which the manipulating tool can carry a material mat under water. It is important here that the manipulating tool is also able reach underwater positions which are difficult to access. In an embodiment the manipulating tool comprises for this purpose a robot arm which is connected to the support body and provided with a pick-up tool for a material mat.

[0012] In a further improved embodiment the robot arm comprises at least two members coupled for movement relative to each other, wherein a first member is connected to the support body, a second member is connected to the pick-up tool and the second member is curved so that the pick-up tool can be carried at least partially under the support body.

[0013] There are further advantages in respect of accessibility when the pick-up tool is also connected to a robot arm for rotation around a longitudinal axis of the robot arm. This results in additional degrees of freedom during manipulation of a material mat.

[0014] A side edge of a material mat is brought according to the invention into a desired and precisely determined starting position by having the guide construction, and more specifically the guide frame, extend into the starting position. In an embodiment the guide frame is connected to the support body such that the guide frame of the guide construction can be carried from a rest position to an operating position, in which operating position the guide frame extends underwater from the support body into the starting position. The guide frame can thus be connected for instance for pivoting around a preferably horizontal axis to the support body.

[0015] A further improvement can be achieved with an embodiment in which the engaging means for a material mat side edge can be carried to the starting position from a clamping position located above water. This can for instance take place in that the engaging means for a material mat side edge comprises clamps movable along lateral girders of the guide frame into the starting position. In this embodiment the clamps engage a side edge of a material mat and the clamps are then slid, for instance by means of a drive, into the starting position along the lateral girders of the guide frame which are situated par-

tially in the water. It will be apparent that other possible embodiments are available to the skilled person.

[0016] With the invented device a protective material mat can be arranged on a bottom under water in efficient and precise manner. Provided for this purpose according to the invention is a method wherein a manipulating tool and a guide construction for the material mat are provided on a floating support body; the manipulating tool picks up a material mat roll; a side edge of the material mat is attached to an engaging means of the guide construction; the engaging means is moved along a guide frame of the guide construction into a starting position and carries the side edge of the material mat with it into the starting position; and the material mat is unrolled from the starting position onto the bottom by the manipulating tool. During these operations the support body, for instance in the form of a pontoon provided with spud poles or an assembly of pontoons, is preferably fixed in a position relative to the bottom. Once a number of material mats have been laid, the support body is uncoupled from the bottom and positioned and preferably fixed in a new location, after which the above stated steps are repeated.

[0017] The advantages of the invention become particularly manifest in an embodiment of the method wherein pouring material is arranged by a pouring device on a material mat unrolled onto the bottom, wherein an inlet of a throughfeed unit of the pouring device receives the pouring material and an outlet deposits the pouring material onto the material mat, wherein the outlet of the throughfeed unit is moved relative to the support body. A suitable embodiment pours the pouring material onto a material mat unrolled onto the bottom in a previous position of the support body, preferably the immediately preceding position of the support body.

[0018] Suitable embodiments of the invented method comprise methods wherein the manipulating tool is moved in a plane of the support body and/or wherein the floating support body is advanced in a direction of forward movement and the manipulating tool and/or the outlet of the throughfeed unit is moved in a direction running transversely of the direction of forward movement and/or wherein the manipulating tool comprises a robot arm connected to the support body and the material mat is picked up with a pick-up tool provided on the robot arm.

[0019] In another suitable embodiment the pick-up tool is carried at least partially under the support body with at least two members of the robot arm coupled for movement relative to each other, wherein a first member is connected to the support body and a second curved member is connected to the pick-up tool, wherein the pick-up tool is rotated around a longitudinal axis of a robot arm.

[0020] In another embodiment the robot arm comprises at least two members coupled for movement relative to each other, wherein a first member is connected to the support body, a second member is connected to the pick-up tool and the second member is connected to the first member for pivoting out of a plane (generally a vertical

plane) comprising the first member. The pick-up tool can hereby be carried at least partially under the support body.

[0021] Other further embodiments relate to a method wherein the guide frame of the guide construction is carried from a rest position to an operating position, in which operating position the guide frame extends underwater from the support construction into the starting position and/or wherein the engaging means for a material mat side edge is carried to the starting position from a clamping position located above water and wherein clamps of the engaging means for a material mat side edge are moved along lateral girders of the guide frame into the starting position.

[0022] Although the device and method according to the invention are particularly suitable for arranging a protective layer in the context of deepening and/or widening a channel, they can also be applied extremely well in other circumstances. It is thus possible for instance to apply the device and method for the purpose of providing underwater pipelines and other structures with a protective layer. The material mat to be arranged on the underwater bottom or other structure located underwater can comprise any material mat which is unrollable from a carrier frame in which the mat is accommodated. The pouring material to be arranged can for instance be sand, gravel or clay and sometimes even comprise rocks and pieces of concrete or cement. The pouring material preferably comprises gravel.

[0023] It is stated expressly that the embodiments of the invention described in this patent application can be combined in any possible combination of these embodiments, and that each embodiment can individually form the subject-matter of a divisional patent application.

BRIEF DESCRIPTION OF THE FIGURES

[0024] The invention will now be further elucidated on the basis of the description of the accompanying figures, without otherwise being limited thereto. In the figures:

Figure 1 is a schematic perspective view of a part of the device according to an embodiment of the invention;

Figure 2 is a schematic perspective detail view of a manipulating tool according to an embodiment of the invention;

Figure 3 is a schematic top view of a device according to an embodiment of the invention;

Figure 4 is a schematic side view of the embodiment of the device according to the invention shown in figure 3;

Figure 5 is a schematic front view of a guide construction according to an embodiment of the invention;

Figure 6 is a schematic front view of a detail of the guide construction shown in figure 5;

Figure 7 is a schematic perspective view of a part of

the device according to another embodiment of the invention; and

Figures 8A, 8B and 8C are schematic front views of a manipulating tool according to an embodiment of the invention in different positions.

