

W. J. & F. A. BOND.

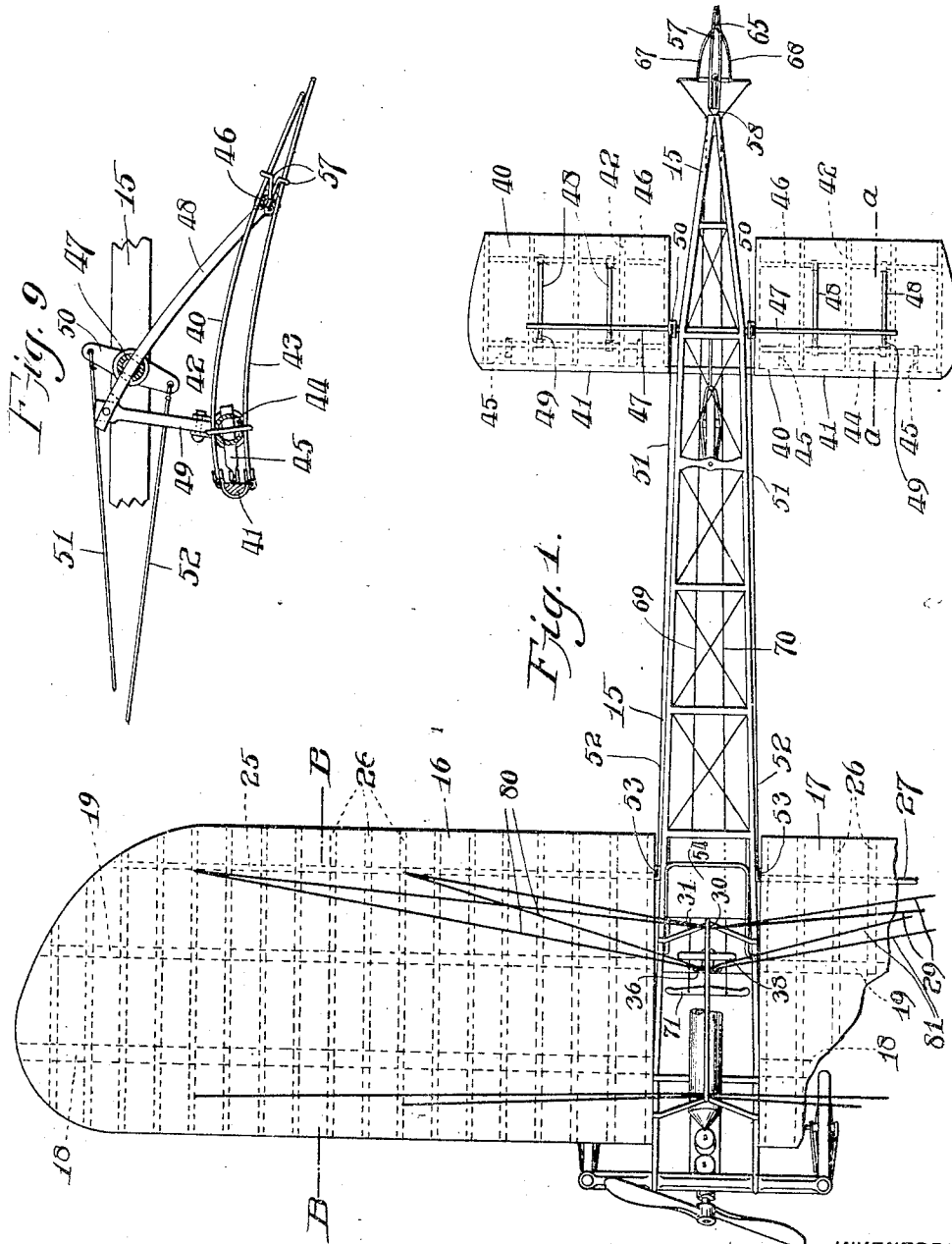
AEROPLANE.

APPLICATION FILED JAN. 13, 1912.

Patented Apr. 29, 1913.

