H. G. HOOPER.

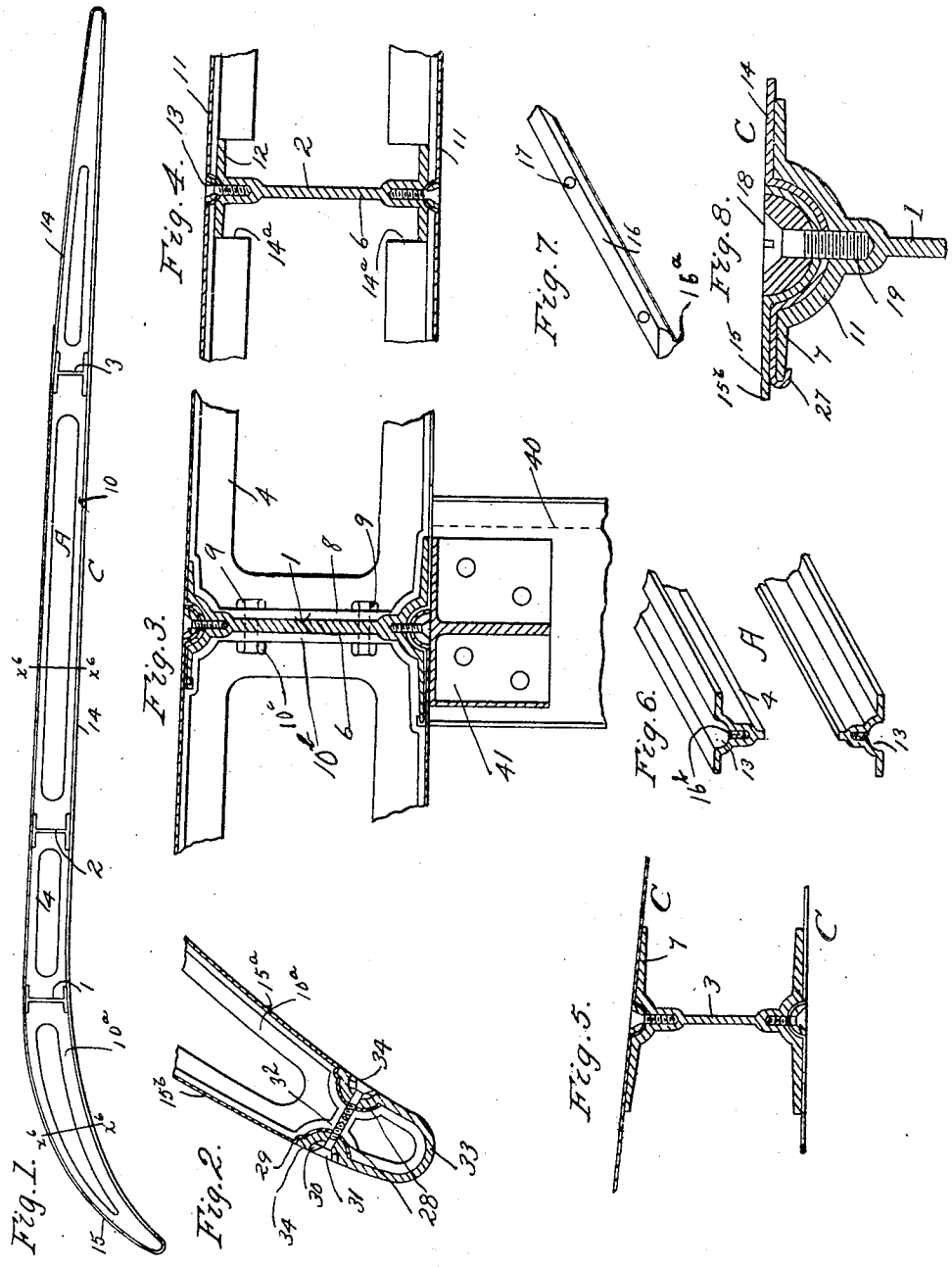
AEROPLANE CONSTRUCTION.

APPLICATION FILED OCT. 9, 1917.

1,331,150.

Patented Feb. 17, 1920.

2 SHEETS—SHEET 1.



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2 SHEETS—SHEET 2.

