June 19, 1928.

1,674,471

J. W. ISHERWOOD

CONSTRUCTION OF FLOATING VESSELS

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5 Sheets-Sheet 1

Fig. 2.

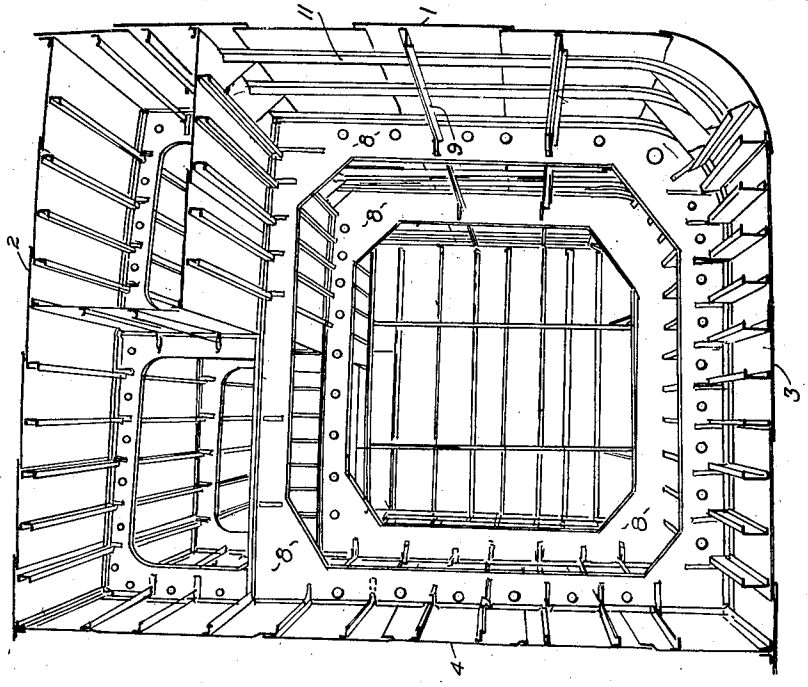
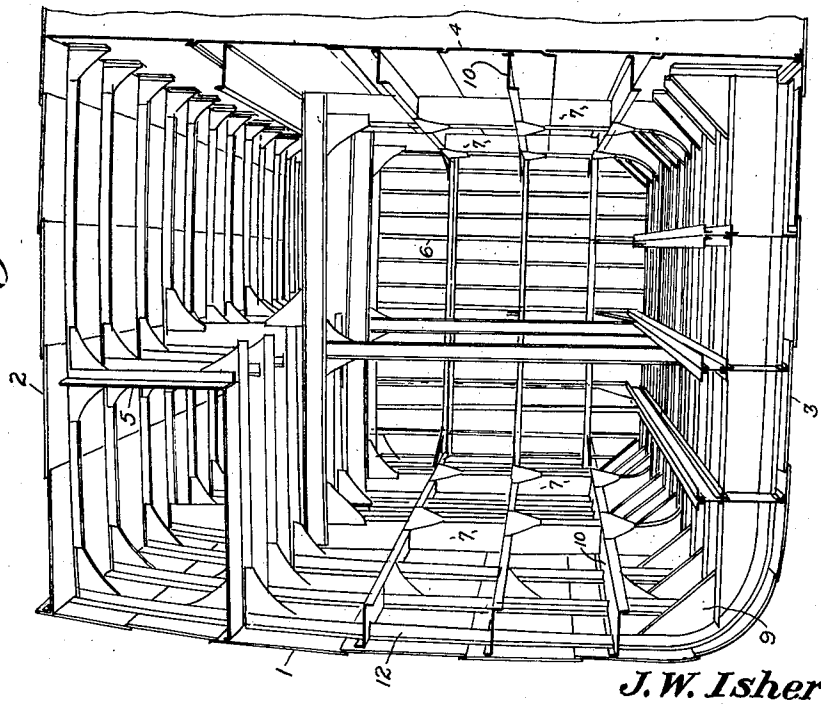


Fig. 1.



