

(19)



(11)

EP 3 647 177 A1

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:
06.05.2020 Bulletin 2020/19

(51) Int Cl.:
B63B 35/66 (2006.01)

(21) Application number: **19177595.6**

(22) Date of filing: **31.05.2019**

(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:
KH MA MD TN

(71) Applicant: **Ogiienko, Oleg**
Odessa (UA)

(72) Inventor: **Ogiienko, Oleg**
Odessa (UA)

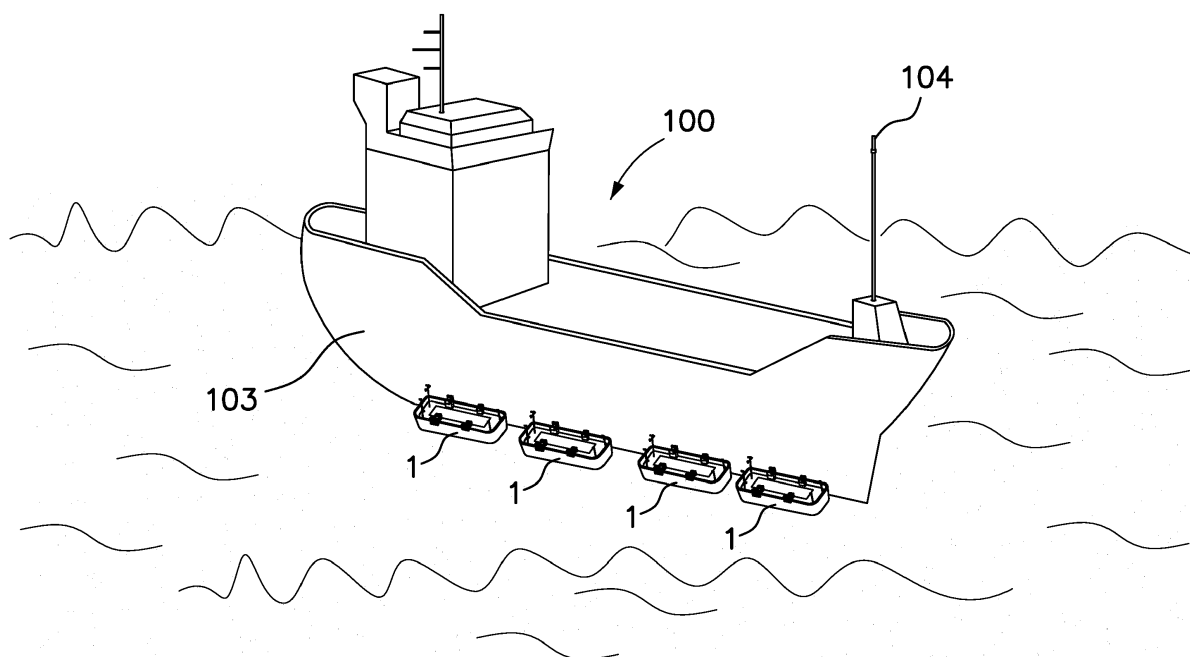
(74) Representative: **Manresa Val, Manuel et al**
Manresa Industrial Property Netherlands, B.V.
Parklaan 34
3016 BC Rotterdam (NL)

(30) Priority: **29.10.2018 EP 18203197**

(54) **A TOWING SYSTEM FOR VESSELS AND AN UNMANNED TUGBOAT FOR USE IN IT**

(57) Comprises at least one unmanned tugboat (1), wherein each unmanned tugboat (1), that is at least one, comprises at least one attachment member (6) and at least one radio navigation beacon (4) provided on each said unmanned tugboat, at least one radio navigation beacon (4) provided on a towed vessel (100), and plurality of radio navigation beacons (204) provided in determinate locations of the port (200), a control unit (201) provided in the port (200) for controlling the unmanned tugboats (1) and the towed vessel (100) during towing

operation, such that at least one unmanned tugboat (1) is detachably attached to a hull (103) of the towed vessel by means of said attachment member (6), characterized in that the radio navigation beacons (4, 104, 204) provided in the unmanned tugboat (1), in the towed vessel (100) and in the port (200) are all of them integrated in an electronic navigation infrastructure controlled by the control unit (201), in order to assist the unmanned tugboat (1) in its manoeuvres outside the port and inside the port (200), with and without the towed vessel (100) duly attached.

**FIG. 3****EP 3 647 177 A1**

Description

[0001] A towing system for vessels, comprising at least one unmanned tugboat, wherein each unmanned tugboat, that is at least one, comprises at least one attachment member and at least one radio navigation beacon provided on each said unmanned tugboat, at least one radio navigation beacon provided on a towed vessel, and plurality of radio navigation beacons provided in determinate locations of the port, a control unit provided in the port for controlling the unmanned tugboats and the towed vessel during towing operation, such that at least one unmanned tugboat is detachably attached to a hull of the towed vessel by means of said attachment member, characterized in that the radio navigation beacons provided in the unmanned tugboat, in the towed vessel and in the port are all of them integrated in an electronic navigation infrastructure controlled by the control unit, in order to assist the unmanned tugboat in its manoeuvres outside the port and inside the port, with and without the towed vessel duly attached.

BACKGROUND OF THE INVENTION

[0002] It is known in the state of the art different patents that comprise drifting ships called "tugs" especially designed for towed vessels, which connect to a towed vessel. Also, different systems for tugboat controls were developed.

[0003] It is a part of the state of the art the PCT application WO2017/167884 "A METHOD AND SYSTEM FOR OPERATION ONE OR MORE TUGBOATS", of 2017, in the name of A.P.MOLLER-MERSEK A/S which discloses a system comprising a control center for wirelessly remote controlling the tugboats. The system is primarily arranged such that when the tugboat reaches the target position, the control is taking from the land-based control system to human operating mobile control system located on the assisted vessel.

