H. L. WILLOUGHBY.

AIRSHIP.

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1,008,096.

Patented Nov. 7, 1911.

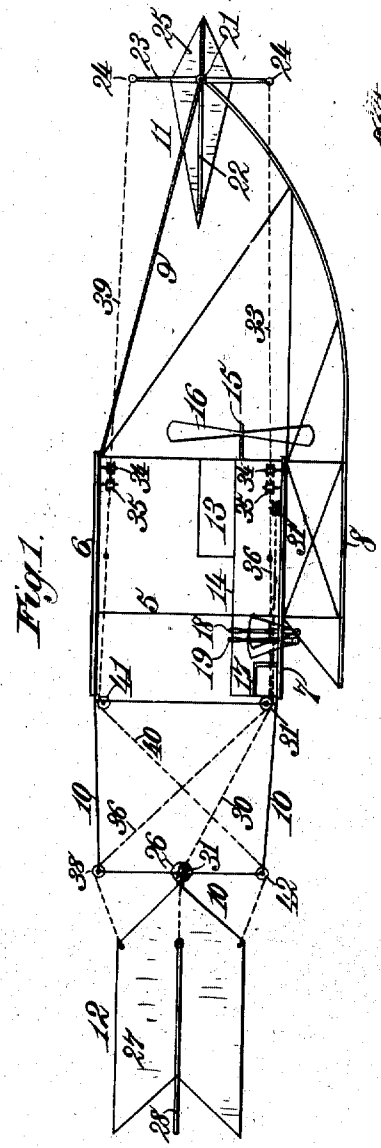

Fig. 1.

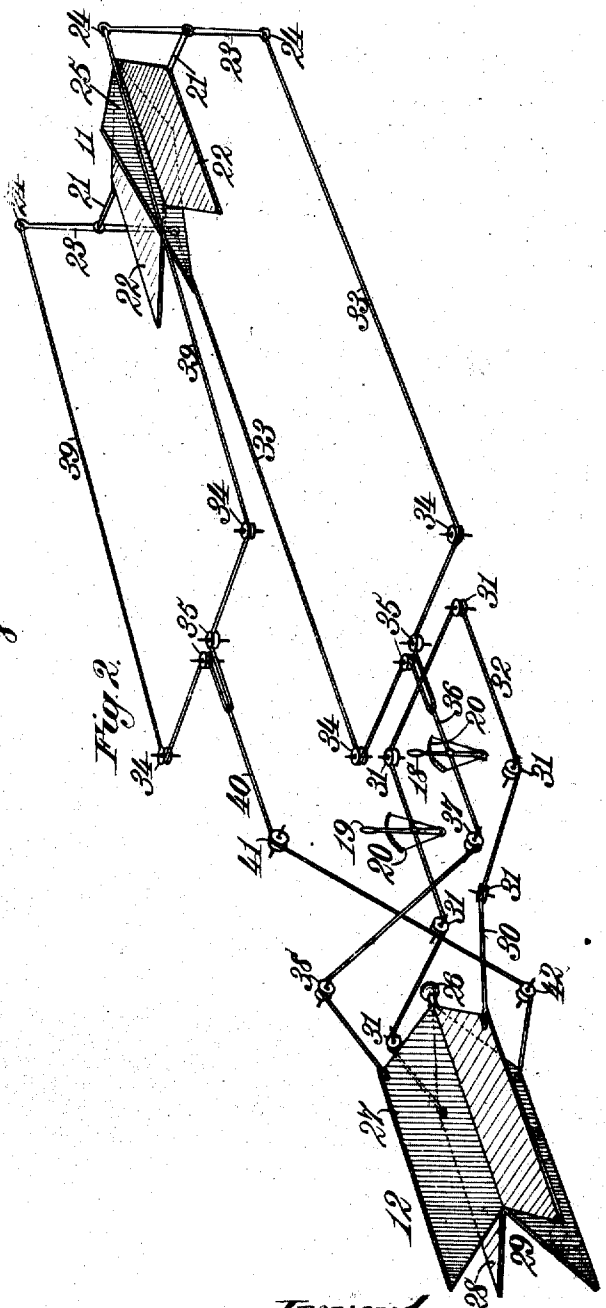

Fig. 2.