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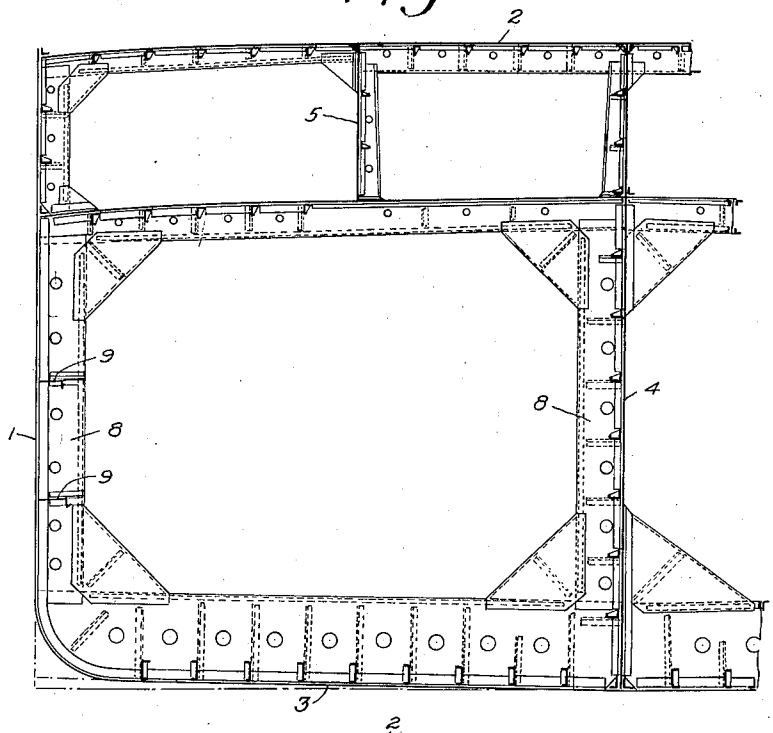
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CONSTRUCTION OF FLOATING VESSELS

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Fig. 3.



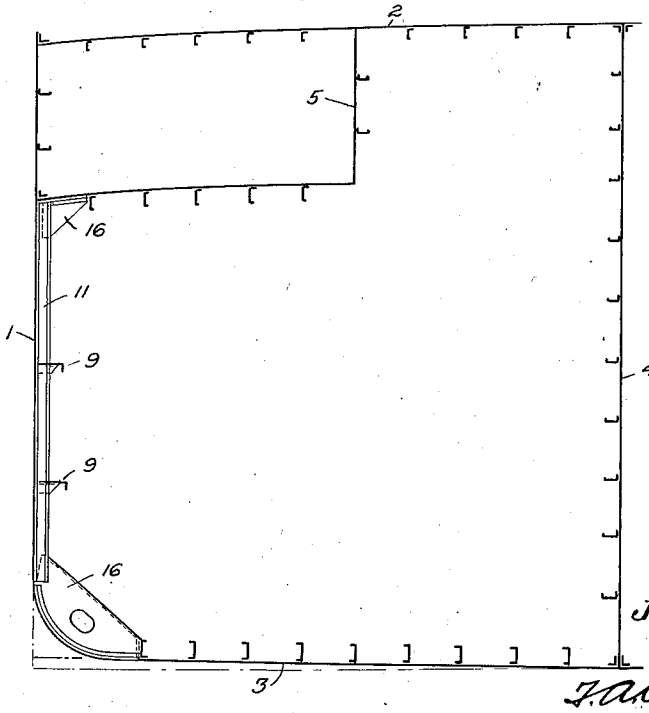


Fig. 4.

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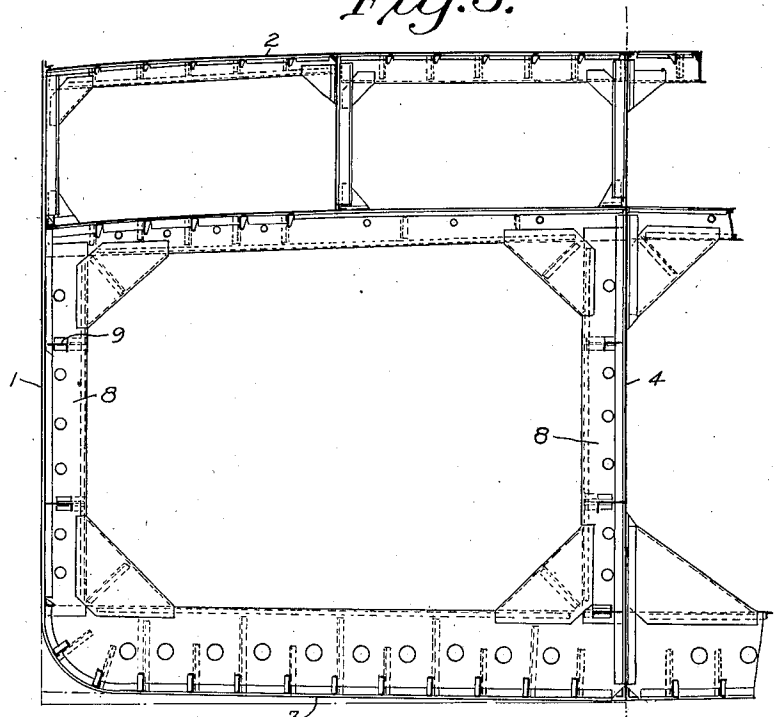
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CONSTRUCTION OF FLOATING VESSELS

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Fig. 5.



