March 26, 1935. I. I. SIKORSKY 1,995,905

LIFT INCREASING APPARATUS

Filed May 10, 1932 6 Sheets-Sheet 1

Fig. 1.

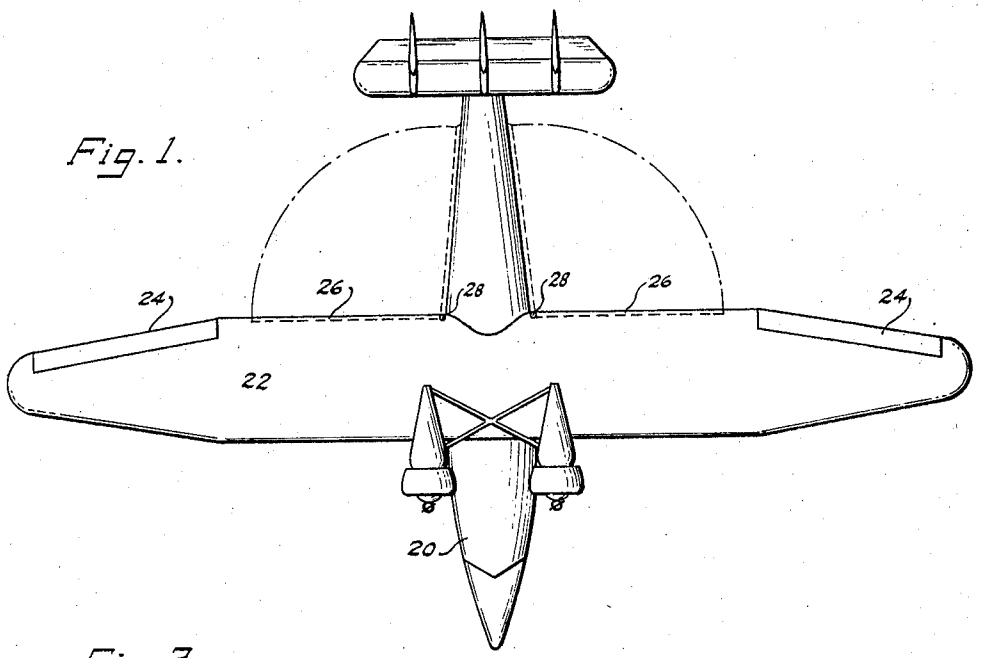


Fig. 2.

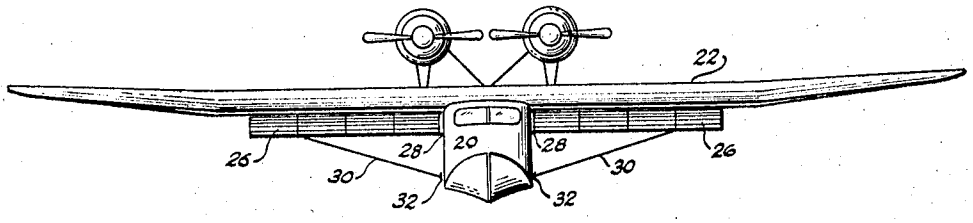
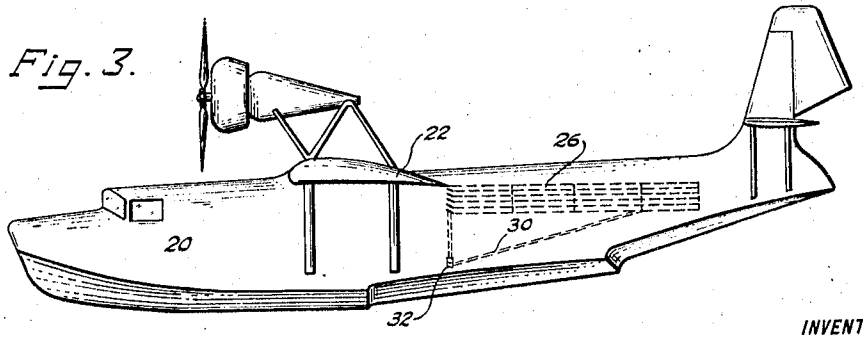


Fig. 3.



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March 26, 1935. I. I. SIKORSKY 1,995,905

LIFT INCREASING APPARATUS

Filed May 10, 1932 6 Sheets-Sheet 2

Fig. 4.

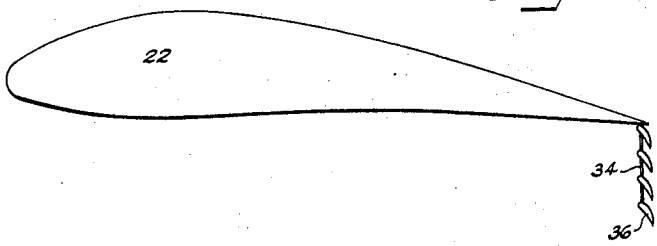


Fig. 5.

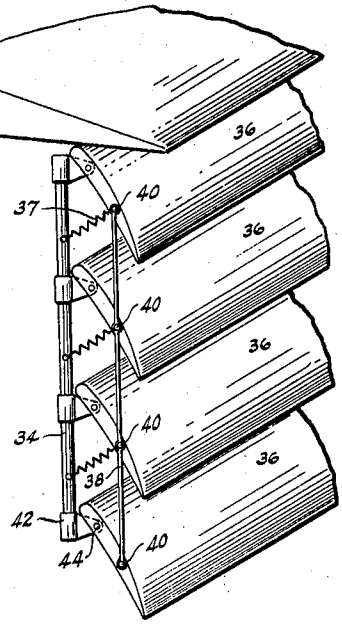


Fig. 6.

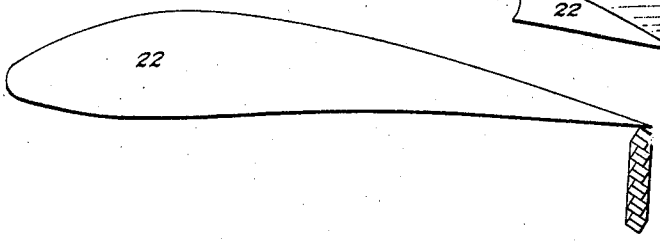


Fig. 7.

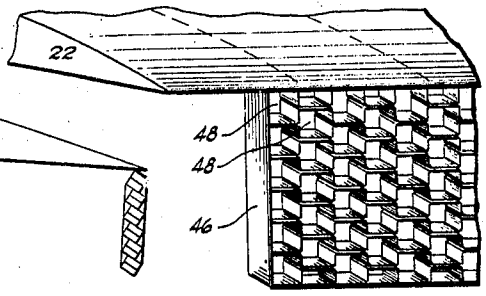


Fig. 8.

