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(71) Applicant: **Tietoset Oy**
00370 Helsinki (FI)

(72) Inventors:
- **Siiskonen, Antti**
  00370 Helsinki (FI)
- **Ekqvist, Jussi**
  00370 Helsinki (FI)

(74) Representative: **Papula Oy**
P.O. Box 981
00101 Helsinki (FI)

(54) **PIER MODULE AND METHOD OF ANCHORING A PIER MODULE**

(57) A pier module (1) for boat (19) mooring and/or storage, comprising a frame (2) and at least one ballast tank (3) attached to the frame (2). The pier module (1) comprises at least one anchor (21), the frame (2) includes an anchor space (22) for each anchor (21), and the anchor (21) is removably arranged in said anchor space (22).

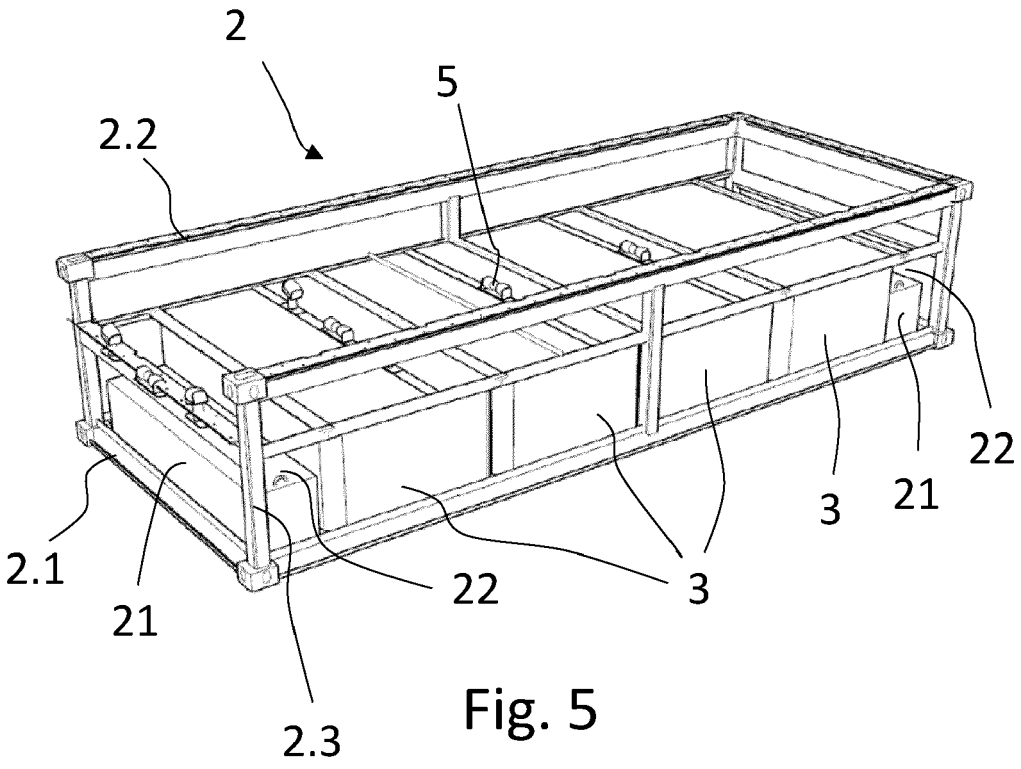

Fig. 5

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Description

FIELD OF THE INVENTION

[0001] The invention relates to a pier module according to the preamble of claim 1. The invention also relates to a method of anchoring a pier module.

BACKGROUND OF THE INVENTION

[0002] Boats are lifted from water and placed on a land area at the marina for winter storage. This requires a lot of valuable land area at the marina.

[0003] Conventional piers are typically assembled from large pier sections which require an installation barge and/or a floating lifting platform for moving the pier sections to desired locations. Therefore, it is difficult to assemble the pier and modify the pier configuration, for example the size of the pier and/or location of the pier sections. Further, the transportation of large pier sections to the marina area is difficult and costly.

[0004] Anchoring of the pier is also costly and time-consuming. Typically, about half of the installation costs of the pier are related to the anchoring.

[0005] The object of the present invention is to reduce the above-mentioned drawbacks.

SUMMARY

[0006] The object of the invention can be achieved by a pier module according to claim 1 and a method according to claim 12.

[0007] The pier module according to the invention comprises a frame and at least one ballast tank attached to the frame. The pier module further comprises at least one anchor and the frame includes an anchor space for each anchor, and anchor is removably arranged in said anchor space.

[0008] Significant benefits can be achieved by the means of the invention.

[0009] The anchor (s) of the pier module are arranged in the anchor space(s) within the frame of the pier module and held in the anchor space(s). Thus, the pier module with the integrated anchor(s) can be stored and transferred to the installation place of the pier module as a single unit. When the pier module has been moved to a desired anchoring location, the anchors are removed from the anchor spaces and lowered to the bottom of the waterway. Respectively, for moving the pier module from the anchoring location the anchor(s) are lifted from the bottom of the waterway into the anchor space(s) inside the frame. Thereafter, the pier module with the anchors can be moved as a single unit. This makes it easier and faster to transport and install the pier module.

