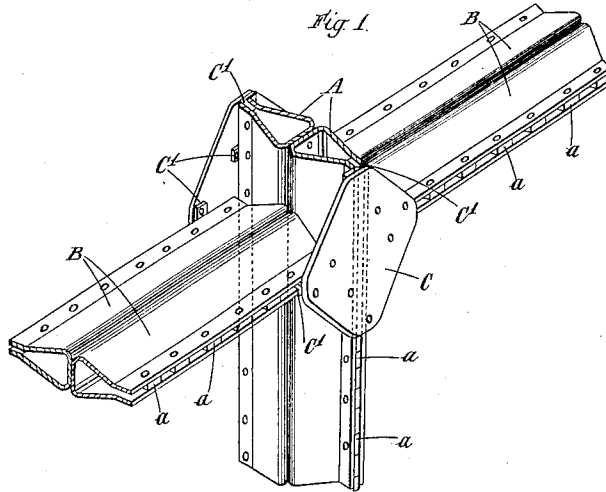
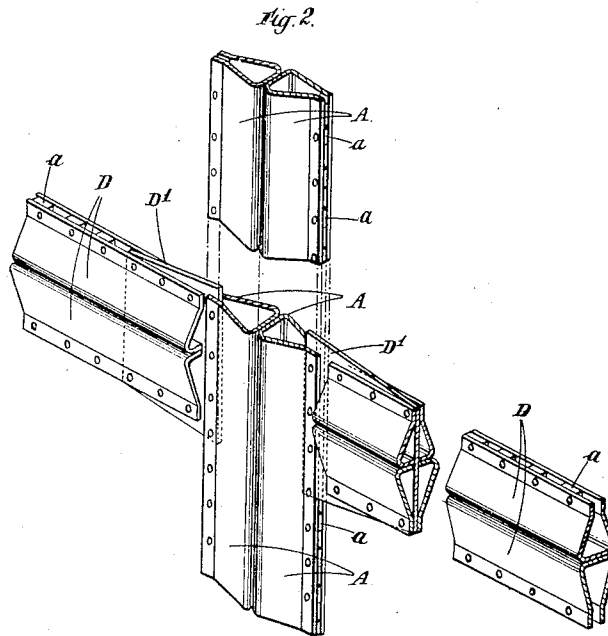


L. A. DANIELS.  
METAL STRUCTURE.  
APPLICATION FILED NOV. 25, 1919.

1,331,247.

Patented Feb. 17, 1920.  
2 SHEETS—SHEET 1.