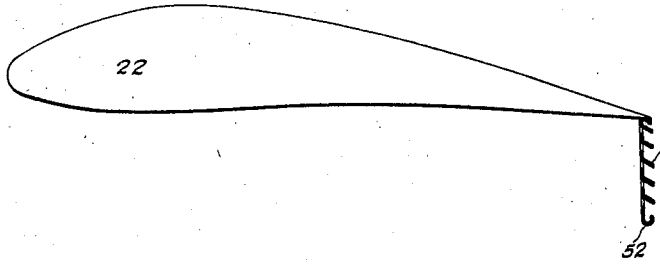
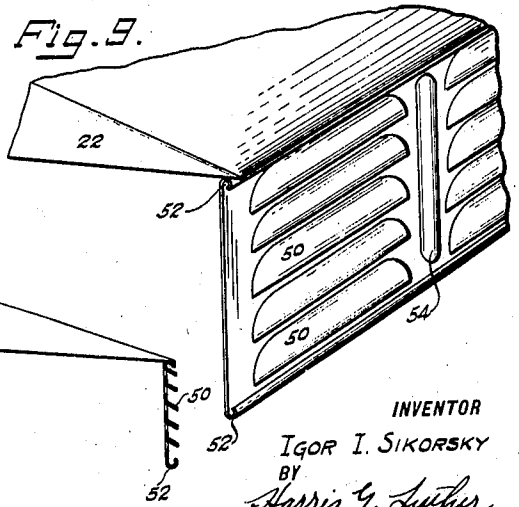


Fig. 9.



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March 26, 1935. I. I. SIKORSKY 1,995,905

LIFT INCREASING APPARATUS

Filed May 10, 1932 6 Sheets-Sheet 3

Fig. 10.

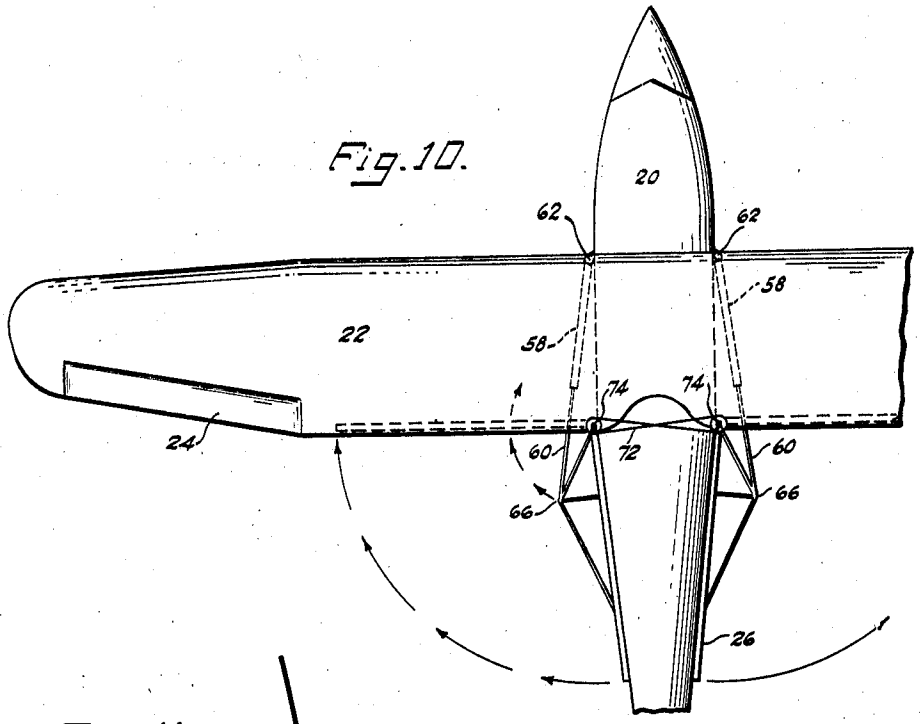
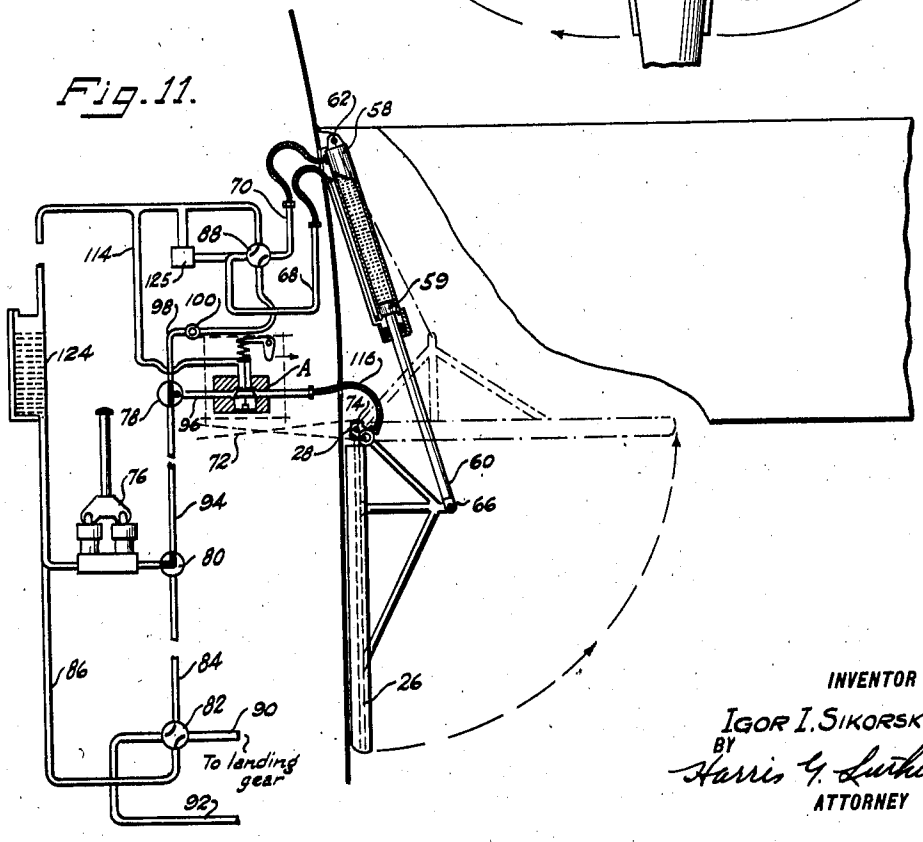


Fig. 11.



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March 26, 1935. I. I. SIKORSKY 1,995,905

LIFT INCREASING APPARATUS

Filed May 10, 1932 6 Sheets-Sheet 4

Fig. 12.