[0010] Since the anchors are arranged in the anchor spaces of the pier module during the transport and installation of the module, it is not necessary to use separate anchors that must be installed with an installation barge or similar. This significantly reduces the transport and installation costs of the pier module and the pier.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] In the following the invention will be described in detail by means of examples with reference to the accompanying drawings, in which

Fig. 1 shows a pier module according to an embodiment of the invention,

Fig. 2 shows the pier module of fig. 1 having a free end in a lowered position,

Fig. 3 shows the pier module of fig. 1 and a boat lifted on the pier module,

Fig. 4 shows a pier module of fig. 1 provided with a roof.

Fig. 5 shows a frame of the pier module of fig. 1.

Fig. 6 shows a flow diagram of a control arrangement of the pier modules of fig. 1.

DETAILED DESCRIPTION

[0012] Figs. 1 to 6 show a floating pier module 1 according to an embodiment of the invention. The pier module 1 can be used as a mooring and/or a storage platform for boats 19. The pier module 1 comprises a frame 2 and at least one ballast volume, such as ballast tank 3, attached to the frame 2. Typically, the pier module 1 comprises three or more, for example 3 to 6 ballast tanks 3. In the embodiment shown in the drawings the pier module 1 comprises four ballast tanks 3. The ballast tanks 3 are arranged one after the other in a longitudinal direction of the frame 2 and/or the pier module 1. The ballast tanks 3 extend over the entire width of the frame 2. The ballast tanks 3 are placed inside the frame 2. The ballast tanks 3 can have a circular or rectangular cross-sectional shape.

[0013] The frame 2 comprises a lower frame part 2.1 and an upper frame part 2.2. The lower and upper frame parts are rectangular. The lower frame part 2.1 and the upper frame part 2.2 are arranged one on top of the other. The lower frame part 2.1 and the upper frame part 2.2 are arranged at a distance from each other in the vertical direction. The frame 2 further comprises connecting posts 2.3 that connect the lower frame part 2.1 and the upper frame part 2.2 to each other. The connecting posts 2.3 are vertical. The connecting posts 2.3 are located at least at the corners of the frame parts 2.1; 2.2. The ballast tanks 3 are located within the frame 2 between the frame parts 2.1, 2.2.

[0014] The length and the width of the frame 2 and/or pier module 1 are equal to or less than those of the 20

feet standard container (length 6.1 m, width 2.44 m) or 40 feet standard container (length 12.2 m, width 2.44 m). Thus, the frame 2/pier module 1 can be transported and/or stored as a container-type structure. Two or more frames 2/pier modules 1 can be placed on top of the other during the transport and storage to form a standard container-type structure. This enables efficient and cost-effective transportation of the pier modules 1.

[0015] End ballast tanks 3 nearest to the ends of the pier module 1 adjust the tilt angle of the pier module 1, i.e. the tilt angle with respect to water surface. Middle ballast tank(s) 3 in the middle, i.e. between the end ballast tanks 3, adjust the buoyancy of the pier module 1. The ballast tanks 3 may be internally divided into sections to increase their stability. The ballast tanks 3 can be fluidly disconnected from each other so that liquid cannot flow therebetween.

[0016] The pier module 1 comprises a deck 4 located above the ballast tanks 3. The deck 4 is attached to the frame 2. The deck 4 is provided with keel rollers 5 for supporting a hull of the boat 19 as the boat 19 is on the deck 4 and/or when the boat 19 is lifted and pulled onto pier module 1 and lowered from the pier module 1 into the water.

[0017] In the embodiment shown in the drawings the deck 4 comprises a lower deck 4.1 and an upper deck 4.2. The lower deck 4.1 is located above the ballast tanks 3 and the upper deck 4.2 at a distance from the lower deck 4.1 in the vertical direction. The pier module 1 comprises a storage space located between the lower deck 4.1 and the upper deck 4.2. The upper deck 4.2 is hingedly attached to the frame 2. Thus, the upper deck 4.2 can be turned to an upright position in which it provides shelter for the boat 19 placed on the pier module 1. The lower deck 4.1 is provided with the keel rollers 5.

[0018] The pier module 1 is also provided with a winch 6 for pulling/lifting the boat 19 onto the pier module 1, i.e. onto the deck 4. The winch 6 is installed at a dry end of the pier module 1. The dry end of the pier module 1 is the end that is intended to be connected to another pier part, e.g. to another pier module or to a fixed pier structure. The dry end of the pier module 1 is pivotally connected to said pier part. The opposite end of the pier module 1 is the free end. The boat 19 is lifted onto the pier module 1 from the free end.

[0019] The pier module 1 comprises side plates/skirts 7 covering the sides of the pier module 1. The pier module 1 may further comprise end plates covering the ends of the pier module 1. The side plates 7 and/or end plates are fastened to the frame 2.