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UNITED STATES PATENT OFFICE.

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AIRSHIP.

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To all whom it may concern;

Be it known that I, HUGH L. WILLOUGHBY, a citizen of the United States, residing at Newport, in the county of Newport and State of Rhode Island, have invented new and useful Improvements in Airships, of which the following is a specification.

This invention relates to steering means or rudders or controlling planes for aeronautical machines of all types, but particularly adapted to that class known as aeroplanes.

The primary object of the invention is to so arrange and operate steering rudders or controlling planes at the forward and rear extremities of an aeronautical machine as to cause one plane to operate inversely with relation to the other.

When one plane or rudder is adjusted downwardly the other is given a downward inclination or dip at a reverse angle, and conversely when the one plane is elevated above the horizontal the remaining plane is elevated at a reverse angle so that the machine will travel or be propelled upwardly or downwardly in accordance with the reverse movements of the controlling planes or steering rudders at opposite extremities of the machine below and above a horizontal plane. This operation of the controlling planes at the front and rear extremities of the machine is accomplished through the medium of a simple arrangement of steering cords, wires or strands connected to controlling levers and in part crossed, as will be hereinafter more fully explained, but in demonstrating the practicability of the invention by this particular adjusting means and as shown in the accompanying drawings, it will be understood that the object sought may be obtained by any other means, the essential feature of the invention being the simultaneous adjustment, or the capability of simultaneously moving the front and rear controlling or steering planes or rudders of an aeronautical machine so that they will assume a position upwardly above or downwardly below a horizontal plane and cause the planes to operate inversely relatively to the air, one with relation to the other, for the purpose of balancing the resistance of one plane with respect to the other.

In the drawing: Figure 1 is a side elevation of a machine embodying the features of the invention. Fig. 2 is a perspective view of the front and rear steering rudders or controlling planes and the actuating or steering devices diagrammatically arranged in operative relation thereto.

The numeral 5 designates the body of the machine comprising upper and lower planes 6 and 7 which are arranged parallel and suitably braced and stayed by a light framework of any suitable construction and arrangement and embodying a lower support 8. Extending from the body in forward and rearward directions are braces or stays 9 and 10 of suitable light material for maintaining the forward and rear steering rudders or controlling planes 11 and 12 in proper operative position and for the application of the steering cords, wires or strands, pulleys and other appurtenances that may be necessary.

Only enough of the body and the stay structure has been shown to practically demonstrate the operation of the features of the invention, and it will be understood that it is proposed to adopt any of the approved types of body planes and stay means that may now be in use or well known or any equivalent arrangements or organizations to which the features of the invention may be applicable. Hence it is deemed unnecessary to particularize the structural features relating to the body planes, frame and stays completely as they form no part of the invention.

In central relation to the plane 7 and above the latter a suitable motor 13 is supported by a frame 14 of any suitable form and construction, and projecting forwardly from the body is a propeller shaft 15 operatively associated with or connected to the motor 13 and carrying any preferred form of propeller 16. The motor 13 will, of course, be equipped with means for starting and stopping the same at the will of the operator or aviator, and the propeller and its shaft will be so disposed as to have an unretarded operation in advance of the body of the machine or be fully clear of any part of the steering mechanism or devices, care being taken to arrange the latter in such manner as to render it impossible for the same to contact with or engage the propeller blades. At the rear of the lower planes 7 within the frame 14 or otherwise disposed in central relation with respect to the lower part of the body 5 is a seat 17 for occupancy by the operator or aviator and in advance of this seat independently operable levers 18

and 19 are supported on the plane 7 and preferably engage toothed segments 20, the said levers respectively connected to the steering rudder or controlling plane 11 and the steering rudder or controlling plane 12 in a manner which will be more fully hereinafter specified.

