A. L. MOONEY.

SHIP CONSTRUCTION.

APPLICATION FILED DEC. 6, 1907.

950,860. Patented Mar. 1, 1910.

3 SHEETS—SHEET 1.

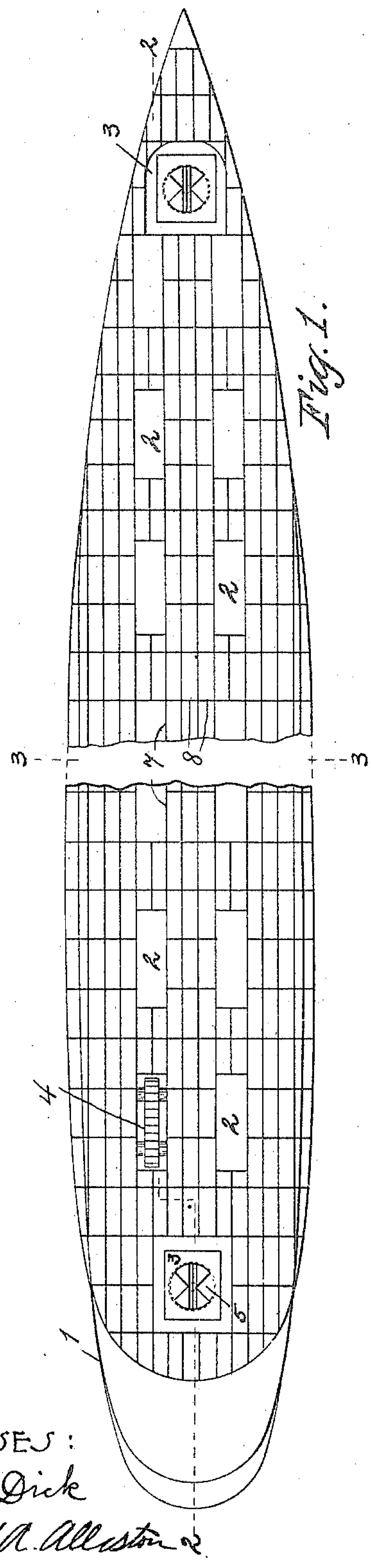

Fig. 1.

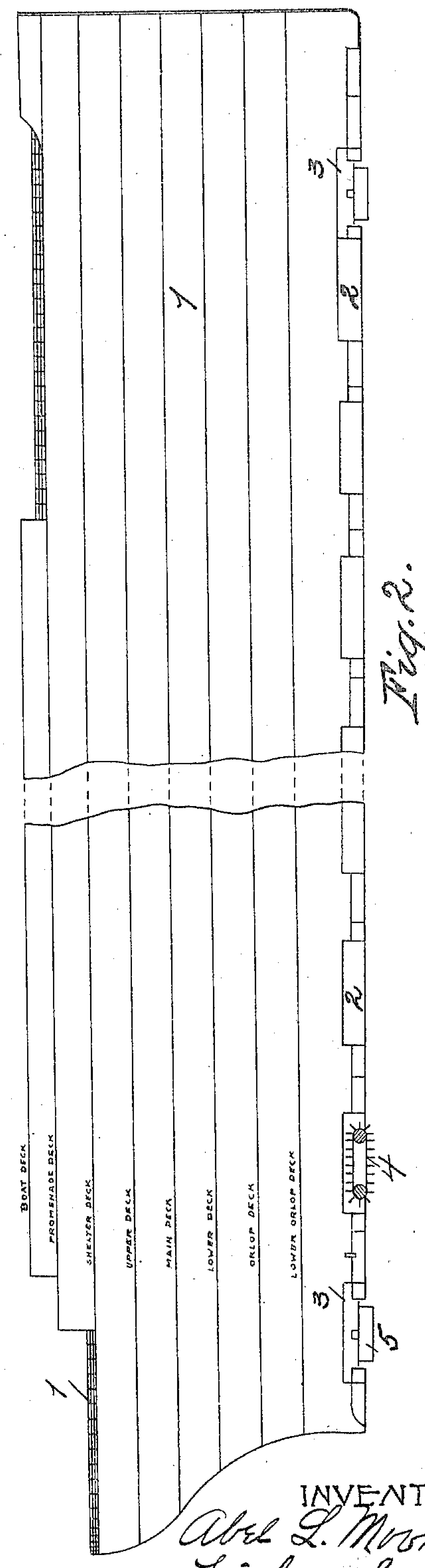

Fig. 2.

WITNESSES:

Albert Dick

Clifford A. Allerston

INVENTOR

Abel L. Mooney

BY Fischer & Sanders. Attys.

A. L. MOONEY.

SHIP CONSTRUCTION.

APPLICATION FILED DEC. 6, 1907.

950,860.

Patented Mar. 1, 1910.