[0020] The pier module 1 can further comprise a roof 8 placed above the deck 4. The roof 8 is mounted on posts attached to the corners of the pier module 1. The roof 8 protects the boat 19 stored on the deck 4 and acts as a sun and rain cover. The top surface of the roof 8 is covered by solar panels. The pier module 1 may further comprise a ladder mounted on the frame 2 and/or other accessories.

[0021] The pier module 1 comprises at least one, typically two or four anchors 21 for anchoring the pier module 1 to a bottom of a waterway. The anchor 21 is fastened to the frame 2 by means of chains. During the transport and installation of the pier module 1, the anchor 21 is placed inside the frame 2 and detachably attached to the frame 2. The anchor 21 has a shape of a prism, typically a rectangular prism, or a cylinder. The anchor 21 is made of reinforced concrete or steel. The length of the anchor 21 is at most equal to the width of the frame 2. The length of the anchor 21 is at least 80 cm. The height of the anchor 21 is at most equal to the height of the frame 2. Thus, the anchor 21 can be entirely fitted into the space between the lower frame part 2.1 and the upper frame part 2.2.

[0022] The frame 2 comprises an anchor space 22 for receiving and storing the anchor 21. The frame 2 comprises an anchor space 22 for each anchor 21. The anchor space 22 is located inside the frame 2, typically between the frame end and the end ballast tank 3 nearest to said frame end and/or between successive ballast tanks 3. Typically, the pier module 1 comprises two or four anchors 21 and two or four anchor spaces 22. The anchor spaces 22 are located at both ends of the frame 2. The ballast tank(s) 3 are located between the anchor spaces 22. The anchor spaces 22 are located between the lower frame part 2.1 and the upper frame part 2.2. The anchor space(s) 22 extends over the entire width of the frame 2.

[0023] In case the pier module 1 comprises two anchors 21, a single anchor space 22 is located at both ends of the frame 2. In case of four anchors 21, two anchor spaces 22 can be located at the free end and two at the dry end of the frame 2 such that the anchor spaces 22 at the frame end are disposed one after the other in the width direction of the frame 2. This enables spreading the anchors 21 beyond the perimeter of the pier module 1 during anchoring, thus enabling a shallower anchor chain angle and higher resistance to changes in water level, wind, waves, and other forces affecting the pier module 1.

[0024] The anchor(s) 21 are removably arranged and/or removably arrangeable in the anchor space(s) 22. The pier module 1 comprises transport support(s) by which the anchor(s) 21 is/are supported and held in the anchor space(s) 22 during the transport and installation of the pier module 1. The transport support can comprise a bar that extends over the opening of anchor space 22.

[0025] As shown in fig. 6, the pier module 1 comprises a control arrangement 9 configured to adjust amount of liquid, typically water, in the ballast tanks 3, typically in at least in the end ballast tanks 3, for varying buoyancy of the pier module 1 and/or tilt angle of the pier module 1 with respect to water surface. The amount of liquid in each ballast tank 3, typically in each end ballast tank 3, is independently adjustable. Typically, the control arrangement 9 is also configured to adjust amount of liquid in the middle ballast tank(s) 3 for varying buoyancy and/or

tilt angle of the pier module 1.

[0026] The control arrangement 9 comprises a main pipe 10 and a pump unit 11 connected to the main pipe 10 for pumping liquid into and/or out of the selected ballast tanks 3. The control arrangement 9 comprises branch pipes 12 connected to the ballast tanks 3. The control arrangement 9 comprises a separate branch pipe 12 for each end ballast tank 3 and/or for each middle ballast tank 3. The branch pipes 12 branch from the main pipe 10. Each branch pipe 12 comprises a control valve 13, 16 for controlling, i.e. allowing and preventing, a flow of water through said branch pipe 12.

[0027] The pump unit 11 is configured to pump liquid into and/or out of the ballast tanks 3 through the branch pipes 12. The pump unit 11 comprises a two-way pump capable of pumping liquid in opposite directions or two one-way pumps arranged to pump liquid in opposite directions.

[0028] One end 20 of the main pipe 10 is arranged or can be arranged in flow communication with a liquid source 14. Liquid is pumped from the liquid source 14 into the ballast tanks 3 and from ballast tanks 3 to the liquid source 14. The liquid source 14 can be a waterway surrounding the pier module 1 or a separate liquid tank. The pump unit 11 is connected to the main pipe 10 between the main pipe end 20 and branch points 15 of the branch pipes 12. All the branch points 15 are located between the pump unit 11 and the ballast tanks 3. Thus, liquid can be pumped by the pump unit 11 into and/or out of each ballast tank 3.

[0029] The control arrangement 9 can comprise a shut-off valve (not shown) for opening and closing flow communication between the main pipe end 20 and the branch points 15. The shut-off valve is installed in the main pipe 10 between main pipe end 20 and the branch points 15. The pump unit 11 is connected to the main pipe 10 between the main pipe end 20 and the shut-off valve. Alternatively, as shown in fig. 6, instead of the shut-off valve the control arrangement 9 can be provided with a three-way control valve 16 that is installed in the branch point 15 that is nearest to the main pipe end 20. The pump unit 11 is connected to the main pipe 10 between the three-way control valve 16 and the main pipe end 20. The three-way control valve 16 acts as a control valve 13 of the branch pipe 12 nearest to the pump unit 11.

