

Sept. 9, 1947.

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2,427,065

AIRFOIL STRUCTURE

Filed June 6, 1944

3 Sheets-Sheet 1

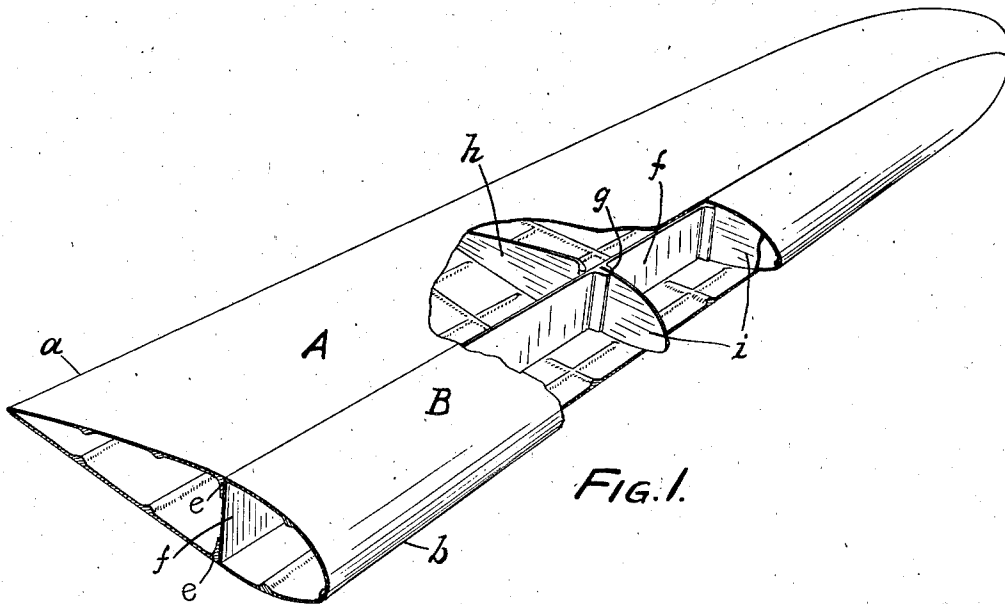


FIG. 1.

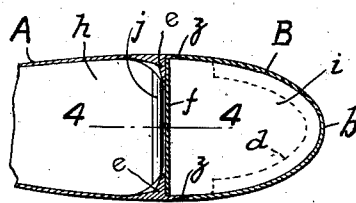


FIG. 3.

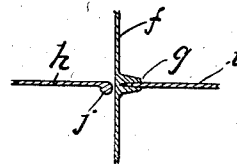


FIG. 4.

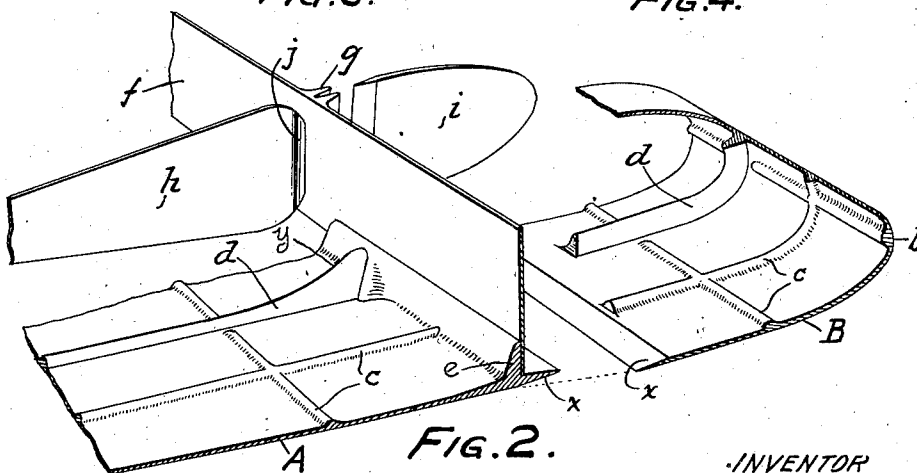


FIG. 2.

