May 3, 1932. H. V. THADEN 1,856,143

AEROPLANE WING

Filed Dec. 11, 1929 3 Sheets-Sheet 1

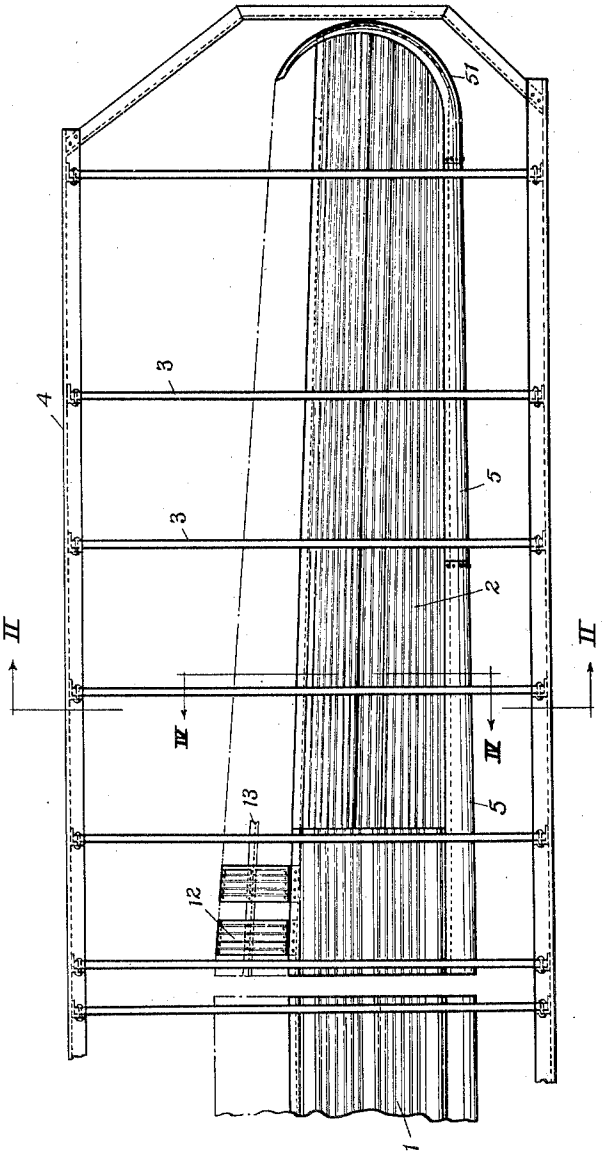


Fig. 1.

INVENTOR

Herbert V. Thaden

by Christy Christy and Wharton

his attorneys

May 3, 1932. H. V. THADEN 1,856,143

AEROPLANE WING

Filed Dec. 11, 1929 3 Sheets-Sheet 2

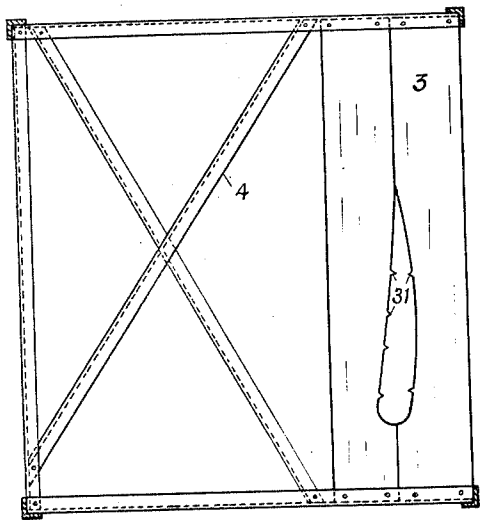


Fig. II.

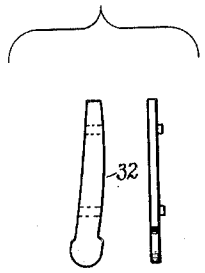


Fig. III.

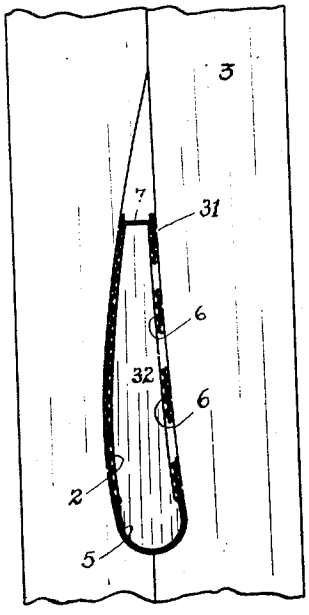


Fig. IV.

