

June 6, 1933.

B. N. WALLIS

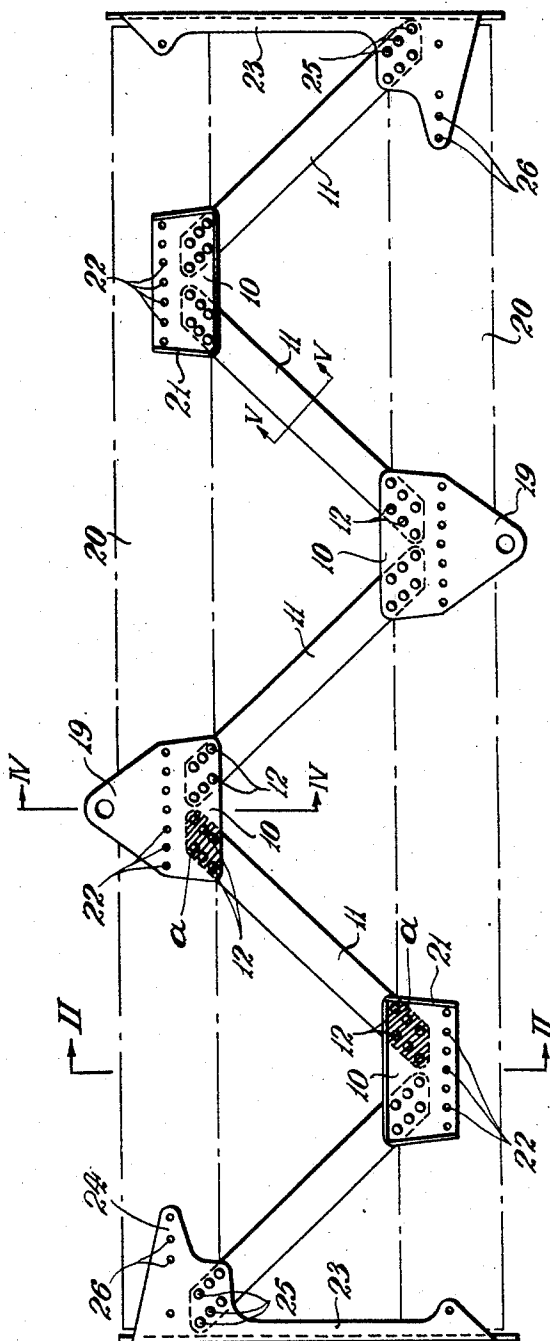
1,913,097

METHOD OF CONSTRUCTING A GIRDER

Filed March 14, 1932

3 Sheets-Sheet 1

Fig. 1.



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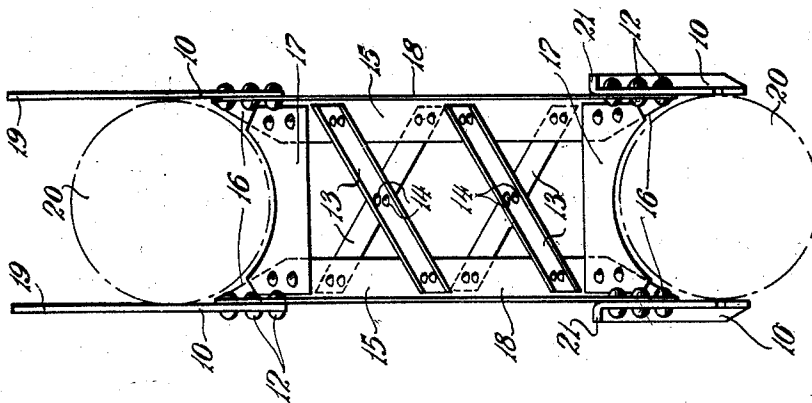


Fig. 2.

