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MAY 25, 1943.
BY A. P. C.

A. DE MUYSER

CONSTRUCTION OF AIRPLANES

Filed Aug. 24, 1939

Serial No. 291,636

4 Sheets-Sheet 1

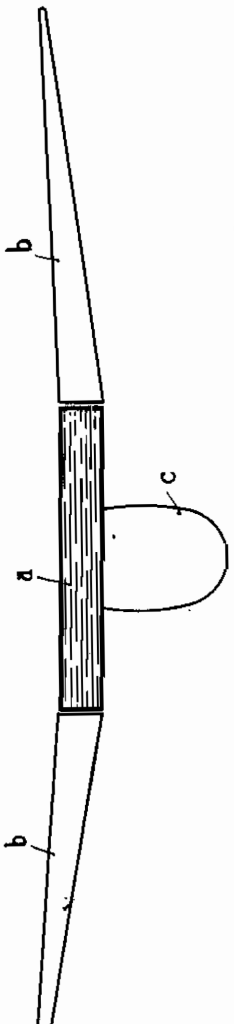

FIG.1.

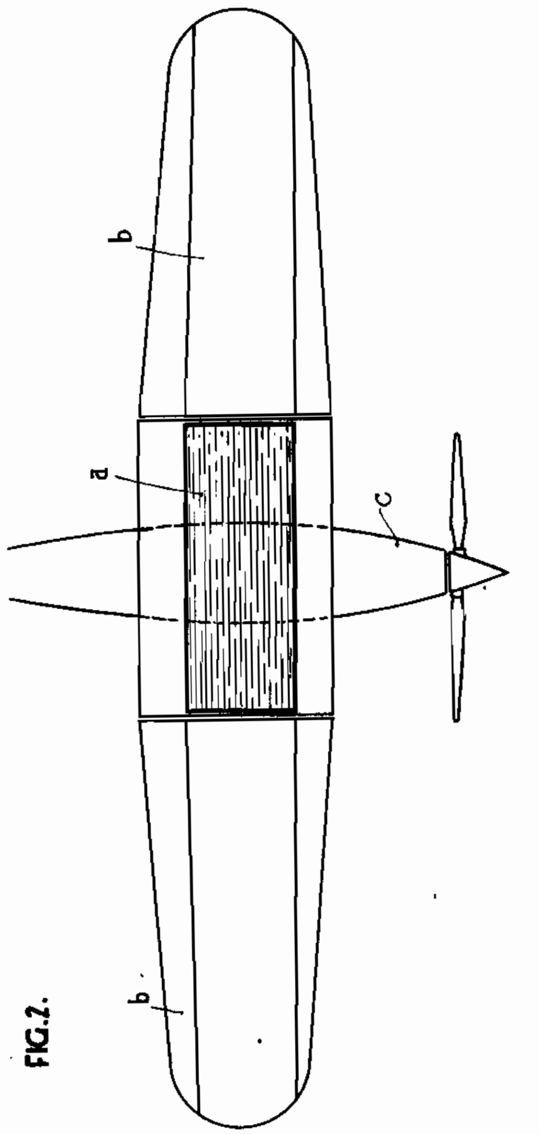

FIG.2.

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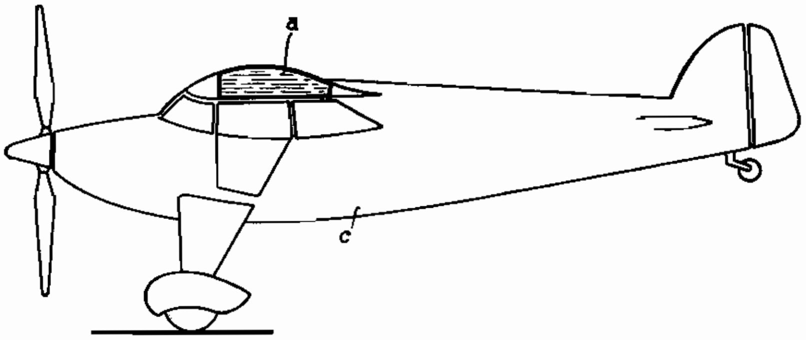
FIG. 3.



