E. V. CROWELL AND W. HAWKINS.

AEROPLANE WING CONSTRUCTION.

APPLICATION FILED FEB. 10, 1921.

1,412,455. Patented Apr. 11, 1922.

Fig. 1.

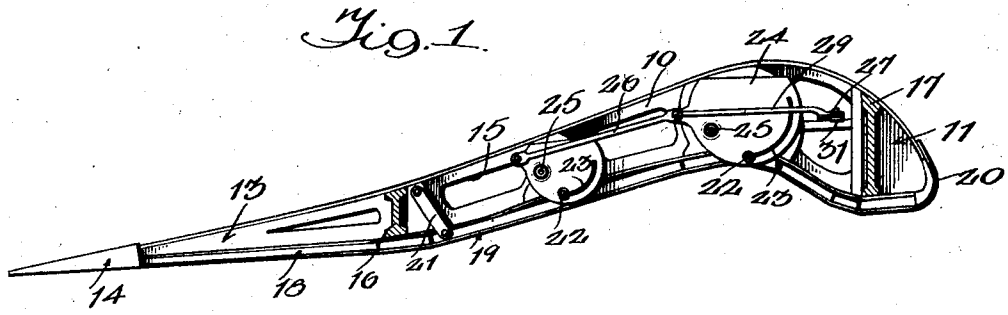


Fig. 2.

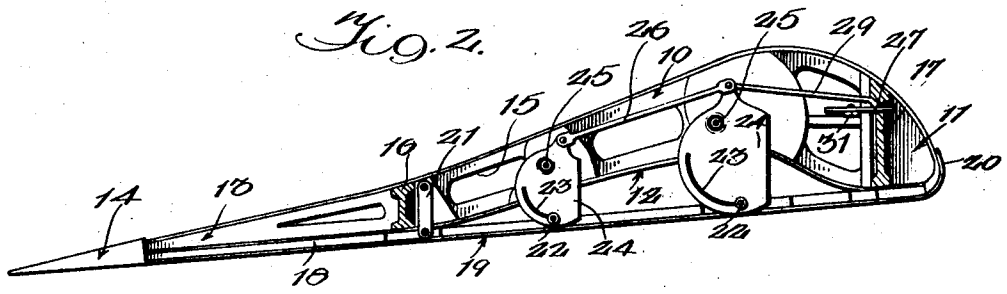


Fig. 3.

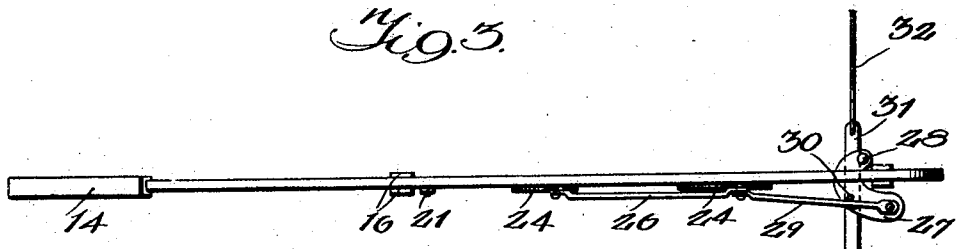
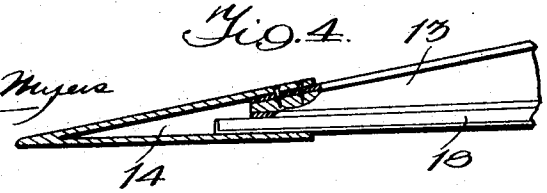


Fig. 4.



WITNESSES

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AEROPLANE-WING CONSTRUCTION.

1,412,455. Specification of Letters Patent. Patented Apr. 11, 1922.

Application filed February 10, 1921. Serial No. 443,875.

To all whom it may concern:

Be it known that we, ERD V. CROWELL and WHITEMAN HAWKINS, citizens of the United States, and residents of Tulsa, in the county of Tusla and State of Oklahoma, have invented certain new and useful Improvements in Aeroplane-Wing Construction, of which the following is a specification.