[0004] Korean patent KR20160034642 "UNMANAGED TUGGING SYSTEM AND TUGGING METHOD USING THE SAME", of 2014, in the name of DAEWOO SHIP-BUILDING & MARINE which relates to the ship tugging method comprising step of determination the number of tugboats which have remote control function, a step of setting a tugging path using the position information and tugging position of the ship, a step of moving the tugboats adjacent to the ship and a step of moving the ship to the tugging position through wireless remote control of the tugboats. The objective of the invention is to reduce tugging time by precisely controlling the arrangement position and conditions of the tugboat.

[0005] It is also an important document to mention PCT application No. 2018/021917 "APPARATUS FOR CONNECTING A DRIFTING OBJECT TO A TOWING VESSEL AND METHOD FOR USING SAID APPARATUS", dated 2017, in the name of STORMLINKER AS, that refers to an apparatus and a method for connecting a drift-

ing object to a towing vessel; the apparatus comprising; - an attachment unit provided with a towing line connected to the towing vessel, the attachment unit comprising at least one magnet for connecting the attachment unit to the drifting object; and - a controllable, movable member arranged to be able to extend from the towing vessel, the movable member having a first end portion for connection to the towing vessel and a second end portion capable of releasably carrying the attachment unit, wherein the attachment unit further comprises a releasable gripping mechanism for disconnecting the attachment unit from the movable member after connecting the attachment unit to the drifting object.

BRIEF DESCRIPTION OF THE INVENTION

[0006] The present invention provides a towing system for vessels using unmanned tugboats, the system is cost effective and environmentally friendly, what is called "green technology".

[0007] The closest prior art is the PCT application WO2017/167884.

[0008] As it was indicated in the closest document, one of the big problems is the elevated expenses for operating tugboats which need to be operated by crew. Operational costs for tugboats which assist the towed vessel are elevated due to the costs of the crew and/or the costs of the fuel which the tugboats consume. All these costs are normally included in the towing operation and increase the costs of the stop in the port of call.

[0009] The invention of the closest document provides a solution that reduces the problem of operational costs (at least tugboat crew) by providing the land-based controller which is in control of a plurality of autonomous tugboats from berthing position to mobilized position.

[0010] The system is configured such that when the tugboat is in mobilized position, the control of tugboat is taken over by a mobile remote controller located in the vessel. Therefore, all responsibility and control of the manoeuvre of tugboats that are towing the vessel to the port is on human pilot operating and the navigation system of the vessel, including the collision prevention system controlled by land-based or remote-control systems.

[0011] Said invention has the problem that the tugboats do not communicate directly with land-based controller after entering into the mobilized position. Therefore, the drawback of controlling the manoeuvre of the vessel assisted by tugboats is that it does not comprise the whole integrated control system, rather than there are two control systems involved: "land-based controller - tugboats" and "remote controller - tugboats".

[0012] The object of the invention is to overcome the drawback of the prior art, providing an integrated towing system for vessels that are assisted by unmanned tugboats detachably attached to a hull of the towed vessel, controlled directly by the control unit located in the port.

[0013] Then, the control unit that is the one that has all the information, can manage directly the manoeuvres of

the vessel, even, if it was necessary, adding new tugboats or removing them on time.

[0014] A first object of this invention is a towing system for vessels, comprising at least one unmanned tugboat, wherein each unmanned tugboat, that is at least one, comprises at least one attachment member and at least one radio navigation beacon provided on each said unmanned tugboat, at least one radio navigation beacon provided on a towed vessel, and plurality of radio navigation beacons provided in determinate locations of the port, a control unit provided in the port for controlling the unmanned tugboats and the towed vessel during towing operation, such that at least one unmanned tugboat is detachably attached to a hull of the towed vessel by means of said attachment member, characterized in that the radio navigation beacons provided in the unmanned tugboat, in the towed vessel and in the port are all of them integrated in an electronic navigation infrastructure controlled by the control unit, in order to assist the unmanned tugboat in its manoeuvres outside the port and inside the port, with and without the towed vessel duly attached.

[0015] A further object of the present invention is an unmanned tugboat for use in a towing system for vessel that comprises at least one attachment member provided in the unmanned tugboat to be detachably attached to the hull of the towed vessel; power means and driving means that provide autonomous movement of the unmanned tugboat; remotely controlled navigation means configured to transmit and receive radio signal, such as a radio navigation beacon, characterized in that the said attachment members are arranged in both port and starboard side of the unmanned tugboat.

[0016] Still another object of the present invention is an electronic navigation infrastructure for use in towing system for vessels, wherein it comprises the radio navigation beacons provided in the unmanned tugboat, in the towed vessel and in the port controlled by the control unit in order to assist the unmanned tugboat in its manoeuvres outside the port and inside the port, with and without the towed vessel duly attached.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] In order to facilitate the explanation of this specification there are five sheets of drawings accompanying this specification, representing the practical embodiments, which are provided as non-limiting examples of the scope of this invention:

- Figure 1 is a view of a conventional tugboat,
- Figure 2 is a view of an example tugboat of the present invention,
- Figure 3 is a view of towed vessel with tugboats of the present invention which are attached to the towed vessel
- Figure 4 is a view of the plurality of tugboats in column formation
- Figure 5 is a schematic illustration of the port and

the towed vessel entering to it.

SPECIFIC EMBODIMENT OF THE PRESENT INVENTION

[0018] Figure 1 shows a conventional tugboat 11 that belongs to the state of the art.

