Nov. 7, 1933. J. KJEKSTAD 1,933,860

TRUSS WELD SYSTEM

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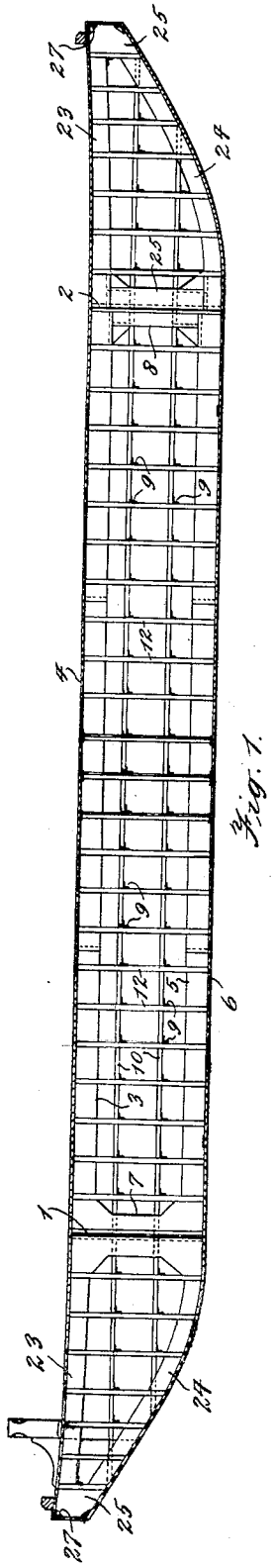


Fig. 1.

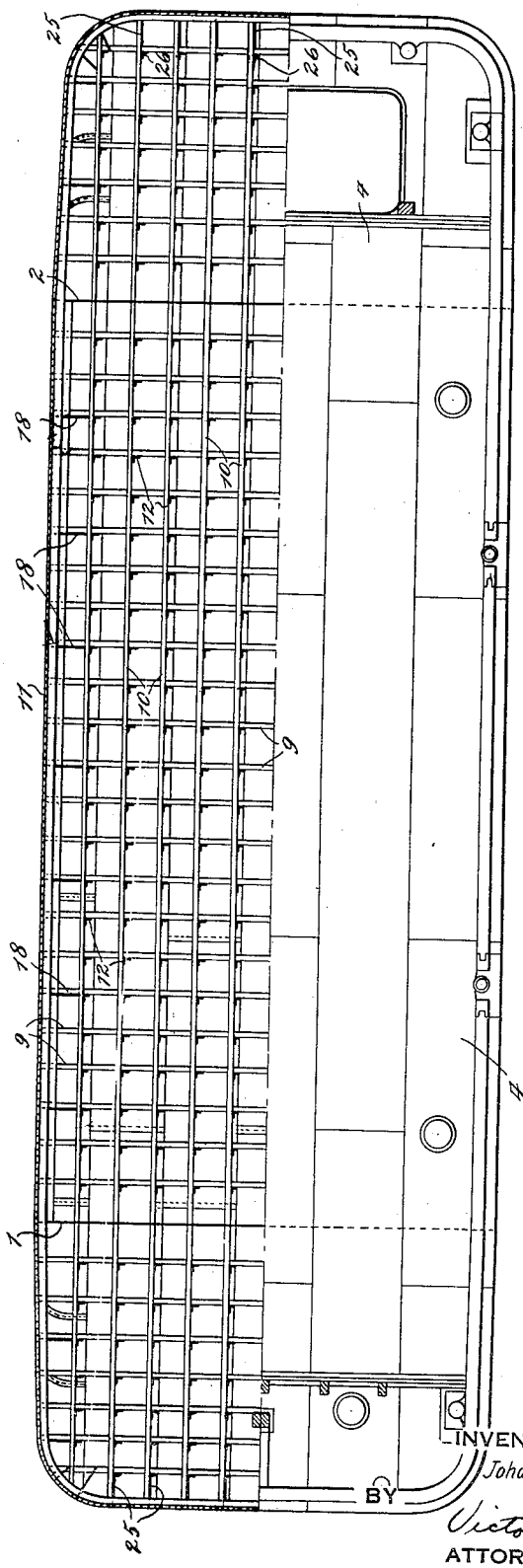


Fig. 2.

