(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 4 501 772 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
05.02.2025 Bulletin 2025/06

(21) Application number: **23390001.8**

(22) Date of filing: **04.08.2023**

(51) International Patent Classification (IPC):
B63B 19/18 *(2006.01)* ***B63B 19/26*** *(2006.01)*

(52) Cooperative Patent Classification (CPC):
B63B 19/18; B63B 19/26

(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 ME MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA
Designated Validation States:
KH MA MD TN

(71) Applicant: **Lemissoler Corporate Management Ltd.**
3027 Limassol (CY)

(72) Inventors:
- **Philis, Philippos**
  3027 Limassol (CY)
- **Solomonides, Dimitris**
  3027 Limassol (CY)

(74) Representative: **Mewburn Ellis LLP**
Aurora Building
Counterslip
Bristol BS1 6BX (GB)

Remarks:
Amended claims in accordance with Rule 137(2) EPC.

(54) CARGO HATCH

(57) The present disclosure relates to a cargo hatch for use on a bulk carrier or other ship to allow access to the cargo hold. Cargo hatches comprise one or more hatch covers resting on hatch coaming which surrounds a hatch opening through which the cargo hold is accessible. A seal is often provided between the hatch cover and the hatch coaming in order to prevent water ingress into the cargo hold from the outside environment. The seal may be prone to deterioration. The present disclosure proposes a cargo hatch for a bulk carrier comprising a hatch coaming surrounding a hatch opening and a hatch cover configured to be removably located on the hatch coaming such that the hatch cover reversibly closes the hatch opening, wherein the cargo hatch comprises two sealing systems configured to provide respective and separate seals between the hatch coaming and the hatch cover in use.

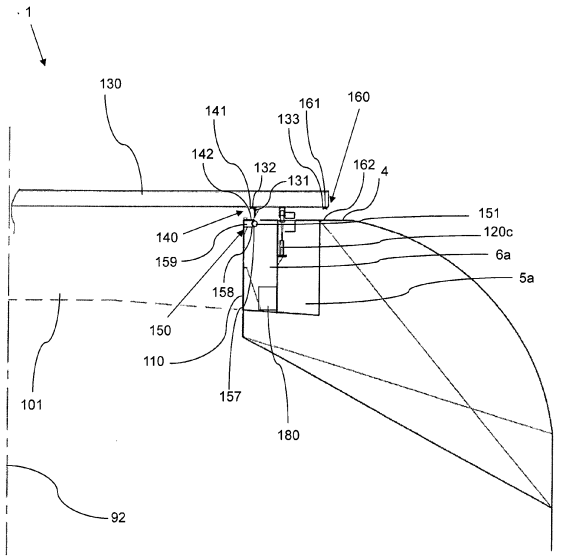

Fig. 6

EP 4 501 772 A1

Description

Field of the Invention

[0001] The present invention relates to a cargo hatch and particularly, although not exclusively, to a cargo hatch for a bulk carrier.

Background

[0002] A bulk carrier is a merchant ship which transports cargo known as bulk cargo such as coal, cement, ores and grains. Generally, the bulk cargo is deposited directly into the hold(s) of bulk carriers without packaging or any additional container, although bulk carriers can be used to transport other cargoes (e.g. packaged cargoes) as well. On bulk carriers, cargo holds are accessed via hatch openings on the deck of the ship, which are covered by one or more hatch covers. The hatch covers rest on hatch coaming (vertically extending flat surfaces/-plates) entirely surrounding the hatch opening and a seal is provided to protect the cargo hold from weather and seawater.

[0003] Traditionally, the seal is achieved with a compression bar fitted to the top of the hatch coaming and a cooperating gasket (e.g. a rubber gasket) fitted inside a channel (e.g. a steel channel) on the bottom of the hatch cover. When the hatch cover is in its closed position, the gasket sits on the compression bar such that the gasket conforms to the shape of the compression bar under the weight of the hatch cover, thereby creating a seal. This type of prior art arrangement is known to provide protection against rainwater, but may provide limited protection against seawater ingress into the cargo hold, for example during rough weather at sea.

[0004] Further, over the lifetime of a bulk carrier, the effectiveness of this traditional type of seal may deteriorate due to damage to components of the cargo hatch (e.g. the hatch coaming, hatch cover, gasket or compression bar). Such damage may be caused by weathering or corrosion over time, or may even be caused by accidents during loading or unloading of the ship. As a result, one of the most frequent problems with the transportation of bulk and other cargoes in bulk carriers is contamination by ingress of seawater or rainwater into the cargo hold(s). This leads to damage of cargoes (in particular because cargoes are often unpackaged) and subsequent insurance claims.

[0005] The present invention has been devised in light of the above considerations.

Summary of the Invention

[0006] At its most general the present disclosure relates to a cargo hatch for a bulk carrier comprising a hatch coaming surrounding a hatch opening and a hatch cover configured to be removably located on the hatch coaming such that the hatch cover reversibly closes at least a part of the hatch opening, wherein the cargo hatch comprises two sealing systems (e.g. a double sealing arrangement), configured to provide respective and separate seals between the hatch coaming and the hatch cover in use.

[0007] In a first aspect, there is provided a cargo hatch for a bulk carrier comprising: a hatch coaming surrounding a hatch opening; a hatch cover configured to be removably located on the hatch coaming such that the hatch cover reversibly closes at least a part of the hatch opening; a first sealing system comprising a gasket and a compression bar, and configured to provide a seal between the hatch coaming and the hatch cover in use; and a second sealing system comprising an expandable seal and configured to provide a seal between the hatch coaming and the hatch cover in use.

[0008] As used herein, "in use" means when the hatch cover is located on the hatch coaming such that the hatch opening is closed by the hatch cover. In this situation, the cargo hatch may be referred to as being in a closed state.

[0009] By providing a cargo hatch according to the first aspect, improved sealing between the hatch cover and the hatch opening (e.g. as defined by the hatch coaming) may be achieved. In particular, ingress of water into the hold and contamination of cargoes in the hold may be reduced or eliminated. In particular, the second sealing system comprising an expandable seal may contribute to increased waterproofing of the cargo hatch and hold. Further, by providing a second sealing system comprising an expandable seal, the cargo hatch may maintain a watertight seal over repeated use despite physical changes to (e.g. the dimensions of) the hatch cover and/or hatch coaming over time e.g. due to weathering and/or corrosion.

[0010] The hatch cover may be configured to be removably located on the hatch coaming such that the hatch cover reversibly closes the hatch opening (e.g. the entire hatch opening). In other words, a single unitary hatch cover may be used to close the hatch opening.

[0011] By providing a hatch cover which reversibly closes the entire hatch opening, fewer paths may be provided for potential water ingress into the hold compared to traditional side-rolling hatch covers which typically comprise two cooperating hatch covers which each cover a respective half of the hatch opening and meet at a middle seam when closed. In this traditional type of side-rolling hatch cover design, the middle seam provides an additional path for water ingress into the hold, in addition to the regions around the edge of the hatch opening where the hatch cover(s) abut the hatch coaming. In other words, in embodiments where the hatch cover reversibly closes the entire hatch opening, the length of sealing system(s) required by the cargo hatch is reduced.

[0012] The operation of the cargo hatch according to the first aspect is as follows. After cargo is loaded into the hold via the hatch opening, the hatch cover is moved into place such that it is located on the hatch coaming. As a result, the hatch opening is closed by the hatch cover.

This process may be referred to as closing the hatch cover. The gasket and the compression bar may be positioned on opposing surfaces of the hatch cover and the hatch coaming. For example, the compression bar may be located on the hatch coaming and the gasket may be positioned on the hatch cover. When the hatch cover is located on the hatch coaming, the gasket abuts (e.g. sits on) the compression bar and the gasket conforms to the shape of the-compression bar (e.g. under the weight of the hatch cover) such that a seal is provided between the hatch coaming and the hatch cover. This is the first sealing system.

[0013] Whilst closing the hatch cover, the expandable seal is in an unexpanded state. When the hatch cover is located on the hatch coaming, the expandable seal is expanded to an expanded state. In the expanded state, the expandable seal abuts both the hatch cover and the hatch coaming, and conforms to the shape of the hatch cover (e.g. a skirt of the hatch cover, see below) and the hatch coaming, such that a seal is provided between the hatch cover and the hatch coaming. This is the second sealing system. In the expanded state, the expandable seal has a volume greater than the volume of the expandable seal in the unexpanded state.

[0014] When access to the hold is desired, the hatch cover may be removed from the hatch opening such that the hold can be accessed via the hatch opening. When the hatch cover is removed from the hatch opening, the cargo hatch may be said to be in an uncovered state. In the uncovered state, the hatch cover may be adjacent the hatch opening such that the hold is accessible via the hatch opening.

[0015] The expandable seal may be a reversibly expandable seal. In other words, the expandable seal may be expanded from an unexpanded state to an expanded state and also (e.g. subsequently) collapsed (i.e. reduced in volume) from an expanded state to an unexpanded state. In embodiments where the expandable seal is a reversibly expandable seal, the operation of the expandable seal may be as follows. When the cargo hatch is in a closed state, the expandable seal may be expanded from an unexpanded state to an expanded state to provide a seal between the hatch cover and the hatch coaming as described above. When the hatch cover is to be removed, the expandable seal may be collapsed from the expanded state to the unexpanded state such that the second seal is no longer provided between the hatch cover and the hatch coaming. This may allow the hatch cover to be more easily removed from the hatch opening in order to open the hatch. It also means that the expandable seal is returned to the unexpanded state, ready for the next closure of the hatch cover, e.g. after new cargo is loaded into the hold via the hatch opening.

[0016] The expandable seal may be an inflatable seal. For example, the seal may be expanded from an unexpanded state to an expanded state by directing inflating gas (e.g. air) into an inflatable volume defined within the inflatable seal. Further, the seal may be collapsed from the expanded state to the unexpanded state, via deflation by venting or otherwise removing inflating gas from the inflatable volume. For example, the expandable seal may comprise a skin enclosing a cavity. The volume of the cavity may be increased (e.g. from an unexpanded state to an expanded state) by injecting gas and, in embodiments having a reversibly expandable seal, may be decreased (e.g. from an expanded state to an unexpanded state) by removing gas.