3 SHEETS—SHEET 2.

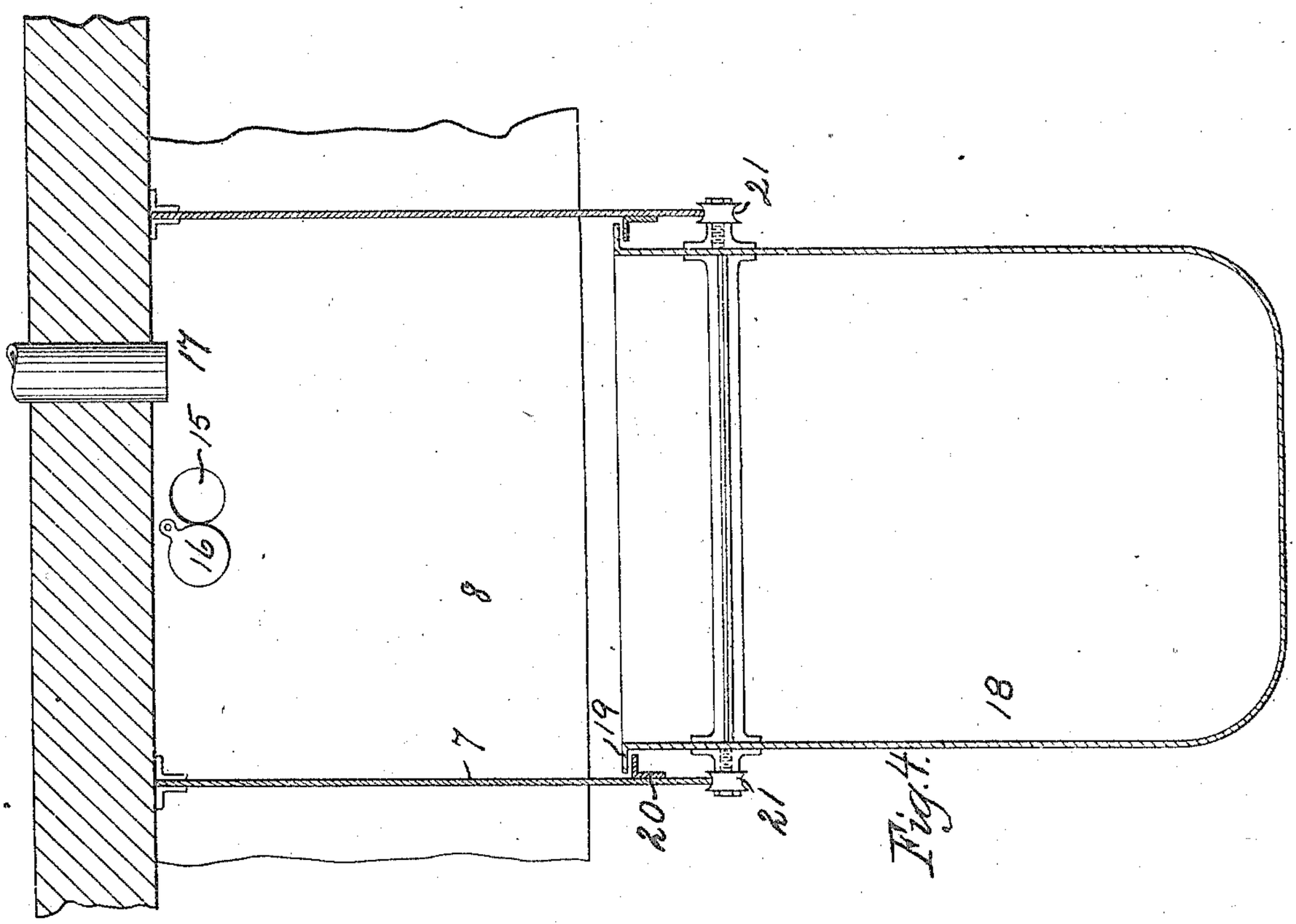

Fig. 4.