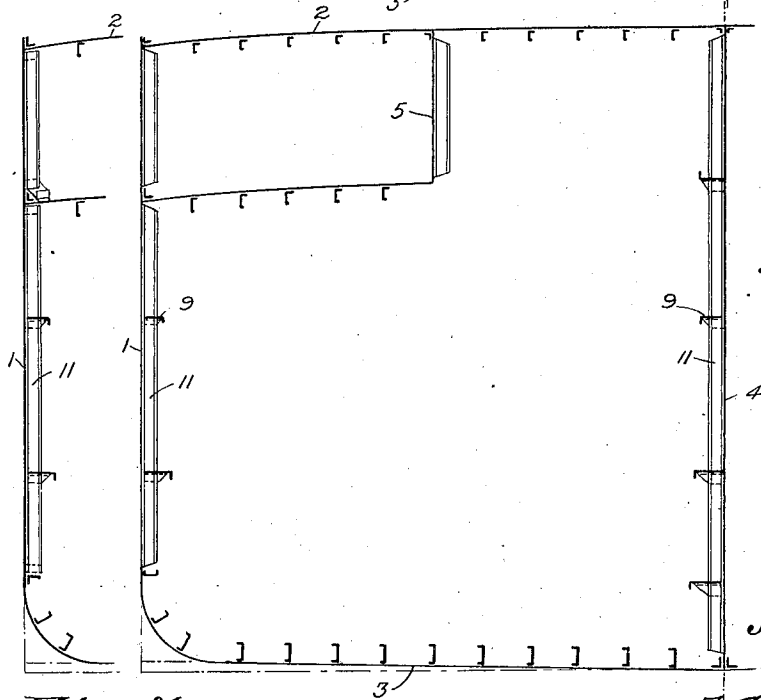


Fig. 6.

Fig. 7.

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June 19, 1928. 1,674,471

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CONSTRUCTION OF FLOATING VESSELS

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Fig. 8.

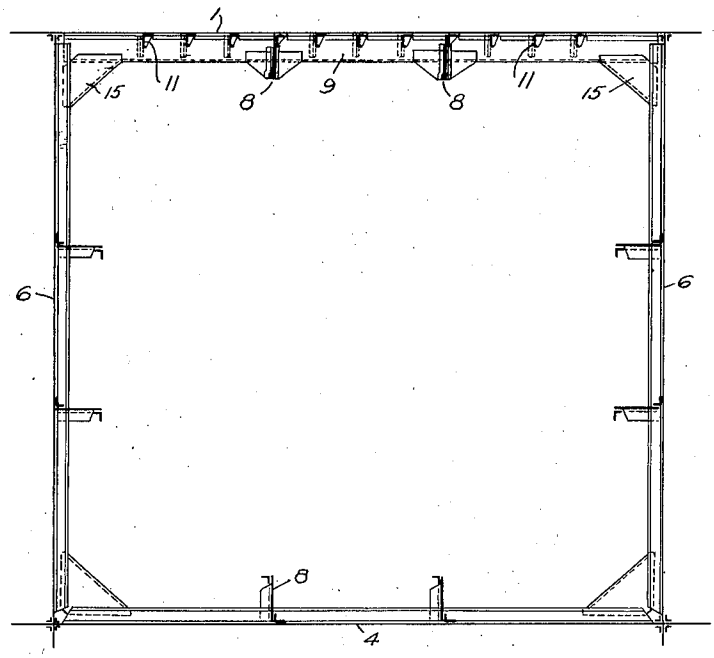
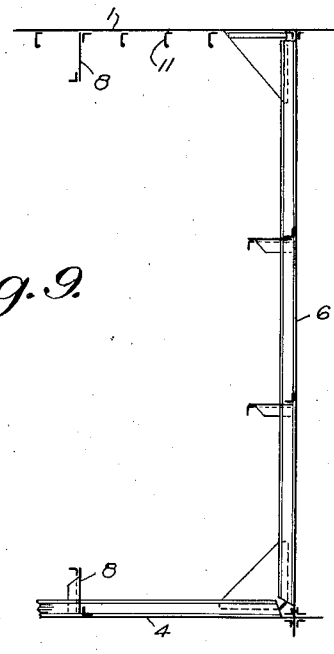


Fig. 9.