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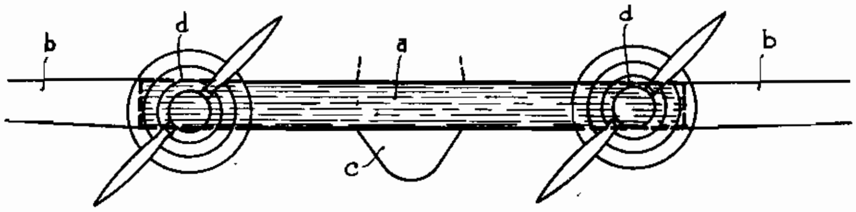

FIG. 5.

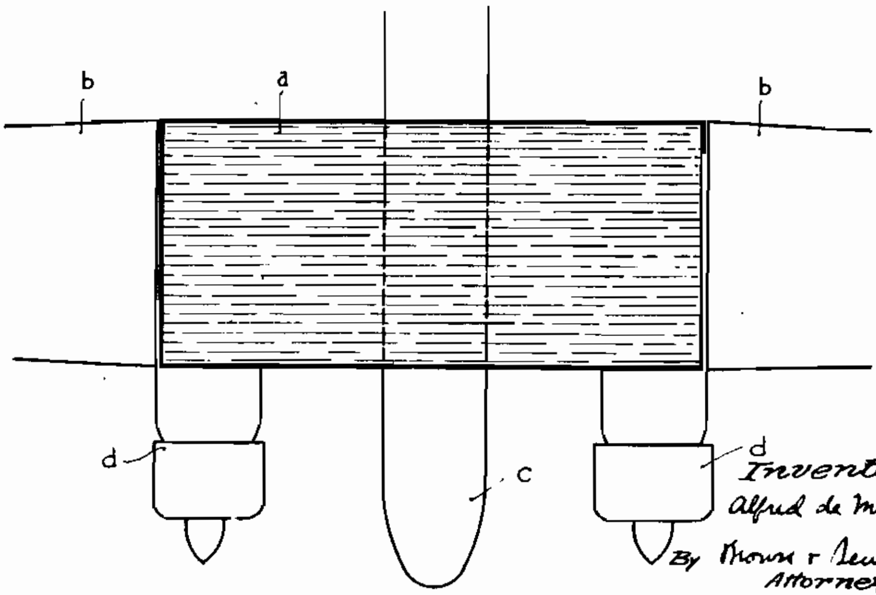

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FIG. 6.

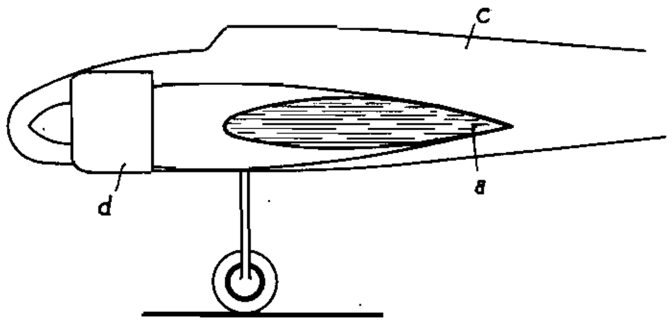


FIG. 7.

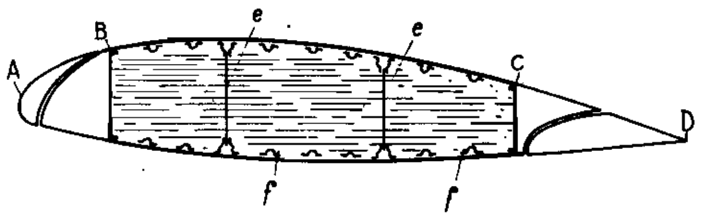


FIG. 8.