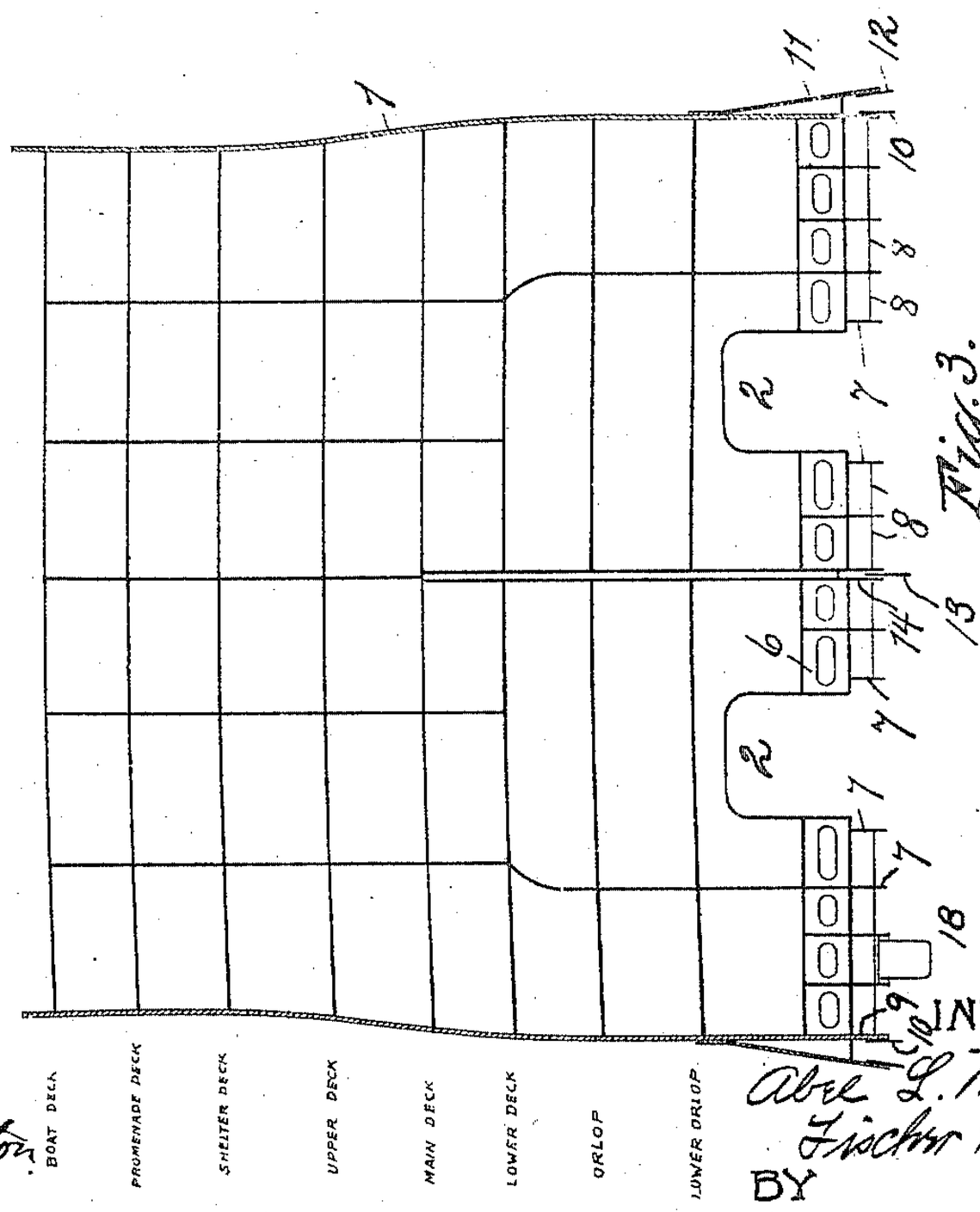

Fig. 3.

WITNESSES:

Albert Dick

Clifford A. Allison.

INVENTOR

Abel L. Mooney

Fischer & Sanders.

BY

Atty.

A. L. MOONEY.

SHIP CONSTRUCTION.

APPLICATION FILED DEC. 6, 1907.

950,860.

Patented Mar. 1, 1910.

3 SHEETS—SHEET 3.

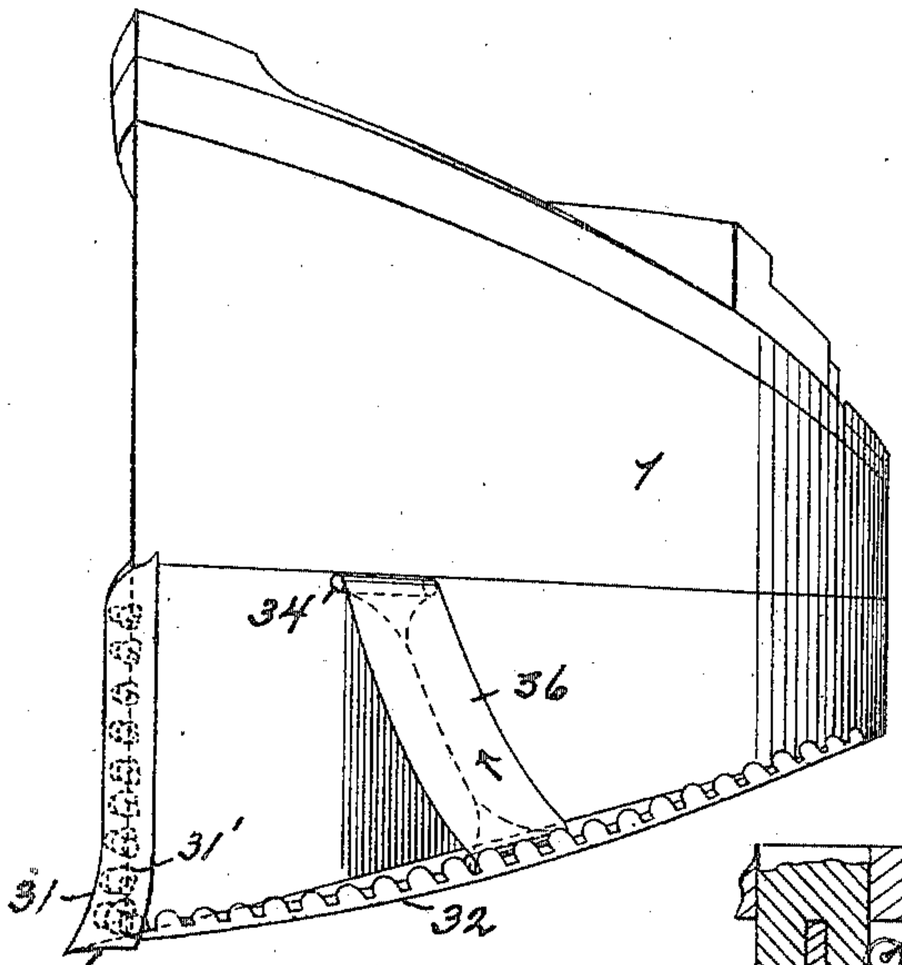

Fig. 5.