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WITNESSES

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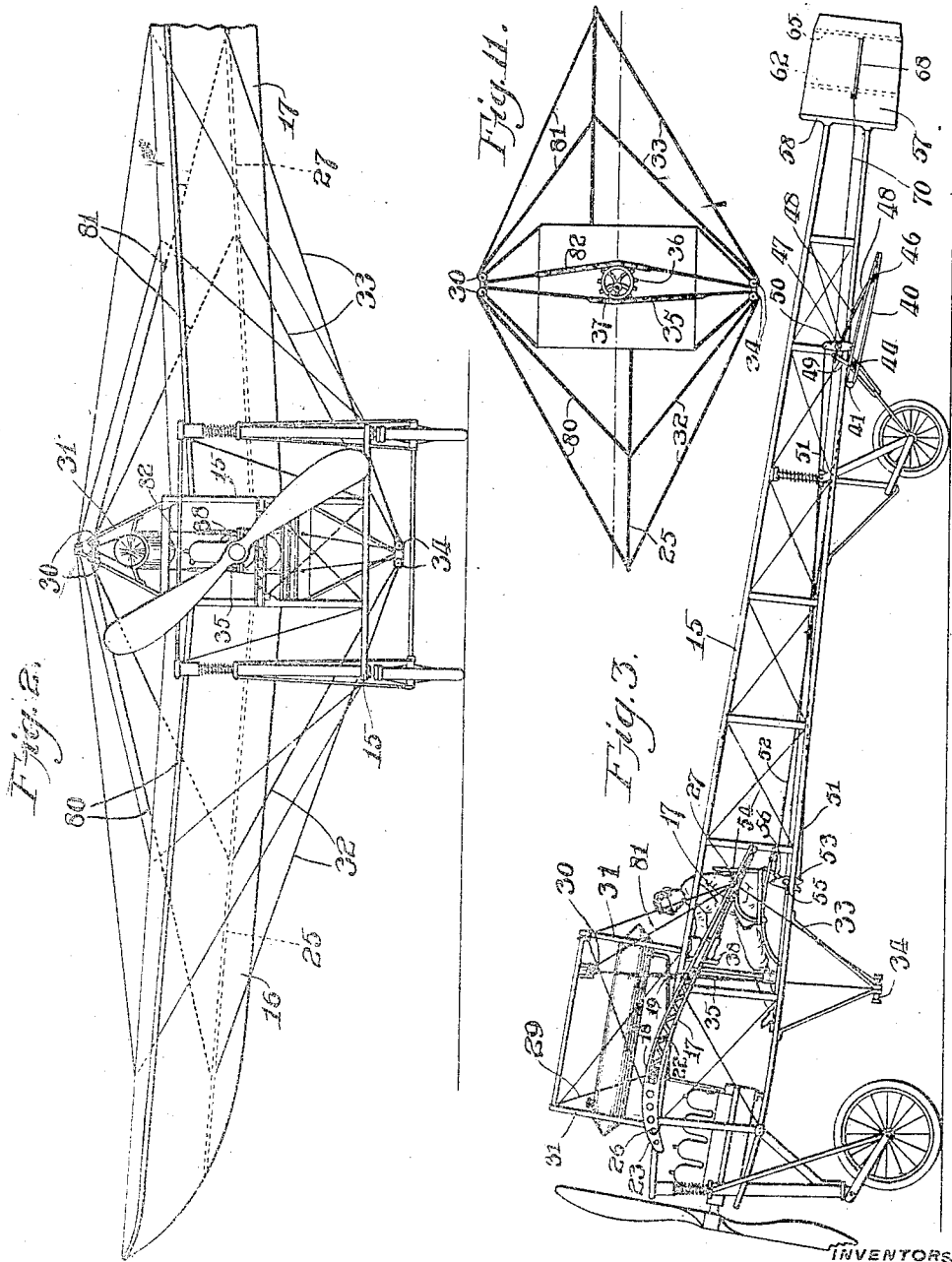
