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J. J. F. PERRIN
CONTROL SYSTEM FOR THE STEERING OF AN AERODYNE
AND CHIEFLY OF A GLIDER

3,120,935

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2 Sheets-Sheet 1

FIG. 1

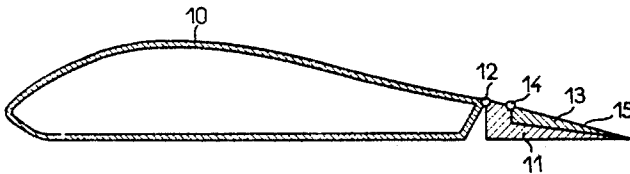


FIG. 2

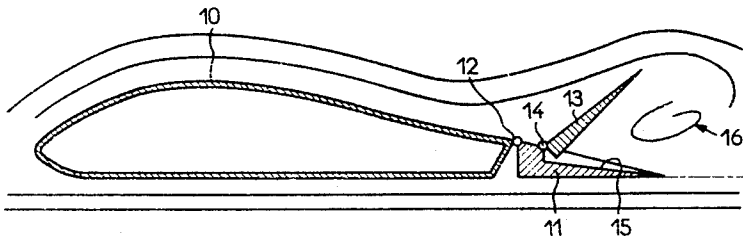


FIG. 3

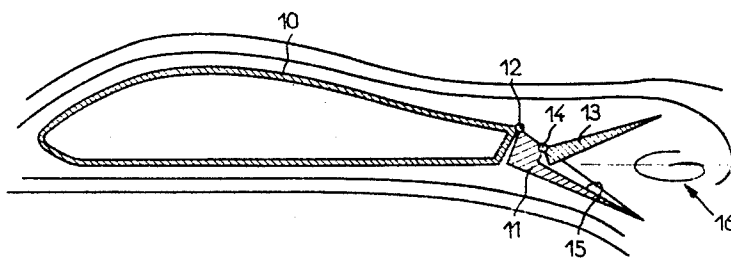
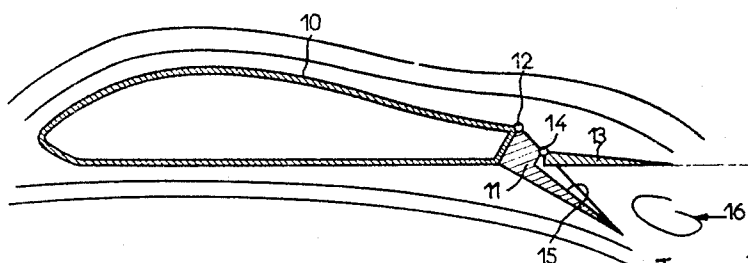


FIG. 4



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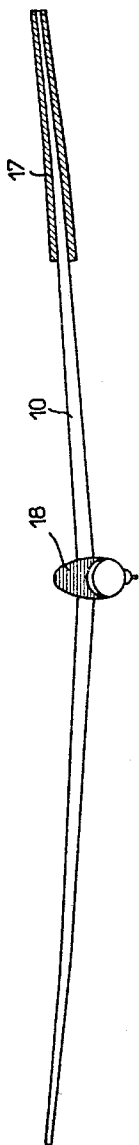


