

Nov. 22, 1938.

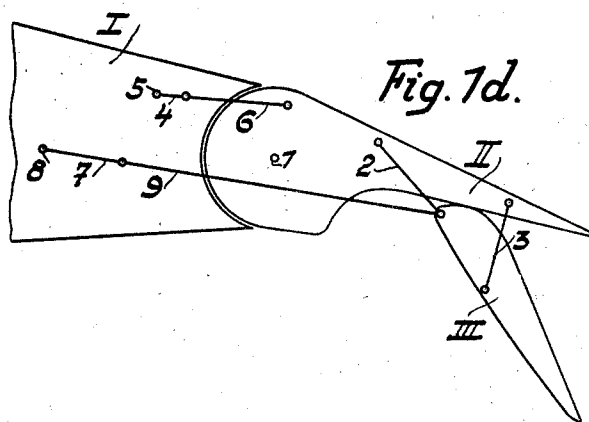
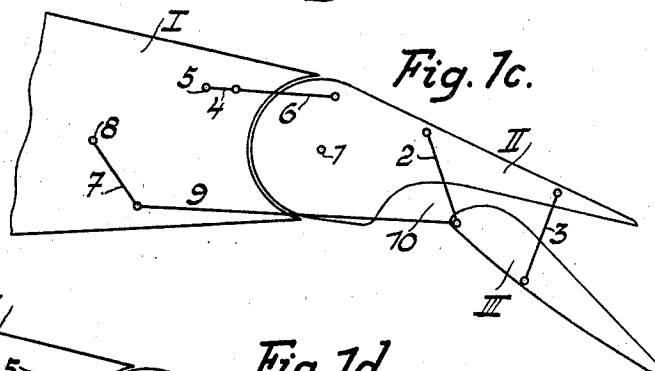
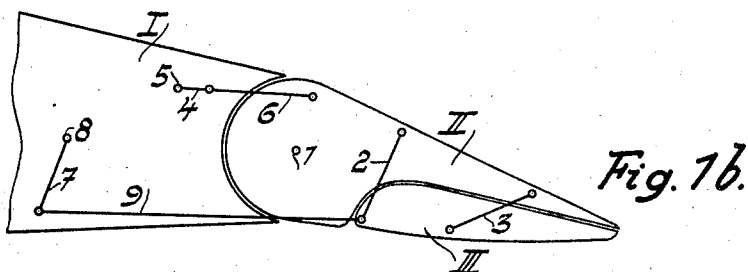
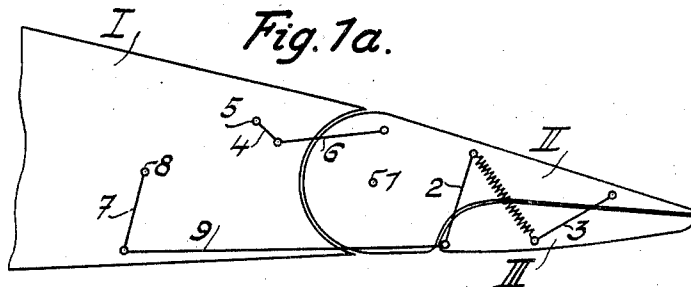
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2,137,879

SUPPORTING SURFACE FOR FLYING MACHINES

Filed Feb. 24, 1936

10 Sheets-Sheet 1



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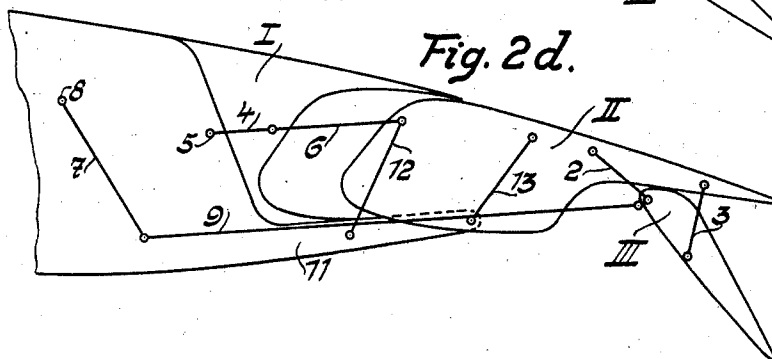
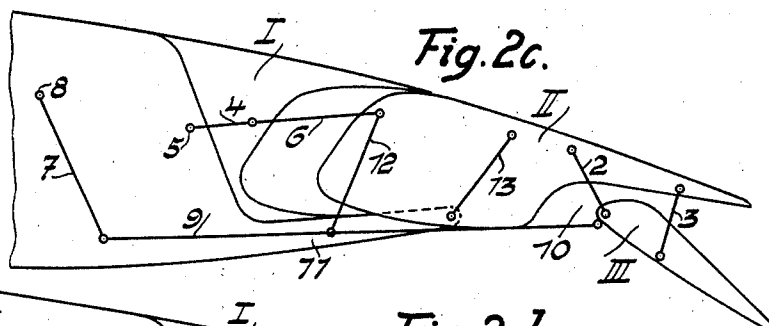
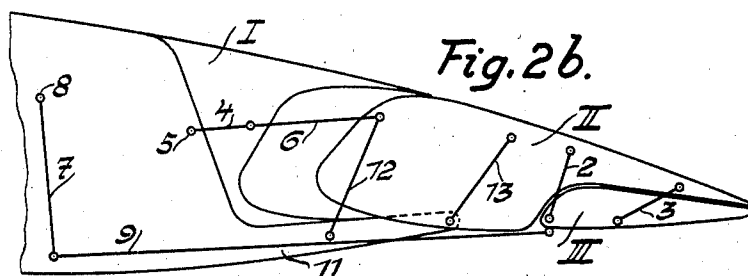
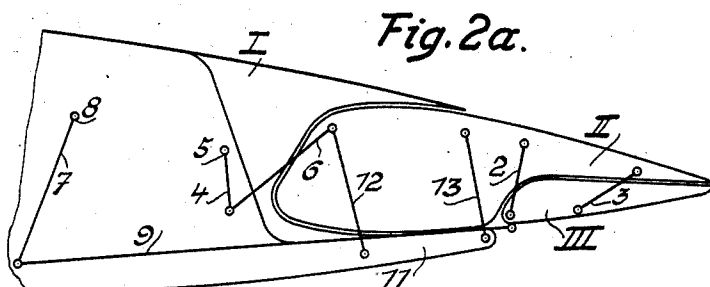
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SUPPORTING SURFACE FOR FLYING MACHINES

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10 Sheets-Sheet 2



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SUPPORTING SURFACE FOR FLYING MACHINES

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Fig. 3a.

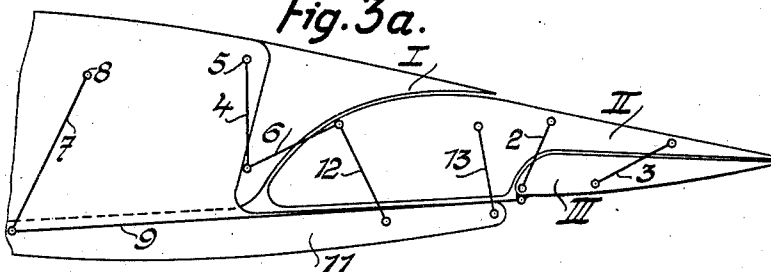


Fig. 3b.

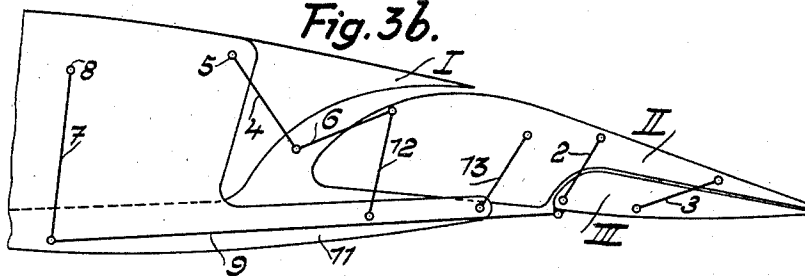


Fig. 3c.