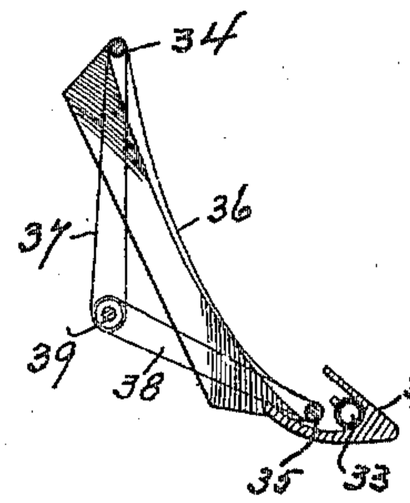

Fig. 6.

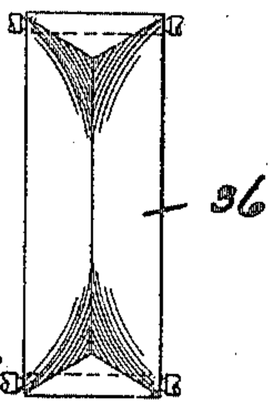

Fig. 7.

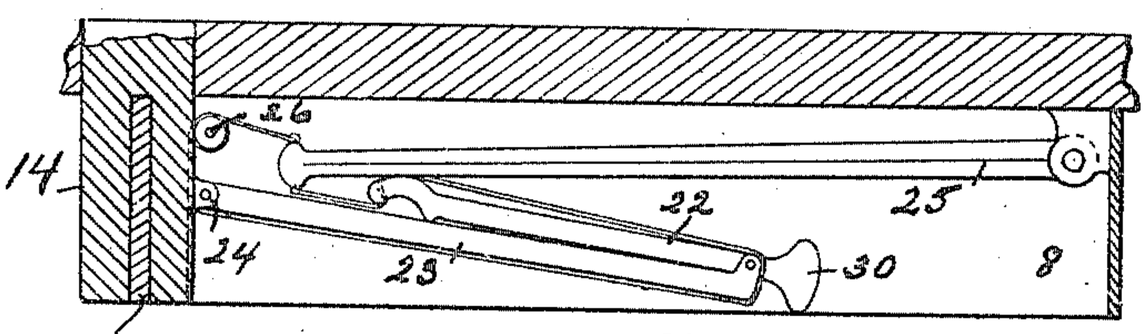

Fig. 9.