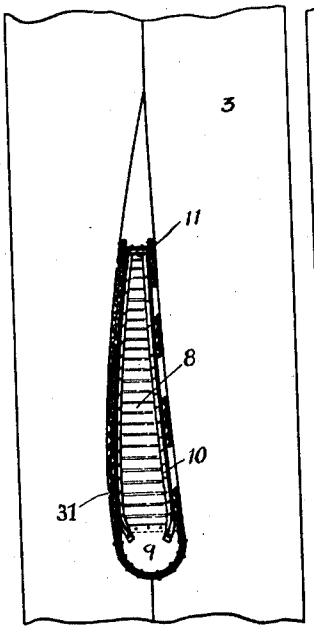


Fig. V.

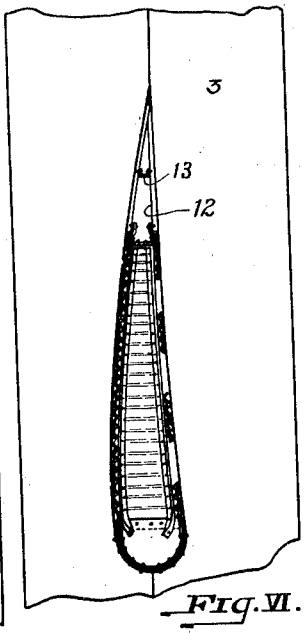


Fig. VI.

INVENTOR

Herbert V. Thaden

by Christy Christy and Wharton

his attorneys

May 3, 1932. H. V. THADEN 1,856,143

AEROPLANE WING

Filed Dec. 11, 1929 3 Sheets-Sheet 3

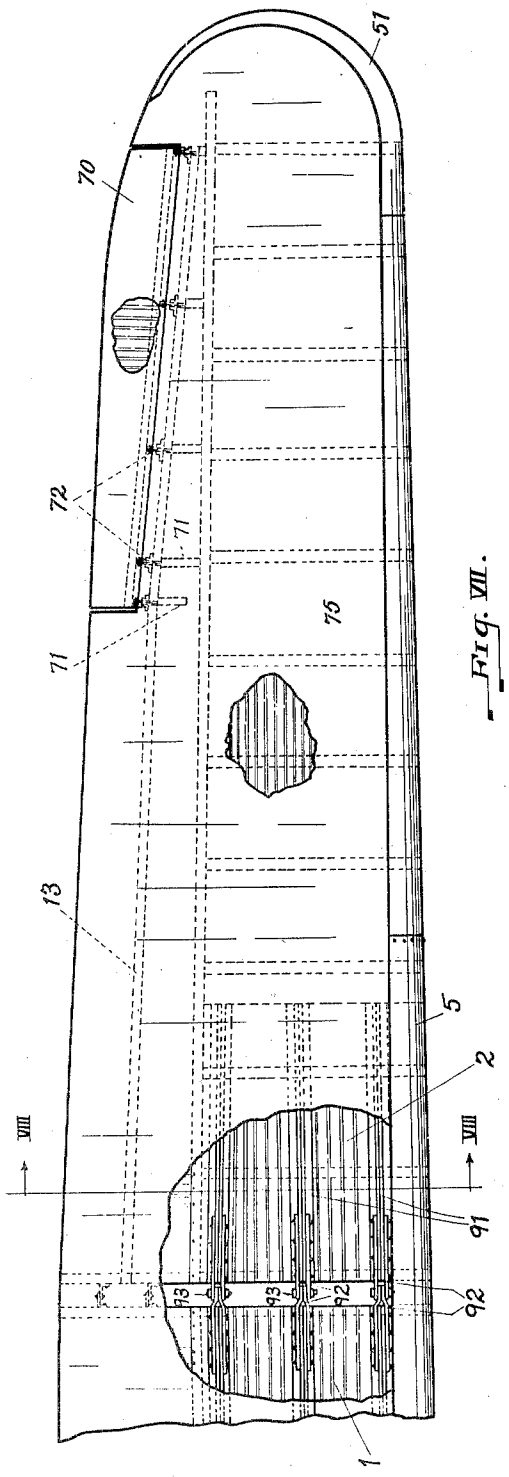


Fig. VII.

