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LATERAL CONTROL SURFACES OF AIRPLANES

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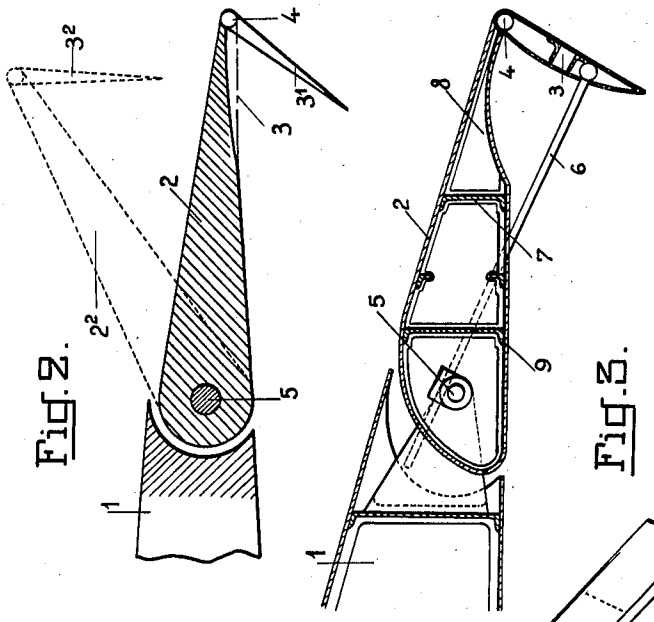


Fig. 2.

Fig. 3.

Fig. 1.

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LATERAL CONTROL SURFACES OF AIRPLANES

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3 Claims. (Cl. 244—42)

In my patent application filed in the United States on January 30, 1937, No. 123,263, I have described a double flap including an upper flap hinged to the wing and a lower flap hinged to the upper flap, each of said flaps being adapted to be operated independently of one another. In this device, the lower flap is hinged to the front part of the upper flap and when it opens, its trailing edge moves away from the trailing edge of the upper flap, thus forming an angle, the apex of which is on the underside of the upper flap and which is open to the rear.

This device affords numerous advantages. In addition to the increase in the maximum lift when the upper flap is in the neutral position, it permits and increases the manoeuvrability of the airplane when the upper flap is operated and drives the lower flap, especially at high incidences. It presents however some difficulties of construction, particularly regarding the possibility of conveniently ensuring suitable resistance and rigidity of the upper flap, while providing a suitable location to receive the lower flap in the closed position.

It is furthermore known to dispose on the trailing edge of the wing a flap which opens towards the front and which, like the ordinary split flap, increases the maximum lift. The same effect of increasing the lift is obtained moreover with a flap of lesser depth than that of the ordinary split flap.

I have found that advantages may be obtained relatively to the known arrangements of lateral control surfaces by combining an upper flap of the type of the aileron, similar to that employed in double flaps, with a lower flap opening towards the front and hinged by its own trailing edge to the trailing edge of the upper flap or in its proximity.

By utilizing the high-lift qualities of the flap opening towards the front I can, without reducing the lift, make the lower flap of a lesser depth than that of the lower flaps utilized in the previously known double flaps.

My invention affords the following advantages:

1. From the aerodynamic point of view.

When the lower flap is open and driven by the upper flap without variation of the angle formed between these two flaps, the deflection of the upper flap creates a rolling moment which is not only greater than that obtained with single ailerons, but is still further increased relatively to that obtained with the combined double flaps according to the aforesaid patent application of January 30, 1937.

2. From the constructional point of view.

Since the lower flap may be small, its location in the upper flap is less important and only occupies a slight depth in the rear of said latter flap. The front part of said latter flap, which is the thickest, may thus form a "cell" or closed box, rigid as regards torsion and adapted to receive reinforcements and ensures the best conditions of rigidity and resistance.

