Jan. 5, 1937. D. BIRKIN 2,066,388

CONSTRUCTION OF METAL GIRDERS

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Fig. 1

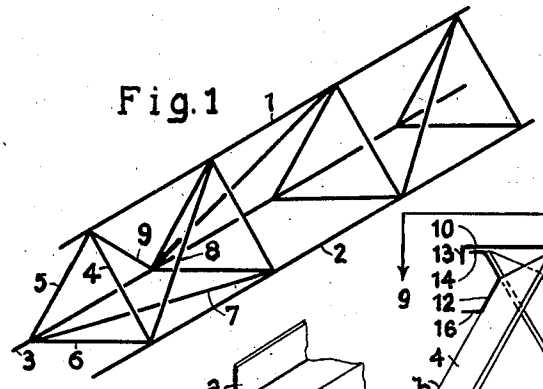


Fig. 2

Fig. 3

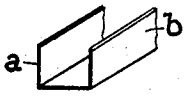


Fig. 4

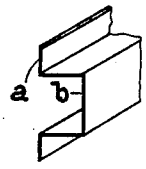


Fig. 5

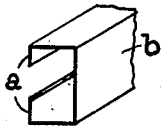


Fig. 6

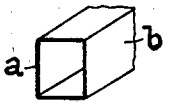


Fig. 7

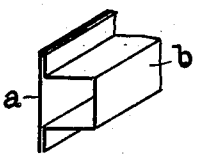


Fig. 8

Fig. 9

INVENTOR
DIMITRI BIRKIN.

BY John P. Barlow

ATTORNEY

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CONSTRUCTION OF METAL GIRDERS

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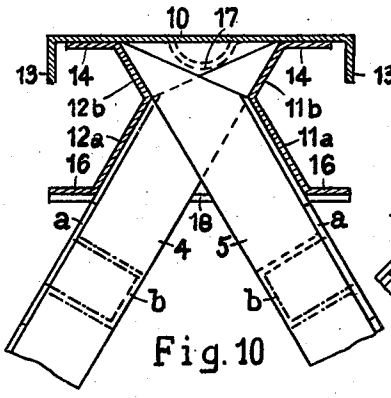


