M. STUPAR.

AEROPLANE.

APPLICATION FILED FEB. 1, 1915.

1,220,374

Patented Mar. 27, 1917.

2 SHEETS—SHEET 1.

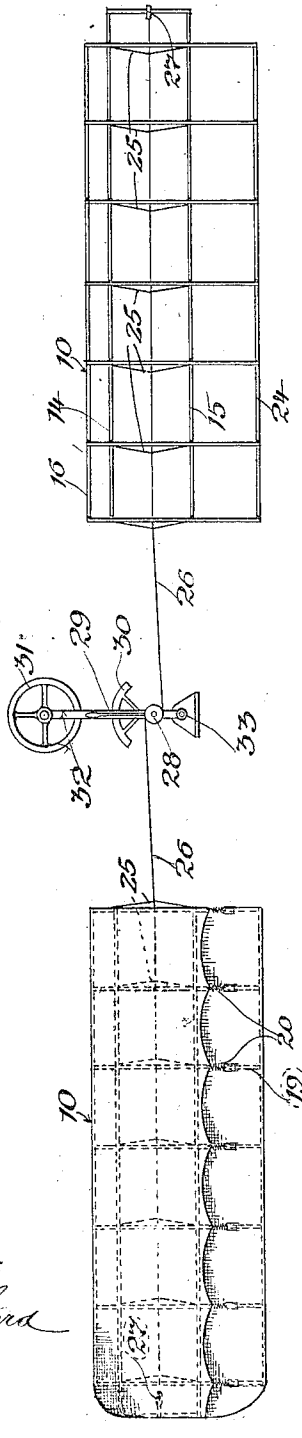


Fig. 1

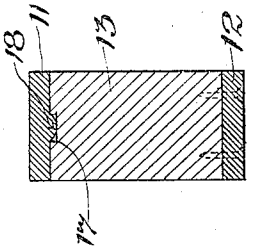


Fig. 5.

Witnesses:
Frank G. Blanchard
G. E. Towle.

Inventor:
Maximilian Stupar
By William L. Steel
Attorney

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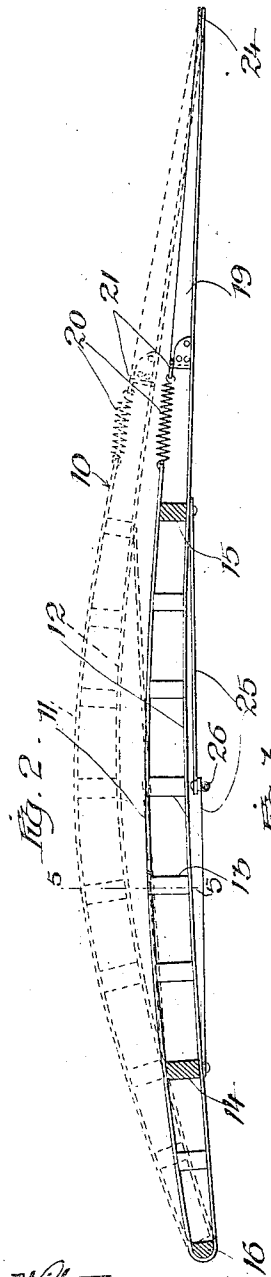


Fig. 2.

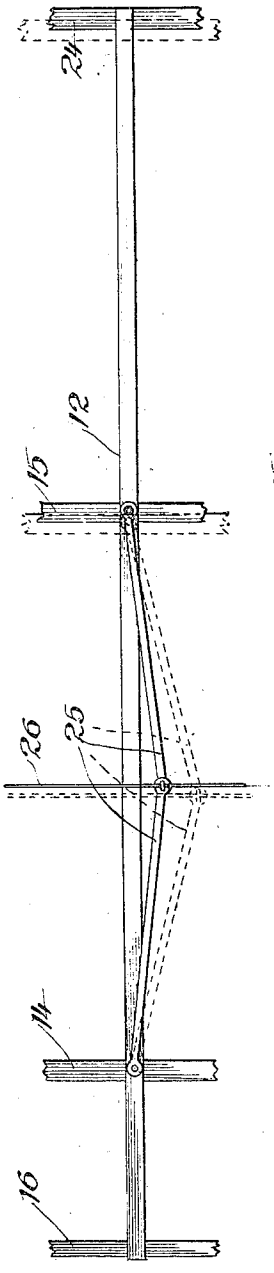


Fig. 3.