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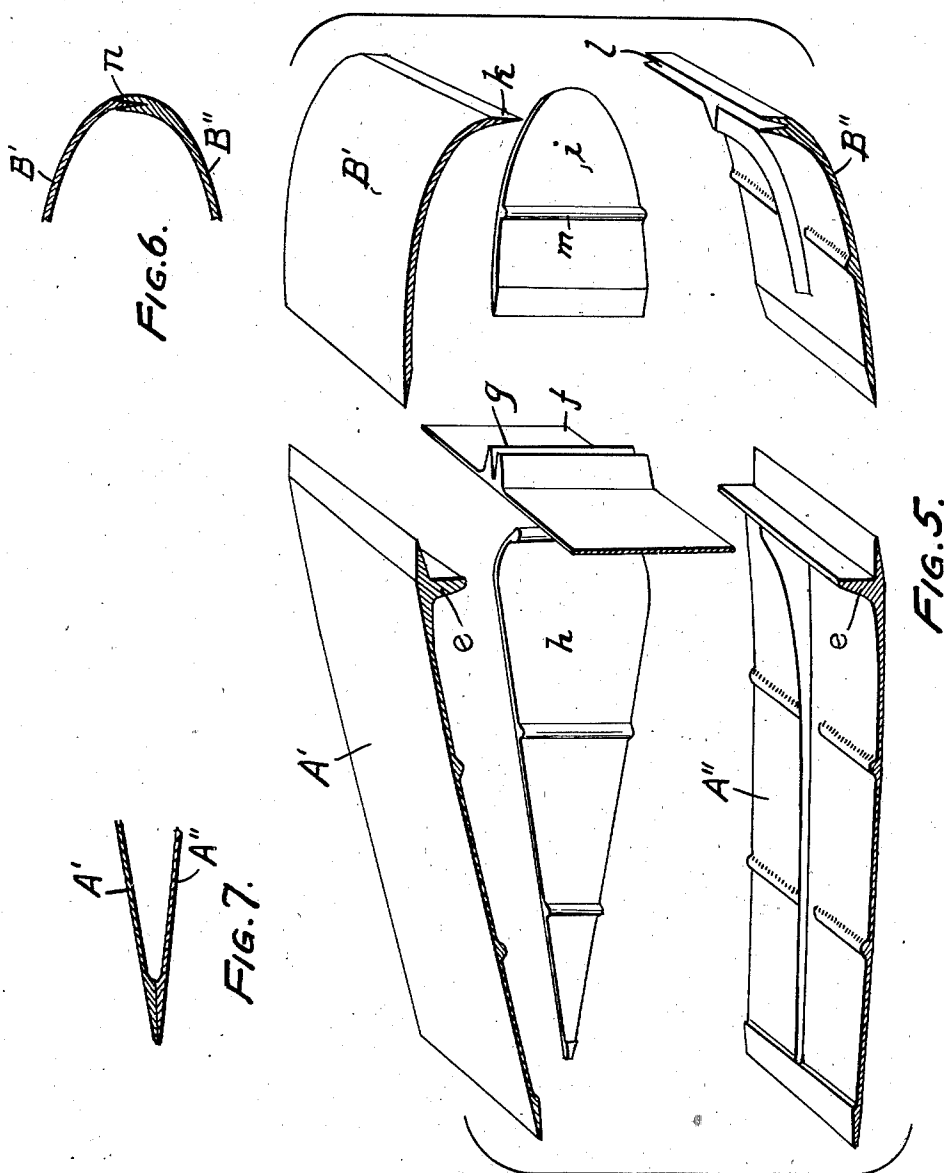
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AIRFOIL STRUCTURE

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3 Sheets-Sheet 2



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AIRFOIL STRUCTURE

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3 Sheets-Sheet 3

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2,427,065

AIRFOIL STRUCTURE

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Application June 6, 1944, Serial No. 533,945

4 Claims. (Cl. 244—123)

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This invention relates to an improvement in airfoil structure and more particularly relates to a novel structure for wings, control surfaces, and the like, for airplanes.

Heretofore airfoils, as wings, control surfaces, and the like, have been constructed by the assembly of a large number of detailed parts of intricate design requiring for their construction and assembly a large number of man hours. Further, as heretofore constructed, such structures have required expensive materials in order to minimize weight and the resultant structures have not presented smooth aerodynamic surfaces and, under high loading, their skins have tended to wrinkle.

Now it is the object of this invention to provide an airfoil structure which will comprise a greatly reduced number of parts, which will be quickly formed and assembled, which will present smooth aerodynamic surfaces and which will present a skin proof against wrinkling.

The structure in accordance with this invention will, in addition to the advantages of fewer parts and ease and speed of assembly, lend itself to production from inexpensive material, as, for example, any fibrous material, such as fibre glass, fabric, paper, or any other type of material, as wood, which, suitably impregnated, may be laminated.

Having now indicated, in a general way, the nature and purpose of this invention, I will proceed to a detailed description of preferred embodiments thereof, with reference to the accompanying drawings, in which:

Figure 1 is a perspective view of a wing, partly broken away.

Figure 2 is an exploded view, partly in section and partly broken away, showing the elements composing the wing shown in Figure 1.

Figure 3 is a partial sectional view of the wing shown in Figure 1.

Figure 4 is a sectional view showing a detail of construction.

Figure 5 is an exploded view, partly in section, showing a modification of the structure shown in Figure 1.

Figures 6 and 7 are sectional views showing details of construction of the structure shown in Figure 5.

Figure 8 is an exploded view, partly in section, showing a further modification of the structure shown in Figure 1.

Figures 9, 10 and 11 are sectional views showing details of construction of the structure shown in Figure 8.

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Referring more particularly to Figures 1-4, the wing shown in Figure 1 comprises essentially a main skin section A and a nose skin section B. The nose section provides a leading edge *b* for the wing and the main section provides a trailing edge *a*.

The skin sections A and B are formed separately, by molding a plurality of plies of any material, as indicated, which can be laminated to the shape of the respective sections.

