E. P. EKMAN.

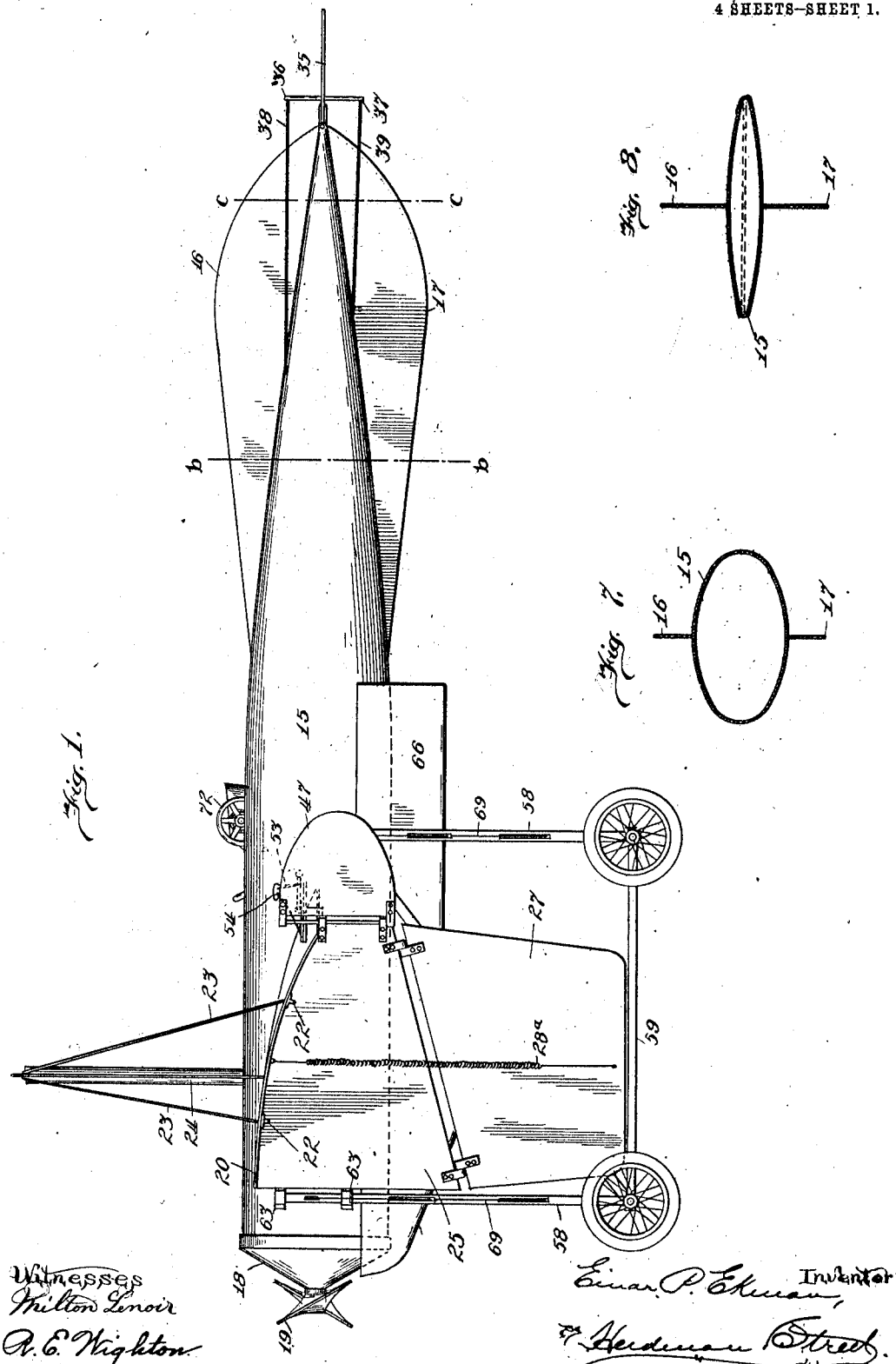
HYDROAEROPLANE.

APPLICATION FILED SEPT. 15, 1911.

1,026,304.

Patented May 14, 1912.