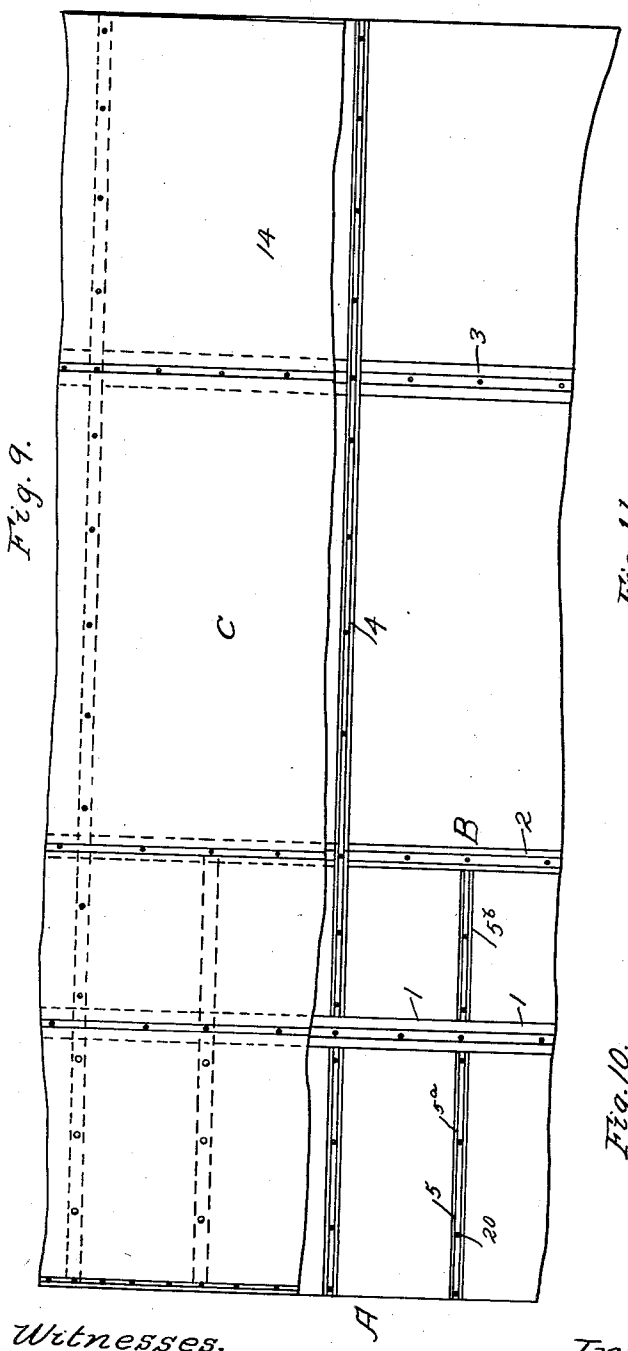


Fig. 9.

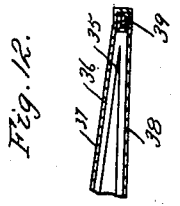


Fig. 12.

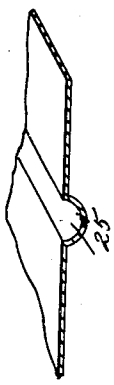


Fig. 11.

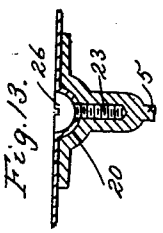


Fig. 13.

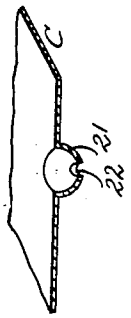


Fig. 10.

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UNITED STATES PATENT OFFICE.

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AEROPLANE CONSTRUCTION.

1,331,150. Specification of Letters Patent. Patented Feb. 17, 1920.

Application filed October 9, 1917. Serial No. 195,618.

To all whom it may concern:

Be it known that I, HARRIS G. HOOPER, a citizen of the United States, residing at Los Angeles, in the county of Los Angeles and State of California, have invented new and useful Improvements in Aeroplane Constructions, of which the following is a specification.

This invention relates to improvements in flying machines, and more particularly to wing or sustaining surface construction for heavier-than-air machines, such as aeroplanes.