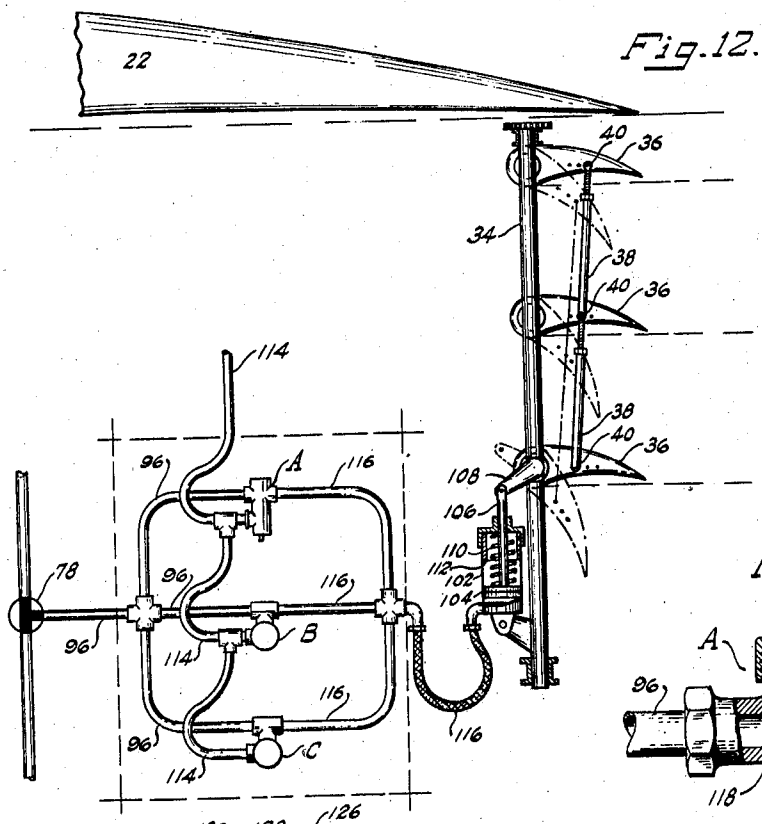
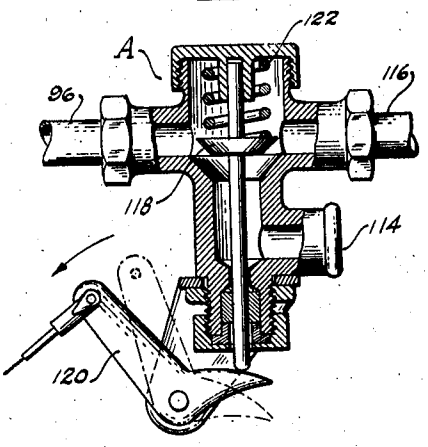


Fig. 13.



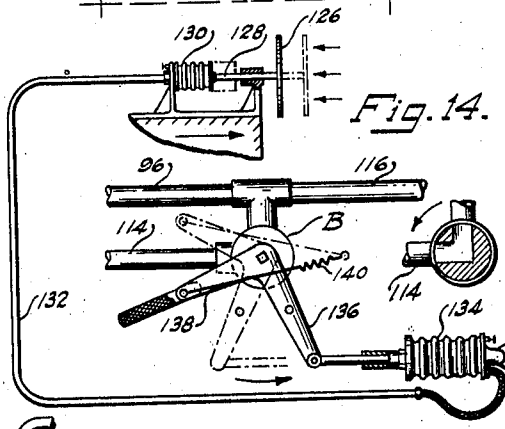


Fig. 14.

Fig. 14a

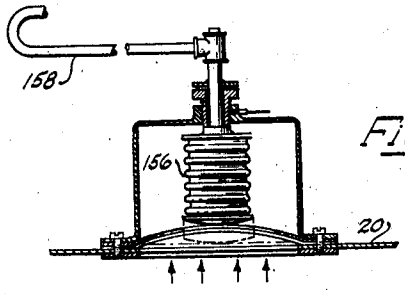


Fig. 15a

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March 26, 1935. I. I. SIKORSKY 1,995,905

LIFT INCREASING APPARATUS

Filed May 10, 1932 6 Sheets-Sheet 5

Fig. 15.

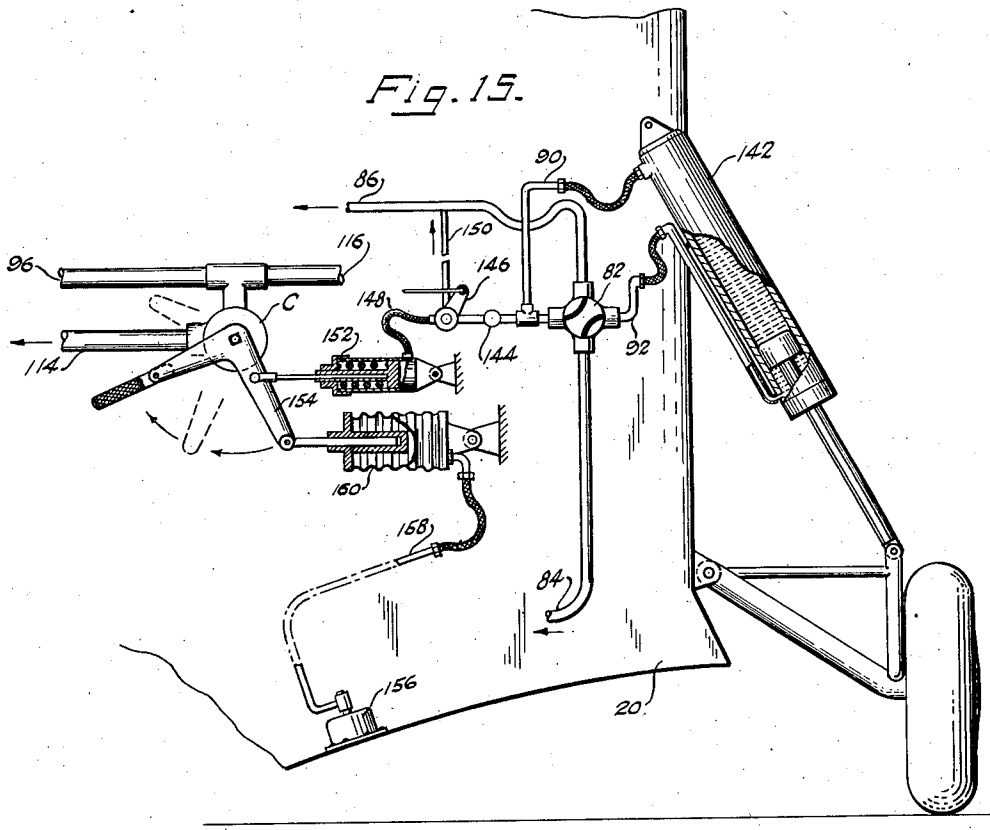
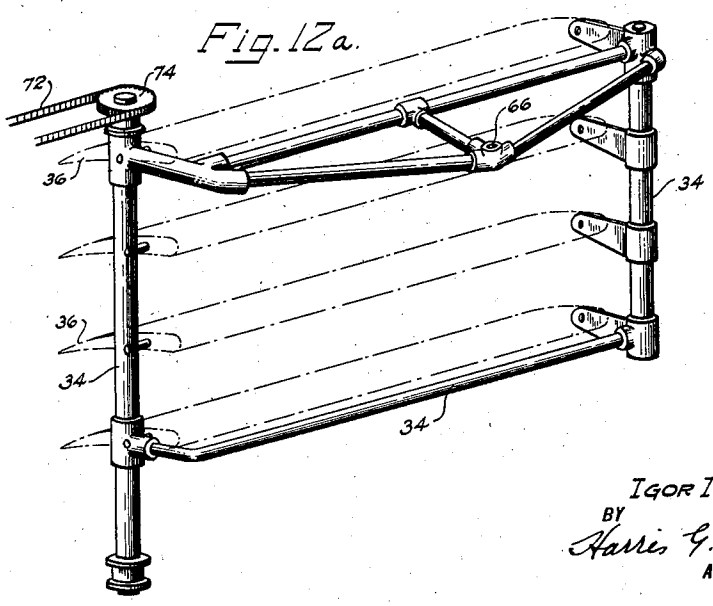