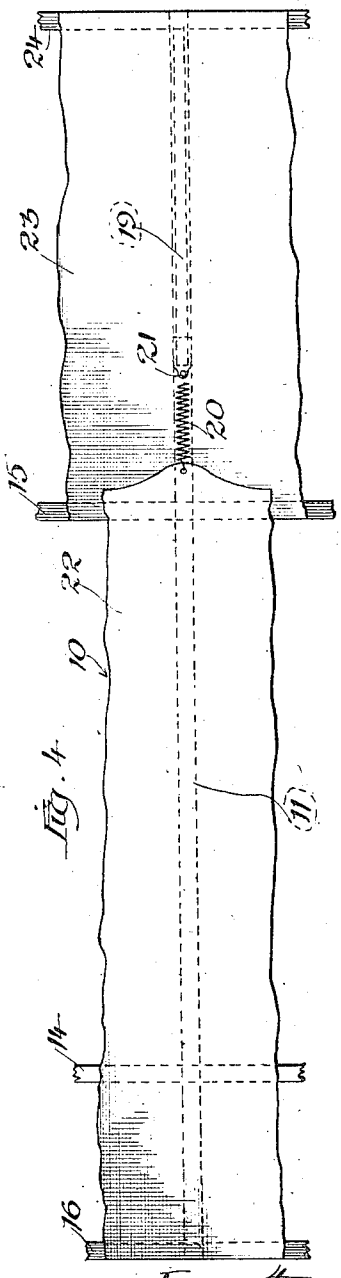


Fig. 4.

Witnesses:

Frank S. Blanchard

G. E. Dowle.

Inventor:

Maximillian Stupar.

By William b. Hall

Attorney.

BEST AVAILABLE COPY

UNITED STATES PATENT OFFICE.

MAXAMILLIAN STUPAR, OF CHICAGO, ILLINOIS, ASSIGNOR OF ONE-HALF TO HERBERT S. RENTON, OF CHICAGO, ILLINOIS.

AEROPLANE.

1,220,374. Specification of Letters Patent. Patented Mar. 27, 1917.

Application filed February 1, 1915. Serial No. 5,348.

To all whom it may concern:

Be it known that I, MAXAMILLIAN STUPAR, a citizen of the United States, and a resident of Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Aeroplanes; and I do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, and to the characters of reference marked thereon, which form a part of this specification.

This invention relates to improvements in aeroplanes and refers more specifically to an improved construction in the plane proper and controlling means therefor designed to enable the speed of a heavier-than-air flying machine to be varied while maintaining a given load-carrying efficiency, and also arranged to effect and maintain lateral equilibrium of the machine.

It is the purpose of the invention to provide means for adjusting the camber of an aeroplane, so constructed as to enable the camber to be adjusted at will during flight and to be maintained at a given adjustment, both for the purpose of enabling the speed of a flying machine carrying a given load to be varied in a way that will admit of the natural functioning of the ordinary steering and controlling means of the machine, and which will also enable the lateral balance of the machine to be maintained without warping the planes in a manner heretofore common in the control of aeroplanes.

One of the purposes of the invention is to provide an aeroplane having the characteristics above described wherein the adjustment of the camber, for the purposes set forth, can be made without affecting the symmetry of the plane with respect to its center of pressure or change in center of pressure when change of angle of incidence is made, so that the machine is not thrown out of balance, whereby changes in the angle of incidence of the plane meets with like responses in all camber adjustments of the plane. Therefore variations of camber, for the purpose set forth, do not introduce new problems or additional changes in plane control.

A further object is to provide an aeroplane which may thus be symmetrically cambered and the frame of which may be made light and strong and the parts of which are very flexible so as to insure easy and prompt control.

A further object of the invention is to provide an aeroplane having means to increase its lift without introducing undue or correspondingly increasing head resistance and which does not present the planes or auxiliary surfaces at unnatural or inefficient angles to the air.

