

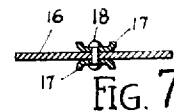
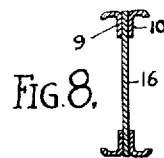
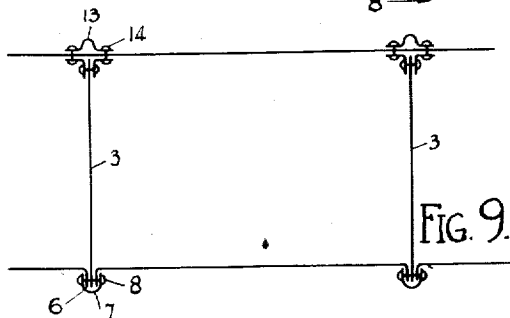
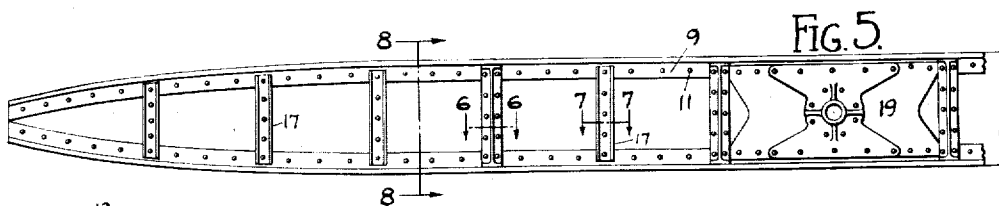
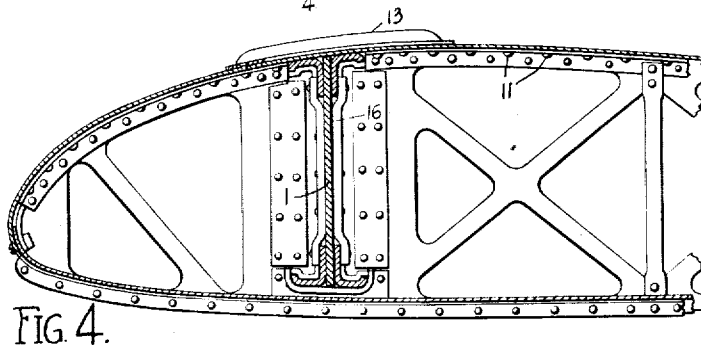
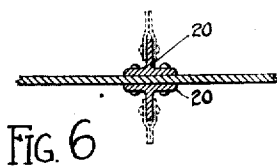
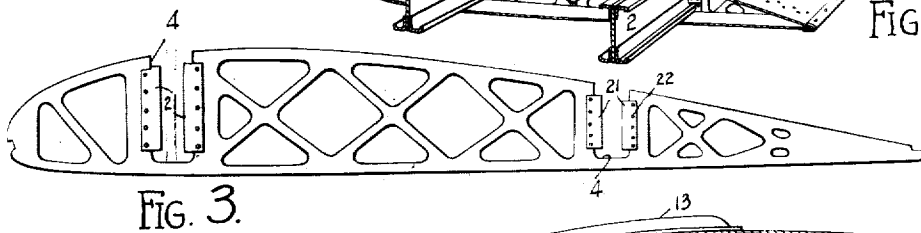
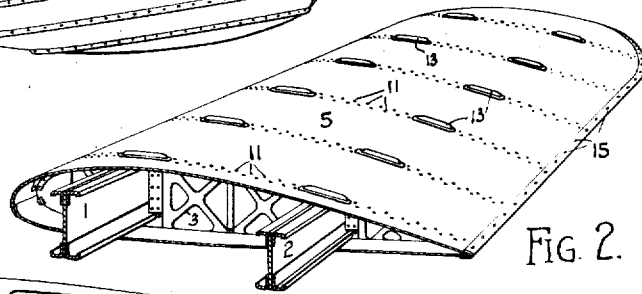
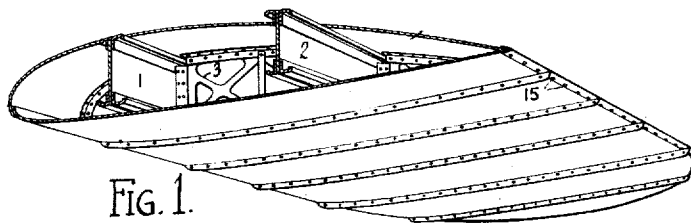
March 28, 1933.

E. A. HUGHES

1,902,956

METALLIC AIRFOIL

Filed May 6, 1930



INVENTOR
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UNITED STATES PATENT OFFICE

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METALLIC AIRFOIL

Application filed May 6, 1930. Serial No. 450,149.

This invention relates to improvements in airplanes and more especially to the method and manner of constructing metallic airfoils therefor.

5 The principal object of the invention is to obtain a smooth top surface thus preserving the true upper contour of the airfoil throughout its length, and by keeping the surface smooth to thereby decrease to a minimum the skin frictional resistance.

