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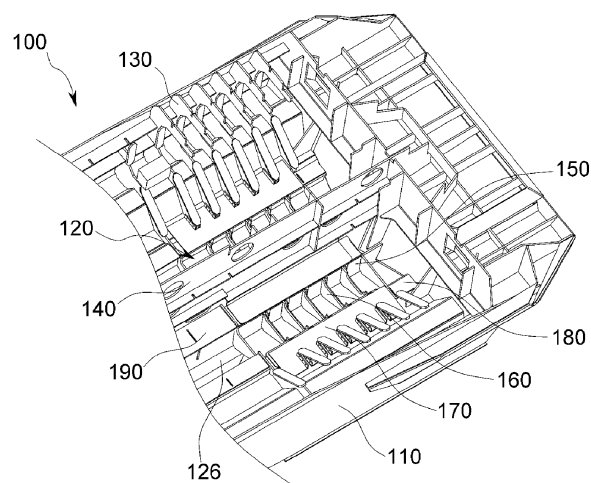
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(54) SHIP HULL HAVING THERMAL DEFORMATION PREVENTION STRUCTURE

(57) A ship hull with a thermal deformation prevention structure that specifically includes a hull having an accommodation space and a reinforcement member installed in the accommodation space to prevent thermal deformation of the hull. The hull includes a bottom part forming the floor of the hull, outer plates positioned on each side of the bottom part; and a plurality of hold frames protruding inward from the outer plates and arranged

along the longitudinal direction of the hull. The reinforcement member is positioned on the bottom part and includes a first reinforcement plate having a plurality of hold frame insertion grooves into which the hold frames are inserted, and a pair of first fixing pieces located on either side of the hold frame insertion grooves and extending upward from the first reinforcement plate.

FIG. 1



Description

TECHNICAL FIELD

[0001] The present invention relates to a ship hull having a heat deformation prevention structure, and more specifically, to a ship hull constructed of High Density Polyethylene ("HDPE"), in which a reinforcement member formed of aluminum alloy (AL5083-H321) is installed in a part of each component installed in the hull of the ship by a butt-bolting method, thereby enabling a reduction in the weight of the ship, increasing the propulsion efficiency of the ship, and also enabling improvement of fuel efficiency, and in particular, preventing longitudinal and transverse thermal deformation in advance of a ship hull made of HDPE material, which is severely subjected to heat deformation due to sunlight.

BACKGROUND ART

[0002] In general, a ship is a means of transportation that carries cargo and passengers and travels on the sea or river. These ships are classified into merchant ships, warships, fishing boats, and special ships, and are also classified into small ships and large ships according to size.

[0003] And, in the case of small ships, they are classified into yachts, boats, and combi boats, and are also manufactured with various materials. For example, they are made of FRP (Fiberglass Reinforced Plastic), wood, and aluminum.

[0004] In particular, FRP ships are manufactured using a mould method, so they have the advantage of being mass-produced.

[0005] This FRP is a composite material combining aromatic polyamide fibers such as fiberglass, carbon fiber, and Kevlar, with thermosetting resins such as unsaturated polyester and epoxy resin. It is a material with excellent durability, bullet resistance, abrasion resistance, and workability.

[0006] Therefore, ships made of FRP have sufficient strength, are lighter, have no joints, resulting in an attractive appearance and reduced hull resistance.

[0007] However, due to the nature of the material, FRP has a high level of vibration under impact, a low elasticity modulus, and a disadvantage of having larger damaged areas in case of cracks or breakage.

[0008] FRP ships are particularly susceptible to hull damage because they are frequently exposed to impacts of varying severity. This includes collisions with reefs or other underwater structures during operation, as well as continuous dynamic loads such as slamming and springing caused by wave impacts. Such damage can ultimately lead to flooding.

[0009] Meanwhile, polyethylene (HDPE) is a thermoplastic universal resin that is a non-toxic, environmentally friendly plastic without detectable endocrine disruptors. This type of polyethylene can be broadly classified into

two categories based on crystallinity: low-density polyethylene, which has low crystallinity due to manufacturing under pressure conditions, and high-density polyethylene, which has high crystallinity.

[0010] This polyethylene boasts superior mechanical properties, moisture resistance, humidity resistance, cold resistance, chemical resistance, and electrical insulation, along with excellent moldability and low manufacturing costs, leading to its widespread use in various containers, packaging materials, pipes, household goods, fibers, and wire coatings.

[0011] High-density polyethylene (HDPE), in particular, exhibits a yield strength of approximately 27 MPa and a specific gravity of approximately 1. Importantly, it contains no detectable levels of bisphenol, phthalate, or melamine (endocrine disruptors), ensuring high safety. Its weight provides stability, resisting tipping, while its durability minimizes breakage from drops. Finally, its high heat resistance, even without surface coating, allows for use in dishwashers and similar applications.

[0012] Meanwhile, in overseas shipbuilding countries, research and development are being conducted to build vessels made of polyethylene, which can address the shortcomings of non-recyclable fiber-reinforced plastics and aluminum fishing boats that have weaknesses in pricing and maintenance. In South Korea, the Korea Maritime Transportation Safety Authority is conducting research to establish safety regulations related to the manufacturing of polyethylene ships in the future.

[0013] Polyethylene ships offer the advantage of hull material recyclability at end-of-life, lower construction costs compared to aluminum ships, and a significantly reduced risk of hull damage from collisions with reefs or other vessels.

[0014] However, polyethylene ships face challenges in joining techniques that are different from those used for conventional materials like aluminum or fiber-reinforced plastics, making it difficult to construct watertight bulkheads at the bow and stern. Specifically, while steel can be joined by cutting sheets into smaller units and welding them together, and composite materials allow for easy joining and overlapping, vessels made from high-density polyethylene require larger sheets due to their high thermal contraction coefficient. As welding is the only available joining method, it becomes problematic to form the necessary watertight bulkheads.

[0015] Furthermore, the welding machines for high-density polyethylene are larger compared to standard welding equipment, which creates a problem when workers need to operate in confined spaces beneath the deck. This limited size can result in areas where upward welding is impossible, making the process more challenging.

[0016] To address these issues, polyethylene ships can be equipped with multiple hollow polyethylene balls positioned below the deck, creating an air layer inside. This design can help prevent the sinking of the vessel in the event of impact by providing buoyancy and enhancing overall stability.

[0017] However, vessels equipped with polyethylene balls cannot establish watertight bulkheads, which means they cannot guarantee the intrinsic safety of the polyethylene ship itself. In the event of hull leakage, this design may lead to a decrease in performance and an increased risk of accidents, indicating that it does not provide a fundamental solution to the safety concerns.