[0017] The hatch cover may comprise a bottom surface which, in use, faces towards the hatch opening e.g. towards the hold of the bulk carrier. The hatch cover may comprise a top surface on an opposite side to the bottom surface which faces away from the hatch opening in use. In use, the top surface may form part of the deck of the bulk carrier.

[0018] The hatch opening may have a principal axis. The hatch cover may also have a corresponding principal axis. The principal axes of the hatch opening and the hatch cover may extend in a vertical direction, e.g. the principal axes may be parallel with the vertical axis of the bulk carrier. When the cargo hatch is in the closed state, the principal axis of the hatch cover may be collinear with the principal axis of the hatch opening.

[0019] The hatch opening may have a width (e.g. in a direction substantially between the port and starboard side of the bulk carrier) of between about 10 m and 25 m, e.g. between about 15 m and 20 m, e.g. about 15 m. The hatch opening may have a length which is substantially perpendicular to the width and thus parallel to the centreline of the bulk carrier. The length of the hatch opening may be smaller than the width. For example, the length of the hatch opening may be between about 5 m and 20m, e.g. between about 10 m and 15 m, e.g. about 10 m.

[0020] The hatch coaming may comprise the compression bar of the first sealing system. For example, the hatch coaming may have a top surface (e.g. facing away from the deck of the bulk carrier, for example facing a substantially vertical direction) to which the compression bar is attached. The hatch cover may comprise a corresponding gasket which, in use, abuts (e.g. sits on) the compression bar and conforms to the shape of the compression bar, thereby providing a seal between the hatch coaming and the hatch cover. The seal may be maintained by the downward force of the hatch cover on the compression bar.

[0021] The first sealing system may extend between all regions of connection between the hatch cover and the hatch coaming. For example, the compression bar may extend entirely around the perimeter of the hatch coaming. For example, the compression bar may extend entirely around the top of the hatch coaming. In such embodiments, the gasket of the first sealing system may extend entirely around a region of the hatch cover which (when the cargo hatch is in a closed state) corresponds to a region of the hatch cover which connects to the compression bar (e.g. via the gasket). For example, the gasket of the first sealing system may extend entirely

around the perimeter of the hatch cover (e.g. on the bottom surface of the hatch cover) and may be spaced inwardly from the peripheral edge of the hatch cover such that the shape of the gasket (when viewed from below) corresponds to the shape of the compression bar on the hatch coaming (when viewed from above).

[0022] In some embodiments, the hatch opening may have a quadrilateral (e.g. rectangular) shape. In other words, the hatch opening may be a quadrilateral aperture (e.g. opening) in the deck of the bulk carrier. Accordingly, the hatch coaming, which extends around the entire perimeter of the hatch opening may have a quadrilateral shape when viewed from above. Further, the compression bar (e.g. on a top surface of the hatch coaming), may also have a quadrilateral when viewed from above, such that it surrounds the perimeter of the hatch opening.

[0023] In embodiments where the compression bar has a quadrilateral shape, the corresponding gasket of the first sealing system may also have a quadrilateral shape such that it corresponds to the shape of the compression bar. For example, the gasket of the first sealing system may be on the bottom surface of the hatch cover so that, when viewed from below, the gasket of the first sealing system may form a quadrilateral on the bottom surface of the hatch cover which corresponds to the shape of the compression bar.

[0024] The hatch cover may comprise an inner gasket channel (e.g. a steel channel), which is configured to house the gasket of the first sealing system. The inner gasket channel may be on the bottom surface of the hatch cover. The inner gasket channel may have a quadrilateral, such that the gasket of the first sealing system has a quadrilateral as described above.

[0025] The hatch coaming may comprise one or more side surfaces. The one or more side surfaces may face a direction substantially perpendicular to the principal axis of the hatch opening. The expandable seal may be located on the side surface or side surfaces of the hatch coaming. For example, the expandable seal may be located on the side surface or side surfaces proximate the top of the hatch coaming such that, in an expanded state, the expandable seal abuts the hatch cover to form a seal as described above.

[0026] By providing the expandable seal on the side surface or side surfaces of the hatch coaming, the expandable seal may be spaced from, and thereby not interfere with the operation of, the first sealing system which may be located on the top surface of the hatch coaming.

[0027] In some embodiments, the hatch coaming may comprise a channel (e.g. a half-pipe channel having a substantially semi-circular cross-section) configured to house the expandable seal. For example, the side surface or side surfaces of the hatch coaming may comprise said channel. For example, the channel may extend (e.g. continuously) around all the side surfaces of the hatch coaming. The channel may define an outwardly-directed opening. When expanding from an unexpanded state to an expanded state, the expandable seal may expand through the opening.

[0028] The channel may be connected (e.g. attached) to the hatch coaming via a channel support. The channel support may extend away from the hatch coaming (e.g. in a direction substantially perpendicular to the principal axis of the hatch opening) such that the channel is spaced from the hatch coaming (e.g. in a direction substantially perpendicular to the principal axis of the hatch opening). In some embodiments, the side surface or side surfaces of the hatch coaming may comprise said channel support e.g. the channel support may extend (e.g. continuously) around all the side surfaces of the hatch coaming. The channel may be spaced from the hatch coaming by (e.g. the extension of the channel support from the side surface or side surfaces may be) between about 100 mm and about 500 mm, e.g. by between about 150 mm and about 450 mm e.g. by between about 200 mm and about 400 mm e.g. by between about 250 mm and about 350 mm e.g. by between about 300 mm and 350 mm, for example by about 300 mm. The channel may have a depth between about 20 mm and about 100 mm e.g. between about 30 mm and about 90 mm e.g. between about 40 mm and about 80 mm e.g. between about 50 mm and about 70 mm, e.g. between about 50 mm and about 60 mm, for example about 60 mm. Here, "depth of the channel" means the dimension of the channel extending from the opening of the channel, for example in a direction perpendicular to the principal axis of the hatch opening and/or in a direction of extension of the channel support away from the side surface of the hatch coaming. In embodiments where the channel is a half-pipe channel, the half-pipe channel may have a diameter of between about 40 mm and about 200 mm e.g. between about 60 mm and about 180 mm, e.g. between about 80 mm and about 160 mm, e.g. between about 100 mm and about 140 mm, e.g. between about 100 mm and 120 mm, for example about 120 mm.

[0029] The side surface or side surfaces of the hatch coaming may respectively be an outer side surface or outer side surfaces of the hatch coaming such that the side surface or side surfaces face(s) away from the hatch opening (e.g. towards the gunwale of the bulk carrier). In other words, the side surface or side surfaces may be outwardly-directed.

[0030] By providing the expandable seal on an outer side surface of the hatch coaming, in use, the second sealing system may provide a seal between the hatch coaming and the hatch cover which separates the first sealing system from the outside environment. As a result, the second sealing system may reduce the likelihood of damage to the first sealing system caused by weathering or corrosion.

[0031] The second sealing system may extend around all regions of connection between the hatch cover and the hatch coaming. For example, the expandable seal (e.g. and the channel configured to house the expandable seal) may extend entirely around the hatch coaming

and the hatch opening.

[0032] In embodiments where the hatch opening has a quadrilateral shape (as described above), the expandable seal may extend (e.g. continuously extend) along each side of the quadrilateral shape. In these embodiments, the hatch coaming may comprise the expandable seal (e.g. and the channel housing the expandable seal) on each side of the quadrilateral shape.

[0033] The bulk carrier (like all ships) has a centreline. In embodiments where the hatch opening is a quadrilateral shape, the quadrilateral shape may substantially align with the centreline of the bulk carrier. In other words, the hatch opening may have four sides which respectively face forward, aft, port and starboard. Further, other features which have a corresponding quadrilateral shape (as described above) may be similarly aligned with the centreline of the bulk carrier. For example, the hatch coaming may have four outer side surfaces which respectively face forward, aft, port and starboard.

[0034] The hatch cover may comprise a skirt. The skirt may extend away from the hatch cover, e.g. from the bottom surface of the hatch cover. For example, the hatch cover may comprise a skirt which in use extends from the bottom surface of the hatch cover towards the hatch opening. The skirt may resemble a plate attached to the hatch cover (e.g. attached to the bottom surface of the hatch cover), which is substantially perpendicular to the hatch cover. For example, the skirt may comprise a plate which forms a continuous loop, extends from the hatch cover, and is substantially perpendicular to the hatch cover. The skirt may comprise a side surface or side surfaces which face(s) a direction substantially perpendicular to the principal axis of the hatch cover.

[0035] In use, the skirt may extend around the entire perimeter of the hatch opening. The shape of the skirt (when viewed from below) may be mathematically similar to the shape of the hatch coaming (when viewed from above). In embodiments where the hatch coaming is a quadrilateral shape when viewed from above, the skirt may be a complementary quadrilateral shape when viewed from below.

[0036] In use, the skirt (e.g. the side surface or side surfaces of the skirt) may overlap with the hatch coaming (e.g. the side surface or side surfaces of the hatch coaming). In preferred embodiments, in use, the hatch coaming may be located to the side of the skirt nearest the hatch opening. In these embodiments, the skirt may be said to be located to the outside of the hatch coaming because the skirt is between the hatch coaming and the outside environment. The spacing between the hatch coaming and the skirt may be uniform around the hatch opening.

[0037] The inner gasket channel (and the gasket) may be positioned inside the skirt when the hatch opening is closed by the hatch cover, such that the skirt is positioned between the inner gasket channel and the edge of the hatch cover. The outer wall of the inner gasket channel (e.g. the wall closest to the edge of the hatch cover) may be proximate (e.g. connected to and optionally aligned with) the skirt such that the gasket of the first sealing system is proximate (e.g. connected to) the skirt.

[0038] By providing a hatch cover having a skirt which in use extends from the bottom surface of the hatch cover towards the hatch opening, seals and sealing systems may be more easily provided between the hatch cover and the hatch coaming. Further, a longer and/or more complex path may be provided between the outside environment and the hatch opening such that the ingress of water to the hold via the hatch opening may be reduced. In particular, by providing the skirt on the outside of the hatch coaming when in use, the path for water ingress requires water to travel in an upward direction before travelling over the top of the hatch coaming. Further, by providing the skirt on the outside of the hatch coaming when in use, the first sealing system and the expandable seal are protected from the outside environment by the skirt. This may increase the lifetime of the sealing systems by reducing damage caused by weathering and/or corrosion.