[0030] The control arrangement 9 comprises a further pump unit 17 connected to the main pipe 10 between branch points 15 of two branch pipes 12 or to the branch pipe 12 of the end ballast tank 3. The further pump unit 17 comprises a two-way pump capable of pumping liquid in opposite directions or two one-way pumps arranged to pump liquid in opposite directions. The further pump unit 17 is configured to pump liquid from the end ballast tank 3 located at the free end of the pier module 1 into the end ballast tank 3 at the dry end of pier module 1 and vice versa. The further pump unit 17 is also capable of pumping liquid into and out of the middle ballast tanks 3.

[0031] The pump unit 11 and/or the further pump unit 17 is/are located at the dry end of the pier module 1.

[0032] The control valves 13,16 of the branch pipes 12 can comprise manual and/or power actuator, such as an electric actuator, connected/connectable to a power supply. The control arrangement 9 comprises a control unit 18 configured to control the control valves 13, 16, typically the control valves having power actuators. The control valves 13 of branch pipes 12 of the middle ballast tanks 3 can be manually operated valves. The control valves 13, 16 of the branch pipes 12 of the end ballast tanks 3 nearest to the ends of the pier module 1 can be operated by power actuator.

[0033] The control unit 18 is also configured to control the pump unit 11 and/or the further pump unit 17.

[0034] The control arrangement 9 may further comprise safety devices that prevent overfilling of the ballast tanks 3 and/or excessive kneeling/tilting of the pier module 1.

[0035] The control arrangement 9 comprises a balance sensor for measuring the kneeling/tilting angle of the pier module 1. The measurement data of the balance sensor is transmitted to the control unit 18, and the control unit 18 controls the pump units 11, 17 and the control valves 13, 16 to adjust the kneeling/tilting angle of the pier module 1. The control unit 18 may comprise pre-set ballast/buoyancy scenarios based on weight of the boat 19, centre of gravity and/or kneeling/hoisting depth of the pier module 1.

[0036] The control arrangement 9 is operated as follows. The buoyancy of the pier module 1 is adjusted by filling and/or emptying selected ballast tanks 3, typically the middle ballast tank(s) 3 between the end ballast tanks 3 at the ends/nearest to the ends of the pier module 1. This is done by opening the control valve 13 of the branch pipe 12 of the selected ballast tank 3 and the shut-off valve in the water pipe 10 or the three-way control valve 16 to enable flow communication between the pump unit 11 and the selected ballast tank 3. Thereafter, liquid, such as water, is pumped into or out of the selected ballast tank 3 to adjust the buoyancy of the pier module 1. When the ballast tank 3 includes a desired amount of liquid, the control valve 13 of the branch pipe 12 is closed. The amount of liquid in the other ballast tanks 3 can be adjusted in a similar manner. The liquid is pumped into and/or out of the selected ballast tank(s) 3 by the pump unit 11.

[0037] The buoyancy of the pier module 1 is highest as the ballast tanks 3 are empty. High buoyancy can be utilized in icy conditions and/or during storage of the boat 19 on the pier module 1, for example. Normal buoyancy of the pier module 1 is achieved with partially filled ballast tanks 3.

[0038] The pier module 1 is tilted around a horizontal transverse axis 23 of the pier module 1, i.e. the free end of the pier module 1 is lifted or lowered, by adjusting the amount of the liquid, such as water, in the selected ballast tank(s) 3, typically in the free end ballast tank 3 and/or the dry end ballast tank 3. The free end is lifted by pump-

ing liquid from the free end ballast tank 3 into the dry end ballast tank 3. The free end is lowered by pumping liquid from the dry end ballast tank 3 into the free end ballast tank 3. Liquid is pumped by the further pump unit 17. The control valves 13, 16 of the branch pipes 12 of the ballast tanks 3 at the free and the dry ends are open to allow flow of liquid through said branch pipes 12. The liquid flow to the pump unit 11 is prevented by the shut-off valve or the three-way control valve 16.

[0039] Alternatively, the free end of the pier module 1 is lifted and lowered by pumping liquid out of and into the free end ballast tank 3 by the pump unit 11 and/or the further pump unit 17. In this case, the control valve 13, 16 of the branch pipe 12 of the free end ballast tank 3 is opened. Further, the shut-off valve or the three-way control valve 16 is opened to allow flow of liquid between the main pipe end 20 and the free end ballast tank 3. Liquid can also be pumped into and out of the dry end ballast tank 3 by means of the pump unit 11 for lifting and lowering the free end of the pier module 1. The amount of liquid in each ballast tank 3 is independently adjusted.

[0040] In both above described embodiments, the free end of pier module 1 is lowered to a desired level or height, for example to the level of water surface or below it. When the free end of pier module 1 is in a lowered position, as shown in fig.2, the boat 19 is lifted and/or pulled from the water onto the pier module 1 or lowered from the pier module 1 into the water. Thereafter, the free end of the pier module 1 is lifted back to its normal or original position by pumping liquid out of the free end ballast tank 3.