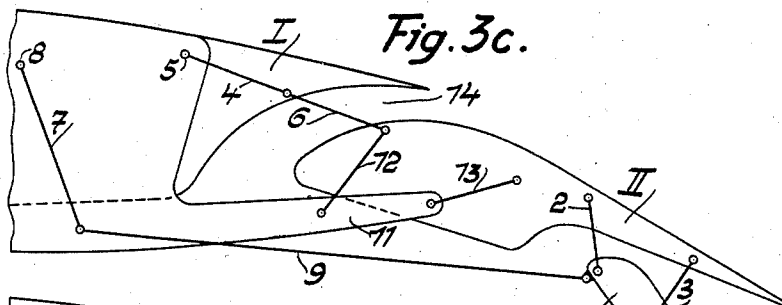
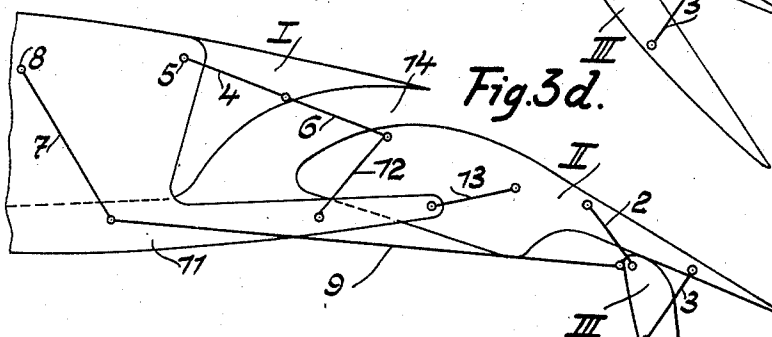


Fig. 3d.



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SUPPORTING SURFACE FOR FLYING MACHINES

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Fig. 4a.

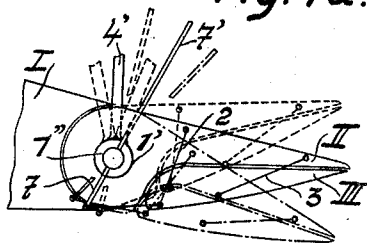


Fig. 4b.

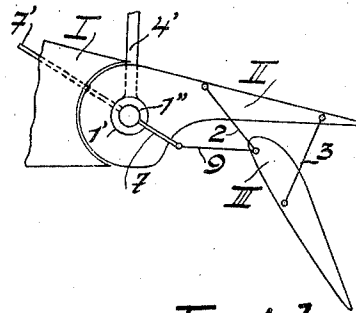


Fig. 4c.

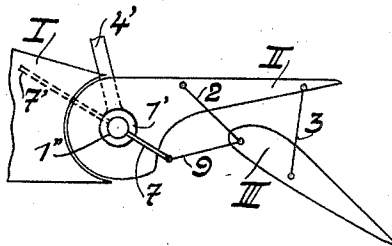


Fig. 4d.

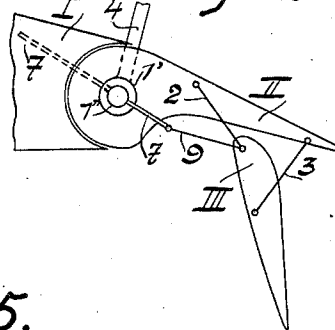
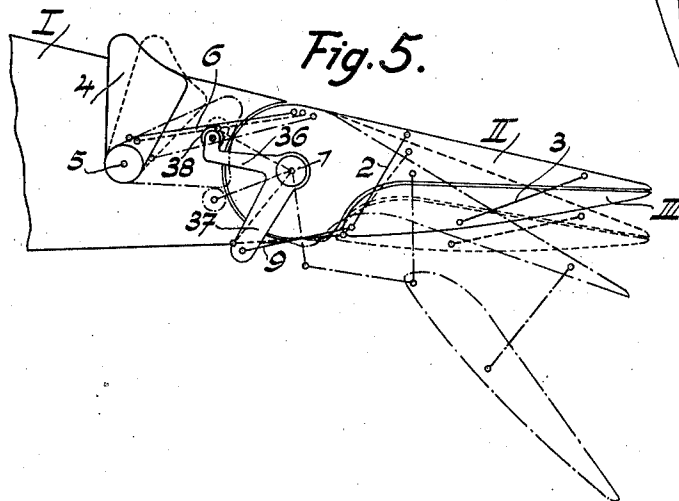


Fig. 5.



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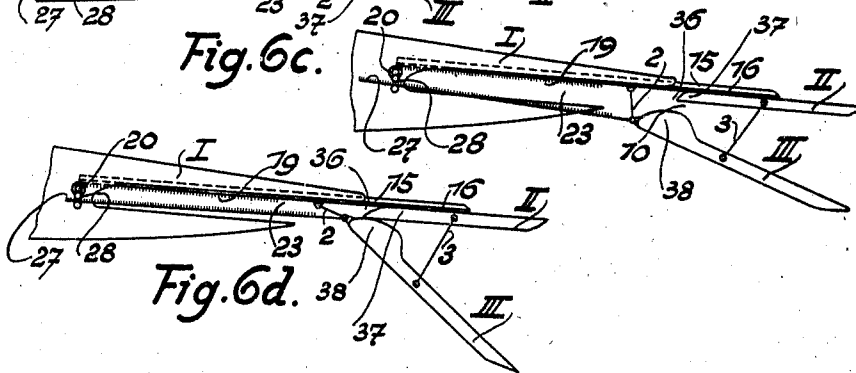
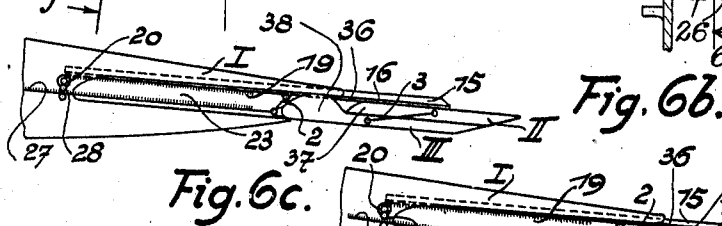
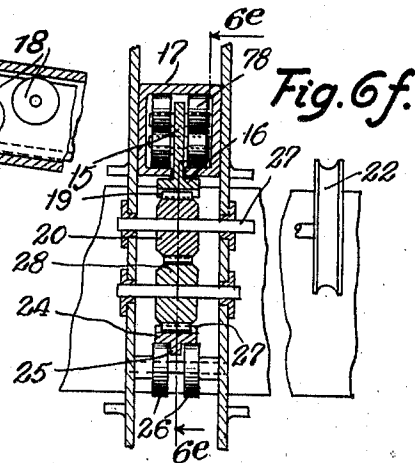
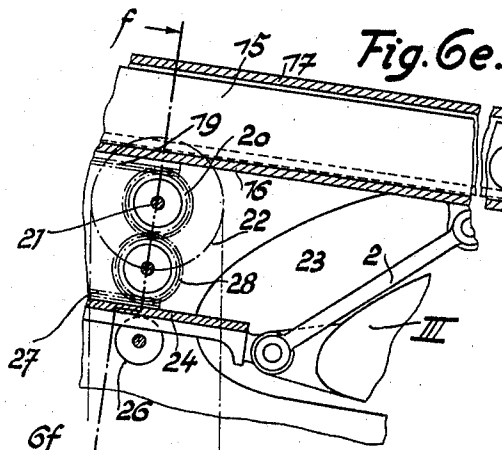
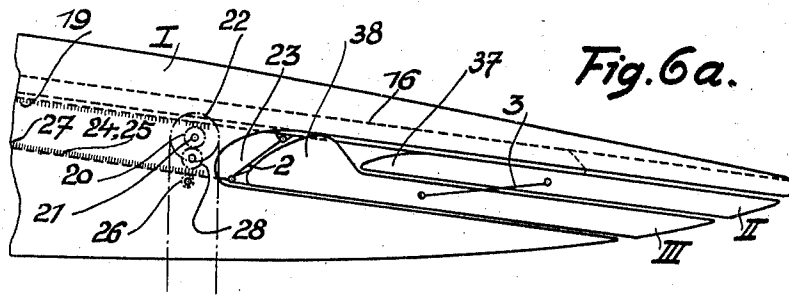
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SUPPORTING SURFACE FOR FLYING MACHINES