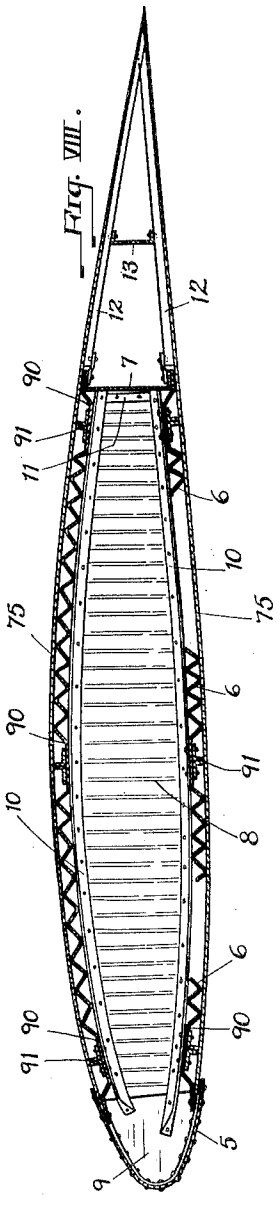


Fig. VIII.

INVENTOR
Herbert V. Thaden
by Christy Christy and Wharton
his attorneys

Patented May 3, 1932

1,856,143

UNITED STATES PATENT OFFICE

HERBERT V. THADEN, OF MOUNT LEBANON, PENNSYLVANIA, ASSIGNOR, BY MESNE ASSIGNMENTS, TO GENERAL AVIATION CORPORATION, OF NEW YORK, N. Y., A CORPORATION OF DELAWARE

AEROPLANE WING

Application filed December 11, 1929. Serial No. 413,255.

My invention relates to the structure of the wing of an aeroplane, and consists in features which make for strength, lightness, and cheapness.

In the accompanying drawings the wing of an aeroplane is shown in course of building and in them the features of structure which constitute my invention are illustrated. Fig. I is a fragmentary and diagrammatic view in side elevation of an aeroplane wing, in course of building. The wing is shown in place in a "jig", or forming frame. Fig. II is a view in cross-section of the forming frame itself, on the plane indicated by the line II—II, Fig. I. Fig. III shows in front and side elevation a member employed in building. Figs. IV, V, and VI are views in cross-section, on the plane indicated at IV—IV, Fig. I, and to larger scale, and illustrate successive steps in the progress of the building of the wing. Fig. VII is a plan view of a completed wing, showing its outer cover or skin broken away, and revealing the means which are employed rigidly to interconnect the middle and outer sections of the wings. Fig. VIII is a view in cross-section, on the plane indicated at VIII—VIII, Fig. VII, and to larger scale, and illustrating the wing as it is finally covered with an outer metallic skin.

The "wing" of an aeroplane is indeed a pair of wings, built in a single expanse, and to this wing structure the body or fuselage is united. Conveniently, for purposes of shipment, the wing is built in sections, bolted together; but this is a matter of circumstance merely, and when the vessel is assembled, the wing structure is indeed a unitary thing. Fig. I shows fragmentarily a wing built in three sections: A middle section, 1, and two lateral sections, 2, one of which is shown. The middle section and the lateral section are here shown in the forming frame spaced slightly apart, in their permanent relationship, and as presently will appear the bolted union is completed while the sections are still in their forming frame. After completion unbolting may be resorted to for purposes of shipment, etc., as has been intimated.

The wing of an aeroplane consists of a body and a cover. The cover, formed of any suitable material, is laid upon the completed body. My invention has to do primarily with body structure, and to it more particular attention will be directed. Suffice it to repeat here that the body of my invention, after building, is suitably covered.

The body consists of a shell of sheet metal, supported from within. The posterior margin of the wing, ordinarily called the "trailing edge", is conveniently formed as a structurally supplemental part, and in this trailing edge the ailerons are included. The sheet metal which constitutes the upper and lower faces of the shell is corrugated, and the corrugations extend longitudinally of the wing. In Fig. I the reference numerals 1 and 2 are applied immediately to these corrugated sheets. The middle section of the wing is of uniform width throughout, and in it the corrugations are uniform throughout their extent; the lateral sections, however, taper outwardly, and, accordingly, the corrugations taper in size and converge outwardly. The longitudinal corrugating and the tapering of the corrugations afford augmented strength and rigidity; furthermore, the tapering of the corrugations is advantageous in that the separate sheets of which the shell is necessarily made up may be fitted snugly together with overlapping edges and with the corrugations in register, and thus a firm and strong seam may be formed, ordinarily by riveting. Presses may be provided, for shaping the sheets to the desired corrugated configuration.