DESCRIPTION OF EXEMPLARY EMBODIMENTS

[0025] A device 1 according to an exemplary embodiment of the invention is shown with reference to figure 1. Using device 1 a protective material mat 2 can be arranged on a bottom 3 under water 4. The shown device 1 comprises a floating support body in the form of a pontoon assembly 5 consisting of different mutually coupled pontoons. Pontoon assembly 5 is constructed such that it encloses an open space or moon pool 51 (see figures 3 and 4) through which the underlying water is accessible. Provided on a work deck 50 of pontoon assembly 5 is a manipulating tool 6 with which a rolled-up material mat 2 received in a carrier frame 60 can be manipulated. Several positions of the same manipulating tool 6 are shown in figure 1, although it is also possible to provide pontoon assembly 5 with a plurality of manipulating tools 6. It is noted that in figures 1 and 7 the connection of manipulating tool 6 to pontoon assembly 5 is not shown. This connection is for instance the lever crane 61 shown in figures 3 and 4. A guide construction 7 for material mat 2 is further mounted on a side edge of moon pool 51. Guide construction 7 comprises a guide frame 71 and a framework 73 which is movable along two lateral girders 72 of the frame into a desired starting position 30 and which is provided on an underside with an engaging means for a side edge of a material mat 2 in the form of a clamp 74. Guide frame 71 is connected to the side edge of moon pool 51 for pivoting around a substantially horizontal axis 52, this allowing guide frame 71 to be carried from a rest position (not shown), in which the frame is clear of bottom 3, to the operating position shown in figure 1 in which guide frame 71 extends in the water 4 from the side edge of moon pool 51 into a desired starting position 30 on bottom 3. A side edge of a material mat 2 picked up by manipulating tool 6 can be placed in this precisely determined starting position 30 by clamping the side edge of material mat 2 fixedly in clamp 74, wherein clamp 74 (and framework 73) are situated in a clamping position A located above water (see figure 5) and then sliding clamp 74 with framework 73, optionally by means of a drive (not shown), in the direction 75 along the lateral girders 72 of guide frame 71 which are located partially in the water 3 and into the starting position 30. Clamp 74 is situated here in a low position B located underwater. Manipulating tool 6 can (partially) follow this movement here so as to prevent excessive unrolling of material mat 2 out of carrier frame 60. Once starting position 30 has been reached, material mat 2 is unrolled onto the bottom from carrier frame 60.

[0026] In order to increase accuracy the pontoon assembly 5 is fixed to the bottom during unrolling of material

mats 2. Pontoon assembly 5 is provided for this purpose according to figure 3 with a number of fixed spud poles 54 and two spud carriages 55, in each of which a spud pole 56 is received. By means of spud carriages 55 a pontoon assembly 5 anchored to the bottom 3 can make a limited movement in the direction of forward movement 57 of pontoon assembly 5 as according to the arrow 58 shown in figure 3. Because the position of the fixed pontoon assembly 5 can be accurately determined with a global positioning system (GPS), the position of the guide frame 7 connected to pontoon assembly 5 is also fixed, and so also the starting position 30 from which a material mat 2 is unrolled by manipulating tool 6. A material mat 2 can in this way be positioned accurately on bottom 3.

[0027] The embodiment shown in figures 3 and 4 further comprises a pouring device 8 which is arranged downstream (relative to the direction of forward movement 57) on pontoon assembly 5 and with which material mats 2 already unrolled onto bottom 3 can be provided with pouring material 81 for the purpose of stabilizing the material mats 2. Pouring device 8 comprises a through-feed unit for the pouring material 81 in the form of a chute 82 with a funnel-shaped inlet 83 along which the material for pouring 81 is received and an outlet 84 along which the material 81 is deposited onto material mats 2. Outlet 84 here forms a flattened funnel. Chute 82 can be displaced in the transverse direction 59 along rails 85 running transversely of the direction of movement 57, whereby chute 82 can cover substantially the whole width of pontoon assembly 5. Chute 82 can if desired take a (partly) flexible form between inlet 83 and outlet 84, for instance comprise a flexible tube. In such an embodiment it is possible to hold inlet 83 of chute 82 at a fixed position and move only outlet 84. A loading crane 86 likewise displaceable in the transverse direction 59 along a suitable guide 90 further provides for supply of sufficient pouring material 81, such as for instance gravel, to inlet funnel 83 of the chute.

[0028] In order to obtain a flat poured layer with an even more precisely defined height level, an embodiment of the invention comprises a device in which chute 82 comprises a telescopically slidable part, whereby a lower edge of outlet 84 of chute 82 can be held at the same height irrespective of the rolling of pontoon assembly 5. A suitable measuring and control system here controls the movement of the telescopic part. It is also possible to provide the device with measuring means configured to determine and control the quantity of material present in chute 82 or the flow rate through chute 82.

[0029] Manipulating tool 6 comprises in the embodiment shown in figures 3 and 4 a lever crane 61 displaceable in transverse direction 59 along a suitable guide 91. Lever crane 61 is provided with a robot arm comprising two members (62, 63) coupled for movement relative to each other. Members (62, 63) can be moved in known manner relative to each other and lever crane 61 by means of hydraulic cylinders 64. Second member 63 is connected to a pick-up tool for a material mat 2 in the

form of a carrier frame 60. Carrier frame 60 is provided with two end plates with holes in which a material mat 2 rolled up on a rod can be arranged. The end plates are optionally provided with an adjustable rolling resistance so that the unrolling of a material mat 2 can take place in controlled manner. Second member 63 is curved so that carrier frame 60 can be carried at least partially under pontoon assembly 5, as shown for instance in figure 1 by the position furthest to the left of manipulating tool 6. Second member 63 is curved such that a lower part thereof moves out of the plane which comprises first member 62. Carrier frame 60 is further connected to a free outer end of second member 63 such that frame 60 can be rotated in a direction 65 around a longitudinal axis of second member 63, as shown in the inset of figure 2. Underwater positions which are difficult to access can hereby also be reached.