Other objects of the invention are to produce a very simple method for controlling the camber of an aeroplane and to otherwise improve aeroplanes, and the invention consists in the combination and arrangement of the parts shown in the drawings and described in the specification, together with the mechanical equivalents thereof, and is set forth in the appended claims.

The system of speed control employed in my invention is based upon the fact that a plane with a deep camber has a greater lifting power, at a given speed, than a flat plane or a plane having a small camber. Therefore, in accordance with my invention the speed of an aeroplane may be decreased or lowered beyond a normal speed, without limiting its load carrying capacity, by the operation of increasing the camber of the plane. It has heretofore been the practice, in order to slow down the speed of a flying machine, to materially increase the angle of incidence or an operation which has been termed by aeronauticians as "stalling." Such stalling operation does not, however, permit a very great range of speed, and is moreover dangerous inasmuch as if the engine be killed during the stalling operation the machine is likely to glide or skid backwardly before it can be controlled for forward volplaning.

In using my new principle of adjustable camber for lateral stability of a flying machine the planes and control therefor are so adjusted relatively to each other that when the camber of the plane on the side toward which the machine tends to dip is increased, thereby increasing the lifting power of such plane, the plane at opposite side of the machine is simultaneously and automatically decreased, and is therefore partially deprived of its lifting efficiency, so that said planes coact to bring the machine to an even keel or to a stabilized equilibrium.

The method herein described for varying the camber of the planes of a flying machine

may be conveniently correlated to the controlling mechanism which is under the direct supervision of the driver in such a way that through the action of the same hand operated device the camber of the planes at both sides of the machine may be simultaneously increased or decreased to vary the speed of a machine carrying a given load, or the reduction of the camber of one side may occur at the same time the camber at the other side of the machine is increased to effect lateral balance of the machine.

I have shown in the drawings, in a somewhat diagrammatic manner, one practical embodiment of my invention and have confined the illustrated embodiment to two planes. It will be understood, however, that said planes may be the wings of a monoplane type of flying machine, or that they may be the upper wings of planes of a biplane type of machine.

In the drawings:—

Figure 1 is a diagrammatic top plane view of a monoplane flying machine and controlling elements embodying my invention.

Fig. 2 is a transverse section of a plane embodying my invention.

Fig. 3 is an underside view of the skeleton frame of the machine.

Fig. 4 is a fragmentary plan view of the plane.

Fig. 5 is a detail section on the line 5—5 of Fig. 2.

As shown in the drawings, and referring in the immediately following parts of the specification to a single plane,—10 designates the plane as a whole. The frame of the plane comprises an upper series of longitudinal members or ribs 11 and a series of lower longitudinal members or ribs 12 which are spaced from each other by spacing blocks 13, 13, and transversely extending spars 14, 15 and 16, the latter spar being located at the entering edge of the plane. The said upper and lower members and spacing members or blocks constitute skeleton or open work ribs which may be made of ample strength while yet sufficiently flexible to be readily bent or curved for a purpose hereinafter described. The said spars 14 and 16 are herein shown as fixed to the upper and lower ribs 11 and 12, respectively, while the spar 15 is fixed to the lower ribs and is unattached to the upper ribs. The spacing blocks 13 are fixed to the lower ribs 12 but have sliding engagement with the upper ribs 11. Such engagement may be effected by providing the blocks 13 with grooves 17 which are engaged by guides 18 on the lower sides of the upper ribs 11. 19 designates one of a series of plates or webs arranged in rear of the spar 15 and fixedly attached in any suitable manner to the associated lower member or rib 12 of the plane frame. Said web or plate 19 is movable relatively to the upper rib 11 of the plane frame, and a spring 20 is attached at one end thereof to the forward wider end of the said web or plate 19 at 21 and is attached at its other end to the upper fabric cover 22 of the plane which overlaps and terminates in rear of the forward edge of the fabric cover strip 23 at the trailing edge of the plane which is stretched between the spar 15 and a spar 24 at the said trailing edge of the plane. A number of said springs is employed and an equal number of plates or webs 19, and the purpose of the springs is to maintain the upper fabric covering 22 tight under all conditions and various degrees of camber and to aid to assist to decrease the camber of the plane. The plane is so constructed that it assumes a normal camber, such as is shown in full lines in Fig. 2, which is an adjustment to adapt the plane to its maximum speed.