Fig. 12a.



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March 26, 1935. I. I. SIKORSKY 1,995,905

LIFT INCREASING APPARATUS

Filed May 10, 1932 6 Sheets-Sheet 6

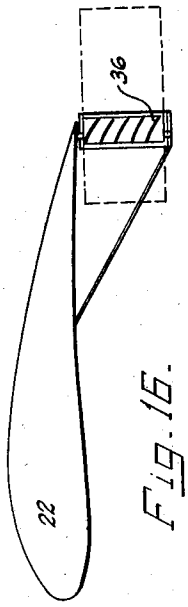


Fig. 16.

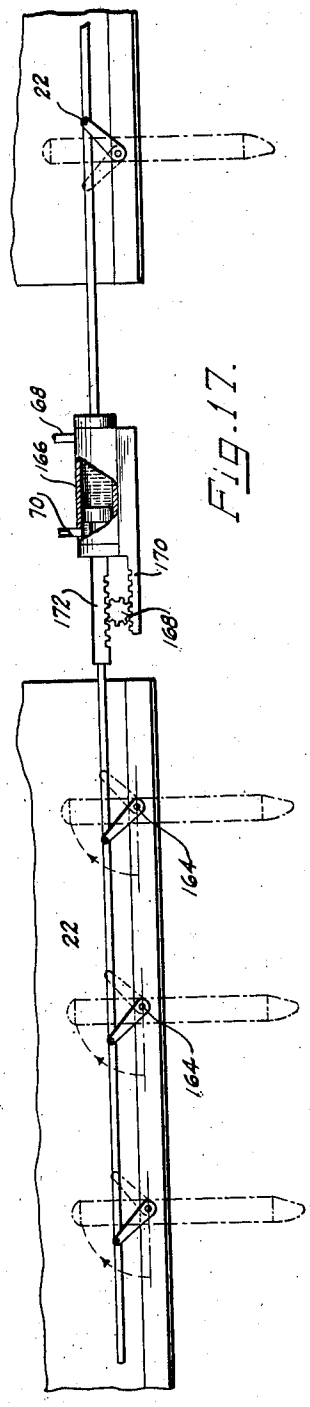


Fig. 17.

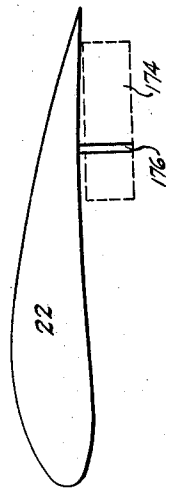
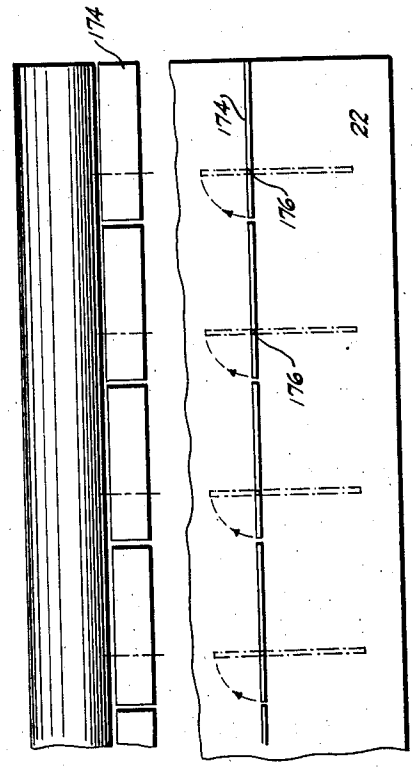


Fig. 18.



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Patented Mar. 26, 1935

1,995,905

UNITED STATES PATENT OFFICE

1,995,905

LIFT INCREASING APPARATUS

Igor I. Sikorsky, Nichols, Conn., assignor, by mesne assignments, to Sikorsky Aircraft Corporation, a corporation of Delaware

Application May 10, 1932, Serial No. 610,367

47 Claims. (Cl. 244—12)

This invention relates to means for improving the operating characteristics of aircraft. An object is to increase the lift coefficient and improve generally the operating characteristics of an aircraft. Further and other objects and advantages will be apparent from the specification and claims, and from the accompanying drawings which illustrate what is now considered the preferred embodiment.

Figure 1 is a top plan view of the device installed on a flying boat.

Figure 2 is a front elevation.

Figure 3 is a side elevation.

Figures 4–9 show the details of three types of deflectors.

Figure 10 is a plan view showing the means for swinging the deflector frame.

Figure 11 is a diagrammatic view partly in section, showing the means for swinging the deflector frame.

Figure 12 is a detail view of the means for operating the vanes in the frame.

Fig. 12*a* is a detail view of the deflector frame.

Figure 13 is a detail view of the hand operated relief valve.

Figures 14, 14*a*, 15, and 15*a* are detail views showing the automatic release devices.

Figures 16 and 18 show a modification of the deflector arrangement.

Figure 17 shows a means for operating the deflectors shown in Figures 16 and 18.