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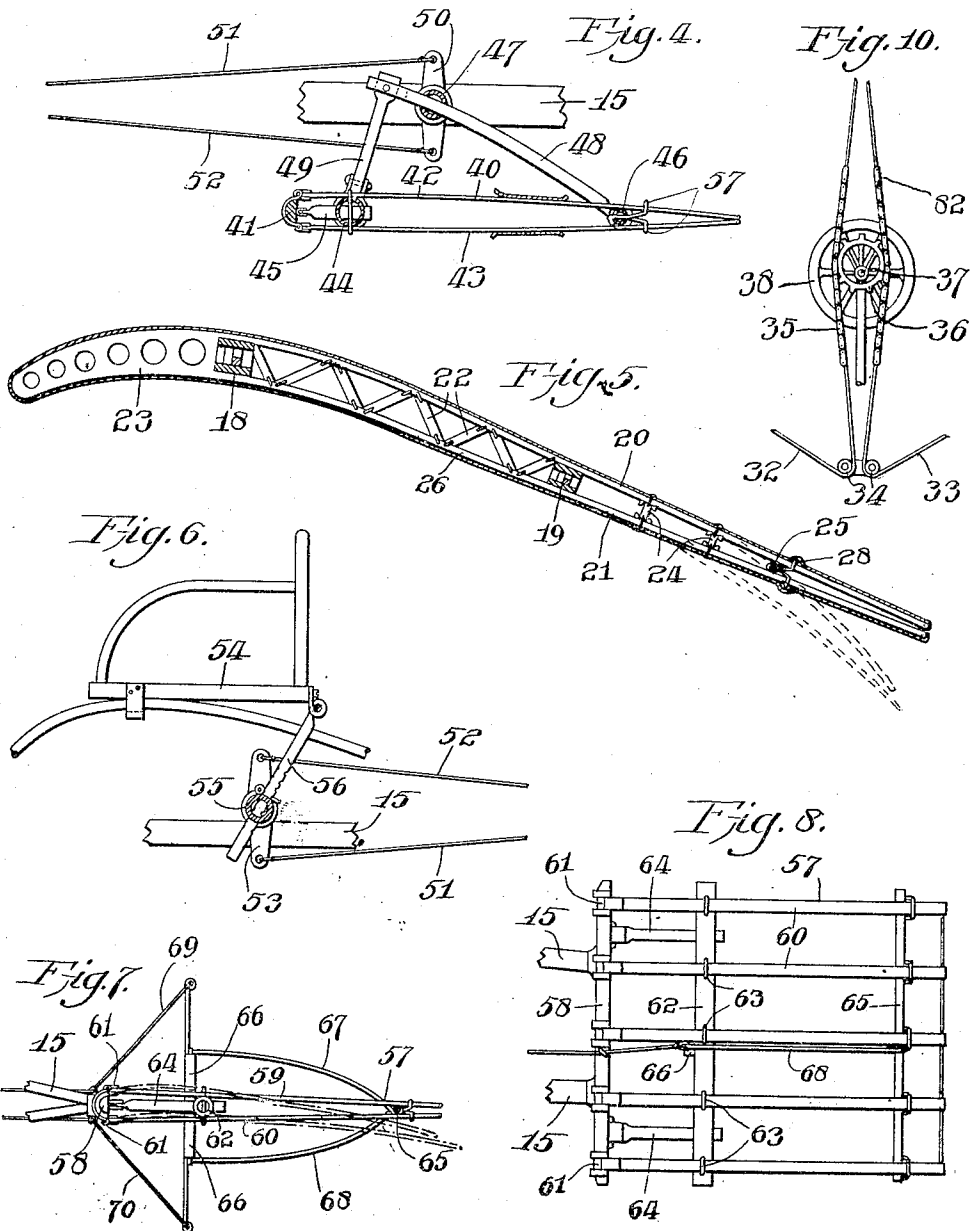
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UNITED STATES PATENT OFFICE.