Filed Feb. 24, 1936

10 Sheets-Sheet 5



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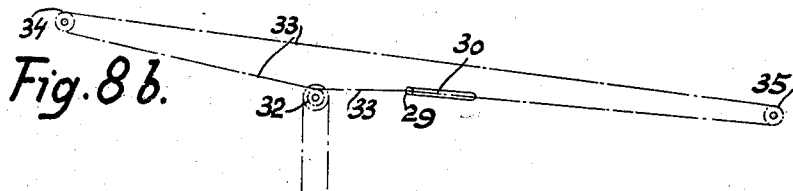
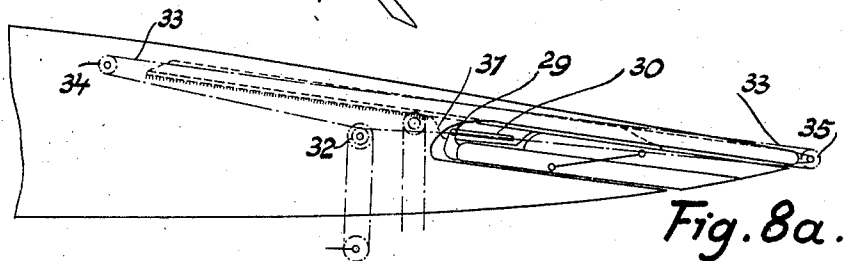
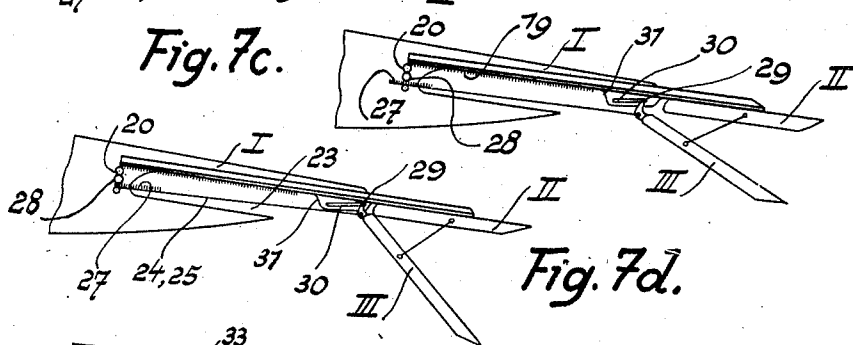
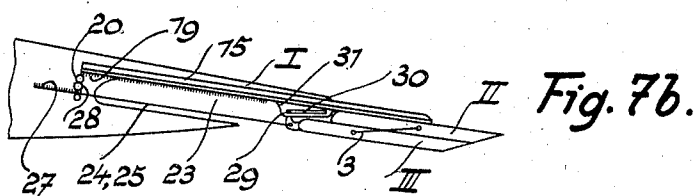
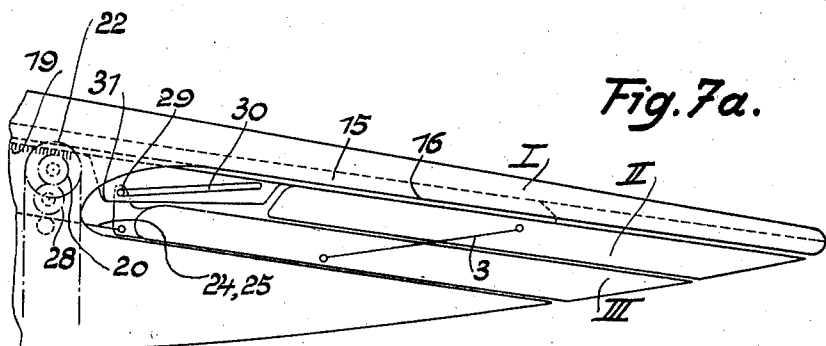
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SUPPORTING SURFACE FOR FLYING MACHINES

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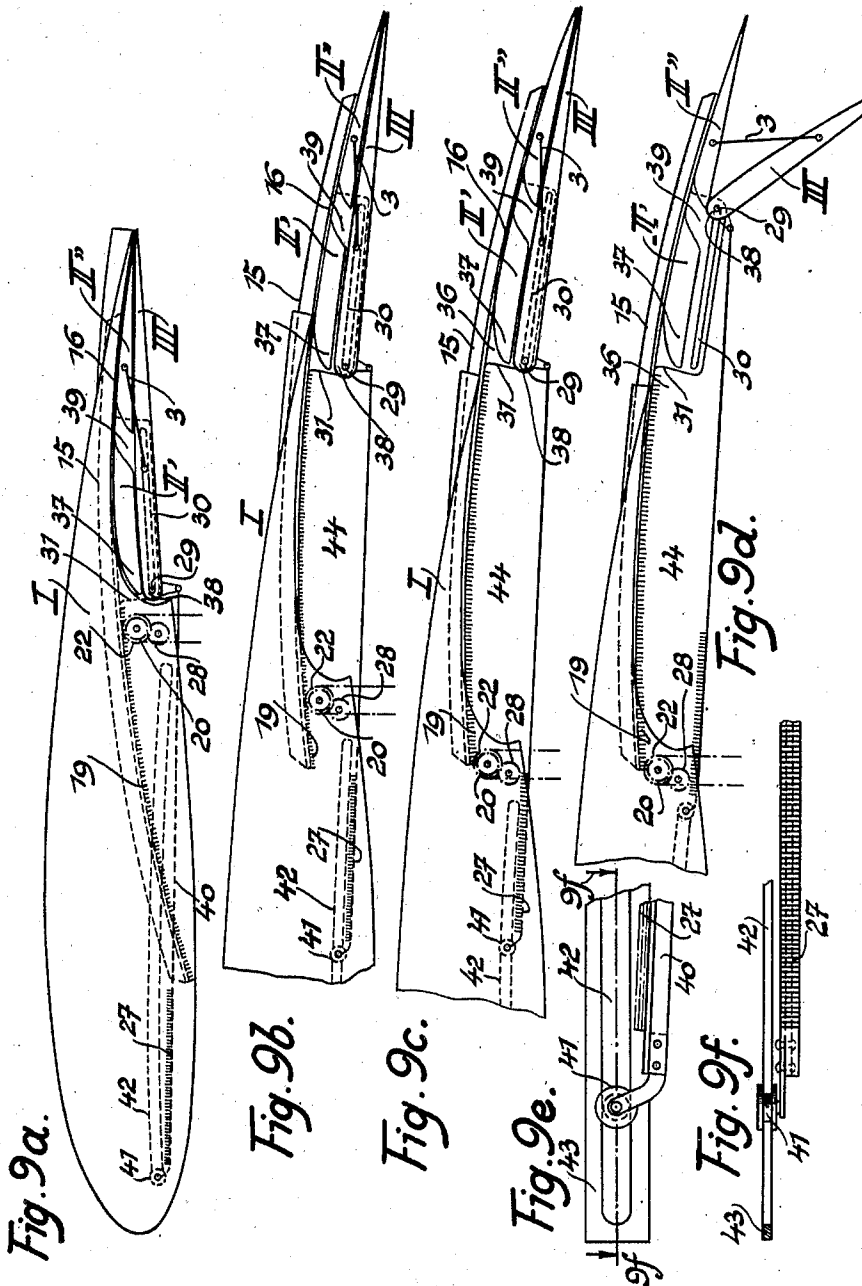
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SUPPORTING SURFACE FOR FLYING MACHINES

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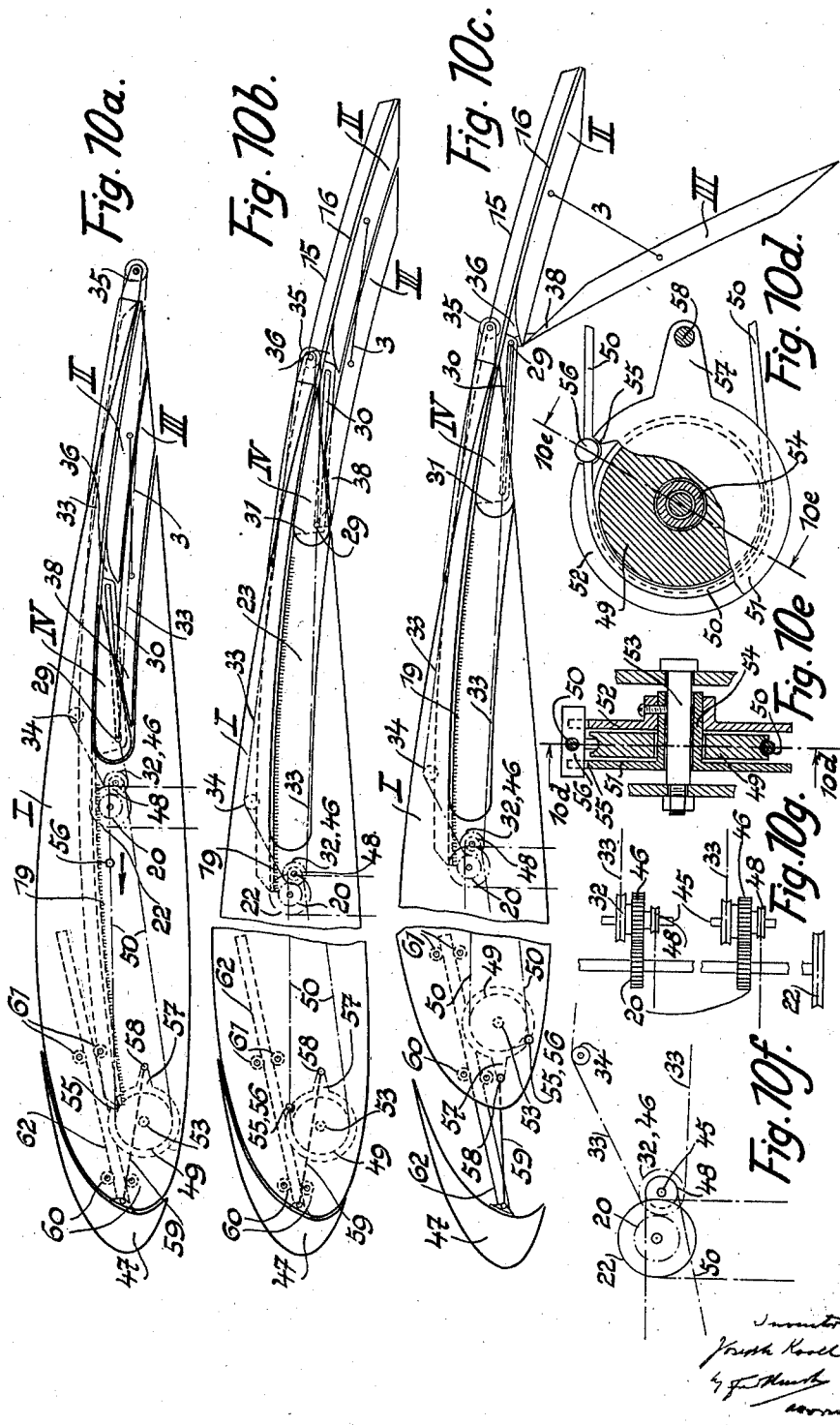
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SUPPORTING SURFACE FOR FLYING MACHINES