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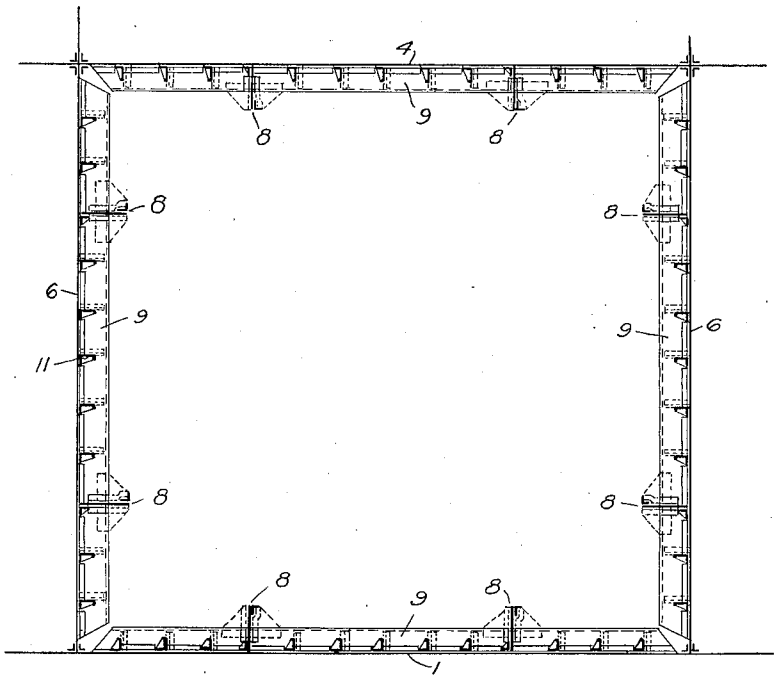
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CONSTRUCTION OF FLOATING VESSELS

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Fig. 10.



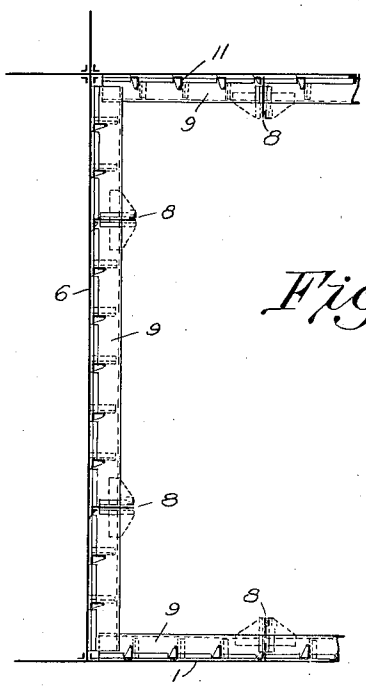


Fig. 11.

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UNITED STATES PATENT OFFICE.

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CONSTRUCTION OF FLOATING VESSELS.

Application filed June 13, 1924, Serial No. 719,861, and in Great Britain September 11, 1923.

This invention relates to floating vessels and has for its object to improve the constructions heretofore proposed for vessels built on the ordinary web frame system and adapted for the carriage of liquid in bulk, which requires closely spaced bulkheads.

With this and other objects in view, the invention consists in the novel details of construction and combination of parts more fully hereinafter disclosed and particularly pointed out in the claims.

Referring to the accompanying drawings forming a part of this specification, in which like numerals designate like parts in all the views:—

Figure 1 is a perspective view partially broken away of a section in a compartment of a well known tank vessel built on the ordinary web frame system;

Figure 2 is a similar view to Fig. 1 showing a section of a tanker made in accordance with this invention;

Figure 3 is a sectional view of a portion of the construction illustrated in Fig. 2, showing transverses of great strength or primary members 8, in conjunction with secondary longitudinal members 9 on the sides, and on the bulkhead 4 the well known longitudinal stiffening members disclosed in the Isherwood Patent #1,029,546;

Figure 4 shows also a portion of the construction of Fig. 2, and particularly the shallow subsidiary vertical transverse framing 11 that is used in association with the framing 8 and 9 indicated in Fig. 3;

Figure 5 is a view showing a modification of the construction in Fig. 3 and illustrates a substitution of vertical stiffening members in various parts of the vessel in lieu of the longitudinal stiffening members in Figs. 2 and 3;

Figure 6 is a view illustrating a further modified form of the construction shown in Figs. 2 and 4;

Figure 7 illustrates a still further modification of the construction shown in Fig. 6;

Figure 8 is a plan view of an oil compartment of the construction shown in Fig. 2;

Figure 9 is a part sectional view on a plane taken intermediate between the secondary longitudinal members 9 of Figs. 2 and 8;

Figure 10 is a plan view of a further modified form of the construction shown in Fig. 8; and

Figure 11 is a part sectional view showing certain modifications of the construction shown in Fig. 10.

Referring more particularly to Figs. 1 and 2, the numeral 1 indicates the shell plating 2, the deck portion and 3 the bottom portion of the vessel, 4 indicates the central longitudinal bulkhead, and 5 the expansion trunk, while 6 indicates one of the transverse bulkheads of an oil compartment. In this invention these compartments are so braced as to save metal over the prior well known web frame constructions. In other words, 8 indicates web frames or primary members which differ from the corresponding transverse members 7 in the old side and bulkhead web frame construction shown in Fig. 1, in that said members 8 are made of increased strength or of a strength sufficient to support the whole collective load. That is to say, I have discovered that by making the transverse members 8, say from 25% to 50% stronger than the transverses 7, I can so lighten the weight of the longitudinals 9, as to save metal over the construction of Fig. 1, and still meet all the requirements of the classification societies as to strength, seaworthiness, etc. of the vessel.