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AEROPLANE.

1,060,530.

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To all whom it may concern:

Be it known that we, WILLIAM J. BOND and FREDERICK A. BOND, citizens of the United States, and residents of Clifton Heights, in the county of Delaware and State of Pennsylvania, have invented certain new and useful Improvements in Aeroplanes, of which the following is a specification.

Our invention relates to improvements in aeroplanes, and the objects of our invention are, first, to furnish an improved construction of the air engaging surfaces, by which we mean the main wings, the wing or plane for directing the rising or falling of the machine, and the rudder, whereby these parts may accomplish their purposes in a manner superior to that accomplished by any of the constructions at present in use. Second, to provide a sliding or movable seat for the operator so connected with the rear wing or plane which governs the rising or falling of the machine that the instinctive movement of the operator, backward if the front of the machine in flight tilts down, forward, if it tilts up, will not only cause a longitudinal change in the center of gravity of the machine but will at the same time, through the connections between the seat and plane, curve the plane properly to correct its flight. Third, to so connect the main or forward wings of the machine that they will themselves automatically correct the tendency of the machine to turn sidewise when these wings are warped to bring the machine into a horizontal position. Fourth, to so construct the rear, or elevating and depressing, plane and the rudder, that they will have at all times a true aero, or parabolic, curve, sharp at its forward end and more gradual toward its rear.

Our invention will be described in connection with the Bleriot type of monoplane but it will be understood that it may be used, in whole or in part, with any of the other well known types of monoplane or biplane.

Briefly speaking our invention consists in so constructing the main wings, the elevating or depressing plane, and the rudder, either one or all, in such a manner that their rear portions may be bent or curved transversely, the two former either up or, down

and the latter to either side, so as to present an unbroken curved surface to the air for the purpose of balancing the machine, for elevating or depressing it or for steering it. The main wings are so connected to the device that controls their curvature that when the rear surface of one wing is curved upward the rear surface of the other wing is curved downward, but to a lesser degree, and as we depend principally upon these wings for maintaining the horizontal balance of the machine as well as supporting it in the air, the possibility of curving them vertically in different directions simultaneously will result in the air acting to lift one wing and to depress the other wing when they are so operated. If the machine be moving through the air steadily with the main wings horizontal no manipulation of the main wings is required, but if it rocks so that one wing is lowered and the other raised the rear surface of the lower wing is curved downward and the rear surface of the upper wing is simultaneously curved upward with the result that the lower wing is instantly raised while the higher one is instantly lowered.

The rear surface of the elevating or depressing plane can likewise be curved up or down. If it be curved up the pressure of the air against it will act to depress it and the rear part of the machine, hence the machine will rise. If the rear surface of this plane be curved downward the rear part of the machine will be raised and the front part lowered and the machine will fall.

Our rudder is rigidly fastened to the main frame of the machine and guides it in flight to the right or left by being bent to the right or left, a comparatively slight bending of the rudder causing an immediate change in the direction of flight.

Our invention is illustrated in the accompanying drawings in which similar numerals of reference indicate similar parts throughout the several views and in which—

Figure 1, is a plan view of an aeroplane embodying our improvements, part of one of the main wings being broken away; Fig. 2, a front elevation of Fig. 1; Fig. 3, a side elevation of Fig. 1; Fig. 4, a section on an enlarged scale, through the rear, or elevating, plane on a line *a—**a*, Fig. 1; Fig. 5, a

section on an enlarged scale, through a main plane on a line B—B, Fig. 1; Fig. 6, a side elevation of seat showing connection thereto of lever which operates cables leading to means for changing curvature of elevating plane; Fig. 7, a plan, upon an enlarged scale, of the flexible rudder; Fig. 8, a side elevation of Fig. 7; Fig. 9, a side elevation, somewhat distorted, showing the curved shape of the elevating or depressing plane, and the rudder when bent; Fig. 10, a front elevation of parts of wires, pulleys and sprocket wheel for bending rear ends of main wings. Fig. 11, a diagrammatic view of the machine showing the rear portions of the main wings bent one up the other down.

15 is the main frame of the machine which carries the engine, the several wings and rudder, and the operator, it may be of any suitable construction and will not need detailed description.

