

PATENT SPECIFICATION

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(54) A SHIP HULL AND A METHOD OF ASSEMBLING THE SAME

(71) We, TRANS-CONSULTANTS AKTIEBOLAG, a Swedish Body Corporate of Packhusplatsen 3, S-411 13 Göteborg, Sweden, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to a hull for ships or other marine vessels and a method of assembling such hulls. The invention has particular application to a hull of the type having a double bottom construction comprising an outer bottom, transitional parts of the hull's shell extending between the outer bottom and the sides of the hull's shell and an inner bottom which extends between the sides of the hull above the outer bottom.

Demands for increased earning power entail that the size of ships increases rapidly. At the same time as the initial cost is increased along with the size costs increase further due to the fact that shipyards which have resources for assembling such large vessels are being weighed down with ever-increasing establishment costs.

The purpose of the present invention is thus primarily to obtain a hull which, by means of its construction, does not require access to a shipyard in order to be assembled and which has simplified basic members as compared to conventional ships so that assembly costs will be lowered. Another principal purpose of the invention is to obtain a method of assembling the hull according to the present invention without requiring access to the resources of a conventional shipyard.

According to one aspect of the present invention, a hull of the type described above has the features set forth in Claim 1.

According to another aspect of the invention, a method of assembling such a hull has the steps set forth in Claim 9.

The step from the completed hull according to the present invention to a completed ship is considered to be able to be carried out by means of the prior art, and thus is not touched upon below.

As instructive examples, an embodiment of the hull according to the present invention and an example of the method of assembling said hull according to the present invention are described below with reference to the enclosed drawings.

Fig. 1 is a side view of an embodiment of the hull,

Fig. 2 is a cross section along line II-II through the hull shown in Fig. 1.

Fig. 3 is a perspective view of a double bottom section of the hull shown in an inverted position in Fig. 1.

Figs. 4 and 5 are examples of the water plane area above the cylinders integrated in the completed double bottom of the hull.

Fig. 6 is a view of two floating cylinder sections which have been transferred to the assembly location and the adjacent storage location,

Fig. 7 illustrates the process for joining together two adjacent cylinder sections,

Fig. 8 shows how the completed cylinders which serve as bedding and double bottom parts have been placed near each other for the attachment of a first double bottom section,

Fig. 9 shows how the double bottom construction of the middle body has been completed and a first deck and shell plating section has been lowered onto the same, and

Fig. 10 shows the hull in a final stage during completion with bulky equipment purposefully before the previously excluded sections have been mounted into position.

The embodiment of the completed hull 1 shown in a side-view in Fig. 1 has a forebody 2 and an afterbody 3 as well as a middle body 4 extending between the forebody and the afterbody. The side shell plat-

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ing of the middle body is referred to as 5 while the transitional parts of the hull's shell between the side shell plating 5 and an outer bottom 6 of the hull are referred to as 7. One of the two symmetrically arranged cylinders 9, which cylinders function as bedding during assembly and thereafter as an integrated part of a double bottom construction 8, is also shown in the Figure.

10 The cylinders 9, which run along the fore-and-aft direction 10 of the hull 1 are terminated at their ends by specially formed end sections or end pieces 11 and 12.

Fig. 2 is a cross section along line II-II in Fig. 1. In this Figure, it is shown that the double bottom 8 comprises an outer bottom 6, transitional parts of the hull's shell 7 between the outer bottom and the side shell plating 5, cylinders 9 and an inner bottom 13. Double bottom 8 also has fore-and-aft 10 and/or athwartships 14 strength members, such as for example 15 and 16, as well as different attachment means, for example 17, required for the fastening of the cylinders 9.