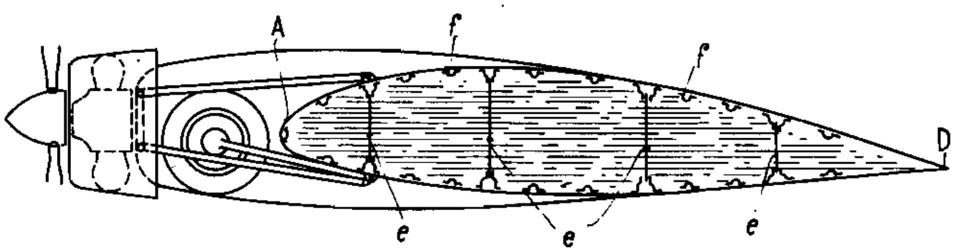
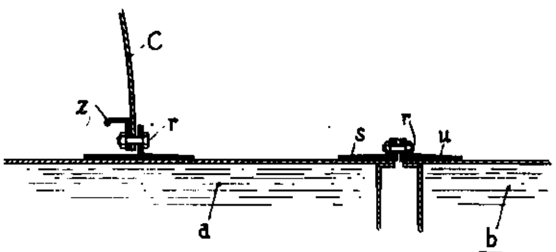


FIG. 11.



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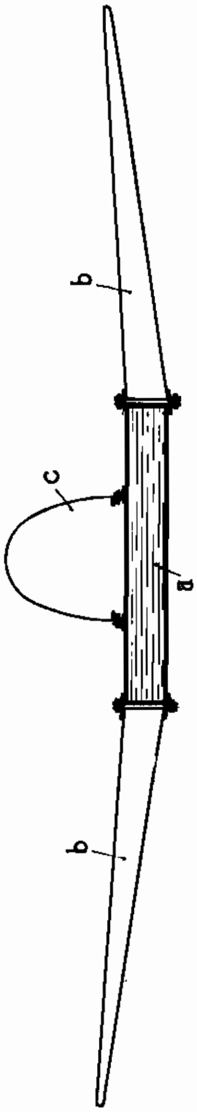

FIG. 9.

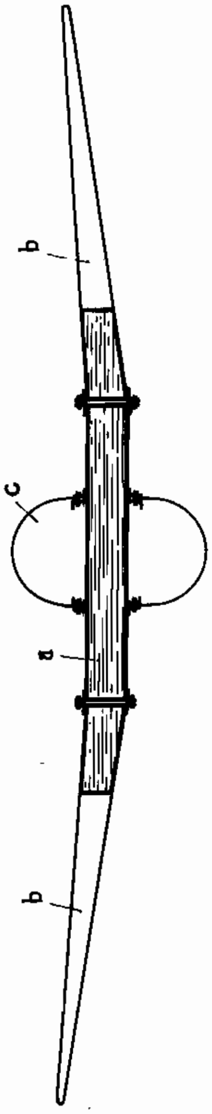

FIG. 10.

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ALIEN PROPERTY CUSTODIAN

CONSTRUCTION OF AIRPLANES

Alfred de Muyser, Luxemburg, Luxemburg; vested in the Alien Property Custodian

Application filed August 24, 1939

The present invention concerns the construction of airplanes.

Its object is to provide an improved method of building airplanes, and also an improved airplane.

The present state of airplane construction is characterized on the one hand by the reduction of the wing area and of the cross section of fuselages, that is to say by a reduction of the aerodynamic resistances, and, on the other hand, by an increase of the motive power which is intended to overcome these resistances.

It results from these tendencies that the amount of fuel necessary for a given flight increases while the volume available on the airplane for storing this fuel decreases. The solutions which were commonly employed, which were hardly sufficient previously, are not longer acceptable under the new conditions above set forth.