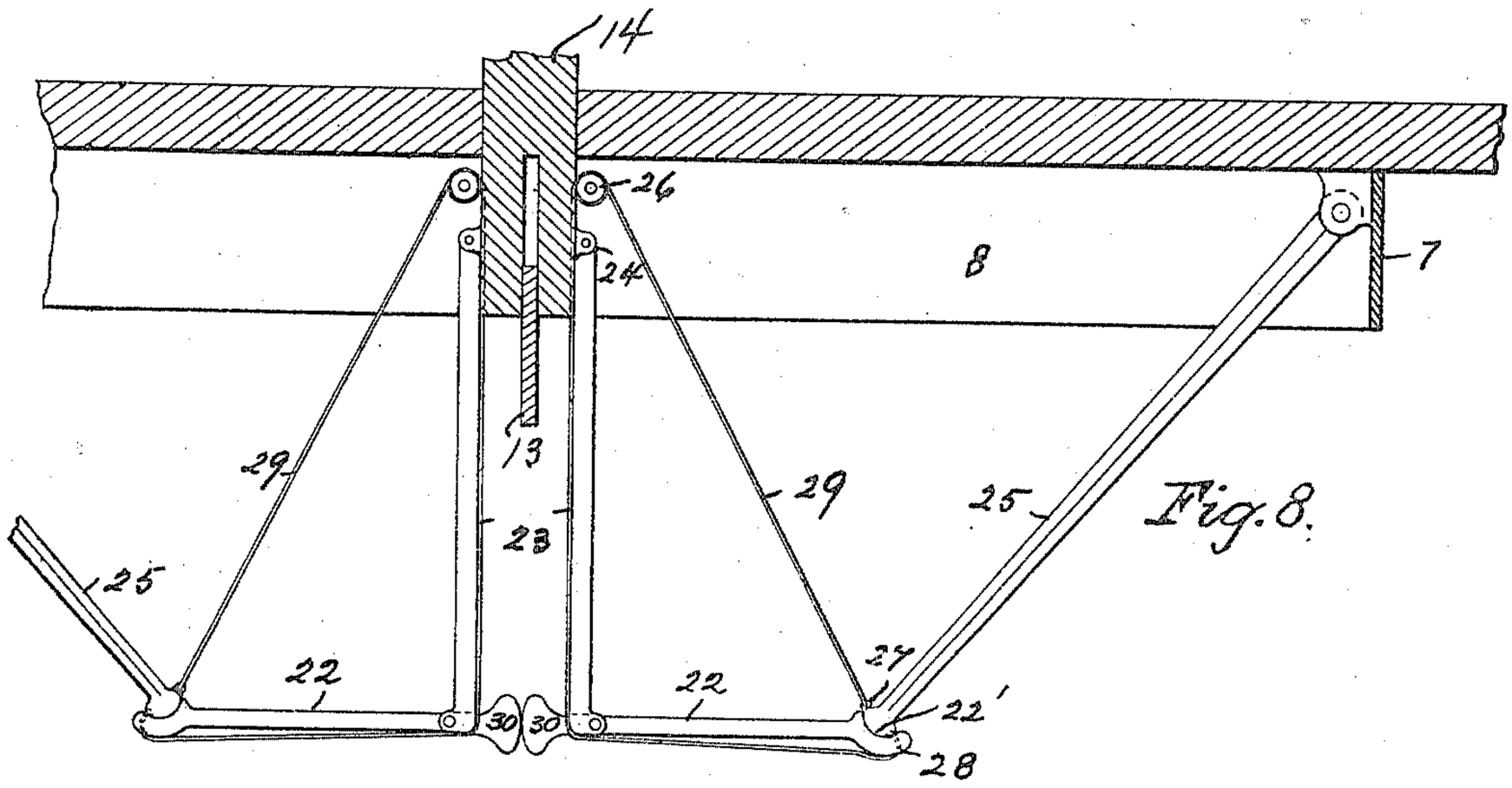

Fig. 8.

WITNESSES:

Albert Dick

Clifford A. Allston.

INVENTOR

Abel L. Mooney

BY Fischer & Sanders.

Attys.

UNITED STATES PATENT OFFICE.

ABEL L. MOONEY, OF SOUTH ORANGE, NEW JERSEY.

SHIP CONSTRUCTION.

950,860. Specification of Letters Patent. **Patented Mar. 1, 1910.**

Application filed December 6, 1907. Serial No. 405,317.

To all whom it may concern:

Be it known that I, ABEL L. MOONEY, a citizen of the United States, residing at South Orange, in the county of Essex and State of New Jersey, have invented certain new and useful Improvements in Ship Construction; and I do hereby declare the following to be a full, clear, and exact description of my invention, such as will enable others skilled in the art to which it pertains to make and use the same.

My invention relates to improvements in the construction of ships and has for its principal objects, the hereinafter described improved means for reducing, what has come to be known in marine-architecture as "skin-friction".

It also has to do with certain improvements in the hulls of vessels, whereby the direct driving parts, and also the steering apparatus are located in cells beneath the hull of the vessel.

Another feature of my invention comprises an improved means for increasing the stability and sea-worthiness of large ocean-going ships.

The various improvements to which my invention relates will be developed in the following detailed description, taken in connection with the accompanying drawings, in which—

Figure 1 is a bottom plan view of the hull of a vessel, indicating its cellular formation. Fig. 2 is a longitudinal section on line 2—2 of Fig. 1. Fig. 3 is a midship section on line 3—3 of Fig. 1. Fig. 4 illustrates an enlarged view of one of the cells beneath the hull of the vessel, with an inspection trolley boat shown as running upon the longitudinal partitions between the cells. Fig. 5 illustrates a perspective view of the bow of the vessel, illustrating the means which I have provided for reducing the skin-friction at the bow and along the sides of the vessel. Fig. 6 illustrates a cross-section of one of the devices for reducing the skin-friction. Fig. 7 illustrates a rear view of the same. Fig. 8 represents a device secured to the keel of the vessel for increasing the stability or reducing the rolling tendency of a vessel during heavy seas, and Fig. 9 represents the same folded into one of the cells.

In the accompanying drawings, similar parts are designated by like numerals.

Referring to the improvements illustrated in Figs. 1, 2, 3 and 4, 1 designates the hull of the boat in general, such hull being provided with the various decks as indicated in Figs. 2 and 3. The entire bottom of the boat, as heretofore described, is of a cellular structure provided with numerous enlarged compartments 2, 2 and 3, 3, for the reception of the driving mechanism 4, and the steering mechanism 5.

The exact nature of the driving mechanism or steering gear forms no part of my present invention, and I have shown such structure in Figs. 1 and 2, diagrammatically merely for purposes of illustration. I do desire, however, to call attention to the fact that the cells 2, 2 and 3, 3 are sufficiently enlarged vertically to permit of the elevation completely of any particular set of mechanism as a propeller wheel or steering mechanism from contact with the water for purposes of repair. The specific form of steering mechanism will form the subject matter of another application.

