

FLOATING VESSEL COMPRISING A COLLISION-RESISTANT HULL

The present invention concerns a floating vessel comprising at least one hull.

A coastwise vessel, a landing craft or a compound ship is subject to collisions with the ground upon approaching the shore or shallows.

Prevention of damage to the hull in case of frontal percussion or grounding is defined by the rules of subdivision of ships to meet the post-damage stability criteria established by international regulations such as the SOLAS (Safety Of Life At Sea) convention of the IMO (International Marine Organization), which sets the minimum required safety rules.

Collision-resistant devices have been developed for berthing ships in port or at sea. These are, for example, dock posts and ship fenders. These defenses aim to distribute the contact stress over a larger surface and/or to absorb the contact energy during maneuvers in the port or at sea between one ship and another, or between a ship and a permanent structure. These defenses avoid permanent deformations of the hull and reduce contact accelerations.

The stems of push vessels or tugboats are equipped with buffers to allow these vessels to work without deformation of the ships they assist. JP61207286 describes one such push vessel stem comprising a deformable rubber buffer. However, this buffer is designed to come into contact with the substantially smooth hull of another ship, and under the privileged conditions of a controlled contact. A buffer of this type therefore cannot endure contact with a more

aggressive surface such as a rocky surface, a fortiori in the case of sometimes violent collisions.

WO 00/30930 describes a floating vessel comprising a packing able to absorb shocks. The packing extends in a space between two hulls on the assembly of the hull surface and in particular above the water line. This type of solution weighs down small crafts and penalizes the vessel's performance. Moreover, the deformations undergone by the hull are permanent.

US 5 353 727 describes a floating vessel, each side of the hull having a packing in module form, able to absorb shocks. However, the packing does not protect all of the live works, in particular does not protect the bottom or the stem and therefore does not allow grounding or tolerance of frontal collisions. Moreover, the deformations caused on the modules are essentially permanent, since a damaged part change is set forth by a procedure which creates substantial costs. Such an arrangement is difficult to contemplate for a vessel undergoing frequent groundings. One will also note that the modules take up a significant amount of space, in particular above the waterline, limiting the vessel's transport capacities proportionately.

For coastwise vessels, landing crafts and compound ships, the collisions of normal operation take place not on the edge of the ship (stem, side plating, stern) but in contact with the floor of the shore or shallows. Moreover, the shores and shallows have discontinuous surfaces which can easily cause tearing of the hull. The usual way of dealing with this risk consists of strengthening the parts in contact to allow frontal collision and to avoid tearing the bottom. This type of solution weighs crafts down without, however, being fully satisfactory.

The invention aims, above all, to allow frequent grounding collisions without tearing or permanent deformation of the ship's structures and while preserving the craft's performance and its transport capacities as much as possible.

According to the invention, a floating vessel comprising at least one hull having at least two sides combined in a submerged lower portion which is liable to encounter obstacles and which substantially corresponds to the underwater hull of the vessel, is characterized in that the lower portion comprises a recess of substantially constant depth and a packing able to absorb the collisions, forming an attached bottom whose shape complements that of the recess and housed in the recess, the assembly composed of the combination of the hull and the attached bottom having a substantially continuous outer surface, the packing being able to adopt its initial shape again after deformation due to a collision.

The hull can comprise, on its forward part, a recess of substantially constant depth and an attached packing stem having a shape complementary to the recess and housed in the recess, the assembly made up of the combination of the hull and the attached stem, having a substantially continuous outer surface.

Advantageously the bottom and/or the attached stem comprises a deformable skin. The skin can comprise a reinforcement on one of its walls. The reinforcement can be made in aramid fiber and/or in polyester.

Advantageously, a structural part capable of great elastic deformation is inserted between the skin and the hull.

The material of the structural part can be taken in the group made up of polyurethane foam and foam rubber. The structural part can also be arranged according to a honeycomb-type structure.

Other characteristics and advantages of the invention will appear in the description below with reference to the appended drawings, but which is in no way limiting.

In these drawings:

Fig. 1 is a longitudinal diagrammatic cross-section of the ship, specifying the part concerned by the frontal collision of the ship and the ground.

Fig. 2 is a longitudinal diagrammatic cross-section of the ship, specifying the part concerned by the risks of tearing of the bottom. This part is concentrated on forward bottom of the ship and the bottom assembly.

Fig. 3 is a transverse diagrammatic cross-section of the ship, with part removed, specifying the zone concerned by the risks of tearing of the bottom according to the depth of breach considered.

Fig. 4 is a detail, on a larger scale, of a diagrammatic transverse cross-section similar to Fig. 3.

Fig. 5 to 8 are details similar to Fig. 4, of different embodiments.

Fig. 9 is a detail of the fixing of the elements illustrated in Fig. 4 to 8.

Fig. 10 is a view similar to Fig. 9 from another fixing embodiment.

Fig. 11 is a view similar to Fig. 9 in the case of fixing at the level edges of the skin.