[0039] The skirt may extend away from the bottom surface of the hatch cover by between about 100 mm and about 400 mm, e.g. by between about 150 mm and about 350 mm, e.g. by between about 200 mm and about 300 mm, e.g. by between about 200 mm and 300 mm, e.g. by about 270 mm.

[0040] The skirt may comprise one or a plurality of strengthening members. Such strengthening members may be provided on the side surface or side surfaces of the skirt, e.g. on the outer side surface or outer side surfaces of the skirt. Outer side surface or outer side surfaces of the skirt means a side surface or side surfaces which face away from the hatch opening when in use. The plurality of strengthening members may be spaced apart from one another along the skirt. The strengthening members may extend away from the bottom surface of the hatch cover. The strengthening members are called brackets.

[0041] The skirt (e.g. the side surface or side surfaces of the skirt), may comprise cleating notches around its perimeter. Some or all of the plurality of strengthening members may comprises a respective cleating notch.

[0042] In embodiments in which the skirt overlaps with the hatch coaming in use, the expandable seal may abut the skirt (e.g. the side surface or side surfaces of the skirt) and the hatch coaming (e.g. the side surface or side surfaces of the hatch coaming) when in the expanded state. For example, in embodiments where the expandable seal is located on the outer side surface or outer side surfaces of the hatch coaming and the skirt is located to the outside of the hatch coaming, the expandable seal may abut the skirt and conform to the shape of the skirt (e.g. the shape of the side surface or side surfaces of the skirt) such that a seal is provided between the hatch cover and the hatch coaming. In other words, the second sealing system may comprise the expandable seal and the skirt, such that, in an expanded state, the expandable

seal abuts the skirt to provide a seal between the hatch coaming and the hatch cover.

[0043] By providing a second sealing system comprising the expandable seal and the skirt, the expandable seal may abut against the skirt when in an expanded state and conform to the shape of the skirt, such that a seal is provided between the hatch cover and the hatch coaming. The skirt provides a surface against which the expandable seal may abut to create a good quality seal. Further, the skirt provides protection for the expandable seal against the outside environment.

[0044] As described above, the hatch cover is moved into place such that it is located on the hatch coaming after the cargo is loaded into the hold via the hatch opening. Prior to moving into place, the hatch cover is located adjacent the hatch opening such that the hatch opening is uncovered (referred to as the uncovered state). The cargo hatch may (reversibly) transition between a covered state (in which the hatch cover is over the hatch opening) and the uncovered state. The hatch cover may move in a direction substantially parallel with the centreline of the bulk carrier between the covered state and the uncovered state.

[0045] In the covered state, the hatch cover is positioned over the hatch opening, but is not located on the hatch coaming. Thus, the cargo hatch may reversibly move (e.g. be lowered and raised) between the covered state and the closed state.

[0046] To ensure the hatch cover sits correctly in its closed position when the cargo hatch is in a closed state, the cargo hatch may comprise a means for correctly locating the hatch cover for example wedge slides.

[0047] The hatch coaming may comprise one or more friction pads (bearing pads) to support the hatch cover. For example, the top surface of the hatch coaming may comprise multiple (e.g. four) friction pads to support the hatch cover. The friction pad(s) may be bolted or welded to the hatch coaming. The hatch cover may rest of the compression bar (or compression bars) described herein via a respective gasket(s) and also rest on the friction pads.

[0048] The hatch cover may be mounted on tracks e.g. wheel tracks such that the hatch cover can move along the tracks to transition between the covered and uncovered states. For example, the cargo hatch may comprise two tracks. The tracks may extend substantially parallel with the centreline of the bulk carrier. One track may be on the starboard side of the hatch opening and the other may be on the port side of the hatch opening. The hatch cover may comprise wheels. One or more wheels may be configured to run along a respective track e.g. rest and roll on a respective track. For example, the hatch cover may comprise two wheels configured to rest and roll on the starboard track and two wheels configured to rest and roll on the port track. In some embodiments, the hatch cover may comprise four such wheels, e.g. located proximate respective corners of the hatch cover.

[0049] One or more motors may be used to drive the wheels along the tracks. The hatch cover may comprise the one or more motors. For example, each wheel may have a corresponding motor. The tracks and wheels may have teeth (e.g. such that the tracks resemble a rack and the wheels resemble cooperating pinions).

[0050] When the hatch cover is to be closed, the hatch cover may be moved over the hatch opening e.g. by moving the hatch cover along the tracks. At this stage, the cargo hatch is in a covered state but not yet in a closed state. The hatch may comprise a means of lowering the hatch cover onto the hatch coaming. For example, one or more hydraulic jacks may be provided to lower the hatch cover onto the hatch coaming. For example, four hydraulic jacks may be provided e.g. one in each corner of the hatch cover. Accordingly, the hatch cover may be located on the hatch coaming (e.g. such that the hatch is in the closed state), and subsequently the sealing systems may be operated as described herein.

[0051] When access to the hold is required, the hatch cover may be lifted (e.g. via the hydraulic jacks) such that the cargo hatch transitions from a closed state to a covered state, and subsequently moved away from the hatch opening (e.g. via the tracks) such that the cargo hatch transitions from the covered state to an uncovered state.

[0052] In use, the hatch cover may extend beyond the hatch opening e.g. the hatch coaming. For example, in use, the hatch cover may extend beyond the hatch opening in a sideways direction e.g. towards the port and/or starboard side of the bulk carrier. In some embodiments, the portion(s) of the hatch cover which extends beyond the hatch opening may, in use, cover a portion of a crew passageway and/or working space adjacent the hatch opening. A working space may be provided between a crew passageway and the hatch coaming (e.g. on one or both sides of the bulk carrier).

[0053] In embodiments where the hatch cover extends beyond the hatch coaming, one or more edges of the hatch cover (in use) may be connected to (e.g. sit on) a support region of the bulk carrier. For example, the support region may be part of the deck of the bulk carrier. In some embodiments, an additional sealing system may be provided between the hatch cover and the support region e.g. deck of the bulk carrier. The additional sealing system may comprise a gasket and a compression bar. For example, the support region (e.g. deck) may comprise a compression bar, and the hatch cover may comprise an additional gasket for the additional sealing system. In use, the gasket of the additional sealing system may abut (e.g. sit on) the compression bar on the support region and conform to the shape of the compression bar, thus providing a seal between the hatch cover and the support region. The seal may be maintained by the downward force of the hatch cover on the compression bar.

[0054] The support region of the bulk carrier may extend entirely around the hatch opening. The additional sealing system may extend between all regions of the connection between the hatch cover and the support

region of the bulk carrier. For example, the compression bar of the additional sealing system may extend entirely around hatch opening. In these embodiments, the gasket of the additional sealing system may extend entirely around a region of the hatch cover which, when the hatch cover is closed, corresponds to a region of the hatch cover which connects to the compression bar of the additional sealing system. For example, the gasket of the additional sealing system may extend entirely around the perimeter of the hatch cover. The shape of the gasket of the additional sealing system (when viewed from below) may correspond to the shape of the compression bar on the support region e.g. deck of the bulk carrier (when viewed from above).

[0055] The compression bar of the additional sealing system may have a quadrilateral (e.g. rectangular) shape (when viewed from above), such that it surrounds the hatch opening. The corresponding gasket of the additional sealing system may have a quadrilateral shape such that it corresponds to the shape of the compression bar of the additional sealing system. For example, where the hatch cover is a quadrilateral shape, the gasket of the additional sealing system may extend around the edge of the hatch cover on the bottom surface such that it also has a quadrilateral shape.

[0056] The hatch cover may comprise an outer gasket channel e.g. a steel channel, which is configured to house the gasket of the additional sealing system. The outer gasket channel may be on the bottom surface of the hatch cover. The outer gasket channel may have a quadrilateral shape such that the gasket of the additional sealing system has a quadrilateral shape as described above.

[0057] In a second aspect there is provided a bulk carrier comprising one or more cargo hatches according to the first aspect. In some embodiments, the bulk carrier according to the second aspect may comprise more than one cargo hatch according to the first aspect, each cargo hatch comprising a respective hatch cover which is configured to be removably located on the respective hatch coaming such that the hatch cover reversibly closes the hatch opening (e.g. the entire hatch opening).

[0058] The hatch covers on the bulk carrier according to the second aspect may move in a direction substantially parallel with the centreline of the bulk carrier in order to cover and uncover the hatch openings.

[0059] In a third aspect there is provided a method of closing a cargo hatch for a bulk carrier, the method comprising the steps of: removably locating a hatch cover on hatch coaming of a cargo hatch, providing first seal between the hatch coaming and the hatch cover with a first sealing system, wherein the first sealing system comprises a gasket and a compression bar (e.g. on opposing surfaces of the hatch coaming and the hatch cover), providing a second sealing system comprising an expandable seal, expanding the expandable seal such that a second seal is provided between the hatch coaming and the hatch cover.

[0060] The step of removably locating a hatch cover on the hatch coaming of a cargo hatch may comprise the steps of: moving the hatch cover over the hatch opening (e.g. such that the cargo hatch transitions between the uncovered state and the covered state), and lowering the hatch cover such that it is located on the hatch coaming.

[0061] In order to access the hold of the bulk carrier via the hatch opening, the method according to the third aspect may further comprise the steps of: collapsing the expandable seal such that the second seal is removed, and moving the hatch cover away from the hatch coaming such that the hatch opening is accessible.

[0062] Moving the hatch cover over the hatch opening may involve, for example, moving the hatch cover in a direction substantially parallel with the centreline of the bulk carrier.

[0063] The invention includes the combination of the aspects and preferred features described except where such a combination is clearly impermissible or expressly avoided. For example, the method of the third aspect may relate to a method of closing a cargo hatch according to the first aspect.

[0064] Throughout this specification, reference is made to the cargo hatch of the first aspect being on a bulk carrier. It is to be appreciated, however, that the cargo hatch of the first aspect may be provided on any type of ship, not just a bulk carrier. Therefore, the skilled person will understand references to bulk carrier to also be references to any other ship or boat.