[0030] In another embodiment manipulating tool 6 comprises a lever crane 61 displaceable in transverse direction 59 along the suitable guide 91, wherein this crane is provided according to the embodiment shown in figures 7 and 8A-8C with a robot arm comprising two members (162, 163) coupled for movement relative to each other. In figure 7 the robot arm is shown in three different positions which are shown in front view in figures 8A, 8B and 8C. Members (162, 163) can be moved in known manner relative to each other and lever crane 61 by means of hydraulic cylinders 164. Second member 163 is connected to a pick-up tool for a material mat 2 in the form of carrier frame 60. Second member 163 is not curved in this embodiment but has a linear progression in a lengthwise direction of member 163. In order to enable placing of carrier frame 60 at least partially under pontoon assembly 5 as shown by the position of manipulating tool 6 furthest to the left in figure 7, second member 163 is connected to first member 162 by means of a hinge connection 166 which is controllable with hydraulic cylinders 165 and which enables pivoting of second member 163 out of a vertical plane 167. Carrier frame 60 is further connected to a free outer end of second member 163 such that frame 60 can be rotated in a direction 168 around a longitudinal axis of second member 163.

[0031] Pontoon assembly 5 is further optionally provided with a number of fixed chutes 87 and with a number of containers 88 which serve as control room 88a, as HPU container 88b and as storage 88c for material mats 2 for placing.

[0032] With the invented device a number of protective material mats 2 can be arranged in efficient and accurate manner on a bottom 3 under water. For this purpose a material mat 2 received in carrier frame 60 is picked up by manipulating tool 6 and a side edge of material mat 2 is secured in clamp 74 in an above water clamping position A of framework 73. Framework 73 is then moved along lateral girders 72 of guide construction 7 into a desired starting position 30, wherein the side edge of material mat 2 is carried along therewith. The desired

starting position 30 can for instance be defined by the base of a sheet piling that has been arranged in the dike body or bank of the channel for widening, after which the bank has been cleared away as far as the sheet piling in order to effect the widening. Material mat 2 is then unrolled from this starting position 30 onto bottom 3 by manipulating tool 6. During these operations the pontoon assembly 5 is fixed in a position relative to bottom 3 with the spud poles. During laying of material mats 2 the pontoon assembly 5 is displaced if desired over a limited distance in the direction of movement 57 by moving spud carriages 55 in the direction 58, which corresponds to the direction of movement 57 of pontoon assembly 5. Once a number of material mats 2 have been laid in this manner, pontoon assembly 5 is uncoupled from bottom 3 by raising spud poles (54, 56) and positioned and preferably fixed in a new position, after which the above stated steps are repeated and the material mats 2 laid in the previous step are provided with a stabilizing poured layer of pouring material 81 by pouring device 8, as shown for instance in figure 4. Although not essential, the direction of forward movement 57 of pontoon assembly 5 usually substantially corresponds to the direction of navigation in the channel. In such a case the material mats 2 are thus unrolled substantially transversely of the direction of navigation in the channel and pouring material 84 is likewise poured substantially transversely of the direction of navigation onto a placed material mat 2. It is useful in this embodiment to place material mats 2 over only a portion of the channel width so that the remaining portion of the channel width remains available for shipping traffic. This portion can then be provided later with material mats 2.

[0033] The invention is not limited to the above described embodiments and modifications could be made thereto to the extent these ensue in self-evident manner from the appended claims.

Claims

1. Device for arranging a protective material mat on a bottom under water, wherein the device comprises a floating support body for a manipulating tool and for a guide construction for the material mat, wherein the manipulating tool is configured to pick up, carry underwater and unroll a material mat roll on the bottom from a starting position, and wherein the guide construction comprises a guide frame and an engaging means for a side edge of the material mat movable along the guide frame into the starting position.
2. Device as claimed in claim 1, wherein it further comprises a pouring device for arranging pouring material on a material mat unrolled onto the bottom, wherein the pouring device comprises a throughfeed unit for the pouring material with an inlet along which the material is received and an outlet along which the material is deposited onto the material mat, wherein the outlet of the throughfeed unit is movable relative to the support body.
3. Device as claimed in claim 1 or 2, wherein the manipulating tool is movable in a plane of the support body.
4. Device as claimed in any of the foregoing claims, wherein the floating support body has a direction of forward movement and the manipulating tool and/or the outlet of the throughfeed unit is movable in a direction running transversely of the direction of forward movement.
5. Device as claimed in any of the foregoing claims, wherein the manipulating tool comprises a robot arm which is connected to the support body and provided with a pick-up tool for a material mat.
6. Device as claimed in claim 5, wherein the robot arm comprises at least two members coupled for movement relative to each other, wherein a first member is connected to the support body, a second member is connected to the pick-up tool and the second member is curved so that the pick-up tool can be carried at least partially under the support body.
7. Device as claimed in claim 5, wherein the robot arm comprises at least two members coupled for movement relative to each other, wherein a first member is connected to the support body, a second member is connected to the pick-up tool and the second member is connected to the first member for pivoting out of a plane comprising the first member.
8. Device as claimed in any of the claims 3-7, wherein the pick-up tool is connected to the robot arm for rotation around a longitudinal axis of the robot arm.
9. Device as claimed in any of the foregoing claims, wherein the guide frame of the guide construction can be carried from a rest position to an operating position, in which operating position the guide frame extends underwater from the support construction into the starting position.
10. Device as claimed in any of the foregoing claims, wherein the engaging means for a material mat side edge can be carried to the starting position from a clamping position located above water.
11. Device as claimed in any of the foregoing claims, wherein the engaging means for a material mat side edge comprises clamps movable along lateral girders of the guide frame into the starting position.
12. Method for arranging a protective material mat on a

bottom under water, wherein a manipulating tool and a guide construction for the material mat are provided on a floating support body; the manipulating tool picks up a material mat roll; a side edge of the material mat is attached to an engaging means of the guide construction; the engaging means is moved along a guide frame of the guide construction into a starting position and carries the side edge of the material mat with it into the starting position; and the material mat is unrolled from the starting position onto the bottom by the manipulating tool.