In the device shown in Figures 1–3, the hull or body is indicated by reference numeral 20, 22 indicates the wings, and 24 the ailerons. The obstruction or deflector 26 is pivoted at 28 upon the hull 20, and may be swung upon this pivot from a position adjacent the hull to a position adjacent and below the rear portion of the wing 22. In considering the action of an airfoil or wing, it has been found that the lift of a wing is equal to the product of a constant, the air density, the square of the air speed and a quantity which may be called the wing lift, and which is the product of the lift coefficient and the wing area. It is thus apparent that any increase in the lift coefficient or the wing lift makes a corresponding increase in the lift of the wing, if the other conditions remain constant, or, this increase in the lift coefficient, or the wing lift will permit a slower air speed with the other conditions remaining constant. When the obstruction is adjacent the wing, it acts to increase the lift coefficient of the wing, and permits slower landing speed or a higher wing loading for a given landing speed or a combination of both. The obstruction or deflector consisting of superimposed vanes or any equivalent structure offers a resistance to the stream of air and therefore increases the pressure below the wing. The pressure created forces the air through the openings between the vanes from which the air escapes in a substantially downward direction. The large mass of air going downward behind the trailing edge of the main wing influences in the desired direction, the air flow behind and above the wing and thereby improves the circulation around the wing. This improved circulation improves the lift of the wing at high incidence where this is most desirable. In this position, the deflector also causes an increase in drag and may be used as a brake to reduce the speed of the machine. When the obstruction is in a position adjacent the hull, it presents but a very small frontal surface to the moving air, and offers a minimum of resistance. In this position, it has little or no influence upon the wing, and the machine functions as a normal or ordinary airplane. A brace 30 attached at one end to the obstruction and pivoted at 32 to the hull may be provided as additional support for the obstruction.

The obstruction or deflector may be a flat plate or any suitable variation therefrom or a combination of several flat or other shaped plates hereinafter called vanes, a few of which are shown in Figures 4–8.

In Figures 4 and 5, 34 indicates a frame upon which movable vanes 36 may be pivoted. A bar 38 connects several vanes at one end, and is attached to each vane at point 40 so that motion of one vane is transmitted to all the others. The vanes are pivoted at 44 to a member 42 rigidly fastened to the frame 34. The vanes 36 may be biased in one direction by the tension springs 37, and their movement in the opposite direction may be limited by stops not shown. By this arrangement, the vanes are automatically closed when the air pressure on them is reduced so that they present a comparatively smooth surface of low resistance when they are retracted to a position adjacent the fuselage and substantially parallel to the line of flight. When the vanes are moved to a position adjacent the wing, the increased air pressure automatically opens the vanes and they then act to increase the air pressure under the wing and smooth the air flow above the wing.

Figures 6 and 7 show a modification comprising a frame 46 with plates bent and assembled to form a built-up structure resembling a honeycomb. Each group or layer of cells 48 is placed

at an angle to the frame and offset with relation to the adjacent group or layer of cells 48.

Figures 8 and 9 show another modification in which the vanes 50 are pressed from a single flat plate, and the plate is suitably reinforced as by rolling the edges 52 and forming channels in the plate as 54.

In each case, the frame supporting the vanes is hinged either to the body of the airplane or to the wing itself. The deflectors on each side of the body 20 may be connected by a chain 72, and sprockets 74 or other means so that movement of one deflector about the pivot 28 will cause a like movement of the other deflector about its pivot 28.

Figures 10 and 11 show a mechanism for operating the deflector. In each of these cases, this operating means is shown as comprising a hydraulic cylinder and piston, but other means may, if desired, be used to operate this device. No. 58 indicates the hydraulic cylinder, 59 the piston, 60 the piston rod. The cylinder is pivoted at 62 at a suitable point on the body, and the piston rod is pivoted at 66 to the obstruction. Nos. 68 and 70 indicate connections through which fluid pressure may be applied to either side of the piston 59 by proper manipulation of the valve 88. The pump 76 may be used to create the fluid pressure and may be the same pump that is used to operate the landing gear. A valve 80 is shown as adapted to direct the pressure either to the landing gear through conduit 84 or to the deflector operating mechanism through conduit 94 and a valve 78 is shown as adapted to direct pressure to either the deflector operating device through conduit 98 or through conduit 96 to the individual vane operating device, presently to be described, or to both of them. A shut-off valve 100 may, if desired, be placed in the line 98 to permit operation of the individual planes without operating the entire deflector. When pressure is applied through member 68, the deflector 26 is swung about its pivot 28 to a position adjacent the wing, and when pressure is applied through the conduit 70 or when the pressure is released from the conduit 68 and the inner side of piston 59, the deflector 26 is released from its position adjacent the wing. Pressure in the conduit 70 will force the deflector 26 to take a position adjacent the body of the airplane. By merely relieving the pressure in the conduit 68 in flight, the pressure exerted by the air upon the obstruction 26 will cause it to move from its position adjacent the airfoil.

As shown in Figure 12, the position of the vanes 36 may be controlled. The bar 38 connecting the several vanes is made adjustable for length by providing a threaded joint between each vane and its point of attachment to the several vanes is also made adjustable so that the various vanes may be given the same or different angles of attack. The position of the vanes 36 may be controlled by the cylinder 102 containing piston 104 and adapted to be actuated by fluid pressure, preferably hydraulic pressure. The cylinder 102 is pivotally mounted on frame 34 and the piston rod 106 is connected to the arm 108 which in turn is connected to vane 36. A compression spring 110 acting on the piston 104 tends to keep the vanes in the position of least resistance, approximately parallel to the main wing, as shown in full lines in Figure 12. Pressure may be applied under the piston through pipes 96 and 116 by means of the pump 76 or other suitable means and the piston 104 moving under this pressure will compress spring 110 and move the vanes 36 to a position at an angle with the main wing 22. The movement of the piston 104 is limited by the stop 112. In order to again bring the vanes 36 to their inoperative position, approximately parallel to the airfoil 22, the pressure under the piston 104 may be released by manual operation of the valve A shown in detail in Figure 13. Manual operation of the bell crank 120 lifts valve 118 against spring 122 and connects the line 116 with line 114 which in turn is connected with the vented storage tank 124. The pressure under piston 104 is thereby relieved, and spring 110 restores vanes 36 to their inoperative position.

In order to avoid undue strain which might be produced upon the deflector by air pressure, due to the high air speed of the airplane, automatic releasing means may be provided. This releasing means may take several forms, one of which might be an automatic relief valve 125 in the conduit 68. This relief valve is set at a predetermined pressure so that, when the airplane reaches a certain air speed, the pressure induced by the deflector in the conduit 68 is relieved and the obstructions are automatically removed from their position adjacent the wing.

Another, and the form now preferred, is shown in Figure 14. A plate 126 is placed in the air stream of the aircraft. A rod 128 connects this plate with a sylphon bellows 130 which is, through conduit 132, connected to another sylphon bellows 134, which in turn is connected to arm 136 of valve B. Valve B is also provided with another arm 138, preferably integral with arm 136, and to which is secured a toggle spring 140, which tends to hold the valve B in the positions shown by full and dotted lines in Figure 14. Actuation of the sylphon 134 moves the valve arm 136 from the full to the dotted line position shown in Figure 14, thus placing the valve passages in the position shown in Figure 14*a*, connecting pipes 116 and 114. The pressure in pipe 116 is thereby relieved and the vanes then assume their inoperative position, as above indicated. Pipe 68 may be connected with pipes 96 and 116 through proper manipulation of valves 88 and 78. Actuation of valve B to relieve the pressure in pipe 116 would then also relieve the pressure in pipe 68 and permit removal of the entire deflector as well as the individual vanes from their operative position. The relief valves are enclosed by dash lines in Figure 11 and in Figure 12.