The primary object of the invention is to provide construction of the above-named character which as compared to the known, and now-in-use construction will be superior in simplicity and inexpensiveness of construction, can be more easily and quickly manufactured, is more strong and durable, capable of greater stress-resistance, and, which will be fire-proof, compact and light.

Another and more specific object of the invention is to provide improvements of the character disclosed which may consist entirely of metal parts capable of standardization and subject to ready and accurate assemblage; and further, the invention consists in the provision of a bullet-proof, non-combustible aeroplane wing which is constructed of metal and has all of the advantages of the wooden or other known wings, with the added strength, serviceability, durability, longevity and facility of assemblage provided by said metal construction.

Other objects and advantages will appear during the course of the following description.

In the drawings:

Figure 1 is a cross sectional view of an aeroplane wing constructed in accordance with the invention;

Fig. 2 is an enlarged sectional view of the forward end of the wing;

Fig. 3 is an enlarged sectional detail view of a portion of the aeroplane;

Fig. 4 is a similar sectional view taken at another portion of the aeroplane;

Fig. 5 is also a similar sectional view taken at still a further portion of the aeroplane;

Fig. 6 is a fragmentary perspective view of one of the frame ribs;

Fig. 7 is a fragmentary perspective view of one of the securing beads;

Fig. 8 is an enlarged sectional view of the means for fastening the envelop to the frame;

Fig. 9 is a fragmentary top plan view of the wing showing it broken away in part;

Fig. 10 is a fragmentary sectional view of the envelop showing the opening punched therethrough to receive a fastening element;

Fig. 11 is a fragmentary perspective view of a grooved portion of the envelop;

Fig. 12 is a detail sectional view showing a modified form of rear edge construction for the wing; and

Fig. 13 is a detail sectional view illustrating the manner of securing the envelop to certain of the ribs.

This application is to a certain extent a companion case to my pending application for patent flying machine, filed Aug. 23, 1917, Serial No. 188,623, the invention herein disclosed being a departure from the metallic aeroplane construction shown in the former application.

Referring to the drawings in which like parts are designated by like characters throughout the several views, A designates an aeroplane wing structure which comprises a frame B and an envelop C incasing and secured to said frame. The frame A is constructed of metallic members or parts preferably, and the envelop is likewise preferably formed of suitable metal. The frame B comprises longitudinal metallic girders 1, 2 and 3 to which are secured preferably sectional cross or transverse metallic ribs 4, said girders and ribs being disposed at right angles to one another so as to provide a network frame construction having the desired strength, ability to withstand stresses and sufficient body to permit of a reliable fastening of the envelop C thereto. The frame also preferably includes auxiliary ribs 5 disposed parallel to and between the ribs 4 and extended from the front edge of the wing A to girder 2, this portion of the wing and frame taking the severest stresses when the wing is in use; and requiring more reinforcement. Each of the girders 1, 2, and 3 is constructed similarly to an I beam and comprises a body portion 6 from the longitudinal edges of which extend lateral flanges 7. These flanges, however, unlike the right angularly disposed flanges of an I beam, are disposed at angles made to coincide with the relative angles of convergence of the upper and lower sides of the envelop, said upper and lower sides converging from

the front to the rear edges of the wing as is customary. The girder 1 is disposed adjacent to front edge of the wing or at the zone of the juncture of the downwardly curved front portion of the wing with the body of the wing and the front ends of the ribs 4 and about the girder 1. Flanges 8 extending at right angles to and from the ends of the ribs 4 and 5 engage and are secured by suitable fastening elements 9 to the body portion 6 of the girder 1. It will be noted that the ribs 4 are sectional and as shown each of the ribs comprises a body or main portion 10 which extends from the beam 1 rearwardly to the rear edge of the wing, and an extension section 10^a which is curved to provide for curvature of the portion of the wing, said extension being disposed for the curved portion of the wing and secured to the girder 1. Right angularly disposed flanges 10^b are formed on rear ends of the extension sections 10^a and are secured to the girder 1 by fastening elements 10^c. The auxiliary ribs 5 are formed in sections also, said sections being designated 5^a and 5^b and being disposed in between the front edge of the wing and girder 1, and between the girders 1 and 2, respectively. These sections are secured to the girders 1 and 2 in the same manner as are the sections of the ribs 4 secured to the girder 1.