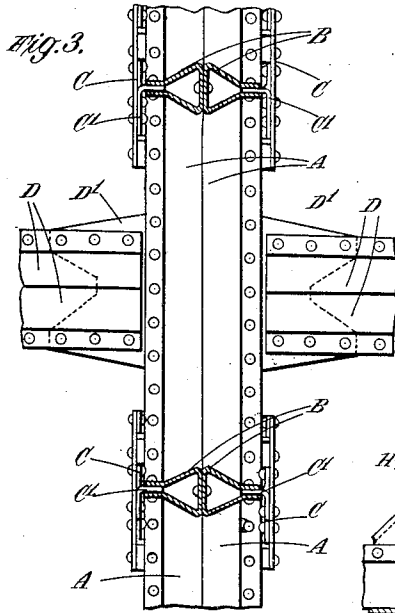
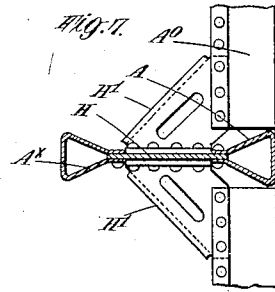
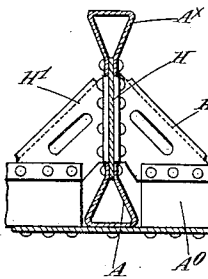
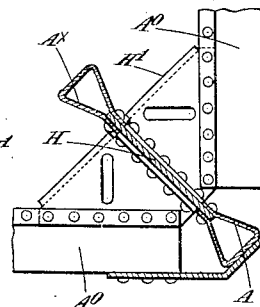
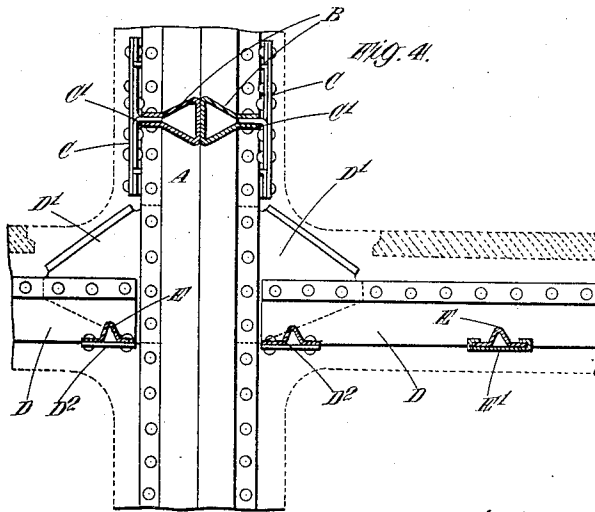
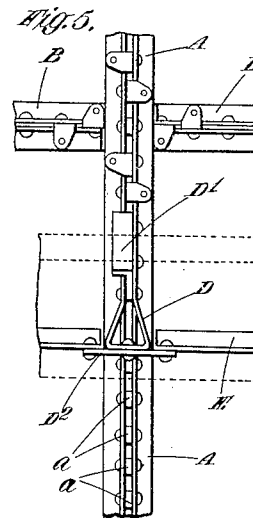
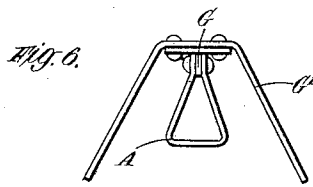
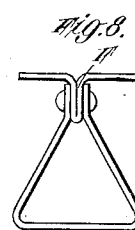
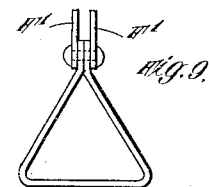
Inventor:  
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By *Wm. C. Lumbard* *Attor*

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2 SHEETS—SHEET 2.



Inventor  
Lester A. Daniels  
By Eugene C. Leitch and Harry H. H.

# UNITED STATES PATENT OFFICE.

LESLIE ARCHIBALD DANIELS, OF LEE, LONDON, ENGLAND.

## METAL STRUCTURE.

1,331,247.

Specification of Letters Patent.

Patented Feb. 17, 1920.

Application filed November 25, 1919. Serial No. 340,577.

*To all whom it may concern:*

Be it known that I, LESLIE ARCHIBALD DANIELS, a subject of the King of Great Britain, residing at 31 Southbrook road, Lee, in the county of London, England, have invented certain new and useful Improvements in or Relating to Metal Structures, of which the following is a specification.

This invention relates to metal structures and is particularly, although not exclusively, intended for use in connection with ferro-concrete construction such as is employed for building purposes and for ferro-concrete ships.

According to the invention the structure comprises a member of hollow triangular form made by bending a metal sheet of suitable thickness into the shape of a triangle with flanges at the apex by which the triangular member thus formed may be riveted or otherwise attached to a suitable connecting member preferably disposed between the two flanges. This connecting member may take the form of a metal plate whose portion that projects beyond the edges of the flanges is slit and the two parts thus formed are bent in opposite directions to form angle pieces with the main portion disposed between and riveted to the flanges, these angle pieces being riveted to any convenient part of the structure, for instance to a diamond shaped connecting plate by which a vertical triangular member, for example, can be connected to two horizontal members of similar formation disposed in line with each other parallel to the base portion of the vertical member and arranged one on each side of the said vertical member. The aforesaid connecting member may also take the form of a plate, one edge of which is riveted between the two flanges of one triangular member and another edge or portion of which may be riveted between the flanges of a second triangular member arranged parallel or at any desired angle to the first mentioned member. In this manner a vertical triangular member for example can be connected to two horizontal triangular members disposed at right angles to the two horizontal triangular members referred to above, or girders can be constructed with the connecting plate constituting the web portion and the triangular members constituting the flanges. Two of the said triangular members may be arranged back to back and riv-

eted together so as to provide a stronger and more rigid construction and to enable the double triangular member thus formed to be connected at opposite sides to other members which may be of similar construction or may be of the single triangular formation first described. At the portions along the length of the triangular members unprovided with connecting members, the flanges may be separated by a number of short distance pieces or washers which are riveted between the flanges and thus provide interstices for the concrete when the structure is used in ferro-concrete construction.