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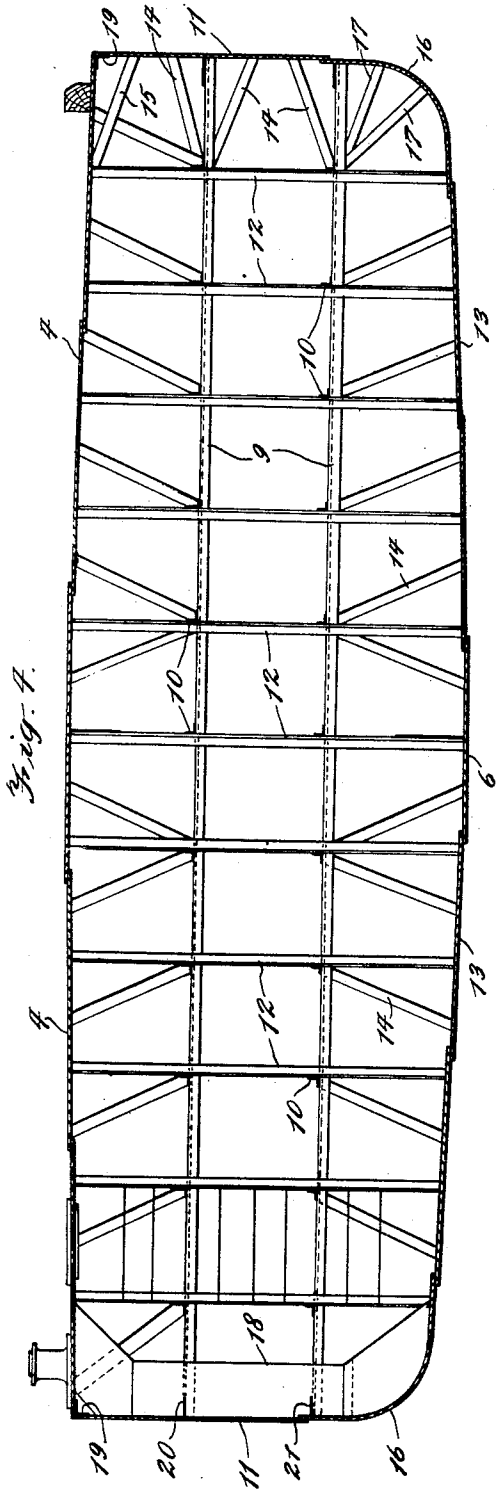


Fig. 4.

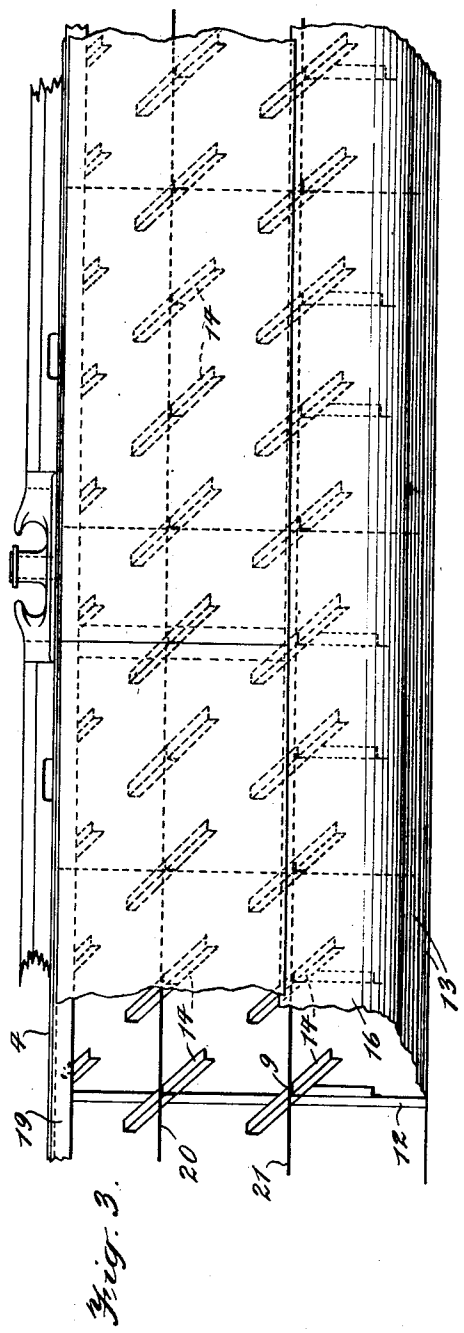


Fig. 3.