[0018] In particular, high-density polyethylene material is susceptible to significant thermal deformation due to solar radiation. When constructing a ship's hull solely from this material, there is a considerable occurrence of longitudinal and transverse deformation caused by heat. Therefore, there is a need for shipbuilding methods that incorporate hull structures designed to prevent thermal deformation, ensuring the stability and integrity of the vessel under varying temperature conditions.

SUMMARY OF THE INVENTION

TECHNICAL PROBLEM

[0019] The present invention aims to solve various conventional problems by incorporating aluminum alloy plates into some components of HDPE ship hulls, thereby enhancing structural strength while reducing weight, improving propulsion efficiency, fuel economy, and preventing significant longitudinal and transverse thermal deformation caused by solar radiation, ultimately extending the vessel's lifespan with a thermal deformation prevention structure.

[0020] Another objective of the present invention is to further equip the surroundings of the reinforcement members and the reinforcement members themselves with temperature detection sensors and cooling means, so that when the temperature of the reinforcement members rises above a predetermined level, the cooling means activates to more effectively prevent thermal deformation in the longitudinal and transverse directions of the hull structure surrounding the reinforced areas due to high temperatures, thereby providing a ship hull with an effective thermal deformation prevention structure.

[0021] Furthermore, the detailed objectives of the present invention will be readily apparent and understood by experts and researchers in the relevant technical field through the specific details provided below.

MEANS FOR SOLVING THE PROBLEM

[0022] An embodiment of the thermal deformation prevention structure for the ship hull according to the present invention to achieve the above objectives includes: a hull formed of high-density polyethylene with an internal accommodation space; and a reinforcement member installed within the accommodation space to prevent thermal deformation of the hull.

[0023] The hull comprises a bottom part forming the hull's floor; outer plates positioned on either side of the bottom part; and a plurality of hold frames that protrude

inward from the outer plates and are arranged along the longitudinal direction of the hull.

[0024] The reinforcement member includes a first reinforcement plate positioned on the bottom part, having a plurality of insertion grooves for the hold frames, where each rib can be inserted; and a pair of first fixing pieces positioned on either side of the insertion grooves, extending upward from the first reinforcement plate.

[0025] Furthermore, the bottom part includes a bottom plate forming the hull's floor; at least one girder groove extending along the longitudinal direction of the hull; and a plurality of side girders inserted into the girder groove, supporting both sides of the groove and arranged longitudinally along its sides.

[0026] The reinforcement member comprises a second reinforcement plate positioned above the bottom plate of the side girders, spaced apart from the first reinforcement plate across the girder groove; and rib plates that are inserted into the girder groove to support both sides of the groove, with floor reinforcement plates installed on each rib plate within the groove, connecting the first and second reinforcement plates.

[0027] Furthermore, the floor reinforcement plate includes a pair of third fixing pieces that protrude longitudinally at both ends and are positioned such that one face is in close contact with the faces of the rib plates within the girder groove while supporting the adjacent side girders.

[0028] Furthermore, the hull includes a central girder positioned on the bottom plate of the bottom part along the inner centerline of the bottom plate, and the second reinforcement plate is positioned between the central girder and one side of the girder groove.

[0029] Moreover, the second reinforcement plate has a projection extending upward from one side and includes a second fixing part that is coupled to the central girder.

[0030] At this time, the hull, the plurality of hold frames, the central girder, and the plurality of side girders are formed from high-density polyethylene (HDPE) material with a yield strength of 27 MPa and a specific gravity of 1, while the reinforcement member is formed from aluminum alloy (AL5083-H321) plates with a yield strength of 270 MPa and a specific gravity of 2.7.

[0031] Furthermore, within the hull, a temperature detection sensor is installed to continuously monitor the internal temperature where the reinforcement members are positioned; and a control unit is included to compare the detected temperature from the temperature detection sensor with a reference temperature and control the operation of the cooling means. Furthermore, at least one cooling means is installed on one side of the reinforcement members, which activates to cool the reinforcement members when the control unit determines that the temperature detected by the temperature detection sensor exceeds the specified reference temperature and outputs a drive signal.

[0032] In this context, an example of the cooling means includes a plurality of PTC (Positive Temperature Coeffi-

cient) thermistors attached to one side of the reinforcement members, which, when supplied with a DC voltage from the control unit, generate heat on one side and cool on the other, thereby effectively cooling the reinforcement members while exhibiting constant temperature characteristics.

[0033] Furthermore, another example of the cooling means includes the installation of cooling coils on one side of the reinforcement members, along with a cooling system installed on one side of the bottom plate that operates in response to output signals from the control unit to supply cold air to the cooling coils.

[0034] Furthermore, another example of the cooling means includes a cooling fan installed in one of the slits positioned at the entrance of the slits formed in the side girders or rib plates that are interconnected in a grid pattern, which operates in response to output signals from the control unit to generate cool air.

[0035] Meanwhile, terminology and words used in the claims of this specification should not be interpreted strictly in their customary or dictionary meanings. Instead, based on the principle that the inventor may appropriately define the concepts of terms to best describe the invention, they should be understood in meanings and concepts that align with the technical spirit of the present invention.

[0036] Therefore, embodiments and configurations illustrated in the drawings provided in this specification are merely examples of the most preferred embodiment of the invention and do not represent all aspects of the technical spirit of the invention. It should be understood that various equivalents and modifications that could replace them exist as of the filing date of this application.

EFFECTS OF THE INVENTION

[0037] As described above, the ship hull with a thermal deformation prevention structure according to the present invention enhances the structural reinforcement by installing reinforcement members shaped from aluminum alloy plates in certain components of the HDPE hull, enabling weight reduction, improving propulsion efficiency and fuel economy, and effectively preventing significant longitudinal and transverse thermal deformation caused by solar radiation, thereby significantly extending the vessel's lifespan.

[0038] Furthermore, the present invention is highly valuable as it further installs temperature detection sensors and cooling means around or on the reinforcement members, which activate the cooling means when the temperature of the reinforcement members rises above a predetermined level, thereby more effectively preventing thermal deformation in the longitudinal and transverse directions of the hull structure in the areas where the reinforcement members are installed due to high temperatures.

[0039] In addition, in the effects of the present invention will become evident and be readily understood by experts

and researchers in the relevant technical field through the specific details described below or during the process of implementing the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0040]

FIG. 1 is a schematic perspective view of a ship applying one embodiment of the present invention. FIG. 2 is an enlarged perspective view of a key part of the ship applying one embodiment of the present invention.

FIG. 3 is an enlarged cross-sectional view of a key part of the ship applying one embodiment of the present invention.

FIGS. 4(a) to (c) are perspective views of reinforcement members used in the present invention.

FIG. 5 is a block diagram illustrating the combination of the temperature detection sensor, control unit, and cooling means applied in another embodiment of the present invention.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0041] The present invention can undergo various modifications and can take on several forms, and specific embodiments are intended to be illustrated in the drawings and described in detail in the text. However, this is not intended to limit the invention to the particular disclosed forms, but rather is to be understood as encompassing all modifications, equivalents, and alternatives that fall within the spirit and technical scope of the invention.