16—17 are the main or supporting wings which are substantially horizontally disposed. They consist each of a front spar 18 and a rear spar 19, dividing the wings longitudinally into three sections of approximately equal width, which are suitably secured to the main frame 15, and of curved ribs 26, consisting each of two members 20—21 between and to which the spars are secured. Between the two spars the ribs 20—21 are strengthened by bracing 22, in front of the front spar 18 the ribs carry, preferably, a solid end 23, which is preferably perforated as shown in Fig. 5 for lightness, and to the rear of the rear spar 19 the ribs may be connected by clips 24 which prevent them from separating but which are so arranged as to permit a slight sliding of the ribs when their parts to the rear of spar 19 are bent upward or downward. At their extreme rear ends the two ribs are not connected but touch, or nearly touch, each other as shown in Fig. 5.

25—27 are rods extending lengthwise one of one main wing the other lengthwise of the other main wing. These rods are placed between the two members 20—21 forming the upper and lower parts of the ribs. The rods are secured to the rib members by spring connections 28 which consist simply of U-shaped pieces of wire the ends of which are secured to the rods and the rights of which pass over the strips 20—21.

To the rod 25 of the wing 16 are secured cables or wires 80, of which there may be any suitable number, one, two, or more, the inner ends of which are secured to the upper end of a sprocket chain 35. 32 are cables or wires, also secured to rod 25, the inner ends of which are secured to the lower end of sprocket chain 35. The sprocket chain, or the cables, pass over pulleys 30—34 carried by the main frame of the machine.

To the rod 27 of the wing 17 are secured cables or wires 81 the inner ends of which are secured to the upper end of a sprocket chain 82. 33 are cables or wires, also secured to rod 27, the inner ends of which are secured to the lower end of sprocket chain 82. The chain 82 or the cables 33—81 pass over pulleys 30—34 similar to those for the chain 35 or cables 32—80.

36 is a sprocket wheel eccentrically carried by a shaft 37 which carries an operating wheel 38, as shown in Fig. 10. The chain 35 is in mesh with the teeth upon one side of the wheel 36, the chain 82 with the teeth upon the opposite side of this wheel and when the flexible parts of the two wings are in their normal, or unbent, position the sprocket wheel is in the position shown in Fig. 10. If the machine tilts to the right it is brought back to the horizontal by operating the sprocket wheel to cause the chain 35, through the cables or wires 32, to bend down the after side of the right wing 16 and the chain 82, through the wires or cables 81, to lift the flexible part of the left wing 17.

The effect of the bending or warping the wings equally is not only to cause the machine to right itself but also to turn to the right if the right wing be lowered, to the left if the left wing be lowered, and in order to counteract this turning we not only warp or bend the two wings simultaneously but we bend one wing up to a greater degree than we bend the other one down. This is performed automatically by the eccentrically mounted sprocket wheel 36 a rotation of which in either direction, causes the sprocket wheel to move one of the chains which it operates to a greater degree than the other.

The bending of the wings causes them to offer more resistance to the air than when in their normal position and the greater the bending the greater the resistance, hence when the machine tilts, if the upper wing be bent or warped to a greater degree than the lower, it will offer greater resistance to the air than the lower and the tendency of the machine to turn in the direction of the lowered wing will be counteracted.

When one of the rods 25—27 is pulled up or pulled down it pulls up or down with it the after ends of the transverse frame 26 of the wings, that is to say it bends up or down that part of these frames which lie to the rear of the rear spars 19.

The rear end of the frames 26 are each constructed of the two superposed pieces 20—21 preferably constructed of thin strips of tough elastic wood; at their after ends the two strips 20—21 are free and when these ends are bent up or down by raising or lowering the rods 25—27 they take a curved form as indicated by dotted

lines in Fig. 5. It has been found that a comparatively slight curving of the entire after ends of the wings, the one in one direction and the other in the other direction, accomplishes our ends perfectly and quickly.

We find it advisable to cover both the top and the bottom of the wings with a fabric so that a smooth unbroken surface is presented at all points to the air. At the after ends of the wings the strips 20—21 are separately covered with fabric so as to permit a bending of these strips without liability of straining either them or the covering or causing the latter to wrinkle when the sticks are bent.

It will be observed that each of our wings are separate and that they do not extend across the main frame 15 and while this construction may not be necessary we prefer it without desiring to confine ourselves to it strictly.