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UNITED STATES PATENT OFFICE

1,933,860

TRUSS WELD SYSTEM

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Application January 9, 1930. Serial No. 419,526

9 Claims. (Cl. 114—79)

My invention is directed to an improved construction of hulls for vessels. The invention contemplates a hull in which the individual members of the internal structure are subjected to compressive or tensile forces only.

The external forces acting upon the hull of a vessel are varied in direction and kind, and various types of hull constructions have been proposed to adequately resist such forces. Among the forces are the lateral pressure upon the sides, bottom and deck, and the torsional stress set up by the twisting of the hull when the vessel is propelled through the water against a head or quartering sea. To prevent the hull from wringing, twisting or breaking under the action of these forces, it has been the common practice to build the shell of the hull about a heavy frame. The more common construction of hulls has been that in which the frame consists of a bar keel to which transverse frame members are secured at their lower end. To the transverse frame members, the sheer strakes, side plates, bilge plates, bottom plates and keel strakes are secured. Above and parallel to the bar keel, running fore-and-aft, there is a keelson to which the lower end of a reverse frame which supports the floor of the hull is secured. The deck beams are supported at their ends by the upper edge of the transverse frame members to which they are secured by knee plates. At their center, the deck beams are supported by solid stanchions which in turn are supported by the keelson. In addition to this structure, a number of stringers are used which, in general, include deck stringers, side stringers, and bilge stringers running fore-and-aft and secured to that part of the frame from which they take their name. In these structures, the principal frame members act as beams resisting the forces acting on the hull by their resistance to bending. In resisting forces by the resistance of a material to bending, the stresses are concentrated in a small area of the material and for the same force applied, the cross sectional area would necessarily be large in comparison with that which would be required if the force were applied in a longitudinal direction setting up compressive or tensile stresses throughout the material. Consequently, the frame members of the internal structure of the hull are unnecessarily large and of great weight.

By my invention, the cross-sectional area of the individual members of the internal structure of the hull is greatly reduced, and the amount of material and consequently the weight of the hull is also reduced with greater strength and carrying capacity imparted thereto. I employ a construction in which the individual members of the internal structure are so arranged that the forces acting on the hull are transmitted to them as compressive and tensile stresses, thereby utilizing the highest values of the material.

Among the characteristics of my invention is the fact that the individual members of the internal structure of the hull are so coordinated that local stresses in any individual member are transferred, distributed to and absorbed by adjacent members, thereby making it possible to reduce the cross-section of the members below, that which would ordinarily be required to absorb local stresses individually.

Another characteristic of my invention is the fact that the arrangement of the internal structure in relation to the plates in the bottom, deck, sides, ends, longitudinal and transverse bulkheads is such that the individual members form longitudinal and transverse box girders with a lesser amount of steel at its neutral axis than where the compression and tension stresses occur. The arrangement also effects a bracing in a lateral direction as well as in longitudinal and transverse directions, and in addition short diagonal braces may be provided for bracing the plates between trusses against lateral pressure.

Another characteristic of my invention is the fact that the bulkheads and reinforcing webs are secured directly to the plates constituting the shell of the hull. The bulkheads thereby enter into the internal structure to absorb stresses set up therein.

Specifically, I provide an arrangement of the individual members of the internal structure such that, in conjunction with the shell of overlapped plates secured together and forming the bottom, sides, bow, stern and deck plates they form a system of internal bracing having a series of trusses arranged in groups at different levels. Each group of trusses comprises two angularly disposed rows of trusses anchored to opposed side or end plates. The trusses forming each group are connected together at their points of intersection. Adjacent the points of intersection of two trusses in several of the groups of trusses anchored to the side and end plates, a series of trusses which are anchored to the deck and bottom plates are disposed, and are connected to the two trusses at each of such points of crossing. The trusses are secured together at the points of intersection so that the local stresses in any member are transferred, distributed to and absorbed by adjacent members. The keel, bottom, side

and deck plates may be braced between the trusses against lateral pressure by short diagonal braces which are anchored to adjacent points of crossing of trusses. The curved portion of the bilge and end plates may be braced between trusses by radial braces secured to adjacent connections of crossing trusses.

