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(54) Title: LIFTING SYSTEM FOR LIFTING AN ITEM

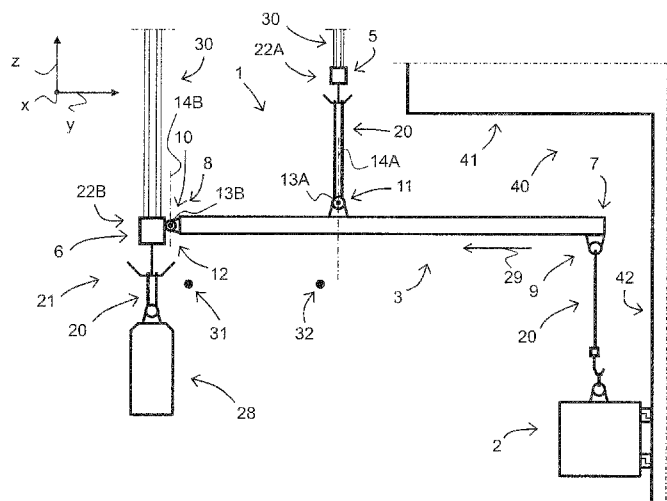


Figure 1

(57) Abstract: A lifting system (1) for lifting an item (2) with a vessel (4) comprising a first support (5) and a second support (6), wherein the lifting system comprises an elongate lifting structure (3) comprising a first end (7) and a second end (8), an item connector constructed and arranged to in use connect the lifting structure to the item near or at the first end, a weight (21) connected to a weight connector (10) provided on the lifting structure near or at the second end, a first connector (11) constructed and arranged to connect the lifting structure (31) in use to the first support, a second connector (12) constructed and arranged to connect the lifting structure in use to the second support, wherein the first connector is located at a distance from the item connector in a direction from the first end to the second end.



Title: Lifting system for lifting an item

The invention relates to a lifting system for lifting an item with a vessel. In practice, such a lifting system is amongst other used for lifting an item to or from a sea platform. The invention furthermore relates to a vessel comprising the lifting system. The invention furthermore relates to a method of moving an item with the lifting system.

5 The lifting system, the vessel and the method may comprise any feature disclosed in the figures and/or the description. The lifting system, the vessel and the method may comprise said feature independent of or in combination with one or more of the other features disclosed.

Embodiments of the lifting system, the vessel and the method will be described by
10 way of example only, with reference to the accompanying schematic drawings in which corresponding reference symbols indicate corresponding parts, and in which:

Figure 1 schematically shows a side view of an embodiment of the lifting system,

Figure 2 schematically shows a side view of a further embodiment of the lifting system,

15 the Figures 3 and 4 schematically show a view in perspective of a further embodiment of the lifting system, and

the Figures 5 and 6 schematically show a view in perspective of a further embodiment of the lifting system.

Figure 1 shows a side view of an embodiment of the lifting system. A co-ordinate
20 system is indicated in the figures 1 and 2. The x- and y-directions are horizontal directions and z-direction is a vertical direction.

The lifting system 1 is constructed and arranged to lift an item 2 with a vessel 4 comprising a first support 5 and a second support 6. The vessel 4 is not shown, only the first support 5 and the second support 6 of the vessel 4 are shown. In the embodiment shown in
25 fig. 2, part of the vessel 4 is shown.

The first support 5 and the second support 6 are each formed by a hoisting block 22A, 22B. The hoisting blocks 22A, 22B are part of a hoisting device provided on the vessel 4. The hoisting device is a crane and the hoisting block 22A, 22B are connected to an upwardly extending crane structure via hoisting wires 30. In other examples, the first support
30 5 is connected to a first hoisting device and the second support 6 is connected to a second hoisting device. In other examples, a different type of hoisting device is used, such as a winch. In other examples, the first support 5 and/or the second support 6 are formed by a fixed support member provided on the vessel 4.

The lifting system 1 comprises an elongate lifting structure 3 comprising a first end 7 and a second end 8 and an item connector 9 constructed and arranged to in use connect the lifting structure 3 to the item 2 at the first end 7. In other examples, the item 2 is connected to the lifting structure 1 near the first end 7.

5 A weight 21 is connected to a weight connector 10 provided on the lifting structure 3 at the second end 8. In other examples, the weight 21 is connected to the lifting structure 1 near the second end 8.

The lifting system 1 comprises a first connector 11 constructed and arranged to connect the lifting structure 3 in use to the first support 5 and a second connector 12
10 constructed and arranged to connect the lifting structure 3 in use to the second support 6.

The weight connector 10 and the second connector 12 are integrated and formed by a single connector. In other examples, the weight connector 10 and the second connector 12 are formed by separate connectors.

The first support 5 is connected to the first connector 11 via a flexible member 20.
15 The flexible member is a flexible line. In other examples a different type of flexible member is used, such as a chain. In other examples, the first support 5 is directly connected to the first connector 11.

The second support 6 is directly connected to the second connector 12. In other examples, the second support 6 is connected to the second connector 12 via a flexible
20 member 20.

In other examples, the first support 5 and/or the second support 6 are connected to the first connector 11 and the second connector 12 via a rigid member, such as a rigid bar.

A weight member 28 is connected to the weight connector 10 via the hoisting block 22B of the second support 6. The hoisting block 22B of the second support 6 is connected to
25 the weight connector 10 in such a way that it's mass forms part of the weight 21 connected to the lifting structure 3. The weight 21 is therefore formed by the weight member 28 and the hoisting block 22B of the second support 6. In other examples wherein the hoisting block 22B forms part of the weight 21, the mass of the hoisting block 22B suffice and an additional mass (such as from the weight member 28) is not required. In other examples, the hoisting
30 block 22B does not form part of the weight 21. In other examples, the weight member 28 is connected directly to the weight connector 10 or via a rigid member.

In a direction from the first end 7 to the second end 8, the first connector 11 is located at a distance from the item connector 9. Said direction is indicated by arrow 29.