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SUPPORTING SURFACE FOR FLYING MACHINES

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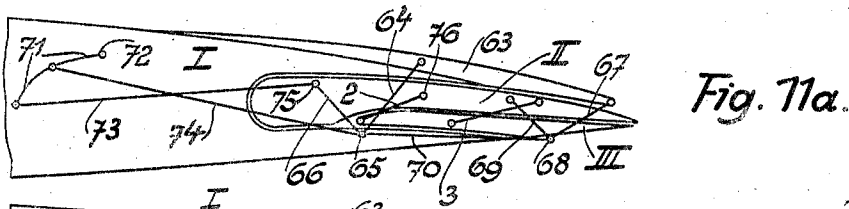


Fig. 11a.

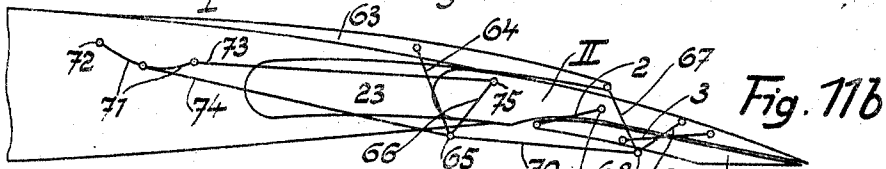


Fig. 11b

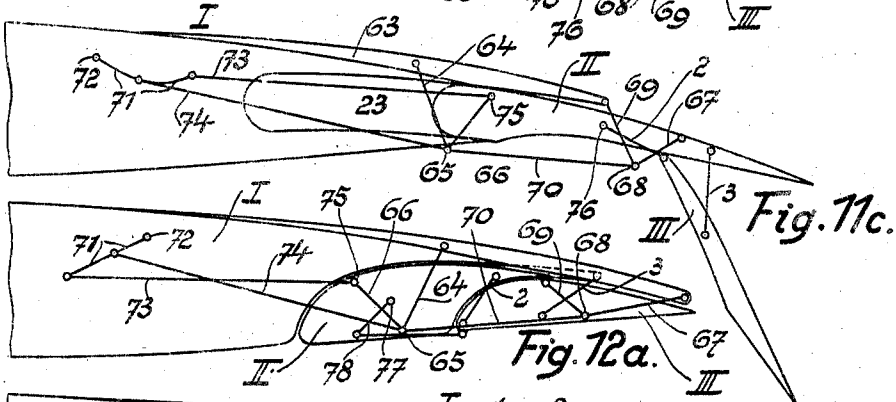


Fig. 11c.

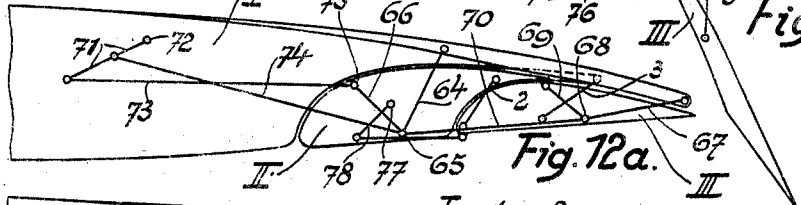


Fig. 12a.

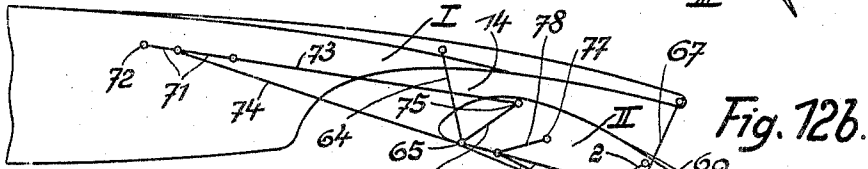


Fig. 12b.

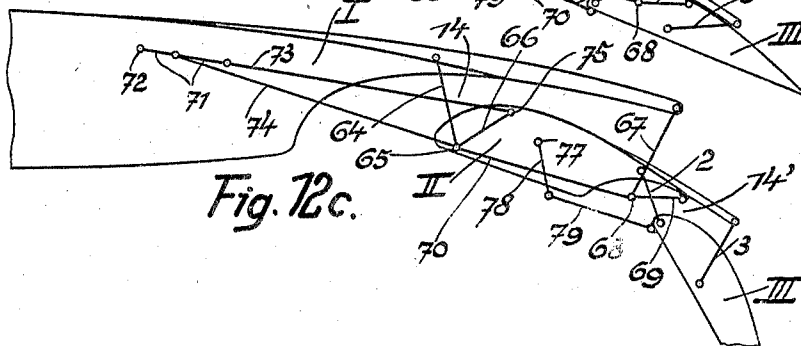


Fig. 12c.

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SUPPORTING SURFACE FOR FLYING MACHINES

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Fig. 13d.

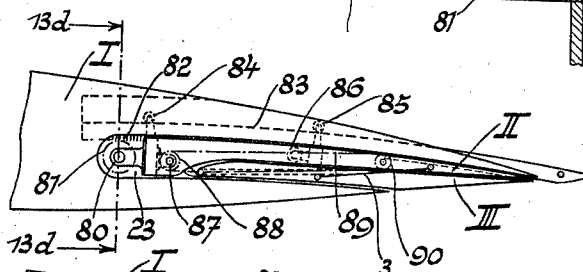
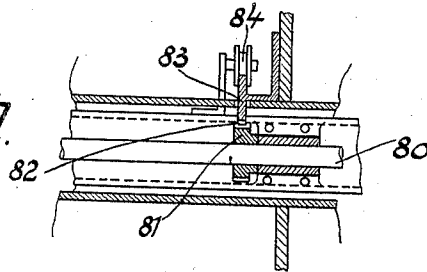


Fig. 13a.

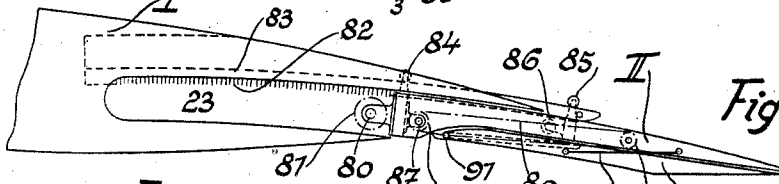


Fig. 13b.

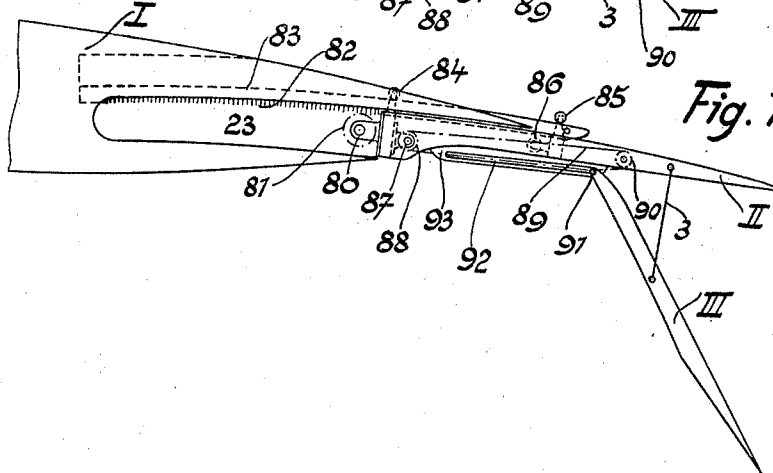


Fig. 13c.