Another object of the invention, due to the smooth upper surface of the airfoil, is to effect simplicity of manufacture since no working or forming of the material is required, except on the elliptical tip section.

15 Still another object resides in the elimination of the customary internal bracing of tie rods, since the smooth sheet metal covering will take tension and other stresses in any direction.

These and other objects will appear as my invention is more fully hereinafter described in the following specification, illustrated in the accompanying drawing and finally pointed out in the appended claims.

Figure 1 is a perspective view of the underside of my improved type of wing.

Figure 2 is a perspective view of the upper side of the wing.

30 Figure 3 is a side view of one of the ribs.

Figure 4 is an enlarged view of the forward end of one of the ribs, showing its method of attachment to the wing spar.

Figure 5 is a side view of one of the wing spars.

Figure 6 is an enlarged sectional view taken on the line 6—6 of Figure 5.

Figure 7 is a sectional view on the line 7—7 of Figure 5.

40 Figure 8 is a sectional view on the line 8—8 of Figure 5.

Figure 9 is a diagrammatic view showing the method of attaching the upper and lower coverings to the ribs.

45 In the form of the invention illustrated an airplane wing of conventional profile is shown, and comprises a forward wing spar 1 and a rear wing spar 2. A plurality of ribs 3, shaped as shown in Figure 3 and formed with cut-out portions 4 are adapted to ac-

curately engage with the wing spars during assembly in any approved type of assembling jib.

All of the above mentioned parts are of metal and when assembled constitute an all metal wing skeleton which is adapted to receive the wing covering 5, which is also of metal.

The top covering of the wing can be of one continuous piece, while the lower covering is made up of a plurality of strips or panels extending from rib to rib. The edges of the panels are turned downwardly to form flanges 6, as shown in Figure 9, to abut each rib on both sides. A metallic cap strip 7 is then placed over the flanges and rib. The cap strip, flanges and rib are then apertured to receive rivets, screws or the like, as indicated at 8, throughout the length of the lower edge of the rib.

The top covering is secured to the ribs by means of cap strips which are formed of angle members 9 and 10 and riveted as at 11. At the two points where each rib is cut out to receive the wing spars, flanged channel members 13 are provided in connection with the wing covering to span the width of the cut-out portion of the wing spar. Rivets 14 are used to unite these channel members, through their flanges, to the wing covering, and thus riveted in place carry the shear and combined stresses around the spar.

The top covering unites with the bottom covering at the leading and trailing edges of the wing and their overlapping edges are held together by any suitable means, such for instance as fasteners, screws, rivets or the like, as indicated at 15.

Each wing spar is a composite plate girder and consists of a plate 16 provided at points spaced apart substantially equal throughout its length with vertical stiffening members 17 riveted to both sides of the plate as at 18. The upper and lower edges of the plate are provided with cap strips which consist of angle members arranged back to back and riveted to the plate. At various points along the spar, any approved type of hinge fittings, or the like as at 19, for supporting the ailerons etc., may be attached.

At equally spaced points along the wing spar where the ribs are to be attached, are T shaped members 20. Riveted at 22 to both sides of the ribs along the opposite vertical edges of the cut-out portions 4 are plates 21, which extend outwardly to embrace the flange portion of the T members (see Fig. 6) and are secured thereto by means of rivets 23.

In finally assembling the wing, that is, attaching the top and bottom covering to the wing skeleton, the top covering is first laid out and the skeleton is placed upon it. The cap strips along the upper edges of the ribs, which as stated above are formed of angles 9 and 10, are then riveted to the covering. With the wing still in this inverted position the lower covering is then applied by placing the strip transversely of the skeleton. The ends of the strips at the leading edge of the wing are then united with the top covering, as hereinabove mentioned by means of cowlings fasteners, screws, rivets or the like. Where the flanges 6 unite with the ribs and are covered by the channel members 7 forming the cap strips on the bottom of the ribs, the riveting is conveniently done from both sides thereof.

Upon completing the application of the top and bottom covering to the wing skeleton, the wing is then turned completely over and the short channel members 13 are then riveted in place across the upper edge of the spar.

While I have shown a particular form of embodiment of my invention, I am aware that many minor changes therein will readily suggest themselves to others skilled in the art without departing from the spirit and scope thereof. Having thus described the invention, what I claim as new and desire to protect by Letters Patent is:—

1. An airfoil including a frame work consisting of front and rear spars, ribs notched at their upper edges to receive said spars, and secured thereto an upper and lower covering for said framework, said upper covering being one continuous sheet and cap strips disposed above the upper covering, across the notches receiving the spars, and secured through the upper covering to the rib beneath, at each side of such notch.