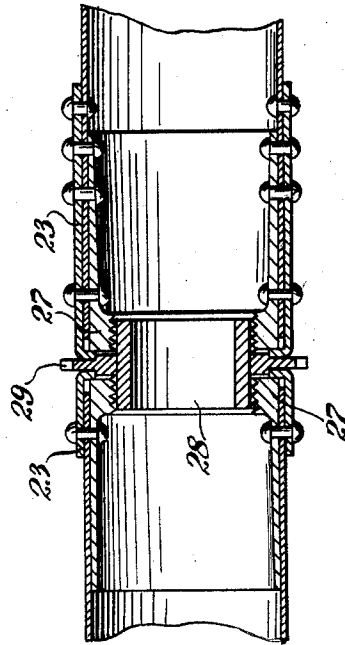


Fig. 3.

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Fig. 4.

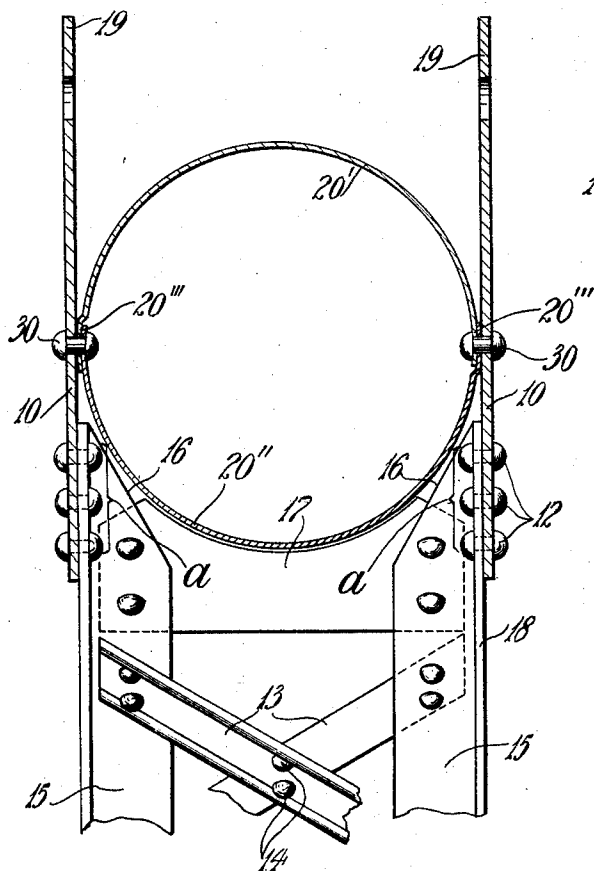
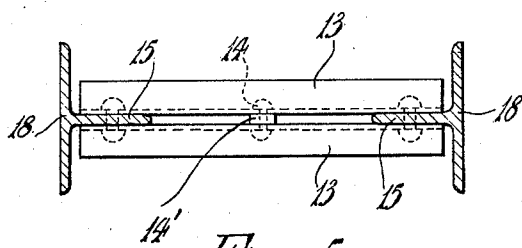


Fig. 5.

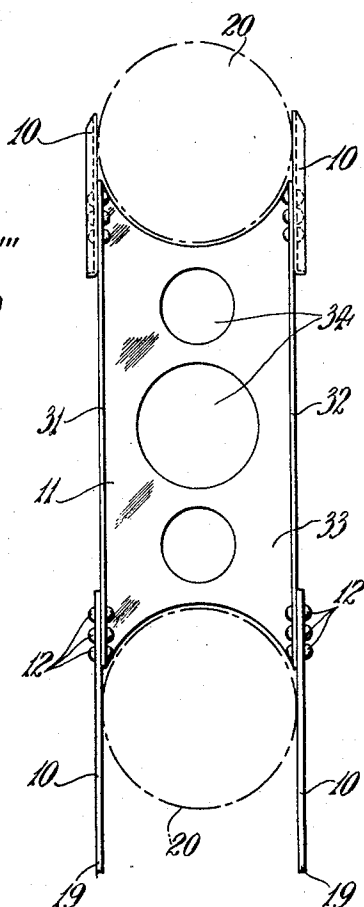


Fig. 6.