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UNITED STATES PATENT OFFICE

2,137,879

SUPPORTING SURFACE FOR FLYING
MACHINES

Joseph Ksoll, Breslau, Germany

Application February 24, 1936, Serial No. 65,250
In Germany February 26, 1935

5 Claims. (Cl. 244-42)

In the new supporting surface for flying machines several known characteristic features of supporting surfaces are combined in order to make the supporting surfaces suitable for all cases which may occur, i. e., for rapid flying (travelling flying), starting, slow flying and landing.

With this object in view the supporting surface comprises a main surface, adjustable on the supporting wing, and an auxiliary surface adjustable on the lower side of said main surface, the auxiliary surface being adapted to participate in the adjustment of the main surface and also to be adjusted independent of and on the main surface, whereby the auxiliary surface is adjustable in such a manner that it can execute on the inner surface both a rotary motion around a transverse axle and a shifting motion towards the rear and back towards the front of the main surface. For the rapid flight (travelling flight), the supporting surface is employed in the standard profile. For the starting, the main adjustable surface, together with the auxiliary adjustable surface, is shifted to the rear, if necessary to the rear and in downward direction, for extending the length and increasing the curvature of the cross section of the supporting surface, and for the slow flight and the landing the auxiliary adjusting surface is turned downwards and at the same time shifted to the rear on the main adjusting surface, which remains in the position shifted to the rear.

The accompanying drawings illustrate different forms of construction of the improved supporting surface for flying machines, generally in diagrammatic views, in side elevation, the different parts being shown in different positions.

Fig. 1a is a diagrammatic fragmentary end elevational view of an airplane wing with an aileron movable relative thereto and a flap associated with the aileron and movable relative to the aileron.

Fig. 1b is a fragmentary end elevational view, similar to Fig. 1a, showing the aileron adjustable at an angle relative to the wing.

Fig. 1c is a fragmentary end elevational view, similar to Figure 1a with the aileron and flap moved relative to each other and to the wing.

Fig. 1d is a fragmentary end elevational view, similar to Fig. 1c, showing the flap moved at a wider angle to the aileron.

Fig. 2a is a diagrammatic end elevational view of another form of invention with another form of support for the aileron on the wing.

Fig. 2b is a fragmentary end elevational view, similar to Figure 2a, showing the aileron moved outwardly of the wing.

Fig. 2c is a fragmentary end elevational view, similar to Fig. 2b, showing the flap carried by the aileron angularly adjusted relative to the aileron.

Fig. 2d is a fragmentary end elevational view, similar to Fig. 2c, showing the flap moved to a wider angle relative to the aileron.

Fig. 3a is a diagrammatic end elevational view of another form of aileron and flap mounting for a wing in which the aileron is lifted from the wing during displacement or operation thereof.

Fig. 3b is a fragmentary end elevational view, similar to Fig. 3a, showing the aileron lifted to an adjusted position.

Fig. 3c is a fragmentary end elevational view, similar to Fig. 3b, showing the aileron lifted to an adjusted position and angularly disposed relative to the wing with the flap associated with the aileron disposed at an angle to the aileron.

Fig. 3d is a fragmentary end elevational view, similar to Fig. 3c, showing the flap disposed at a wider angle relative to the aileron.

Fig. 4a is a fragmentary end elevational view of another form of aileron and associated flap mounting on a wing with the aileron and flap illustrated by dotted lines in adjusted positions.

Fig. 4b is a fragmentary end elevational view, similar to Fig. 4a, showing the flap disposed at an angle to the aileron.

Fig. 4c is a fragmentary end elevational view, similar to Fig. 4b, showing the aileron adjusted to an upper inclination and the flap adjusted downwardly relative to the aileron.

Fig. 4d is a fragmentary end elevational view, similar to Fig. 4c, showing the aileron adjusted in a downward direction relative to the wing and the flap adjusted to a further angle relative to the aileron.

Fig. 5 is a diagrammatic fragmentary end elevational view of another form of aileron mounting wherein the aileron and its associated flap are automatically and cam operated relative to the carrying wing, the aileron and flap being illustrated by dotted lines in relatively adjusted positions and also in adjusted positions relative to the wing.

Fig. 6a is a diagrammatic fragmentary end elevational view of another form of wing and aileron construction wherein the aileron and associated flap are slidably mounted relative to the wing.

Fig. 6b is a fragmentary end elevational view, similar to Fig. 6a, showing the aileron shifted to an extended position and the flap disposed at an angle thereto.

Fig. 6c is a fragmentary end elevational view,

similar to Fig. 6a, showing the aileron and flap slid outwardly of the carrying wing.

Fig. 6d is a fragmentary end elevational view, similar to Fig. 6b, with the flap disposed at a wider angle relative to the aileron,

Fig. 6e is a fragmentary vertical longitudinal sectional view, showing a part of the operating mechanism for the aileron and flap shown in Fig. 6a,

Fig. 6f is a vertical sectional view taken on line 6f—6f of Fig. 6e.

Fig. 7a is a diagrammatic fragmentary end elevational view of another form of aileron and flap mounting on a wing with a single link connection between the aileron and flap, with the aileron and flap slidable on the wing,

Fig. 7b is a fragmentary end elevational view, similar to Fig. 7a, showing the aileron and flap moved outwardly of the carrying wing,

Fig. 7c is a fragmentary end elevational view, similar to Fig. 7b, showing the flap moved at an angle relative to the aileron,

Fig. 7d is a fragmentary end elevational view, similar to Fig. 7c, showing the flap moved at a wider angle relative to the aileron,

Fig. 8a is a diagrammatic fragmentary end elevational view, showing an aileron and flap slidable relative to a wing with pull cords or ropes for the operation thereof,

Fig. 8b is a diagrammatic view of the pull cord system for operating the aileron and flap shown in Fig. 8a,

Fig. 9a is a diagrammatic end elevational view of another form of wing structure embodying a two-part aileron with a flap carried by one of the parts,

Fig. 9b is a fragmentary end elevational view, similar to Fig. 9a, showing the aileron and flap moved from the position shown in Fig. 9a to an intermediate position,

Fig. 9c is a fragmentary end elevational view, similar to Fig. 9b, in which the front ends of the aileron and flap are moved a certain distance from the wing,

Fig. 9d is a fragmentary end elevational view, similar to Fig. 9c, showing the flap moved in an angular position relative to the aileron,

Figs. 9e and 9f show fragmentary side elevational and top plan views of a part of the operating mechanism for the aileron and flap,

Fig. 10a is an end elevational view of another form of wing structure having a movable head on the leading edge of the wing operatively engaged with an associated aileron and flap carried by the trailing edge of the wing,

Fig. 10b is a fragmentary end elevational view, similar to Fig. 10a, showing the aileron and flap projected outwardly of the end of the wing,

Fig. 10c is a fragmentary end elevational view, showing the movable head at the leading edge of the wing moved forwardly thereof, the aileron projected at the rear edge of the flap moved downwardly at an angle relative to the aileron,

Fig. 10d is a fragmentary elevational view, partly in section, of the driving gear for the movable head at the leading edge of the wing,

Fig. 10e is a cross sectional view taken on line 10e—10e of Fig. 10c,

Figs. 10f and 10g are diagrammatic side elevational and top plan views respectively of the driving gear for the movable head, the aileron and flap,

Fig. 11a is a diagrammatic fragmentary end elevational view of another form of wing structure permitting a larger shifting movement of

the aileron relative to the wing and showing the aileron and its associated flap in retracted position relative to the wing,

Fig. 11b is a fragmentary end elevational view, similar to Fig. 11a, showing the aileron and flap projected from the edge of the wing,

Fig. 11c is a fragmentary end elevational view, similar to Fig. 11b, showing the flap moved to an angle relative to the aileron,

Fig. 12a is a diagrammatic fragmentary end elevational view of another form of wing structure, showing another form of adjusting means for the flap relative to the aileron and with the aileron and flap in its retracted position relative to the wing,

Fig. 12b is a fragmentary end elevational view, similar to Fig. 12a, showing the aileron and flap unitarily moved outwardly and downwardly of the wing,

Fig. 12c is a fragmentary end elevational view, similar to Fig. 12b, showing the flap moved angularly downwardly and away from the aileron,

Fig. 13a is a diagrammatic fragmentary end elevational view of another form of wing structure with other operating means for the aileron and flap, the aileron and flap being illustrated in their retracted positions within a recess in the edge of the wing,

Fig. 13b is a fragmentary end elevational view showing the aileron and flap moved outwardly of the wing,

Fig. 13c is a fragmentary end elevational view, similar to Fig. 13b, showing the flap moved downwardly at an angle relative to the aileron, and Fig. 13d is a cross sectional view taken on line 13d—13d of Fig. 13a.