[0065] In the context of this specification, "viewed from above" means viewed facing the deck of the bulk carrier. In the context of the hatch cover and its component parts (e.g. skirt, gasket), "viewed from below" means viewed facing the bottom surface of the hatch cover.

Summary of the Figures

[0066] Embodiments and experiments illustrating the principles of the invention will now be discussed with reference to the accompanying figures in which:

Figure 1. shows a top view of a bulk carrier having a cargo hatch according to the first aspect the cargo hatch being shown in an uncovered state.

Figure 2. shows an aft view of the hatch cover of the cargo hatch shown in Figure 1.

Figure 3. shows a side view of the hatch cover in Figure 2, viewed from the starboard side.

Figure 4. shows a bottom view of the hatch cover of the cargo hatch shown in Figure 2.

Figure 5. shows a top view of the bulk carrier in Figure 1, the cargo hatch being shown in a covered state.

Figure 6. shows a cross-section view of the star-

board side of the bulk carrier in Figure 1, showing the cargo hatch is in a covered state.

Figure 7. shows a cross-section view of the bulk carrier in Figure 1, showing the cargo hatch in a closed state.

Detailed Description of the Invention

[0067] Aspects and embodiments of the present invention will now be discussed with reference to the accompanying figures. Further aspects and embodiments will be apparent to those skilled in the art. All documents mentioned in this text are incorporated herein by reference.

[0068] Figure 1 shows a top view of a longitudinal portion of a bulk carrier 1 having a cargo hatch 100 according to the first aspect.

[0069] The bulk carrier 1 has a starboard topside water ballast tank 2 and a port topside water ballast tank 3 separated by a region of the deck 4 through which the cargo hatch 100 is provided. The two topside water ballast tanks 2, 3 are separated from the region of the deck 4 having the cargo hatch 100 by respective longitudinally extending crew passageways 5a, 5b. The cargo hatch 100 is symmetric about the centreline 91 of the bulk carrier 1.

[0070] Although only one cargo hatch 100 is shown in the Figures, a bulk carrier 1 may have more than one cargo hatch 100, each with a structure identical or similar to the structure of the cargo hatch 100 described herein. Each cargo hatch 100 is usually spaced from the others along the centreline 91 of the bulk carrier 1 (i.e. in a longitudinal direction).

[0071] The cargo hatch 100 has a hatch opening 101 which is a rectangular aperture in the deck 4 of the bulk carrier 1. The hatch opening 101 allows cargo to be loaded therethrough and into the hold of the bulk carrier.

[0072] Hatch coaming 110 surrounds the hatch opening 101 such that it extends around the entire perimeter of the hatch opening 101. As will be understood by a person skilled in the art, the hatch coaming 110 comprises a vertically extending flat surface/plate which surrounds the hatch opening 101. Here the hatch coaming 110 resembles the side faces of a cuboid such that it surrounds the entire perimeter of the hatch opening 101.

[0073] In Figure 1, the cargo hatch 100 is shown in an uncovered state, with a hatch cover 130 positioned adjacent the hatch opening 101 towards the aft of the bulk carrier 1 such that the hold is accessible via the hatch opening 101. In Figure 1, components under the hatch cover 130 are shown for clarity.

[0074] The hatch cover 130 rests on two longitudinally extending wheel tracks 20a, 20b located on respective sides of the hatch opening 101. The hatch cover 130 has a larger area when viewed from above than the hatch opening and extends across the crew passageways 5a, 5b on the port and starboard sides. Proximate each corner of the hatch opening 101 and aligned with the wheel tracks 20a and 20b there is provided a respective hydraulic jack 120a, 120b, 120c, 120d.

[0075] Figure 2 shows an aft view of the hatch cover 130 shown in Figure 1. The hatch cover 130 is a flat plate (e.g. metal such as steel). In this embodiment, the hatch cover 130 is about 450 mm thick, about 19 m wide and about 11.5 m in length (in the longitudinal direction). The skilled person will understand that the hatch cover 130 may be dimensioned differently depending on the size of the cargo hatch 100 and/or bulk carrier 1.

[0076] The hatch cover 130 comprises a skirt 131 which extends from a bottom surface of the hatch cover 130. The skirt 131 extends around the perimeter of the hatch cover 130 and is spaced inwardly from the edge of the hatch cover 130. The hatch cover 130 has a principal axis 93 which extends vertically through the centre of the hatch cover 130. The skirt 131 comprises an outer side surface 134 which, in use, faces a direction substantially perpendicular to a principal axis of the hatch cover. The outer side surface 134 of the skirt 131 may be said to comprise four continuously connected outer side surfaces 134 facing different directions (forwards, aft, port and starboard). Figure 2 shows an outer side surface 134 of the skirt 131 which faces the aft direction. The skirt comprises a plurality of strengthening members 135 spaced along the skirt 131 on the outer side surface 134. The strengthening members 135 (which may resemble ribs) extend away from the bottom surface of the hatch cover 130.

[0077] Figure 3 shows a side view of the hatch cover 130, as viewed from the starboard side. Here an outer surface 134 of the skirt 131 facing the starboard side can be seen, having strengthening members 135 spaced along it.

[0078] The hatch cover 130 comprises four wheels 121a, 121b, 121c, 121d underneath (attached to the bottom surface). Each wheel is located between the skirt 131 and the sides of the hatch cover 130. There are two wheels 121a, 121b on the starboard side as shown in Figure 3, which are transversely aligned with one another and longitudinally spaced apart. There are also two wheels 121c, 121d on the port side which are transversely aligned with one another and longitudinally spaced apart in a similar manner (see Figure 4). The starboard side wheels 121a, 121b rest on the starboard side wheel track 20a and the port side wheels 121c, 121d rest on the port side wheel track 20b such that the hatch cover 130 is moveably supported on the wheel tracks 20a, 20b. The wheels 121a, 121b, 121c, 121d are configured to roll along the wheel tracks 20a, 20b such that the hatch cover 130 can move along the wheel tracks. Each wheel 121a, 121b, 121c, 121d is provided with a respective motor 122a, 122b, 122c, 122d which drives the wheel 121a, 121b, 121c, 121d such that the hatch cover 130 moves along the wheel tracks 20a, 20b.

[0079] Figure 4 shows the hatch cover 130 as viewed from below. In Figure 4, all four wheels 121a, 121b, 121c,

121d and respective motors 122a, 122b, 122c, 122d are visible proximate the corners of the hatch cover 130. As seen in Figure 4, the skirt 131 is rectangular in shape when viewed from below.

[0080] The hatch cover 130 comprises an inner gasket channel 132 provided inside the skirt 131 such that the skirt 131 is positioned between the inner gasket channel 132 and the edge of the hatch cover 130. The inner gasket channel 132 extends entirely around the interior of the skirt 131. The inner gasket channel 132 follows a path having a corresponding rectangular shape when viewed from below. The outer wall of the inner gasket channel 132 is aligned with the skirt 131. The inner gasket channel 132 is configured to house an inner gasket.

[0081] The hatch cover 130 further comprises an outer gasket channel 133 which extends around the perimeter of the bottom surface of the hatch cover 130 at its peripheral edge. The outer gasket channel 133 also follows a rectangular path when viewed from below. The outer gasket channel 133 is configured to house an outer gasket.

[0082] The hatch cover 130 shown in Figure 4 has horizontal and vertical symmetry when in the orientation shown in Figure 4.

[0083] The operation of the cargo hatch 100 will be described next.

[0084] As explained above, Figure 1shows the cargo hatch 100 in an uncovered state. In Figure 5, the cargo hatch 100 is shown in a covered state such that the hatch cover 130 is positioned over the hatch opening 101 (in Figure 5, components under the hatch cover 130 are shown for clarity). The hatch cover 130 is reversibly movable between the uncovered state shown in Figure 1 and the covered state shown in Figure 5. This is achieved by moving the hatch cover 130 along the wheel tracks 20a, 20b, on the wheels 121a, 121b, 121c, 121d which are driven by the motors 122a, 122b, 122c, 122d.

[0085] In the covered state, the hatch cover 130 is located over the hatch opening 101. Figure 6 shows a cross-section view of the starboard side of the bulk carrier where the cargo hatch 100 is in the covered state (i.e. the cargo hatch 100 is covered but not yet closed).

[0086] Figure 6 shows three sealing systems: a first sealing system 140; a second sealing system 150; and an additional sealing system 160.

[0087] The first sealing system 140 comprises an inner gasket 141 which is housed in the inner gasket channel 132 of the hatch cover. The first sealing system 140 also comprises an inner compression bar 142 which is located on the top of the hatch coaming 110. The compression bar 142 extends entirely around the top of the hatch coaming 110 such that it is rectangular in shape when viewed from above (like the hatch coaming 110). When the cargo hatch 100 is in the covered state as illustrated in Figure 6, the inner gasket channel 132 is vertically aligned with the compression bar 142.

[0088] The second sealing system 150 comprises an expandable seal 151 and the skirt 131 of the hatch cover 130. The expandable seal 151 is housed in a half-pipe channel 158 which is located on the outer side surfaces 111 of the hatch coaming 110, proximate the top of the hatch coaming 110. Specifically, the outer side surfaces 111 of the hatch coaming 110 have a channel support 159 which extends outwardly away from the hatch coaming 110 (in a direction substantially perpendicular to the principal axis 92 of the hatch opening 101). The half-pipe channel 158, which has a semi-circular cross-section, is located at the end of the channel support 159 such that it is positioned about 300 mm from the hatch coaming 110. The half-pipe channel 158 extends entirely around the hatch coaming 110. The radius of the half-pipe channel 158 is about 60 mm.

[0089] The expandable seal 151 is configured to reversibly expand from an unexpanded state to an expanded state. When expanding from an unexpanded state to an expanded state, the expandable seal 151 expands through the outwardly facing opening 157 of the half-pipe channel 158 which faces away from the hatch coaming 110.