A sea platform 40 comprising an upper part 41 supported by a platform support
35 structure 42 is shown. The platform support structure 42 may for example be a steel or concrete structure standing on a seabed or floating in sea water. An item 2, such as a boat fender, a piece of pipeline or a riser, is connected to the item connector 9 and to the

platform 40. The item 2 is connected to the platform 40 at a location beneath the upper part 41. The lifting system 1 reaches said location of the item 2.

The lifting system 1 allows that the item 2 is moved beneath an object, such as the upper part 41 of the platform 40. In other examples, the item is move beneath a different object restricting vertical access. In one aspect, the lifting system 1 tends to allow the installation of the item 2 at a location beneath an object and the removal of the item 2 from a location beneath an object. In one aspect, the lifting system 1 tends to allow the installation of the item 1 to a platform 40 at a location beneath the upper part 41 and the removal of the item 1 from platform 40 at a location beneath the upper part 41 (such as the top side structure of the platform).

In the direction 29 from the first end 7 to the second end 8, the second connector 12 is located beyond the first connector 11.

In the direction 29 from the first end 7 to the second end 8, the centre of gravity 31 of the lifting system 1 (mainly determined by the mass of the lifting structure 3 and the weight 21) is located at a distance from the item connector 9. In said direction 29, the centre of gravity 31 of the lifting system 1 is located beyond the first connector 11.

The second connector 12 is located between the first connector 11 and the second end 8. The second connector 12 is located at the second end 8. In other examples, the second connector 12 is located near the second end 8.

The first connector 11 is a pivot connector allowing the lifting structure 3 to in use pivot. The first connector 11 is constructed and arranged to in use allow a pivot movement of the lifting structure 3 about a pivot axis 13A which extends substantially horizontal. The first connector 11 is constructed and arranged to in use allow a pivot movement of the lifting structure 3 about a pivot axis 14A which extends substantially vertical.

The second connector 12 is a pivot connector allowing the lifting structure 3 to pivot at the second connector 12. The second connector 12 is constructed and arranged to in use allow a pivot movement of the lifting structure 3 about a pivot axis 13B which extends substantially horizontal. The second connector 12 is constructed and arranged to in use allow a pivot movement of the lifting structure 3 about a pivot axis 14B which extends substantially vertical.

The second support 6 is constructed and arranged to pivot the lifting structure 1 at the first connector 11. The first support 5 is constructed and arranged to position the lifting structure 1 in a substantially horizontal position.

The first support 5 is constructed and arranged to pivot the lifting structure 1 at the second connector 12. The first support 11 is constructed and arranged to position the lifting structure 1 in a substantially horizontal position.

The first support 5 is constructed and arranged to move the lifting structure 3 in a horizontal direction. The first support 5 is constructed and arranged to move the lifting structure 3 in a vertical direction.

5 The second support 6 is constructed and arranged to move the lifting structure 3 in a horizontal direction. The second support 6 is constructed and arranged to move the lifting structure 3 in a vertical direction.

For pivoting the lifting structure 3 about the first horizontal pivot axis 13A, the second support 6 is moved relative to the first support 5 in the z-direction. For pivoting the lifting structure 3 about the second horizontal pivot axis 13B, the first support 5 is moved relative
10 to the second support 6 in the z-direction.

For moving the lifting structure 3 in a horizontal direction, the first support 5 and the second support 6 are moved in the x- or y-direction. The first support 5 and the second support 6 can be moved relative to the vessel 4 in a horizontal direction and/or the first support 5 and the second support 6 can be moved along with the vessel 4 in a horizontal
15 direction.

For moving the lifting structure 3 in a vertical direction, the first support 5 and the second support 6 are moved in the z-direction.

For pivoting the lifting structure 3 about the first vertical pivot axis 14A, the second support 6 is moved relative to the first support 5 in the x-direction. For pivoting the lifting
20 structure 3 about the second vertical pivot axis 14B, the first support 5 is moved relative to the second support 6 in the x-direction.

The vessel 4 comprises a controlling device 34 constructed and arranged to control the operation of the first support 5 and the second support 6. The controlling device 34 is constructed and arranged to move the first support 5 and the second support 6. The
25 controlling device 34 forms part of the hoisting device 17. The controlling device 34 may be any type of controlling device 34 known for manually or automatically controlling the operation of a hoisting device 17, such as crane.

Figure 2 shows a side view of a further embodiment of the lifting system 1. The lifting structure 1 is supported by a vessel 4 comprising a deck 24 and a hull 25. The first support 5
30 is formed by a hoisting block 22 held by a hoisting device, more specifically a crane (not shown), on the vessel 4. The second support 6 is formed by a fixed support member 26 connected to the vessel 4. The first support 5 is movable relative to the vessel 4. The second support 6 is located in a fixed position relative to the vessel 4.

In the direction 29 from the first end 7 to the second end 7, the distance between the
35 item connector 9 and the weight connector 10 is L. The distance between the item connector 9 and the first connector 11 in said direction 29 is D2. The distance between the weight connector 10 and the first connector 11 in said direction 29 is D1.

In the shown embodiment, L is around 40 meter, D1 is around 16 meter and D2 is around 24 meter. In other examples of the lifting system 1, L is at least 20 meter. In other examples of the lifting system 1, L is at most 60 meter. In other examples of the lifting system 1, D2 is at least $0,3 \times L$ (0,3 times L). In other examples of the lifting system 1, D2 is at most $0,8 \times L$ (0,8 times L).

The lifting structure 3 is constructed and arranged to in use lift an item 2 having a mass of 5000 Kg or more. The mass of the weight 21 is larger than the mass of the item 2. The distance D1 times the mass of the weight 21 is larger than the distance D2 times the mass of the item 2.

10 In the direction 29 from the first end 7 to the second end 8, the centre of gravity 32 of the combination of the lifting system 1 and the thereto connected item 2 is located beyond the first connector 11. In one aspect of the lifting system 1, the lifting system 1 tends to exert a pulling force on the second support 6 via the second connector 12.

15 In other examples of the lifting system 1, the centre of gravity 32 of the combination of the lifting system 1 and the thereto connected item 2 is located substantially in line with the first connector 11 when seen in a vertical direction.