Fig. 10

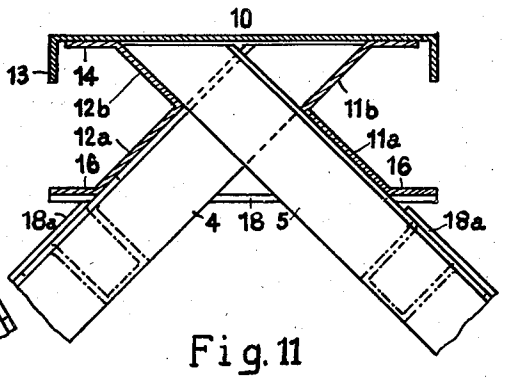


Fig. 11

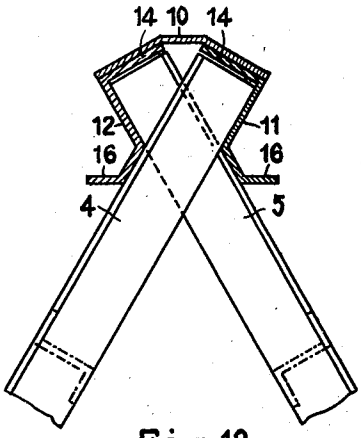


Fig. 12

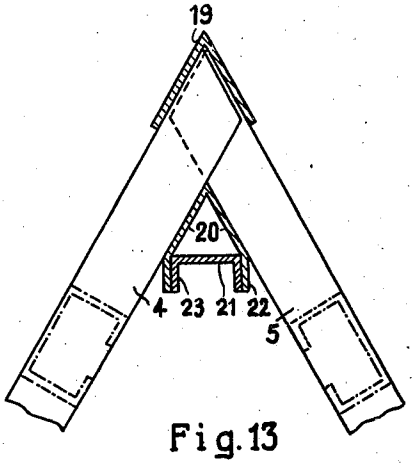


Fig. 13

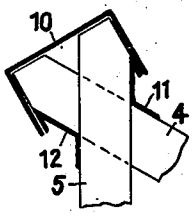


Fig. 15

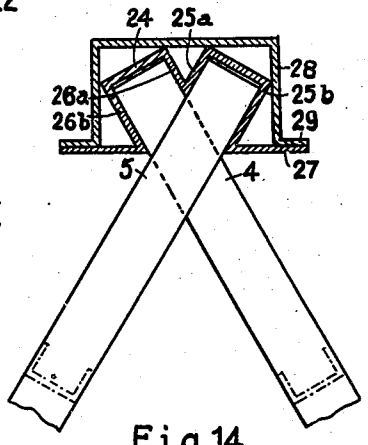


Fig. 14

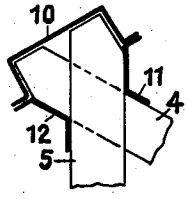


Fig. 16

INVENTOR
DIMITRI BIRKIN
BY John P. Barker
ATTORNEY

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UNITED STATES PATENT OFFICE

2,066,388

CONSTRUCTION OF METAL GIRDERS

Dimitri Birkin, Berlin, Germany, assignor to firm Edward G. Budd Manufacturing Company, Philadelphia, Pa.

Application August 23, 1933, Serial No. 686,364
In Germany September 17, 1932

10 Claims. (Cl. 189—37)

The invention relates to metal girders, and particularly to triangular or quadrangular girders, which are formed by beams and stays connected to one another.

In such structures heretofore employed, the connections between the beams and the stays have been either complicated, expensive and heavy to construct because of the employment of connecting plates or the like, or the connections have been incomplete, in that the entire sections of the stays and beams have not been employed for the transmission of force.

The disadvantages of the known forms are avoided in the invention by the exceptionally simple means of extending the stays towards one another at an angle and engaging them at a suitable place in the beam is adjacent corresponding opposing wall sections of the beam with their walls running in the longitudinal direction of the beam lying opposite one another and is connected with them preferably by spot welding.

Preferably sheet metal of rustless steel alloy, such as chrome-nickel steel, is employed in the individual stays and the connection of the elements preferably effected by spot welding. As the sheet metal sections per se and the sheet metal sections employed, possess very great solidity, and bending strength in proportion to their weight, since in the application of such rustless metal no allowance need be made for rusting-off in the calculation of solidity, and also, since no painting is necessary, the girder of the invention is of exceptionally light weight compared to known girders of similar strength. Girders constructed in accordance with the invention are particularly desirable for the construction of flying-machines, for vehicle construction, for antennae and for other devices. The importance of a reduction in weight in a flying machine is known. Also, for antennae, a small weight is of much importance, as in small antennae for military purposes, which are transportable. For larger antennae, the size of the insulators carrying them and the remaining foundations, the construction of which is usually very difficult, depend very largely on the weight of the antennae.

Further characteristics of the invention will appear from the following description of the examples illustrated in the drawings.

Fig. 1 illustrates in schematic perspective view a triangular girder;

Figs. 2–7 illustrate sections which may suitably be employed as stays;

Fig. 8 illustrates a cross section through a triangular girder;

Fig. 9 illustrates in plan a junction point, looking in the direction of the arrows 9—9, Fig. 8;

Fig. 10 illustrates one of the three junction points shown in Fig. 9 to a larger scale with a somewhat different arrangement of stays;

Fig. 11 illustrates a junction point corresponding to Fig. 10 with stays meeting at an angle of 90°;

Figs. 12–16 illustrate different forms of construction of the connection between stays and beams corresponding to Fig. 10.

The girder illustrated in Fig. 1 comprises longitudinal beams 1, 2, 3, sets of stays 4, 5, 6, each forming a triangle, and connecting the beams to one another, and a set of diagonal stays 7, 8, 9 disposed between each pair of sets of the stays 4, 5 and 6.

The stays, as indicated in Figs. 2–7, are formed with opposite walls *a* and *b* extending parallel to each other.

In the examples illustrated in Figs. 8–11 each unit has a channel, which comprises a base part 10 and two side walls 11 and 12.

The flanges 13, 13, serving mainly for strengthening, are bent up from the edges of the base part 10. The connection of the side wall members 11 and 12 to the base wall 10 is effected by means of flanges 14, 14, bent up from the side wall portions. The side wall parts 12 consist of two parts 11*a*, 11*b* or 12*a*, 12*b* extending towards each other at an angle forming a V-shaped cross-section. Flanges 16, 16, serving for further strengthening, may be bent up from the free edges of the side wall portions 11, 12.

The ends of the stays 4 and 5 are welded to the parts 10–12. The stay 4, of which the cross section is formed according to Fig. 4, is disposed with its wall *a*, formed by flanges, against the wall section 11*a* of the beam thereof and with its base wall *b* against the wall section 12*b*, to which it is connected preferably by welding. In similar manner, the wall *a* of the stay 5 is connected to the wall section 12*a* of the beam and, the wall *b* to the wall section 11*b* thereof.