13. Method as claimed in claim 12, wherein pouring material is arranged by a pouring device on a material mat unrolled onto the bottom, wherein an inlet of a throughfeed unit of the pouring device receives the pouring material and an outlet deposits the pouring material onto the material mat, wherein the outlet of the throughfeed unit is moved relative to the support body.
14. Method as claimed in claims 12-13, wherein the manipulating tool comprises a robot arm connected to the support body and the material mat is picked up with a pick-up tool provided on the robot arm.
15. Method as claimed in any of the claims 12-14, wherein the guide frame of the guide construction is carried from a rest position to an operating position, in which operating position the guide frame extends underwater from the support construction into the starting position, and wherein the engaging means for a material mat side edge is carried to the starting position from a clamping position located above water.

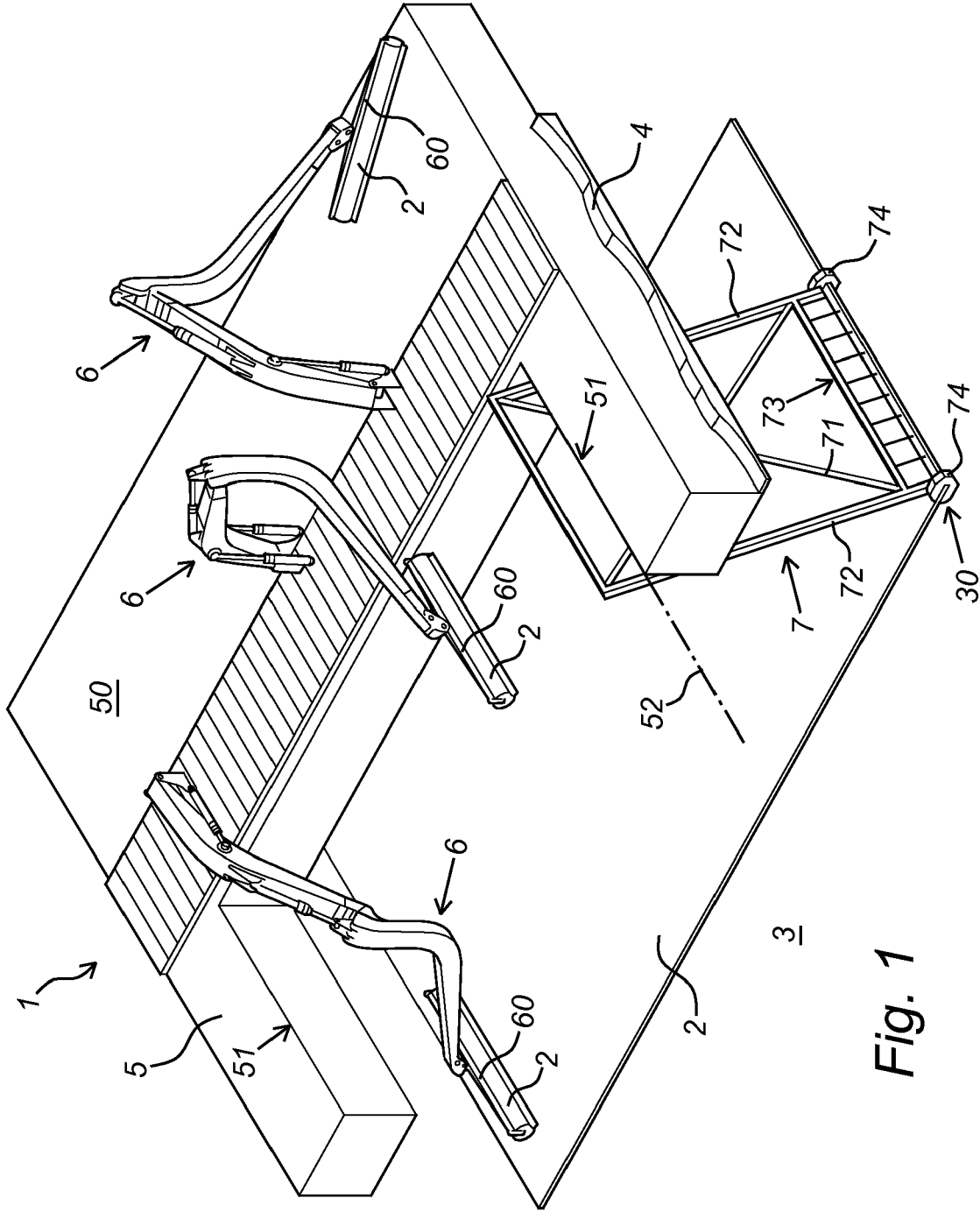


Fig. 1

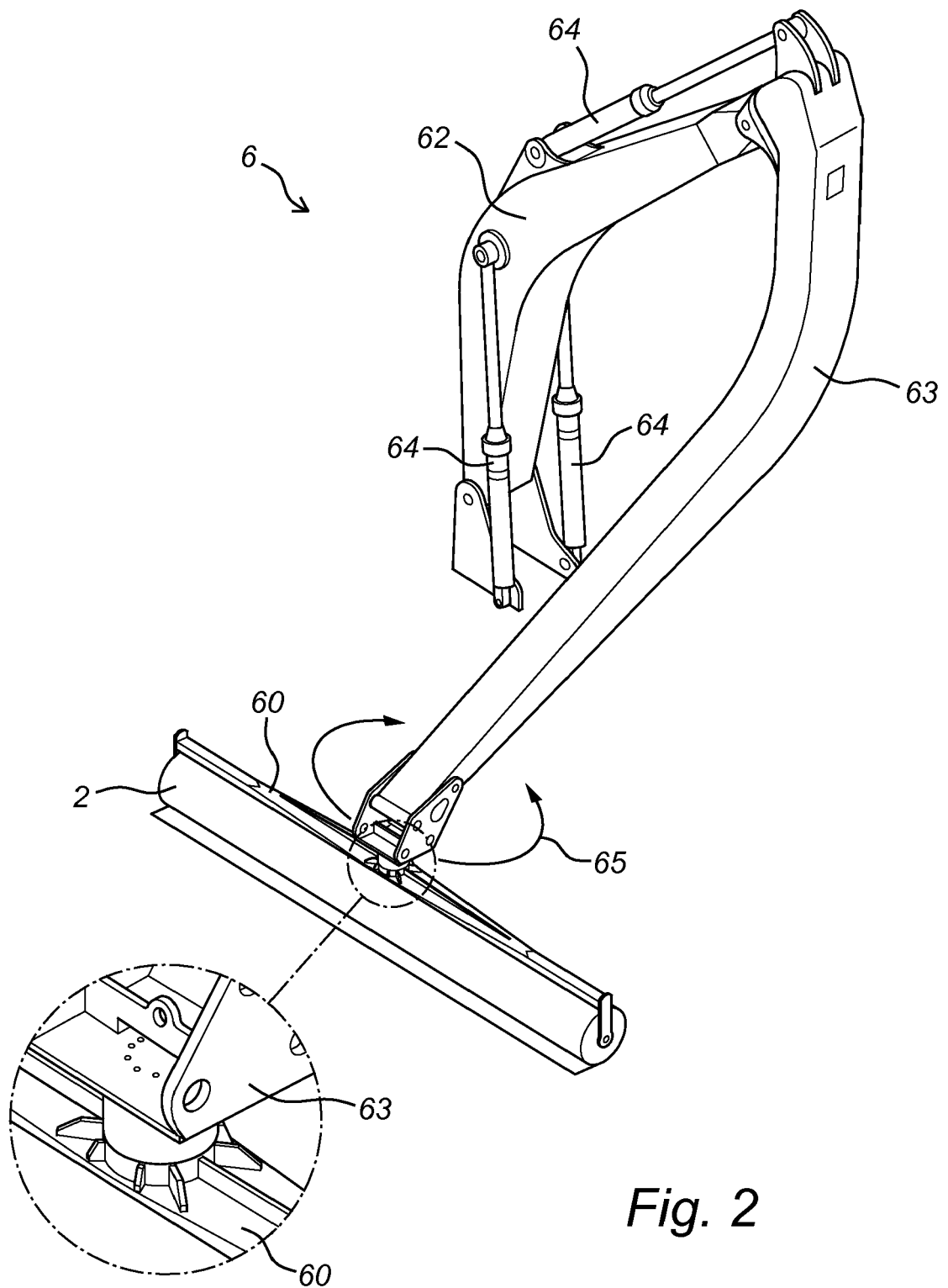
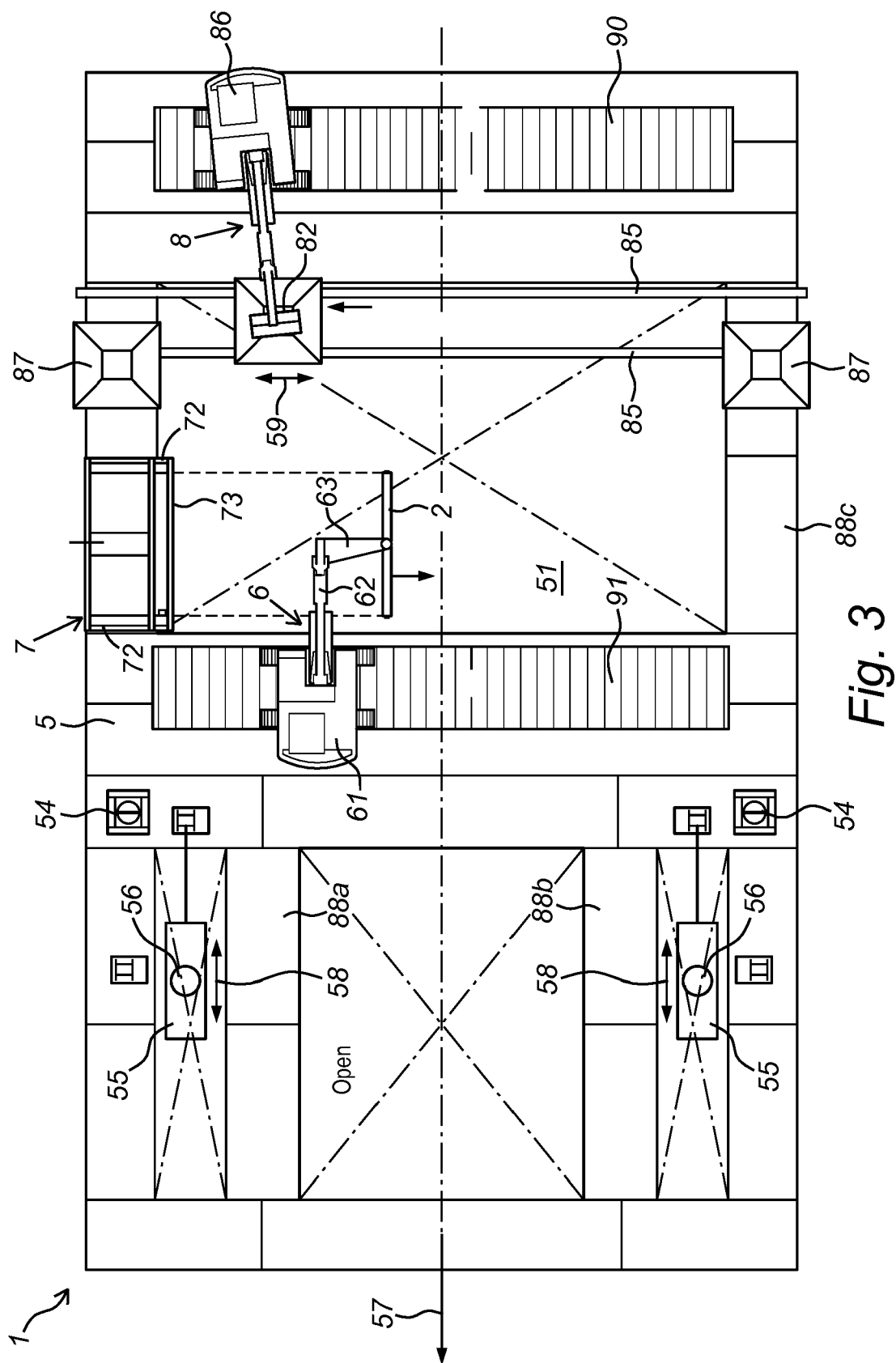