In this invention, therefore, instead of carrying a part of the whole load on the webs 7 and a part on the stringers 10, as is done in the well known prior construction illustrated in Fig. 1, I carry the whole collective load on the web members 8.

9 indicates the side stringers or secondary members, which are made of a less strength and lighter weight than the corresponding members 10 in the old system illustrated in Fig. 1, while 11 indicates the vertical frame or subsidiary members, which are similar to the corresponding members 12 of the prior construction in that they are of substantially the same strength as the said corresponding members 12. I am thus enabled to produce a bracing structure requiring a less weight of metal to provide an equivalent strength than it is possible to attain in the prior web frame construction heretofore employed, all as above stated.

Especially is this the case when said construction is associated with a longitudinally framed deck construction and a longitudinally framed bottom construction such as is disclosed in the said Isherwood Patent #1,029,546, above mentioned. That is, such longitudinal frame construction, when associated with the tank bracing structure just described, serves as is well known to naval architects, to give not only great longitudinal strength to the tank construction, but also adds stiffness to the vessel as a whole and thus enables the construction of a tank or other vessel to efficiently resist local damage as well as racking or twisting strains in a seaway while at the same time producing a seaworthy vessel which is relatively light as compared to other vessels.

It is obvious that this same side construction may be introduced in the bottom and deck portions of ships in general, but as the longitudinal frame, deck and bottom constructions of the Isherwood Patent #1,029,546 offer such great advantages and particularly so as regards longitudinal strength, it is preferred to all others.

It will also be obvious that the middle line and transverse bulkheads 4 and 6, respectively, can be braced with strong webs or primary members such as 8 in association with secondary members 9 and subsidiary members 11 in a like manner to the bracing of the sides of the ship, all as is illustrated in the modified forms of invention shown in Figs. 5, 6, 7, 10 and 11 presently to be described.

Coming now to Fig. 3 of the drawings, the construction there shown is the same as that shown in Fig. 2 but the parts are illustrated on a transverse plane different from that on which Fig. 2 is illustrated.

Coming to Fig. 4, the construction is the same as that illustrated in Figs. 2 and 3, but again the construction is illustrated on a plane different from that of either Figs. 2 or 3.

Coming to the somewhat modified form of invention shown in Fig. 5, the construction is substantially the same as that illustrated in Fig. 2 but with this difference: In Fig. 2 the central line bulkhead 4 is stiffened in a manner similar to that illustrated in the above mentioned Isherwood patent, and the side 1 of the vessel is stiffened in a different manner from said patent as above disclosed. In Fig. 5, on the other hand, the central line bulkhead 4 is stiffened by the relatively deep primary member, or transverse frame 8, as is the case in Fig. 2, but the secondary members 9 and subsidiary members 11 are employed on the bulkhead 4 instead of the Isherwood construction, and also on the side 1 as disclosed in Fig. 2.

Further, in Fig. 2, the between deck construction follows the construction shown in the said Isherwood patent, while in Fig. 5 the between deck construction follows the known vertical frame construction.

Coming now to the further modified form of construction shown in Fig. 6, it discloses the same intermediate construction as in Fig. 2, involving the secondary frame members 9 and subsidiary members 11, but it permits the omission of the brackets (not lettered in Fig. 2 and appearing at the top and bottom of the members 11, these brackets, however, being lettered 16 in Fig. 4) by so spacing the secondary members that each subsidiary member may be considered as a beam having an overhang at each end producing a cantilever of comparative rigidity, said spacing being in accord with ship specifications and such that the load associated with the overhang of a subsidiary member is carried thereby and by the secondary member with a marginal factor of safety. In other words, each subsidiary being considered a beam, the unsupported ends or overhang of each subsidiary will be able to support a load unbracketed for the reason that said overhangs are short enough (considering the beam strength) so that the moment, produced by the load in connection with the length of the cantilever, will fall within the inherent strength of the subsidiary to give sufficient inherent rigidity, thus providing a construction of less weight and yet equal strength. Also it is to be observed that brackets are omitted at the bilge, or bottom. This is made possible by the provision of closely spaced longitudinals or secondary members in the turn of the bilge as distinctly shown in Figs. 6 and 7, as a result of which the entire load is lessened on any one and therefore distributed so as to fall within the inherent rigidity of each with a sufficient factor of safety.

The main advantage of the modified form of invention shown in Fig. 5 resides in the fact that in certain types of vessels and under certain conditions of construction, it is an advantage to provide the same bracing construction on the central bulkhead 4 as is on the sides 1 of the vessel; and the chief advantage in the modified form of invention shown in Fig. 6 resides in the fact that in certain types of vessels, it is of advantage to dispense with the brackets 16 shown in Fig. 4.

