Jan. 17, 1928.

1,656,871

B. SCHNITZER

HOLLOW GIRDER

Filed Feb. 27, 1926

2 Sheets-Sheet 1

Fig. 1.

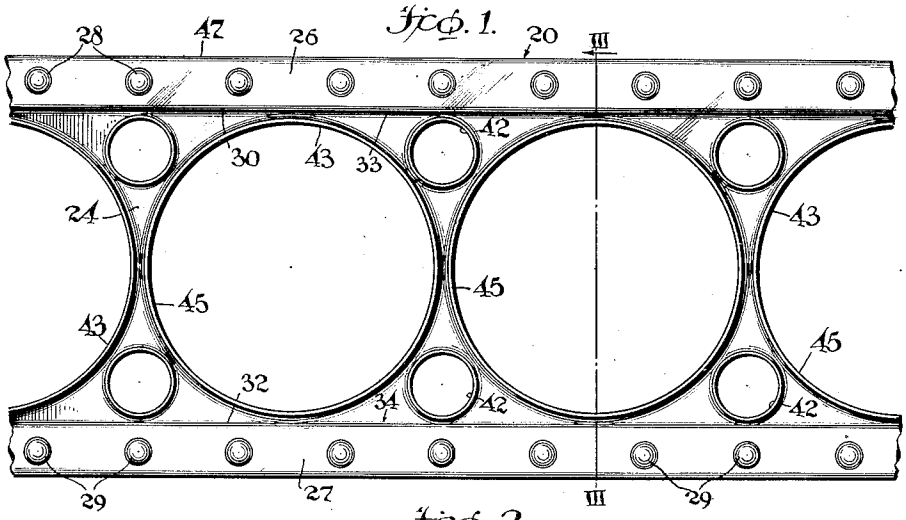


Fig. 2.

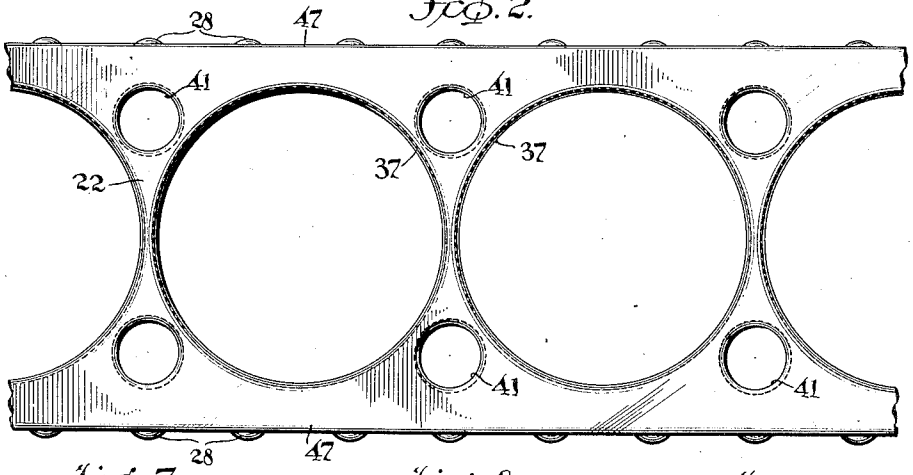


Fig. 7.

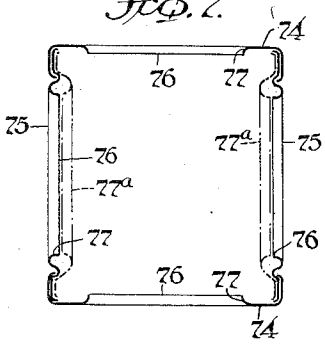


Fig. 8.

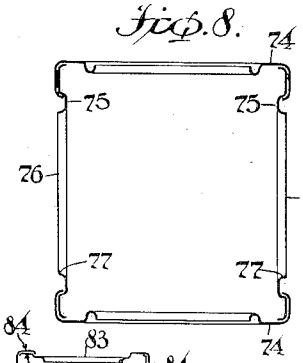


Fig. 9.