3. From the point of view of facility of operation.

When the device according to my invention is provided on an airplane wing at the same time as ordinary single split flaps, extending throughout all or part of the rest of the wing span, the lower flap of the double flap and the single split flaps being controlled by the same operation, the control effort may be very small. The opening of the lower flap of the double flap is assisted by the aerodynamic thrust, while the latter opposes the opening of the single split flaps. On closing, the thrust acts in the opposite direction and likewise exerts opposite effects on the two kinds of lower flaps. I thus obtain an at least partial aerodynamic compensation which reduces the effort to be exerted for controlling the flaps and may even diminish it sufficiently to render possible direct control by the pilot.

The accompanying drawing shows a constructional example of the lateral control surfaces of an airplane according to my invention.

Figure 1 is a view in perspective of an airplane wing and its lateral control surfaces, the latter being in part section.

Figure 2 is a simplified sectional view of the combined flap.

Figure 3 is a constructional example of said flap.

Hinged at 5 to the wing 1 is an upper flap 2. Hinged at 4 to the trailing edge of the flap 2 is a flap 3. Said flap 3 has its trailing edge coinciding with trailing edge of flap 2 and with the hinge 4.

The operations of the flaps 2 and 3 are entirely independent and are ensured by any appropriate means. More particularly, the flap 3 may be controlled by means of the device (such as 6 in Figure 3) described in the United States patent application filed by Mr. Girard on January 30, 1937, No. 123,288.

When the flap 2 assumes any position, such as 2^2, the flap 3 assumes a position 3^2 making with the said flap 2 the same angle as that between 2 and 3^1 in the normal position of flap 2.

With my device, when the flap 3 turns rela-

tively to flap 2, it forms an angle having its apex at 4 on the common trailing edge of flaps 2 and 3 and open towards the front of the wing 1.

The arrangement in Figure 3 shows the construction of the combined flap according to my invention. In the flap 2 is provided a location 8 for receiving the flap 3 in its closed position. Due to the relatively short length of flap 3, said location only occupies a slight depth at the rear of the upper flap 2. This enables the front, thickest part of the flap 2 to be utilized for forming a cell or closed box, which is consequently rigid as regards torsion, limited rearwardly by a bottom end 7, and for providing a reinforcement 9 of considerable height which is rigid as regards bending.

The tapered part may likewise be effectively reinforced by means of appropriate ribs.

This result, arising from the relative disposition of the flaps 2 and 3 could not have been obtained with the double flaps of the type known heretofore. The construction of a rigid and resistant flap necessitated complicated and expensive devices which have been rendered unnecessary by the disposition according to my invention which facilitates the construction while simultaneously affording appreciable improvements in the aerodynamic effect.

At the same time as the double flap 2—3 according to my invention, it is possible to dispose on all or part of the rest of the wing span single split flaps 10 hinged to the wing at 11. The flap 3 and flap 10 are advantageously controlled by the same mechanism, for example that described in the aforesaid United States patent application No. 123,288 in the name of Mr. Girard. Operation in common ensures the opening of the flap 3 towards the front and of the flap 10 towards the rear. The aerodynamic thrusts act in opposite directions on the flaps 3 and 10 tending to open the flap 3 and close the flap 10, or conversely during closing. I thus obtain an aerodynamic compensation reducing the effort to be exerted for operation and rendering it possible by direct action of the pilot.

I claim:

1. On an airplane wing, in the central part of the wing, single split flaps and at the ends superposed double flaps each including an upper flap hinged to the wing and a lower flap hinged by its own trailing edge in the proximity of the trailing edge of the upper flap, the single split flaps and the lower flaps of the double flaps being controlled simultaneously by the same operation.

2. In an airplane having a wing, an upper lateral control flap hinged at its leading edge to the trailing edge of the wing, a lower flap hinged at its trailing edge to the trailing edge of the upper flap, and means for positioning said lower flap relative to the upper flap so that a forwardly open angle is formed between said flaps.

3. In an airplane having a wing, single split flaps hinged to the central portion of the trailing edge of the wing, upper lateral control flaps hinged at its leading edge to the trailing edge of the wing adjacent the ends of said wing, and a lower flap, for each lateral control flap, hinged at its trailing edge to the trailing edge of the lateral control flap with which it is associated, said single split flaps and the lateral control flaps being adapted to be simultaneously controlled, whereby the force tending to close the single split flaps will compensate the force tending to open the lower flap of the lateral control flaps.

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