In order to avoid the dangerous phenomena of leaving the landing surface after having made contact therewith in landing or "bouncing", automatic means are provided for releasing the deflector 26 at the moment contact is made with the landing surface. This means may take several forms, one of which is a valve adapted to be operated by the increase in pressure of the fluid in a hydraulic landing gear or on the bottom of the boat. As soon as the wheels touch the ground, the pressure in the cylinder 142 is increased, which pressure is transmitted through pipe 90, valves 144 and 146 and pipe 148 to a cylinder and piston device adapted to actuate arm 154 of valve C, which valve is identical with valve B and will not be further described, to the dotted line position of Figure 15 and relieve the pressure in line 116. When the boat alights on water the sylphon bellows 156 is actuated by the pressure of the water on the hull bottom. Pres-

sure is transmitted through pipe 158 to sylphon 160 which in turn actuates arm 154 to open valve C. The landing gear may be any fluid type landing gear, but is preferably similar to that described in my co-pending applications, Serial No. 314,585 and Serial No. 354,552. Valve 144 is a shut-off valve which may be used to separate pipe 148 and cylinder 152 from the landing gear and valve 146 may be operated to connect pipe 148 with pipe 86, which is connected with the storage tank, and thus relieve the pressure in the cylinder 152 to allow the valve C to be restored to its closed position.

Figure 16 shows two views of a modification of my vanes in which the vanes 36 are supported in the frames 34 as in the previously described modification, but the frames are pivoted in a stationary frame 162 attached to the rear portion of the airfoil. The frames 34 and their vanes 36 are adapted to be swung on vertical pivots from positions substantially perpendicular to the line of flight to a position substantially parallel to the line of flight by means of a piston and cylinder device 166, the piston of which is connected to rack 172 and the cylinder of which is connected to rack 170. A gear 168 is between and meshes with both racks and is rotatably secured to a fixed portion of the aircraft, so that equal movement of the vanes on each side of the plane is secured. The cylinder and piston device 166 may be actuated by pressure through pipes 68 and 70, the same as cylinder 58 and piston 59 were operated. It will, of course, be understood that the vanes 36 may, if desired, also be operated by a cylinder 102 and piston 104 as shown in Figure 12.

Figure 18 shows another modification in which the deflectors 174 are flat plates and are attached to the wing forward of the trailing edge. They may be operated by the mechanism shown in Figure 17 and are adapted to swing about axis 176 to and from operative position.

In the operating mechanism shown, the pump and storage tank normally used with the landing gear, as shown in the aforementioned copending applications, has been illustrated, but it is obvious that a separate tank or a separate pump or both might be used for operating the vanes. While the vane and deflector operating mechanism has been shown as hydraulically controlled, pneumatic, mechanical or electrical means might, if desired, be used to accomplish the same result and such devices are to be considered as within the range of equivalents.

If desired the frame 34 which supports the vanes 36 may be rigidly fastened to the wing structure, or the boat structure or both and the deflector rendered operative and inoperative by manipulation only of the vanes in the frame. The same result may be accomplished by turning the deflector 26 to the position indicated in dotted lines in Fig. 11 or the full lines in Fig. 16 and allowing it to remain in that position, varying the effect of the deflector by movement only of the vanes 36 in the frame 34. The manipulation of the vanes may be by the air pressure under the wing using a device similar to that shown in Fig. 5 or controlled mechanically or otherwise as in Fig. 12 or it may be a combination of both. The lift is increased by turning the vanes across the line of flight and decreased by turning them parallel to the line of flight.

In another modification the frame 34 containing the vanes 36 as shown in Fig. 5 is pivoted to the underside of the wing on an axis extending longitudinally of the wing and the vanes and is brought into and out of operative positions by oscillation about that axis. When the frame is folded back adjacent to the wing the vanes would assume a closed position under the influence of springs 37 and together with the frame be substantially parallel to the air stream in which they are operating. Their resistance would then be at a minimum value. In order to obtain an increase in lift the frame would be swung to a position substantially normal to the line of flight. The air pressure would then open the vanes and produce the desired air flow and increase in lift.

While I have shown but one landing gear shock absorber in the drawings, others may be connected as shown in my aforementioned copending applications. Line 116, supplying the pressure to operate the vanes, may be connected to all the vane operating cylinders and pipes 68 and 70 connected to the cylinder operating the entire set of vanes or deflectors on one side may be connected to both operating cylinders and thus operate both deflectors. The deflectors have been shown as arranged substantially perpendicular to the lower surface of the airfoil but they may be arranged at an angle more or less than 90° if found desirable.

The operation of the lift increasing device will be understood from the above description and drawings but it will be briefly repeated: In order to take off, the vanes are set in their operative position by supplying pressure to the line 116 and the group of vanes are placed adjacent the rear portion of the wing by supplying pressure to the line 68. In this position. the vanes act to increase the pressure below the wing and improve the air flow over the wing. When sufficient speed, say 90 miles per hour, has been attained, if the vanes have not previously been released by operation of relief valve A, thus releasing the pressure in both line 116 and 68, valve 88 being turned 90° from the position shown in Figure 11, the air pressure against plate 126 would, through the intermediate mechanism 128, 130, 132, 134 and 136 operate valve B and relieve the pressure, through line 114 connected with the vented storage tank 124, just the same as if valve A had been operated. Release of the pressure in line 116 allows the vanes to assume the position shown in full lines in Figure 12, due to the air pressure on the vanes and due to spring 110. Upon release of the pressure in line 68, the deflectors swing back toward the hull, due to the air pressure on the deflectors. If the deflectors do not go all the way back, pressure may be supplied to line 70 by placing valves 88 and 80 in the position shown in Figure 11 and setting valve 78 so that pressure will not be supplied to line 96. Operation of the pump will then force the deflector back. Other methods of operating the valves to render the vanes inoperative will be apparent to anyone familiar with hydraulic actuating mechanisms.

To bring the device to operative position, valve 88 is turned 90° from the position shown in Figure 11 and valve 78 is adjusted so that pipe 96 is cut off from pipe 94. With the valve 80 in the position shown in Figure 11, operation of the pump will create a pressure in line 68 and cause the deflector to assume the position shown in dotted lines in Figure 11. Valve 100 may be operated to hold the deflector in this position and valve 78 may then be turned so that pressure will be sup-

plied to line 116, and the vanes forced to the dotted line position of Figure 12. Pressure may, if desired, be simultaneously applied to both line 68 and line 116 with the same final result.