In Fig. 3, I have shown a midship section showing the various decks and what has come to be known as a water-bottom 6, such water-bottom being of the usual or ordinary construction and divided into a series of water-tight compartments for the reception of the water ballast, or liquid fuel storage when occasion demands the same. The entire bottom of the hull, as heretofore described, is provided with a series of cells opened downward, such cells being formed by means of longitudinal plates 7 running substantially the entire length of the hull of the vessel. These longitudinal plates are secured in any convenient manner to the bottom of the vessel, and run parallel with the keel. Connecting the longitudinal plates 7, transversely, are the lateral plates 8, of less vertical depth than the longitudinal plates 7, so that the projecting portions of the plates 7, form as is clearly shown in Fig. 3, a series of supplemental keels. Instead of rounding the bilge plate as is the usual custom, I extend the lower or bilge plate 9 to a depth slightly more than the longitudinal plates 7 and provide them with what may be termed in the present structure as extensible bilge keels 10, for a purpose hereinafter to be described. I may also in some cases, provide a lateral or supplemental bilge keel 11, extending downwardly at an angle from the bilge plate to a depth substantially the same as that of the bilge keel 9 and also provide said lateral bilge keel 11 with a sup-

plemental extension plate 12. Any means desired or preferred may be used for raising or lowering the extension plates 10 and 12, and if desired, also an extension plate 13 may be provided in the center keel 14, with suitable mechanism for elevating and lowering the same. This center keel 14 is substantially the same depth as bilge keels 9 and 11.

In Fig. 4, I have shown a segregated cross-section of one of the cells, secured to the bottom of the hull. In this figure, it will be noted that I have provided an aperture 15, near the upper edge of one of the lateral plates or partitions, with a shutter 16 for the same. It is to be understood that all of the cells will be intercommunicating through such apertures 15, and such communication may, at any time, be closed by means of the shutters. I have also shown in Fig. 4, a pipe 17, such pipe being for communication with air pressure within the hull of the vessel, by which the cells or compartments, heretofore described, may be filled with air, under pressure. Under such circumstances, when air is forced into the compartments through the tube or pipe 17, the water which ordinarily would fill such compartments may be driven out until the level of the water comes to the bottom edge of the keels 9, 11 and 14. When the water has been expelled from the cells to a depth not quite reaching the bottom of the cross-plates 8, it may be desirable to equalize the pressure in the various chambers. When this is necessary, it may be accomplished in the following manner. Through the communicating apertures 15, this air under pressure is permitted to equalize and flow uniformly throughout all of the cells, but should it for any reason be desired to increase the buoyancy of one side of the vessel or any portion of the vessel, it will be understood that the air pressure in any portion, may be increased and the air in correspondingly different portions of the hull may be released to any desired extent, in the meantime, the shutters 16 being closed over the apertures to prevent equalization. In this manner, it will be seen that the buoyancy of a vessel or any portion of the vessel may be increased or decreased at will, so that a shifted cargo producing a list in the vessel, may be neutralized by producing a greater buoyancy on the side toward which the cargo has shifted.

By the introduction of air into the cellular structure hereinbefore described, the direct contact of the water in which the vessel is floating is removed from the hull of the vessel and I am thereby enabled to reduce the skin-friction upon the bottom of the vessel. The extensions 10, with the supplementary bilge keels 11 with their extensions 12, and the extension 13 from the center keel 14, also add materially to the stability of the boat and prevent rolling in heavy seas, for the reason that, inasmuch as such rolling may be considered as oscillation about the center of buoyancy, the greater the distance from said center of buoyancy to which any resistance to rolling is removed, the greater becomes the stability of the vessel.

The stability of a vessel provided with the structure illustrated in Figs. 8 and 9, is materially increased as heretofore described, while the rolling tendency of such vessel in heavy seas is materially reduced by the extended bilge keels 10, 12 and 13. It will be understood that when a vessel equipped with the cellular bottom heretofore described, and the bilge keels 10, 12 and 13, rolls slightly the air in the various compartments will tend to spill out over into the adjoining compartments and were not some means provided for arresting this spilled out portion of air, it would travel over to one side of the vessel, and thus escape around the lower edge of the bilge keel on that side. By locating the extension keel 13 in connection with the center keel, this tendency of the spilled out air from the several compartments to escape is arrested, while the air traveling toward the rising bilge will escape and thus correspondingly reduce the buoyancy of that side and thereby tend to force an equilibrium.

I have not shown any means for raising or lowering the extensions 10, 12 and 13, inasmuch as any of the usual means for raising and lowering end plates or center boards of vessels may be utilized for this purpose. A rack and pinion or cable connection might be used if desired.