The girder 2 is disposed in parallel relation to the girder 1 closer to said girder than to the girder 3 and near to the point in the front of the wing where the curvature thereof is most abrupt. This girder 2 is so disposed in order that the wing will be strengthened or reinforced where the greatest strains and stresses are imposed. The girder 3 is disposed in parallel relation to girders 1 and 2 near the rear edge of the wing. Each of the girders is provided centrally in the flanges 7 with a groove 11 extending longitudinally of said girder and being, as shown, preferably semicircular in cross section. Each of the ribs 4 and 5 is of a construction similar to the girders, there being flanges 12 provided thereon, said flanges of the ribs 4 being centrally and longitudinally grooved as at 13 so as to correspond to the grooved construction of the girder flanges and said flanges of the girders and ribs both lie in substantially the same plane. To provide for this arrangement, the ribs 4 are extended over the girders 2 and 3 and are recessed or cut away as at 14^a to allow the extension of the girders therethrough. The flanges 7 of the girders 2 and 3 are cut to allow their vertical ribs to engage the under faces of the flanges 12 of the ribs 4 and the grooves 11 and 13 are thus disposed in substantially the same plane.

The envelop C, as shown, preferably comprises a main sheet metal section 14 of one piece, and a similar sheet metal front section 15. These sections, however, may be divided into further sections if desired. The main section 14 of the envelop has its longitudinal edges disposed within the grooves 11 of the girder 1, said section being extended from the lower groove 11 over and in engagement with the ribs 4 and girder 3 around the rear ends of the ribs 4 and upon the upper sides of said ribs and the girder and back to the groove 11 on the upper side of the girder 1. The front sheet metal section 15 of the envelop comprises lower and upper sheets 15^a and 15^b. The lower sheet 15^a has its rear longitudinal edge held within the lower groove 11 of the main girder 1 and is extended along and in engagement with the under side of the front sections of the ribs to a point adjacent to the forward extremities of the ribs and are then secured at such points as will be later more fully described. The upper sheet 15^b is disposed upon the upper side of the front sections of the ribs in the same manner as is the lower sheet.

As a means for securing the main section and also the front section of the envelop to the frame I preferably cause the metal of said envelop to be forced into and clamped within the grooves 11 and 13. To this end I preferably provide longitudinal securing beads 16 which are semicylindrical approximately in cross section and provided at spaced intervals with openings 17 to receive screws 18, there being provided screw threaded openings 19 in the grooves 11 and 13 along the median lines thereof. There may be provided ribs 16^a on the under sides of the beads 16, said ribs 16^a acting to center the beads, there being an auxiliary groove 16^b formed in the grooves 11 and 13 for the reception of the ribs.

After the main section 15 of the envelop C has been positioned as hereinbefore defined, it is securely fastened in place by the strip 16. In fastening the main section of the envelop the material thereof is forced into the grooves 11 and 13 and after this is done the strips 16 are placed against the inwardly forced portions of the envelop, within the grooves and are then secured in place by screws 18 which pass through the openings 17 in said strips and have threaded engagement with the screw-threaded openings 19. Thus it will be seen that where the envelop is secured to the frame members the surface thereof is maintained free from irregularities and is comparatively smooth. The upper flat surfaces of the strips 16 lie flush with the envelop surfaces, as shown in detail in Fig. 8 of the drawings and therefore provide for the smooth wing surfaces above-mentioned. The section 14 of the envelop is also secured to the sections of the ribs 5 that are disposed between the girders

1 and 2, this being particularly shown in Fig. 9 of the drawings. The flanges upon the upper and lower edges of the ribs 5 are provided with grooves 20, and the metal of the envelop is punched as at 21, so as to provide protuberances 21′ to engage in said grooves as shown in detail in Figs. 10 and 13 of the drawings, there being provided openings 22 in said indentations 21 provided in the envelop. Screws 23 are inserted through the openings 22 and turned into screw-threaded openings formed in the indentations 21. Both the indentations 21 and the grooves for the beads 16, which for the sake of clearness, shall be designated 25, are formed in the envelop at the time of assembling or securing the same upon the frame, or before the assemblage as desired. The screws 23 have enlarged heads 26 which are adapted to engage snugly within the indentations 21 and provide for a tight union of the envelop with the ribs, and also for the disposal of the upper faces of the screws in flush relation to the envelop surface to provide for an even and uninterrupted wing surface as a whole.