Our present invention relates generally to the wing construction of aeroplanes, and more particularly to means providing for a change in the wing curve of aeroplanes at the will, and under the control, of the operator. The term wing curve is well known in practical aerodynamics, having reference to the cross section of an aeroplane wing, particularly form or contour of the lower surface of a wing.

It is a well known fact that among the qualities necessary in a commercial aeroplane, the two most important or outstanding are first its ability to take the air from, and land within, a confined space, coupled with horizontal stability at low speeds, with a useful load, and second extreme speed with minimum power consumption. These two qualities however have been found to require materially different wing curves and it is the common practice of wing construction at the present time to produce a wing having a curvature resembling to the greatest possible extent those curvatures necessary for the two qualities above outlined. This practice results in a wing without extreme lifting power and without extreme speed, and our primary object in the present instance is to provide in one construction for both extreme lift and extreme speed.

In a wing construction providing for extreme lift and maximum stability at low speeds with useful loads, carrying with it the ability to take the air from, or land within, a confined space, it is necessary that the wing be deeply concaved adjacent to its forward edge upon its lower surface and this form of wing curve sets up considerable resistance to speed, commonly referred to as "drag." On the other hand a wing designed for speed requires a substantially flat lower surface and it is our purpose to permit of answering these requirements by a wing having a deeply concaved lower surface which may be straightened out into a substantially flat line for the purpose of eliminating the drag and thus permitting of maximum speed with minimum power.

It becomes quite obvious that with other things equal the concaved wing curve requires increase of horse power and area of wing surface in order to accomplish speed and it is also quite obvious that the common practice of piling on horse power and wing area is a decided drawback in a commercial machine, both on the account of increased first cost and of subsequent maintenance.

In proposing our present construction therefore we seek to avoid the disadvantages of the ordinary practice and produce the desired results in a simple economical and efficient manner.

For the purposes of our invention we propose a wing web or rib, of which each wing may include any number, provided with means controlled by the operator whereby the lower edge may be flexed from a substantially straight line into a concavely curved line and vice versa.

In the accompanying drawing which illustrates our invention and forms a part of this specification,

Figure 1 is a side elevation of our improved wing web or rib showing the same in position for maximum lift and minimum speed,

Figure 2 is a similar view showing the position of minimum lift and maximum speed,

Figure 3 is a top plan view showing a portion of the connections between ribs or webs, and

Figure 4 is an enlarged section through the slide housing at the rear end of the rib or web.

Referring now to these figures our invention proposes a wing rib or web whose body 10 is rigid and has a decided arch adjacent to its forward end 11 producing a deep concave 12 upon its undersurface, the entire body tapering from its front end 11 to its rear end 13, the latter of which is provided with a rigid housing 14 also of tapering form.

The rib or web 10 which may have a lengthwise series of longitudinally slotted openings 15, provides as usual for the reception of wing beams 16 and 17 which determine the length of the wing and extend transversely through a number of ribs or webs 10 in the finished wing structure depending in number upon the desired length.

According to our invention the rib or web is provided along its lower edge with a

series of jointed strips 18 whose beveled ends are in abutting relation, and the rear end of the rearmost strip of which is slidably disposed within the rear tapering housing 14. These several strips are each securely fastened to a flexible strap 19, the forward end 20 of which is turned upwardly around, and secured to the forward end 11 of the rigid body of the web or rib. This strap is preferably formed of a suitable light flexible metal which, in view of the joints between the several strips 18 attached thereto, is movable into the concave 12 of the body 10, against and parallel with the lower edge of the body, as seen in Figure 1, and is also shiftable into a straight line from the front to the rear of the body 10 across the concave 12 as shown in Figure 2.