The interior support for the shell consists of a succession of transversely disposed webs or so-called bulkheads. These also are formed essentially of corrugated sheet metal, and the corrugations extend transversely of the wing, between the sheets which constitute its upper and lower faces.

The "jig" or structure in which the wing is built consists of a set of templets 3 standing vertically and aligned, being carried in a framework 4. The templets are made of wooden planks, each advantageously consisting of two parts removably secured in the framework. The planks are cut away and

the templets are formed with interior openings, and each opening presents in profile the shape of the wing in cross-section, at the point where in the assembly that particular templet stands. The templets, seven of which are shown in Fig. I, are set up in the framework and so aligned that in their assembly they constitute a form within which the wing is to be built. Guiding teats 31 may be left along the margins of the cuts in the templets, and the cut-away portions 32 of the planks may be trimmed marginally, as shown in Fig. III.

The form having been made ready, the sheets of metal which are to constitute the shell are brought to place and accurately shaped within it. These sheets include smooth and uncorrugated sheets 5, to constitute the leading edge of the wing. The sheets 5, it will be seen, are bent transversely to a curve of relatively short radius. The other sheet-metal parts shaped within the form are the corrugated sheets 2 which constitute the upper face of the body of the wing, and the corrugated sheets 6 which constitute the lower face. The sheets 6 are advantageously spaced apart transversely of the wing, so that the completed wing body is left with spaces or openings in its lower face, through which access may be had to the interior. It is desirable to have such openings; they permit access to the interior of the body during construction, and are serviceable in case of repair; furthermore, removal of metal in this region affords a structure lighter in weight and of unimpaired strength. The leading edges of sheets 2 and the nearest adjacent sheets 6 underlie the edges of sheets 5, and these sheets 2 and 6 are united to sheet 5 in seams, ordinarily by riveting. Rearwardly, the sheets 2 and 6 do not reach to the end of the templet space; they terminate short of that, and between them a web 7 is introduced. This conveniently is formed of sheet metal, bent to channel shape. The edges of sheets 2 and 6 overlap the flanges of the channel, and there also seams are formed, conveniently by riveting.

As the sheet-metal parts 5, 2, 6, and 7 are brought to place within the form, the sections 32 cut from the planks 3, having been trimmed peripherally to serve their further purpose, are introduced, in the position shown in Fig. IV, in alignment with the templets from which they have been cut. They serve to shape minutely the sheet-metal parts within the form and to bring the parts accurately to position, and to hold the parts in such position. While so held the plurality of sheets of metal which make up the wing surfaces are riveted or otherwise secured along the seams.

The uncorrugated sheets 5 compose, as has been said, the anterior edge of the structure. At the outer end of the wing these plates are combined with and terminate in a preformed shoe 51 of sheet metal, which defines the tip of the wing and overlies the terminal edges of the sheets 2 and 6.

Each transverse web consists essentially of a corrugated sheet of metal 8, shaped to the cross-section of the wing at the point where it is eventually to be situated. At the forward end, the web may include an uncorrugated sheet 9, and this part in the assembly will lie within the uncorrugated sheets 5 which constitute the anterior edge of the shell. The sheets 8 and 9 will overlap and will be united in a suitable seam, as by riveting. The otherwise free edges of the sheets 9 may be flanged by cutting and bending, and bent angles 10 and 11, properly shaped, will be secured to the edges of the corrugated sheets 8. As the shell structure is progressively shaped and integrated at the seams, the temporary shaping blocks 32 are removed, and the webs are introduced, and secured by their marginal flanges to the sheet metal shell, conveniently by riveting. The webs 8 will ordinarily correspond in number and position to the templets and to the temporary spacing blocks 32, but they may be set at other convenient intervals throughout the extent of the wing structure.

To the posterior edge of the shell so built the marginal portion is built within the form. This marginal portion consists of sheets of metal 12 secured to the edges of sheets 2 and 6, converging rearwardly, and united in a marginal seam. The sheets 12 are preferably corrugated, and the corrugations extend transversely of the wing as a whole. This marginal portion is preferably reenforced by an angle 13 (formed of bent sheet) situated intermediate the length of sheets 12 and to which the sheets are secured. The sheets 12 are arranged opposite one another in pairs and, as indicated in Fig. I, sufficient strength may be had and weight may be reduced, if these sheets 12 do not extend in continuity. It suffices if they be arranged in pairs, at intervals throughout the length of the wing, excepting, of course, those portions in the extent of the wing which are reserved for the ailerons (70). These ailerons are hinged to the angle 13, as is indicated at 72. The posterior portion of the wing may be additionally strengthened with transversely extending webs 71 (Fig. VII), adjacent that portion of angle 13 to which the aileron is hinged.