The stays 9 are connected to or support a transversely extending steering rod or shaft 21 to which the steering rudder or controlling plane 11 is fixed, the said steering rod or shaft 21 passing transversely through the rudder or plane 11 or in a simplified form connected to the opposite side edges of horizontal planes 22 forming part of the rudder or plane 11 and thereby constructed in two sections, each section of the steering rod or shaft projecting out equally from the said horizontal planes 22. It is proposed to make the rod or shaft 21 either in one piece or in two parts, the one construction being the obvious equivalent of the other, and whether the rod or shaft 21 be constructed from a single rod or member or composed of two parts it will be hereinafter designated under the term of a steering rod or shaft, and to the outer extremities thereof tillers are centrally fixed, the said tillers being indicated by the numeral 23, one tiller being secured to each rod or shaft extremity and having eyes 24 at opposite extremities. In addition to the horizontal planes 22 of the forward steering rudder or controlling plane 11 the latter includes a vertical plane 25 of elongated diamond or kite shape, the planes 22 intersecting and being fixed to the plane 25 along the longitudinal axis of the latter plane. The forward extremities of the planes 22 and 25 have a converging contour so as to effectively cleave the air and the rear extremity of the plane 25 is between the rear extremities of the planes 22, the latter being cut away at their rear extremities to have a fish tail arrangement in relation to the rear extremity of the said plane 25. The entire plane 11 constituting the forward steering rudder is freely movable through the actuation of the steering rod or shaft 21 so as to depress the nose or head of the rudder below a horizontal plane or elevate the said nose or head above a horizontal plane in accordance with the movement imparted to the steering rod or shaft 21. This front steering rudder or controlling plane steers only in the vertical plane. The vertical plane 25 serves to prevent the machine from having a too rapid movement either to the right or left during turning operations and which are effected by the rear steering rudder or controlling plane 12. In other words, the machine is steadied in its turning movements in a horizontal plane by the resistance set up by the vertical plane 25.

The rear steering rudder or controlling plane 12 has the central portion of its forward extremity connected to one of the stays or braces 10, as shown by Fig. 1, by a universal ball and socket joint 26 so that it will be sensitive for free vertical movement above and below a horizontal plane and also laterally in opposite directions. This rear rudder or controlling plane is composed of two planes 27 and 28 intersecting each other and disposed at right angles, the plane 27 being arranged vertically and the plane 28 horizontally, both planes being recessed at their rear extremities as at 29 to provide a fish-tail or arrow terminal like construction. The front extremities of the two planes converge toward the universal joint connection 26, and both steering rudders or controlling planes 11 and 12 are shaped generally and the planes so disposed as to effect a sure and positive action in the steering functions as performed by the said rudders or controlling planes. The rear steering rudder or controlling plane 12 is not only adapted to conjointly operate with the rudder or controlling plane 11 in the manner hereinbefore explained, but also has an operation independent of the said plane 11 or is shiftable laterally to the right and left for correspondingly turning the machine to change its course in a horizontal plane, for instance, after the manner of ordinary steering rudders, and this operation is accomplished through the medium of a tiller line 30 having its terminals secured to the outer forward portions of the horizontal plane 28 and then passed over guiding and friction reducing devices which may be of any suitable construction but as shown are in the form of sheaves or pulleys 31 suitably supported by the body 5 or the lower plane 7 of the latter and the stays or braces 10, the said guiding and friction reducing devices being disposed of at proper angles and in spaced relation to practically separate a looped portion 32 of the steering line in relation to the lower plane 7 over which it extends to give proper clearance and avoid interference with other devices extending over the said plane 7 and which will be hereinafter specified. A portion of the loop 32 of the steering or tiller line 30 is attached to the lever 19, such degree of tautness being maintained in the said tiller line that an adjustment of the latter in opposite directions by the actuation of the lever 19 will result in a uniform movement of all portions of the said tiller line so that a pulling strain exerted on one part will result in a corresponding give in the remaining portion without the least slackness or lost motion.