I find that the longitudinal plates 7 afford a very convenient means for permitting the inspection of the bottom of a vessel, and the mechanism which I have provided for this purpose is as follows: As heretofore described, it will be noted that the longitudinal plates 7 composing the cellular bottom are of greater vertical depth than the lateral plates 8. I may then make use of these projecting edges as tracks upon which to run an inspection trolley boat 18, clearly shown in Figs. 3 and 4; such trolley boat ordinarily being empty and its wales projecting up into the spaces between the plates 7, produce in combination an air compartment, in which an inspector may travel from one part of the hull to another, and so long as the upper flanged edge 19 of the trolley boat 18 extends up into the air compartment formed by the plates 7 and 8, the inspector may travel without at any time becoming wet. In order to provide safety devices for the trolley boat 18, to prevent its derailment, I have located the angle guard rail 20 along the insides of the longitudinal plates 7, the flanges 19 of the trolley boat taking over such guard rail 20, and so long as the trolley wheels 21 are in engagement with the lower edges of the

plates 7, there can be no derailment. The upper edge of the boat, as indicated in Fig. 4, will come just beneath the lateral plates 8, so that on coming to such a lateral plate, the inspector has only to lower his head and shoulders into the boat 18 to pass from one compartment to another, when he can rise and inspect such compartment. The buoyancy of the inspection boat 18, inasmuch as it is submerged in the water and is hollow and empty, will maintain its position by the upward pressure of the water, against the lower edges of the longitudinal plates 7.

As a further means for increasing the stability of the vessel, I provide broad flat sheets of metal 22, pivoted to the lower edge of a similar vertical plate 23, which in turn is pivoted to the keel 14 of the vessel. These plates 22 and 23 extend longitudinally of the vessel, and are located at such points along the center keel and are of such length that they are capable of being folded into the cellular compartments as indicated in Fig. 9. The plate 23 is pivoted at 24 to the keel, and when in the position indicated in Fig. 8, the parts are held in stable equilibrium by means of the strut 25 pivoted at its upper end to some portion of the bottom of the vessel, or plates 7. Passing over a pulley 26 is a cable 29, one end of which is connected at 27 to the lower end of the strut 25, thence passing over the pulley 26 along the inner side of the plate 23 and thence along the under side of plate 22 through an aperture 28 in the outer edge of the plate 22, the opposite end of the cable to the opposite side of the strut 25.

Any desired mechanism may be used for rotating the pulley 26 to unfold the apparatus just described into the position illustrated in Fig. 8. When, however, the pulley is rotated in a direction to draw the lower end of the strut 25 toward the pulley 26, it will be seen that the whole structure consisting of the plates 22 and 23, and the strut 25 will be drawn upwardly and into the compartments formed by the downwardly extending plates 7 and 8. Ordinarily, these steadying devices or plates 22 and 23 are arranged in pairs as indicated in Fig. 8, on either side of the keel, so that the adjacent edges 30 of these plates being broadened or thickened abut against each other, and when drawn down with the struts 25 into the concavities 22′ in the outer edges of the plates 22, the thickened or broadened edges 30 of the plates 22 will abut against each other and thus form a rigid structure. Now these broad plates 22 and 23 being immersed as they are in the water, and located far beneath the hull of the vessel, serve as steadying plates so that the tendency of the vessel to roll will be resisted by the leverage provided by the considerable bulk of water which lies above the plates 22. At the same time, the plates in traveling through the water along with the hull of the vessel are presented edgewise to the water and thereby produce comparatively little obstruction to the forward movement of the vessel.

With the comparatively thin film of air inclosed in the cellular bottom of the vessel as indicated in Figs. 1, 2 and 3, I have succeeded in removing the direct contact of the water with the broad flat surfaces of the bottom of the vessel. It remains now to describe the means which I provided for reducing the skin-friction, or the friction between the water and the sides of the vessel. By producing a continuous thin film of air between the water and the hull of the vessel, I am able to still further reduce the skin-friction between the vertical sides of the hull and the water. In order to provide for this thin film of air, I make use of a plow-shaped prow 31, as indicated in Fig. 5, secured to the stem of the vessel in such a position as to afford a space behind such plow-shaped projections that I am able to send a jet of air through the series of apertures 31′ upon either side of the stem and to the rear of this false prow 30. During the forward motion of the vessel, this thin film of air is being projected through the apertures 31′ to such an extent that it trickles upward and rearward along the prow of the vessel so as to break the contact between the hull and the water and thereby reduce very materially, the skin-friction between the hull of the vessel and the water. In addition to these means for breaking the contact between the hull and the water, I may provide a shoe device 32 extending along the bow from the stem to some point toward the stern. This shoe carrying in its interior as indicated in Fig. 6, a tube or pipe 33, which is provided with a series of upwardly and inwardly directed discharge orifices, so that air may be driven from such orifices and thus provide additional means for projecting the thin film of air between the sides of the vessel and the water. As an additional means for breaking this contact between the vessel and the water, I may provide along the bow of the vessel, a series of endless curtains, as indicated in Figs. 5, 6 and 7, the upper end of the endless curtain being supported upon a roller 34 upon the side of the hull as indicated in Fig. 5, and the lower portion carried over a roller 35, within the shoe 32. The two rollers 34 and 35 are kept in rotation by any suitable means driven by power from within the hull of the vessel, so that the curtain 35 travels upwardly in the direction of the arrow shown in Fig. 5.