Fig. 2



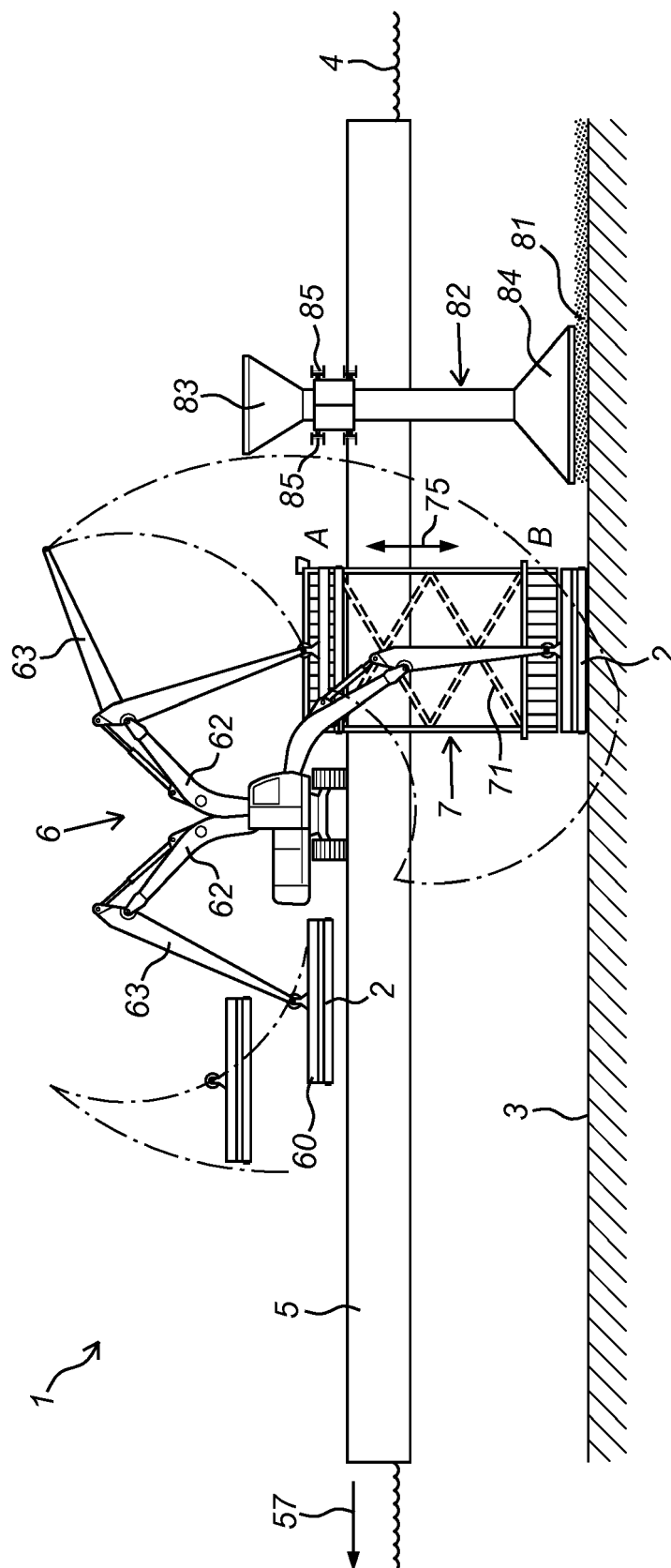


Fig. 4

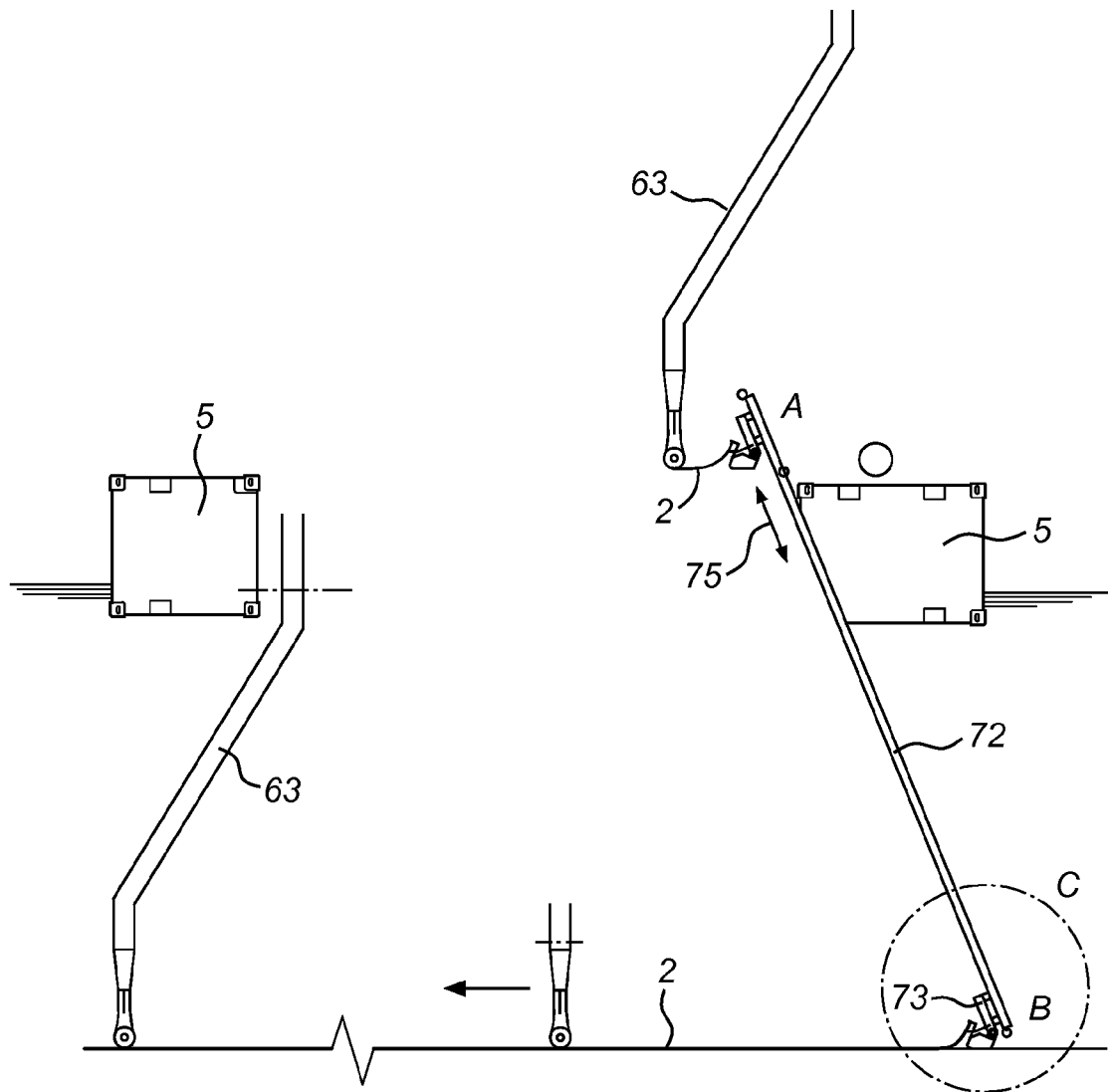


Fig. 5

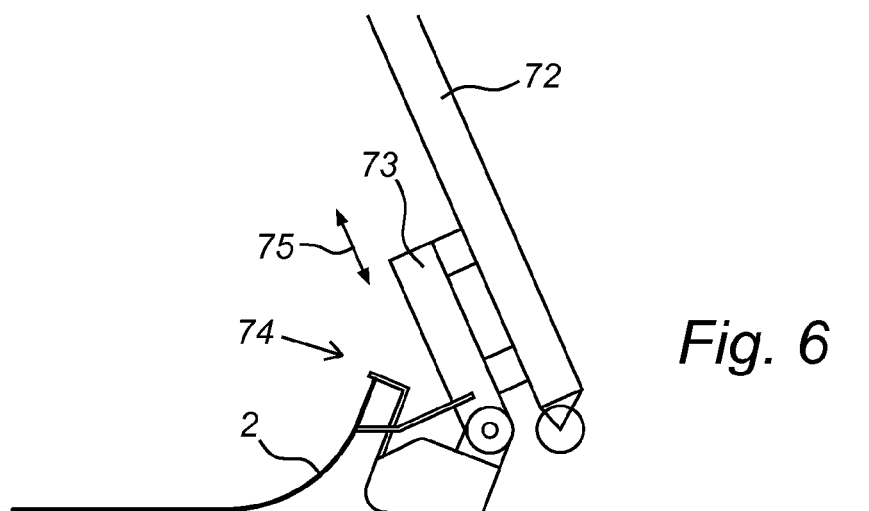


Fig. 6

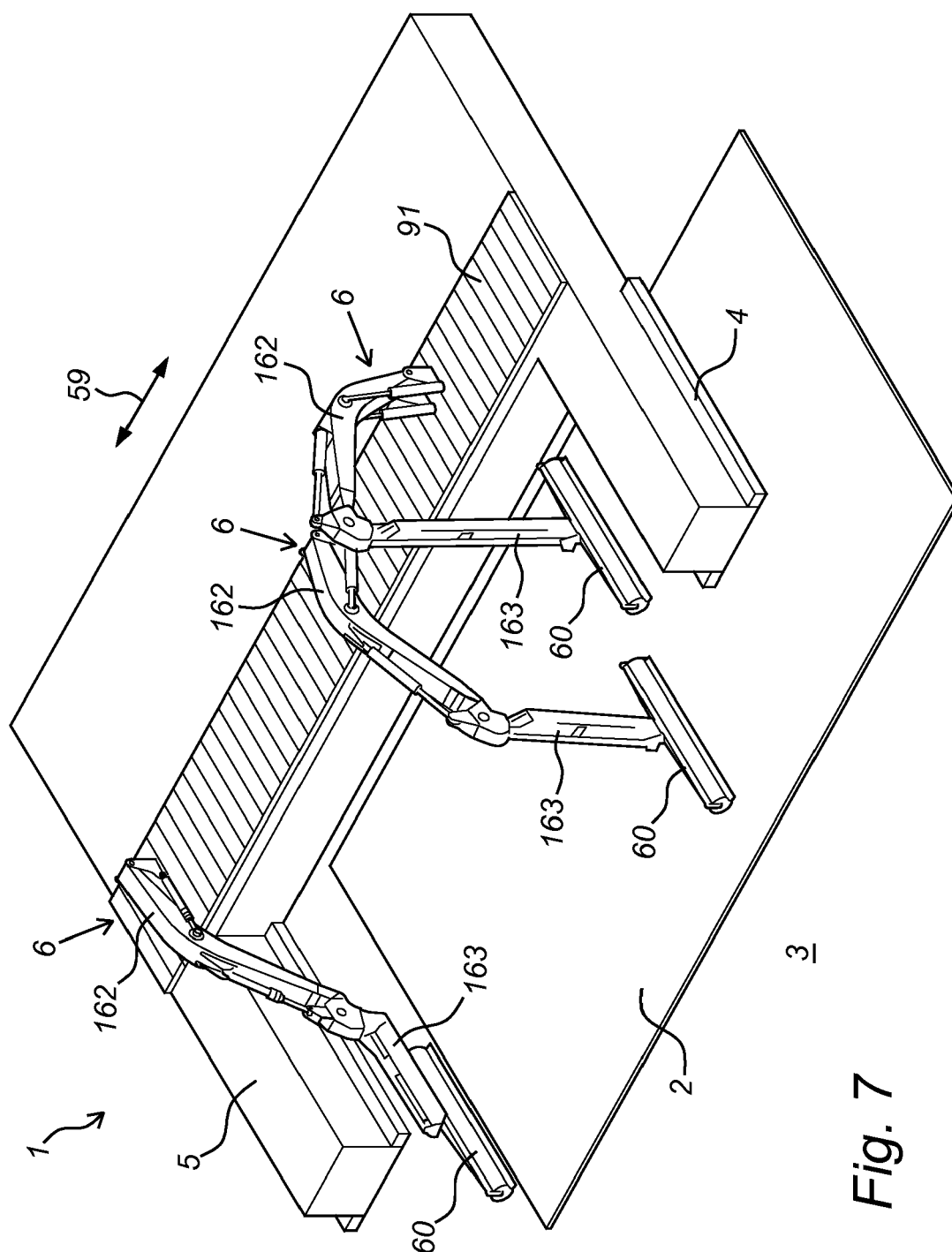


Fig. 7

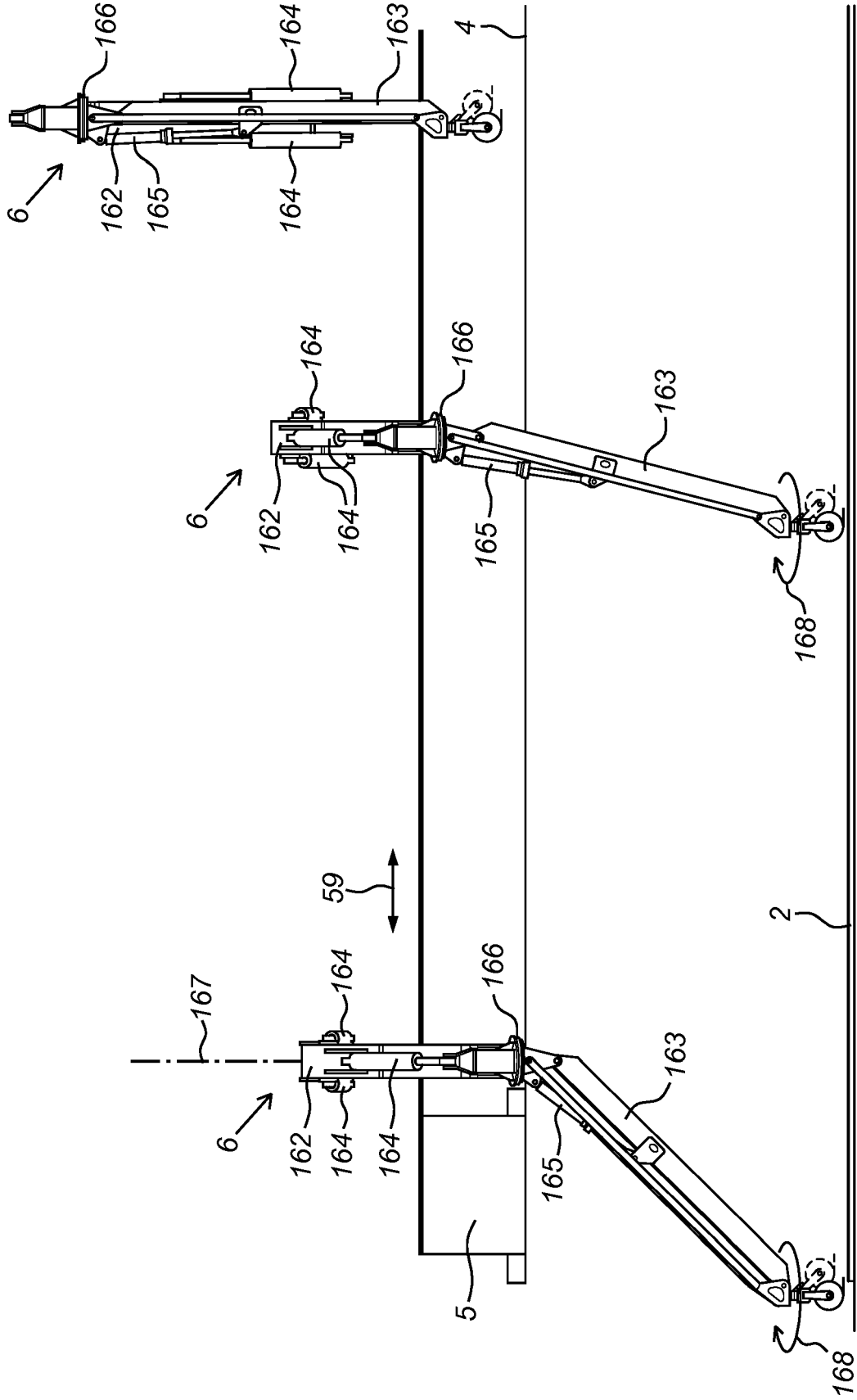


Fig. 8C

Fig. 8B

Fig. 8A



EUROPEAN SEARCH REPORT

Application Number
EP 16 15 8568

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