In the particular form of construction shown in Fig. 7, the bracing structure is substantially the same as that in Fig. 6, except in the between deck construction an attachment is fitted at the top and bottom of the subsidiary members 11 and an attachment is also fitted at the top and bottom of the side construction as indicated by dotted lines in said figure.

In the still further modified form of the invention shown in Fig. 10, the construction

is substantially the same as that illustrated in Fig. 2, except the bracing structure illustrated in the said Isherwood patent on the central bulkhead 4 is omitted, and the combined bracing structure of this invention which is formed by the members 8, 9 and 11 is employed on all four sides of the tank walls illustrated in said Fig. 10. In addition to the above the usual bracket attachments of the secondary members 9 are omitted from the corners of the tank structure, this being made possible by so spacing the primary members that each secondary member may be considered as a beam having an overhang at each end producing a cantilever of comparative rigidity, said spacing being in accord with ship specifications and such that the load associated with the overhang of a secondary member is carried thereby and by the primary member with a marginal factor of safety. In other words, each secondary being considered a beam, the unsupported ends or overhang of each secondary will be able to support a load unbracketed for the reason that said overhangs are short enough (considering the beam strength) so that the moment, produced by the load in connection with the length of the cantilever, will fall within the inherent strength of the secondary to give sufficient inherent rigidity, thus providing a construction of less weight and yet equal strength. That is to say, I have further discovered that when desired the primary members not only in the side of the ship but in the middle lines and transverse bulkheads 4 and 6 can be so spaced as to render unnecessary the fitting of the brackets 15 that are illustrated in Fig. 8, and which connect the secondary members 9 to the transverse bulkheads.

The secondary members 9 on the skin 1 at the turn of the bilge can be so spaced as shown in Figs. 6 and 7 as to render unnecessary the fitting to the members 11 of the brackets 16 shown in Fig. 4 connecting the intermediate frame 11 to the bottom. That is to say, where a bracket would normally be used between a subsidiary member on the side of the vessel and a corresponding subsidiary member of the bottom, this bracket is dispensed with by spacing the longitudinals closer together whereby the loads or strains or both are absorbed by the secondary members and a saving of metal effected as will be apparent. When brackets to the secondary members 9 are thus dispensed with as hereinbefore disclosed the longitudinal strength of the ship as a whole can be maintained by the fitting of the doublings to the skin or overlapping plate members, or two-ply plates to the skin in the neighborhood of the transverse bulkheads, or by increasing the thickness of the plating at the proper points. That is to say, and by way of an example, in a tanker having dimensions of 330 feet by 46 feet by 27 feet with 24 foot tanks it will be found that under the ordinary web frame system of construction there would be provided two webs with a spacing of 8 feet, a multiplicity of side stringers of approximately equal spacing, and vertical framing 24 inches apart. For this same size vessel under the Isherwood system as disclosed in U. S. Letters Patent #1,029,546 there would be one strong transverse every 12 feet or perhaps two spaced 8 feet apart, longitudinals spaced 30 inches apart, and no vertical framing. Under the construction covered by the above disclosure there would be two primary members in each tank spaced 10 feet apart and each 5 feet from the tank bulkheads, a plurality of secondary members spaced to suit equal loads the middle span being greatest, and vertical framing or subsidiary members spaced 24 inches apart, it being understood that these dimensions are merely illustrative of the principles involved.

For a tanker having dimensions of 500 feet by 63 feet by 35 feet with 36 foot tanks the construction under the web frame system would provide three webs 9 feet apart, a multiplicity of side stringers, and vertical framing 27 inches apart. The Isherwood system of Patent #1,029,546 would provide two strong transverses 12 feet apart or may be three 9 feet apart, longitudinals spaced 30 inches, and no vertical framing. Under this invention the construction would provide three primary members with a 10 foot 8 inch spacing therebetween having a distance of 7 feet 4 inches between each outer primary member and its adjacent bulkhead, a plurality of secondary members spaced to suit equal loads, and subsidiary members spaced 27 inches apart.

In Fig. 2, I have illustrated the center line bulkhead 4 as provided with transverse and longitudinally disposed bracing members, the longitudinal members as compared to the transverse members being relatively weak and very closely spaced, all as disclosed in the Isherwood Patent #1,029,546 above mentioned. But it is obvious that any other one or more bulkheads of the ship may be provided with the same bracing structure if so desired. It is also clear from the above disclosure that the deck constructions and the bottom construction of the vessel is provided with transverse and longitudinally disposed bracing members, the longitudinal members as compared to the transverse members being very closely spaced and relatively weak, likewise as is disclosed in the said Isherwood patent, and as is well known from the principles of ship construction the decks and bottoms built in this manner serve to very greatly strengthen and stiffen the side construction of the vessel.