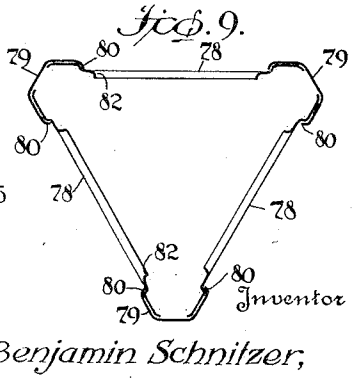
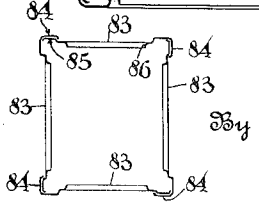


Fig. 10.



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Jan. 17, 1928. 1,656,871

B. SCHNITZER

HOLLOW GIRDER

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Fig. 3.

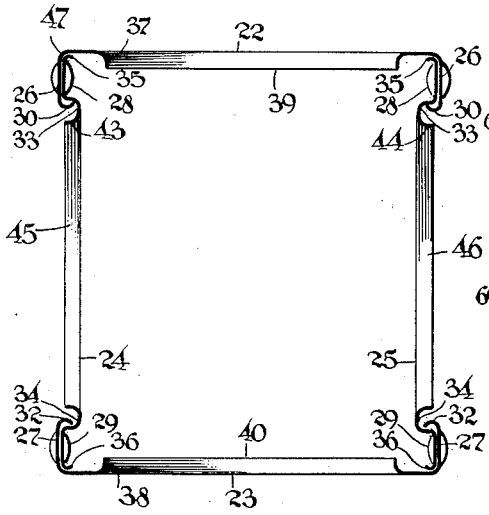


Fig. 6.

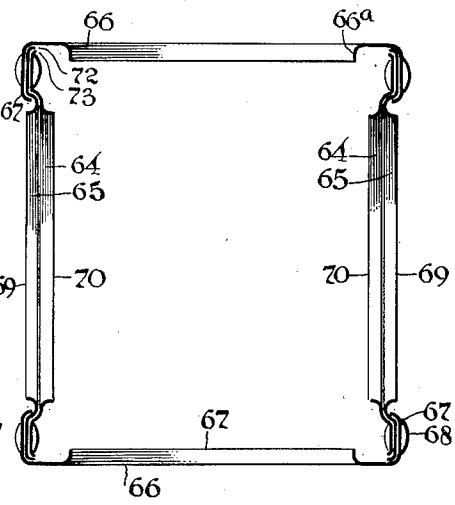


Fig. 4.

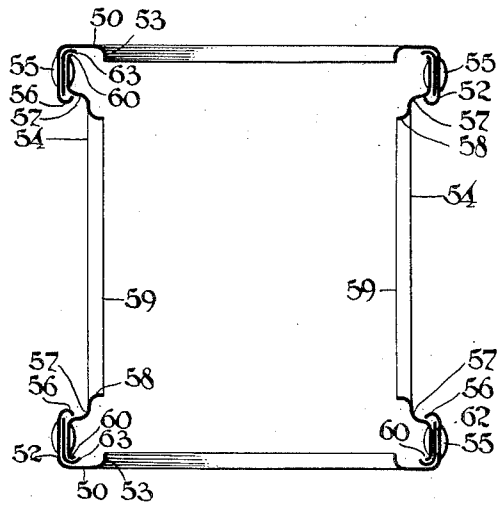
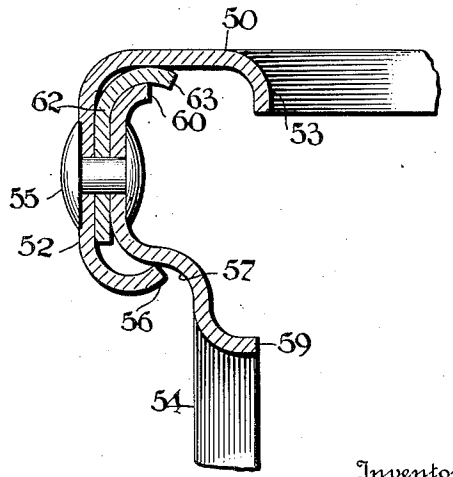


Fig. 5.



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Benjamin Schnitzer,

By R. O. Trogner

Attorney

Patented Jan. 17, 1928. 1,656,871

UNITED STATES PATENT OFFICE.