[0090] The additional sealing system 160 comprises an outer gasket 161 which is housed in the outer gasket channel 133 of the hatch cover 130. The additional sealing system 160 also comprises an outer compression bar 162 which is located on the deck 4 of the bulk carrier 1. The outer compression bar 162 is rectangular in shape when viewed from above, such that the outer gasket channel 133 is vertically aligned with the compression bar 162 when the cargo hatch 100 is in the covered state as illustrated in Figure 6. In other words, every part of the outer gasket channel 133 is vertically aligned with a part of the compression bar 162 when the cargo hatch 100 is in the covered state. As a result, the outer compression bar 162 surrounds and is spaced from the hatch opening 101 and the hatch coaming 110.

[0091] Figure 7 shows a transverse cross-section view of the bulk carrier 1. In Figure 7, the cargo hatch 100 is shown in a closed state such that the hatch cover 130 is located on the hatch coaming 110. To close the cargo hatch 100, the cargo hatch 100 is lowered from the covered state shown in Figure 6 to the closed state shown in Figure 7. Specifically, the hatch cover 130 is lowered from its position in the covered state by the hydraulic jacks 120a, 120b, 120c, 120d to its position in the closed state (on the hatch coaming 110). As the skilled person will understand, in the closed state, the hatch cover 130 may be secured in a conventional way, for example via cleats provided around the skirt 131.

[0092] In the closed state, the inner gasket 141 of the first sealing system 140 sits on the inner compression bar 142. The inner gasket 141 conforms to the shape of the inner compression bar 142 under the weight of the hatch cover 130 such that a weatherproof seal is provided between the hatch cover 130 and the hatch coaming 110, thereby sealing the hold from the outside environment.

[0093] In the closed state, the outer gasket 161 of the

additional sealing system 160 sits on the outer compression bar 162. The outer gasket 161 conforms to the shape of the outer compression bar 162 under the weight of the hatch cover 130 such that an additional seal is provided between the hatch cover 130 and the deck 4. The additional sealing system thus provides a weatherproof seal between the crew passageways 5a, 5b and the outside environment.

[0094] In the closed state, the skirt 131 of the hatch cover 130 closely surrounds the hatch coaming 110. The shape of the skirt 131 when viewed from below is a mathematically similar shape to the shape of the hatch coaming 110 when viewed from above (i.e. a rectangular shape in the embodiment illustrated). The proximity between the hatch coaming 110 and the skirt 131 facilitates the second sealing system 150.

[0095] During movement of the cargo hatch from the uncovered state (as shown in Figure 1), to the covered state (as shown in Figures 5 and 6), and then to the closed state (as shown in Figure 7), the expandable seal 151 is maintained in an unexpanded state. When the cargo hatch 100 is in a closed state, the expandable seal 151 is expanded from the unexpanded state to an expanded state, through the opening 157 of the half-pipe channel 158, such that it abuts the skirt 131. When expanded in this manner, the expandable seal 151 conforms to the shape of the skirt 131 such that it provides a seal between the hatch cover 130 and the hatch coaming 110. The second sealing system 150 thereby provides a waterproof seal between the hatch opening 101 and the outside environment. Further, because the second sealing system 150 is outside the first sealing system 140, the second sealing system 150 protects the first sealing system 140.

[0096] When access to the hold is desired via the hatch opening 101, the expandable seal 151 is collapsed from an expanded state to an unexpanded state and the hydraulic jacks 120a, 120b, 120c, 120d are operated to lift the hatch cover 130 such that the cargo hatch 100 transitions from the closed state to the covered state. The hatch cover 130 is subsequently moved along the wheel tracks 20a, 20b such that the hatch opening 101 is uncovered (i.e. the cargo hatch 100 transitions from a covered state to an uncovered state).

[0097] It is to be understood that the expandable seal 151 can be expanded in various different ways. In some embodiments, for example, the expandable seal 151 by be pneumatically expanded, via inflation, by directing a volume of inflated gas into the internal volume of the expandable seal 151. In some such examples, the inflating has may be air and may be directed into the expandable seal by a compressor arrangement 180 in a manner known *per se.* As will be appreciated, such embodiments may further comprise a venting arrangement configured to vent the internal volume of the expandable seal 151 to release the inflating air and thereby transition the expandable seal 151 from its expanded state back to its unexpanded state.

[0098] Alternative embodiments are envisaged in which the expandable seal 151 may instead be hydraulically expanded by directing a volume of a suitable hydraulic liquid into the internal volume of the expandable seal 151. In some such arrangements the hydraulic liquid may be provided within a closed hydraulic circuit (not shown) comprising a liquid reservoir and one or more flow conduits in fluid communication with the internal volume of the expandable seal 151. A reversibly operable hydraulic pump may be provided to i) pump the hydraulic liquid from the reservoir to the internal volume of the expandable seal 151 to expand the expandable seal 151, and ii) pump the hydraulic liquid from the internal volume of the expandable seal 151 to the reservoir to collapse the expandable seal 151.

[0099] Figure 7 also shows working spaces 6a, 6b provided between the hatch coaming 110 and the respective crew passageways 5a, 5b.

[0100] In Figures 6 and 7, the principal axis 92 of the hatch opening 101 is shown. In Figures 2 and 3, the principal axis 93 of the hatch cover 130 is shown. These principal axes are parallel to the vertical axis of the bulk carrier. Throughout this specification, references to directions such as vertical, top, bottom etc. refer to directions when the bulk carrier is in a normal upright position e.g. as it would be in a dock. In other words, when the centreline of the bulk carrier is horizontal, and the longitudinal axis of the hatch opening is vertical (e.g. as shown in the Figures). The skilled person will understand that the orientation of the bulk carrier and cargo hatch may change when e.g. the bulk carrier is at sea. As such, any directions referred to should not be understood to limit the invention to the orientation of the cargo hatch as shown in the Figures.

[0101] The features disclosed in the foregoing description, or in the following claims, or in the accompanying drawings, expressed in their specific forms or in terms of a means for performing the disclosed function, or a method or process for obtaining the disclosed results, as appropriate, may, separately, or in any combination of such features, be utilised for realising the invention in diverse forms thereof.

[0102] While the invention has been described in conjunction with the exemplary embodiments described above, many equivalent modifications and variations will be apparent to those skilled in the art when given this disclosure. Accordingly, the exemplary embodiments of the invention set forth above are considered to be illustrative and not limiting. Various changes to the described embodiments may be made without departing from the spirit and scope of the invention.

[0103] For the avoidance of any doubt, any theoretical explanations provided herein are provided for the purposes of improving the understanding of a reader. The inventors do not wish to be bound by any of these theoretical explanations.

[0104] Any section headings used herein are for organizational purposes only and are not to be construed as

limiting the subject matter described.

[0105] Throughout this specification, including the claims which follow, unless the context requires otherwise, the word "comprise" and "include", and variations such as "comprises", "comprising", and "including" will be understood to imply the inclusion of a stated integer or step or group of integers or steps but not the exclusion of any other integer or step or group of integers or steps.

[0106] it must be noted that, as used in the specification and the appended claims, the singular forms "a," "an," and "the" include plural referents unless the context clearly dictates otherwise. Ranges may be expressed herein as from "about" one particular value, and/or to "about" another particular value. When such a range is expressed, another embodiment includes from the one particular value and/or to the other particular value. Similarly, when values are expressed as approximations, by the use of the antecedent "about," it will be understood that the particular value forms another embodiment. The term "about" in relation to a numerical value is optional and means for example +/- 10%.

Claims

1. A cargo hatch for a bulk carrier comprising:

a hatch coaming surrounding a hatch opening;
a hatch cover configured to be removably located on the hatch coaming such that the hatch cover reversibly closes at least a part of the hatch opening;
a first sealing system comprising a gasket and a compression bar, and configured to provide a seal between the hatch coaming and the hatch cover in use; and
a second sealing system comprising an expandable seal and configured to provide a seal between the hatch coaming and the hatch cover in use.

2. The cargo hatch according to claim 1 wherein the expandable seal is a reversibly expandable seal.

3. The cargo hatch according to claim 1 or claim 2 wherein the expandable seal is an inflatable seal.

4. The cargo hatch according to any one of the preceding claims wherein the hatch coaming comprises a side surface, wherein the expandable seal is located on the side surface.

5. The cargo hatch according to claim 4 wherein the side surface is an outer side surface which faces away from the hatch opening.

6. The cargo hatch according to any one of the preceding claims wherein the hatch cover comprises a skirt extending from a bottom surface of the hatch cover towards the hatch opening so as to overlap with the hatch coaming in use.

7. The cargo hatch according to claim 6 wherein in use, the skirt is located to the outside of the hatch coaming.

8. The cargo hatch according to claim 6 or claim 7 wherein the second sealing system comprises the skirt such that, in an expanded state, the expandable seal abuts the skirt to provide a seal between the hatch coaming and the hatch cover.

9. The cargo hatch according to any one of the preceding claims wherein the hatch cover is configured to be removably located on the hatch coaming such that the hatch cover reversibly closes the entire hatch opening.

10. The cargo hatch according to any one of the preceding claims wherein the hatch cover is moveable in a direction substantially parallel with a centreline of the bulk carrier between a covered position in which the hatch opening is covered by the hatch cover, and an open position in which the hatch opening is uncovered.

11. A bulk carrier comprising one or more cargo hatches according to any one of claims 1 to 10.

12. A method of closing a cargo hatch for a bulk carrier, the method comprising the steps of:

removably locating a hatch cover on hatch coaming of the cargo hatch;
providing a first seal between the hatch coaming and the hatch cover with a first sealing system comprising a gasket and a compression bar;
providing a second sealing system comprising an expandable seal; and
expanding the expandable seal such that a second seal is provided between the hatch coaming and the hatch cover.

13. The method according to claim 12 wherein the step of removably locating the hatch cover on the hatch coaming of the cargo hatch comprises the steps of: moving the hatch cover over the hatch opening in a direction substantially parallel with a centreline of the bulk carrier, and lowering the hatch cover such that it is located on the hatch coaming.

14. The method according to any one of claims 12 and 13 comprising the steps of:

collapsing the expandable seal such that the second seal is removed;

moving the hatch cover away from the hatch coaming such that the hatch coaming is accessible.

Amended claims in accordance with Rule 137(2) EPC.