Where bulkheads are used, either fore-and-aft or athwartship, the edges of the bulkheads are secured to the plates constituting the shell of the hull. The members of the internal structure running at an angle to the bulkheads are secured thereto. In this way, the bulkheads are made a component part of the internal structure of the hull and serve to absorb stresses set up in the hull.

In some constructions, such for instance as a hopper barge, the distance between the side of the hopper and the side of the hull may be such, that the trusses extending between and anchored to the bottom and deck plates may be omitted along the side of the hopper, the transverse trusses being anchored to the side of the hull and the adjacent side of the hopper, and the longitudinal trusses, as in other constructions being anchored to the end plates.

My invention has other features and advantages and comprehends various other details of construction as will hereinafter more particularly appear.

I shall now describe one embodiment of my invention in connection with the accompanying drawings in which:

Fig. 1 is a longitudinal central section of a barge constructed in accordance with my invention;

Fig. 2 is a plan with part of the deck plates removed;

Fig. 3 is a fragmentary side elevation with parts broken away to show the details of the side bracing; and,

Fig. 4 is a midship section.

In the drawings, I have illustrated my invention as embodied in the hull of a steel barge. It is, however, to be understood that the details of construction which will be hereinafter described are equally applicable to all marine vessels regardless of their use, size, shape or means of propulsion.

The barge illustrated is that of the ordinary type which is used for carrying a deck load of sand, gravel or any other commodity carried by such barges. Obviously, the barge illustrated may be designed for transporting, in addition to the deck load, a liquid cargo in the hold such as oil or gasoline as the bracing and internal structure of the hull is designed to resist both internal and external lateral pressure. On the deck, the barge shown carries the usual appliances such as the deck house, hatches, winches, deck rails and mooring apparatus, the deck plates constituting the roof or upper side of the hull.

The shell of the hull is made up of a plurality of steel plates, the ends of which overlap and are welded together. The shell so formed is divided into three sections, two end and a central section, by two athwartship bulkheads 1 and 2. The edges of the bulkheads 1 and 2 are firmly secured to the plates constituting the shell. Along the longitudinal center of the hull, an upper web 3, the upper edge of which is secured to the deck plates 4, and a lower web 5, the lower edge of which is secured to the keel plates 6 extend between and have their end edges secured to the bulkheads 1 and 2. The webs 3 and 5 are united by vertical webs 7 and 8 which are secured along one edge to the bulkheads 1 and 2 respectively. Within the central section of the hull, between the bulkheads 1 and 2, a series of trusses are arranged in horizontal groups at different levels, each group comprising transverse horizontal truss 9 and a longitudinal horizontal truss 10 which are connected at their points of intersection by welding. The trusses may desirably consist of what is known to the trade as angle-irons. The ends of the transverse horizontal trusses 9 are anchored to the inner surfaces of opposed side plates 11, and the longitudinal trusses 10 are anchored at their ends to the bulkheads 1 and 2. A series of vertical trusses 12 disposed immediately adjacent the two trusses and several of the horizontal groups are connected to the transverse horizontal and longitudinal horizontal trusses at their points of crossing. The ends of the vertical trusses are anchored to the inner surfaces of opposed deck and bottom plates 4 and 13 respectively. All of the trusses are shown as of uniform cross-section, and are uniformly positioned longitudinally, transversally and vertically. This arrangement of trusses, relative to the plates in bottom, deck, sides and bulkheads forms longitudinal and transverse box girders. At the midpoints, i. e., at the point of intersection of the diagonals drawn on the plates from the points of anchorage of adjacent trusses, a diagonal short truss or brace 14 is anchored at one end, the other end being secured to the point of intersection of the trusses running at 90 degrees to those from the ends of which the diagonals are drawn. These diagonal braces serve to resist lateral pressure on the plates between longitudinal, transverse or vertical trusses.