The manner of fastening the ends or edges of the sections 14 and 15 of the envelop is particularly worked out so as to insure a leak-proof rigid fastening. In this connection it will be noted with particular reference to Figs. 3 and 8 that the edges both upper and lower of the main section 14 of the envelop after being first forced into the grooves 11 are extended over the flanges 7 of the girders 1 and bent around the edges of said flanges 7 as indicated at 27. The sheets 15^a and 15^b of the front envelop section 15 are forced into the grooves 11 so as to lie upon the portions of the section 14 already forced into the said grooves and the edges of said sheets 15^a and 15^b are disposed in flush relation to the outer surfaces of the strip 16 and envelop sections 14 and 15. Then, the strips 16 are secured in position as shown in Fig. 8 of the drawings, tightly clamping and holding the sections 14 and 15 in a rigid union and securely fastened to the frame.

The ribs 4 and 5 adjacent to their forward ends are provided with transverse grooves 28 on the opposed sides thereof and the forward extremities of the sheets 15^a and 15^b are forced in any suitable manner into said transverse groove, or preferably, said sheets are grooved along their entire forward edges as at 29 so as to provide for the reception of the strips 30 corresponding to the strips 16 and through which are inserted screws 31 having threaded engagement with openings 32 formed in the grooves 28. As a means for protecting the forward edge of the wing so as to prevent air from getting under the envelop and otherwise, so as to provide a leak-proof rigid joint, I preferably employ a heavy metallic nose section or strip 33 which is of substantially U-shape in cross section and receives the forward ends of the ribs 4 and 5, as shown in detail in Fig. 2 of the drawings. This heavy section overlaps or overlies the grooved portions 29 of the sheets 15^a and 15^b, being in turn grooved as at 34 for the reception of the strips 30, the longitudinal edges of said heavy section 33 being disposed flush with the outer surfaces of the strips 30 and sheets 15^a and 15^b. The strips 30 and screws 31 provide for the securing of the heavy section 33, as well as the sheets 15^a and 15^b, to the frame. It is to be understood that I show as a preferred form the semi-circular fastening. I may use fastening of other form of section.

Referring particularly to Fig. 12 wherein there is illustrated a modified construction, 35 designates the tapering rear end formation of an aeroplane wing frame constructed in accordance with the present invention. In this type of construction the envelop 36 is divided into upper and lower sections 37 and 38, respectively, which sections are joined at their rear ends by a special form of joint. This special form of joint is provided by forming what is ordinarily known as a double seam designated 39 and allowing the bead formed by the seam to project rearwardly from the end of the frame 35. This double seam provides a wind and water, that is to say, an element proof joint of rigid, compact and neat formation. This modification particularly provides for the reliable joining of the envelop at the rear edge of the wing in case the envelop is made into upper and lower sections instead of being formed as shown in connection with the preferred form of the invention.

The manner of assembling the structure embodying this invention may be varied as desired. However, it is obvious with reference to the foregoing description and accompanying drawings that the frame B is first assembled, the elements comprising the girders 1, 2 and 3 and ribs 4 and 5 being inter-connected along prescribed and scientific lines so as to produce a body structure for a wing of scientific outline. In this connection it is noted that the flanges 7 of the girders 1, 2 and 3 and the flanges 12 of the ribs 4 and 5 are disposed at angles scientifically pre-determined in order to properly support the envelop and give the strict scientific angle to the wing surface. It is to be understood that these angles and changes affecting the same may be varied in accordance with the particular condition at hand. After the assemblage of the frame the envelop C may be secured or assembled upon the frame. The frame, however, is connected preferably as shown in Fig. 3 of the drawings. In this figure a strut 40 of an aeroplane structure, not shown, is fastened by

suitable means 41 to the flanges 7 of the main girder 1. This manner of connecting the frame with an aeroplane body does not enter into this invention and need not be described in detail. The assemblage of the envelop C takes place as hereinbefore described and may be carried on in any suitable manner, however, provided the method of fastening such as illustrated and described herein, is carried out, such method being one of the most essential features of the invention.