FIG. 5

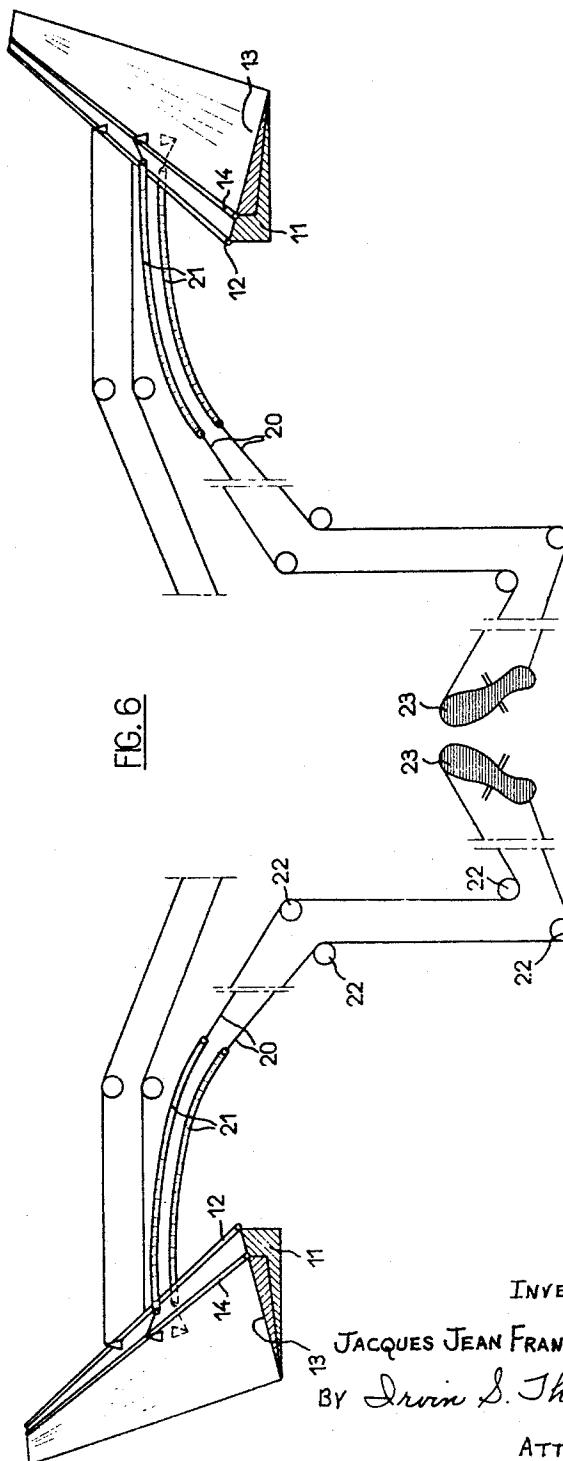


FIG. 6

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CONTROL SYSTEM FOR THE STEERING OF AN AERODYNE AND CHIEFLY OF A GLIDER

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1 Claim. (Cl. 244—90)

My invention has for its object a control system for the steering of an aerodyne. It is a well-known fact that aerodynes are generally provided with a rear vertical rudder which allows controlling their direction in flight. Now, such a vertical rudder forms a surface which is detrimental to the proper penetration of the aerodyne in air, chiefly in the case of a glider. For this reason, it has already been proposed to cut it out and to replace it by a so-called butterfly tail surface, but this only shifts the problem, since it leads to an increase of the non-lifting sections of the tail surface at the expense of the capacity of penetration. Arrangements have been proposed which are similar to birds' wings as substitutes for the vertical rudder, since birds steer their flight through a folding of one of their wings or through the expansion of their bastard wings, which produces an increase in the drag. However, the modifications thus brought to the wing structure of an aerodyne leads to the formation of dangerous eddies, to the mechanical twisting of vital parts of the aerodyne and also to intense vibration which risk leading to the destruction of the aerodyne.

My invention has for its object a control system for the steering of an aerodyne, which system leads to a substantial reduction in the size of the steering rudder, or even to its cutting out, without showing any of the drawbacks of the above-referred to prior arrangements.

According to my invention, the conventional warping aileron associated with a wing of the aerodyne and adapted to pivot around an axis adjacent the trailing edge of said wing, carries on its outer surface a secondary aileron which is hinged to the aileron round an axis parallel with the pivotal axis of said warping aileron, while control means are provided for operating each secondary aileron.

Through this arrangement, it is possible to obtain, through an opening of one of the secondary ailerons, that is by making it pivot with reference to the warping aileron, the production of an eddying area in the vicinity of the trailing edge of the wing with which it is associated, that is an increase in the drag of said wing and a corresponding pivotal movement of the aerodyne round its yawing axis.

It will be readily understood that when the secondary aileron opens by a predetermined angle with reference to the warping aileron, the eddying area produced is shifted, adjacent the trailing edge of the wing, together with the warping aileron; thus, this eddying area reduces the lift, if it is located in the vicinity of the outer surface of the wing. It is neutral if it is located within the wake of the wing and it increases the lift if it is located in the vicinity of the lower surface of the wing. Consequently, nothing prevents correcting the lateral stability of the aircraft by acting in a conventional manner on the warping ailerons.

In all cases, the point of application of the parasitic drag produced is such that the lift center is shifted rearwardly, which increases the aerodynamic stability of the wing section and, in the case of a reduction in the drag, the wing has a tendency to become self-stabilizing.

The chief features and advantages of my invention will appear readily from the reading of the following description, given by way of example, of a preferred embodiment

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of the said invention, illustrated in the accompanying drawing, wherein:

FIG. 1 is a cross-section of a wing, of which the warping aileron carries a secondary aileron or yawing aileron according to my invention, said yawing aileron being shown in its closed position.

FIGS. 2, 3 and 4 are similar views, wherein the yawing aileron is shown in its open position, while the warping aileron is shown respectively in three different positions with reference to the wing carrying it.

FIG. 5 is a front view of a glider adapted to be equipped with my improved arrangement.

FIG. 6 is a diagrammatic view of the means for controlling two yawing ailerons of an aircraft.