When the body has been built within the form, the templets are opened; one of the pairs of planks which constitutes each templet is taken away; the body structure of the wing may then be taken out.

The cover material may be such as is desired. I prefer to employ sheet metal. If it be of sheet metal it may be smooth or corrugated. The cover 75 (see Figs. VII and

VIII) preferably does not overlie the rounded anterior edge of the body, formed by the sheets 5. Having been properly cut to pattern, the anterior edges of the cover are inserted beneath the rear edges of the plates 5 and between those edges and the outer surfaces of sheets 2 and 6, and when the edges of the cover have so been introduced they are secured to place.

I have indicated in Fig. VII convenient means rigidly to unite the central and lateral wing portions. The corrugations of the body sheets 2 and 6 are interrupted, part-way of their length, to provide a plurality of elongated flat faces 90 upon the body structure of the wing. Positioned on each of these faces 90 and extending longitudinally therewith are two angles 91, arranged flange-to-flange, and riveted to the body structure. To the abutting flanges of the angles 91 there are riveted steel plates 92, extending past the ends of the wing portions with which they are associated. The extending portions of the plates 92 are shaped to provide tongue-and-groove interengagement, as shown in Fig. VII. Pins or bolts 93 are passed through the interengaging ends of the plates 92, and thus the wing sections are locked in position to provide a sturdy union of the wing portions. The separable union of the wing sections may be such as is preferred; I have shown and described uniting means of one particular form, by way of example merely.

The metal employed will advantageously be one of the light, strong alloys of aluminum which have been worked out for the very purpose. One of these alloys rolled into sheet form with surfaces of pure aluminum is the best of known materials for the purpose.

What I claim is:

1. A body for an aeroplane wing consisting of a shell of sheet metal with upper and lower faces corrugated in the direction of the length of the wing, the lower face being discontinuous in its transverse extent, the said faces being borne upon an interior support.

2. A body for an aeroplane wing consisting of a shell of sheet metal with upper and lower faces and corrugated in the direction of the length of the wing, and borne upon an interior support which includes a transversely extending web of corrugated metal of airfoil contour disposed parallel to the line of flight of the aeroplane, the corrugations of the web extending vertically between such upper and lower faces.

3. A body for an aeroplane wing consisting of a spar in the form of a shell whose upper and lower faces are formed of sheet metal corrugated in the direction of the length of the wing, and borne upon an interior support, and a trailing edge portion secured to the said spar and formed of sheet metal corrugated transversely of the length of the wing.

4. A body for an aeroplane wing consisting of a spar in the form of an interiorly supported shell whose upper and lower faces are formed of sheet metal corrugated in the direction of the length of the wing, and upper and lower sheets of corrugated metal spaced apart in pairs longitudinally of the structure secured to said spar and converging rearwardly and forming the internal supporting portion of the trailing edge of the wing.

5. A body for an aeroplane wing consisting of a shell of sheet metal with upper and lower faces corrugated in the direction of the length of the wing, the lower face being discontinuous in its transverse extent, the said faces being spaced by interior supports composed of sheet metal members of airfoil contour and corrugated vertically.

6. A body for an aeroplane wing comprising an upper sheet metal member corrugated in the direction of the length of the wing and continuous from a point near the leading edge to a point near the trailing edge of the wing, a lower member comprising a plurality of sheet metal members each disposed in spaced relationship to the upper member in a vertical direction and in spaced relationship to each other in the direction of flight and each corrugated in the direction of the length of the wing, and interior supports connecting all of said members into a unitary structure.

7. An aeroplane wing comprising a smooth metal cover, and a spar within said cover and secured thereto comprising a hollow shell of airfoil contour composed of sheet metal corrugated in the direction of the length of the wing, said shell being held in shape by a sheet metal web of airfoil contour corrugated vertically, and a trailing portion secured to said shell and composed of sheet metal corrugated in the direction of flight.

8. An aeroplane wing comprising a smooth metal cover, and a spar within said cover and secured thereto comprising a hollow shell of airfoil contour composed of sheet metal corrugated in the direction of the length of the wing, said shell being held in shape by a sheet metal web of airfoil contour corrugated vertically, and a trailing portion secured to said shell and comprising a hollow tapered member composed of sheet metal corrugated in the direction of flight.

In testimony whereof I have hereunto set my hand.

HERBERT V. THADEN.