25, 25 designate toggle rods or bars which are pivotally connected at their opposite ends in any suitable manner to the spars 14, 15, respectively, in front and in rear of the center of pressure of the plane, which center is herein shown as located about one-third of the distance between the entering and trailing edges of the plane. The said rods are loosely connected at their adjacent ends to a controlling wire or cable 26, arranged beneath, and extending from end to end of, the plane for connection beyond the inner end of the plane with an operating mechanism to be hereinafter described. A restoring member 27, which connects the outer end of each cable 26 to the plane frame at its outer end and which may have the form of a helical spring or of a stout elastic band, tends to normally draw the cable 26 outwardly, and acts in conjunction with the controlling gear hereinafter described to hold the rods 25 in adjusted positions and aids to restore the plane to its normal camber, as shown in Fig. 2 when the controlling gear is adjusted to normal position. The normal positions of said rods 25 when the plane occupies its normal camber is shown in Figs. 1, 3 and 4 wherein it will be noted that they are disposed at a slight angle to each other and to the ribs and that they lie on the sides of their associated ribs adjacent to the inner end edges of the wing.

An endwise pull on the cable 26 shifts the rods 25 to the dotted line positions shown in Fig. 3 with the result of drawing the spar 15 toward the spar 14. By reason of the initial slight camber of the planes, the effect of drawing one spar toward the other springs the ribs upwardly as indicated in dotted line in Fig. 2. It may be assumed that the dotted line position shown in Fig. 2 is the extreme camber which the plane is capable of assuming, that the full line position of the plane as shown in Fig. 2 is the

minimum camber thereof, and that between these two positions the camber may be adjusted to any degree desired to correspond with a speed correlative to the curve of the camber and a given load.

Referring now to the manner of connecting a central control device to the wings, it will be noted that cables 26 extend inwardly past the inner end edges of the planes and are wrapped about a drum 28 located at the center of the machine in front of the driver's position, and said cables are fastened to the drum in such a way that when the controlling lever 29 of the said drum is swung along a segment 30 both cables will be wound upon the drum and, therefore, both planes will be cambered equally, through the operation of the rods 25, as is necessary to change the speed of the aeroplane. When the lever 29 is swung in the other direction the spring elements 27, assisted by the springs 20, restore the planes to a smaller camber. The lever 29 may be provided with any well known means for locking it to the segment.

31 designates a hand wheel which is adapted to be connected in any suitable manner, not necessary to be herein shown, with the steering rudder of the machine. The steering wheel post or column 32 on which the steering wheel is mounted is pivoted at 33 below the drum so that it may be swung from side to side and the drum is mounted in said column so as to be thereby shifted in an arcuate path, when the column is swung on its pivot. This movement of the steering column is provided for controlling the lateral balance of the machine through the camber adjustment described. Assuming, for instance, that the machine shown in Fig. 1 should tip down toward the left, the steering wheel column is swung to the right and this movement of the column and the drum carried thereby acts through the left hand cable 26 and the associated bars 25 to increase the camber of the lower plane while the spring elements 27, 20 act on the other cable, which is at this time slackening, to correspondingly decrease the camber of the higher plane. The effect of increasing the camber of the lower plane is to increase the lifting capacity of the said plane and the effect of decreasing the camber of the higher plane is to decrease its lifting capacity. Thus the balancing functions of the adjustable camber on each side of the machine coöperate to bring the machine to an even keel without decreasing the load carrying capacity of the machine or the speed of the machine. Assuming that the machine should tip toward the right the steering wheel column is swung toward the left with the result of reversing the operation of the parts 26, 25, 20 and 27 to bring the machine to a balance. The tendency of the plane is to remain at the same camber at which it is manually set, regardless of the changes in the air pressure, the spring controlling elements keeping the wires 26 tight and to assist in straightening the plane.

It will be observed from an inspection of Fig. 2 that the varying curvatures or cambers of the plane are symmetrical with respect to the center of pressure of the plane, so that the adjustment of the camber does not tend to, or actually throw the plane out of balance by presenting unnatural or inefficient angles of the plane to the air, and this without regard to the angle of incidence at which the plane is presented to the air. In other words, the plane at its minimum camber has the same characteristics, such as location of center of pressure and change in center of pressure, resulting in change of angle of incidence, as at the greater camber.