The embodiment shown in the Figures has two cylinders 9 which, in the athwartships direction 14, are spaced, said cylinders, in the fore-and-aft direction 10, having essentially the same length as the middle body 4 of the hull. However, three or more athwartships spaced cylinders 9 also lie within the scope of the invention. The cylinders can be of different lengths. However, it is essential that the cylinders are hollow, thereby contributing to a great extent to the buoyancy of the hull. Fig. 2 also shows that peripheral shells 18 of the cylinders 9 each have a portion 19 mounted on the outside of the double bottom 8 and another portion 20 mounted inside the double bottom 8. Such is the case at least along the major part of the length of the cylinders 9. In the shown embodiment of the hull, the portions 19 and 20 are of essentially the same size. However, embodiments in which the casing portion 19 is very small in comparison to the portion 20 and vice versa lie within the scope of the invention. This is effected by means of the cylinders 9 being accommodated more or less within the double bottom 8. Cylinders 9 can also, in their entirety, be positioned at the transitional parts 7 of the hull's shell or form transitional members between the transitional parts 7 of the hull's shell and the outer bottom 6.

Fig. 3 is a perspective view of a building section 21 of the double bottom 8 of the hull 1 shown in Figs. 1 and 2. In Figure 3 the bottom section 21 is upside down in relation to its intended position in the hull. The inner bottom 13 is thereby turned downwards and the outer bottom 6 is turned upwards. The inclined transitional parts 7

of the hull's shell are visible on either side and, furthermore, and the strength members 15, 16 are located on either side as well. Two openings 22 are arranged between the outer bottom 6 and the transitional parts of the hull's shell 7, each of said openings being intended to contain a respective cylinder 9, the fore-and-aft extending edges 23 of the openings 22 being watertight and rigidly connected to the shells 18 of the cylinders 9. Similarly, at least the shell portions 19 which are situated outside of the edges 23 of the openings 22 are watertight, whereby the cylinders form an integrated part of the double bottom construction 8 of the hull 1.

Figs. 4 and 5 are intended to illustrate the shape of a hull according to the present invention by means of reproducing the water plane areas 24, 24' for two different embodiments of the hull 1. Common for the shown water plane areas 24, 24' is that they are situated above the cylinders 9 as the latter could otherwise cause great irregularities in the area contours. The areas 24, 24' are demarcated by a plurality of straight lines which are solid in the drawings. With the help of dotted lines, the areas 24, 24' have then been divided into simple geometrical surface elements. Both of the Figures are herewith dominated by one large rectangular surface element 25, 25'. In Fig. 4, surface element 25 covers the middle body 4 of the hull as well as its afterbody 3 while surface element 25' in Fig. 5 only covers the middle body. Fig. 4 only has a smaller triangular surface element 27 which is connected to one of the short sides 26 of the rectangle 25 and which forms a tapering extension to rectangle 25 in the fore-and-aft direction 10 of the hull 1. Surface element 27 covers the forebody 2 of the hull.

Fig. 5 has three smaller surface elements shaped as a triangle 43 or trapezoid 41, 42. Surface elements 41, 42 are connected to their respective short sides 26, 28 of rectangle 25' while element 43 is connected to the side 44 of element 42 which faces away from rectangle 25'. Elements 41, 42 form a tapering extension of the rectangle while element 43 forms a tapering extension of trapezoid 42.

Forebodies and afterbodies which have water lines having simple geometrical surface elements combined in another manner than the one shown here also lie within the scope of the present invention.

Due to the form of the hull 1 shown in Figs. 1-5, all the plates included in the hull have an uncomplicated shape. The plates are either plane or single bent or are shaped as at least a part of a cylindrical casing. Single bent plates are included for example in transitional parts 7 in the embodiment of the hull shown in Figs. 1-3. Partially

cylindrical plates are naturally included mainly in the cylinders 9, eventually with the exception of the end pieces 11, 12 of the cylinders. The stem plates 30 of the hull can also be partially cylindrical.

The transitional parts 7 of the hull's shell, which are corresponded to by "the bilge" in conventional hulls, have preferably plane or single bent plates. At least partially cylinder casing-shaped plates are, however, also feasible. When plane or single bent plates are used, they suitably incline towards and downwards from the shell plating 5.

In a preferred embodiment of the hull according to the present invention, the opposing shell platings 5 are parallel with or almost parallel with one another.