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UNITED STATES PATENT OFFICE

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METHOD OF CONSTRUCTING A GIRDER

Application filed March 14, 1932, Serial No. 598,821, and in Great Britain April 11, 1931.

This invention relates to spars, ribs and girders (hereinafter referred to simply as "girders") particularly for use in aircraft construction, of the type comprising tubular booms stayed apart by diagonal members extending in a continuous zig-zag formation from end to end of the girder, and secured to the booms by means of gusset plates, and has for its object to provide an improved method for the construction of such girders.

The improved method of construction according to the invention will be understood from the following description with reference to the accompanying drawings in which:—

Fig. 1 is a side elevation of the intermediate staying structure employed in the construction of a two-boom girder.

Fig. 2 is a section, on a larger scale, taken along the line II—II in Fig. 1 looking in the direction of the arrows.

Fig. 3 is a sectional plan view illustrating the joint between successive sections of a two-boom girder of the kind indicated in Fig. 1.

Figure 4 is a cross section on the line IV—IV in Figure 1, drawn to an enlarged scale but showing the tubular boom and showing the method of securing this boom to the intermediate staying structure.

Figure 5 is a section on the line V—V in Figure 1, also drawn to an enlarged scale and showing the construction of the diagonal members.

Figure 6 is a similar view to Figure 2, but illustrates a modified construction of the diagonal members.

Like reference numerals indicate like parts throughout the drawings.

The first step in building up the two-boom girder illustrated in Figs. 1-5, is to construct the intermediate staying structure illustrated in Fig. 1. This staying structure comprises gusset plates 10 to which diagonal bracing members 11 are attached by means of the rivets 12 contained in areas indicated by the shading *a* in Figure 1 and by the bracket *a* in Figure 4, from which all perpendicular lines intercept the boom, so that said areas are opposed to the boom. The diago-

nal bracing members 11 are built up of pairs of T-section members, having side flanges 18 and having flanges 15 which are intumed towards one another, interconnected by cross bracings 13 of channel section, the webs of the channels being secured together by rivets 14 through washers 14', the washers having a thickness equal to that of the flanges 15 of the T-sections. The T-sections are cut away at each end, as indicated at 16, and riveted to throat pieces 17, which are shaped elliptically to embrace the intumed faces of the tubular booms, which are indicated in chain dotted lines in Figures 1 and 2 by the reference 20. As will be seen, the cut away portions 16 of the T-sections and the throat pieces 17 are so shaped that the diagonal members will fit snugly against the booms.

Each of the gusset plates, as will be seen, is wide enough to accommodate two diagonal members, approaching the gusset plate in opposed directions and meeting at an angle equal to or approximating to a right angle.

Certain of the gusset plates are provided with triangular extensions, indicated at 19, apertured to receive bolts for the attachment of stays or other supports. Certain of the gusset plates are flanged outwardly as at 21 for the purpose of increasing their rigidity.

The diagonal frames, when secured by the gusset plates in their proper relation to each other, resemble in appearance a firework of the type known as a "cracker" which has been allowed to expand into zig-zag form, but in which the points of the zig-zag are separated from each other and have no connecting member. Such a zig-zag intermediate staying structure is supported in a suitable jig with the gusset plates maintained in their correct relative positions, and is then ready to receive the tubular booms between the inner faces of the gusset plates. The rivet holes 22 in the gusset plates serve for the reception of the rivets for securing the gusset plates to the tubular booms. In the case when the booms are two strips 20', 20'' of sheet metal bent longitudinally and riveted in a straight line

through a lap joint 20", the rivet holes in the lap joint which coincide with the holes 22 in the gusset plates may be omitted, and when the tubes have been placed in the correct position in register with the intermediate staying structure the necessary holes may be drilled and the rivets 30 inserted through both the gusset plates and the double thickness of the lap joint as shown in Figure 4.