The side plates 11 are reinforced against lateral pressure between trusses by two diagonal braces which extend from the intersection of the longitudinal horizontal trusses with diagonally opposed horizontal transverse trusses forming a box girder with respect to the side plates. Short diagonal braces 15 are also used in the upper portion of the hull, and are anchored at one end to the upper portion of the side plates 11 and at the other end to the deck plate 4. The curved portion of the bilge plates 16 are braced by radial braces 17 extending from adjacent intersections of the longitudinal, horizontal and vertical trusses. At intervals along the sides of the hull, webs 18 are secured to the side plates 11, bilge plates 16 and deck plates 4 as shown in Fig. 4. These webs 18 serve to reinforce the sides and deck, and the connection between the side and deck plates. The webs 18 also serve to distribute stresses conveyed through the trusses secured thereto over a greater plate area. At the intersection of the side and deck plates, the webs 18 are cut away to accommodate deck stringers 19 which run fore-and-aft. Side and bilge stringers 20 and 21 are provided in the form of webs extending between and secured at their ends to the sides of the webs 18 by welding. The aligned sections are so secured, that for all practical purposes, they form continuous stringers running fore-and-aft. The longitudinal edges of the stringers are secured to the side and bilge plates respectively.

The keel plates 6 are supported by the web 5 and short diagonal braces extending from adjacent connections of crossing trusses on both sides of the web 5.

In the deck there is provided a manhole through which a man may enter the hull to inspect the internal structure and make repairs, if necessary.

The end sections which are identical, are constructed in a manner similar to that of the central section described immediately above. These sections have upper and lower central webs 23 and 24, and vertical connecting webs 25. The vertical connecting webs are secured along one edge to the bulkhead in alignment with the vertical webs 7 and 8 of the central section. The lower webs 24 are bent to the shape the bow and stern of the boat will take in the finished form. The end edges of the webs 23 and 24 in contact with the bulkheads are welded thereto in alignment with the the webs 3 and 5 respectively and for all practical purposes the three sections form one continuous web running fore-and-aft from the bow to the stern. The internal structure in the ends is similar to that of the central section, longitudinal, horizontal, transverse, horizontal and vertical trusses being provided, the curved sections of the bow and stern being braced between trusses by radial braces 26 extending from the adjacent intersection of the through trusses. In a manner similar to the longitudinal central webs, the end of the longitudinal horizontal trusses of the end and central sections are welded in alignment to the bulkheads 1 and 2. The deck plates and end plates are reinforced at their intersection by angle-irons 27, the central vertical end webs 25 being cut away to receive the angle-irons 27.

It will be noted that the construction of a hull as described immediately above arranges the individual trusses so that they are subjected to tensile or compressive stresses only, and that because of the interconnection of the trusses, localized stresses in any individual truss are transmitted to adjacent trusses, thereby permitting a lesser cross sectional area of individual trusses than would ordinarily be required were the trusses to sustain all of the local stresses set up therein. Furthermore, the interconnection of the internal structure with the bulkheads and securing the edges of the bulkheads to the shell of the hull utilize the steel in the bulkheads for absorbing stresses.

The construction results in an extremely simple relatively inexpensive and rigid design requiring a minimum of steel for a given deck carrying capacity and thereby decreasing both the cost of manufacture and the weight of the hull.

It is obvious that various changes may be made in the illustrated embodiment above particularly described within the principle and scope of my invention as expressed in the appended claims.

I claim:

1. A hull for ship constructions comprising in combination with the shell of overlapped plates secured together and forming the bottom, sides, bow, stern and deck plates, a system of internal bracing therefor comprising upper and lower longitudinal central webs running fore-and-aft from bow to stern and secured along one edge to the inner surface of the deck and keel plates respectively and a plurality of interconnected fore-and-aft, transverse and vertical trusses anchored at their ends to the inner surface of the plates constituting the shell of the hull.

2. A hull for ship constructions comprising in combination with the shell of overlapped plates secured together and forming the bottom, sides, bow, stern and deck plates, a system of internal bracing therefor comprising upper and lower longitudinal central webs running fore-and-aft from bow to stern and secured along one edge to inner surface of the deck and keel plates respectively, fore-and-aft end webs uniting the upper and lower central webs and secured along one edge to the bow and stern plates respectively, and a plurality of interconnected fore-and-aft, transverse, and vertical trusses anchored at their ends to the inner surface of the plates constituting the shell of the hull.