An example of the method of assembly according to the present invention is illustrated in Figs. 6-10. Fig. 6 shows a front view of the assembly location which is formed by a harbour basin or some other protected water area 31. A storage location is situated next to the assembly location, said storage location being in the form of for example a quay 32, upon which prefabricated sections 21, 33, 34, 38, 39, equipment parts 36, etc., have been previously stored. As the hull is later assembled, the sections are brought from the storage location to the assembly location, for example by means of a lifting crane resting on the quay or being supported on pontoons. When brought to the assembly location, the sections are joined together.

The cylinders included in the double bottom construction of the hull 1 are made of cylinder sections 11, 12, 33 in the manner shown in the Figures, said cylinder sections being prefabricated. In Fig. 6, two cylinder sections 33', 33'' are shown floating on the water. This is possible because each cylinder section, at this stage, has at least one watertight space contained between the cylinder casing 18 and end walls 45 arranged at a distance from the ends 35'' of the cylinder sections.

In Fig. 7, the two cylinder sections 33', 33'', still floating on the water, have been connected so that an extension of their respective longitudinal axes 36', 36'' coincide simultaneously as the facing ends 35', 35'' of the cylinder sections have been pulled in towards each other. The ends 35', 35'' have been previously prepared for welding, so that they can be welded to each other, after necessary tacking, the welding being effected either manually or by a suitable welding apparatus 37 while the cylinder sections are caused to rotate around their longitudinal axes. The peripheral speed for the rotation of the cylinder sections is therewith suitably brought to coincide with the welding speed.

By means of joining each cylinder section

in a corresponding manner to the previously joined cylinder section, the completed cylinders 9 are obtained, said cylinders having great buoyancy.

In Fig. 8, the completed cylinders have 70 been mounted parallel with one another at a determined distance from and in front of each other. The distance between the cylinders is therewith so selected that it corresponds to the distance between the openings 22 (cf. Fig. 3) in the double bottom sections 21. Each section 21 is then lowered down to the intended position in relation to the cylinders 9, for example until the elements 17 (Fig. 2) rest against the cylinders, after 80 which section 21 is welded to the cylinders at least along the edges 23 (Fig. 3) of the openings 22.

In the above description, it has been assumed that width of the openings 22 essentially 85 corresponds to the corresponding dimension of the associated cylinders 9. If the cylinders 9 are to project out of the double bottom 8 less than what has been assumed in the Figures, it can be necessary that the width of the openings 22 be reduced after 90 the openings have been moved down over the cylinders to the intended position. For this purpose, the necessary seam elements (not shown here) can, in advance, be 95 mounted on the cylinders or set in place simultaneously as the double bottom sections are welded on.

As the cylinders 9 according to the above have essentially the same length as the 100 middle body 4, all the double bottom sections 21 belonging to this section can be welded in a corresponding manner onto the cylinders 9 and, further, to each other. After this has been done, the deck and shell plating sections 34 which are included in 105 the middle body 4, are assembled and fastened, as well as the fore and after sections 38, 39 of the forebody and the afterbody 2, 3. The deck and shell plating sections 34 in front of a machinery space 110 40 and on the other places where bulky equipment shall be conveyed to the inside of the hull are, however, omitted until said equipment has been installed. 115

The order between the fore and after sections and the deck and shell plating sections can vary depending on the size of the ship, the draught after completion of the double bottom of the middle body etc. This 120 order is thus not considered to be an essential characteristic for the method according to the invention.

When the majority of sections 34, 38, 39 have been mounted onto the hull and welded 125 to the same, at least all the bulky equipment intended to be installed inboard is loaded. This applies for primary engines 36, auxiliary engines, boilers etc. Only after this has been done is the incomplete hull 1 completed 130

with the previously omitted sections which can belong to the middle body as well as the fore and/or after body.

Beyond the above mentioned advantages of the hull according to the present invention, it can be mentioned that the design of the hull can give rise to good stability, resulting in the possibility of loading large deck cargoes. The parallel sides of the hull provide, further, advantageous load space in the lowest deck as well.

Furthermore, it can be stated that the bottom construction of the hull gives rise to increased buoyancy even when the hull is in a state of damage. A low tonnage coefficient can also be obtained for current measurement rules. Furthermore, the ship has a minimum draught.