BENJAMIN SCHNITZER, OF AKRON, OHIO, ASSIGNOR TO GOODYEAR-ZEPPELIN CORPORATION, OF AKRON, OHIO, A CORPORATION OF DELAWARE.

HOLLOW GIRDER.

Application filed February 27, 1926. Serial No. 91,070.

My invention relates to light weight girder structures, particularly suitable for use in rigid or semi-rigid airships, and it has particular relation to the construction and arrangement of the individual elements which compose the so-called box girder type.

The invention herein disclosed is directed to improvements in air craft girders of the general type disclosed in an application of Karl Arnstein, Serial No. 727,849, filed July 23, 1924, and assigned to Luftschiffbau Zeppelin Gesellschaft mit Beschrankter Haftung, of Friedrichshafen, Bodensee, Germany.

One object of my invention is to provide a girder which is composed of light weight material and is so constructed that it is particularly adapted to withstand compression forces.

Another object of my invention is to provide a box type girder which is constructed of a plurality of metal plates so formed and arranged that all of the edges of the plates project inwardly and the corner portions are curved, thereby presenting smooth surfaces upon which the relatively fragile gas bags or envelope material may rest without possibility of injury thereto.

Another object of my invention is to provide a box girder in which all outwardly disposed edges are obviated.

In the manufacture of hollow girders or beams, which have heretofore been employed in building the superstructure of rigid airships, relatively thin sheets of material have been employed. In order to increase the effectiveness of these girders against compression forces, ribs or similar outwardly projecting edges have been provided for stiffening purposes. These outwardly projecting edges were objectionable because it was necessary to cover them with fabric or similar material in order to avoid injury to the gas bags and to the outer covering or envelope of the airships which came into contact therewith.

One of the primary advantages of my invention, as herein disclosed, lies in the provision of a box girder in which the undesirable outwardly projecting edges are obviated and effective reinforcing elements are disposed entirely within the outer contour of the girder. This is accomplished by employing members of channel shape, whose flanges are provided with inwardly bent edges, the flanges in turn being connected to web members of the girder. Recesses or depressions are provided in the web members to receive the inturned edges of the channel flanges. Both the channel members and the webs are punched to provide flanged weight reducing openings, the bent flanges of the openings serving as stiffening members.

As a general rule, girders of the general type designated are constructed of sheet metal of uniform thickness, although in some instances it is desirable to reinforce the corner portions of the girder. To provide this reinforcement, sheet material having varying thickness, being thicker at its edges, has been employed for strengthening the corner portions of the girders, but it has been found that such construction is not practical. In order to overcome the disadvantages of the material of varying thickness, I provide separate reinforcing strips at the corners of the girder when it is desirable to impart additional strength thereto. Such strips are prevented from buckling because they are riveted between the edge flanges of the channel members and adjacent web members. Thus relatively light thin channel and web members may be employed and the saving in the amount of material punched from such members to provide weight reducing openings is an important item. As the size of the reinforcing strips may be varied according to the degree of strength required, it is only necessary to maintain in stock relatively few thicknesses of channel and web material.

For a better understanding of my invention, reference may now be had to the accompanying drawings forming a part of this specification, of which;

Fig. 1 is a fragmentary elevational view of a girder embodying my invention;

Fig. 2 is a fragmentary plan view of the girder shown in Fig. 1;

Fig. 3 is a cross-sectional view of a girder embodying my invention, the section being taken substantially along the line III—III of Fig. 1;

Fig. 4 is a cross-sectional view of a girder similar to that shown in Figs. 1 and 2, illustrating another form which my invention may assume;

Fig. 5 is a fragmentary cross-sectional

view on an enlarged scale illustrating in detail the structure of one of the corner portions of the girder shown in Fig. 4;

Fig. 6 is a cross-sectional view of a girder similar to that shown in Figs. 1 to 3, illustrating another form which my invention may assume;

Fig. 7 is a cross-sectional view of a girder somewhat similar to that shown in Fig. 3;

Fig. 8 is a cross-sectional view of a girder embodying my invention, in which the flanges of the weight reducing openings are turned outwardly;

Fig. 9 is a cross-sectional view of a triangular girder embodying my invention; and

Fig. 10 is a cross-sectional view of a girder embodying another form which my invention may assume.

