April 25, 1939. R. M. HILL ET AL 2,155,546

VARIABLE AIRFOIL STRUCTURE

Filed May 3, 1937

FIG. 1

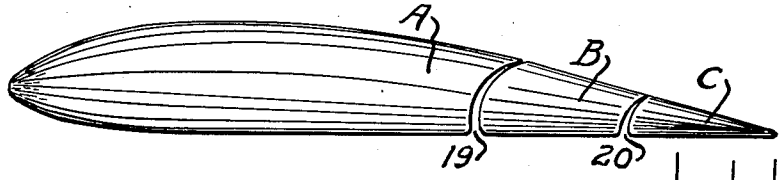


FIG. 2

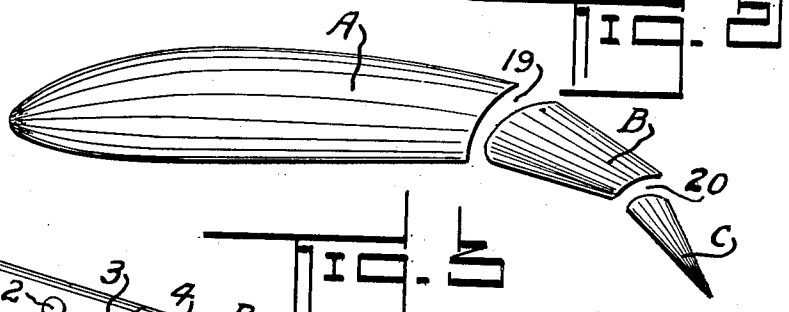


FIG. 3

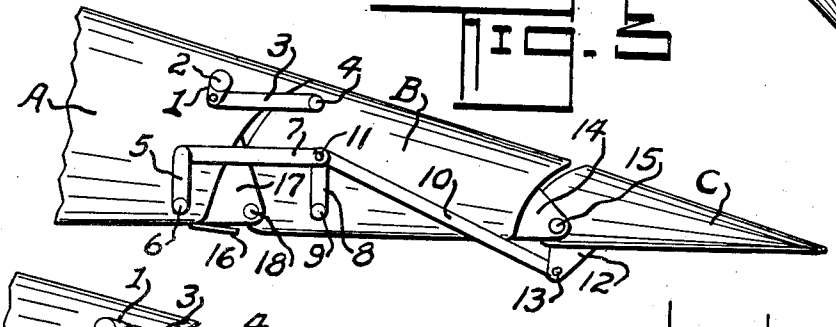
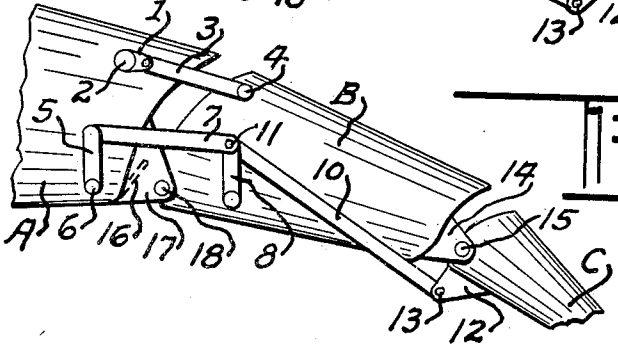


FIG. 4



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VARIABLE AIRFOIL STRUCTURE

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1 Claim. (Cl. 244—44)

The present invention relates to improvements in the art of aeronautics and has reference directly to a variable camber airfoil structure composed of three segments disposed serially hinge connected and incorporating a system of control linkage whereby the last two segments are controlled in combination for change of camber and independently controlled for trimming and balancing purposes.

With the foregoing in mind, it will become readily apparent that the invention possesses further advantages, all of which will be clearly revealed during the course of the following detailed description, illustrated throughout the accompanying drawing, and more fully pointed out in the appended claim.

With reference to the drawing:

In Figures 1 and 2 the mechanism is omitted.

Figure 1 shows diagrammatic sectional view of the airfoil as it would appear in a normal flight; and Figure 2 is a view similar to Fig. 1 showing the segments of the airfoil deflected.

In Figures 3 and 4 diagrammatic sectional view of the mechanism is shown.