The forward and rear steering rudders or controlling planes are connected for conjoint or simultaneous operation to uniformly and similarly elevate the said rudders or

planes above or depress them below a horizontal plane and a preferred connection for this purpose is shown in the drawing and consists of a tiller line 33 having its terminals attached to the lower eyes 24 of the tillers 23 fixed to the steering shaft 21. The tiller line 33 is looped and extends back to the body 5 to a point above the lower plane 7 and traverses outer and inner pairs of guides and friction reducing devices 34 and 35, the inner pair of guides and friction reducing devices 35 being continuously arranged and the looped portion of the tiller line 33 is passed therebetween and continued rearwardly for a short distance and connected to a single strand tiller line 36 attached to the lever 18. From the lever 18 the single strand tiller line 36 extends rearwardly in a horizontal plane over a guiding and friction reducing device 37 and then upwardly at a rear inclination over a similar guiding and friction reducing device 38 and from the latter downwardly to the upper front portion of the plane 27 of the rear steering rudder or controlling plane 12. A second steering line 39 having the same form and arrangement as the steering line 33 is terminally attached to the upper eyes 24 of the tillers 23 and engages outer and inner pairs of guiding and friction devices arranged close to the upper plane 6 of the body 5 in precisely the same manner as the pairs of guiding and friction reducing devices 34 and 35 with which the tiller line 33 coöperates and having the same reference characters applied thereto. The rear extremity of the looped tiller line 39 is projected rearwardly between its inner pair of guiding and friction reducing devices 35 the same distance as the corresponding rear portion of the tiller line 33, and attached to this rearwardly extending portion of the tiller line 39 is a single strand tiller line 40 which extends rearwardly in a horizontal plane over a guiding and friction reducing device 41 and then downwardly and rearwardly at an inclination under or over a guiding and friction reducing device 42 and then upwardly to the forward portion of the lower edge of the vertical plane 27 of the rear steering rudder or controlling plane 12. It will be seen that the single strand steering lines or tiller line sections 36 and 40 cross in reverse directions between their guiding and friction reducing devices 37 and 38 and 41 and 42, and the degree of tautness of the steering lines or of all the tiller strands between the rudders or planes 11 and 12 is such that when a pulling strain is exerted in one direction on the strand or line 36 by the lever 18 the tiller lines 33, 39 and 40 will uniformly respond without the least slack or lost motion and hence the rudders or planes 11 and 12 will be instantly and simultaneously moved above or below a horizontal plane in accordance with the direction of movement of the said lever 18.

The levers 18 and 19 are located within easy reaching distance of the seat 17 and all the parts, including the motor 13, will be disposed in the body 5 to maintain a practical equipoise and obtain the best results during propulsion or flying of the machine. The tiller lines will all be preferably made of suitable metal wire of a non-resilient character so that there will be no liability of stretching or variation in the tautness of the steering or tiller lines after they have been applied and connected up and preliminarily stretched to establish the necessary degree of tautness throughout the entire series of lines. It will also be observed that the looped tiller lines 33 and 39 running rearwardly to the front portion of the body 5 clear the propeller 16 so that there is no possibility of the said lines contacting with the blade of the propeller.

A material advantage in the organization embodying the front and rear steering rudders or controlling planes and the tiller lines for operating the same is that the operator or aviator in observing the position or adjustment of the front rudder or controlling plane will have a positive assurance that the rear rudder or controlling plane will be properly and correspondingly adjusted, thereby avoiding the necessity of rear inspection or looking backward, which is a dangerous expedient and in fact an impossibility if it is desired to maintain full control of the machine.