Figure 3 shows a view of a further embodiment of the lifting system 1. The lifting system 1 is carried by a vessel 4 floating in sea water 33. A hoisting device 17, more specifically a crane, is provided on the vessel 4. The hoisting device 17 is provided with a controlling device 34 for controlling the operation of the hoisting device 17. The hoisting device 17 comprises a first hoisting block 22A and a second hoisting block 22B. The first hoisting block 22A forms the first support 5 and the second hoisting block 22B forms the second support 6.

Figure 4 shows the lifting system 1 of fig. 3 positioned near a sea platform 40. The item 2 (which in this situation is a boat fender) is located beneath the upper part 41 of the platform 40. The item connector 9 is connected to the item by flexible members 20, such as wires and/or chains.

Figure 5 shows a view of a further embodiment of the lifting system 1. The lifting system 1 is carried by a vessel 4 floating in sea water 33. A hoisting device 17, more specifically a crane, is provided on the vessel 4. The hoisting device 17 is provided with a controlling device 34 for controlling the operation of the hoisting device 17. The hoisting device 17 comprises a hoisting block 22 forming the first support 5. Two fixed support members 26 are provided on the vessel 4. Said fixed support members 26 form the second support 6.

35 Figure 6 shows the lifting system 1 of fig. 5 positioned near a sea platform 40. The item 2 is located beneath the upper part 41 of the platform 40. The item connector 9 is connected to the item by flexible members 20, such as wires and/or chains.

Referring to the figures 1-6, the method of moving the item 2 with the vessel 4 comprises supporting the lifting system 1 with the first support 5 at the first connector 11 and with the second support 6 at the second connector 12, connecting the item connector 9 to the item 2, and moving the item 2 by moving the lifting system 1.

5 The method may comprise moving the lifting system 1 by moving the first support 5 and/or the second support 6. The method comprise moving the lifting system 1 by moving the vessel 4.

10 The method may comprises moving the item 2 connected to the lifting system 2 below an object. The method may comprises moving the item 2 connected to the lifting system 2 below an upper part 41 of an sea platform 40.

15 The method may comprise positioning the vessel 4 besides a sea platform 40 to which the item 2 is connected, moving the lifting system 1 to position the item connector 9 near the item 2, connecting the item connector 9 to the item2, disconnecting the item 2 from the platform 40, and moving the lifting system 1 to move the item 2 away from the platform 40.

20 The method may comprise positioning the vessel 4 besides a sea platform 40, moving the lifting system 1 with the item 2 connected to the item connector 9 to positioning the item 2 near the platform 40, connecting the item 2 to the platform 40, disconnecting the item 2 from the item connector 9, and moving the lifting system 1 away from the platform 40.

25 The method may comprise moving the item 2 connected to the lifting system 1 below an upper part 41 of the platform 40.

30 The method may comprise pivoting the lifting structure 3 at the first connector 11. The method may comprise positioning the lifting structure 1 substantially horizontal with the second support 6.

35 The method may comprise pivoting the lifting structure 3 at the second connector 12. The method may comprise positioning the lifting structure 3 substantially horizontal with the first support 5.

40 The method may comprise moving the lifting structure 3 in a horizontal direction 15. The method may comprise moving the lifting structure 3 in a vertical direction 16.

45 It will be apparent to those skilled in the art that various modifications can be made to the invention without departing from the scope of the invention.

Claims

1. Lifting system for lifting an item with a vessel comprising a first support and a second support, wherein the lifting system comprises;
 - an elongate lifting structure comprising a first end and a second end,
 - an item connector constructed and arranged to in use connect the lifting structure to the item near or at the first end,
 - a weight connected to a weight connector provided on the lifting structure near or at the second end,
 - a first connector constructed and arranged to connect the lifting structure in use to the first support,
 - a second connector constructed and arranged to connect the lifting structure in use to the second support, wherein the first connector is located at a distance from the item connector in a direction from the first end to the second end.
2. Lifting system according to claim 1, wherein in the direction from the first end to the second end the second connector is located beyond the first connector.
3. Lifting system according to claim 1 or 2, wherein in the direction from the first end to the second end the centre of gravity of the lifting system is located at a distance from the item connector.
4. Lifting system according to any of the preceding claims, wherein in the direction from the first end to the second end the centre of gravity of the lifting system is located beyond the first connector.
5. Lifting system according to any of the preceding claims, wherein the second connector is located between the first connector and the second end.
6. Lifting system according to any of the preceding claims, wherein the second connector is located near or at the second end.
7. Lifting system according to any of the preceding claims, wherein the weight connector and the second connector are formed by a single connector.

8. Lifting system according to any of the preceding claims, wherein the first connector is a pivot connector allowing the lifting structure to in use pivot.

5 9. Lifting system according to any of the preceding claims, wherein the first connector is constructed and arranged to in use allow a pivot movement of the lifting structure about a pivot axis which extends substantially horizontal.

10 10. Lifting system according to any of the preceding claims, wherein the first connector is constructed and arranged to in use allow a pivot movement of the lifting structure about a pivot axis which extends substantially vertical.

15 11. Lifting system according to any of the preceding claims, wherein the second connector is a pivot connector allowing the lifting structure to pivot at the second connector.

12. Lifting system according to any of the preceding claims, wherein the second connector is constructed and arranged to in use allow a pivot movement of the lifting structure about a pivot axis which extends substantially horizontal.

20 13. Lifting system according to any of the preceding claims, wherein the second connector is constructed and arranged to in use allow a pivot movement of the lifting structure about a pivot axis which extends substantially vertical.

25 14. Lifting system according to any of the preceding claims, wherein in the direction from the first end to the second end the distance between the item connector and the weight connector is L.

30 15. Lifting system according to any of the preceding claims, wherein in the direction from the first end to the second end the distance between the item connector and the first connector is D2.

35 16. Lifting system according to any of the preceding claims, wherein in the direction from the first end to the second end the distance between the weight connector and the first connector is D1.

17. Lifting system according to any of the preceding claims, wherein $D2$ is at least $0,3 \times L$.

18. Lifting system according to any of the preceding claims, wherein $D2$ is at most $0,8 \times L$.

19. Lifting system according to any of the preceding claims, wherein the weight connector and the second connector in a vertical direction are substantially in line with each other.