1. A cargo hatch for a bulk carrier comprising:

a hatch coaming surrounding a hatch opening, the hatch opening having a principal axis extending in a vertical direction;
a hatch cover configured to be removably located on the hatch coaming such that the hatch cover reversibly closes at least a part of the hatch opening;
a first sealing system comprising a gasket and a compression bar, and configured to provide a seal between the hatch coaming and the hatch cover in use; and
a second sealing system comprising an expandable seal and configured to provide a seal between the hatch coaming and the hatch cover in use,
wherein the hatch coaming comprises a side surface facing a direction substantially perpendicular to the principal axis of the hatch opening, and
the expandable seal is located on the side surface.

2. The cargo hatch according to claim 1 wherein the expandable seal is a reversibly expandable seal.

3. The cargo hatch according to claim 1 or claim 2 wherein the expandable seal is an inflatable seal.

4. The cargo hatch according to claim any one of the preceding claims wherein the side surface is an outer side surface which faces away from the hatch opening.

5. The cargo hatch according to any one of the preceding claims wherein the hatch cover comprises a skirt extending from a bottom surface of the hatch cover towards the hatch opening so as to overlap with the hatch coaming in use.

6. The cargo hatch according to claim 5 wherein in use, the skirt is located to the outside of the hatch coaming.

7. The cargo hatch according to claim 5 or claim 6 wherein the second sealing system comprises the skirt such that, in an expanded state, the expandable seal abuts the skirt to provide a seal between the hatch coaming and the hatch cover.

8. The cargo hatch according to any one of the preceding claims wherein the hatch cover is configured to be removably located on the hatch coaming such that the hatch cover reversibly closes the entire hatch opening.

9. The cargo hatch according to any one of the preceding claims wherein the hatch cover is moveable in a direction substantially parallel with a centreline of the bulk carrier between a covered position in which the hatch opening is covered by the hatch cover, and an open position in which the hatch opening is uncovered.

10. A bulk carrier comprising one or more cargo hatches according to any one of claims 1 to 9.

11. A method of closing a cargo hatch according to any one of claims 1 to 9, the method comprising the steps of:

removably locating a hatch cover on hatch coaming of the cargo hatch;
providing a first seal between the hatch coaming and the hatch cover with a first sealing system comprising a gasket and a compression bar;
providing a second sealing system comprising an expandable seal; and
expanding the expandable seal such that a second seal is provided between the hatch coaming and the hatch cover.

12. The method according to claim 11 wherein the step of removably locating the hatch cover on the hatch coaming of the cargo hatch comprises the steps of: moving the hatch cover over the hatch opening in a direction substantially parallel with a centreline of the bulk carrier, and lowering the hatch cover such that it is located on the hatch coaming.

13. The method according to any one of claims 11 and 12 comprising the steps of:

collapsing the expandable seal such that the second seal is removed;
moving the hatch cover away from the hatch coaming such that the hatch opening is accessible.