The elevating and depressing plane is carried by the main frame 15 to the rear of the main wings 16—17. It consists of a spar 41 which is secured at right angles to the main frame 15 and of an air engaging surface carried by this spar which can be curved up or down as may be necessary to react upon the air to cause the machine to rise or to fall. To the spar 41 are pivotally attached the forward ends of thin strips of tough elastic wood 42—43 one directly above the other. The after ends of these strips are free. Passing between the strips 42—43, and parallel to the spar 41, is a tube 44 which is held in a fixed relation to the spar 41 by arms 45 secured to both the spar and to the tube.

46 are rods passing between the strips 42—43, near their after ends.

From Fig. 1 it will be seen that while the spar passes completely across the main frame 15 the elevating and depressing plane is itself made in two parts one to each side of the main frame.

Suitably carried in bearings carried by the main frame 15 is a shaft 47 and carried by this shaft are arms 48 the after ends of which embrace the rods 46. To the forward end of each arm 48 is pivotally attached one end of an arm 49 the other end of which embraces the rod 44. Secured to shaft 47 are levers 50 which are connected by wires 51—52 with levers 53 which are carried by frame 15 near the seat 54. The levers 53, which are double ended, as are the levers 50, are carried upon a shaft 55 through which passes a rod 56 the upper end of which is pivotally attached to the seat 54 of the operator. The seat 54 is slidably carried by the frame 15.

If the machine in flight should dip downward in front the operator would instinctively throw himself backward and in doing this he would slide the seat 54 back-

ward, the seat being so carried by the frame 15 that it can be moved forward or backward, changing the center of gravity of the machine and through rod 56 causing a rocking of shaft 55 backward. The movement of this shaft would cause a corresponding movement of the double-headed lever 53 which movement would be transmitted through the crossed wires 51—52 in a reverse direction to the lever 50 the upper end of which would be moved forward moving up the outer end of arms 48 which would raise rods 46 and bend upward strips 42—43, which are secured to the rods 46 by spring connections 57 precisely similar to the connections 28 described in connection with the rods 25 and flexible strips 20—21 of the main wings. If the machine tilt backward the operator would slide forward and these conditions would be reversed. The effect of the lifting or lowering of the outer end of rod 48 is to bend the strips 42—43 upward or downward. If the after ends of the strips, and the fabric which covers them, be bent upward the action of the air would be to depress the plane 40 and to lift the front of the machine. If this plane be bent downward the effect would be to lift the rear of the machine and to depress its front.

In Fig. 9 a view of the plane with its rear bent downward is shown.

The rudder 57, or steering plane, is arranged at right angles to the other planes and its forward end is rigidly attached to the rear end of the main frame 15, that is to say it is not hinged to the main frame as is the usual practice and does not swing around upon pivots.

58 is a vertical bar forming part of or attached to the rear of the frame 15.

59—60 are two thin flexible tough strips, of wood preferably, one opposite the other, the forward ends of which are secured by pivots 61 which are precisely similar to the fastening at the front ends of the strips 42—43 of the elevating and depressing plane 40.

62 is a rod or tube passing between the several strips 59—60 and secured thereto in any suitable manner, by staples or lashings 63 for instance. The tube 62 is attached and held in a fixed relation to the bar 58 by rods 64 as is the tube 44 of the planes 40.

65 is a rod passing between the strips 59—60 of the rudder and near its after end. This rod is parallel to tube 62 and rod 58.

66 is an arm, carried by tube 62 and projecting out from both sides and at right angles to the rudder.

67—68 are arms connecting arm 66 and rod 65.

69—70 are cables, suitably guided on frame 15, which connect opposite ends of arm 66 with opposite ends of a lever 71, Fig. 1, which lies longitudinally, is pivoted 130

at its middle to frame 15 and which is adapted to be engaged and worked, either side, back and forth by the feet of the operator. If the operator advance the left end of lever 71 with his feet the cable 70 will pull forward the right end of lever 66 and the arm 67 connecting this lever and the rod 65 will bend the several strips 59—60 of the rudder to the left as shown by dotted lines in Fig. 7. An opposite movement of the lever 71 will result in an opposite bending of the rudder. When bent the rudder has a substantially parabolic form the forward end of the curve being the sharpest; when bent the rudder has the same form as has the elevating or depressing plane when bent, this form being shown in Fig. 9.