[0042] The terms "first," "second," and so forth may be used to describe various components, but such components should not be limited by these terms. These terms are used solely for the purpose of distinguishing one component from another. For example, a first component may be named the second component without departing from the scope of the invention, and similarly, a second component may also be referred to as the first component.

[0043] The terminology used in this application is merely for explaining specific embodiments and is not intended to limit the invention. Unless the context clearly dictates otherwise, singular expressions should be understood to include plural expressions. In this application, terms such as "comprise" or "have" are intended to indicate that the specified features, numbers, steps, actions, components, or parts, or combinations thereof, are present. They should not be understood as precluding the possibility of the presence or addition of one or more other features, numbers, steps, actions, components, parts, or combinations thereof.

[0044] Unless otherwise defined, all terms used herein, including technical and scientific terms, have the same meaning as commonly understood by one of ordinary

skill in the art to which this invention belongs.

[0045] Terms that are generally defined in commonly used dictionaries should be interpreted as having meanings consistent with the context of the relevant art, and should not be interpreted in an idealized or overly formal sense unless explicitly defined in this application.

[0046] Hereinafter, the operating state according to each configuration, including a preferred embodiment according to the present invention, will be described in detail with reference to the attached drawings.

[0047] FIG. 1 is a perspective view illustrating a vessel to which one embodiment of the present invention is applied. FIG. 2 is an enlarged perspective view of the key part of the vessel to which one embodiment of the present invention is applied. FIG. 3 is a cross-sectional view of the key part of the vessel to which one embodiment of the present invention is applied. FIG. 4(a) to 4(c) show perspective views of the reinforcement members applied in the present invention.

[0048] Furthermore, Figure 5 is a block diagram illustrating the combined configuration of the temperature detection sensor, control unit, and cooling means as applied in another embodiment of the present invention.

[0049] According to this, the hull of the vessel equipped with a thermal deformation prevention structure in one embodiment of the present invention may include an outer plate (110) and a bottom part (120), as illustrated in Figures 1 to 4(a) to 4(c). The bottom part (120) may form the bottom of the hull (100). The outer plate (110) may be positioned on the outside of the bottom part (120). The bottom of the outer plate (110) may be connected to the bottom part (120). The bottom part (120) and the outer plate (110) may extend from the bow to the stern. By forming the bottom part (120) and the outer plate (110) to extend from the bow to the stern, the hull (100) can have a predetermined size of accommodation space inside.

[0050] Furthermore, the inner side of the outer plate (110) of the hull (100) may have a structure in which a plurality of hold frames (130) are installed to protrude. The plurality of hold frames (130) may be arranged along the longitudinal direction (lengthwise direction of the hull) of the hull (100) so as to protrude upward from the outer plate (110).

[0051] Furthermore, the bottom part (120) that forms the bottom of the hull (100) may include a bottom plate (121), a center girder (140), a plurality of side girders (150), a plurality of floors (160), a girder groove (170), a margin plate (180), and an inner bottom plate (190).

[0052] At this time, the bottom plate (121) is installed in a manner that connects to the bottom of the outer plate (110), thereby serving the function of a bottom plate for the bottom part (120) of the hull (100).

[0053] Furthermore, the center girder (140) is positioned on the bottom plate (121) and installed in the longitudinal direction along the internal centerline of the bottom plate (121), serving a reinforcing function for the longitudinal direction of the hull.

[0054] Furthermore, the plurality of side girders (150)

may be installed in the longitudinal direction on both sides of the center girder (140) on the upper surface of the bottom plate (121). The plurality of floors (160) may be positioned on the upper surface of the bottom plate (121), and the plurality of floors (160) are installed at regular intervals in the transverse direction (widthwise direction of the hull) within the girder groove (170) formed between the adjacent side girders (150).

[0055] Through the plurality of side girders (150) and the plurality of floors (160), the hull (100) may have a structure in which at least one girder groove (170) is formed elongated along the longitudinal direction.

[0056] At this time, the floors (160) may be inserted and arranged along the transverse direction within the girder groove (170), thereby supporting the side girders (150) installed on both sides of the girder groove (170).

[0057] Furthermore, the margin plate (180) is installed toward the hold frames (130), including the upper surfaces of the side girders (150) and the floors (160), and the inner bottom plate (190) is installed between the margin plate (180) on the upper surface of the center girder (140) and the side girders (150) or the side girder (150).

[0058] Meanwhile, the outer plate (110) of the hull (100), including the bottom plate (121), the plurality of hold frames (130), the center girder (140), the plurality of floors (160), the plurality of side girders (150), the margin plate (180), and the inner bottom plate (190) are formed from high-density polyethylene (HDPE) material that has a yield strength of approximately 27 MPa and a specific gravity of about 1. Furthermore, no environmental hormones such as bisphenol, phthalates, or melamine are detected, ensuring high stability. The material is weighty, making it difficult to tip over and resistant to breaking even when dropped, demonstrating high durability. Furthermore, it features high heat resistance (i.e., thermal stability) without surface coating.

[0059] Below, the functions of each component constituting the hull (100) are examined as follows.

[0060] First, the outer plate (110) serves as a longitudinal strength member, capable of withstanding not only the hydrostatic pressure and cargo pressure within the cargo hold but also the forces resulting from collisions with other vessels and the bending moments acting within the cross-section.

[0061] The bottom plate (121) serves as the floor for the bottom part (120) of the hull (100). Its thickness is determined by factors such as the frame spacing, length of the vessel, fully loaded draft, and section modulus of the hull's central cross-section; it is thicker in the central portion and gradually becomes thinner toward the bow and stern. However, since significant impact pressures from slamming are applied to the bottom plate at the bow, it is preferable for this section to be formed with a sufficient thickness to withstand these pressures.

[0062] Furthermore, the plurality of hold frames (130) serves to maintain the transverse strength of the hull (100) and prevent lateral deflection.

[0063] Furthermore, the center girder (140) is a longitudinal strength member installed to span the center of the bow and stern from the inside of the bottom plate (121) and is joined to the floors (160) arranged transversely within the hull (100). Since this component will bear concentrated loads during drying and loading, it is important to avoid creating continuous holes. In the case of longitudinal frame arrangements, where the spacing between the floors is large, it is preferable to install brackets at the midpoint of the floors to provide support.