The diagonal members at the end of the section of the intermediate staying structure, indicated in Fig. 1 are riveted to end frames 23. The end frames are of channel form and are provided with extensions 24, extending parallel with the length of the booms, and serving as gusset plates, for the reception of the diagonal members which terminate at the ends of the section. The end plates are riveted to the diagonal members by the rivets 25 during the operation of constructing the intermediate staying structure. When the booms have been assembled in their correct position with respect to the staying structure they are riveted to the end frames through the rivet holes indicated at 26. Those portions of the end frame which abut against the booms are apertured, as indicated in Fig. 3. The tubular booms 20 have inserted into their ends internally flanged strengthening sleeves 27. Adjoining sections of the girder are secured to one another by means of externally screwed spigots 28, screw-threaded oppositely on either side of their medial plane and engaging with corresponding screw-threads on the inside of the strengthening sleeves 27. By turning the keyring 29 the adjoining sections of the girder may be tightly clamped together. As will be seen from Fig. 3, the end frames 23 are gripped between the keyring and the strengthening sleeves 27.

In a modification, instead of constructing the diagonal frames of opposed pairs of T-section members with inturned flanges interconnected by cross-bracing members, these diagonal members may consist of channel members, as shown in Figure 6, having their flanges 31 and 32 secured to the gusset plates and having their webs 33 extending transversely, said webs being formed with holes 34 to reduce the weight of said members.

The method according to the invention is also applicable to the construction of girders having more than two booms, in particular square-section four boom girders for use in the construction of aircraft wings of the single spar type. It will be understood that in the case of girders having three or more booms, the intermediate staying structure is first built up by securing the diagonal members to the gusset plates, and finally the booms are placed in position with respect to the intermediate staying structure and

riveted to the gusset plates to give the finished girder.

Throughout the specification it has been stated that rivets are employed for securing the gusset plates to the booms. It is, however, to be understood that the invention includes the use of nuts and bolts as a permanent securing means in place of rivets.

What I claim as my invention and desire to secure by Letters Patent is:—

1. A method for the construction of a girder, particularly for use in aircraft construction, of the kind comprising tubular booms, diagonal bracing members and gusset plates securing the diagonal members to the booms, which comprises the steps of forming tubular booms by riveting together sheet metal strips along opposed lap joints omitting the rivets in those portions of the lap joints which are to receive the gusset plates, building up an intermediate staying structure of zig-zag formation by riveting the diagonal members to the gusset plates, and finally completing the structure by securing the booms to the gusset plates by means of rivets extending through the gusset plates and the double thickness of the lap joints.

2. A method for the construction of a girder, particularly for use in aircraft construction, of the kind comprising tubular booms, diagonal bracing members and gusset plates securing the diagonal members to the booms, which comprises the steps of forming tubular booms by juxtaposing bent sheet metal strips with their borders overlapping, drilling holes through said overlapping borders, but omitting the holes in those portions of the borders which are to receive the gusset plates, and securing the strips together by means of rivets inserted through said holes, building up an intermediate staying structure of zig-zag formation by riveting the diagonal members to the gusset plates, assembling the booms in register with the intermediate staying structure, drilling holes through the gusset plates and the corresponding portions of the overlap joints in the booms, and finally securing the booms to the gusset plates by rivets inserted through said holes.

3. A method for the construction of a girder, particularly for use in aircraft construction, of the kind comprising tubular booms, diagonal bracing members and gusset plates securing the diagonal members to the booms, which comprises the steps of constructing diagonal bracing members by uniting together pairs of flanged sections, arranged with their flanges inturned and facing one another, by means of cross bracings interconnecting said flanges, attaching the ends of said diagonal members to throat pieces shaped elliptically to fit the

booms, riveting the diagonal bracings to the gusset plates to form an intermediate staying structure of zig-zag formation, and then completing the structure by riveting
5 the booms to the gusset plates.

In witness whereof I have hereunto set my hand.

BARNES NEVILLE WALLIS.

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