Figure 3 shows a mechanism in the act of holding the segments of the airfoil with minimum camber; and in Figure 4 the mechanism is shown as effecting increased camber.

The invention consists of a complete airfoil with movable segments or members B and C which are externally controlled, also fixed segment A as indicated. Lever 1 is secured to control shaft 2 upon segment A, and one end of said lever is pivoted to link 3, the opposite end of link 3 being pivoted to segment B as at 4.

Segment C control lever 5 upon shaft 6 pivotally connects with link 7, and said link is in turn secured to lever 8 upon hinge 9, and in this manner lever 8 is restrained by the action of segment C control lever 5.

Link 10 is pivotally secured to lever 8 as at 11, and the opposite end of said link is likewise connected to arm 12 as at 13, said arm being an integral part of segment C as indicated, said segment being hinged to arm 14 as at 15, and this arm being an integral part of movable segment B.

Flap 16 is provided where indicated and is coordinated with the mechanism so that it will automatically close as in Figure 3, and likewise open as in Figure 4.

Movable segment B is hinged to arm 17 as at 18, and said arm is fixed with segment A where shown.

It is now understood that the mechanism will camber the profile of the airfoil.

Referring to Figure 3, it will be seen that if control shaft 2 be held stationary with respect to segment A as indicated, and control shaft 6 be rotated slightly in a clockwise direction, segment B will remain stationary and segment C will be deflected in a counter-clockwise direction with respect to B; conversely if control shaft 6 be rotated in a counter-clockwise direction segment C will be deflected in a clockwise direction with respect to segment B through the action of linkage system, 5, 7, 11, 8, 9, 10 13 and 12. Thus we have control of segment C with respect to B.

Referring to Figure 3 again it will be seen that if control shaft 6 be held stationary with respect to segment A, and control shaft 2 be slightly rotated counterclockwise, segment B will be deflected in a clockwise direction with respect to segment A about the hinge point 18, and segment C will be deflected in a clockwise direction with respect to segment B through the action of the linkage 5, 7, 11, 8, 10, 13 and 12 as indicated in Figure 4. Also, if control shaft 2 be held stationary with respect to segment A as indicated in the position shown in Figure 4, and control shaft 6 be rotated in either direction that we can still deflect segment C to any desired rotational deflection with respect to segment B. It will now be seen that segment C may be freely deflected with respect to segment B with segment B in any position. Thus segment C may be rotated to a neutral air reaction position relative to segment B thereby using segment B as a semi-permanent aerodynamic trimming agency or segment C may be deflected either side of the air reaction neutral position, in one case decreasing the lifting action of the airfoil as a whole and in the other case increasing the lifting action of the airfoil.

As segments B and C are deflected as above stated it will be noted, in Figures 3 and 4, that the openings between the three segments vary with the change of angular deflection thus varying the air leakage between them.

Positive mechanical linkages are employed combined with fixed hinge locations to eliminate airfoil flutter that has resulted from the use of sliding or rotating segment connections and the use of yielding means in the control system.

The combination of the aforesaid methods of multisection attachment and control results in a new structure stability, simplicity of control and flexibility of action that has not been ob-

tainable in previous developments of the variable camber airfoil.

Having thus fully described our invention, what we claim as new is:

An airfoil comprising a fixed primary section, an intermediate trailing section pivotally connected to the primary section and forming an air passage between the sections when said intermediate section is depressed, an outer trailing section pivotally connected to the intermediate section and forming an air passage between the intermediate and outer sections when the outer section is depressed, a mechanical operating linkage extending from the primary section to the intermediate section and adapted to swing the latter about its pivotal axis, a mechanical operating linkage extending from the primary section to the outer section and adapted to swing the latter about its pivotal axis, means connecting said last mentioned operating linkage to said intermediate section at a point spaced from the pivotal axis thereof, said connecting means affecting the operation of said last mentioned operating linkage in such manner that it causes the outer section to swing about its pivotal axis at the same time as the intermediate section is swung about its pivotal axis, the connection of the last mentioned operating linkage to the outer section being such that when the intermediate section is swung about its pivotal axis the outer section is swung proportionately thereto and in the same direction.

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