The supporting surface is designated in all figures of the drawings by I, the main adjustable surface by II and the auxiliary adjustable surface by III, these elements extending either undivided along the whole supporting surface of the flying machine, or they are composed of several parts located at the right and left of the body of the supporting surface. The mechanisms for adjusting the main and auxiliary adjustable surfaces, which will be hereinafter described, form as usually only one of several adjusting mechanisms of similar construction which are connected the one with the other by rotatable axles extending transversely through the supporting surface of the flying machine and connecting the corresponding control elements of the individual adjusting mechanisms so that these can all be actuated from the pilot's seat simultaneously and all together by a common operating means. If the adjusting mechanisms of the auxiliary adjustable surface are not constructed so that this surface is positively returned by them into the inoperative position, the main adjustable surface and the auxiliary adjustable surface will have to be connected, as indicated in some of the figures, by springs which are put under tension when the auxiliary adjustable surface is being moved outwards from the inoperative position, said spring returning subsequently the auxiliary adjustable surface into the initial position.

Form of construction illustrated in Figs. 1a-1d.—The main adjustable surface II is turnable around an axle 1 mounted on the supporting surface I, the auxiliary adjustable surface 3 being positively shiftable towards the rear on the main adjustable surface and turnable. The auxiliary adjustable surface III is connected with the main adjustable surface II by links 2, 3.

For adjusting the main adjustable surface II levers 4 are provided, which are keyed on an axle 5 extending transversely through the supporting surface I and adapted to be turned from the pilot's seat, said levers being connected by rods 6 with the main adjustable surface II. The axle 5 can be secured in its position, after the levers 4 have been turned, by suitable means not illustrated. For adjusting the auxiliary adjustable surface III other levers 7 are provided, which are keyed on an axle 8 freely rotatable on the supporting surface I and connected by rods 9 with the lower joints of the links 2.

If by means of axle 5 the levers 4 are turned from the initial position (Fig. 1a) in anti-clockwise direction, the adjustable surfaces II and III are turned together into the position shown in Fig. 1b in downward direction, the surface III turning by means of rods 9 the levers 7 with the axle 8 in clockwise direction. Turning of axle 3 in clockwise direction would cause upward turning of the two surfaces II and III, the surface III turning the lever 7 through the rods 9 in anti-clockwise direction.

If after turning of the levers 4 the axle 5 and through the same also the surface II is secured in the position of Fig. 1d on the supporting surface I, the surface III is shifted by rotating of the axle 8 with the lever 7 in anti-clockwise direction from the position shown in Fig. 1b towards the rear, in being turned downwards at the same time, a gap 10 being first formed (Fig. 1c) between the surfaces II and III, said gap being subsequently closed again (position Fig. 1d). This effect results therefrom that the rods 9 act on the head of the surface III and are connected with the surface II by the links 2, 3 in forming hinged quadrilaterals.

Form of construction shown in Figs. 2a-2d.—This form of construction corresponds to that shown in Figs. 1a to 1d with the exception that the main adjustable surface II is fixed on the lower levers 11 of the supporting surface I by means of pairs of turnable links 12, 13 and shifted during the rotation in anti-clockwise direction of the axle 5 with levers 4 from the position shown in Fig. 2a together with the surface III to the rear into the position of the Fig. 2b. After the axle 5 with the levers has been locked, the adjusting of the surface 3 into the positions of Figs. 2c-2d is then effected by rotating the axle 8 with the lever 7.

Form of construction shown in Figs. 3a-3d.—Differing from the similar form of construction illustrated in Figs. 2a-2d the path of movement of the main adjustable surface II relatively to the supporting surface I is such that the main adjustable surface II is lifted from the supporting surface I during the displacement from the position shown in Fig. 3a into that shown in Fig. 3c, a nozzle gap 14 being formed between the supporting surface and the main adjustable surface.

Form of construction shown in Figs. 4a-4d.—The main adjustable surface 2 is rigidly mounted on a continuous hollow axle 1' mounted on the supporting surface I, a control lever 4' being fixed on this hollow axle. Through the hollow axle 1' an axle 1'' extends on which a control lever 7' and levers 7 are fixed which extend through suitable slots of the hollow axle 4' and are hingedly connected by rods 9 with the auxiliary adjustable surface III. The main adjustable surface II can be turned as shown in Fig. 4a by means of the lever 4 together with

the auxiliary adjustable surface III in upward or downward direction around the axle 1', the auxiliary adjustable surface II being adapted to be adjusted by means of the lever 7' (Figs. 4b-4d) in any adjustable position of the main adjusting surface II, for instance in the medium position (Fig. 4b), the upper position (Fig. 4c) or the lower position (Fig. 4d) of the main adjustable surface after the lever 4 and through the same the main surface II have been secured in position.

Form of construction according to Fig. 5.—If the main adjustable surface II has assumed a certain position, its operating device also actuates the auxiliary adjustable surface II. The levers 4 constructed like cams are keyed on the axle 5 rotatable from the pilot's seat and they are connected by links 6 with the main adjustable surface II. This main adjustable surface is keyed on the continuous axle I on which the levers for adjusting the auxiliary adjustable surface III are loosely mounted, which in this instance are constructed like angle levers. The lever arms 37 are connected by rods 9 with the auxiliary adjustable surface III connected with the main adjustable surface II by the pairs of links 2, 3. The arms 36 of the angle levers carry each a roller 38 situated in the path along which the lever 4 oscillates. If the axle 5 with the cam levers 4 is rotated in clockwise direction, this rotation effects first a common turning of the two surfaces II and III around the axle I, the rods 9 pushing forwards the levers 37 and turning thereby also the angle levers 36, 37 in clockwise direction around the axle I. If the rotation of axle 5 with levers 4 continues, these levers strike against the rollers 38, whereby the angle levers 36, 37 are turned in anti-clockwise direction and the surface III is adjusted on the surface II. This form of construction is suitable also for these surface portions serving for the transverse stabilization of the supporting surfaces of the aeroplane.

Form of construction shown in Figs. 6a-6f.—On the supporting surface or wing I the main adjustable surface II is shiftable in straight direction obliquely towards the rear and downwards. The auxiliary adjustable surface 3 is connected by pairs of links 2, 3 with the main adjustable surface. The two adjustable surfaces II and III, when in the normal position, are located in the standard profile of the supporting surface of the aeroplane in a recess 23 of wing I, this recess being arranged in the middle of the wing I, i. e. at a distance from its upper side as well as from its lower side. This construction permits of a good constructive configuration of the recess and prevents, if the two adjustable surfaces are shifted towards the rear out of the recess, formation of eddies on the underside of the supporting surface, which would effect an increase of the cross sectional resistance. Springs (not shown) between the two adjustable surfaces II and III tend to pull the surface III against the surface II.

The main adjustable surface II is mounted on several longitudinally directed straight bars 15, 16 (Figs. 6e, 6f) which may be curved if necessary. Each bar is of T-shape and adapted to move to and fro in a correspondingly shaped casing 17 provided on the supporting surface I. Guide pulleys 18 are fixed on the web 15 of the bars and adapted to roll on the walls of the casing 17. The flange 16 of each bar situated outside the casing carries a rack 19 with which a toothed wheel 20 meshes. All toothed wheels

20 are keyed on an axle 21 extending transversely through the supporting surface I and journaled in the same. A rope or sprocket wheel 22 is mounted on the axle 21 and adapted to be turned in a suitable manner from the pilot's seat. If the spur wheel is rotated in clockwise direction, the racks 19 are shifted in rearward direction and thereby the main adjustable surfaces displaced in downward direction. The racks 19 are only of such length that the meshing with the toothed wheels 20 ceases if the main adjustable surface II has arrived in the position shown in Figs. 6b-6d and the shifting movement of the main adjustable surface is then stopped.