20. Lifting system according to any of the preceding claims, wherein L is at least 20 meters.

21. Lifting system according to any of the preceding claims, wherein L is at most 60 meters.

22. Lifting system according to any of the preceding claims, wherein the lifting structure is constructed and arranged to in use lift an item having a mass of 5000 Kg or more.

23. Lifting system according to any of the preceding claims, wherein in use $D1 \times$ the mass of the weight is larger than $D2 \times$ the mass of the item.

24. Lifting system according to any of the preceding claims, wherein in the direction from the first end to the second end the centre of gravity of the combination of the lifting system and the thereto connected item is in use located beyond the first connector.

25. Vessel for moving an item, which vessel comprises a lifting system according to any of the preceding claims, a first support and a second support, wherein the first support and second support are constructed and arranged to support the lifting structure.

26. Vessel according to claim 25, wherein the second support is constructed and arranged to pivot the lifting structure at the first connector.

27. Vessel according to claim 25 or 26, wherein the first support is constructed and arranged to position the lifting structure in a substantially horizontal position.

28. Vessel according to any of the claims 25-27, wherein the first support is constructed and arranged to pivot the lifting structure at the second connector.

5 29. Vessel according to any of the claims 25-28, wherein the first support is constructed and arranged to position the lifting structure in a substantially horizontal position.

30. Vessel according to any of the claims 25-29, wherein the first support is constructed and arranged to move the lifting structure in a horizontal direction.

10 31. Vessel according to any of the claims 25-30, wherein the first support is constructed and arranged to move the lifting structure in a vertical direction.

15 32. Vessel according to any of the claims 25-31, wherein the second support is constructed and arranged to move the lifting structure in a horizontal direction.

33. Vessel according to any of the claims 25-32, wherein the second support is constructed and arranged to move the lifting structure in a vertical direction.

20 34. Vessel according to any of the claims 25-33, wherein the vessel comprises at least one hoisting device providing the first support.

35. Vessel according to any of the claims 25-34, wherein the vessel comprises at least one hoisting device providing the second support.

25 36. Vessel according to any of the claims 25-35, wherein the first support and the second support are provided by a single hoisting device.

30 37. Vessel according to any of the claims 25-35, wherein the vessel comprises a first hoisting device providing the first support and a second hoisting device providing the second support.

35 38. Vessel according to any of the claims 25-37, wherein the vessel comprises a controlling device constructed and arranged to control the operation of the first support.

39. Vessel according to any of the claims 25-38, wherein the controlling device is constructed and arranged to control the operation of the second support.

5 40. Vessel according to any of the claims 25-39, wherein the controlling device is constructed and arranged to control the operation of the at least one hoisting device.

41. Vessel according to any of the claims 25 -34, 38, 40, wherein the vessel comprises at least one fixed support member forming the second support.

10 42. Vessel according to any of the claims 25 -33, 35, 39, 40, wherein the vessel comprises at least one fixed support member forming the first support.

43. Use of a lifting system according to any of the claims 1-24.

15 44. Use of a vessel according to any of the claims 25-42.

45. Method of moving an item with a vessel according to any of the claims 25-42, which method comprises;
- supporting the lifting system with the first support at the first connector and with the
20 second support at the second connector,
- connecting the item connector to the item,
- moving the item by moving the lifting system.

46. Method according to claim 45, wherein the method comprises moving the lifting
25 system by moving the first support and/or the second support.

47. Method according to claim 45 or 46, wherein the method comprises moving the lifting system by moving the vessel.

30 48. Method according to any of the claims 45-47, wherein the method comprises moving the item connected to the lifting system below an object.

49. Method according to any of the claims 45-48, wherein the method comprises;
- positioning the vessel besides a sea platform to which the item is connected,
35 - moving the lifting system to position the item connector near the item,
- connecting the item connector to the item,
- disconnecting the item from the platform,

- moving the lifting system to move the item away from the platform.

50. Method according to any of the claims 45-49, wherein the method comprises;

- positioning the vessel besides a sea platform,
- 5 - moving the lifting system with the item connected to the item connector to positioning the item near the platform,
- connecting the item to the platform,
- disconnecting the item from the item connector,
- 10 - moving the lifting system away from the platform.

51. Method according to any of the claims 45-50, wherein the method comprises moving the item connected to the lifting system below an upper part of the platform.

52. Method according to any of the claims 45-51, wherein the method comprises pivoting
15 the lifting structure at the first connector.

53. Method according to any of the claims 45-52, wherein the method comprises positioning the lifting structure substantially horizontal with the second support.

20 54. Method according to any of the claims 45-53, wherein the method comprises pivoting the lifting structure at the second connector.

55. Method according to any of the claims 45-54, wherein the method comprises positioning the lifting structure substantially horizontal with the first support.

25 56. Method according to any of the claims 45-55, wherein the method comprises moving the lifting structure in a horizontal direction.

30 57. Method according to any of the claims 45-56, wherein the method comprises moving the lifting structure in a vertical direction.