[0041] The buoyancy of the pier module 1 is adjusted by adjusting the amount of liquid in the selected ballast tanks 3, typically in the middle ballast tank(s) 3. This is done by pumping liquid into and/or out of the selected ballast tank(s) 3 by means of the pump unit 11 and/or the further pump unit 17.

[0042] The operation of the pump units 11, 17 and the control valves 13 and/or the three-way control valve 16 is controlled by the control unit 18.

[0043] If the pier comprises two or more above described pier modules 1, the control arrangements 9 of all pier modules 1 can be operated by a single control unit 18.

[0044] When the pier module 1 is anchored, the transport support of the anchor 21 is removed and the anchor 21 is lowered from the anchor space 22 onto a waterway bottom. Thereafter, the anchor chains are adjusted and locked in place inside protective tubes that are attached, e.g. welded or bolted, to the frame 2. The protective tubes separate the chains from the frame 2 and enable chain locking above the pier module's 1 water line. The other anchors 21 of the pier module 1 are lowered in a similar manner. The pier module 1 is released by lifting the anchor 21 from the waterway bottom into the anchor space 22. Thereafter, the anchor 21 is held in the anchor space 22 by the transport support. The other anchors 21 of the pier module 1 are lifted in a similar manner.

[0045] The anchor 21 is lowered and/or lifted by means of the winch 6 of the pier module 1 or a separate portable winch. In the latter case, the anchor handling can be done with the help of a A-boom or similar where hoisting points can be selected for different anchor configurations. A chain pulley or similar is used for lowering and lifting the anchors 21 with a separate hoisting chain, cable, or rope. If the boat hoisting winch 8 is used, a suitable block can be connected to the A-boom or the frame 2 to achieve correct hoisting angle.

[0046] It is obvious to a person skilled in the art that with the advancement of technology, the basic idea of the invention may be implemented in various ways. The invention and its embodiments are thus not limited to the examples described above, instead they may vary within the scope of the claims.

[0047] Instead of or in addition to liquid/water, the middle ballast tank(s) 3 can be filled with non-liquid material, such as sand and/or gravel, for adjusting the buoyancy of the pier module 1. In this case, the control arrangement 9 can be provided without branch pipes 12 branching from the main pipe 10 to the middle ballast tanks 3.

[0048] The control arrangement 9 can comprise a compressed air system, by which liquid is removed from the ballast tanks 3. In this case, liquid is added into the ballast tanks 3 by a pump or the ballast tanks 3 are provided with bottom valves through which water is gravitationally added into the ballast tanks 3.

Claims

1. A pier module (1) for boat (19) mooring and/or storage, comprising a frame (2) and at least one ballast tank (3) attached to the frame (2), **characterized in that** the pier module (1) comprises at least one anchor (21), the frame (2) includes an anchor space (22) for each anchor (21), and the anchor (21) is removably arranged in said anchor space (22).

2. The pier module (1) according to claim 1, **characterized in that** the anchor space (22) is located within the frame (2).

3. The pier module (1) according to claim 1 or 2, **characterized in that** the pier module (1) comprises two anchors (21) and two anchor spaces (22).

4. The pier module (1) according to any of the preceding claims, **characterized in that** the frame (2) comprises a lower frame part (2.1) and an upper frame part (2.2) between which the ballast tank(s) (3) and the anchor space(s) (22) are located.

5. The pier module (1) according to claim 4, **characterized in that** the lower frame part (2.1) and the upper frame part (2.2) are rectangular and connected to each other by vertical posts (2.3).

6. The pier module (1) according to any of claims 3 to 5, **characterized in that** the anchor spaces (22) are located at both ends of the frame (2), and the ballast tank(s) (3) is/are located between the anchor spaces (22).

7. The pier module (1) according to any of the preceding claims, **characterized in that** the pier module (1) comprises three or more ballast tanks (3) arranged one after the other in a longitudinal direction of the pier module (1).

8. The pier module (1) according to any of the preceding claims, **characterized in that** the anchor(s) (21) have a shape of a rectangular prism.

9. The pier module (1) according to any of the preceding claims, **characterized in that** the length of the frame (2) is at most 20 feet (6.1 m) and the width of the frame (2) is at most 8 feet (2.44 m).

10. The pier module (1) according to any of the preceding claims, **characterized in that** anchor (21) is made of reinforced concrete or steel.

11. The pier module (1) according to any of the preceding claims, **characterized in that** the pier module (1) comprises a transport support(s) configured to support and/or hold the anchor(s) (21) in the anchor space(s) (22) during the transport and installation of the pier module (1).

12. Method of anchoring a pier module (1) according to any of the preceding claims, **characterized in that** the anchor(s) (21) is/are removed from the anchor space(s) (22) and lowered onto a waterway bottom.

13. The method according to claim 12, **characterized in that** the anchor(s) (21) is/are lifted from the waterway bottom into the anchor space(s) (22).

14. The method according to claim 12 or 13, **characterized in that** the anchor (s) 21 is/are held in the anchor space(s) (22) by transport support(s).