[0064] Furthermore, the plurality of floors (160) is arranged and installed in the transverse direction (widthwise direction of the hull) within the girder groove (170) formed between the center girder (140) and the side girders (150) at the designated positions of the double bottom within the bottom plate (121). Furthermore, the floors (160) are installed at the bow and on the bottom plate (121), where large wave impact forces act, as well as in the lower sections of the transverse bulkheads and engine rooms. In the case of longitudinal frame arrangements, a slot is made to penetrate the longitudinal frames through the floors (160), and a vertical reinforcement member may be attached to support the longitudinal frames installed on the bottom plate (121) and the inner bottom plate (190).

[0065] Furthermore, the plurality of side girders (150) serves to simplify the connection between the bottom plate (121) and the inner bottom plate (190), and it is preferable to install them on both sides centered on the center girder (140) and penetrate the bow as much as possible. However, it is also possible to cut them between the floors (160) and attach vertical reinforcements while creating manholes for passage. In the case of longitudinal frames arrangements, the side girders primarily function to prevent lateral deformation of the floors and are not included as longitudinal strength members.

[0066] Furthermore, the margin plate (180) is installed between the hold frames (130) on the upper surfaces of the side girders (150) and the floors (160), and it is a component that forms the bridge area at both ends to ensure that the inner bottom plate (190) has a watertight or fluid-tight structure.

[0067] Furthermore, the inner bottom plate (190) is a plate that covers the upper surface of the double bottom, installed on the upper surfaces of the center girder (140) and the side girders (150). In the event of an accident, such as grounding, where the bottom plate (121) may become damaged, the inner bottom plate (190) will bear hydrostatic pressure.

[0068] Therefore, it is preferable for it to be installed with sufficient strength and a watertight structure to withstand such pressure.

[0069] Meanwhile, the vessel to which one embodiment of the present invention is applied further includes a reinforcement member (200) installed in the accommodation space of the hull (100) itself to prevent thermal deformation of the hull (100).

[0070] The reinforcement member (200) functions to

prevent thermal deformation in both the longitudinal and transverse directions of the hull (100) of the vessel being dried, made of HDPE material.

[0071] At this time, the reinforcement member (200) may include a first reinforcement plate (210), a second reinforcement plate (220), and a floor reinforcement plate (230).

[0072] Among the reinforcement member (200), the first reinforcement plate (210) is configured to include a plurality of hold frame insertion grooves (211) into which the hold frames (130) are each inserted, and a pair of first fixing pieces (212) that extend upward from both sides of the hold frame insertion grooves (211), and performs longitudinal and transverse reinforcing functions for the hold frames (130) and the margin plate (180) as well as a function of preventing thermal deformation when positioned on the upper surface of the margin plate (180).

[0073] More specifically, the first reinforcement plate (210) has a shape corresponding to the margin plate (180), as shown in (a) of FIG. 4, and has a plurality of hold frame insertion grooves (211) formed at a set interval on one side into which the plurality of hold frames (130) can be respectively inserted, and the pair of first fixing pieces (212) are formed extending upward from both sides of the hold frame insertion grooves (211).

[0074] The first reinforcing plate (210) is installed between the hold frames (130) and the upper surface of the friction plate (180). It is then detachably secured to the hold frames (130) using multiple bolts, etc., which connect to the hold frames via the first fixing piece (212). This allows the first reinforcing plate (210), resting on the upper surface of the friction plate (180), to be easily attached and detached from the inner frame ribs (130).

[0075] Accordingly, the first reinforcement plate (210) not only has a longitudinal and transverse reinforcing function for the hold frames (130) and the margin plate (180) as well as the hull (100) itself, but also has a function of radiating heat generated from the hold frames (130) and the margin plate (180) to the outside, thereby preventing the hold frames (130) and the margin plate (180) from being overheated and thermally deformed by solar heat including heat generated from the engine.

[0076] Furthermore, the second reinforcement plate (220) is fixedly installed on the upper surface of the inner bottom plate (190) at a position spaced apart from the first reinforcement plate (210) with the girder groove (170) therebetween, and performs the function of reinforcing the inner bottom plate (190) as well as the hull (100) itself in the longitudinal direction and preventing thermal deformation.

[0077] More specifically, the second reinforcement plate (220) has a shape corresponding to the inner bottom plate (190), as shown in (b) of FIG. 4, but has a shape in which a second fixing piece (221) is extended or bent upward from one side.

[0078] The second reinforcement plate (220) is positioned on the upper surface of the inner bottom plate (190) and is detachably fixed to the upper portions of the

center girder (140) or the side girders (150) using a plurality of bolts or similar fasteners through the second fixing piece (221).

[0079] Therefore, the second reinforcement plate (220) not only provides transverse reinforcement for the inner bottom plate (190) and the hull (100) itself, but also facilitates the dissipation of heat generated from the inner bottom plate (190) to the outside. This action helps to prevent the inner bottom plate (190) from overheating and undergoing thermal deformation due to solar heat and heat generated by the engine in advance.

[0080] Furthermore, the floor reinforcement plate (230) has a shape in which a pair of third fixing pieces (231) are formed to protrude in the longitudinal direction from both ends, and is arranged transversely with respect to the width direction of the hull in a shape that is in close contact with one surface of the floors (160) installed in the girder groove (170), and performs a transverse reinforcement function for the floors (160) including the bottom plate (121) and a function of preventing thermal deformation.

[0081] Specifically, the floor reinforcement plate (230) has a shape corresponding to the floors (160), as shown in (c) of FIG. 4, but has a third fixing piece (231) formed in an extended or folded shape such that the floor reinforcement plate (230) itself is fixed to the side girders (150) in the longitudinal direction at both ends while allowing both sides of the floor reinforcement plate (230) to support the side girders (150).

[0082] The floor reinforcement plate (230) of this type is detachably and fixedly installed to the side girders (150) using a plurality of bolts, etc., which are connected to the side girders (150) through the third fixing pieces (231) in a state where one side is in close contact with the opposite surfaces of the floors (160) and a pair of third fixing pieces (231) provided at both ends are arranged in close contact with the opposite surfaces of the adjacent side girders (150).

[0083] Accordingly, the floor reinforcement plate (230) can prevent the bottom plate (121) and the floors (160) from being thermally deformed in advance by having a transverse reinforcement function for the floors (160) as well as the hull (100) itself, and by dissipating heat generated from the bottom plate (121) and the floors (160) to the outside.

[0084] At this time, it is preferable that the upper portion of the third fixing pieces (231) provided at both ends of the floor reinforcement plate (230) be formed to be extended high enough to be in direct contact with the other surfaces of the first reinforcement plate (210) and the second reinforcement plate (220) exposed toward the girder groove (170).

[0085] In this way, when the upper portion of the pair of third fixing pieces (231) provided on both ends of the floor reinforcement plate (230) is formed to be extended high enough to be in contact with the other surfaces of the first reinforcement plate (210) and the second reinforcement plate (220), the other surfaces of the first reinforcement

plate (210) and the second reinforcement plate (220) are each hung on the back surface of the third fixing piece (231) of the floor reinforcement plate (230). Therefore, even without performing separate fixing work on the other sides of the first reinforcement plate (210) and the second reinforcement plate (220), it is possible to prevent longitudinal movement within the hull.