These old solutions consisted in placing one or several tanks intended to contain the fuel in the empty spaces left between the parts of a carcass constituting the frame of the airplane. These tanks were housed either in the fuselage or in the wings. There was always a loss of available space since the walls of the tank could not conform exactly to the shape of the carcass. This resulted from the fact that it was necessary to make provision for the removal of the tanks, and the manufacture of tanks does not permit of giving them the complicated shapes of walls which would have been necessary in order to have them fitting exactly in the empty spaces of the carcass.

An intermediate solution was also studied and experimented. It consists in making use of a main spar which also acts as tank, but this solution does not permit of occupying the whole available space in the skeleton because it is necessary to provide a secondary carcass fixed on the main spar and intended to support the external covering of the wing and to give it the desired shape. In this case also, consequently, there is a wing covering around the tank forming spar and a certain volume is lost.

Another intermediate solution, which can be considered as the inverse of that above explained, was also experimented. It consists in making a wing having a single spar which supports the bending stresses, the torsional stresses being supported by tanks secured to the spar. In this system also, the whole available volume of the wing is not utilized since the spar which supports the bending stresses must be positioned at the place where the wing section is of maximum height. Consequently, the tanks are necessarily of smaller height and their total volume hardly reaches one third or one half of the total volume of the external surface of the wing.

On the other hand, the reduction of the wing area, the cleaner outline of the supporting surfaces, and the reduction of section of the fuselage have led to employing, for the wings, the tail unit, the fuselage, etc., the so-called "stressed skin" method of construction, which affords the maximum strength for the minimum weight. Now, with the stressed skin construction, the problem of housing the tanks is still more complicated, and when it has been possible to house them it becomes extremely difficult to remove them, because, in order to get them out, it is necessary to provide holes in the skin or covering, which reduces the rigidity of the airplane structure and involves complications in the designing and the actual construction.

According to the present invention, the construction combines the two above mentioned tendencies, that is to say it avoids any lack of continuity of the stressed skin of the structure and, on the other hand, it gives, for housing the fuel, the whole of the volume inside the stressed skin.

In order to obtain this result, an airplane made according to the present invention includes the following elements.

a. A tank which constitutes the centre-section of the wing. This combined tank and center section is made in the same manner as a stressed skin wing section, with, of course, the further condition that this structure must be fluidtight;

b. outer wing sections mounted on said centre-section;

c. a fuselage carried by the tank and centre-section unit.

Therefore, according to the present invention the tank and centre-section unit constitutes the central and main part of the airplane. The fuselage, engine or engines, and wings are built around said part and thereon.

In addition to its own lift (since this unit is a portion of the wing system) said part receives the lift from the outer wing sections, and it transmits the whole of the lift to the parts that are to be supported (fuselage and engines). The tank and centre-section unit must therefore be capable of withstanding all the bending and twisting stresses which were previously supported by the spar or spars or by the wing covering.

The volume available for the fuel is maximum since it is equal to the external volume of the wing less the volume of the metallic elements which constitute the tank. It should be noted that if the skin or covering is to be stiffened by pieces of closed cross section, it suffices to make some small holes therein and the internal volume of these stiffening pieces is utilized for containing fuel.

If the airplane is of the twin-engine or multi-engine type, the tank and centre-section unit will further support the nacelles containing the engines.

It is advantageous to limit the fluidtight tank, in the direction of the wing chord, to the central portion of the wing, because the volume of the trailing edge region is very small and that of the leading edge region is useful for housing the rods or cables for actuating the control surfaces of other parts to be operated.

Furthermore, the space corresponding to the trailing edge portion must nearly always be capable of housing the lift increase devices which are nearly always provided on modern airplanes. Likewise, the front region will serve to house the auxiliary parts for forming slotted wings.

However, in some cases, it will be advantageous to utilize the whole of the wing chord for the tank.

The tank and centre-section unit may, of course, be located as well above as below the fuselage. Also, the tank may, according to the invention, extend across the fuselage.

Other features of the present invention will result from the following detailed description of some specific embodiments thereof.