Fig. 12 is a view similar to Fig. 11 of another embodiment.

Fig. 13 is a detail of the fixing of two elements making up the skin to each other.

Fig. 14 is a view similar to Fig. 13 of another embodiment of the fixing of two elements making up the skin to each other.

Fig. 15 is a view similar to Fig. 13 of another embodiment of the fixing of two elements making up the skin to each other, and

Fig. 16 is a view similar to Fig. 13 of another embodiment of the fixing of two elements making up the skin to each other.

By referring to Fig. 1, 2 and 3, one can see the implementation of the invention on the hull C of a ship. The hull C is made up of alloys of steel or aluminum, plastic materials or composites. The invention is more particularly adapted to vessels subject to risk of frontal collision as well as risks of bottom tears.

The hull C comprises, in its lower portion, a recess R having a substantially constant depth. The recess R is dimensioned to make it possible to house a packing G. The recess R is essentially located below the waterline and

begins by an indentation toward the inside of the wall of the hull. Due to the presence of the recess R, the hull C has, in its lower portion, a deviation E relative to what would be its profile without modification.

One attaches on the hull C of the vessel, in the recess R, the anti-collision packing G, according to a structure which directly extends the structure belonging to the vessel to the outside plating as shown by figure 3. The underwater hull designates the keel and the sides of the vessel to the waterline and the plating designates its outer envelope.

The packing G is defined to resist the static and dynamic forces which may be exerted on the vessel under all allowed operating conditions without these forces causing an unacceptable permanent deformation and/or a loss of sealing, or compromising the safety of operation of the vessel. The packing G has a sufficient elasticity to absorb the energy of a collision without causing deformation of the hull C, and to adopt its initial shape again after the collision. The packing G consists of a bottom attached on the lower portion of the hull C and/or a stem connected on the front of the hull C. For implementation of the packing in the form of a stem, as illustrated in Fig. 1, the hull can comprise, on its forward part, a recess having a substantially constant depth, and a packing stem G, having a shape complementary to the recess, is attached and housed in the recess. The assembly composed of the combination of the hull and the attached stem has a substantially continuous and smooth outer surface.

The packing G is made up of two parts : a skin 1 located outside ensuring sealing, resistance to abrasion and to tearing, and a structural part 2 ensuring shock absorption and sealing. The packing G is connected

mechanically, or by sticking or adhesive treatment, to the structure of the vessel to take collision efforts. This arrangement ensures the continuity of the underwater hull. The packing G can constitute a double bottom of the ship. The stem can comprise a bulb or any other form of stem.

The skin 1 constitutes the new outside plating. The skin 1 is made in an elastomer (for example polyurethane or rubber) or plastic material (for example polypropylene or polyethylene) particularly resistant to abrasion, possible reinforced on its inner surface by a flexible fabric (for example in aramid fiber or polyester) having great resistance to traction and tearing. In the example described, one uses polyurethane strengthened by aramid fibers. The assembly thus formed constitutes the skin 1 covering the structural part 2 and ensures sealing without tearing of the packing G. The skin 1 transmits the pressure and collision efforts to the structural part 2. The skin 1 is sufficiently flexible to adopt its initial position again after deformation.

Fixing of the skin 1 is done by adhesive treatment or by sticking on the structural part 2. The connection with the outside plating of the hull C of the vessel is done mechanically or by sticking as shown in figure 8. Another embodiment consists of over molding, above the structural part 2, one or several layers of abrasion-resistant material integrating the recess(es) in flexible fabric.

The structural part 2 is made up of meshes of elastic material with great deformation (for example polyurethane foam or foam rubber, honeycomb) making it possible to absorb the major movements of foreign bodies as well as the energy of heaving (due to the vertical up and down motion of the vessel) and surging (due to the up and down motion of the

vessel along its longitudinal axis) collisions of the vessel on the bottom, caused by the swell, the rudder effect or breaking waves. The structural part 2 is sufficiently elastic to adopt its initial shape again after undergoing a collision.

The reticulated structure of the part 2 is illustrated in Fig. 5 to 8.

Fig. 5 shows a meshed structure with flat panels 2a deforming through overall buckling. In the absence of strain, the panels 2a are substantially perpendicular to the surface of the hull C or form a weak angle α with the normal at the surface of the hull C.

Fig. 6 shows a structure where the meshes are defined upon combined flexion. The meshes can be parallelepiped, one edge of each rhomb 2b being connected with the skin 1 and another opposite parallel edge being in contact with the hull C.

Fig. 7 shows a variation where the meshes are made up of open or closed cells 2c of structural foam forming a honeycomb-type structure. The cells 2c shown here are spherical.

Fig. 8 shows a variation of the structure illustrated in Fig. 5 where the panels 2d are no longer flat, but comprise a substantially parabolic biconcave profile.