[0086] Meanwhile, the exposed outer surface of the first reinforcement plate (210), the second reinforcement plate (220), or the floor reinforcement plate (230) presented as the reinforcement member (200) may further include a plurality of heat dissipation fins formed in a protruding manner, although not shown.

[0087] For example, in the case of the first and second reinforcement plates (210)(220), the plurality of heat dissipation fins may be further formed protrudingly on the upper surface thereof, and in the case of the floor reinforcement plate (230), the plurality of heat dissipation fins may be further formed protrudingly on the front surface.

[0088] In this way, by further protruding and forming the plurality of heat dissipation fins on the outer surface of the first reinforcement plate (210), the second reinforcement plate (220), or the floor reinforcement plate (230), the heat dissipation area for each reinforcement plate can be significantly expanded, thereby further increasing the heat dissipation efficiency through each reinforcement plate.

[0089] Here, the first reinforcement plate (210), the second reinforcement plate (220), and the floor reinforcement plate (230) presented as the reinforcement member (200) are preferably manufactured using a plate formed from an aluminum alloy having a yield strength of 270 MPa and a specific gravity of 2.7, for example, AL5083-H321.

[0090] The aluminum alloy (AL5083-H321) described above has a low specific gravity and excellent strength, so when used as a molding material for the reinforcement member (200) as described above, the weight of the hull can be reduced, which reduces fuel costs and enables faster ship speeds.

[0091] Meanwhile, in the explanation so far, the first reinforcement plate (210), the second reinforcement plate (220), and the floor reinforcement plate (230) included in the reinforcement member (200) are detachably and fixedly installed to the hold frames (130) or the center girder (140) or the side girders (150) using the plurality of bolts as described above, but this is not limited thereto, and they may be fixed to each other as one piece using welding or adhesive, etc.

[0092] Furthermore, the contact portion between the first reinforcement plate (210) and the floor reinforcement plate (230) and the contact portion between the second reinforcement plate (220) and the floor reinforcement plate (230), that is, between the upper portion of the third fixing piece (231) on one side of the floor reinforcement plate (230) and the other side of the first reinforcement plate (210) in contact therewith, and between the upper

portion of the third fixing piece (231) on the other side of the floor reinforcement plate (230) and the other side of the second reinforcement plate (220) in contact therewith, may be integrated by welding into one reinforcement member (200).

[0093] In this way, when the first reinforcement plate (210), the second reinforcement plate (220), and the floor reinforcement plate (230) are integrated into a single reinforcement member (200) through mutual welding, the reinforcement member (200) equipped with all of the first reinforcement plate (210), the second reinforcement plate (220), and the floor reinforcement plate (230) can be detachably and fixedly installed to the hull at once, thereby significantly reducing the time and labor costs associated with installation and disassembly of the reinforcement member.

[0094] Alternatively, in addition to the bolt fastening method or welding method used to fix the reinforcement member (200), it may further include filling a heat-conductive adhesive formed by including any one of epoxy, urethane, and silicone between the bottom surface of the first reinforcement plate (210) and the top surface of the margin plate (180), or between the bottom surface of the second reinforcement plate (220) and the top surface of the inner bottom plate (190), and between the contact surface of the floor reinforcement plate (230) and the floor (160).

[0095] In this way, by further filling the heat conductive adhesive between each contact surface, not only can the fixing strength of the reinforcement member (200) fixed by bolts or welding be further enhanced, but also the heat generated from each component plate including the hull (100) made of HDPE material can be efficiently and quickly transferred to the reinforcement member (200) through the heat conductive adhesive. Accordingly, the heat dissipation efficiency through each reinforcement member (200) can be significantly improved, and thus the heat deformation prevention efficiency of each component plate including the hull can be further increased.

[0096] Meanwhile, FIG. 5 is a block diagram illustrating a combination state of a temperature detection sensor, a control unit, and a cooling means applied in another embodiment of the present invention, according to which a temperature detection sensor (300), a control unit (400), and at least one cooling means (500) may be further installed inside the hull (100). At this time, the temperature detection sensor (300), although not shown in the figure, detects the temperature of the internal space in which the reinforcement member (200) is installed or the reinforcement member (200) itself in real time while installed in the bottom part (120) of the hull (100) in which the reinforcement member (200) are installed or in each reinforcement member (200) within the bottom part (120) and transmits the temperature to the control unit (400).

[0097] Furthermore, the control unit (400), although not shown in the figure, has a reference temperature value set internally and, while installed in the ship bottom part (120), compares the temperature detected in real

time through the temperature detection sensor (300) with its own reference temperature, and performs a function of controlling the operation of the cooling means (500) in response to the result.

[0098] Furthermore, the cooling means (500), although not shown in the figure, is installed on at least one side of the reinforcement member (200), and when the temperature detected in real time by the temperature detection sensor (300) in the control unit (400) is judged to have risen above a set reference temperature and a predetermined driving signal is output, the cooling means (500) operates and performs the function of cooling the reinforcement member (200) as well as the members on which the reinforcement member (200) is installed.

[0099] In this way, in the present invention, the temperature detection sensor (300) and the cooling means (500) are further installed around or on the reinforcement member (200), and when the temperature of the reinforcement member (200) rises above a predetermined temperature, the cooling means (500) is operated, thereby more effectively preventing the hull component plates in the area where the reinforcement member (200) is further provided from being subjected to thermal deformation in the longitudinal and transverse directions due to high temperatures.

[0100] At this time, the cooling means (500) may have various configurations, and as an example, may include a plurality of PTC thermistors (510).

[0101] The plurality of PTC thermistors (510), although not shown in the figure, which have temperature-regulating properties, are installed in a form where the cooling section is attached to one side of the reinforcement member (200). The PTC thermistors (510) operates such that one surface fixed to the reinforcement member (200) generates heat when a direct current voltage is supplied from the control unit (400), while the opposite surface functions to cool. Through this method of directly cooling the reinforcement member (200), the system performs the function of indirectly cooling the components to which the reinforcement member (200) are attached.

[0102] Alternatively, another example of the cooling means (500) may include a cooling coil (520) and a cooling system (530). At this time, the cooling coil (520), although not shown in the figure, may be installed in a zigzag shape on one side of the reinforcement member (200), and the cooling system (530) may be installed on one side of the bottom plate (121).

[0103] In this way, when the cooling coil (520) is installed on one side of the reinforcement member (200) and the cooling system (530) is installed on the bottom plate (121), when the temperature detected in real time by the temperature detection sensor (300) is judged to have risen above a set reference temperature, the control unit (400) operates the cooling system (530) to flow refrigerant to the cooling coil (520). Therefore, the reinforcement member (200) as well as the members on which the reinforcement member (200) is installed can be automatically cooled by the cold air emitted from the

cooling coil (520).