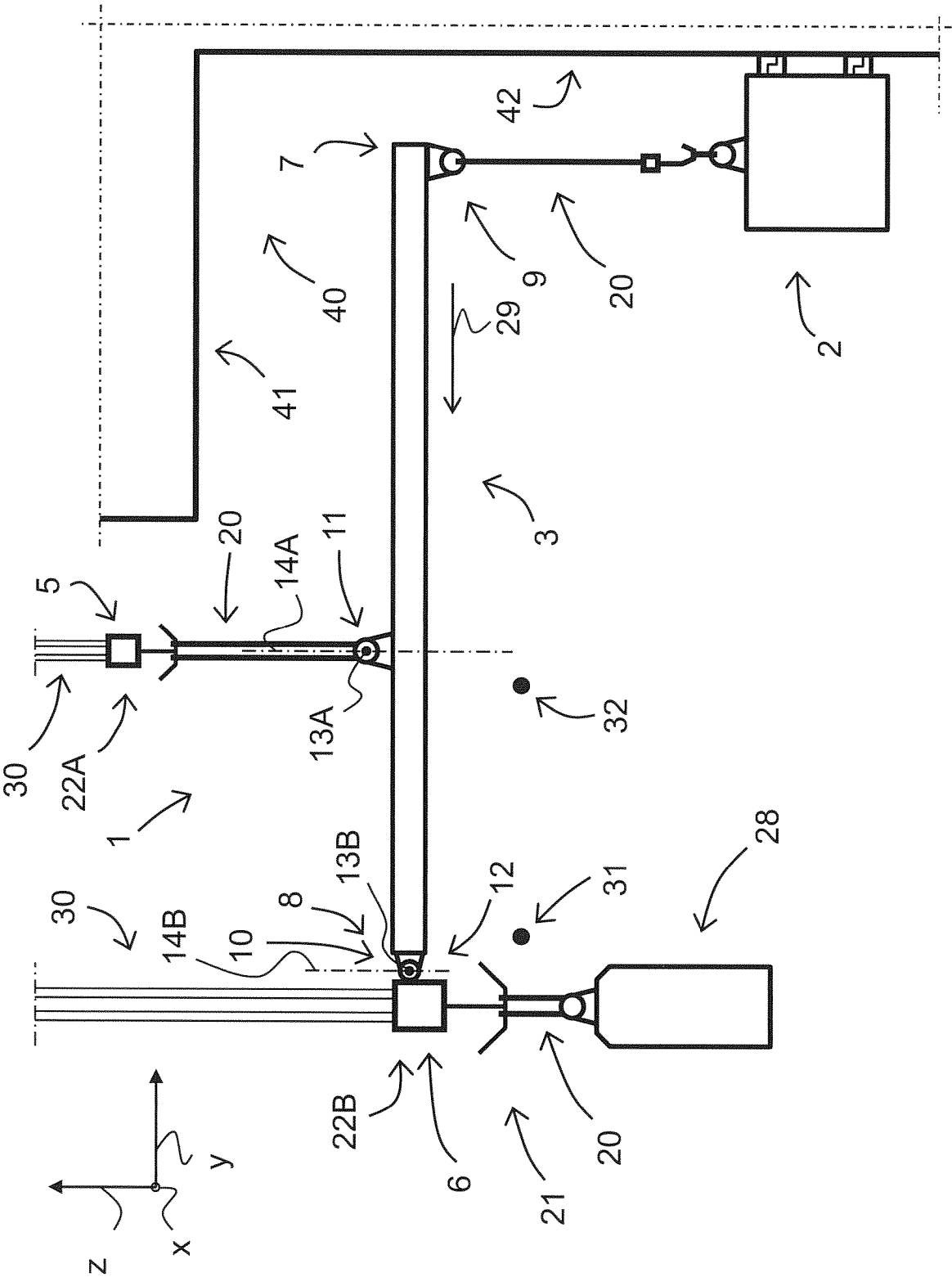


Figure 1

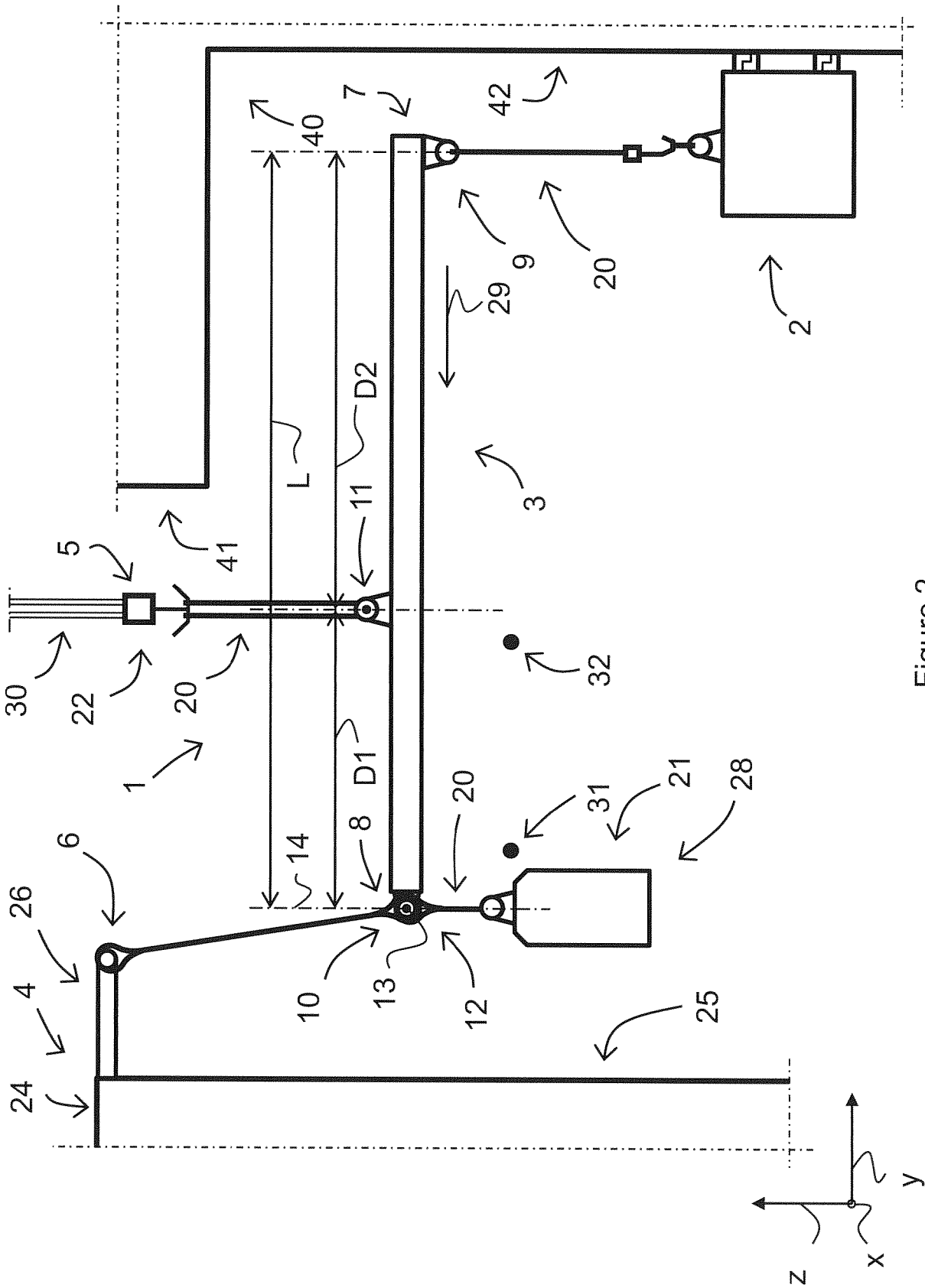


Figure 2

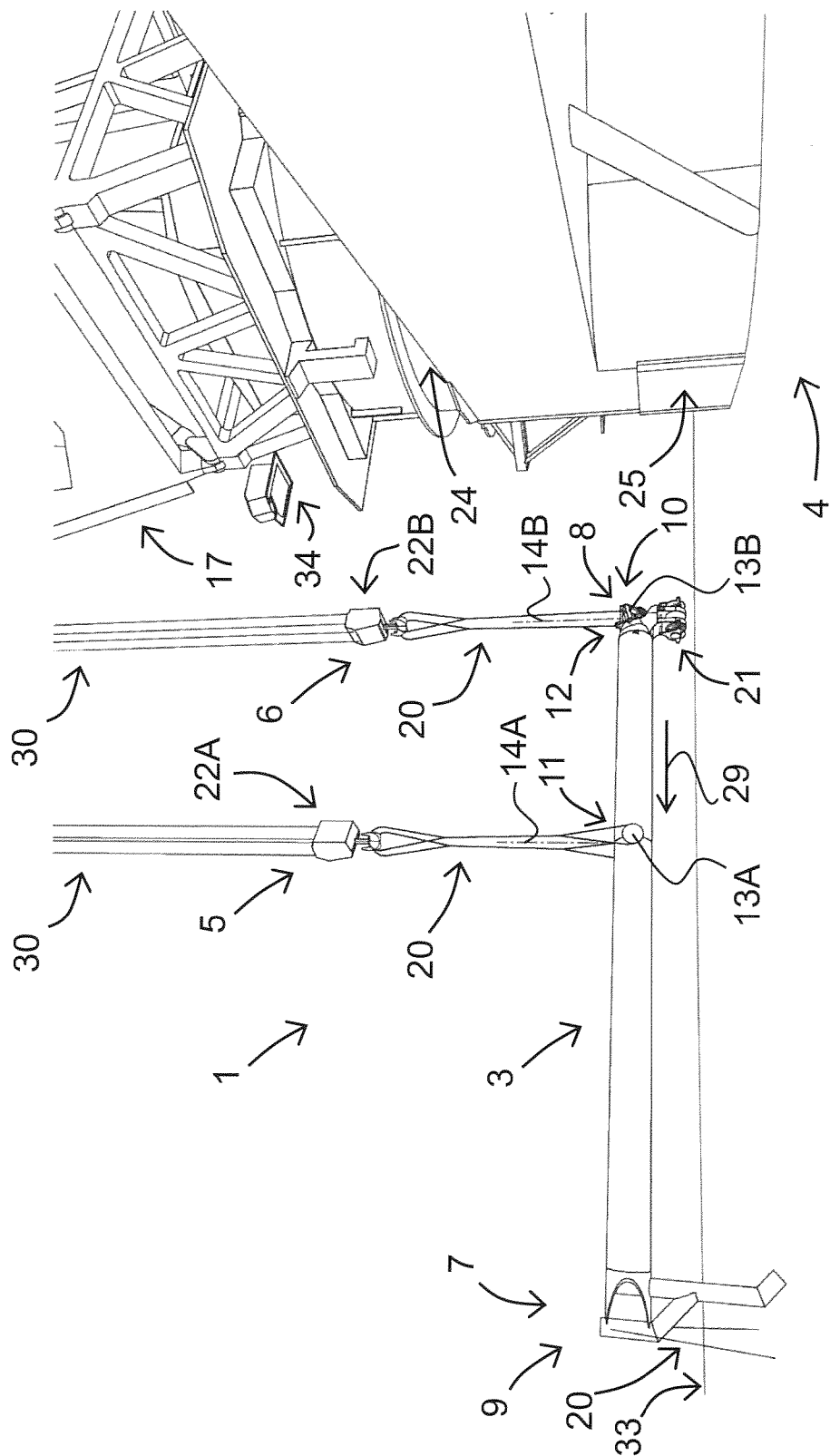


Figure 3

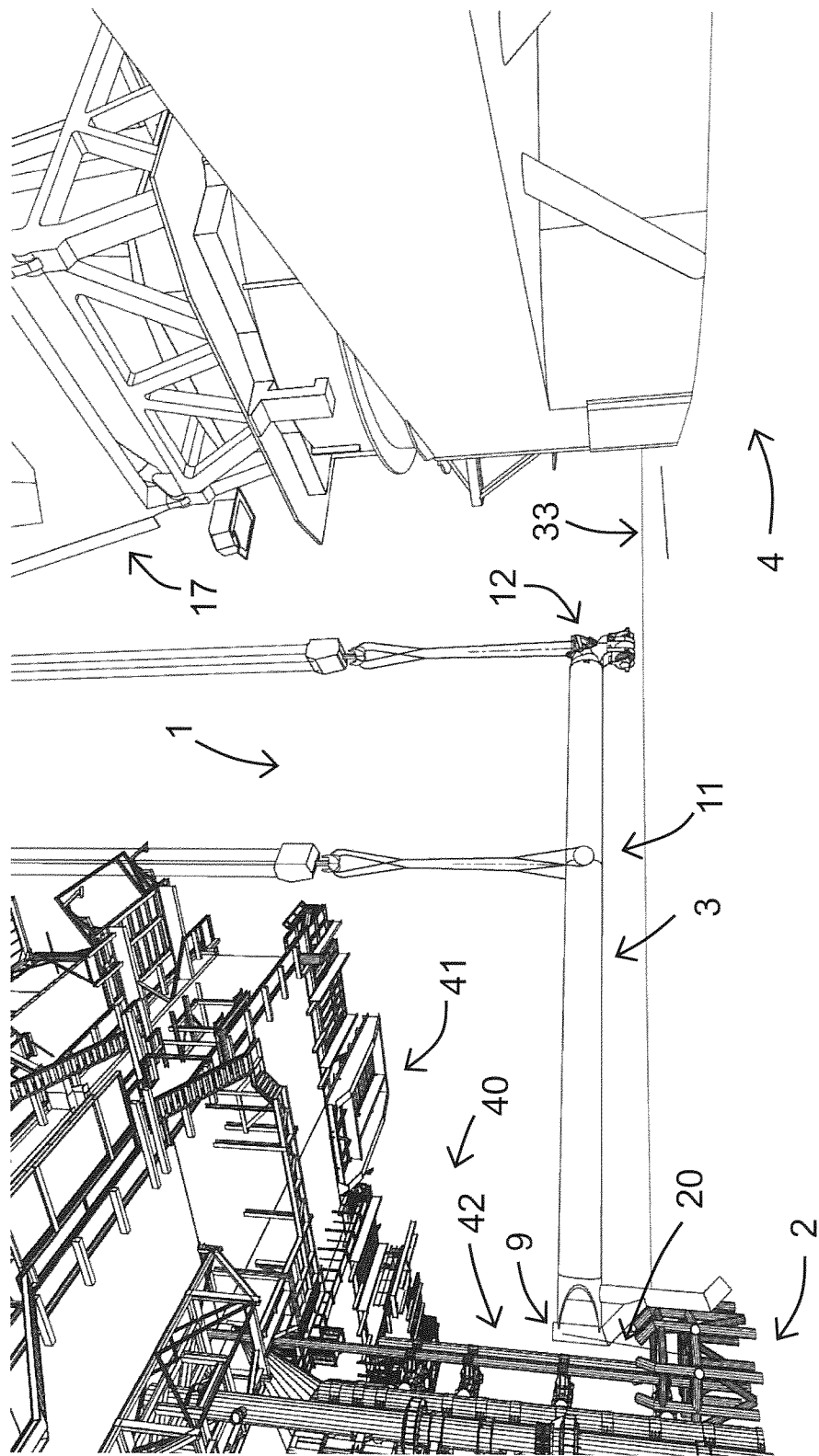


Figure 4

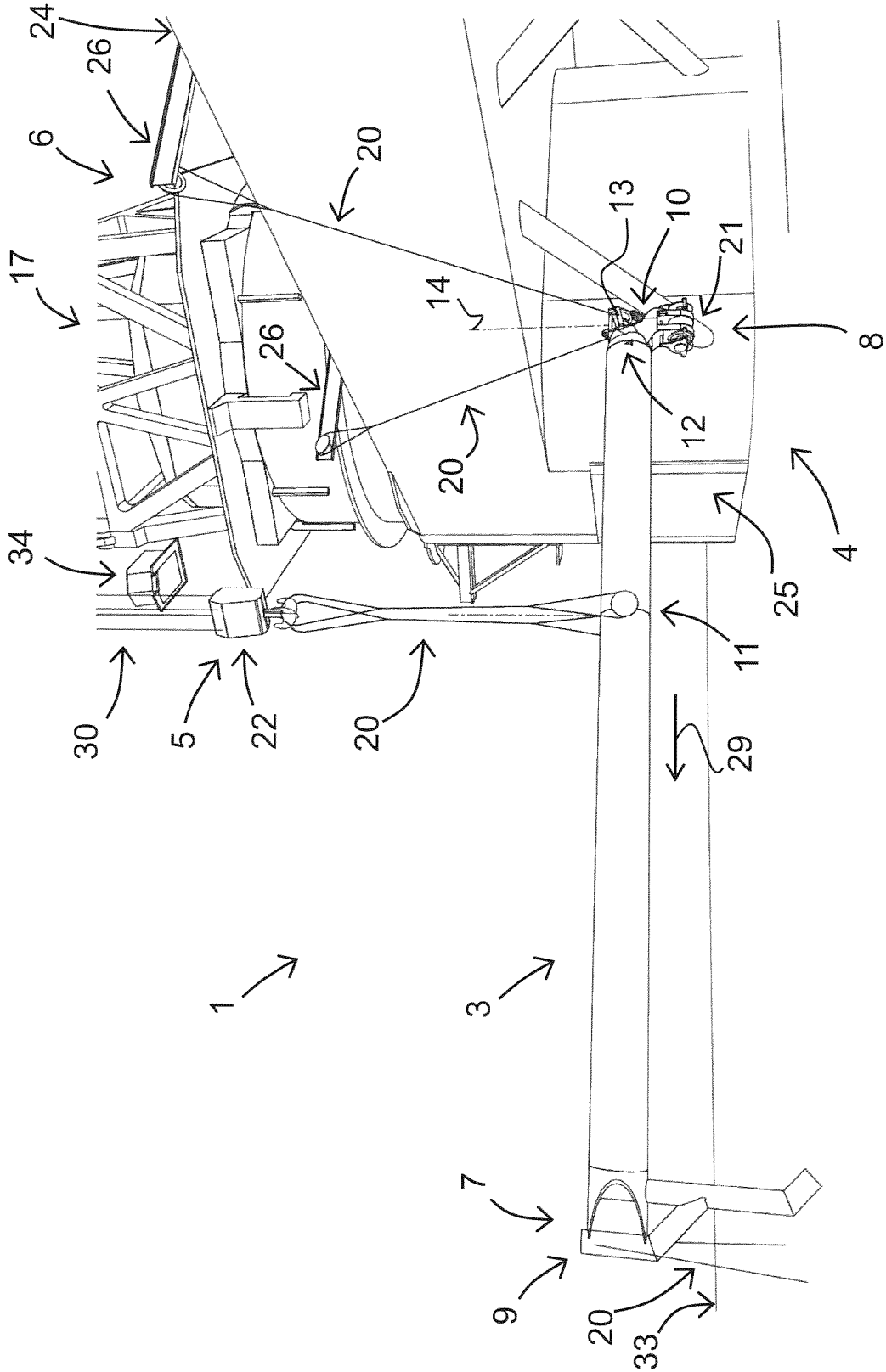


Figure 5

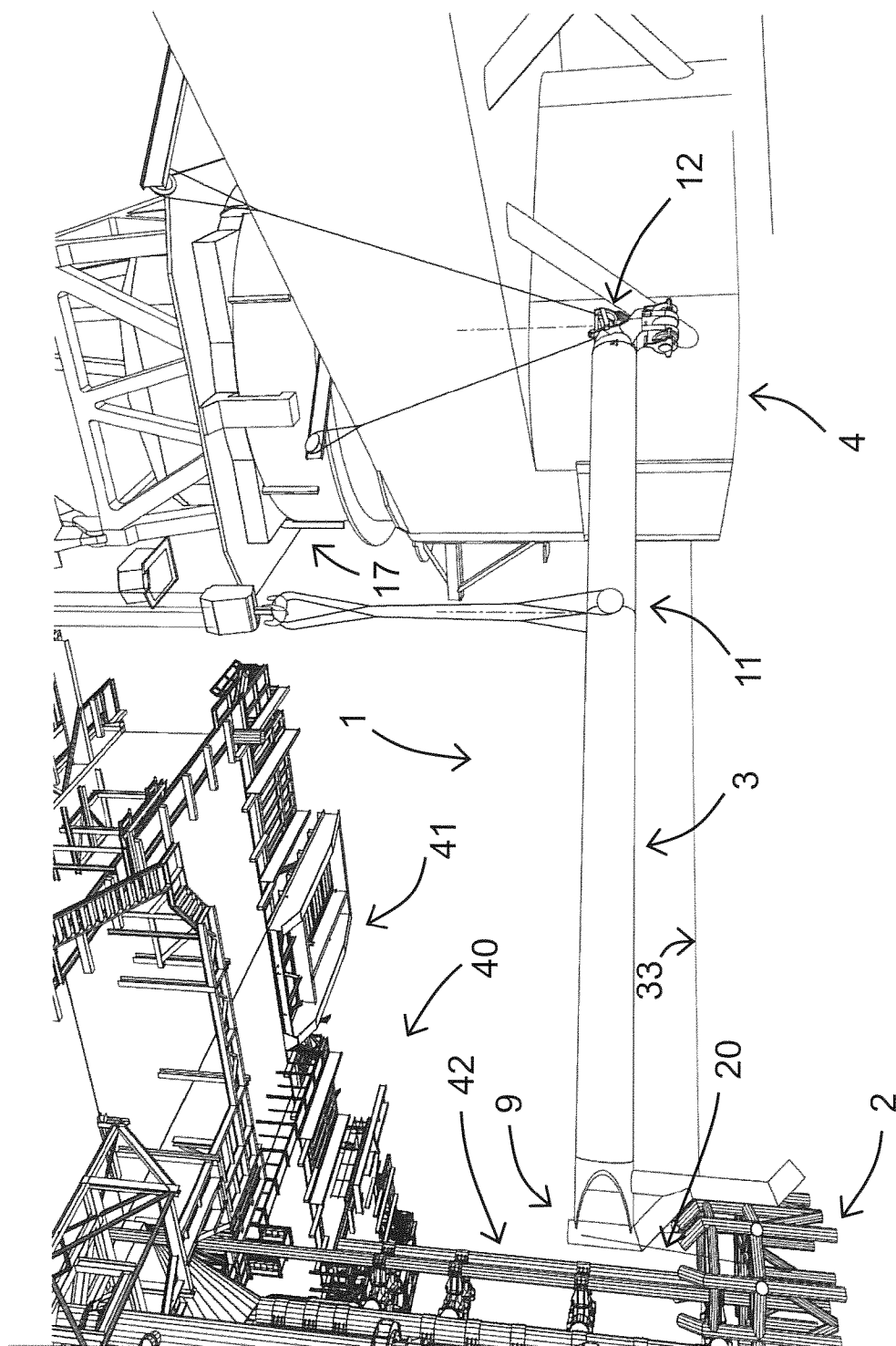


Figure 6

INTERNATIONAL SEARCH REPORT

International application No
PCT/NL2012/050414

A. CLASSIFICATION OF SUBJECT MATTER

INV. B66C1/10 B66C1/16 B66C23/52 E02B17/00 B66C23/10