In the molding of the skin sections, skin stiffeners *c*, *c* and rib caps *d*, *d* are formed on the inner side of the skin by molding, while a spar cap *e* is formed interiorly of the main skin section adjacent its forward-end. Each of said spar caps having a forwardly extending flange and an inwardly extending flange forming an angular recess in each cap for the reception of a spar web.

A spar web *f* comprising a flat panel is formed from any suitable laminated material and is provided with wedges *g* molded on its forward face; and rib webs *h*, *i*, for the main and nose skins, respectively, comprise flat panels formed from laminated material. The rib webs *h*, for the main skin section, have stiffeners *j* molded at their forward ends, while the rib webs *i*, for the nose skin section are tapered at their rear ends for entry into the wedges *g* on the spar web.

The forward edge portions of the main skin section and the rear edge portions of the nose skin are scarfed as at *x*, *x*.

For the assembly of the structure shown in Figure 1, comprising the parts shown in Figure 2, the rib webs *h* and spar web *f* are assembled into the main skin section A with glue, it being noted that shear connections are made between rib webs *h* and the spar web *f* in the main skin section by the provision of extra gluing surface at the end of the rib caps, as at *y*, Figure 2; and the rib webs *i* are assembled, with glue into the nose skin section B. Then the two sections are brought together, with entry of the tapered ends of the rib webs *i* into the wedges *g* on the spar web *f*, as shown in detail by Figure 4, and glued together through the joints *z*, *z* made by scarfed edge portions *x*, *x* above and below the spar web.

As will be observed, the rib webs *h* and the stiffeners *c* in the skin sections A and B are, when the sections are assembled, lined and related to the spar web *f* so that when the scarfed joints *z*, *z* are made, an integral structure, to all intents and purposes, is formed.

Having reference now to Figures 5-7, the structure shown is essentially the same as that de-

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scribed above with reference to Figures 1-4, and like parts are given like reference characters. However, the nose skin section comprises an upper skin section B' and a lower skin section B'', the upper section being tapered at its forward edge portion *b*, as at *k*, and the lower section being provided with a wedge *l* at its forward edge. The sections B' and B'' are provided with integrally molded stiffeners *c* and rib caps *d* and are assembled, with glue, to the rib webs *i*, each in this case provided with a stiffener *m*, and together through the joint *n* (Figure 6) formed by the entry of the tapered edge portion *k* of section B' into the wedge *l* of section B''.

And further, the main section comprises an upper skin section A' and a lower skin section A'', secured together by gluing the surfaces *o*, *o* formed on the inner faces of the skin sections at the trailing edge.

The skin sections forming the main and nose sections having been formed with the rib webs in place, the spar web being in place in the main section, the two sections are assembled together as described with reference to Figures 1-4.

With reference to Figures 8-11, the modified structure shown is similar to the structure shown in Figures 5-7 in that the main section comprises an upper skin section A' and a lower skin section A'' and the nose section comprises upper and lower skin sections B' and B''. However, in this modification the main and nose skin sections are provided with inner skins *p*, *p* spaced by the stiffeners *c* from the outer skins *q*, *q* and between the skins are sheets or sections *s* of low density filling material, such, for example, as balsa wood, cellulose acetate, or the like, which are bonded to the outer skins. The stiffeners *c* are formed to provide flat gluing surfaces *r* for the gluing thereto of the inner skins *p*, *p*.

As will be appreciated, the above detailed description of this invention in various modifications is for illustrative purposes only, it being contemplated that various modifications in detail may be made within the principle of the invention and without departing from the scope of the claims appended hereto.

What I claim and desire to protect by Letters Patent is:

1. An airfoil structure formed from laminated material and comprising a molded main skin section, a molded nose skin section, stiffeners molded in said skin sections, rib caps molded in said sections, spar caps molded in the main section adjacent the forward edge thereof, a spar web, wedges molded on a face of the spar web, rib webs secured to the rib caps in said sections and said sections being joined by scarfed joints adjacent said spar web with the rear ends of the rib webs in the nose skin section entered in the wedges on a face of the spar web.

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2. An airfoil structure formed from laminated material and comprising a molded main skin section, a molded nose skin section, the main section comprising upper and lower skin sections joined at the trailing edge of the section and the nose section comprising upper and lower skin sections joined at the leading edge of said sections, rib caps and stiffeners molded integrally with the upper and lower skin sections of said main and nose sections, spar caps molded integrally in said upper and lower skin sections of said main section, a spar web secured to the spar caps in said main section and said sections being secured together through the medium of scarfed joints joining the upper skin sections and the lower skin sections of said main and nose skin sections.

3. An airfoil structure according to claim 2, characterized by the fact that upper and lower skin sections of the main and nose skin sections include an outer skin and an inner skin spaced from the inner skin and a low density filling material in the space between the outer and inner skins.

4. An airfoil structure formed from laminated material and comprising a molded main skin section, a molded nose skin section, spar caps molded in the main section, each having a forwardly extending flange and an inwardly extending flange, a spar web having wedges molded on the forward face thereof, the spar web and wedges being seated within recesses formed by the forwardly and inwardly extending flanges of the spar caps, rib webs in the nose section having tapered ends seated between said wedges and scarfed joints between the forwardly extending flanges of the spar caps and the nose section joining said sections to the spar web.

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