Coming now to the modified form of construction shown in Fig. 11, it is substantially the same as the construction shown in Fig. 10, except the secondary members 11 overlap at the corners of the tank structure as illustrated but are not provided with any brackets.

As an example of the dimensions of a vessel built according to this invention, it may be 430′ long, 60′ wide and 32′ deep with a between decks constructions adapted to form an expansion trunk in the center for the oil, 8′ deep. The transverses 8 can be spaced 7½′ apart, while the side frames 11 can be spaced 2½′ apart and formed of bulb angles 8″ deep by ½″ thick with 3½″ width of flange, and the side stringers 9 can be formed of flanged plates 18″ deep by .4″ thick with 5″ width of flange bracketed to the transverse bulkheads 15 as shown in Fig. 8. The frames 11 are bracketed to deck and bottom 16 as shown in Fig. 4, while the main transverses 8 are 30″ side by .46″ thick. The face bar is 6″ deep by ½″ thick with 3½″ width of flange. The remaining forms and scantlings may be in accordance with the disclosure of the said Isherwood Patent #1,029,546.

It will now be clear from the foregoing that the present invention constitutes a combination of closely spaced longitudinals or stiffeners on the deck, bottom and bulkheads with strong widely spaced webs or transverses such as is disclosed in the Isherwood Patent #1,029,546, coacting with vertically disposed side framing between strong webs or transverses, the latter being in line with the deck and bottom transverses. These strong webs or transverses, which may be substituted by a bulkhead, become what I call primary members with equivalent strength necessary to sustain the loads distributed by one, two or more longitudinals attached to the sides, or the bulkheads, which I term secondary members. These latter may be notched through or bracketed to the primary members in the manner well known. These secondary members in turn carry the loads of the closest spaced vertical frames or stiffeners which are disposed from two to three feet apart and which I term subsidiary members. These latter members are notched through the secondary members as illustrated and all are attached directly to the shell plating or the bulkheads. Such a relation or combination of parts as covered by this invention gives a structure producing great strength for all purposes, together with a minimum weight of metal, and it differs from any other previous construction with which I am acquainted, in that the stresses are disposed over the three members 8, 9 and 11 through the primary members 8 which latter have to be strong enough to carry the whole load, and in that brackets may be dispensed with. This said bracing structure of the side of the vessel combined with the deck or bottom which is disclosed in the Isherwood Patent #1,029,546, gives a combination of great efficiency. Said construction also constitutes an improvement over previous practice in shipbuilding in that it involves the best features of the well known longitudinal and transverse stiffening, and it constitutes a combination of parts which is able to withstand all that is required of it in a seaway. Said construction also is enabled to withstand local bumping and side damage thus minimizing the cost of repairs.

It is obvious that those skilled in the art may vary the details of construction as well as the arrangements of parts without departing from the spirit of the invention, and therefore I do not wish to be limited to the above disclosure except as may be required by the claims.

What is claimed is:—

1. In a floating vessel provided with a skin including the decks, sides and bottom, and a bulkhead, the combination of a plurality of bracing sets each comprising primary, secondary, and subsidiary members of a web frame type of vessel, said primary members being of a greater strength, said secondary members being of a lesser strength, and said subsidiary members being of substantially the same strength as the corresponding members in a vessel of the same size and class built on the web frame system, the aggregate weight of said members being less than the weight of the corresponding members in said last named web frame vessel, and one of said sets being attached to said skin and another of said sets being attached to said bulkhead.

2. In a floating vessel provided with a skin including the decks, sides and bottom, and a bulkhead, the combination of a bracing set comprising primary, secondary, and subsidiary members of a web frame type of vessel, said primary members being of a greater strength, said secondary members being of a lesser strength, and said subsidiary members being of substantially the same strength as the corresponding members in a vessel of the same size and class built on the web frame system, the aggregate weight of said members being less than the weight of the corresponding members in said last named web frame vessel, said set being attached to said skin, and said bulkhead being provided with transverse and longitudinal frames which as compared with said transverse frames are individually weak and very closely spaced.

3. A floating vessel adapted for the carriage of liquid in bulk requiring closely spaced bulkheads and including primary, secondary, and subsidiary bracing members

of a kind belonging to a web frame type of vessel, said primary members being of a greater strength, said secondary members being of a lesser strength, and said subsidiary members being of substantially the same strength as the corresponding members in a vessel of the same size and class built on the web frame system, said primary members between adjacent bulkheads being spaced apart a greater distance than the distance from a bulkhead to the adjacent primary member, said secondary members being spaced apart a greater distance than the distance from the outer secondary member to the deck or turn of the bilge, and the aggregate weight of all of said members being less than the weight of the corresponding members in the last named web frame vessel.