[0019] Figure 2 represents an unmanned tugboat 1 with a radio navigation beacon 4, a frame structure 2, a hull 3, driving means 5 and attachment means 6.

[0020] Figure 3 illustrates the unmanned tugboat 1 with its radio navigation beacon 4 and a towed vessel 100 with its radio navigation beacon 104.

[0021] Figure 4 shows the unmanned tugboats 1a, 1b, 1c and 1d.

[0022] Finally, Figure 5 represents the unmanned tugboat 1, the towed vessel 100 and its radio navigation beacon 104, a port 200 with its radio navigation beacon 204, chargers 207, a control unit 201, a berth 202, an entrance 203 and inoperative unnamed tugboats 205.

[0023] As a preliminary note, when referred to a "radio navigation beacon" means a radio transmitter emitting/receiving signals to guide vessels.

[0024] Also, when referred to a "towed vessel" means a vessel/boat that is being towed and/or pushed by a tugboat.

[0025] The towing system for vessels comprises at least one unmanned tugboat 1. Depending the size of the towed vessel 100 it can be necessary to use more than one, as it can be seen in the different drawings.

[0026] The unmanned tugboat 1 comprises at least one attachment member 6. Depending on the construction of the unmanned tugboat 1 the number can be increased by two or more, as it can be seen in the drawings.

[0027] Also comprises at least one radio navigation beacon 4 provided on each unmanned tugboat 1 and also at least one radio navigation beacon 104 provided on a towed vessel 100.

[0028] The port 200 also comprises a plurality of radio navigation beacons 204 in specific locations of the port 200, that allow always the interconnection with the other radio navigation beacons 4, 104 located respectively at each unmanned tugboat 1 and the towed vessel 100.

[0029] There is a control unit 201 in the port 200 that controls the unmanned tugboats 1 and the towed vessel 100 during towing operation, outside the port as well as inside the port 200.

[0030] The unmanned tugboat 1 is detachably attached to the hull 103 of the towed vessel 100 by means of said attachment member 6, allowing the unmanned tugboat 1 to fix to the towed vessel 100 and control its movements through the control unit 201.

[0031] Optionally, the unmanned tugboats 1 are detachably attached at the port side and at the starboard side of the towed vessel 100 in its operative mode. The number of unmanned tugboats 1 may depend on the size and the maneuverability of the towed vessel 100. It could be at least two, for example in figs. 3 and 5 are four. The

place to attach to the side of the vessel 100 also depends on the size and maneuverability, being possible to attach the unmanned tugboats 1 in one side of the vessel 100 or in both sides.

[0032] Also, optionally, the tugboats 1a, 1b, 1c, 1d (Fig. 4) in its operative mode are delivered to the towed vessel 100 in column and connected to each other. This would make easier to control long groups and at the same time save energy, due to the fact that it would be necessary that only the ones that are in the ends 1a and 1d are operatives.

[0033] The radio navigation beacons 4, 104, 204 provided in the unmanned tugboat 1, in the towed vessel 100 and in the port 200 respectively, are all of them integrated in an electronic navigation infrastructure controlled by the control unit 201, in order to assist the unmanned tugboat 1 in its maneuvers outside the port and inside the port 200, with and without the towed vessel 100 duly attached.

[0034] Then, the radio navigation beacons 4, 104, 204 manage the movements of the vessel 100 and unmanned tugboats 1 in the port area 200, under the surveillance of the control unit 201.

[0035] Optionally, it is possible to keep at least one unmanned tugboat 1 in inoperative mode 205 in a predetermined location of the port 200, in case that while performing the operations inside or outside the port 200 there is a need to have a better performance of the control or maneuver of the towed vessel 200, that this unmanned tugboat in inoperative mode 205 could help.

[0036] The unmanned tugboat 1 for use in the towing system comprises at least one attachment member 6 provided in the unmanned tugboat 1 to be detachably attached to the hull 103 of the towed vessel 100, in order to take the control of the maneuvers to enter the vessel 100 in the port 200 or to leave the port 200.

[0037] Also, it comprises power means (not shown) and driving means 5 that provide autonomous movement of the unmanned tugboat 1, always controlled by the control unit 201.

[0038] There are remotely controlled navigation means configured to transmit and receive radio signals as explained before, such as the radio navigation beacon 4.

[0039] The attachment members 6 are arranged in both port and starboard side of the unmanned tugboat 1, which allow that the unmanned tugboat 1 can be connected to the vessel 200 for both sides.

[0040] Optionally, the attachment members 6 comprise a plurality of magnets to connect to the boat, taking the benefit that the hull 103 of the vessel 200 is made of metal. The plurality of magnets could be permanent magnets or electromagnets or combination thereof.

[0041] Optionally and an alternative or used in combination with the magnets the attachment members 6 comprise a vacuum cup, that will connect the tugboat 1 to the vessel 200 by suction.

[0042] One of the possible power means are batteries

or other perspective power supply unit. Batteries have the advantage that is green technology and chargers can be placed in several parts of the port, where the unmanned tugboat 1 can moor, with very low cost for installation, because electricity is almost at all parts of the port. If the power means use fuel, the inconvenience is that is a technology that contaminates and at the same time the refueling stations cannot be placed anywhere, because laws are very strict about the place to install them.

[0043] Also, optionally, the tugboat 1 comprises means for connecting one tugboat with the one immediate and/or previous, as it can be seen in Fig. 4. This would help to move several tugboats 1a, 1b, 1c, 1d at the same time, reducing the energetic costs, because only the first 1a and/or the last tugboat 1d should have the power means connected and would move the rest of the tugboats.

[0044] So, figure 1 illustrates a conventional tugboat 11 which is suitable for towing or pushing large ships or vessels which are indispensable in berthing large vessels.