In practicing my invention, I provide a girder, generally indicated by the numeral 20, which is composed of two oppositely disposed channel members 22 and 23 and two oppositely disposed web members 24 and 25. Although I have illustrated in the drawings a box girder having four sides, it is to be understood that any convenient number of sides may be employed according to the shape of the girder desired to be constructed.

Each of the channel members 22 and 23 is provided with flanges 26 and 27, respectively, which are riveted, as indicated at 28 and 29, and overlap the adjacent edges of the web members 24 and 25. The edge portions of the channel flanges 26 and 27 are provided with reentrant bent edges or flanges 30 and 32, which are adapted to project inwardly within longitudinally extending recesses 33 and 34, in the web members 24 and 25. At the extremities of the overlapped portions of the web members 24 and 25, flanged edge portions 35 and 36 are provided, which serve to strengthen the corner portions of the girder.

The channel plates 22 and 23 are provided with a series of weight reducing openings 37 and 38, which are punched therefrom and are surrounded by stiffening flanges 39 and 40, extending inwardly with respect to the assembled girder. Smaller flanged weight reducing openings 41 (Fig. 2) are punched adjacent the larger openings in the channel members. Likewise, small weight reducing openings 42 and relatively large weight reducing openings 43 and 44 are punched in the web members 24 and 25, the latter being provided with flanges 45 and 46 extending outwardly with respect to the girder. It will be observed by reference to Fig. 3, that the extremities of the flanges 45 and 46 are located inwardly from a plane coinciding with the outer surface of the channel flanges 26 and 27, and that the outer surfaces of the channel members 22 and 23 are smooth. The corner portions of the girder are smoothly curved, as indicated at 47. Thus it will be apparent that an airship envelope or gas bag (not shown), upon engagement with the girder, either against the channel members or against the web members, will not engage any sharp edges which would cause injury thereto. All of the extreme edges 30 and 32 are turned inwardly to prevent such injury, and the flanges 45 and 46 do not extend outwardly a sufficient distance to directly engage the envelope or gas bag.

In the form of my invention, illustrated in Fig. 4, the shape of the girder is substantially the same as that shown in Figs. 1 to 3. In this figure, upper and lower channel members 50, provided with flanges 52 and weight reducing openings 53, are secured adjacent the edges of web members 54. Each of the flanges 52 is riveted, as indicated at 55 to the web members, and is provided with a reentrant edge portion 56, which is adapted to extend toward inwardly bent portions 57 of the web members. It will be observed that the weight reducing openings 58 of the web members are provided with inwardly extending flanges 59 and that overlapped edge portions of the webs 54 are provided with inwardly turned edge portions 60.

As best shown in Fig. 5, each of the corner portions of the girder is reinforced by a separate strip 62, riveted between the flanges 52 and the webs 54. This strip is bent and provided with a reentrant strengthening edge portion 63. The size and shape of the reinforcing member 62 may be varied according to the most desirable proportion of weight to strength obtainable for a certain structure of girder. By this structure, relatively thin web channel members may be employed without reducing the efficiency of the girder. This is very important from a standpoint of saving the material punched from the sheets of metal in the formation of weight reducing openings. The structures illustrated in Figs. 4 and 5 provide smooth outer surfaces to prevent injury of airship envelope or gas bags in substantially the same manner as that described and shown in connection with Figs. 1 to 3.

In the event it is desirable to impart additional strength to the girder between the corners thereof, pairs of web members 64 and 65 may be employed as embodied in the structure illustrated in Fig. 6. The outer contour of the girder in this instance is substantially the same as that shown in Fig. 3. Channel members 66 provided with punched flanged openings 66^a and with flanges 67 are riveted, as indicated at 68, to the pairs of web members 64 and 65. It will be observed that flanges 69 and 70 of the web members extend in opposite directions, and that their edge portions 72 and 73 are turned inwardly in the same manner as the edge portions of the web members shown in Figs. 1 to 3.

The girder embodying the form of my invention illustrated in Figs. 7 and 8 consists of channel members 74 and web members 75, which are connected together to provide corner portions substantially the same as those shown and described with reference to Fig. 3, and further description of these corner portions is accordingly not required for a thorough understanding thereof. In Fig. 7, I have illustrated flanges 76 surrounding weight reducing openings 77. The flanges extend inwardly of the girder, while in Fig. 8 the flanges 76 of the weight reducing openings extend outwardly, but not to the outer contour of the girder, as defined by lines drawn from corner to corner thereof.