15. The method according to any of claims 12 to 14, **characterized in that** the anchor(s) (21) are lowered and/or lifted by means of a winch (8).

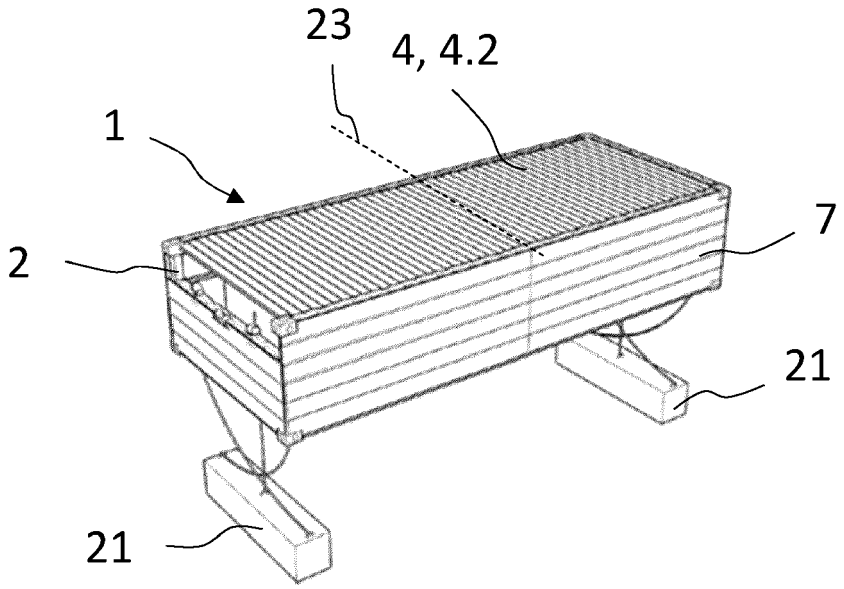

Fig. 1

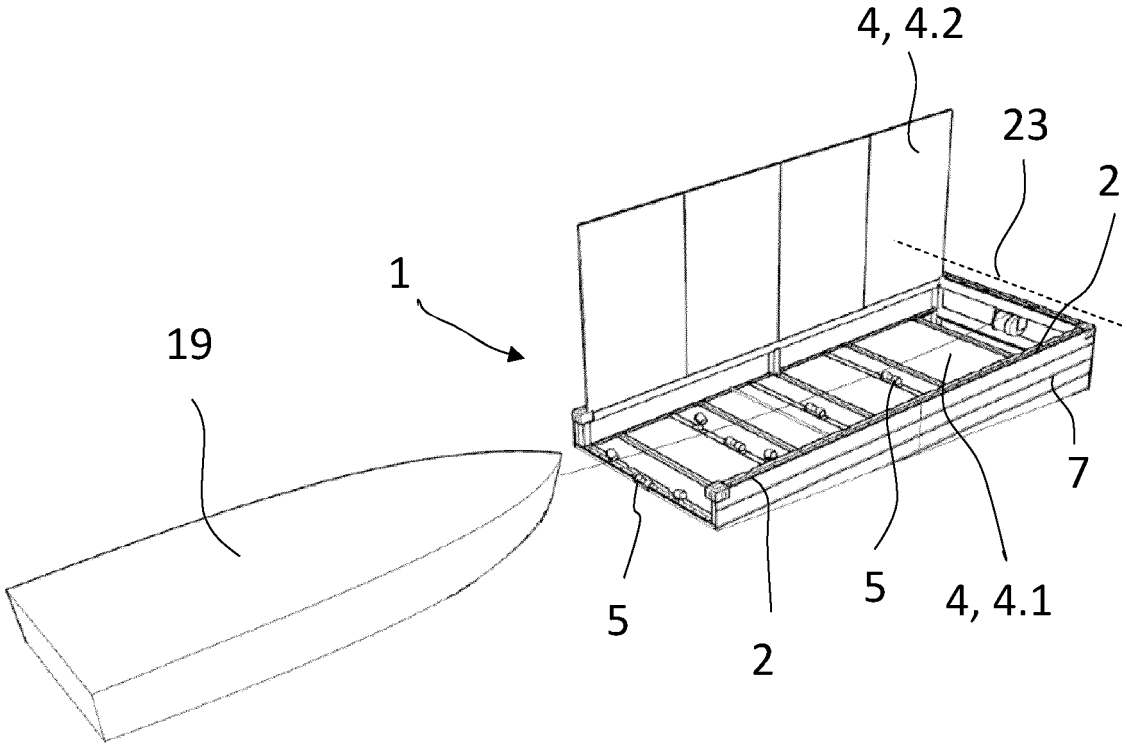

Fig. 2

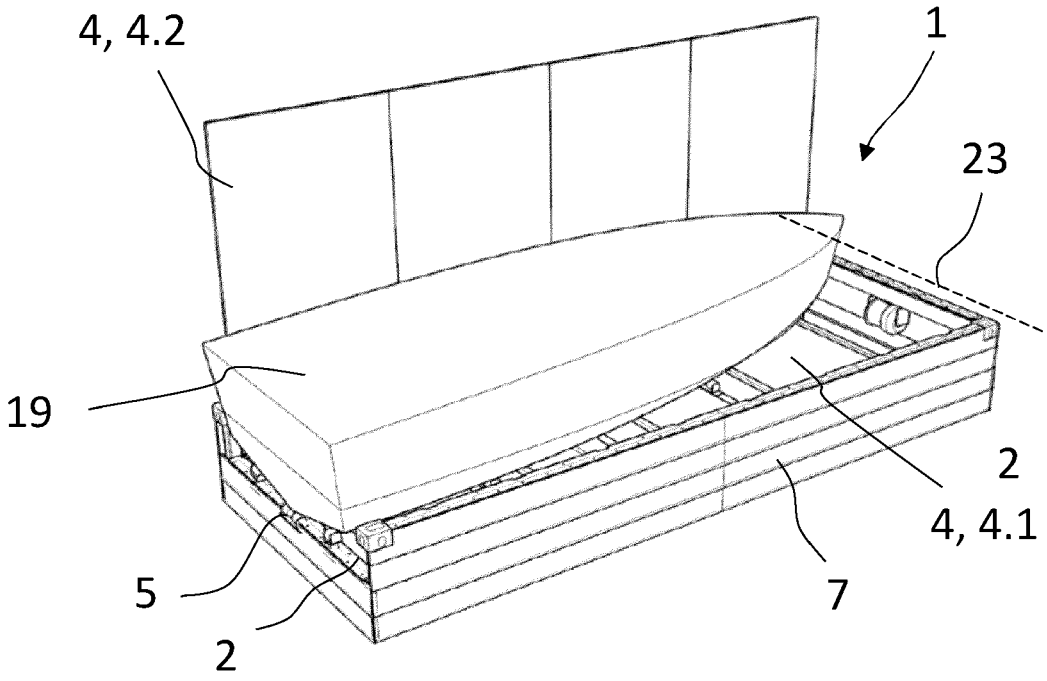

Fig. 3

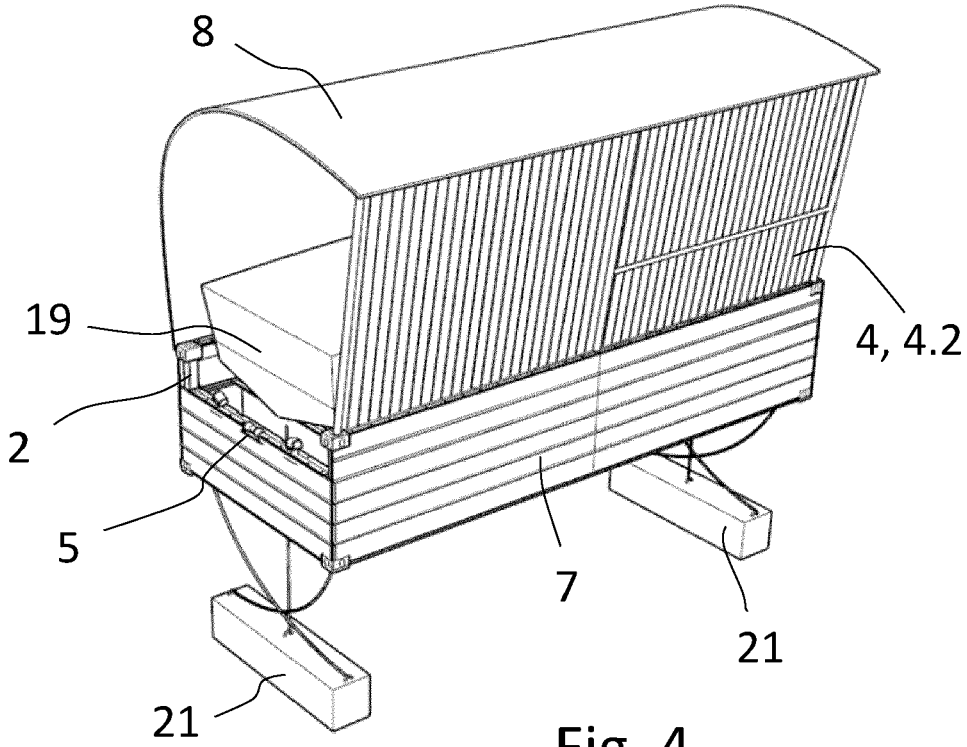

Fig. 4

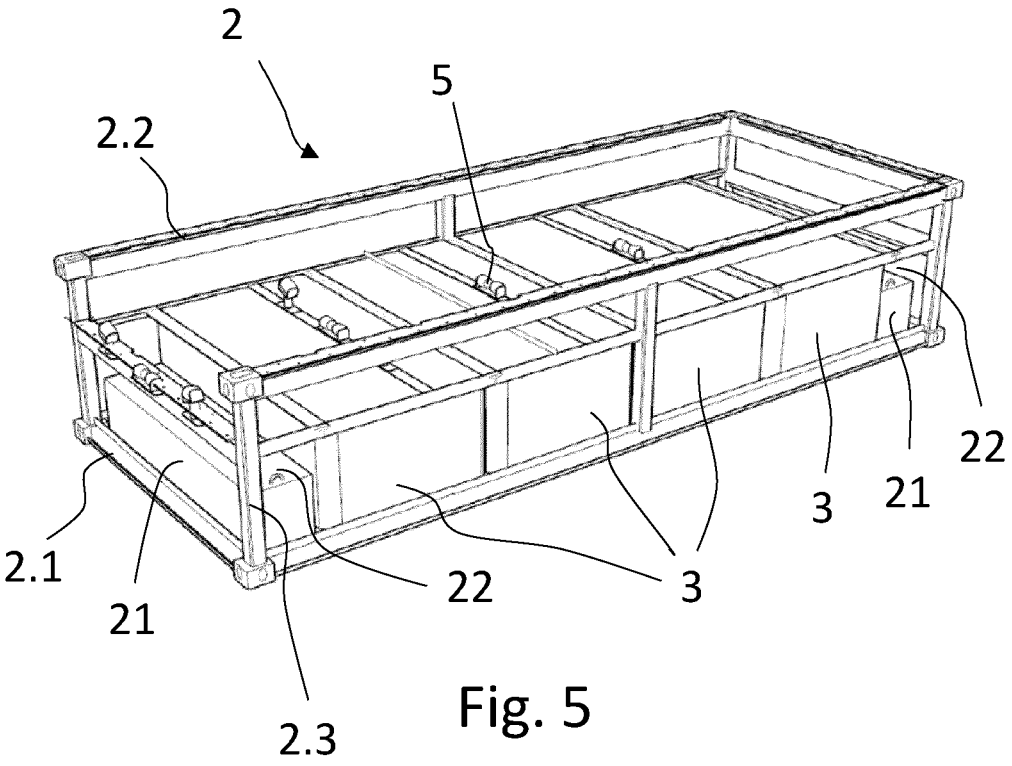
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Fig. 5

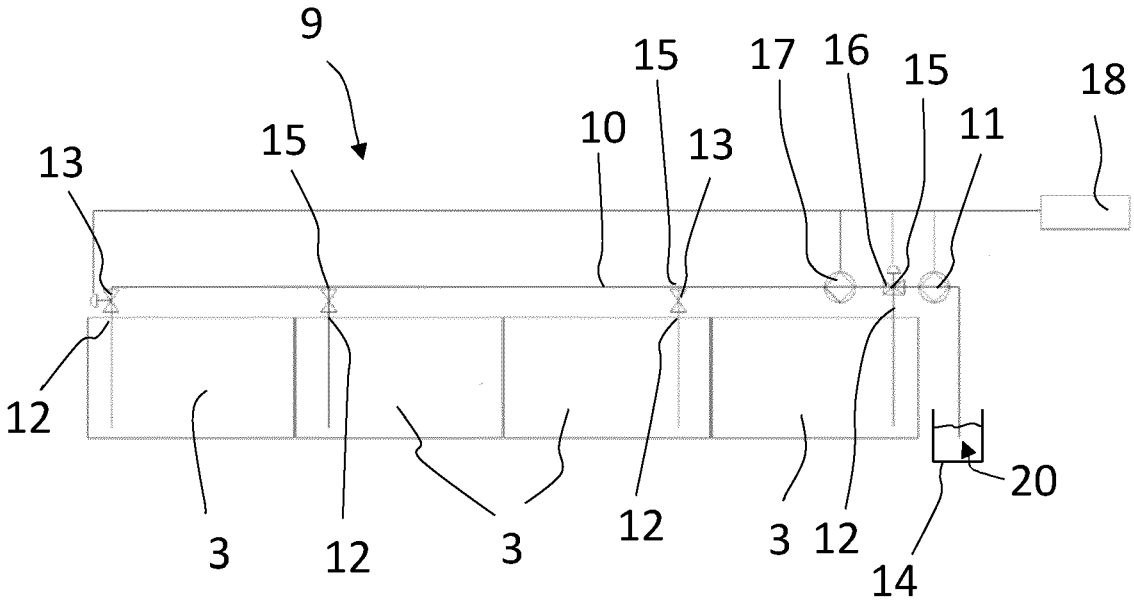
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Fig. 6

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EUROPEAN SEARCH REPORT

Application Number
EP 20 20 8846

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	JP H05 193555 A (MODETSUKU KK; TORIO MARINE TEC KK; MORINAGA GUMI KK) 3 August 1993 (1993-08-03) * See paragraphs [0001], [0008]-[0010] of the enclosed machine translation * * figures *	1-15	INV. B63C1/06 B63B35/42
X	US 2014/133910 A1 (BARNES SEAN A [US] ET AL) 15 May 2014 (2014-05-15) * abstract * * figures *	1-15	
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TECHNICAL FIELDS SEARCHED (IPC)

B63C
B63B
E02B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	10 May 2021	Gardel, Antony

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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EPO FORM 1503 03.82 (P04C01)

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10-05-2021

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