2. An airfoil including an all metal frame work consisting of front and rear plate girder spars, metallic ribs secured to said spars, an upper and lower metallic covering for said framework, said upper covering being of one continuous metallic sheet, said lower covering consisting of a multiplicity of metallic sheets arranged side by side and having their edges flanged and riveted to said ribs, said upper edge of said spars being secured through cap strips to the said upper covering, said ribs having cut-out portions to embrace said spars, and plates secured to the ribs to connect with extensions on said spars.

3. An airfoil comprising a framework in-

cluding front and rear spars flanged at top and bottom, ribs notched at their upper edges to receive said spars, plates secured to the ribs and disposed between the spar flanges, T-shaped members on said spars secured to said plates to space the ribs, and thereby to retain the spars and ribs in interlocked relationship, cap plates extending over the spars to close the notches in the ribs and secured thereto, and means to prevent torsion in said ribs and spars.

4. An airfoil truss comprising a plurality of flanged spars extending longitudinally of the airfoil, ribs notched at one edge to be received by said spars, plates secured to said ribs intermediate of the flanges on said spars to hold the ribs in proper lateral disposition to said spars, means connecting said spars and ribs to prevent longitudinal displacement of said ribs along said spars, and means to prevent torsion in said truss.

5. An airfoil comprising a framework including a plurality of spars and ribs supported thereon, a sheet covering one side only of the airfoil and secured to the ribs and spars to stiffen the framework, the ribs having individual interlocking engagement with the spars from the side of the airfoil opposite that whereon the cover sheet is secured, and sectional sheets secured to this side of the ribs and spars, and completing the covering of the airfoil, whereby upon removal of less than the whole number of sectional sheets individual ribs may be removed and replaced.

6. An airfoil comprising a framework including a plurality of spars, ribs secured thereon and a single sheet covering the top of said ribs and spars to prevent torsion therein, said ribs extending from leading edge to trailing edge, and having interlocking engagement with the spars from below, whereby they may be applied to said spars without removing said upper wing covering.

7. An airfoil comprising a rib and spar assembly and a single covering sheet extending over one side of said assembly, the ribs being continuous from leading edge to trailing edge, and said ribs being notched at one edge to straddle a spar, means securing said ribs to said spar whereby the ribs may be inserted into said assembly without removing said covering sheet, and easily removable means to cover the other side of the assembly.

8. An airfoil truss comprising a plurality of spars extending longitudinally of the airfoil, ribs secured thereto having their upper edges flush with the upper edges of said spars, and their lower edges extending below the lower edges of said spars, cover plates adapted to be received between the extended lower edges of said ribs, and a cover for the upper surface of said airfoil.

9. The method of replacing damaged ribs in airfoils consisting of removing the covering from one side only of the airfoil over the

5 damaged ribs, disengaging the broken ribs from the rib and spar assembly and withdrawing them through the gap formed by the removed covering, inserting new ribs through the gap, connecting the new ribs to the assembly and replacing the portion of the wing covering which had been removed.

In testimony whereof I affix my signature.

EDWIN A. HUGHES.

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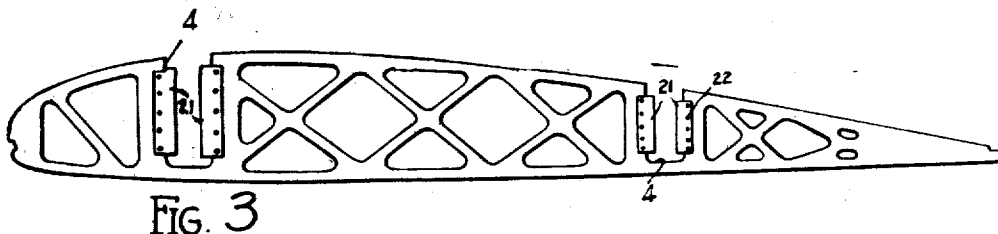
CERTIFICATE OF CORRECTION.

Patent No. 1,902,956.

March 28, 1933.

Edwin A. Hughes.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: In the drawing "Fig. 3" should appear as shown below instead of as shown in the patent:



And that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 30th day of May, A. D. 1933.

M. J. Moore.

(Seal)

Acting Commissioner of Patents.

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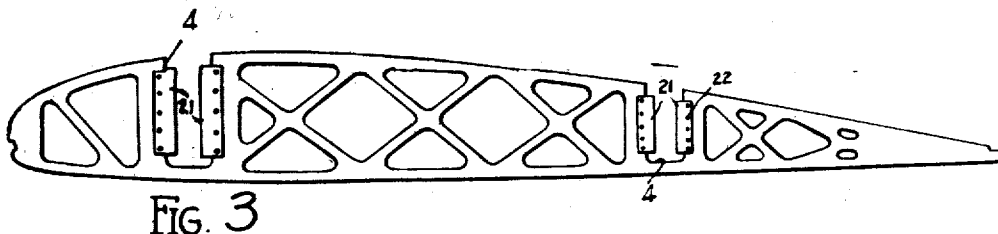
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