In order that the said invention may be clearly understood and readily carried into effect, I will describe the same more fully with reference to the accompanying drawings, in which:—

Figure 1 is a perspective view showing diagrammatically a form of the invention and illustrating its use in connecting a double triangular vertical member to two horizontal members of similar formation disposed in line with each other parallel to the base portion of the vertical member and arranged one on each side of the latter member.

Fig. 2 is a view similar to Fig. 1 showing another form of the invention and illustrating its use in connecting a double triangular vertical member to two horizontal members of similar formation arranged at right angles to the two horizontal members of Fig. 1.

Fig. 3 is a side elevation showing more in detail the constructions illustrated in a perspective manner in Figs. 1 and 2.

Fig. 4 is a view similar to Fig. 3 but showing the lower horizontal members as being of single triangular form and also showing the manner in which the construction is adapted for ferro-concrete purposes used, for example, in building.

Fig. 5 is a sectional side elevation of Fig. 4 with the diamond-shaped connecting plate removed so as to show more clearly certain details.

Fig. 6 is a sectional plan showing a form of the invention as applied to the stem of a ferro-concrete ship.

Fig. 7 is a vertical section showing a form of the invention as applied to a ferro-concrete ship.

Fig. 8 is a transverse section showing a modified form of the connecting plate riv-

eted between the flanges of the triangular member, and

Fig. 9 is a transverse section showing a modified arrangement of attaching the connecting member to the triangular member.

Referring first more particularly to Fig. 1, A, A are two single triangular vertical members riveted back to back to form the aforesaid double triangular vertical member and B, B are the elements of two double triangular horizontal members similarly constructed and connected to the double triangular vertical member at right angles thereto and parallel to the bases of the triangular members A, A. C is the diamond-shaped connecting plate which is attached to the vertical and horizontal members by means of a number of metal plates C<sup>1</sup> which are disposed between and riveted to the flanges and whose portions that project beyond the edges of the flanges are slit and the two parts thus formed are bent in opposite directions to form angle pieces with the main portion, these angle pieces being riveted to the diamond-shaped connecting plate C. This arrangement will be clearly understood by reference to the upper portions of Figs. 3, 4 and 5.

In Fig. 2, A indicates the double triangular vertical member constructed as in Fig. 1 and D, D are the double triangular horizontal members which are disposed at right angles to the members B, B of Fig. 1. In this construction the connection between the member A and each of the members D is effected by a connecting plate D<sup>1</sup> whose edge is disposed between and riveted to the flanges of the member A and whose projecting portion is disposed in slots formed in the bases of the members D, D and is riveted between the flanges of the latter members. The details of this construction are shown in Fig. 3 and also in Figs. 4 and 5; in the latter case, however, the horizontal members are of single triangular formation and the connecting plate D<sup>1</sup> does not project into a slot formed in the base of this member but is disposed as shown by the dotted lines in Fig. 4.

In Figs. 4 and 5 lattice bars E are shown as connecting the member D to other similar members and these bars are of triangular formation with projecting flanges as shown. The means of connection between the bars E and the members D comprise, in the example shown, plates D<sup>2</sup> which are riveted to the base of the member D and which have projecting portions to which the flanges of the bars E are riveted. These bars are used in connection with ferro-concrete construction to provide gripping surfaces for the concrete. In order to prevent these bars from becoming deformed I provide at suitable points along their length a clip strip E<sup>1</sup> one of which is shown at the right hand side

of Fig. 4; this clip strip is bent over the flanges of the bars and thus avoids liability of the said bars becoming distorted from their original triangular shape.

In using the lattice bars E in conjunction with horizontal members D of double triangular form such as is shown in Figs. 2 and 3, the lower one of the two triangular members riveted back to back carries between its flanges one or more supporting plates for the bars which are riveted to the said supporting plates in the manner described with reference to Figs. 4 and 5. This supporting plate may if desired be in the form shown in Fig. 8 (but inverted) in which a plate F is shown as being bent back upon itself to form a double thickness which is riveted between the flanges of the triangular member.

The flanges of the various triangular members are shown as being separated by small distance pieces or washers *a* which are riveted between the flanges. The provision of these distance pieces instead of a continuous separating plate, results in a lightening of the structure and also provides interstices for the concrete when the structure is used in ferro-concrete construction.