B66C23/12 B66C23/16 F03D1/00 B66C1/12

ADD.

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)

B66C E02B F03D

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 practicable, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 7 157280 A (FUJITA CORP) 20 June 1995 (1995-06-20) abstract; figure 2 -----	1-24,43
X	FR 2 152 450 A1 (BATIMETAL BATIMETAL [FR]) 27 April 1973 (1973-04-27) the whole document -----	1-24,43
A	WO 01/70616 A1 (SEAMETRIC INTERNAT AS [NO]; KJERSTAD JOSTEIN [NO]) 27 September 2001 (2001-09-27) abstract; figures -----	1,45



Further documents are listed in the continuation of Box C.



See patent family annex.

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Information on patent family members

International application No

PCT/NL2012/050414

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 7157280	A	20-06-1995	NONE
FR 2152450	A1	27-04-1973	NONE
WO 0170616	A1	27-09-2001	AT 253527 T 15-11-2003
		AU 4487901 A 03-10-2001	
		AU 2001244879 B2 22-12-2005	
		BR 0109417 A 10-12-2002	
		CA 2403650 A1 27-09-2001	
		CN 1422233 A 04-06-2003	
		DE 60101160 D1 11-12-2003	
		DE 60101160 T2 16-09-2004	
		DK 1272419 T3 15-03-2004	
		EP 1272419 A1 08-01-2003	
		ES 2210141 T3 01-07-2004	
		HK 1056352 A1 21-10-2004	
		MX PA02009211 A 23-05-2003	
		NO 20001471 A 24-09-2001	
		OA 12146 A 05-05-2006	
		PT 1272419 E 31-03-2004	
		US 2003037716 A1 27-02-2003	
		WO 0170616 A1 27-09-2001	