In FIGS. 1 to 4, the wing 10 of an airplane or of a glider carries at its rear end a warping aileron 11 pivotally secured to said wing round the axis 12. The aileron 11 carries in its turn on its upper surface a secondary aileron 13 pivotally secured round a spindle 14 rigid with the aileron 11 and parallel with the axis 12 of said aileron 11. A recess 15, inside which the aileron 13 may be collapsed, is formed inside the outer surface of the aileron 11.

It is apparent, from inspection of FIG. 1, that when the yawing aileron 13 is closed, that is when it is collapsed inside the recess 15, the system of ailerons 11 and 13 appears as a conventional aileron. The system of aileron 11 produces then its usual effects.

When the yawing aileron 13 has been opened by a predetermined angle with reference to the aileron 11, there is formed an eddying area 16 to the rear of the wing 10. The drag of the wing 10 increases. In other words, said wing is considerably braked, while the other wing of the airplane has a tendency to continue along its prior path, so that the airplane executes consequently an angular movement round its yawing axis.

Of course, the operation of one of the yawing ailerons 13 with a view to making the airplane turn round said axis, is all the more efficient when said yawing aileron is located further away from the fuselage. For this reason, the yawing ailerons are preferably located approximately in the third fraction 17 of the span of the wing furthest from the fuselage 18 (FIG. 5). For this reason too my invention is of particular interest in the case of aerodynes having a comparatively large span, such as gliders.

It will be observed that the eddying area 16 reduces the lift when it lies in the vicinity of the outer surface (FIG. 2), neutral if it is located in the wake of the wing (FIG. 3) and increases the lift if it is located in the vicinity of the lower surface (FIG. 4). Consequently, it is possible, by operating in a conventional manner the warping ailerons 11, to correct the lateral stability of the airplane round the axis of the rolling moment. Furthermore, nothing acts detrimentally to any substantial extent on any part of the airplane.

The point of application of the supplementary drag produced is such that the center of the lift is shifted rearwardly in all cases, which increases the aerodynamic stability of the wing section and, in the case of a lift-reducing drag, has a tendency to render the wings self-stabilizing.

To these advantages, there should be added the fact that the steering operation of the control system according to my invention, constrains any beginner pilot to make the aerodyne bank as required simultaneously with any change of direction.

It should be remarked also that the arrangement according to my invention allows obtaining, in addition to the changes in direction, a substantial aerodynamic braking through the simultaneous opening of the yawing

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aileron 13 of the right-hand and left-hand wings. Such an operation does not produce any eddy which might be detrimental to the tail surfaces, since the latter lies outside the action of the aerodynamic shielding produced by the yawing ailerons. It is further to be remarked that my invention may be readily applied to extant aerodynes without it being necessary to bring substantial modifications to such aerodynes.

My invention includes, as shown in FIG. 6, the control of each of the yawing ailerons 13 by a system of cables 20 inserted in loosely fitted sheaths 21, stops being provided on the sheaths which are rigid with the warping ailerons 11. Said arrangement has for its object to allow a shifting of the ailerons 11 without any modification in the angular setting of the yawing ailerons 13 with reference to the ailerons 11 carrying them.

Each pair of cables 20 associated with a yawing aileron 13 passes over transmission pulleys 22 and reaches one of the pedals 23 of the swing bar, which allows operating as desired separately or simultaneously the two yawing ailerons 13 associated each with one of the two wings 10. The independent action of the pilot's right-hand foot, for instance, leads to the opening of the right-hand yawing aileron and makes the aerodyne pivot towards the right-hand side, while constraining it to assume a bank which may furthermore be corrected by an action of the stick after the manner of conventional piloting.

This control system of the yawing ailerons 13 does not require therefore any special education of the reflexes of a pilot accustomed with the piloting of conventional aerodynes.

My invention is not limited to the embodiment selected and illustrated which has been given solely by way of

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example and which may, within the scope of the accompanying claim, form the object of various modifications. In particular, the depth of the yawing ailerons 13 may be more or less considerable with reference to the warping ailerons 11. It is also possible to replace the cables 20 and the sheaths 21 by suitable gears. The cables or links connecting the yawing ailerons may be also operatively connected with a handwheel or with a lever. Furthermore, the yawing ailerons may be indifferently hinged as illustrated, or else, secured through any other suitable pivotal means. They may, further, be provided with slots or otherwise.

What I claim is:

In an aerodyne, chiefly a glider, including two wings and a warping aileron pivotally connected to the outer third of each wing around a pivotal axis adjacent the trailing edge thereof, a steering control system comprising a yawing aileron carried on the upper surface of each warping aileron, said yawing aileron being pivotally connected to said warping aileron around a pivotal axis parallel to the pivotal axis of said warping aileron, and control means for pivoting each yawing aileron around its pivotal axis independently of the setting of the other yawing aileron and independently of the settings of each of said warping ailerons.

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