Upon landing, water pressure on the hull acting through sylphon 156 or fluid pressure above the shock absorber acting through cylinder 152 operates valve C the same as disc 126 operates valve B, and relieves the pressure holding the vanes in operative position, and they then assume an inoperative position as previously explained.

It is to be understood that the invention is not limited to the specific embodiment herein illustrated and described, but may be used in other ways without departure from its spirit as defined by the following claims.

What I claim as new and desire to secure by Letters Patent is:

1. In an aircraft, in combination, an airfoil, and means for increasing the lift coefficient of said airfoil, comprising a plurality of superimposed vanes positioned adjacent and under the rear part of the airfoil.

2. Means for increasing the lift of an airfoil comprising a plurality of superimposed vanes adapted to be placed adjacent and under the airfoil.

3. In an aircraft, in combination, an airfoil, and a frame adjacent and below said airfoil, vanes pivoted in said frame, means for moving said vanes in said frame and means for moving said frame on an axis substantially perpendicular to said airfoil.

4. An airfoil, a deflector adapted to be placed adjacent said airfoil, said deflector comprising a plurality of independently supported vanes adapted to oscillate on an axis longitudinal of said airfoil, between inoperative and operative positions, means for moving said vanes between said positions, said vanes being substantially parallel to the line of flight when in inoperative position and arranged at different positive angles of attack and in spaced relation when in operative position.

5. In an aircraft, in combination, an airfoil, and means for increasing the lift coefficient of said airfoil, comprising a plurality of plane surfaces assembled in honeycomb formation adjacent and below the rear position of said airfoil.

6. In an aircraft, an airfoil, means for increasing the lift coefficient of said airfoil, comprising a perforated deflector adjacent said airfoil, and a pivot about which said deflector may swing about a substantially vertical axis from a position substantially parallel to the line of flight to a position substantially perpendicular to the line of flight.

7. In an aircraft, an airfoil, a movable obstruction adjacent said airfoil, means for preventing movement of said obstruction and means for disabling said preventing means substantially at the moment of landing.

8. In an aircraft, an airfoil, a movable obstruction adjacent said airfoil, means resisting movement of said obstruction, and means responsive to the speed of the aircraft for disabling said resisting means.

9. In an aircraft, an airfoil, an obstruction adjacent said airfoil, means resisting movement of said obstruction and means responsive to an increase in pressure upon said obstruction for disabling said resisting means.

10. In an aircraft, an airfoil, means for increasing the lift coefficient of said airfoil, comprising a deflector adapted to be placed adjacent and below said airfoil, said deflector comprising a plurality of vanes, each vane adapted to oscillate about an axis longitudinal of the vane, means connecting said vanes so that they will operate simultaneously, means biasing said vanes in one direction, means for swinging said deflector upon a vertical axis from a position substantially parallel to the line of flight to a position substantially perpendicular thereto, said last named means comprising a cylinder and piston construction and means for supplying pressure to either side of said piston and relieving the pressure on the other side.

11. In combination with means for operating the landing gear of aircraft, means for operating a plurality of deflectors adapted to increase the lift of said aircraft, a storage tank and a pump common to both means and a valve adapted to connect either means with said pump.

12. In combination, an airfoil, means for increasing the lift of said airfoil, comprising a perforated deflector adjacent and below said airfoil and secured thereto, means for moving said deflector upon an axis substantially normal to said airfoil from a position substantially parallel to the line of flight to a position substantially perpendicular thereto, said deflector comprising means for directing in a downwardly inclined direction air passing through the perforations.

13. In an aircraft, in combination, an airfoil and means for increasing the lift of said airfoil, comprising a perforated obstruction adjacent and under the rear part of said airfoil, said obstruction having means to direct in a downward and backward direction the air passing through said obstruction.

14. In an aircraft, in combination, an airfoil and means for increasing the lift coefficient of said airfoil, comprising a plurality of vanes contiguous to and under the rear part of the airfoil, said vanes all extending in the same general direction and directing air passing therebetween in a downward path to thereby assist the smooth flow of air over said airfoil.

15. In an aircraft, in combination, an airfoil and means for increasing the lift coefficient of said airfoil, comprising a plurality of individually pivoted vanes contiguous to and below the rear part of the airfoil and hinge means fixed with respect to said airfoil about which said vanes may bodily oscillate.

16. Means for increasing the lift of an airfoil, comprising a plurality of superimposed vanes, means for placing said vanes in position adjacent and below said airfoil while in flight, and means for removing said vanes from said position to a position to the rear of said airfoil.

17. In an aircraft, in combination, an airfoil and means for increasing the lift coefficient of said airfoil, comprising a plurality of superimposed individually, independently pivotally supported vanes arranged adjacent and below said airfoil, means for moving said vanes from a position in which they are substantially parallel to the path of air passing under said airfoil to a position in which each vane is arranged at a different positive angle of attack.

18. In combination with an airfoil, means for increasing the lift coefficient of said airfoil, comprising a plurality of superimposed vanes arranged adjacent and below said airfoil, means for

airfoil, and means for moving said vanes from a position in which they are substantially parallel to the path of air passing under said airfoil to a position in which each vane is arranged at a positive angle of attack.

19. In an aircraft, in combination, an airfoil and a frame adjacent and below said airfoil, vanes pivoted in said frame, means for positively moving said vanes in said frame and means for moving said frame upon an axis fixed with respect to said airfoil.

20. In an aircraft, in combination, an airfoil and means for increasing the lift coefficient of said airfoil, comprising a frame adjacent and below said airfoil, vanes pivoted in said frame and means for positively moving said vanes about their pivots in said frame.

21. An airfoil, a deflector, means to hold said deflector stationary contiguous to and below the rear portion of said airfoil, said deflector comprising a plurality of vanes, means to oscillate each vane on an axis longitudinal of said airfoil from an inoperative to an operative position while said deflector is held stationary, said vanes all being arranged at a positive angle of attack and in spaced relation when in operative position.

22. In an aircraft, in combination, an airfoil and means for increasing the lift coefficient of said airfoil, comprising a plurality of plane surfaces asembled in honeycomb formation adjacent said airfoil, said plane surfaces being arranged at a positive angle of attack.

23. In an aircraft, in combination, a body, an airfoil and means for increasing the lift coefficient of said airfoil comprising a plurality of superimposed vanes, means for moving said vanes upon a substantially vertical axis from a position adjacent said body to a position adjacent and below the rear part of said airfoil.

24. In an aircraft, in combination, a body, an airfoil and means for increasing the lift coefficient of said airfoil, comprising a plurality of superimposed vanes, fluid pressure means for moving said vanes from a position adjacent said body to a position adjacent and below the rear part of said airfoil and/or vice versa.

25. In an aircraft, in combination, an airfoil, means for increasing the wing lift of said airfoil and means responsive to a function of the aircraft in landing for reducing the effectiveness of the wing lift increasing means.