Preferred embodiments of the present invention will be hereinafter described, with reference to the accompanying drawings, given merely by way of example, and in which:

Fig. 1 is a vertical sectional view of the body of an airplane made according to the invention, the fuselage being located below the level of the tank and centre-section unit;

Fig. 2 is a horizontal sectional view corresponding to Fig. 1;

Fig. 3 is a side elevational view corresponding to Fig. 1;

Figs. 4, 5 and 6 are views, corresponding respectively to Figs. 1, 2 and 3, showing a twin-engined airplane made according to the present invention;

Fig. 7 is a vertical section showing the structure of the tank and centre-section unit according to the invention;

Fig. 8 is a similar view showing a modification.

Fig. 9 is a diagrammatic front view, in section, of an embodiment of an airplane according to the invention in which the fuselage is mounted above the tank and centre-section unit;

Fig. 10 is a view, similar to Fig. 9, of another embodiment in which the tank extends across the fuselage;

Fig. 11 is a view on an enlarged scale showing details of assembly;

In all the views of the drawing, reference character *a* designates the wing centre-section which, according to the invention, constitutes the tank, and is the main part of the airplane. Reference characters *b*, *b* designate the outer wing sections, and *c* the fuselage.

In the embodiment illustrated by Figs. 1, 2, and 3, the fuselage *c* is located below the level of piece *a*. The airplane shown by these figures is provided with a single engine.

Figs. 4, 5 and 6 show a twin-engine airplane. In this embodiment, the tank and centre-section unit supports, in addition to the outer wing sections *b*, *b*, and to the fuselage *c*, the two nacelles *d* containing the engines.

Fig. 7 shows an embodiment of the structure of the tank and centre-section unit. In this example, the portion of the structure of the wing which constitutes the tank is practically limited to the central zone B—C. Zone C—D is reserved for housing the lift increase devices, and zone A—B serves to house the elements for constituting the slotted wing structure.

On the contrary, in the embodiment of Fig. 8, the whole space of the wing structure is used for storing fuel.

In Figs. 7 and 8, I have shown at *e* the bracing members and at *f* the reinforcing sectional bars, or stringers.

In a general manner, the walls of the tank unit are defined as follows:

The upper and under walls are constituted by the wing covering. In other words, the upper wall directly constitutes the upper side of the wing and the under wall constitutes the under side of the wing. The front and rear walls are constituted by transverse sections of the wing or bulkheads (see Figs. 7 and 8). Of course, the portion forming the tank will be made fluidtight so that it can hold fuel.

Fig. 9 shows an embodiment of the invention corresponding to a low wing airplane in which the fuselage is fixed above the tank and centre-section unit *a*.

Fig. 10 shows another embodiment, of an airplane in which the tank and centre-section unit *a* extends across the fuselage *c*. On the other hand, in this embodiment, a portion of the wing outer sections constitutes fluidtight tanks for the fuel.

In some cases, corresponding for instance to airplanes of small size or to airplanes in which it is desired, in order to simplify construction, to make the wing of a single piece, the centre-section will be made fluidtight and the usual construction will be continued on either side of the tank and centre-section unit.

In the case of airplanes which must have a very long radius of operation, the construction which consists in making a tank the upper and under walls of which coincide with the upper and under surfaces of the wing may be extended to the whole span of the wing, the latter being either made of a single piece, as just above mentioned or made of a plurality of sections, as illustrated by Fig. 10.

A detail of construction is shown by Fig. 11, which is an enlarged view of the assemblies of elements of Figs. 9 and 10.

As shown by this view, on the tank and centre-section unit *a* there is fixed, for instance by riveting or welding, a T-shaped sectional element *t*; fuselage *c* is reinforced by an L-shaped sectional element *z*, and the whole is assembled together by means of bolts *r*.

For the assembly of the centre-section *a* and of the outer section *b*, tank *a* is fitted along its edge with a L-shaped sectional element directly riveted or welded to the stressed skin thereof. The wing outer section *b* is similarly fitted with a L-shaped sectional element *u*. The two L-shaped sectional elements are secured together by means of bolts which ensure the assembly of *b* with *a*.

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