4. A floating vessel adapted for the carriage of liquid in bulk by the provision of closely spaced athwart ship bulkheads to form a plurality of tanks and including reinforced primary, bracketless secondary, and subsidiary bracing members of a kind belonging to a web frame type of vessel, said primary members being of a greater strength, said secondary members being of a lesser strength, and said subsidiary members being of substantially the same strength as the corresponding members in a vessel of the same size and class built on the web frame system, the primary members in a tank being spaced apart a greater distance than the distance from a bulkhead to the adjacent primary member, the secondary members in said tank being spaced apart a greater distance than the distance from the outer secondary member to the top or the bottom of said tank, and the aggregate weight of all of said members being less than the weight of the corresponding members in the last named web frame vessel.

5. A floating vessel adapted for the carriage of liquid in bulk and provided with a skin including the decks, sides and bottom, a plurality of athwart ship bulkheads to form a plurality of tanks, and primary, secondary and subsidiary bracing members of a kind belonging to a web frame type of vessel, but differing therefrom in the characteristics that said primary members are of a greater strength, said secondary members are of a lesser strength and said subsidiary members are of substantially the same strength as the corresponding members in a vessel of the same size and class built on said web frame system and also differing therefrom in that the aggregate weight of said members is less than the weight of the corresponding members in the vessel built according to said web frame system, said spacing of the primary and secondary members from the adjacent walls of the tank being less than the similar spacing of the corresponding members of said web frame system whereby brackets are unnecessary at the ends of the secondary and subsidiary members.

6. A floating vessel adapted for the carriage of liquid in bulk by the provision of a plurality of athwart ship bulkheads to form a plurality of tanks and including primary, secondary, and subsidiary bracing members of a kind belonging to a web frame type of vessel, said primary members being of a greater strength, said secondary members being of a lesser strength, and said subsidiary members being of substantially the same strength as the corresponding members in a vessel of the same size and class built on the web frame system, the primary members in a tank adjacent a bulkhead being placed closer to said bulkhead while the spacing between the remaining primary members remains the same, whereby brackets are dispensed with between the adjacent secondary members at right angles to each other in said tank, the aggregate weight of all of said members being less than the weight of the corresponding members in the last named web frame vessel.

7. A floating vessel adapted for the carriage of liquid in bulk by the provision of a plurality of athwart ship bulkheads to form a plurality of tanks and including primary, secondary, and subsidiary bracing members of a kind belonging to a web frame type of vessel, said primary members being of a greater strength, said secondary members being of a lesser strength and said subsidiary members being of substantially the same strength as the corresponding members in a vessel of the same size and class built on the web frame system, the secondary member in a tank adjacent a deck being placed closer to said deck while the spacing between the remaining secondary members remains the same, whereby brackets are dispensed with between the subsidiary members of the sides of said tank and said deck, the aggregate weight of all of said members being less than the weight of the corresponding members in the last named web frame vessel.

8. A floating vessel adapted for the carriage of liquid in bulk by the provision of a plurality of athwart ship bulkheads to form a plurality of tanks and including primary, secondary, and subsidiary bracing members of a kind belonging to a web frame type of vessel, said primary members being of a greater strength, said secondary members being of a lesser strength and said subsidiary members being of substantially the same strength as the corresponding members in a vessel of the same size and class built on the web frame system, the secondary member in the side of a tank adjacent the turn of the bilge being placed closer to said turn while the spacing between the remaining secondary

members in said side remains the same and additional closely spaced secondaries being provided in said turn, whereby brackets are dispensed with between the subsidiary members of the sides of said tank and the bottom, the aggregate weight of all of said members being less than the weight of the corresponding members in the last named web frame vessel.

9. A floating vessel adapted for the carriage of liquid in bulk requiring closely spaced bulkheads and including primary, secondary, and subsidiary bracing members of a kind belonging to a web frame type of vessel, said primary members being of a greater strength, said secondary members being of a lesser strength, and said subsidiary members being of substantially the same strength as the corresponding members in a vessel of the same size and class built on the web frame system, the primary members being spaced in each bulkhead compartment to provide the secondary members with unsupported ends short enough to support a load due to the inherent strength of each secondary member said ends being devoid of brackets, and the aggregate weight of all of said members being less than the weight of the corresponding members in the last named web frame vessel.

10. A floating vessel adapted for the carriage of liquid in bulk requiring closely spaced bulkheads and including primary, secondary, and subsidiary bracing members of a kind belonging to a web frame type of vessel, said primary members being of a greater strength, said secondary members being of a lesser strength, and said subsidiary members being of substantially the same strength as the corresponding members in a vessel of the same size and class built on the web frame system, the secondary members being spaced in each bulkhead compartment to provide the subsidiary members with unsupported ends short enough to support a load due to the inherent strength of each subsidiary member said ends being devoid of brackets, and the aggregate weight of all of said members being less than the weight of the corresponding members in the last named web frame vessel.

In testimony whereof I affix my signature.

JOSEPH W. ISHERWOOD.