It is to be understood that the web members 75 may be reinforced by additional plates 77ª indicated in dot and dash lines of Fig. 7, thereby providing a pair of web plates at each side of the girder. In this arrangement of pairs of web plates the flanges around the openings of the outer plates 75 extend inwardly, whereas the flanges surrounding the openings of the inner plates 77ª are turned outwardly.

Fig. 9 illustrates a girder of substantially triangular cross-section, in which web members 78 are secured to channel members 79, the latter being provided with reentrant edge portions 80. All of the corners of the structure illustrated in this figure are curved and the edges of the channel and web members extend inwardly to prevent injury to airship envelope or gas bags. Flanged weight reducing openings 82 are provided, which openings function in the manner described above in connection with the other forms of my invention.

The structure shown in Fig. 10 illustrates a form of my invention in which web members 83 are connected to each other in overlapping relation. Adjacent one edge of each web member a flange 84 is provided which overlaps the edge portion 85 of the adjacent web member. The web members are provided with flanged weight reducing openings 86. Although channel members having two equally large flanges are not employed in this embodiment of my invention, it will be observed that the corner structure of the girder is substantially the same as that described above in connection with the other forms of my invention.

From the foregoing description it will be apparent that I have provided a girder structure which is well balanced, and which is of relatively light weight in proportion to its strength. Thus a saving of material as well as increased efficiency in withstanding aerodynamical forces will result from the use of girders of this construction in the building of aircraft of the type mentioned.

Although I have illustrated but the preferred forms which my invention may assume and have described those forms in detail, it will be apparent to those skilled in the art that it is not so limited but that various minor modifications and changes may be made therein without departing from the spirit of the invention or from the scope of the appended claims.

What I claim is:

1. A hollow girder polygonal in cross-section comprising overlapping interconnected sheet metal members provided with edge flanges extending inwardly of the girder, the legs defined by the cross-sectional contour of the corner portions thereof being substantially in alignment with the outer surface planes of the girder, the inner overlapping members being provided with depressions to receive the edge flanges of the outer overlapping members, each member being provided with flanged weight reducing openings.

2. A quadrilateral hollow girder comprising oppositely disposed sheet metal webs provided with edge flanges extending inwardly of the girder, oppositely disposed sheet metal channel members connected to the webs, each web and channel member being provided with weight reducing openings and flanges surrounding each opening, the flanges surrounding the openings of the webs extending in one direction with respect to the interior of the girder and the flanges surrounding the openings of the channel members extending in the other direction with respect to the interior of the girder.

3. A hollow girder polygonal in cross-section comprising oppositely disposed sheet metal webs provided with edge flanges extending inwardly of the girder, oppositely disposed sheet metal channel members connected to the webs, each web and channel member being provided with weight reducing openings and flanges surrounding each opening, the flanges surrounding the openings in the webs extending outwardly with respect to the girder.

4. A box girder comprising interconnected sheet metal members provided with edge flanges extending inwardly of the girder and a separate reinforcing strip connected to and inclosed by the sheet metal members adjacent each corner portion of the girder, said strips being bent along one edge thereof.

5. A box girder comprising interconnected sheet metal members provided with reentrant edge flanges and a separate reinforcing strip arranged between the edge portions of the metal members adjacent reentrant flanges at each corner of the girder, said strips being provided with flanges turned inwardly with respect to the girder.

6. A box girder comprising interconnected metal channel and web members each being provided with reentrant edge flanges, each

metal member being provided with a plurality of weight reducing openings, flanges surrounding the openings extending inwardly of the girder and a reinforcing strip of substantially the same width as each leg of the channel members, said strips being secured between the legs of the channel members and the edge portions of the web members.

7. A box girder comprising oppositely disposed sheet metal webs provided with reentrant edge flanges, oppositely disposed sheet metal channel members provided with reentrant flanges connected to the webs, each web and channel member being provided with weight reducing openings, flanges surrounding each opening and reinforcing strips connected within the channel members flush with the legs thereof adjacent the corners of the girder, said strips being formed with reentrant flanges.

In witness whereof, I have hereunto signed my name.

BENJAMIN SCHNITZER.