It will be understood that the essential features of my invention are capable of embodiment in aeroplane flying machines of varying structural details and that the invention is not limited to the particular embodiment shown except as the details are hereinafter specifically claimed and as imposed by the prior art; and it is the intent to claim all of inherent novelty shown in the drawings and described in the specification.

I claim as my invention:—

1. In an aeroplane flying machine, means to vary the speed of the machine comprising means to adjust the camber of the plane at will during flight symmetrically to the fore and aft center of pressure of the plane embracing elongated means extending from the inner to the outer end of the plane and resiliently anchored at its outer end to the outer end of the plane with means for connecting it to the plane in front and in rear of the center of pressure of the plane.

2. In an aeroplane flying machine, a plane comprising upper and lower longitudinally flexible plane members extending fore and aft across the center of pressure of the plane; transverse spars between said members fixed to the lower members and one of which is fixed to the upper members, and means for moving one of the spars toward the other to vary the camber of the plane.

3. In an aeroplane flying machine, a plane comprising upper and lower sets of flexible ribs, front and rear transverse spars between the ribs, one of said spars being fixed to the upper and lower sets of ribs and the other spar being fixed to one set of ribs and slidable on the other set, and means for moving one spar toward the other.

4. In an aeroplane flying machine, a plane comprising upper and lower sets of flexible ribs, front and rear transverse spars between the ribs, one of said spars being fixed

to the upper and lower sets of ribs and the other spar being fixed to one set of ribs and slidable on the other set, a cable extending transversely beneath the ribs between the spars, toggle bars loosely connected to said cable and to the spars, and operating means acting on the cable and acting through the toggle bars to vary the camber of said plane.

5. In an aeroplane flying machine, a plane comprising a frame consisting of flexible longitudinal ribs and means for varying the camber of the plane comprising a transverse cable and a series of toggle bars connected to said cable and connected also to said ribs in front and in rear of the center of pressure of the plane.

6. In an aeroplane flying machine, a plane comprising a frame consisting of flexible longitudinal ribs and means for varying the camber of the plane comprising a transverse cable, a series of toggle bars connected to said cable and connected also to said ribs in front and in rear of the center of pressure of the plane, a manual operating device connected to the inner end of said cable and a resilient member to anchor the outer end of said cable to the plane structure.

7. In an aeroplane flying machine, a plane comprising upper and lower longitudinally flexible plane members, transverse spars between said members fixed to the lower members and one of said members being slidable relatively to the upper member, a cable arranged beneath the plane and connected at the inner end of the plane to an operating element and at the outer end of the plane to a resilient element, and cross bars connected to said cable and to said transverse spars.

8. In an aeroplane flying machine, a plane comprising longitudinal ribs and transverse spars connected to certain of the ribs and movable relatively to the other ribs, whereby when the spars are moved one toward the other the camber of the plane is changed, and a camber controlling cable extending transversely beneath the plane and connected to said spars.

9. In an aeroplane flying machine, a plane comprising longitudinal ribs and transverse spars connected to certain of the ribs and movable relatively to the other ribs, whereby when the spars are moved one toward the other the camber of the plane is changed, a cable extending transversely beneath the plane and connected to said spars, a plane controlling device connected to the inner end of said cable and a resilient device for anchoring the outer end of the cable to the plane structure.

10. In an aeroplane flying machine, a plane comprising longitudinal ribs and transverse spars connected to certain of the ribs and movable relatively to the other ribs, whereby when the spars are moved one toward the other the camber of the plane is changed, a cable extending transversely beneath the plane and connected to said spars, a plane controlling device connected to the inner end of said cable, a resilient device for anchoring the outer end of the cable to the plane structure, a flexible plane cover, and resilient means for connecting the rear edge of said cover to the plane structure.

11. An aeroplane flying machine comprising planes at the sides of the machine constructed to be curved to vary the camber thereof, and means for curving the planes, including cables extending beneath the planes, restoring elements connected to the outer ends of the cables and to the plane frames, and manually operable means connected to the inner ends of said cables.