The belts 37 and 38, which drive the rollers 34 and 35 may be driven by a longitudinal shaft 39, which as above indicated, is connected with the driving power. The rear of the curtain 36 is given a fold as in-

dicated in Figs. 6 and 7, passing downwardly through a guiding frame that serves as a kind of brace to support metal work of the projecting bow on which the exterior or upwardly traveling portion of the curtain moves. During the forward motion of the vessel, it is understood that a series of these curtains located along the bow of the vessel are constantly traveling upward in the direction of the arrow, so that they form a sort of moving contact between the water and the vessel, and assist not only in reducing the so-called skin-friction but also assist in the upward motion of the water.

It will thus be seen that the instrumentalities which I have provided for reducing the area of contact between the hull of the vessel and the water are material departures from anything heretofore proposed, and effectually assist in the propulsion of the vessel. The cellular bottom lends itself admirably to the installation of multiple unit propelling mechanism, while the effective portion of such propelling mechanism is located in live, dense water at all times, thereby preventing a racing of driving power. The enlarged cells in which the propelling mechanism and the steering devices are installed affords a ready means of access for inspection and repair. The location of the rudders near the bow and stern as indicated in the drawings, will give better results than if a single rudder is placed alone at the stern. Other advantages of my improved construction will suggest themselves to those skilled in the art.

I claim:

1. An improvement in ship construction, comprising the hull or body of a ship in combination with a plurality of longitudinal and lateral plates arranged vertically upon the bottom of said hull or body and means for establishing communication between the spaces on opposite sides of said plates.

2. An improvement in ship construction, comprising in combination the hull of a ship and a plurality of vertically arranged plates secured to the bottom of said hull to form a plurality of open-bottomed cells and means for establishing communication between said cells.

3. An improvement in ship construction, comprising a plurality of vertical plates secured longitudinally to the bottom of the hull of a ship, and a plurality of vertical plates arranged laterally of said bottom and secured thereto, said plates being provided with apertures in their upper margins to afford means for equalizing pressure on opposite sides thereof.

4. An improvement in ship construction, comprising the hull or body of a ship in combination with a plurality of longitudinal and lateral plates arranged vertically upon the bottom of said hull or body, means for establishing communication between the spaces on opposite sides of said plates and means for expelling substantially all of the water from said spaces.

5. An improvement in ship construction, comprising in combination the hull of a ship and a plurality of vertically arranged plates secured to the bottom of said hull to form a plurality of open-bottomed cells, means for establishing communication between said cells and means for expelling substantially all of the water from said cells.

6. An improvement in ship construction, comprising a plurality of vertical plates secured longitudinally to the bottom of the hull of a ship, and a plurality of vertical plates arranged laterally of said bottom and secured thereto, said plates being provided with apertures in their upper margins to afford means for equalizing pressure on opposite sides thereof and means for expelling all the water from the spaces between said plates.

7. In a device for relieving a ship's hull from skin-friction, means for interposing a stratum of air between the bottom of said hull and the water and means for equalizing the pressure of air throughout said bottom.

8. In an improved ship structure, the combination with the hull of said ship, of a plurality of open-bottomed cells or chambers extending throughout the bottom of said hull and a plurality of hinged plates extending parallel with the keel of the ship and means for holding said plates into the cells or chambers adjacent to said keel.

9. In an improved ship structure, the combination with the hull of a ship, of a plurality of open-bottomed cells or chambers in the bottom of said hull lying parallel with and adjacent to the keel of the ship, a plurality of plates hinged to said keel to extend vertically into the water, and a plurality of plates hinged to the free edges of said first named plates and adapted to extend at right angles thereto at a distance below said hull and means for folding said plates into said cells or chambers and for extending said plates into vertical and horizontal positions respectively.

10. In a device for reducing "skin-friction" between the hull of a ship and the water in which it is immersed, the combination of means for projecting a film of air between the bow of the ship and the water and a series of upwardly traveling curtains secured to said hull and adjacent to the bow beneath the surface of the water.

11. In a device for relieving a ship's hull from skin-friction, means for interposing a stratum of fluid between the bottom of said hull and the water, such fluid being of less density than water, and means for equalizing the fluid pressure throughout said bottom.

12. An improvement in ship construction, comprising the hull or body of a ship in combination with a plurality of longitudinal and lateral plates arranged vertically upon the bottom of said hull or body, means for establishing communication between the spaces on opposite sides of said plates and means for interposing and maintaining a fluid of less density than water between said spaces.

13. An improvement in ship construction, comprising in combination the hull of a ship and a plurality of vertically arranged plates secured to the bottom of said hull to form a plurality of opened-bottomed cells, means for establishing communication between said cells and means for interposing and maintaining a stratum of fluid of less density than water within said cells.

14. An improvement in ship construction, comprising a plurality of vertical plates secured longitudinally to the bottom of the hull of a ship, and a plurality of vertical plates arranged laterally of said bottom and secured thereto, said plates being provided with apertures in their upper margins to afford means for equalizing pressure on opposite sides thereof and means for interposing and maintaining a fluid of less density than water between the spaces and opposite sides of said plates.

This specification signed and witnessed this 31st day of October, 1907.

ABEL L. MOONEY.

Witnesses:
CLIFFORD A. ALLISTON,
L. M. SANDERS.