[0104] Furthermore, another example of the cooling means (500) may include a plurality of blower fans (540).

[0105] The plurality of blower fans (540) are installed in one slot (151; see the cross-sectional view of FIG. 3) provided at the beginning among the slots formed in the side girders (150) which are connected in a mutual grid form. The plurality of blower fans (540) are operated in response to the output signal of the control unit (400) and perform the function of generating cold air to automatically cool the reinforcement member (200) as well as the members on which the reinforcement member (200) is installed.

[0106] The embodiments of the cooling means (500) described above are not limited thereto, and any type of cooling means (e.g., water-cooling means, heat sink, etc.) may be applied as long as it can cool the members in which the reinforcement member (200) are installed when the temperature rises above a predetermined temperature.

[0107] As described above, the present invention is not limited to the described embodiments, and it is obvious to those skilled in the art that various modifications and variations can be made without departing from the spirit and scope of the present invention.

[0108] Thus, the embodiments of the present invention can be implemented in various forms without departing from the technical concept or essential characteristics. Therefore, the embodiments of the present invention should not be construed as limiting examples in any respect and may be modified and implemented in various ways.

[0109] That is, although the detailed description of the present invention described above has been described with reference to preferred embodiments of the present invention, it will be understood by those skilled in the art or having common knowledge in the art that the present invention can be variously modified and changed within a scope that does not depart from the spirit and technical scope of the present invention described in the claims to be described later.

Claims

1. A ship hull with thermal deformation prevention structure, comprising:

a hull having an accommodation space within it and formed of high-density polyethylene; and a reinforcement member installed within the accommodation space that prevents thermal deformation of the hull, wherein the hull comprises a bottom part that forms the floor of the hull; outer plates positioned on each side of the bottom part; and a plurality of hold frames that protrude inward from the outer plates and are arranged along the longitudinal

direction of the hull,

wherein the reinforcement member comprises a first reinforcement plate positioned on the bottom part and having a plurality of hold frame insertion grooves into which the hold frames are respectively inserted; and a pair of first fixing pieces positioned on each side of the hold frame insertion grooves and extending upward from the first reinforcement plate.

2. The ship hull with thermal deformation prevention structure of claim 1, wherein the bottom part comprises a bottom plate forming the bottom of the hull; at least a girder groove formed elongated along the longitudinal direction of the hull; and a plurality of side girders inserted into the girder groove that support both sides of the girder groove and are arranged longitudinally on both sides of the girder groove; wherein the reinforcement member comprises a second reinforcement plate that is spaced apart from the first reinforcement plate with the girder groove interposed therebetween and is positioned on an inner bottom plate above the side girders; and a floor reinforcement plate installed on each of the floors that are inserted into the girder groove, supporting both sides of the girder groove, and connecting the first reinforcement plate and the second reinforcement plate.
3. The ship hull with thermal deformation prevention structure of claim 2, wherein the floor reinforcement plate protrudes longitudinally from both ends, is positioned within the girder groove with one surface in close contact with the surfaces of the floors, and further includes a pair of third fixing pieces that each support an adjacent side girder.
4. The ship hull with thermal deformation prevention structure of claim 2, wherein the hull further comprises a center girder positioned on the bottom plate of the bottom part of the hull and installed on the inner centerline of the bottom plate, and the second reinforcement plate is positioned between the center girder and one side of the girder groove.
5. The ship hull with thermal deformation prevention structure of claim 4, wherein the second reinforcement plate comprises a second fixing piece that protrudes upward from one side and is connected to the center girder.
6. The ship hull with thermal deformation prevention structure of claim 1, wherein the reinforcement member is formed of an aluminum alloy.