12. An aeroplane flying machine comprising planes at the sides of the machine constructed to be curved to vary the camber thereof, and means for curving the planes, including cables extending beneath the planes, restoring elements connected to the outer ends of the cables and to the plane frames, manually operable means connected to the inner ends of said cables, a flexible plane cover and resilient means fixed to the rear edge of said cover and acting in opposition to said manually operable means.

13. An aeroplane flying machine comprising planes at the sides of the machine constructed to be curved to vary the camber thereof, and means for curving the planes, including cables extending beneath the planes, restoring elements connected to the outer ends of the cables and to the plane frames, a drum between the planes about which the inner ends of the cables are oppositely wound, with means to rotate said drum to simultaneously increase or decrease the camber of both planes, as desired, and means to lock the drum rotating means.

14. An aeroplane flying machine comprising planes at the sides of the machine constructed to be curved to vary the camber thereof, and means for curving the planes, including cables extending beneath the planes, restoring elements connected to the outer ends of the cables and to the plane frames, a drum between the planes about which the inner ends of the cables are oppositely wound, with means to rotate said drum to simultaneously increase or decrease the camber of both planes, as desired, means to lock the drum rotating means, and means to swing the drum on a prescribed arc to increase the camber of one plane simultaneously with a decrease of camber of the other plane.

15. An aeroplane flying machine comprising planes at the sides of the machine constructed to be curved to vary the camber thereof, and means for curving the planes, including cables extending beneath the

planes, restoring elements connected to the outer ends of the cables and to the plane frames, a drum between the planes about which the cables are reversely wound, with means to rotate it to simultaneously change the plane cambers, and means connected to the cables constructed to increase the camber of one plane simultaneously with the decrease of camber of the companion plane.

16. An aeroplane flying machine comprising planes at the sides of the machine constructed to be curved to vary the camber thereof, and means for curving the planes, including cables extending beneath the planes, restoring elements connected to the outer ends of the cables and to the plane frames, and a drum between the planes about which the cables are reversely wound, with means to rotate it to simultaneously change the plane cambers, and a pivoted column on which the drum is mounted, whereby swinging movement of the column serves to increase the camber of one plane simultaneously with the decrease of camber of the other plane.

17. An aeroplane flying machine, a plane comprising light, flexible longitudinal ribs, front and rear transverse spars between them, with the center of pressure between the spars, and means acting on said spars to longitudinally camber the planes without changing the characteristics of the planes relatively to the center of air pressure at any angle of incidence.

18. In an aeroplane flying machine, means to vary the speed of the machine, comprising means to adjust the camber of the plane at will during flight symmetrically to the fore and aft center of pressure of the plane, embracing means extending from the inner to the outer end of the plane, and connected to said outer end of the plane, and connected between its ends to the plane in front and in rear of the center of pressure thereof, a flexible plane cover and resilient means fixed to the rear edge of said cover and acting in opposition to the camber adjusting means.

19. An aeroplane comprising longitudinal ribs and transverse spars with adjusting means to vary the camber of the plane, rigid members attached to the plane at the trailing edge thereof, a fabric cover for the plane terminating short of the trailing edge thereof, and resilient elements connecting said rigid members to the rear edge of the fabric cover and acting in opposition to the camber adjusting means.

20. An aeroplane comprising longitudinal ribs, transverse spars, adjusting means to vary the camber of the plane, a plurality of longitudinally arranged rigid members attached to the rear ends of the lower ribs and movable relatively to the upper ribs, a fabric cover for the plane and spring elements connecting said members to the rear edge of the fabric cover.

21. An aeroplane comprising longitudinal ribs, transverse spars, adjusting means to vary the camber of the plane, a plurality of longitudinally arranged rigid members attached to the rear ends of the lower ribs and movable relatively to the upper ribs, a fabric cover for the plane and a cover piece overlapped at its forward edge by the rear edge of said fabric cover and attached at its rear edge to the trailing edge of the plane.

In testimony, that I claim the foregoing as my invention I affix my signature in the presence of two witnesses, this 20th day of January, A. D. 1914.

MAXAMILLIAN STUPAR.

Witnesses:
W. L. HALL,
G. E. DOWLE.