As is the case with the elevating or depressing planes the several strips 59 on one side of the rudder are covered by fabric and the strips 60 on the other side are similarly covered so as to permit a free bending of the strips without danger of wrinkling or straining the covering fabric.

25 Having thus described our invention we claim as new and desire to secure by Letters Patent:—

1. In the main wing of an aeroplane, in combination, spars carried by the main frame of the machine, a series of parallel ribs at right angles to and secured to said spars, said ribs having a rigid front portion and a rear portion constructed of two superposed flexible members the rear ends of which can play past and in contact with one another, a rod passing between and at right angles to said flexible members forward of their rear ends, a spring connection between said rod and each of said flexible members, and means for operating said rods to bend said flexible members either up or down.

2. The combination in an aeroplane, of a main frame, a seat sliding lengthwise of said frame, a two armed lever adapted to be rocked back and forth by the movements of said seat, an elevating and depressing plane constructed of an air engaging surface supported by a series of pairs of superposed flexible members the after ends of which can slide past and in contact with one another and the forward ends of which are hingedly connected to a spar carried by the main frame, a rod 44 passing between and near the forward end of said flexible members, a hinge connection between said rod and said spar, rod 46 passing between said flexible members near their after ends a spring connection between said rod and said flexible members, a rock shaft 47 carried by the main frame, a double armed lever carried by said rock shaft, connections between the ends of said double armed levers and the ends of the two armed levers adjusted to be rocked by the movements of

the seat, arms 48 carried by said rock shaft 47 the rear ends of which are pivotally connected to the rod 46, and arms the upper ends of which are pivotally connected to the front ends of arms 48 and the lower ends of which are secured to the rod 44.

3. In an elevating or depressing plane for an aeroplane, in combination, a main frame, a spar rigidly carried by said frame, a series of pairs of flexible superposed members the forward ends of which are hingedly secured to said spar and the after ends of which can slide past and in contact with one another, a means for keeping said after ends in engagement, a rock shaft passing above and to the rear of said rigid spar, connections between said rock shaft and said flexible members, and means for rocking said shaft and for simultaneously bending the rear ends of the flexible members in one direction and their forward ends in an opposite direction, substantially as and for the purposes set forth.

4. In an aeroplane, in combination, a main frame, a vertical bar rigidly secured to the rear of said main frame, a series of pairs of flexible members the forward ends of which are hinged to said vertical bar, a rod parallel to said vertical bar passing between the flexible members near their forward ends, connections between said bar and said rod a connection between said rod and each flexible member, a second rod parallel to said first rod passing between said flexible members near their rear ends, a sliding connection between said latter rod and said flexible members, a cross arm connected to the front rod, connections the forward ends of which are secured to opposite ends of said cross arm and the after ends of which are pivotally secured to said rear rod, and means for rocking said cross-arm for the purposes set forth.

5. In an aeroplane, in combination, a main frame, main wings, carried by said frame, the forward parts of which are rigid and the after parts of which are flexible, a sprocket wheel carried eccentrically by a shaft, chains upon opposite sides of and in mesh with said gear, a connection between the ends of one chain and the flexible part of one wing, a connection between the ends of the other chain and the flexible part of the other wing, and guides for said chains or connections between said sprocket wheel and said wings.

6. In an aeroplane, in combination, a main frame, a spar secured at right angles to said frame, flexible superposed strips of material the forward ends of which are secured to said spar, a tube or rod 44 passing between said strips and secured to said spar, a rod, parallel to said tube 44, passing between said strips near their after ends, a shaft carried in bearings in the main

frame and parallel to said rods, arms carried by said shaft the after ends of which are attached to the rod near the after ends of the flexible strips, an arm pivoted to
5 the forward end of said first arm and to the tube 44, a line on said shaft, and means operated by the operator for rocking said lever to cause the several parts connected

therewith to bend said flexible strips upward or downward.

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