The structural part 2 can be made by combining these different structures. The structural part 2 can be made in a single unit or in an assembly of structures separated from each other. Each of the structures is assembled mechanically or by sticking to the hull C.

One example of this type of fixing by sticking is shown by figure 9. The structural part 2 comprises legs 3a widening in the vicinity of the metallic structure of the hull C in order to maximize the contact surface. A film of glue 4 is inserted between the legs 3a and the metallic structure of the hull C.

One example of mechanical fixing is shown in figure 10. The structural part 2 comprises legs 3b having a shape similar to those used in the case of fixing by sticking. The legs 3b also comprise a cylindrical orifice 5 having an axis substantially perpendicular to the outer surface of the hull C. The proximal part of the orifice 5 relative to the outer surface of the hull C is reinforced by an insert 6 in a material having a higher resistance comprising a coaxial orifice 7 having a smaller diameter than that of the orifice 5 making it possible, via a screw 8, to make the leg 3b integral with the hull C. A stopper 5b is introduced into the end of the orifice 5 remaining open.

Examples of connection between the skin 1 of the packing G and the hull C of the boat are illustrated in figures 11 and 12. According to Fig. 11, the upper end of the skin 1 comprises a sort of hook 1a. The hook 1a makes it possible, via a shim 9 comprising a protuberance 9a complementary to the hook 1a and fixed to the hull C by screws 10, to make the skin 1 integral with the hull C. A sealing product 11 is arranged in the interface areas between the different elements.

According to Fig. 12, the skin 1 is stuck directly on the hull C via a film of glue 12.

Lastly, examples of connection between the elements of the packing G are illustrated in figures 13 to 16. Fig. 13

illustrates sticking by covering two portions of skin 1. A reinforcement 13a, flexible or stiff, may be stuck on the connecting area.

Fig. 14 is another type of connection by sticking without covering where the reinforcement 13b is essential.

Fig. 15 illustrates a screwed assembly where inserts 14, made in more resistant materials making it possible to produce threads, are submerged in the skin elements to be assembled and thus made integral therewith. These inserts 14 enable the use of screws 16 to make the two packing elements G integral. A sealing product 15 is placed at the interfaces between the different elements.

Fig. 16 illustrates another type of screwed assembly where the two skin elements 1 to be assembled are clamped between two stiff or semi-stiff shims 17 and 18. The shim 17 which is in contact with the hull C is embedded in a housing provided in the skin elements 1 to be assembled. The shim 17 and/or 18 and the packing elements G can comprise devices similar to the hook 1a and to the protuberance 9a used in the embodiment illustrated in Fig. 11. A sealing product 15 is placed at the interfaces between the different elements.

Another embodiment consists of projecting a structural foam directly on the resistant structure of the ship.

In operation, the characteristic stiffness of the skin 1 combined with the bearing on the structural part 2 ensures the continuity of the underwater hull with a minimal deformation under the normal operating pressure of the vessel.

In case of collision, the skin 1 avoids possible tearing while the combination of the skin 1 with the structural part 2 makes it possible to absorb the energy of the collision by eliminating, or at least substantially limiting, permanent deformations on the hull C. The continuity of the profile obtained by joining the hull C and its packing G makes it possible not to damage the performance of the ship. Due to the fact that after a collision the packing G adopts its primitive shape again, the hydraulic profile of the vessel is not damaged.

CLAIMS

1. A floating vessel comprising at least one hull (C) having at least two sides combined in a submerged lower portion which is liable to encounter obstacles and corresponding substantially to the underwater hull of the engine, characterized in that the lower portion comprises a recess (R) of substantially constant depth and a packing (G), able to absorb collisions, forming an attached bottom whose shape complements that of the recess (R), the assembly composed of the combination of the hull and the attached bottom having a substantially continuous outer surface, the packing being able to adopt its initial shape again after deformation due to a collision.
2. The vessel according to claim 1, characterized in that the hull (C) comprises, on its forward portion, a recess of substantially constant depth and an attached packing stem (G) having a shape which complements that of the recess and housed in the recess, the assembly composed of the combination of the hull and the attached stem, having a substantially continuous outer surface.
3. The vessel according to claim 1 or 2, characterized in that the bottom and/or the attached stem comprise a deformable skin (1).
4. The vessel according to claim 3, characterized in that the skin (1) comprises a reinforcement on one of its walls.
5. The vessel according to claim 4, characterized in that the reinforcement is made in aramid fiber and/or in polyester.

6. The vessel according to claim 3, 4 or 5, characterized in that a structural portion (2) capable of great elastic deformation is inserted between the skin (1) and the hull (C).
7. The vessel according to claim 6, characterized in that the structural portion (2) is sufficiently elastic to adopt its initial shape again after having undergone a collision.
8. The vessel according to claim 6 or 7, characterized in that the material of the structural portion (2) is taken from the group composed of polyurethane foam and foam rubber.
9. The vessel according to claim 6 or 7, characterized in that the structural portion (2) is arranged according to a structure of the honeycomb type.