WHAT WE CLAIM IS:—

1. A hull for ships or other marine vessels having a double bottom construction comprising an outer bottom, transitional parts of the hull's shell extending between the outer bottom and the sides of the hull's shell and an inner bottom which extends between the sides of the hull above the outer bottom, wherein said hull has at least two hollow cylinders arranged fore-and-aft and separated in the athwartships direction, said cylinders constituting an integrated part of the double bottom construction and having substantially the same length as the middle body of the hull, said cylinders, along the major part of their length, being partially located within the double bottom and projecting through openings, said openings being situated in the outer bottom and/or the transitional parts of the hull's shell, the cylinders being connected to the edges of the openings in a watertight manner, end pieces of the cylinders and those parts of the cylinders projecting outside of the openings being watertight.

2. A hull according to claim 1, wherein a water-plane above the cylinders is divisible into at least two geometrical surface elements, one of which is larger than the other or others and has the shape of a rectangle, and wherein either a single smaller surface element is in the form of a tapering extension to the rectangle and is connected to one of its short sides, or a smaller surface element is in the form of a tapering extension and is connected to a further smaller surface element, which is connected to one of the short sides of the rectangle.

3. A hull according to claim 2, wherein the smaller surface elements each have the shape of a triangle or a trapezoid.

4. A hull according to any of claims 1-3, wherein all of the plates included in the hull are plane, single bent or partially cylindrical casing-shaped.

5. A hull according to claim 4, wherein

the partially cylindrical plates are at least included in the shells of the cylinders.

6. A hull according to claim 5, wherein the partially cylindrical plates are also included in the stem of the hull.

7. A hull according to any of claims 4-6, wherein the transitional parts of the hull's shell between the sides of the hull and the outer bottom incline inwards and downwards and that only plane or single bent plates are included in these transitional parts.

8. A hull according to any of claims 1-7, wherein the hull sides of the middle body are essentially parallel.

9. A method of assembling the hull according to any of claims 1-8, whereby completed and/or partially completed basic hull elements are joined together into hull sections, said sections as well as equipment for installation in the hull being transported to and stored at a storage location situated next to an assembly location intended for the hull, said assembly location being formed by a protected stretch of water, the hull sections then being brought from the storage location in planned sequence and taken to the assembly location where they are joined together, wherein hollow cylinders having substantially the same length as the middle body of the hull under construction are conveyed to the stretch of water and there, floating on the water, are arranged parallel with and at the same draft with respect to each other and at a predetermined spaced relationship, and wherein double bottom sections of the middle body, said sections having downwardly facing openings which are adapted to receive the cylinders, are then lowered onto the cylinders and joined with the same and with each other so as to form a buoyant double bottom construction having approximately the length of the middle body; wherein thereafter hull sections formed by deck and/or shell plating elements, except those hull sections which are located in front of a machinery space, are placed on the double bottom floating on the water and joined together with the same and each other so as to form an incomplete middle body of the hull; wherein at least one forebody hull section and one afterbody hull section are then joined to the middle body; and wherein at least part of the equipment is conveyed to the hull floating on the water and installed on board, which hull is incomplete at least in front of the machinery space, after which the remaining deck and shell plating hull sections are mounted in their intended positions and joined together with each other and/or to the previously assembled adjacent hull sections.

10. A method according to claim 9, wherein the hollow cylinders are each

with the previously omitted sections which can belong to the middle body as well as the fore and/or after body.

Beyond the above mentioned advantages of the hull according to the present invention, it can be mentioned that the design of the hull can give rise to good stability, resulting in the possibility of loading large deck cargoes. The parallel sides of the hull provide, further, advantageous load space in the lowest deck as well.

Furthermore, it can be stated that the bottom construction of the hull gives rise to increased buoyancy even when the hull is in a state of damage. A low tonnage coefficient can also be obtained for current measurement rules. Furthermore, the ship has a minimum draught.