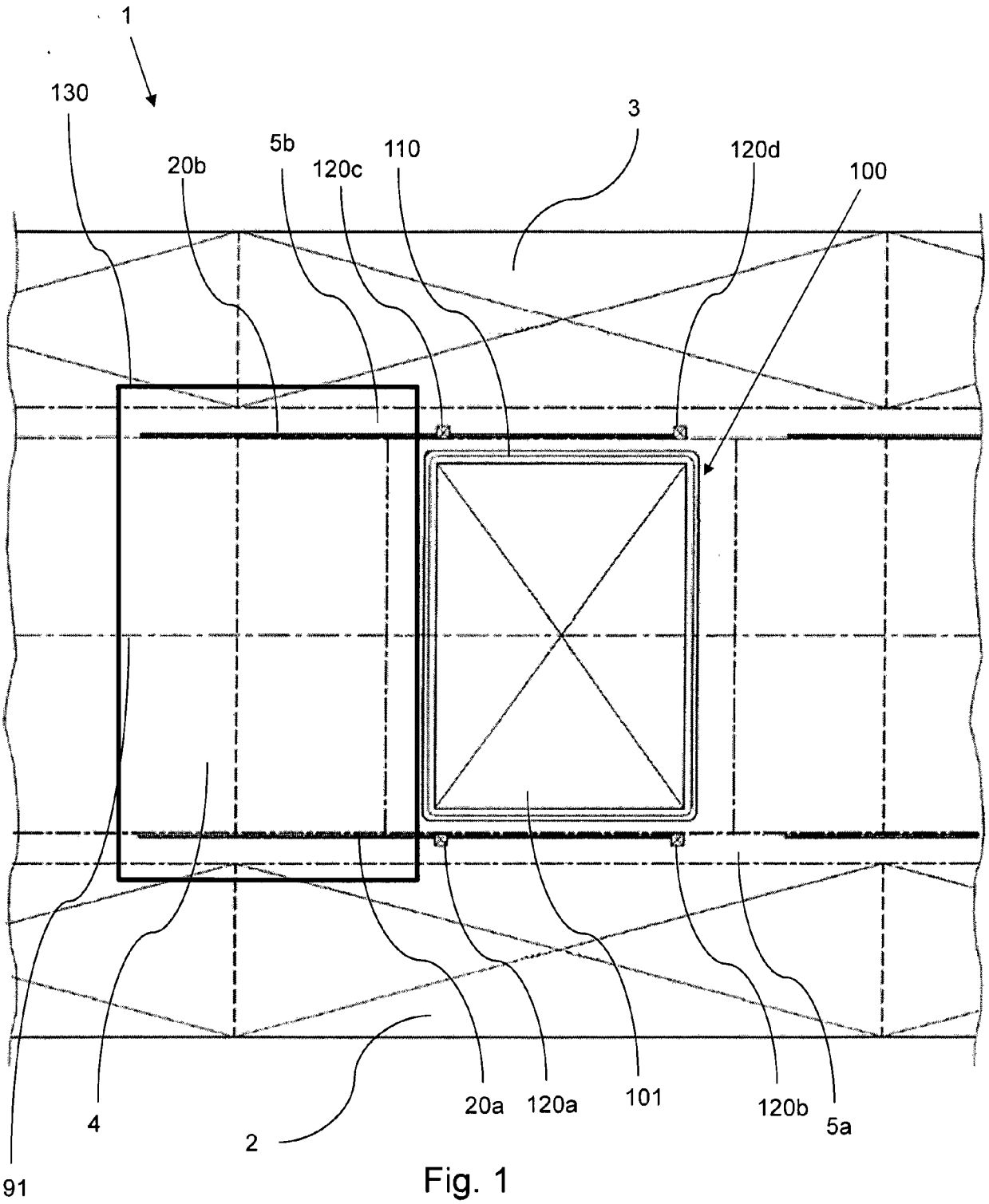

Fig. 1

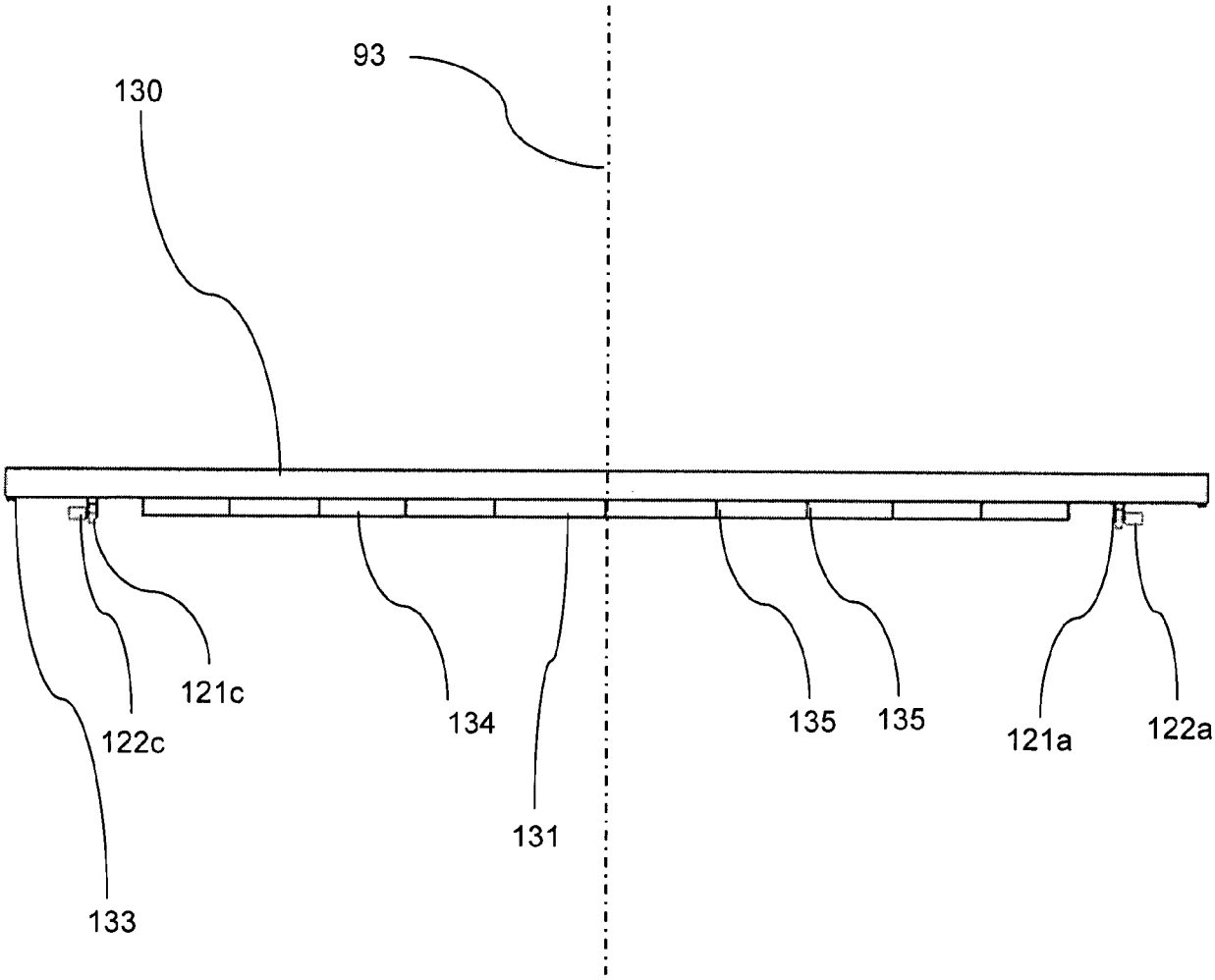

Fig. 2

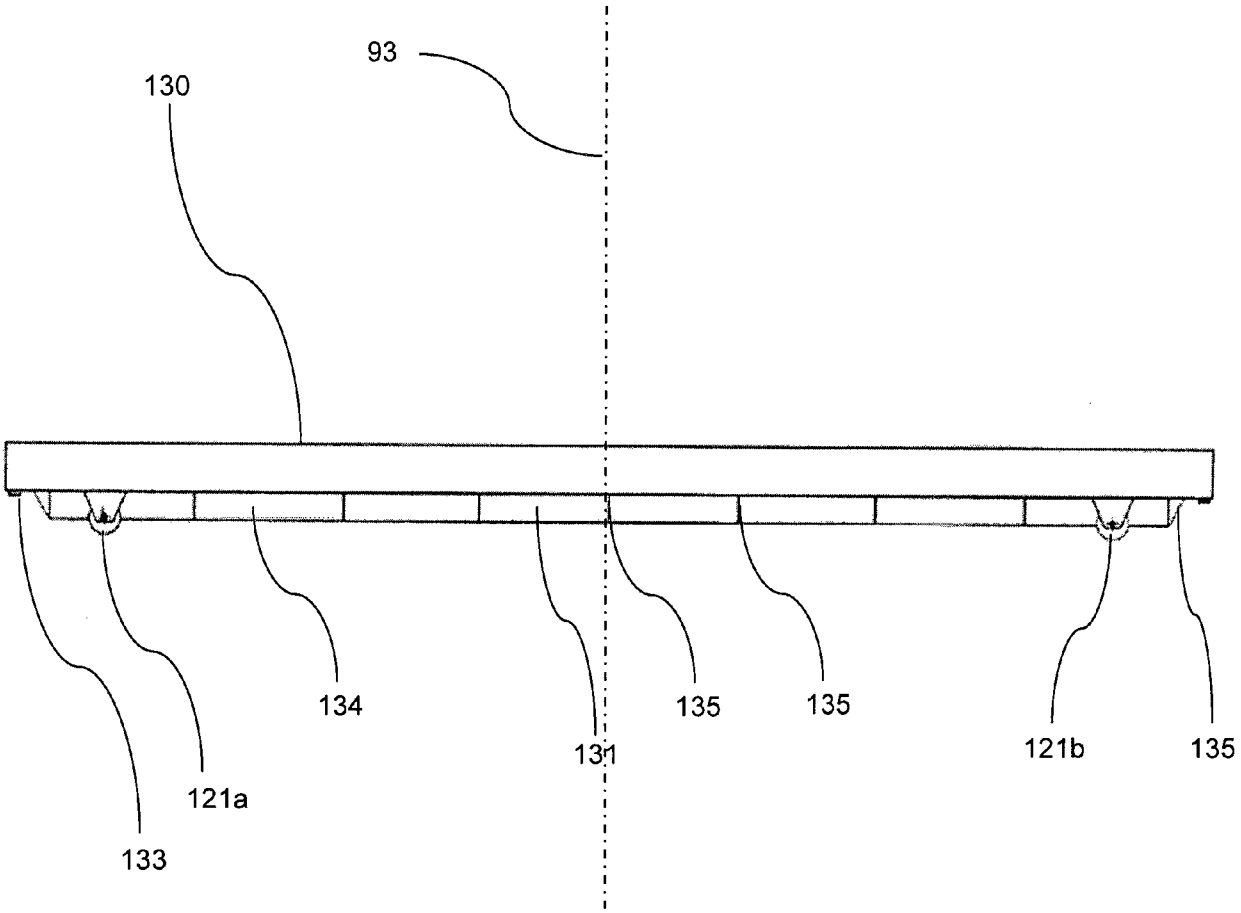

Fig. 3

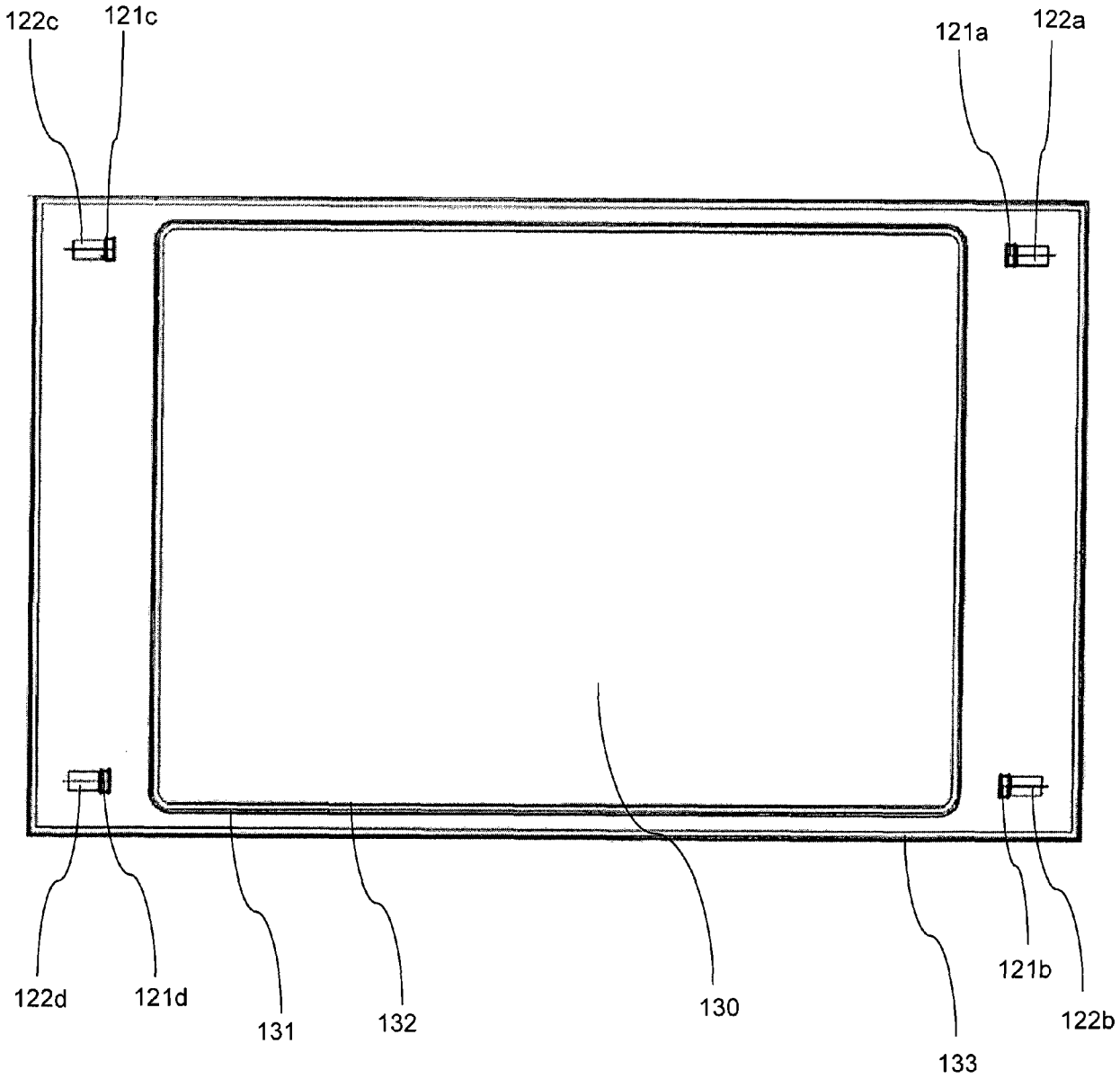

Fig. 4

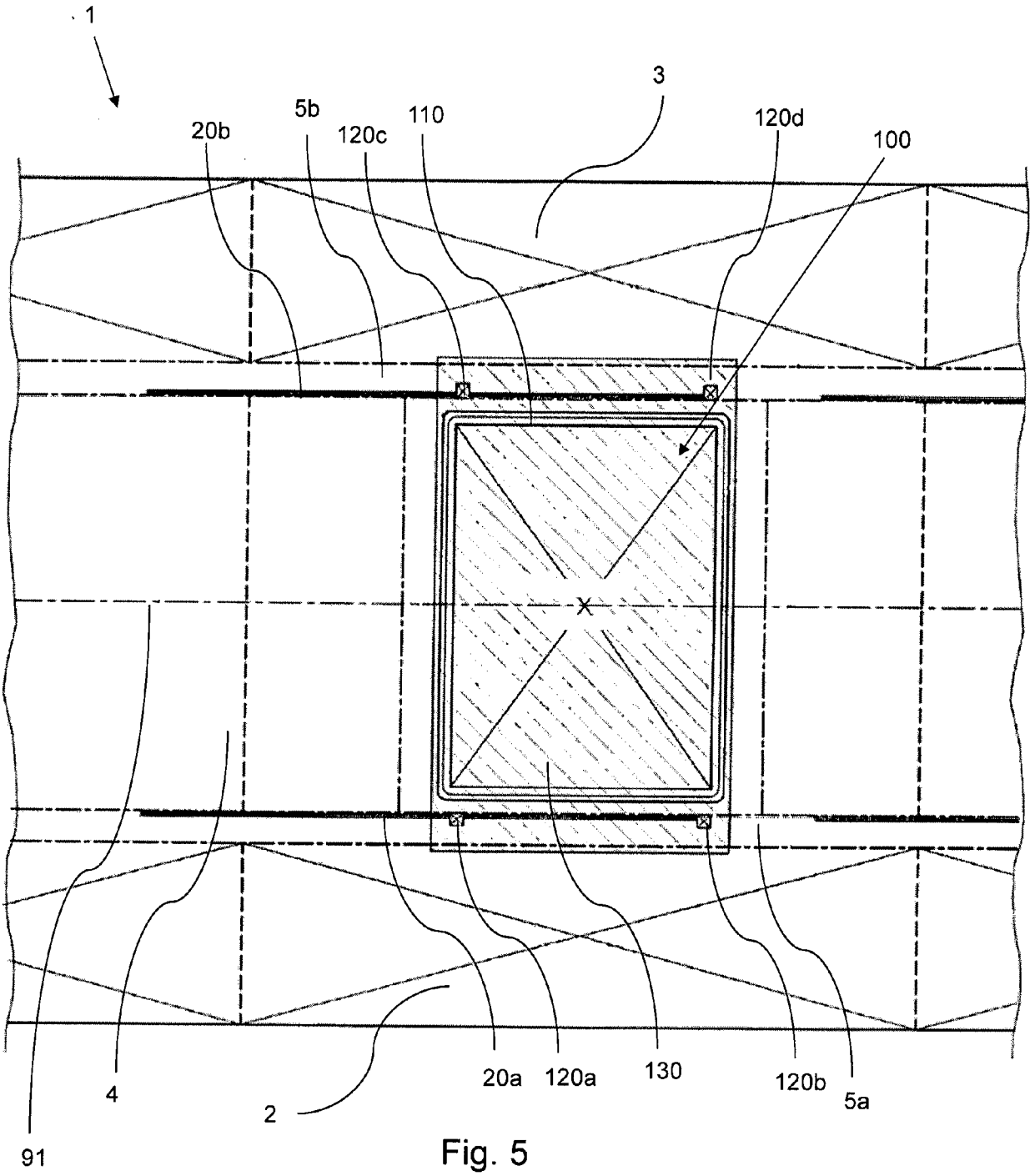

Fig. 5

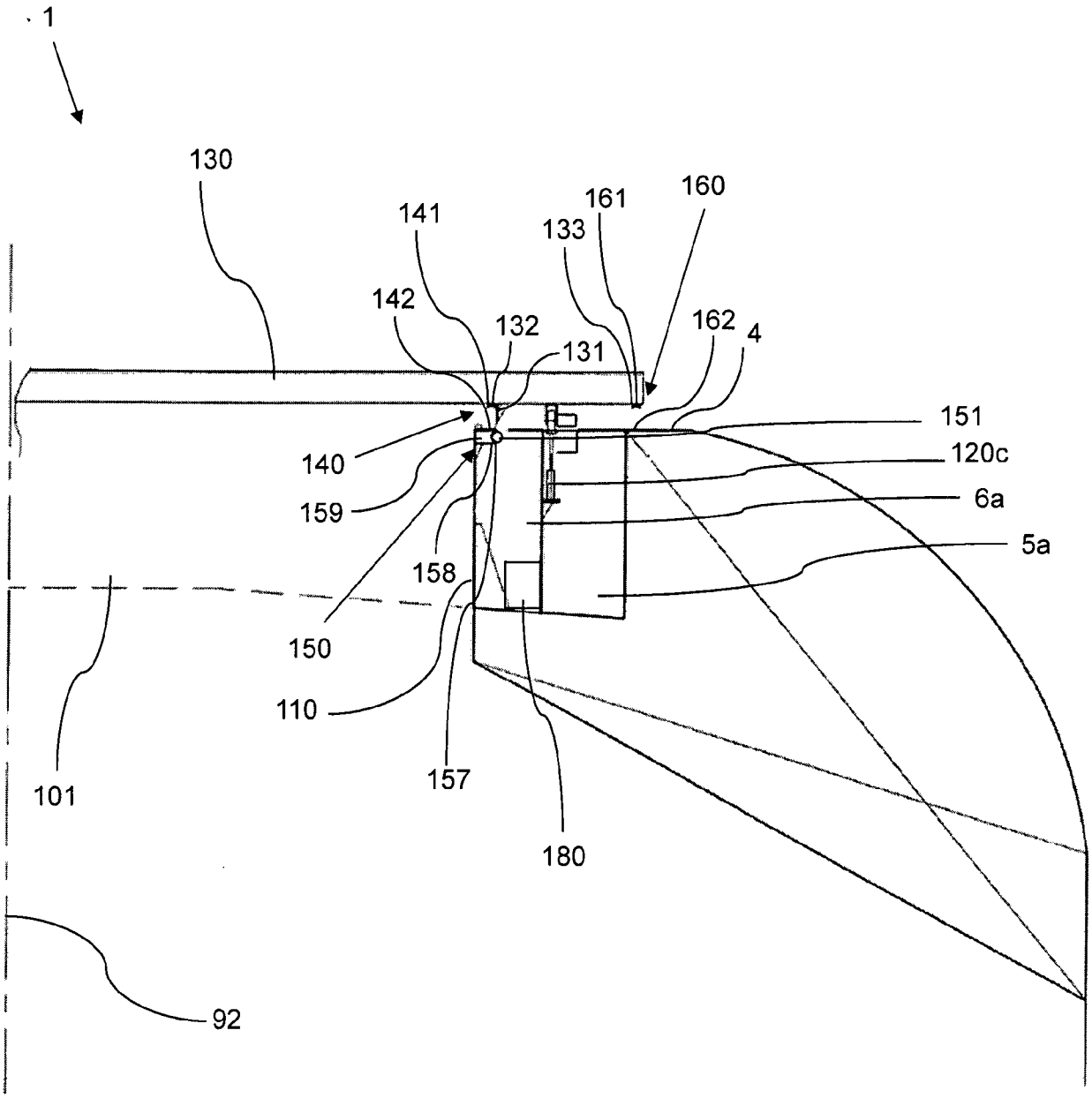
1
130
141
161
160
133
142
132
162
4
131
151
140
120c
159
6a
5a
158
150
110
157
101
180
92

Fig. 6

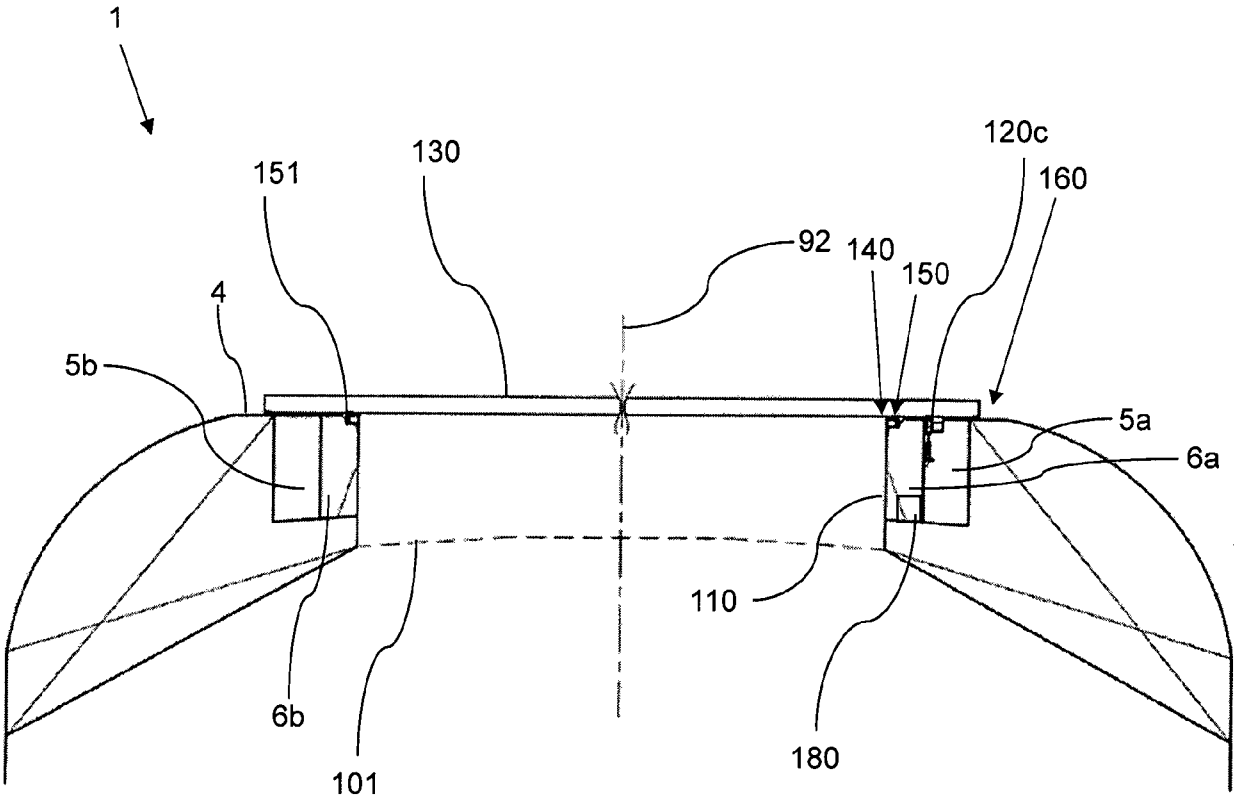

Fig. 7

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 23 39 0001

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	EP 0 261 425 A1 (MACOR MARINE SYSTEMS [DE]) 30 March 1988 (1988-03-30) * column 3, line 21 - column 4, line 18; figures 1,2 *	1-14	INV. B63B19/18 B63B19/26
X	JP 2003 175886 A (DAIKO SANGYO KK) 24 June 2003 (2003-06-24) * machine translation; figure 8 *	1,4-13	
X	JP S54 15292 A (YOSHIKAWA SHINYA) 5 February 1979 (1979-02-05) * machine translation; figures 2,3 *	1-13	
X	JP S48 53086 U (KURUTO TAATEKONRAATO BURIYUBUTSUKURU) 9 July 1973 (1973-07-09) * Machine translation; figure 1 *	1-3,11, 12	

TECHNICAL FIELDS SEARCHED (IPC)

B63B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	23 January 2024	Mauriès, Laurent

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. EP 23 39 0001

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.

23-01-2024

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0261425 A1	30-03-1988	BR 8704568 A	26-04-1988
		CN 1031679 A	15-03-1989
		DD 264407 A1	01-02-1989
		DE 8623792 U1	07-01-1988
		DK 459787 A	05-03-1988
		EP 0261425 A1	30-03-1988
		FI 873814 A	05-03-1988
		JP S63219494 A	13-09-1988
		PL 267545 A1	04-08-1988
		YU 162987 A	31-12-1989
JP 2003175886 A	24-06-2003	JP 3723768 B2	07-12-2005
		JP 2003175886 A	24-06-2003
JP S5415292 A	05-02-1979	NONE	
JP S4853086 U	09-07-1973	NONE	

EPO FORM P0459

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