[0045] Figure 2 represents an example embodiment of an unmanned tugboat 1 for use in towing system for vessels of the present invention. The tugboat 1 comprises a tugboat frame structure 2 without a conventional bridge or superstructure with hull 3 extending from the stern to the bow of the tugboat 1. The tugboat frame structure 2 houses power and driving means 5 which can be, for example, the electrical prime movers with suitable containerised type batteries or other perspective power supply unit. Two radio navigation beacons 4 can be located in the stern and in the bow of tugboat 1. The frame structure 2 also provides the support for attachment means 6, that can be two magnets located in both sides, port side and starboard side of the tugboat. Optionally the hull 3 can be provided with a safety fender or buffer (not shown).

[0046] Figure 3 shows a towed vessel 100 and a plurality of tugboats 1 which are attached with its starboard side to the hull 103 of the vessel, in this embodiment to the port side of the towed vessel 100. Depending on the size of the vessel, the number of the tugboats 1 can vary. At least one radio navigation beacon 104 is provided on the towed vessel 100, that when necessary the vessel is ready to be controlled by shore-based control unit 201. The type of vessel to be towed can be different: container ships, barges, general cargo ships, etc.

[0047] Figure 4 depicts four tugboats 1a, 1b, 1c, 1d which are lined up in column, ready to operate and are in the way that the vessel to be towed. The tugboats 1b, 1c, 1d are connected by its bow to the stern of the one forward. The number of tugboats can be different depending on the type and size of towed vessel 100, to which, this group of unmanned tugboats 1a, 1b, 1c, 1d in column, is assigned.

[0048] Figure 5 refers to one of the embodiments of the electronic navigation infrastructure of the port 200 designed for the system of the present invention. The

following elements are illustrated: a control unit 201 able to receive and process the signal of the radio navigation beacons 4, 104, 204, a plurality of radio navigation beacons 204 located in different locations of the port, preferably marking some defined points of the port like entrance 203, berth 202, chargers 207, etc., the towed vessel 100 with the unmanned tugboats 1 attached entering in the port 200, and the unmanned tugboats in inoperative mode 205.

[0049] So, in a specific embodiment the control unit 201 assigns the predetermine number of unmanned tugboats 1 for the towing operation to a vessel 100, which tugboats 1 are equipped with a predetermine number of attachment means 6 each one, suitable to stack directly to the hull 103 of the towed vessel 100. As an example, an unmanned tugboat 1 can be provided with four magnets: two in the port side and two in the starboard side of the tugboat.

[0050] The mathematical model of the port 200 can be designed for processing the information of the variables like the position of the vessel and unmanned tugboats and other required information (including but not limiting to weather conditions, vessel parameters, etc...) and operating of the electronic navigation infrastructure without or with minimum human intervention. This allows to increase reliability of the towing system and minimize the human factor errors and reducing the staff costs.

[0051] The control unit 201 can provide special instructions to move and form the column for unmanned tugboats 1 assigned for towing operation which are found into inoperative mode in the port, to facilitate the group of assigned unmanned tugboats 1 for towing operation to get the operational position.

[0052] When the assigned group of unmanned tugboats 1 reach the towed vessel 100, they can be distributed in to both sides of the hull 103 of the towed vessel. In this embodiment, at least two unmanned tugboats 1 are detachably attached at the port side of the vessel 100 and at least two unmanned tugboats 1 are detachably attached to the starboard side of the towed vessel 100 in its operative mode.

[0053] Further, in the mathematical model the actions like the detection and replacement of assigned unmanned tugboats by one inoperative tugboat 205 are foreseen in situ in the case of any irregular situation like the unmanned tugboat 1 failure or in a situation of emergency or changing the batteries.

[0054] The towing system and the unmanned tugboat 1 for use in it of the present invention enables cost saving in the towing operations, like crew cost, cost of fuel because of use the electrical power, which can be recharged when the unmanned tugboat 1 is found in the inoperative mode, unmanned tugboat maintenance and CO2 emissions in comparison with the conventional tugboats 11 used at the present.

[0055] This patent describes a towing system for vessels, a method for controlling the towed vessel with tugboats and an unmanned tugboat for use in towing system

for vessel. The examples mentioned herein are non-limiting of this invention, therefore it could have different applications and/or adaptations, all within the scope of the following claims.

Claims

1. A towing system for vessels, comprising:

- At least one unmanned tugboat (1), wherein each unmanned tugboat (1), that is at least one, comprises at least one attachment member (6) and at least one radio navigation beacon (4) provided on each said unmanned tugboat,
- at least one radio navigation beacon (4) provided on a towed vessel (100),
- and plurality of radio navigation beacons (204) provided in determinate locations of the port (200),
- a control unit (201) provided in the port (200) for controlling the unmanned tugboats (1) and the towed vessel (100) during towing operation,

such that at least one unmanned tugboat (1) is detachably attached to a hull (103) of the towed vessel by means of said attachment member (6), **characterized in that**

the radio navigation beacons (4, 104, 204) provided in the unmanned tugboat (1), in the towed vessel (100) and in the port (200) are all of them integrated in an electronic navigation infrastructure controlled by the control unit (201), in order to assist the unmanned tugboat (1) in its manoeuvres outside the port and inside the port (200), with and without the towed vessel (100) duly attached.

2. A system, in accordance with claim 1, wherein at least one unmanned tugboat (1) is remained in inoperative mode (205) in predetermine location of the port (200).

3. A system, in accordance with claim 1, wherein at least two unmanned tugboats (1) are detachably attached at the port side and at least two unmanned tugboats (1) are detachably attached to the starboard side of the towed vessel (100) in its operative mode.