As shown in Figs. 8 and 9, the stays 4, 5 and 6, of each set thereof, forming with each other a triangular brace, do not extend absolutely perpendicular to the longitudinal direction of the beam, but each stay is disposed at a slight angle to the plane of its set, so that each adjacent pair of stay ends engaging a beam lie in adjacent side-by-side, or longitudinal overlapping, relation to one another for longitudinal side-by-side positioning, each beyond the adjacent end of the adjacent stay.

In the examples illustrated in Figs. 8 and 9,

the channel-shaped stays 4, 5, 6 and also the diagonal stays 7, 8, 9 are so disposed that the openings of the channels are directed towards the interior of the triangular girder. As indicated in Fig. 10 the openings of the channels are directed outwardly from the girder. In the arrangement, illustrated in Fig. 10, the walls *a* of the stays 4, 5 are connected to the wall sections 11*a* and 12*a* of the beam and the walls *b* to the wall sections 12*b* and 11*b* thereof. Although detracting somewhat from the appearance of the construction to have the stays opening outwardly, this construction has an advantage over the construction illustrated in Figs. 8 and 9, in that the stays may be placed in close relation to each other, since the side-flanges *a* do not cross.

The example illustrated in Fig. 11 differs essentially from the example illustrated in Fig. 10 only in that the stays approach each other at an angle of 90° instead of 60°.

In the examples illustrated, the front faces of the stays may run parallel to the base part 10 of the beam, as in Fig. 11, or be sloped sharply thereto, as illustrated in Figs. 8 and 10. The sharp sloping avoids a cutting operation of the stay flanges which extend toward each other in the arrangement illustrated in Figs. 10 and 11. A stiffening rib 17 as indicated in dotted lines in Fig. 10, may be provided in the base wall 10 of the beam.

The channel of the beam may be closed by a plate 18 (Figs. 10 and 11) connected to the flanges 16 and having an opening for the stays. In corresponding manner, as indicated in Fig. 11, the portions of the stays lying outside the beam may be closed by strips of metal sheet 18*a* connected to the flanges *a* of the stays, so that the stays become of closed box-section.

In the form of the cross section of the stay illustrated in Figs. 8 and 9, parts 10, 11 and 12 of the beam may be united before their assemblage with the stays; the structure, as thus formed, admitting the ends of the stays. In the form of the cross section of the stays illustrated Figs. 10 and 11, the stays are first connected to the parts 10 and 11 of the beam, after which, the union of the base wall 10 to the flanges 14 of the parts 10 and 11 is effected. Otherwise, the places of connection of the walls *b* of the stays 4 and 5 to the wall-sections 11*b* 12*b* of the beam would be inaccessible.

The example illustrated in Fig. 12 differs from the examples previously illustrated only by the construction of the base plate 10 of the beam, to fit the flanges 14 of the side wall portions 11 and 12 of the beam, which are directed toward each other. Instead of the Z-shaped cross-section of the stays 4 and 5 of this example, other cross-sections may be employed, without alteration of the cross section of the beam.

The example illustrated in Fig. 13 differs from the previously illustrated examples by consisting of two opposite parts 19 and 20. The part 19, forming a simple angle iron, is connected to the outer side walls *b* of the stays 4 and 5. The beam section 20 forming a similar simple angle iron, is connected to the inner side flange sections *a* of the stays. The opening of the angle iron 20 may be formed as a closed box girder by a rail 21, which is placed in position after the connection of the rail 20 to the stay. For effecting the connection, flanges 22 and 23 are bent from the rail 20 and preferably spot welded to the rail 21. Also the rail 19 may be completed as a closed box girder aside the places of entry of the stays by flanges bent inwardly therefrom similar to the flange 22.

In the example illustrated in Fig. 14, the beam comprises a double channel-shaped portion 24, in which one stay 4 is connected to the side walls 25*a*, 25*b*, of the one channel and the second stay 5 is connected to the side walls 26*a* and 26*b*. For strength, lateral flanges 27 may be bent up from the part 24, and for further strength, and also for improved appearance, a channel-shaped covering rail 28 may be connected to the rail 24 by means of flanges 29 adjacent to the flanges 27.

In place of the stay sections, illustrated in Figs. 13 and 14 other stay sections may be employed, without alteration of the shape of the beam.