FIG. 1

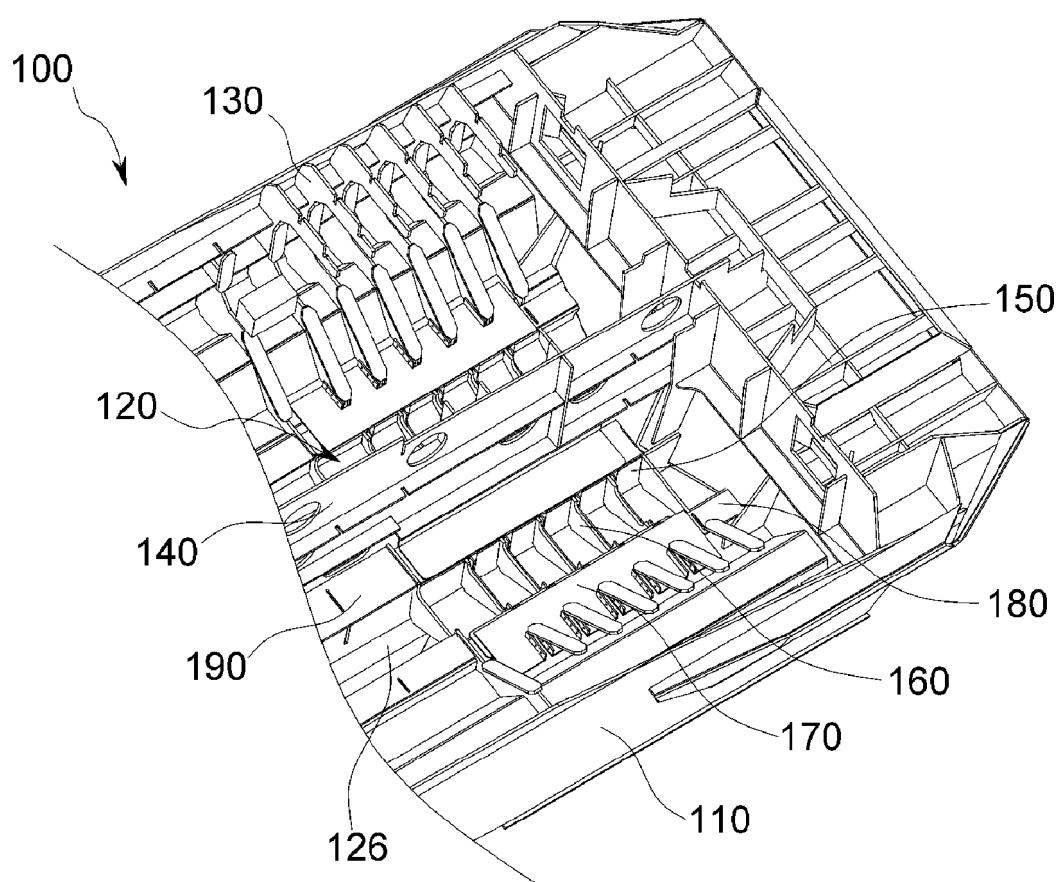


FIG. 2

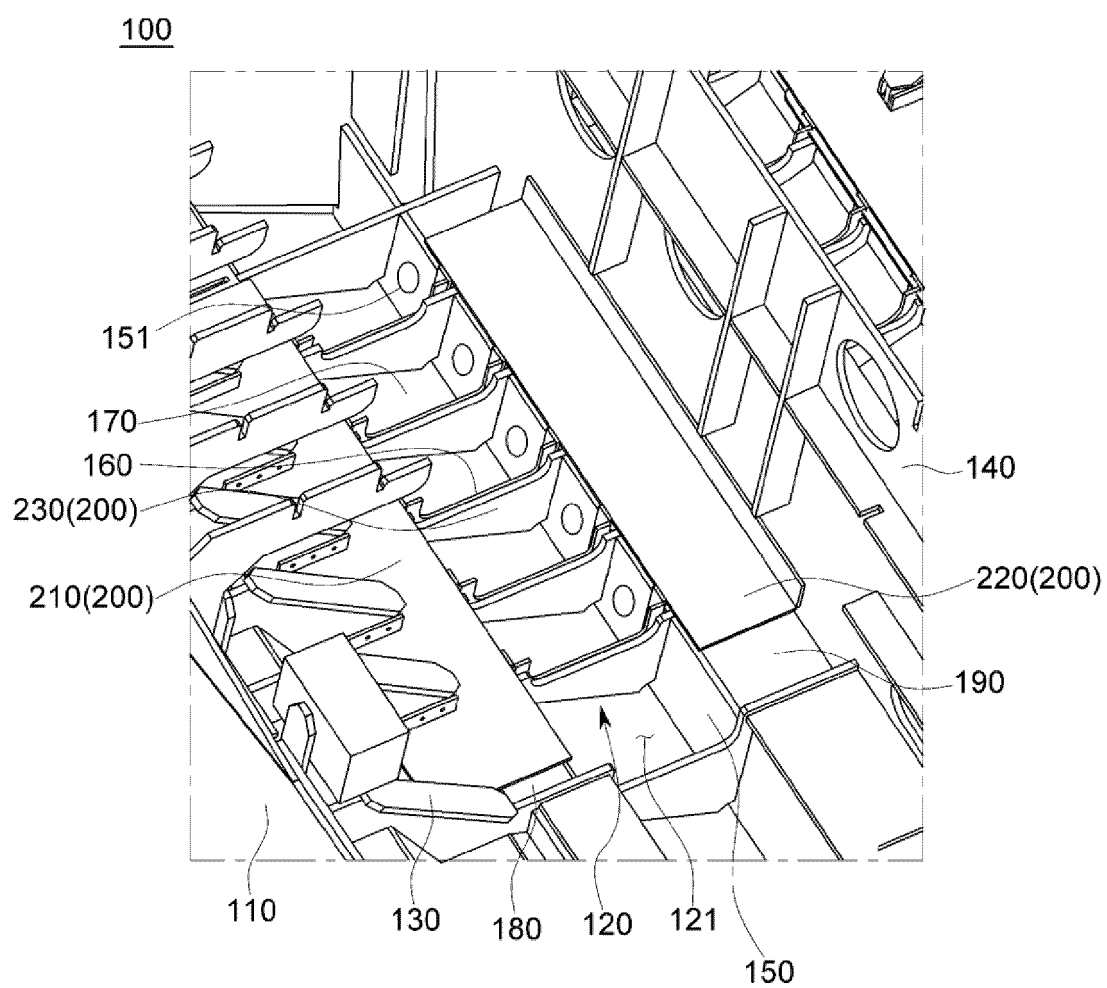


FIG. 3

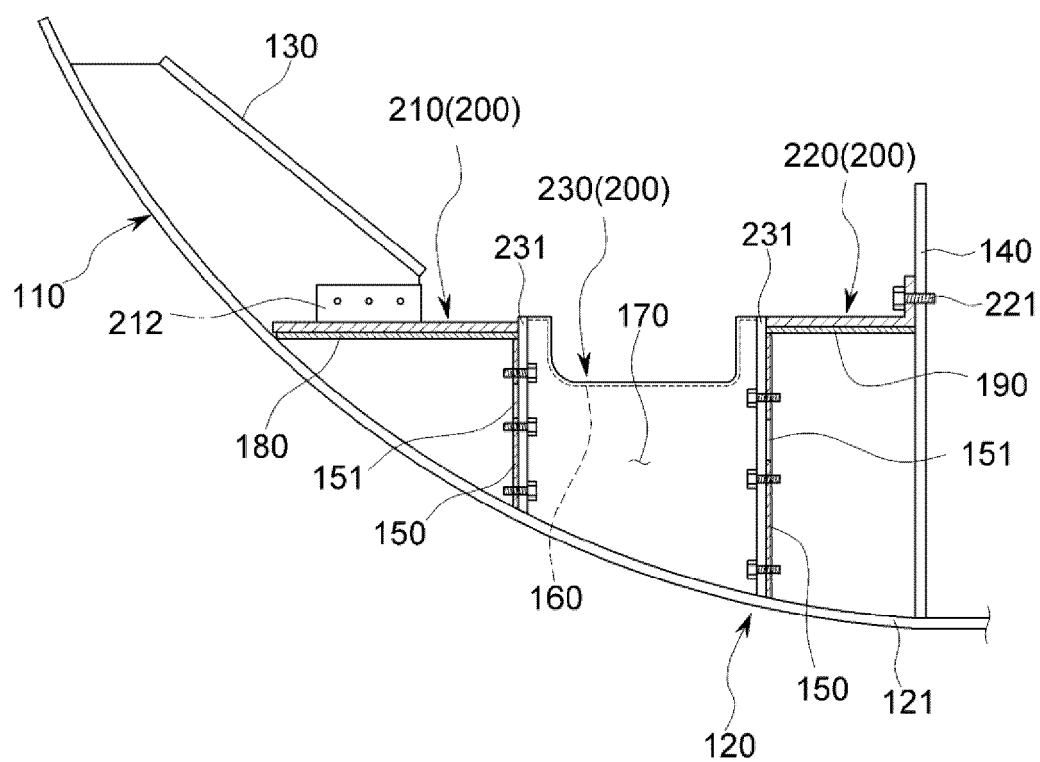


FIG. 4

200

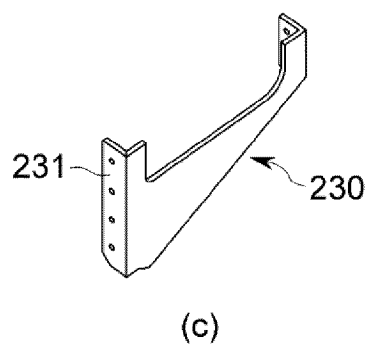
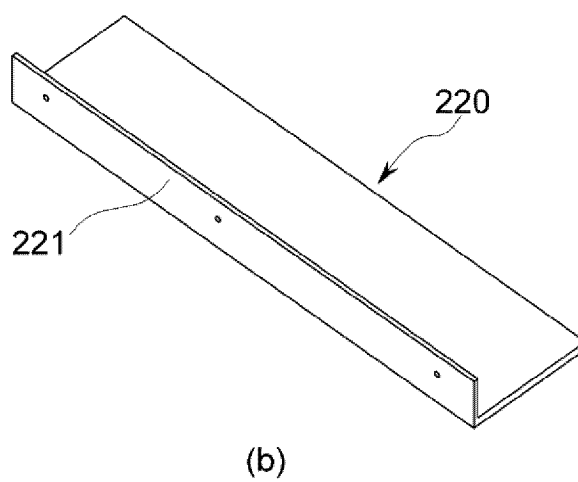
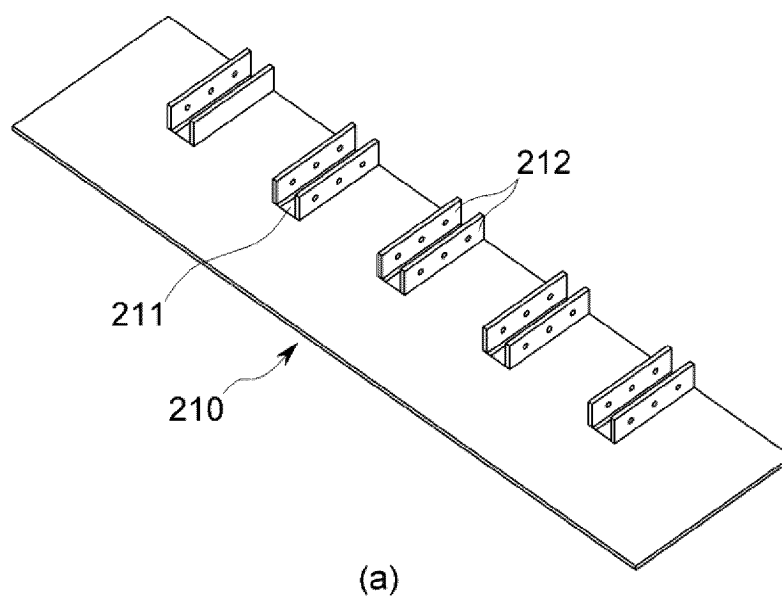
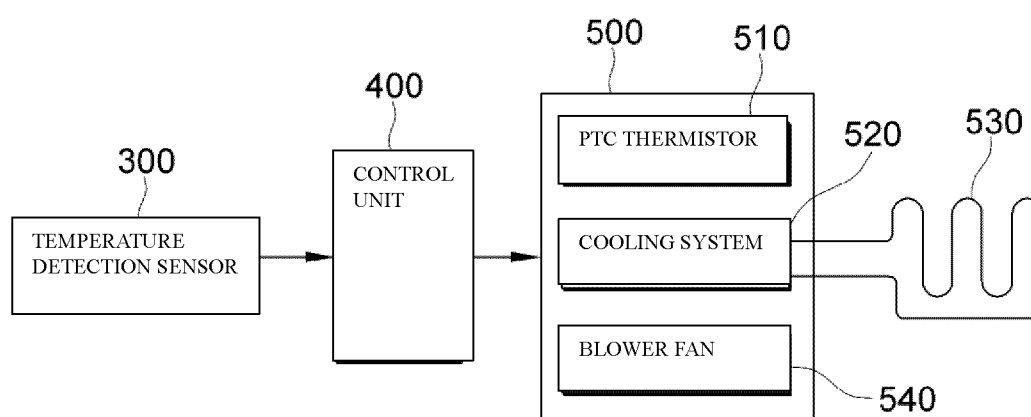


FIG. 5



INTERNATIONAL SEARCH REPORT

International application No.

PCT/KR2022/013660

5	A. CLASSIFICATION OF SUBJECT MATTER		
	B63B 5/24(2006.01)i		
	According to International Patent Classification (IPC) or to both national classification and IPC		
10	B. FIELDS SEARCHED		
	Minimum documentation searched (classification system followed by classification symbols) B63B 5/24(2006.01); B63B 1/04(2006.01); B63B 7/04(2006.01); B63B 73/10(2020.01); B63B 73/46(2020.01); B63B 73/60(2020.01); B63B 9/00(2006.01); B63B 9/06(2006.01); B63H 21/17(2006.01)		
15	Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Korean utility models and applications for utility models: IPC as above Japanese utility models and applications for utility models: IPC as above		
	Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) eKOMPASS (KIPO internal) & keywords: 선박(ship), HDPE(High Density Polyethylene), 보강(reinforcing), 늑골(frame) 및 거더(girder)		
20	C. DOCUMENTS CONSIDERED TO BE RELEVANT		
	Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
25	Y	KR 10-2330762 B1 (KOALA STUDIO) 24 November 2021 (2021-11-24) See paragraphs [0029]-[0049] and figure 1.	1-6