For this purpose swinging side links 21 are pivotally attached at their upper ends to opposite sides of the web or rib 10 at the rear of its concave 12 and are pivotally attached at their lower ends to certain of the strips 18, and at spaced points of that portion of the flexible member formed by the strips 18 and their connecting strap 19 opposite the concave 12 of the rigid body of the rib or web, the strips 18 having laterally extending pins 22 projecting through the arcuate slots 23 of cam plates 24, these plates being pivotally mounted at 25 to the rigid body 10 and connected by a link or connecting rod 26 so as to constrain the same to simultaneous movement. Shifting of these cam members 24 in one direction serves to draw the pins 22 upwardly in view of the eccentricity of the slots 23 in respect to the pivots 25, as shown in Figure 1.

The connections for actuating the cam plates 24 may include any suitable means as for instance a lever 27 pivotally mounted at 28 on a portion of each web or rib and having a connecting rod 29 extending from one end to the foremost cam plate 24, lever 27 being connected intermediate its ends by a pivot 30 with an arm 31 projecting through one of the slots 15 of the rib and in turn connected either to adjacent ribs or to a manual lever (not shown) by rods 32.

It is thus obvious that as the cam plates are shifted from the position of Figure 1 for maximum stability and lifting power, to the position of Figure 2 for maximum speed, the rear end of the strap 19 recedes rearwardly into the housing 14 as it assumes a straight line, and that in the opposite movement, namely to the position of Figure 1 it is drawn forwardly in order to give the required extra length necessary in order to follow the curvature of the concave underportion of the rib.

By means of our invention, and in view of the fact that the material of which the wing surface is formed is flexible in its nature and capable of attachment to the strap 19 and the strips 18, it is quite obvious that the desired change of wing curve may be readily effected in such manner as to enable the operator to shift the parts into the position shown in Figure 1 when rising in the air or landing and then shift the parts to the speed position of Figure 2 when the machine is straightened out in horizontal flight.

Our invention thus answers the two major requirements as far as wing structure is concerned, without increasing wing area and likewise without increasing motive power.

It is obvious that many changes may be made, and as to the flexible metal strap 19 joining the strips 18, entire dependence need not be placed upon such a strap but the strips 18 may be hingedly connected at their ends to one another if it is so desired or if it is found in practice that the constant flexure or bending is too great for the metal strap alone to be depended upon. Furthermore although we have shown and described certain means including a lever 27 for actuating the cam plates, other means may be utilized including for instance cam shafts extending the full length of the wing and connecting and actuating the several cam plates of the several ribs within the wing.

We claim:

1. A web for aeroplane wings comprising a rigid body having a lower concavely curved edge, a flexible cover supporting member along said edge, and means for flexing said member into and out of the concave of the body, including cam members mounted at lengthwise spaced points of the body and having operative connection with the said member at lengthwise spaced points of the latter.

2. A web for aeroplane wings comprising a rigid body having a lower concavely curved edge, and a flexible member extending along said edge and shiftable into and out of the concave thereof, said member consisting of a lengthwise series of strips having beveled abutting ends, and a flexible continuous strap to which said strips are connected.

3. A web for aeroplane wings comprising a rigid body having its lower edge provided with a concavely curved portion, and a flexible strip extending continuously along said edge having a rear sliding portion and a forward portion yieldable into and out of the said concaved portion, said body having a housing member at its rear end in which the rear end of the rear sliding portion of said flexible strip is movably supported.

4. A web for aeroplane wings comprising a rigid body having its lower edge provided with a concavely curved portion, a pair of cam plates connected to one another and pivoted to the said body and provided with eccentric slots, a flexible strip extending

along the lower edge of the body and having outstanding pins projecting into the slots of said cam plates for shifting movement thereby into and out of the concaved portion, and means for moving said cam plates in opposite directions.

5. A web for aeroplane wings comprising a rigid body having its lower edge provided with a concavely curved portion, a pair of cam plates connected to one another and pivoted to the said body and provided with eccentric slots, a flexible strip extending along the lower edge of the body and having outstanding pins projecting into the slots of said cam plates for shifting movement thereby into and out of the concaved portion, and means for moving said cam plates in opposite directions, said flexible strip being secured at its forward end to the forward end of the web, and a housing member at the rear end of the web in which the rear end of the strip is movably supported.

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