On the head end of the auxiliary adjustable surface III several longitudinally directed T-shaped bars 24, 25 are arranged which run on rotatable rollers 26 mounted on the supporting surface I. The flange 24 of each bar 24, 25 carries a rack 27 adapted to mesh each with one of two spur wheels 28 rotatably arranged on the supporting surface I. All toothed wheels 28 are keyed on a common axle extending transversely through the supporting surface and meshing each with a spur wheel 20. The racks 19 and 27 extend parallel to one another so that the two adjustable surfaces II and III are shifted from the position of rest shown in Fig. 6a during the turning of wheel 22, both together towards the rear and downwards into the position shown in Fig. 6b, without changing the mutual position and go out of the recess of the supporting surface. In this position the front ends of the racks 19 do no longer mesh with the toothed wheels 20. The racks 27 are, however, longer than the racks 19 so that they still mesh with the toothed wheels 28. If the adjustable surfaces II and III have arrived in the position shown in Fig. 6b, and the rotation of the wheel 22 continues, as the rotation of this wheel is transmitted by the now idly running toothed wheels 20 upon the toothed wheels 28, and the racks 27, which mesh with the toothed wheels 28 and can oscillate in the joints connecting them with the auxiliary adjustable surface III, adjust this the auxiliary adjustable surface on the main surface II, so that between these two surfaces at first a gap 36 is formed (Fig. 6c) which is subsequently closed again (Fig. 6d).

If wheel 22 is turned backwards, the racks 27 first move forward, in bringing the springs (not shown) arranged between the two surfaces II and III shifting the auxiliary adjustable surface III again towards the main auxiliary surface II, the racks 19 meshing a little later also with the toothed wheels 20 so that, if the backward turning of the wheel 22 continues, also the main adjustable surface II together with the auxiliary adjustable surface III is brought back into the initial position shown in Fig. 6a.

As Figs. 6b-6d show, the main adjustable surface II is shifted from the supporting surface so far towards the rear that between these two surfaces, if the main adjustable surface II has been completely shifted towards the rear, a gap 36 is produced. As long as the auxiliary adjustable surface has not yet been shifted from the position shown in Fig. 6b, the front end 38 of this auxiliary adjustable surface overlaps the front end 37 of the main adjustable surface II so that in the extreme position of the same (Fig. 6b) the front end 38 covers the gap 36. The path of movement along which the auxiliary adjustable surface III moves while being shifted on the main adjustable surface II extends so that during this

adjusting the front end 38 of the auxiliary adjustable surface II is lowered from the rear end of the supporting surface I, whereby the gap 36 between the front end 37 of the main adjustable surface II and the rear end of the supporting surface I is opened. The front end 38 of the auxiliary adjustable surface III is thickened and shaped so that, if the main adjustable surface II is in the extreme position (Fig. 6b), it shuts off the rear open end of the recess 23 of the supporting surface I. In the form of construction shown in the Figs. 6a to 6f the auxiliary adjustable surface III may be adjusted only if the main adjustable surface II has been moved from the initial position (Fig. 6a) into the position shown in Fig. 6b, whereby this form of construction differs from the forms of construction shown in Figs. 1a-1d, 2a-2d, 3a-3d and 4a-4d, in which the auxiliary adjustable surface III may be adjusted on the main adjustable surface II in any position of the latter.

Form of construction shown in Figs. 7a-7d.—In this instance the adjustable surfaces II and III are not connected by pairs of links 2, 3 as in the form of construction illustrated by Figs. 6a-6f, but merely by links 3, whereas for the other links 2 a guide 3 is substituted fixed on the lower side of every bar 15, 16, said guide having a longitudinal slot 30 with which engages a stud 29 fixed on the head of the auxiliary adjustable surface III or a sliding roller. The racks 27 of bars 24, 25 are only short and begin to mesh with the toothed wheels 28 only as shown in Fig. 7b if the racks 19 begin to disengage from the toothed wheels 20 and consequently the adjustable surfaces II and III are already in the position shown in Fig. 7b.

Form of construction shown in Figs. 8a and 8b.—The auxiliary adjustable surface III is in this instance actuated by means of a pull rope. The auxiliary adjustable surfaces III have each a stud 29 and guides 31 are provided on the bars 15, 16 and have longitudinal slots 13 with which the studs 29 or instead of the same rollers engage. On one of the studs 29 the two ends of the rope 33 are attached the rope being wound once around a rope drum 32 arranged on the supporting surface I and further guided over two guide pulleys 34, 35 one on the supporting surface and the other on the rear end of the main adjustable surface II. For adjusting the main adjustable surface II the same means are employed as in the forms of construction illustrated in Figs. 6a-6f and 7a-7d. If, after the two adjustable surfaces II and III have together been shifted into the extreme position (corresponding to Figs. 6b or 7b), the adjusting drum 32 is rotated from the pilot's seat by a suitable driving mechanism, the auxiliary adjustable surface III is adjustable on the main adjusting surface II in a similar manner as in the forms of construction 6a-6d and 7a-7d.

Form of construction shown in Figs. 9a-9d.—The main adjustable device is subdivided into two parts II', and II'', between which a nozzle gap 39 is formed and which are carried both by bars 15, 16 which in this instance are curved. Connecting rods 40 are hingedly connected to the head of the auxiliary adjustable surface III. The front ends of these connecting rods carry according to the form of construction illustrated in Figs. 7a-7d short racks 27 which begin to mesh with the toothed wheels 28 only if the racks 19 of the bars 15, 16 effecting the adjustment of the main adjustable surfaces II', II'' have al-

ready disengaged from the toothed wheels 20. The front ends of the connecting rods 40 carry rollers 41 (also shown in Figs. 9e and 9f), which slide in the longitudinal slots 42 of guide bars 43 extending from the front to the rear. As in the forms of construction shown in Figs. 7a-7d and 8a-8b, studs 29 are arranged on the auxiliary adjustable surface III and guides 31 on the bars 15, 16, said guides having longitudinal slots 13 in which the studs 29 are guided.

The main adjustable surfaces II' and II'' and the auxiliary adjustable surface III can be brought from the normal position shown in Fig. 9a through the intermediate position shown in Fig. 9b into the position shown in Fig. 9c, in which the front ends 37 and 38 of the two surfaces are at a certain distance from the rear end of the supporting surface I so that a gap 36 is formed between. The auxiliary adjustable surface III can be moved from the position 9c into the position shown in Fig. 9d, whereby the nozzle gap 39 existing between the two adjustable surfaces II' and II'' is also opened.

As can be seen, the surfaces II', II'' and III are also in this form of construction accommodated in the inoperative position within the standard profile of the supporting surface of the aeroplane in a recess of the supporting wing, the recess 44 (Figs. 9c-9d) being in this instance in the lower side of the supporting wing I and open at the underside.

Form of construction shown in Figs. 10a-10g.—In this form of construction the supporting surface of the aeroplane is fitted in known manner with a fore-wing or slat adapted to be lifted off the head of the supporting surface. The levers of this fore-wing are connected with those of the auxiliary adjustable surface in such a manner that the fore-wing remains at rest during the common shifting of the auxiliary adjustable surface with the main adjustable surface and is automatically lowered from the head of the supporting wing during the shifting of the auxiliary adjustable surface on the main adjustable surface.

In this instance three surfaces located in the position of rest in the standard profile of the supporting surface of the flying machine in a recess 23 of the supporting wing I, i. e. the main adjustable surface II, the auxiliary adjustable surface III and a surface IV (shutting off surface) which in the extreme position of the main adjustable surface II shuts off the rear end of the recess 23, are provided. This shutting off surface IV is arranged in front of the surfaces II and III, fixed same as the main adjustable surface II on the bars 15, 16 and is at a certain distance from the main adjustable surface II so that between the two a gap 36 is formed. Similar as in the form of construction shown in Figs. 6a-6d the gap 36, if the main adjustable surface II has arrived together with the auxiliary adjustable surface III in the position of Fig. 10b, lies behind the rear end of the supporting surface I and is still covered by the overlapping front end 38 of the auxiliary adjustable surface III. If the auxiliary adjustable surface III is then shifted on the main adjustable surface II from a position shown in Fig. 10b into the position shown in Fig. 10c, the gap 36 is opened at the same time.

The bars 15, 16 with racks 19, toothed wheels 20 and driving wheel 22 serve again for the common adjustment of the surfaces II, III and IV

from the position Fig. 10a into the position Fig. 10b.

Several similar pull ropes serve for operating the auxiliary adjusting surface III. Stud 29 are mounted on the auxiliary surfaces III and guides 31 on the bars 15, 16, the studs 29 or instead of them rollers engaging in the longitudinal slit 30 of the guides. On each stud 29 the two ends of a rope 33 are fixed. This rope is conducted over a guide roller 33 arranged on the rear end of the supporting surface I, over a guide roller 34 arranged in the front portion of the supporting surface and over a guide pulley 33, around which it is wound once. All guide pulleys 32 are keyed on a shaft 45 which further carries toothed wheels 46 meshing with the toothed wheels 20 (Figs. 10f-10g). The toothed wheels 20 and 46 and the rope drums 32 have similar diameter so that, when the toothed wheels 20 rotate, the racks 19 and the ropes 33 move at the same speed. The position of the studs 29 in the slots 30 remains unchanged during the shifting of the adjustable surfaces II and IV, i. e. these studs bear during this shifting permanently against the left end of the corresponding slot 30.