It is manifest from the foregoing description and accompanying drawings that various minor changes as to details of construction and as to the shape and size of parts and of elements of the construction will be required from time to time, dependent upon conditions concurrent with the adoption of the construction embodying my invention, and it is to be understood that such changes may be made without departing from the true spirit and scope of the invention.

Having thus disclosed my invention, I claim and desire to secure by Letters Patent:

1. An aeroplane sustaining surface, comprising a frame formed of intersecting metallic girders and ribs having their upper and lower edges in substantially the same planes and provided with recessed portions, a sheet metal envelop fitted upon the frame and formed with depressed portions received within the recessed portions of the frame members, and fastening members securing the said depressed portions of the sheet metal envelop in the recessed portions of the frame members.

2. An aeroplane sustaining surface, comprising a frame having members provided with indentations, a metallic sheeting covering the frame, and a means for securing the sheeting in the indentations in said frame member to fasten said sheeting to the frame.

3. In an aeroplane sustaining surface, a frame member having a longitudinal groove therein, a metallic sheet extending over and into the groove, and a bead secured within the groove and upon the sheet to secure the sheet to the frame member.

4. In an aeroplane sustaining surface, a frame member having a longitudinal groove therein, a metallic sheet extending over and into the groove, and a bead secured within the groove and upon the sheet to secure the sheet to the frame member; said bead being flush on its outer face with the outer face of the sheet.

5. In an aeroplane sustaining surface structure, a frame member having a groove therein, metallic sheeting extending over the member and into the groove therein, a bead mounted upon the sheeting within the groove, and fastening elements inserted through the bead and into the frame member.

6. In an aeroplane sustaining surface structure, a frame having members each comprising a body portion and flanges extending laterally from the body portion on the upper and lower sides thereof, and metallic sheeting for covering the frame, mounted upon and secured to the flanges of said frame members; said members having grooves in the flanges thereon, and means for securing said sheeting in the grooves of the flanges to secure the sheeting to the frame members.

7. An aeroplane sustaining surface, comprising a frame having members provided with indentations therein, a metallic envelop for the frame and having protuberances on its inner faces formed by providing indentations in the outer faces thereof, said protuberances engaging in said indentations in the frame members, and means for securing the envelop to the frame members.

8. An aeroplane sustaining surface, comprising a frame having members provided with indentations therein, a metallic envelop for the frame and having protuberances on its inner faces formed by providing indentations in the outer faces thereof, said protuberances engaging in said indentations in the frame members, and means for securing the envelop to the frame members, including members engaging in and closing the indentations provided in said envelop.

9. In improvements of the character disclosed, a skeleton frame-work, a metallic envelop mounted upon said frame-work with its edges terminated short of the front edges of the frame-work, said uncovered portions of the frame-work at the front edges thereof being provided with indentations in which said envelop is disposed, a nose strip of heavy material extended over the ends of the frame-work at the front thereof into said indentations and over the envelop, and means for securing said strip in place.

10. In improvements of the character disclosed a skeleton frame-work, a metallic envelop mounted upon said frame-work with its edges terminated short of the front edges of the frame-work said uncovered portions of the frame-work at the front edges thereof being provided with indentations in which said envelop is disposed, a nose strip of heavy material extended over the ends of the frame-work at the front thereof into said indentations and over the envelop, and means for securing said strip in place, comprising a bead mounted upon said strip of material and holding the latter into the indentations.

11. In an aeroplane sustaining surface, a frame including a main longitudinal girder of substantial I beam construction, other longitudinal girders disposed in parallel re-

lation to the main girder, a plurality of ribs secured to the girders in spaced parallel relation to one another and extending beyond the girders, such extended portion terminating at the front edge and rear edge portions of the frame, respectively, other ribs secured to the main girder intermediate of the first mentioned ribs and extended forwardly of said main girder to a point in line with the adjacent ends of the other ribs, and an envelop secured upon said frame.

In testimony whereof, I have signed my name to this specification in the presence of two subscribing witnesses.

HARRIS G. HOOPER.

Witnesses:
CHAS. J. CHUNN,
WILLIS S. MITCHELL.