	Y	KR 20-2021-0001706 U (HYUNDAI HEAVY INDUSTRIES CO., LTD.) 23 July 2021 (2021-07-23) See paragraphs [0021]-[0026] and figures 2 and 3.	1-6
30	Y	KR 10-2016-0119322 A (SDN CO., LTD.) 13 October 2016 (2016-10-13) See paragraphs [0029]-[0033] and figures 3 and 4.	2-5
	A	KR 10-2013-0111818 A (CHO, Hyun Chul) 11 October 2013 (2013-10-11) See paragraphs [0020]-[0047] and figures 1-5b.	1-6
35	A	US 2011-0061585 A1 (KOPYLOV, Eduard) 17 March 2011 (2011-03-17) See paragraphs [0077]-[0117] and figures 11-29.	1-6
40	☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.		
45	* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "D" document cited by the applicant in the international application "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family		
50	Date of the actual completion of the international search 22 February 2023		Date of mailing of the international search report 23 February 2023
55	Name and mailing address of the ISA/KR Korean Intellectual Property Office Government Complex-Daejeon Building 4, 189 Cheongsaro, Seo-gu, Daejeon 35208 Facsimile No. +82-42-481-8578		Authorized officer Telephone No.

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/KR2022/013660

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KR 10-2016-0119322 A	13 October 2016	KR 10-1720789 B1	03 April 2017
KR 10-2013-0111818 A	11 October 2013	WO 2013-151210 A1	10 October 2013
US 2011-0061585 A1	17 March 2011	US 8448593 B2	28 May 2013

Form PCT/ISA/210 (patent family annex) (July 2022)