WHAT WE CLAIM IS:—

1. A hull for ships or other marine vessels having a double bottom construction comprising an outer bottom, transitional parts of the hull's shell extending between the outer bottom and the sides of the hull's shell and an inner bottom which extends between the sides of the hull above the outer bottom, wherein said hull has at least two hollow cylinders arranged fore-and-aft and separated in the athwartships direction, said cylinders constituting an integrated part of the double bottom construction and having substantially the same length as the middle body of the hull, said cylinders, along the major part of their length, being partially located within the double bottom and projecting through openings, said openings being situated in the outer bottom and/or the transitional parts of the hull's shell, the cylinders being connected to the edges of the openings in a watertight manner, end pieces of the cylinders and those parts of the cylinders projecting outside of the openings being watertight.

2. A hull according to claim 1, wherein a water-plane above the cylinders is divisible into at least two geometrical surface elements, one of which is larger than the other or others and has the shape of a rectangle, and wherein either a single smaller surface element is in the form of a tapering extension to the rectangle and is connected to one of its short sides, or a smaller surface element is in the form of a tapering extension and is connected to a further smaller surface element, which is connected to one of the short sides of the rectangle.

3. A hull according to claim 2, wherein the smaller surface elements each have the shape of a triangle or a trapezoid.

4. A hull according to any of claims 1-3, wherein all of the plates included in the hull are plane, single bent or partially cylindrical casing-shaped.

5. A hull according to claim 4, wherein

the partially cylindrical plates are at least included in the shells of the cylinders.

6. A hull according to claim 5, wherein the partially cylindrical plates are also included in the stem of the hull.

7. A hull according to any of claims 4-6, wherein the transitional parts of the hull's shell between the sides of the hull and the outer bottom incline inwards and downwards and that only plane or single bent plates are included in these transitional parts.

8. A hull according to any of claims 1-7, wherein the hull sides of the middle body are essentially parallel.

9. A method of assembling the hull according to any of claims 1-8, whereby completed and/or partially completed basic hull elements are joined together into hull sections, said sections as well as equipment for installation in the hull being transported to and stored at a storage location situated next to an assembly location intended for the hull, said assembly location being formed by a protected stretch of water, the hull sections then being brought from the storage location in planned sequence and taken to the assembly location where they are joined together, wherein hollow cylinders having substantially the same length as the middle body of the hull under construction are conveyed to the stretch of water and there, floating on the water, are arranged parallel with and at the same draft with respect to each other and at a predetermined spaced relationship, and wherein double bottom sections of the middle body, said sections having downwardly facing openings which are adapted to receive the cylinders, are then lowered onto the cylinders and joined with the same and with each other so as to form a buoyant double bottom construction having approximately the length of the middle body; wherein thereafter hull sections formed by deck and/or shell plating elements, except those hull sections which are located in front of a machinery space, are placed on the double bottom floating on the water and joined together with the same and each other so as to form an incomplete middle body of the hull; wherein at least one forebody hull section and one afterbody hull section are then joined to the middle body; and wherein at least part of the equipment is conveyed to the hull floating on the water and installed on board, which hull is incomplete at least in front of the machinery space, after which the remaining deck and shell plating hull sections are mounted in their intended positions and joined together with each other and/or to the previously assembled adjacent hull sections.

10. A method according to claim 9, wherein the hollow cylinders are each



manufactured by joining buoyant hollow cylinder sections together, the sections being floated on the stretch of water, each cylinder section then being brought to float end against end with one other cylinder section so that the longitudinal axis of the cylinder section is aligned with the longitudinal axis of the other cylinder section, after which the two cylinder sections are joined together.

10 11. A method according to claim 10, wherein adjacent cylinder sections are joined together by being rotated about their longitudinal axes while floating on the water and that the abutting end edges of the two
15 cylinder sections are welded to one another

during said rotation, whereby the rotation speed essentially corresponds to the welding speed.

12. A hull for ships or other marine vessels substantially as hereinbefore described with reference to Figs. 1 to 5 of the accompanying drawings. 20

13. A method of assembling the hull substantially as hereinbefore described with reference to the accompanying drawings. 25

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