4. A system, in accordance with claim 3, wherein the tugboats (1a, 1b, 1c, 1d) in its operative mode are delivered to the towed vessel (100) in column and connected to each other.

5. A system, in accordance with claim 1 wherein the plurality of radio navigation beacons (204) placed in specific locations of the port are interconnected with the radio navigation beacon (4) of each unnamed

tugboat and with the radio navigation beacon (104) of the towed vessel (100).

6. An unmanned tugboat (1) for use in towing system for vessels of claim 1, an unmanned tugboat (1) comprising: 5
 - at least one attachment member (6) provided in the unmanned tugboat (1) to be detachably attached to the hull (103) of the towed vessel (100); 10
 - power means and driving means (5) that provide autonomous movement of the unmanned tugboat (1);
 - remotely controlled navigation means configured to transmit and receive radio signal, such as a radio navigation beacon (4), 15

characterized in that the said attachment members (6) are arranged in both port and starboard side of the unmanned tugboat (1). 20
7. An unmanned tugboat, according to claim 6 wherein the attachment member (6) comprises a plurality of magnets. 25
8. An unmanned tugboat, according to claim 6 wherein the plurality of magnets are permanent magnets or electromagnets or combination thereof. 30
9. An unmanned tugboat, according to claim 6 wherein the attachment member (6) comprises a vacuum cup.
10. An unmanned tugboat, according to claim 6 wherein power means are containerized type batteries or other perspective power supply unit. 35
11. An unmanned tugboat, according to claim 6, wherein it comprises means for connecting one tugboat with the one immediate and/or previous. 40
12. An electronic navigation infrastructure for use in towing system for vessels of claim 1, wherein it comprises the radio navigation beacons (4, 104, 204) provided in the unmanned tugboat (1), in the towed vessel (100) and in the port (200) controlled by the control unit (201) in order to assist the unmanned tugboat (1) in its manoeuvres outside the port and inside the port (200), with and without the towed vessel (100) duly attached. 45 50
13. An electronic navigation infrastructure in accordance with claim 12 wherein it is operated by the mathematical model designed for processing the information of the variables like the position of the vessel and unmanned tugboats and other required information. 55