The front and rear steering rudders or controlling planes are not only advantageous in modifying the course of the machine when in mid-air, but are particularly effective in starting the machine or in moving from a position of rest as well as in descending and assuming a position of rest or alighting. Many other advantages will also become apparent by practical use of the steering rudders or controlling planes, and changes in the proportions and minor details will be made and adopted as may be found necessary.

What is claimed is:

1. An air ship having a body provided with transversely extending upper and lower planes, elevation and direction controlling planes respectively held in advance and in rear of the body planes and at a distance from the latter, the front plane being mounted for adjustable movement vertically at an angle above and below a horizontal plane and the rear plane mounted for movement at angles above and below a horizontal plane and also laterally in opposite directions, the front plane being held against lateral adjustment in opposite directions, operating means connected to the front and rear

planes for adjusting the latter uniformly at downward and outward angles of inclination or at upward and outward angles of inclination respectively below and above a horizontal plane, a propeller interposed between the body and the front controlling plane and operating means connected solely to the rear plane for controlling the movement of the latter in opposite lateral directions independently of its adjustment at angles above and below a horizontal plane.

2. An air ship having suitable body planes, front and rear controlling planes independent of the body planes held at a distance in advance and in rear of the said body planes and having operating means connected thereto for simultaneously adjusting both of the said controlling planes at reverse angles above or downwardly below a horizontal plane, the front controlling plane being positively held against lateral adjustment in opposite directions, means connected to the rear controlling plane for independently adjusting the latter in opposite lateral directions, and a propeller interposed between the body planes and the front controlling plane and in advance of the body plane.

3. An air ship having transversely extending body planes, front and rear steering means spaced from the body planes, continuous pull devices connected to the front and rear steering means for simultaneously actuating the latter and adjusting them at reverse angles above and below a horizontal plane, the front and rear planes when adjusted either above or below a horizontal plane always standing at outward angles of inclination or in divergent directions relatively to each other, the front steering means being capable solely of an adjustment at reverse angles above and below a horizontal plane and the rear steering means movable laterally in opposite directions independent of its adjustment at reverse angles above and below a horizontal plane, means for laterally shifting the said rear steering means, and a propeller interposed between the front steering means and the body planes and in advance of the latter.

4. An air ship having a body comprising upper and lower planes, propelling means disposed in advance of the body, front and rear steering means spaced from the said body planes and connected to each other and operable for simultaneously adjusting the same at reverse angles above and below a horizontal plane, the propelling means being interposed between the body planes and the front steering means, the front and rear planes when adjusted either above or below a horizontal plane always standing at outward angles of inclination or in divergent directions relatively to each other, the front steering means being capable only of adjustment at reverse angles above and below a horizontal plane, and means for adjusting the rear steering plane laterally in opposite directions independently of the adjustment of said rear steering means at reverse angles above and below a horizontal plane.

5. An air ship having suitable body planes, front and rear controlling planes spaced from the said body planes and simultaneously operable for movement vertically at an angle above and below a horizontal plane at reverse angles to each other, each controlling plane having members intersecting each other in planes at right angles and the front controlling plane having a vertical blade tapering from a point adjacent its front end rearwardly to its rear end, and operating means connected adjusting both of said planes in divergent directions relatively to each other either above or below a horizontal plane.

6. An air ship having suitable body planes, a front controlling plane independent of the body planes and comprising blades intersecting each other in planes at right angles, the vertical blade being tapered from a point adjacent to the front end thereof rearwardly to the rear end of the same, a fulcrum supporting means engaging the intermediate portion of the said plane in advance of the transverse center of the latter, and means for adjusting the said controlling plane.

In testimony whereof I have hereunto set my hand in presence of two subscribing witnesses.

HUGH L. WILLOUGHBY.

Witnesses:
CHAS. S. HYER,
ROBERT EVERETT.