3. A hull for ship constructions comprising in combination with the shell of overlapped plates secured together and forming the bottom, sides, bow, stern and deck plates, a system of internal bracing therefor comprising athwartship bulkheads having their edges secured to the plates constituting the shell and serving as bracing therefor, and a series of longitudinal horizontal, transverse horizontal and vertical trusses between the bulkheads and between the bulkheads and the ends, the ends of the longitudinal horizontal trusses being anchored to the ends and to the bulkheads in alignment so as to constitute continuous trusses running fore-and-aft from bow to stern.

4. A hull for ship construction comprising in combination with the shell of overlapped plates secured together and forming the bottom, sides, bow, stern and deck plates, a system of internal bracing therefor comprising a plurality of fore-and-aft, transverse and vertical trusses anchored at their ends to the inner surface of the plates constituting the shell of the hull, spaced side reinforcing webs secured at the upper edge to the deck plates and along the side edge to the side and bilge plates, and side and bilge stringers formed from sectional webs extending between the side webs and secured in alignment at their end edges to the side reinforcing webs.

5. A hull for ship construction comprising in combination with the shell of overlapped plates secured together and forming the bottom, sides, bow, stern and deck plates, a system of internal bracing comprising a series of trusses arranged in groups at different levels, each group comprising two angularly disposed rows of trusses anchored to opposed side or end plates and connected at their points of intersection, and a series of trusses anchored to the deck and bottom plates with each truss disposed immediately adjacent the points of crossing of two trusses in several of the groups anchored to the side and end plates and connected to the two trusses at each of such points of crossing.

6. A hull for ship construction comprising in combination with the shell of overlapped plates secured together and forming the bottom, sides, bow, stern and deck plates, a system of internal bracing comprising a series of trusses arranged in horizontal groups at different levels, each group comprising two angularly disposed rows of trusses anchored to opposed side or end plates and connected at their points of intersection, and a series of vertical trusses anchored to the deck and bottom plates with each truss disposed immediately adjacent the points of crossing of two trusses in several of the horizontal groups and connected to the two trusses at each of such points of crossing.

7. A hull for ship construction comprising in combination with the shell of overlapped plates secured together and forming the bottom, sides, bow, stern and deck plates, a system of internal bracing comprising a series of trusses arranged in horizontal groups at different levels, each group comprising two angularly disposed rows of trusses anchored to opposed side or end plates and connected at their point of intersection, a series of vertical trusses anchored to the deck

and bottom plates with each truss disposed immediately adjacent the points of crossing of two trusses in several of the horizontal groups and connected to the two trusses at each of such points of crossing, and diagonal braces anchored at one end to the side deck and bottom plates between the points of anchorage of said trusses and connected at the other end to adjacent horizontal and vertical trusses at their points of crossing.

8. A hull for ship constructions comprising in combination with the shell of overlapped plates secured together and forming the bottom, sides, bow, stern and deck plates, a system of internal bracing comprising a series of trusses arranged in horizontal groups at different levels, each group comprising two angularly disposed rows of trusses anchored to opposed side or end plates and connected at their points of intersection, a series of vertical trusses anchored to the deck and bottom plates with each truss disposed immediately adjacent the points of crossing of two trusses in several of the horizontal groups and connected to the two trusses, at each of such points of crossing, and radial braces anchored at one end to the curved portion of the bilge and end plates and connected at the other end to adjacent horizontal and vertical trusses at their points of crossing.

9. A hull for ship construction comprising in combination with the shell of overlapped plates secured together and forming the bottom, sides, bow, stern and deck plates, a system of internal bracing comprising a series of trusses arranged in horizontal groups at different levels, each group comprising two angularly disposed rows of trusses anchored to opposed side or end plates and connected at their points of intersection, a series of vertical trusses anchored to the deck and bottom plates with each truss disposed immediately adjacent the points of crossing, diagonal braces anchored at one end to the side deck and bottom plates between the points of anchorage of said trusses and connected at the other end to adjacent horizontal and vertical trusses at their points of crossing, and radial braces anchored at one end to the curved bilge and end plates and connected at the other end to adjacent horizontal and vertical trusses at their points of crossing.

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