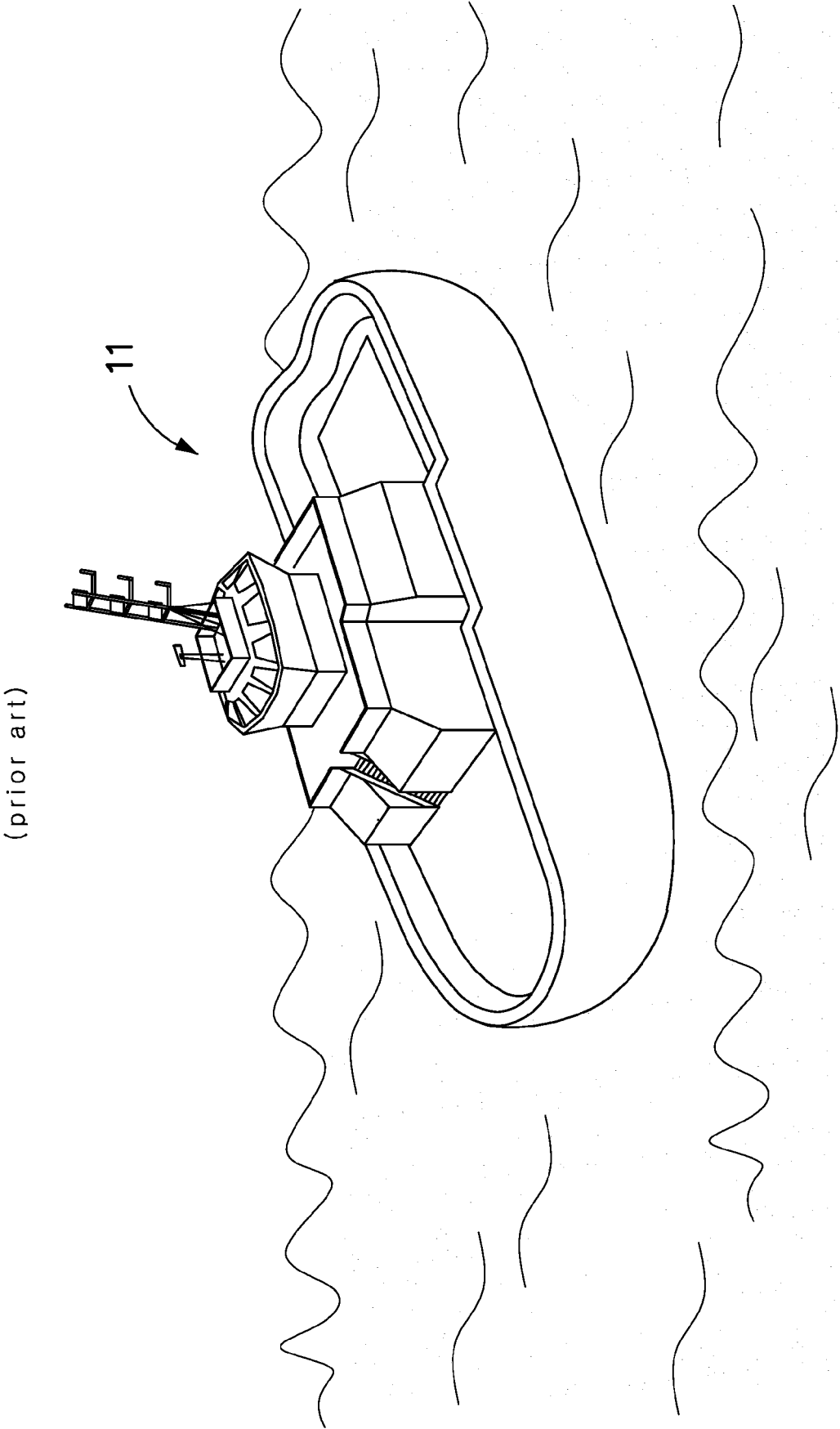


FIG. 1

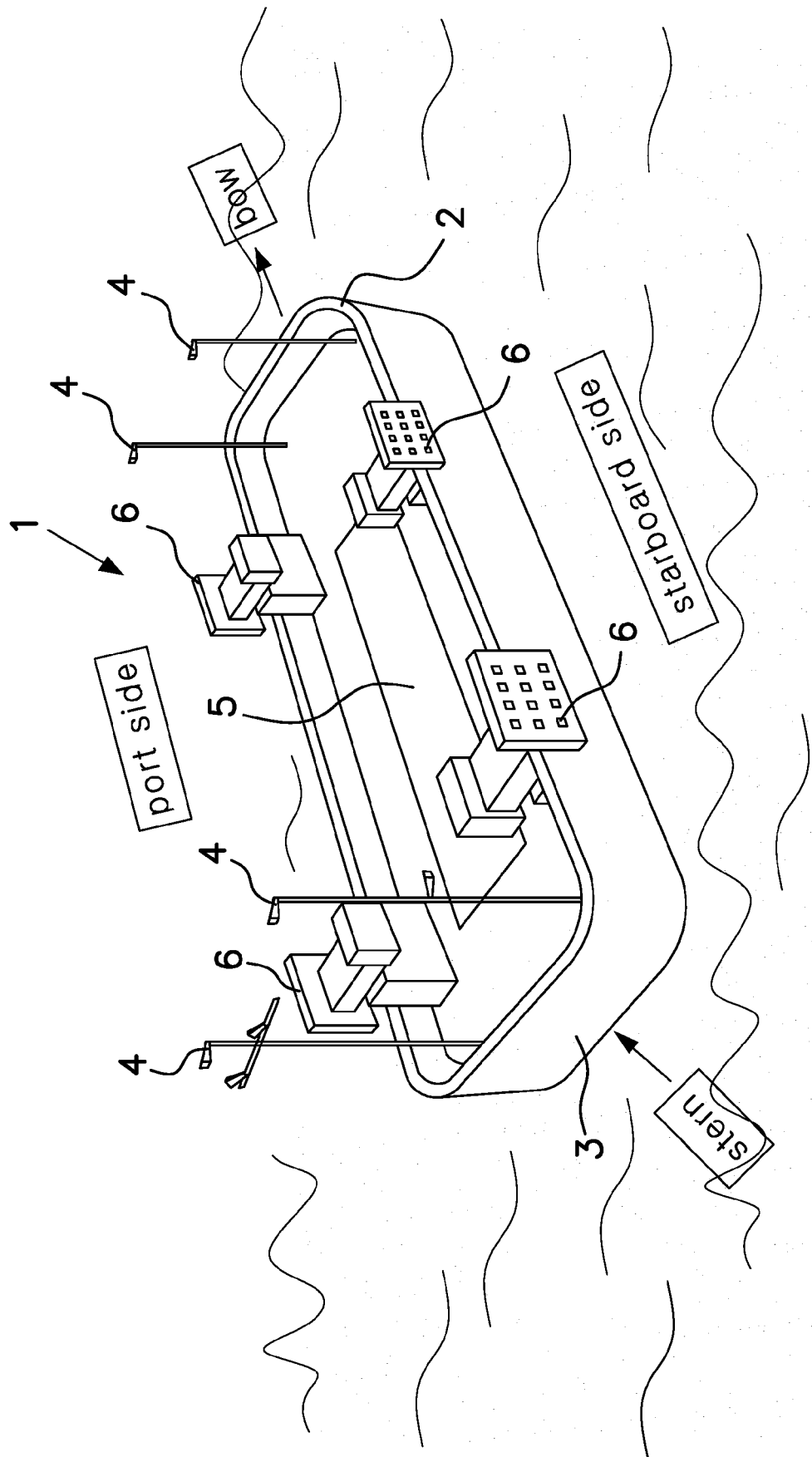


FIG. 2

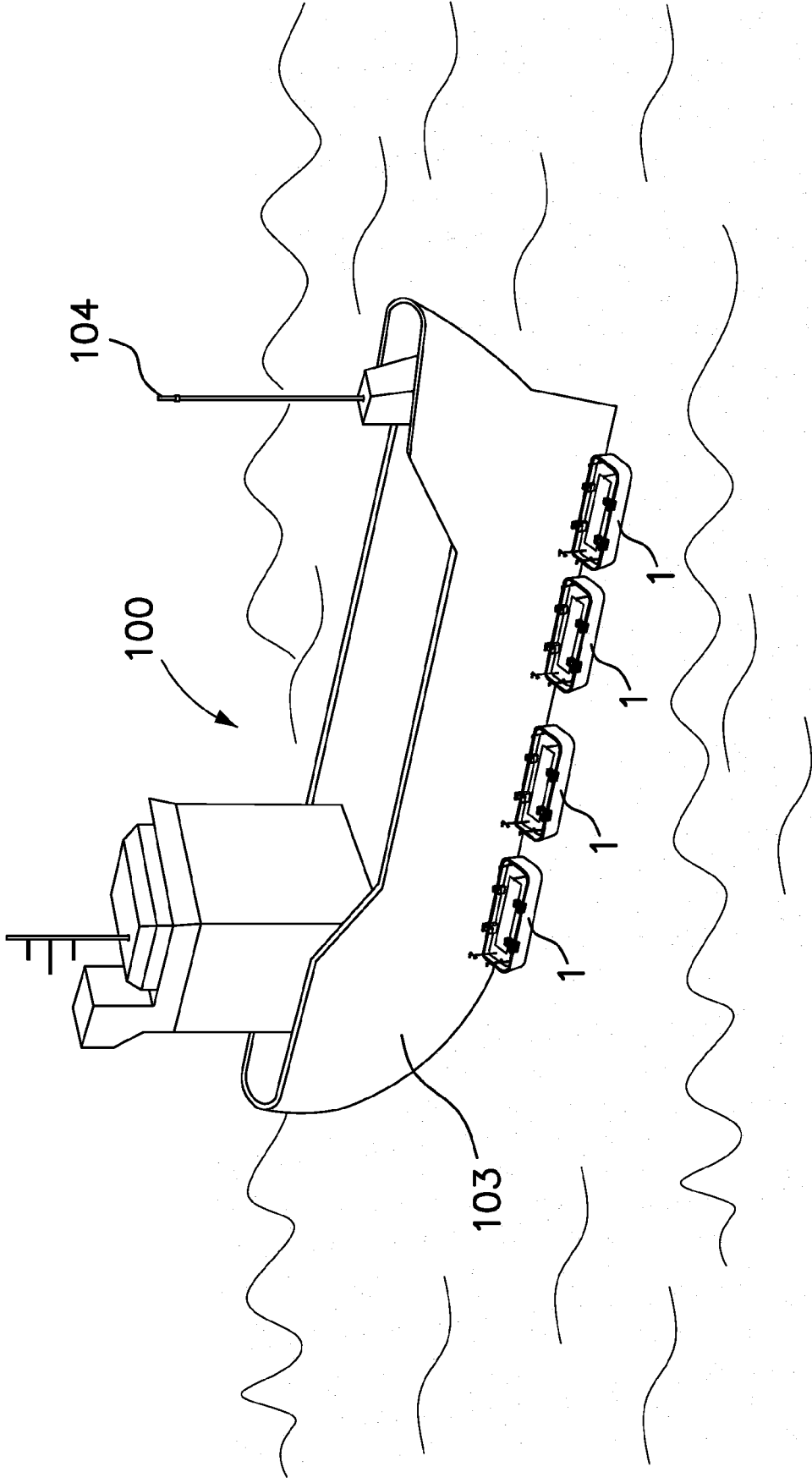


FIG. 3

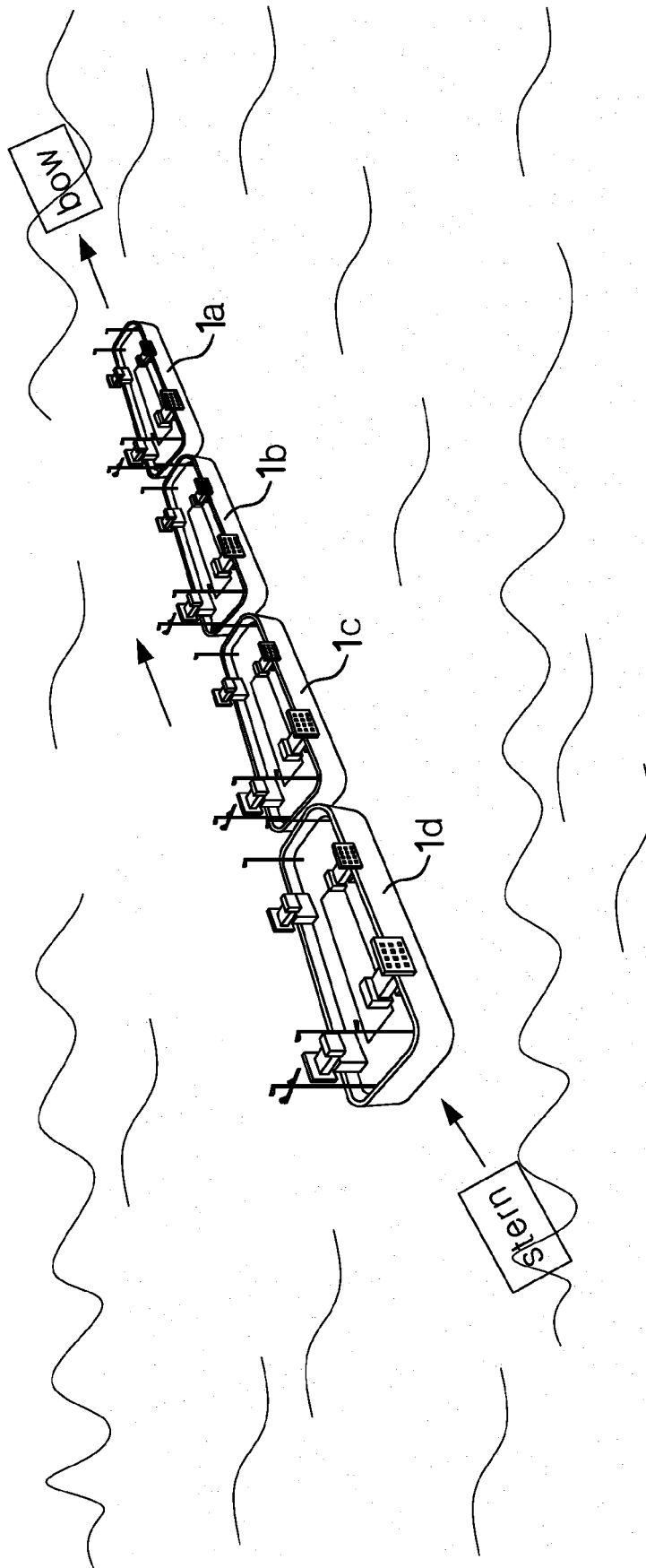


FIG. 4

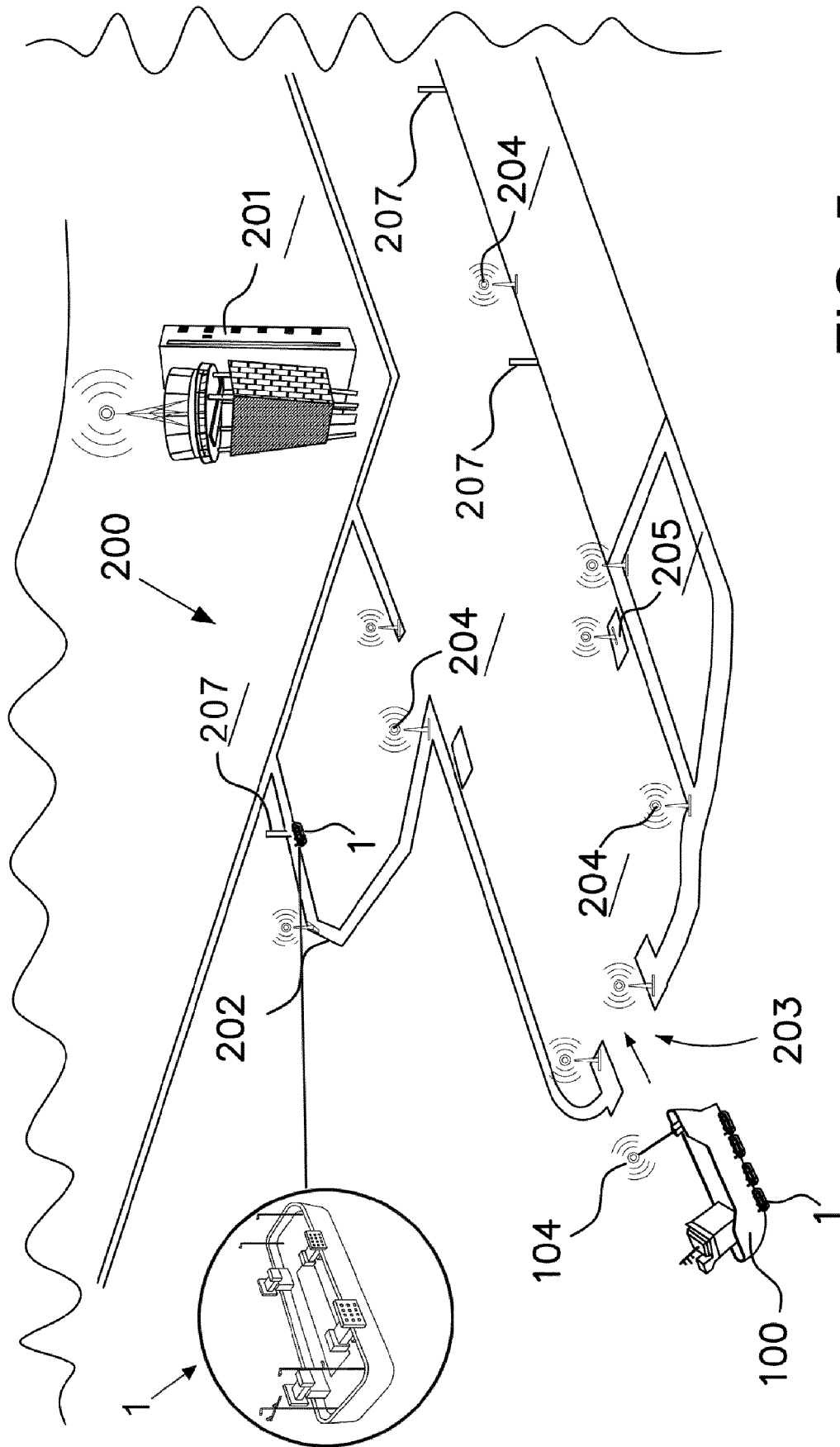


FIG. 5



EUROPEAN SEARCH REPORT

 Application Number
 EP 19 17 7595

5

10

15

20

25

30

35

40

45

50

55

1

EPO FORM 1503 03.92 (P04C01)

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	WO 2016/023080 A1 (FROZEN MOTION PTE LTD [SG]; GOSS TONY [AU]) 18 February 2016 (2016-02-18) * paragraphs [0151], [0154]; figures 1,2,5 *	1-13	INV. B63B35/66
A	US 6 354 235 B1 (DAVIES ROBERT C [US]) 12 March 2002 (2002-03-12) * abstract; figures 9-11 *	11	
A	US 2018/158340 A1 (DE MOURA DANIEL CARDOSO [PT]) 7 June 2018 (2018-06-07) * abstract; figure 7 * * paragraph [0166] *	1-13	
			TECHNICAL FIELDS SEARCHED (IPC)
			B63B G05D
The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
The Hague		28 November 2019	Balzer, Ralf
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			

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

EP 19 17 7595

5 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
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

28-11-2019

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2016023080 A1	18-02-2016	TW 201620785 A WO 2016023080 A1	16-06-2016 18-02-2016
US 6354235 B1	12-03-2002	CA 2357477 A1 US 6354235 B1	19-03-2003 12-03-2002
US 2018158340 A1	07-06-2018	NONE	

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- WO 2017167884 A [0003] [0007]
- KR 20160034642 [0004]
- KR 2018021917 W [0005]