If the adjustable surfaces II, III and IV have arrived in the position shown in Fig. 10b and the racks 19 come out of engagement with the toothed wheels 20, these toothed wheels rotate idly during the rotation of wheel 22 so that the rope drums 32 continue to rotate and the ropes 33 move the studs 29 to the rear end of the longitudinal slots 30. The auxiliary adjustable surface III is thus shifted through the intermediary of the links 3 into the position shown in Fig. 10c, the gap 36 being opened.

The fore-wing or slat is designated by 47. It is also actuated by several single drives, each of which is constructed in the following manner: Rope pulleys 48 are keyed on shaft 45 of the toothed wheels 46 and rope drums 32. A rope 50 is conducted over each of these rope pulleys and over a second and larger rope pulley 49 rotatably mounted in the front portion of the supporting surface of the flying machine. All rope pulleys 49 are mounted each between two discs 51, 52 (Fig. 10c) which are coupled the one with the other and mounted loosely rotatable each one on a short single axle 53. Each rope pulley 49 between the discs 51, 52 is also loosely rotatable on a hub tube 54 connecting the discs. The discs 51, 52 have at a certain point of their circumference apertures 55, in which a transverse rod 56 can engage which is arranged on the rope 50 at a suitable point. The disc 51 has an extension 57 with which by means of a stud 58 one end of a link 59 is connected. The other end of the link 59 is hinged on the fore-wing 47 and further turnably connected with a rod 62 guided between rollers 60 and 61 and arranged on the supporting surface I.

If the adjustable surfaces II, III and IV are moved towards the rear from the position shown in Fig. 10a, the fore-wing 47 remains at first uninfluenced. The rope 50 is also moved in the direction of the arrow indicated in Fig. 10a, but the fore-wing 47 is not actuated hereby. This actuation takes place only if the adjustable surfaces II, III and IV have arrived in the position shown in Fig. 10b at which moment the rope 50 has also moved such a distance that its transverse rod 56 engages in the recesses 55 of the discs 51, 52. If then the turning of the driving wheel 22 is continued from the pilot's seat, not only the auxiliary adjustable surface III is ad-

justed on the main adjustable surfaces II in the manner described above, but the rope 50 rotates by its transverse rod 56 the two discs 51, 52, which consequently turn from the position shown in Fig. 10b into the position shown in Fig. 10c. The fore-wing 47 is thus lifted off the front end of the supporting surface I.

Form of construction shown in Figs. 11a-11c.—This form of construction permits of an extremely large shifting of the main adjustable surface II with the auxiliary adjustable surface III towards the rear. The surfaces II and III are accommodated in a recess 23 of the supporting surface I. One arm 64 and 67 of each of two toggle levers is hingedly connected with the upper cantilever 63 of the supporting surface I, the other arm 66 and 69 of these toggle levers being hingedly connected to the main adjustable surface II. These toggle levers are connected the one with the other by links, i. e. in the present instance by links 70 connecting the hinges 65 and 63 of these toggle levers. Curved levers 71 are fixed on an axle 72 extending through the supporting surface and rotatable from the pilot's seat. Links 73, 74 are connected with these levers at different distances from the axle 72. The links 73 lead to the upper hinge points 75 which connect the lever arms 66 with the main adjustable surface II, the other links 74 leading to the hinges 65 of the toggle lever 64, 66. If the axle 72 with the levers 71 is rotated in anti-clockwise direction, the adjustable surfaces II and III are shifted from the position shown in Fig. 11a into the position shown in Fig. 11b. The travel is rather long for the reason that the shifting distances of the two lever arms of each toggle lever, i. e. the shifting of the lever arms 64 and 66 on the one hand of and 67 and 69 on the other hand is added up.

Another essential characteristic feature of this form of construction is that the adjusting mechanisms of the auxiliary adjustable surface are arranged on the shiftable main adjustable surface and participate in the shifting movement of the same. The control of the supporting surface of the flying machine is thereby simplified considerably. The auxiliary adjustable surface III is in this instance, in a similar manner as in the forms of construction described above, connected with the main adjustable surface II by pairs of links 2, 3, the lower ends of the links 2 being connected with the head of the auxiliary adjustable surface III. In the present instance the links 2 are mounted on a common continuous axle 76, the rotation of which effects the adjustment of the auxiliary adjustable surface III on the main adjustable surface II.

Form of construction shown in Figs. 12a-12c.—This form of construction differs from that shown in Figs. 11a-11d essentially in the construction of the adjusting elements for the auxiliary adjustable surface III. An axle 77 adapted to be rotated from the pilot's seat is mounted on the main adjustable surface II and carries levers 78 which are hingedly connected with the head of the auxiliary adjustable surface III by links 79. The travelling path of the main adjustable surface II extends also in this instance relatively to the supporting surface I so that in the extreme positions (Fig. 12c) of both surfaces on the one hand between the main adjustable surface II and the supporting surface I and on the other hand between the auxiliary adjustable surface III and the main adjustable surface nozzle gaps 75 14, 14' respectively are formed.

Form of construction shown in Figs. 13a-13d.—

The two adjustable surfaces II and III are again accommodated in a recess 23 of the supporting surface I. A continuous transverse axle 80 is provided on the head of the main adjustable surface II and adapted to be rotated from the pilot's seat by means of a driving gear not shown. Toothed wheels 81 are arranged at suitable distances apart on the transverse shaft 80. These toothed wheels mesh with the racks 82 of longitudinally directed guide bars 83 fixed on the supporting surface, rollers 84, 85, 86 fixed in a suitable manner on the main adjustable surface II moving along these guide bars. The main adjustable surface II is shifted by the rotation of shaft 80 from the position in Fig. 13a into the position shown in Fig. 13b. The main adjustable surface II carrier further a second transverse shaft 87 also adapted to be rotated in a suitable manner from the pilot's seat and on which rope drums 88 for endless pull ropes 89 are mounted at distances apart, said pull ropes being conducted over guide pulleys 90 and adapted to shift in a similar manner as described above, with reference to other forms of constructions, the head studs 91 of the auxiliary adjustable surface III connected by the links 3 with the main adjustable surface II in longitudinal slots 92 of guides 93 fixed on the under side of the main adjustable surface II (see especially Fig. 13c). The auxiliary adjustable surface III is thereby adjusted on the main adjustable surface into the position shown in Fig. 13c.

I claim:—

1. In an airplane wing, an aileron, a flap mounted in a cavity at the trailing end of the aileron, the flap and the cavity being of such configuration that the flap when in the cavity, the aileron, and the wing, together make up a complete aerofoil, and mechanism operatively connecting the flap to the aileron for shifting the flap with respect to the aileron, and for varying the angular position of the flap with respect to the aileron.

2. In an airplane wing, an aileron, a flap mounted in a cavity at the trailing end of the aileron, the flap and the cavity being of such configuration that the flap when in the cavity, the aileron, and the wing, together make up a complete aerofoil, a link pivoted to the aileron with one of its ends and to the leading edge of the flap with the other end, another link, also pivoted to the aileron with one of its ends, and to a point between the leading and trailing edges of the flap with the other end, and a control for oscillating one of the links about its pivot on the aileron.

3. In an airplane wing, an aileron, a flap mounted in a cavity at the trailing end of the aileron, the flap and the cavity being of such configuration that the flap when in the cavity, the aileron, and the wing, together make up a complete aerofoil, a link pivoted to the aileron with one of its ends and to the leading edge of the flap with the other end, another link, also pivoted to the aileron with one of its ends, and to a point between the leading and trailing edges of the flap with the other end, and a control for oscillating the link pivoted to the leading edge of the aileron about its pivot on the aileron.

4. In an airplane wing, an aileron, a flap mounted in a cavity at the trailing end of the aileron, the flap and the cavity being of such configuration that the flap when in the cavity, the aileron and the wing, together make up a

complete aerofoil, mechanism operatively connecting the flap to the aileron for shifting the flap with respect to the aileron, and for varying the angular position of the flap with respect to the aileron, a control for the aileron, and means operatively connecting the control to the mechanism.

5 In an airplane wing, an aileron arranged at the trailing end of the wing, a control connecting the aileron with the wing to adjust the
10 aileron with respect to the wing, a flap arranged

on the underside of the aileron, a mechanism operatively connecting the flap with the aileron for adjusting the flap together with the aileron and also for shifting the flap with respect to the aileron and for varying the angular position of the flap with respect to the aileron; the wing, aileron and flap being of such configuration that all these parts when the aileron and flap are in their unadjusted initial position form an airfoil of normal profile.

JOSEPH KSOLL.