Y	NL 6 916 144 A (SHELL INTERNATIONALE RESEARCH MAATSCHAPPIJ N.V.) 29 April 1971 (1971-04-29) * page 2, paragraph 3 - page 3, paragraph 2 * * page 9, paragraph 2 * * page 10, last paragraph - page 11, last paragraph * * figures 1,5 *	1-15	INV. E02B3/12 B66B1/00 E02B5/02
Y	WO 00/26478 A1 (PAYNE LEROY [US]) 11 May 2000 (2000-05-11) * page 1, line 35 - page 2, line 2 * * page 5, line 25 - page 6, line 14 * * page 7, lines 8-15 * * page 8, line 16- * * page 9, lines 8-18 * * figures 1,2,3 *	1-15	
A	US 2004/129376 A1 (PAYNE LEROY [US]) 8 July 2004 (2004-07-08) * paragraphs [0016], [0022], [0025], [0028]; figures 1, 3, 4 *	1-15	TECHNICAL FIELDS SEARCHED (IPC) E02B B66B
A	FR 2 734 291 A1 (MORILLON CORVOL COURBOT [FR]) 22 November 1996 (1996-11-22) * page 6, line 21 - page 9, line 3 * * page 9, line 27 - page 10, line 2; figures * * figures *	1-15	
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 8 July 2016	Examiner Urbahn, Stephanie
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82