26. In an aircraft, in combination, an airfoil, means for increasing the lift coefficient of said airfoil, means responsive to a function of the aircraft in landing for reducing the effectiveness of the lift coefficient increasing means.

27. In an aircraft, in combination, an airfoil, a movable obstruction adjacent said airfoil, means for preventing movement of said obstruction and means operable responsive to a function of the aircraft in landing to disable said preventing means.

28. In an aircraft, in combination, an airfoil, a plurality of superimposed vanes arranged in a position adjacent said airfoil and at a positive angle of attack, means for holding said vanes in said position and means operably responsive to a function of the aircraft in landing to disable said holding means.

29. In an aircraft, in combination, an airfoil, a movable lift increasing means adjacent said airfoil, means for preventing movement of said lift increasing means and means responsive to a function of the aircraft in landing for automatically disabling said preventing means substantially at the moment of landing.

30. In an aircraft, in combination, an airfoil, a movable obstruction adjacent and below the rear portion of said airfoil, means for preventing movement of said obstruction and means responsive to a function of the aircraft in landing for automatically disabling said preventing means substantia ly at the moment of landing.

31. In an aircraft, in combination, an airfoil, an obstruction adjacent said airfoil, means resisting movement of said obstruction, means responsive to the air speed of the aircraft for automatically disabling said resisting means when the pressure on said obstruction exceeds a predetermined value.

32. In an aircraft, in combination, an airfoil, means for increasing the lift of said airfoil and means responsive to the speed of the aircraft for reducing the effectiveness of the lift increasing means.

33. In an aircraft, in combination, an airfoil, a plurality of superimposed vanes arranged in a position adjacent said airfoil and at a positive angle of attack, means for holding said vanes in said position and means operably responsive to the speed of the aircraft to disable said holding means.

34. In an airplane, means for increasing the lift of an airfoil comprising in combination an airfoil, a plurality of superimposed vanes associated therewith, the trailing edge of each vane located above and behind the leading edge of the next lower vane, and means for placing said vanes in a position adjacent and below said airfoil while the airplane is in flight to direct air away from said airfoil.

35. In an aircraft, in combination, an airfoil, a movable deflector for increasing the lift of said airfoil, hydraulically operated means for moving said deflector to increase the lift of said airfoil, means operatively connected with said hydraulically operated means and responsive to a function of the aircraft in landing for reducing the effectiveness of said deflector as a lift increasing means.

36. In an aircraft, in combination, an airfoil, a movable deflector for increasing the lift of said airfoil, hydraulically operated means for moving said deflector, means for supplying liquid under pressure to said hydraulically operated means to move said deflector to increase the lift of said airfoil, and means responsive to a function of the aircraft in landing for relieving the pressure in said hydraulic means and reducing the effectiveness of said deflector as a lift increasing means.

37. In an aircraft, in combination, an airfoil, a movable deflector for increasing the lift of said airfoil, hydraulic means including an expansible pressure chamber for moving said deflector to increase the lift of said airfoil and means operatively connected with said chamber and responsive to a function of the aircraft in landing for reducing the effectiveness of said deflector as a lift increasing means.

38. In an aircraft, in combination, an airfoil, a movable deflector for increasing the lift of said airfoil, means comprising a piston and cylinder construction for moving said deflector, means for introducing fluid under pressure into said piston and cylinder construction for moving the deflector to increase the lift of said airfoil, and means responsive to a function of the aircraft in

landing for relieving the pressure in said piston and cylinder construction to reduce the effectiveness of said lift increasing deflector.

39. In an aircraft, in combination, an airfoil, a deflector mounted to move about a pivot to a lift increasing position to increase the lift of said airfoil, hydraulically operated means for moving the deflector about its pivot to lift increasing position, means for supplying liquid under pressure to said hydraulically operated means and means responsive to a function of the aircraft in landing for releasing liquid from said hydraulically operated means for reducing the effectiveness of said deflector.

40. In an aircraft, in combination, an airfoil, a movable deflector adapted in one position to increase the lift of said airfoil, hydraulic means for holding said deflector in lift increasing position and means responsive to a function of the aircraft in landing for rendering said hydraulic means inoperative.

41. In air aircraft, in combination, an airfoil, a movable deflector adapted in one position to increase the lift of said airfoil, fluid pressure operated means including an expansible pressure chamber for holding said deflector in lift increasing position, means for maintaining fluid pressure in said chamber for holding said deflector in said position and means responsive to a function of the aircraft in landing for relieving the fluid pressure in said chamber.

42. In an aircraft, in combination, an airfoil, a movable deflector adapted in one position to increase the lift of said airfoil, hydraulic pressure operated means, including a piston and cylinder construction, operatively connected with said deflector, means for holding a predetermined volume of liquid under pressure in said piston and cylinder construction to hold said deflector in said position and means responsive to a function of the aircraft in landing for releasing liquid from said piston and cylinder construction.

43. In an aircraft, in combination, an airfoil, a movable deflector adjacent said airfoil for increasing the lift of said airfoil, fluid operated means, comprising an expansible fluid pressure chamber, operatively connected to said deflector, means for introducing fluid under pressure into said chamber for moving the deflector to increase the lift of said airfoil and means responsive to the air speed of the aircraft for relieving the pressure in said chamber for reducing the effectiveness of said deflector.

44. In an aircraft, in combination, an airfoil, a deflector mounted to move about a pivot to a lift increasing position to increase the lift of said airfoil, hydraulically operated means for moving the deflector about its pivot to lift increasing position, means for supplying liquid under pressure to said hydraulically operated means and means responsive to the air speed of the aircraft for releasing liquid from said hydraulically operated means for reducing the effectiveness of said deflector.

45. In an aircraft, in combination, an airfoil, a movable deflector adapted in one position to increase the lift of said airfoil, hydraulic pressure operated means, including a piston and cylinder construction, operatively connected with said deflector, means for holding a predetermined volume of liquid under pressure in said piston and cylinder construction to hold said deflector in said position, and means responsive to the air speed of the aircraft for releasing liquid from said piston and cylinder construction to reduce the effectiveness of said deflector as a lift increasing means.

46. In an aircraft, in combination, an airfoil, a movable deflector adapted in one position to increase the lift of said airfoil, fluid pressure operated means, including an expansible pressure chamber, for holding said deflector in lift increasing position, means for maintaining fluid pressure in said chamber for holding said deflector in said position, and means responsive to the air pressure on said deflector for relieving the fluid pressure in said chamber.

47. In an aircraft, in combination, an airfoil, a movable deflector adapted in one position to increase the lift of said airfoil, hydraulic pressure operated means including a piston and cylinder construction operatively connected with said deflector, and means for holding a predetermined volume of liquid under pressure in said piston and cylinder construction to hold said deflector in said position and means responsive to air pressure on said deflector for releasing liquid from said piston and cylinder construction.

IGOR I. SIKORSKY.