Besides the examples previously described, a large number of other forms are possible. This is especially true of the cross sections of the stays and beams. In connection with the forms, illustrated in Figs. 8–11, the junction place between the part forming the base wall and the parts forming the side walls 11 and 12, may be disposed at another place and may be formed in another manner, as indicated in Figs. 15 and 16. In the construction of the sections and the under portions thereof, care must be taken that the places of connection are accessible for the insertion of welding electrodes, or rivets and riveting tools. In the application of rustless steel alloys the welding is preferably effected during exceptionally short time intervals, such as between 1/25th and 1/500th of a second, and preferably about one 200th of a second, with the application of a correspondingly powerful current. Thus the properties of the material of the stays and beams at the welds, and at the parts lying about the welds, especially the strength, are not disadvantageously altered, as in welding processes of longer time periods heretofore usual.

What is claimed is:

1. A girder comprising sheet-metal beams of hollow divergent section laterally spaced about a common axis, an adjacent pair thereof having inside pairs of spaced inner surfaces diverging as pairs cross sectionally of the girder, and transverse sheet-metal stays having transverse stay surfaces of adjacent ends of a pair of stays extending along the adjacent beam opposite one another and secured in flat-side engagement each to an inside pair of said diverging beam surfaces of the adjacent beam inside the hollow section thereof.

2. A girder comprising sheet-metal beams of hollow section laterally spaced about a common axis and each including separate base and side wall elements secured to each other to form a channel, the side wall elements of each beam having inner surfaces diverging cross sectionally of the girder, and transverse sheet-metal stays having surfaces of adjacent ends of each pair of stays extending along the adjacent beam opposite one another and secured in flat-side relation to said diverging side-wall beam surfaces of the adjacent beam inside the hollow section thereof.

3. A girder comprising sheet-metal beams of hollow section laterally spaced about a common axis and each including separate base and side wall elements secured to each other to form a channel, the side wall elements of each beam being of substantially V-section one arm of which has an angularly- bent flange secured in flat-side relation to the base, and transverse sheet-metal

stays having surfaces of adjacent ends of each pair of stays extending along the adjacent beam opposite one another and secured in flat-side relation to said V-arms of the adjacent beam inside the hollow section thereof.

4. A girder comprising sheet-metal beams of hollow section laterally spaced about a common axis, one of said beams including separate base and side-wall elements secured to each other to form a channel, the side wall elements of said beam having inner surfaces diverging cross sectionally of the girder, one of said side wall elements having a marginal flange bent outwardly therefrom and connected to the base element, and transverse sheet-metal stays having surfaces of adjacent ends of the pair of stays extending along said one beam opposite one another and secured to said diverging side wall beam surfaces inside the hollow beam section.

5. A girder comprising sheet-metal beams of hollow section laterally spaced about a common axis, one of said beams including separate base and side-wall elements secured to each other to form a channel, the side wall elements of said beam having inner surfaces diverging cross sectionally of the girder, and transverse sheet-metal stays having surfaces of adjacent ends of each pair of stays extending along the adjacent beam opposite one another and secured to said diverging side wall surfaces of the adjacent beam inside the hollow section thereof, said base element having edge margins bent in the direction of the adjacent stays.

6. A girder comprising sheet-metal beams laterally spaced about a common axis, and transverse sheet-metal stays of channel section including bottom walls and side walls having free-edge flanges, the said stays extending transversely of the girder and the surfaces of said bottom walls and flanges at adjacent ends of a pair of stays extending along inside the adjacent beam opposite one another and secured flatwise thereto.

7. A girder comprising sheet-metal beams laterally spaced about a common axis, transverse sheet-metal stays of channel section including bottom walls and side walls having free-edge flanges, the said stays extending transversely of the girder and the surfaces of said bottom walls and flanges at adjacent ends of a pair of stays extending along the adjacent beam longitudinally opposite one another and secured flatwise thereto, and elements secured along the stay flanges rendering the stays of closed box sections.

8. In a girder, a chord member having side walls converging toward each other and each terminating short of the projected plane of the other, and stays of angle cross section having their ends projected between the face of the one side wall of the chord and the edge of the other side wall and secured flatwise by one branch of the angle cross section to the inner face of the one side wall.

9. A girder according to claim 8 in which the side walls of the chord have their free edges divergently extended each parallel to the inner face of the other side wall, and the angle cross section members each secured by another branch of their angle cross section to the extended free edge of the opposite side wall from that to whose inner face it is secured.

10. A girder comprising a sheet metal chord having opposed pairs of side wall faces, each face comprising portions extending at an angle to each other, and an angular section stay extending between the pairs of side wall faces and having one of its arms secured flatwise to one angular portion of one of said faces and another of its arms similarly secured to the other angular portion of the opposite side wall face.

DIMITRI BIRKIN.