In the modification shown by Fig. 9, the connecting member F<sup>1</sup> instead of being riveted between the flanges of the triangular member is riveted to the outside of the closed flanges, two such connecting members being preferably employed as shown which may be similarly riveted to another triangular member or to an intermediate plate.

In Fig. 6 which shows the invention applied to the stem of a concrete ship, the flanges of the triangular member A are riveted to the central rib G of a bar of T section forming the stem bar of the ship and a covering or protecting plate G<sup>1</sup> is riveted to this stem bar. In the construction shown by Fig. 7 the bottom, bilge and side portions of the ship are built up of longitudinal triangular members A, A connected by plates H, H to other triangular members A<sup>x</sup>, A<sup>x</sup> the said plates being riveted between the flanges of these members. Horizontal and vertical triangular members A<sup>o</sup>, A<sup>o</sup> are connected to the members A, A as shown and are also connected to the plates H, H by angle plates H<sup>1</sup>, H<sup>1</sup> (which may be corrugated) riveted between the flanges of the members A<sup>o</sup>, A<sup>o</sup>. Secondary framing (not shown) may be provided between the various triangular members and this framing may be constituted by bars similar to the lattice bars of Figs. 4 and 5.

A ferro-concrete vessel in which reinforcing members of the above type are employed can be made of great strength with minimum weight, as the hollow triangular section of the members A is adapted to with-

stand heavy stresses in all directions; the said members are adapted for use in various parts of the vessel as well as in the typical portions already referred to and are preferably left unfilled with the cement.

The structure hereinbefore described and shown in the drawings is intended only to be examples of the use of my invention and it is to be understood that the invention may be used in connection with other forms of metal structures; for example, in the construction of girders generally, a formation similar to that of the member A, A\* and the plates H of Fig. 7 could be employed and in the construction of ladders the longitudinal members would be of triangular form as hereinbefore described and the rungs would be constituted by metal tubes flattened at their end portions for riveting between the flanges of the triangular members.

What I claim and desire to secure by Letters Patent of the United States is:—

1. A metal structure for building purposes comprising two members, each of hollow triangular form closed at the base and having parallel flanges at the apex, and means uniting the bases of said members.

2. A metal structure for building purposes comprising two sheet metal members, each bent into substantially triangular form with the edges separated at the apex, and rivets uniting the base sections of said members.

3. A metal structure for the purposes described, comprising a sheet metal member bent into substantially triangular form with opposite edges forming separated flanges at the apex, and a plate riveted between said flanges and projecting therefrom to form a connecting means, the projecting portion of said plate being slit and having the parts separated by the slit bent in opposite directions.

4. A metal structure for the purposes described, comprising two sheet metal members each bent into a hollow triangular form with separated flanges at its apex, means connecting the bases of said members, and a connecting member in the form of a plate having one of its edges inserted between the

flanges of one of said triangular members and riveted to said flanges.

5. A metal structure for the purposes described, comprising a sheet metal member bent into hollow triangular form with spaced flanges at its apex, and a plurality of distance pieces inserted between and riveted to said flanges.

6. A metal structure comprising in combination a column formed of two metal members, of substantially triangular form in cross section, secured together at their bases and each provided with spaced flanges at its apex, plates extending between and riveted to said flanges of each said member, the portion of each plate that projects from said flanges being slit and having the parts separated by said slit bent in opposite directions, a beam formed of two members similar to those of the column and extending at an angle to the latter, plates riveted between the flanges of the beam members and having a slot formed in the projecting portions thereof and the parts separated by the slit bent in opposite directions, and connecting plates riveted to said bent portions of the column and beam plates.

7. A metal structure comprising in combination a column formed of two metal members, of substantially triangular form in cross section, secured together at their bases and each provided with spaced flanges at its apex, plates extending between and riveted to said flanges of each said member, the portion of each plate that projects from said flanges being slit and having the parts separated by said slit bent in opposite directions, a beam formed of two members similar to those of the column and extending substantially at right angles to the latter, plates riveted between the flanges of the beam members and having a slit formed in the projecting portions thereof and the parts separated by the slit bent in opposite directions, connecting plates riveted to said bent portions of the column and beam plates, and a second similarly formed beam extending at an angle to and secured to the first said beam.

LESLIE ARCHIBALD DANIELS.