4 SHEETS—SHEET 1.



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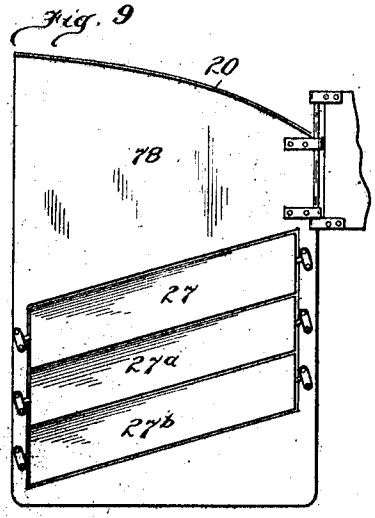
4 SHEETS—SHEET 2

Fig. 9



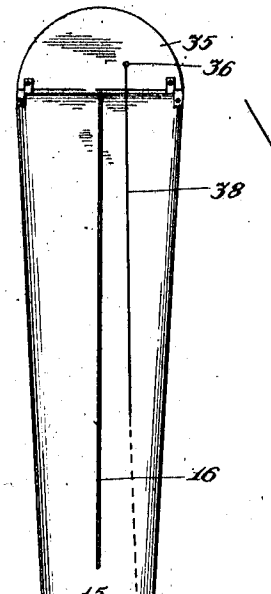


Fig. 10

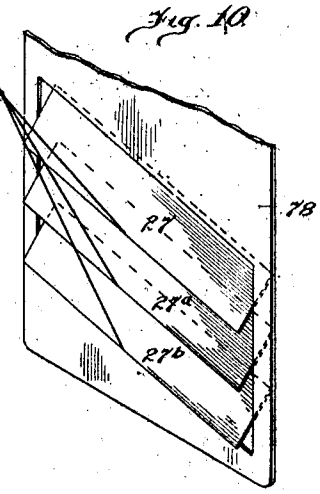


Fig. 2.

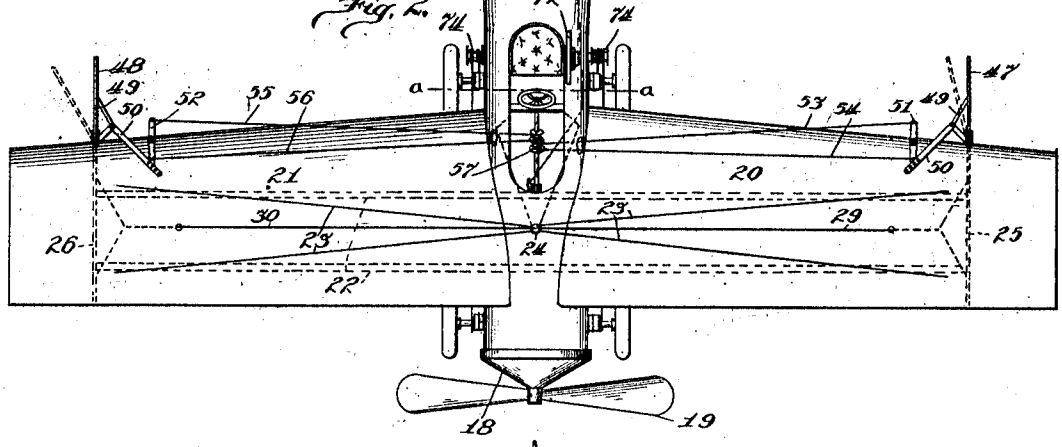
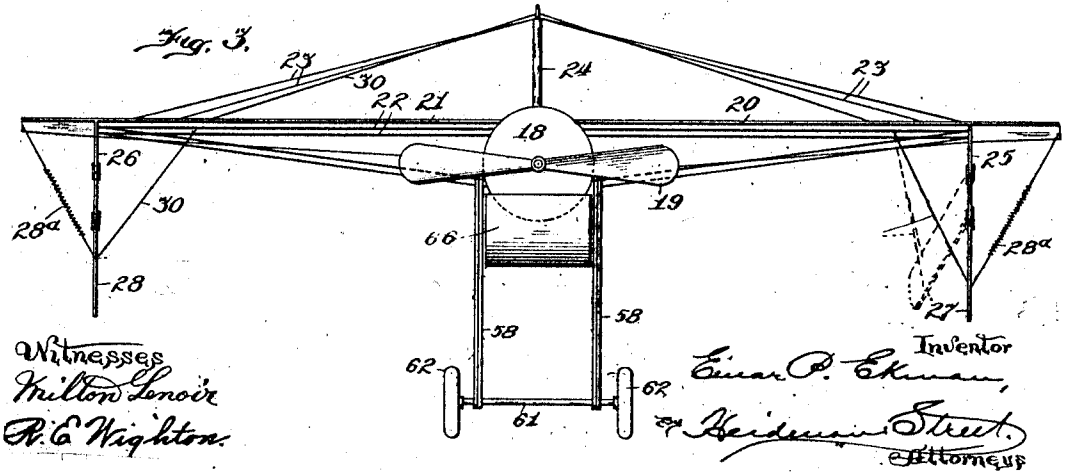


Fig. 3.



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4 SHEETS—SHEET 3.

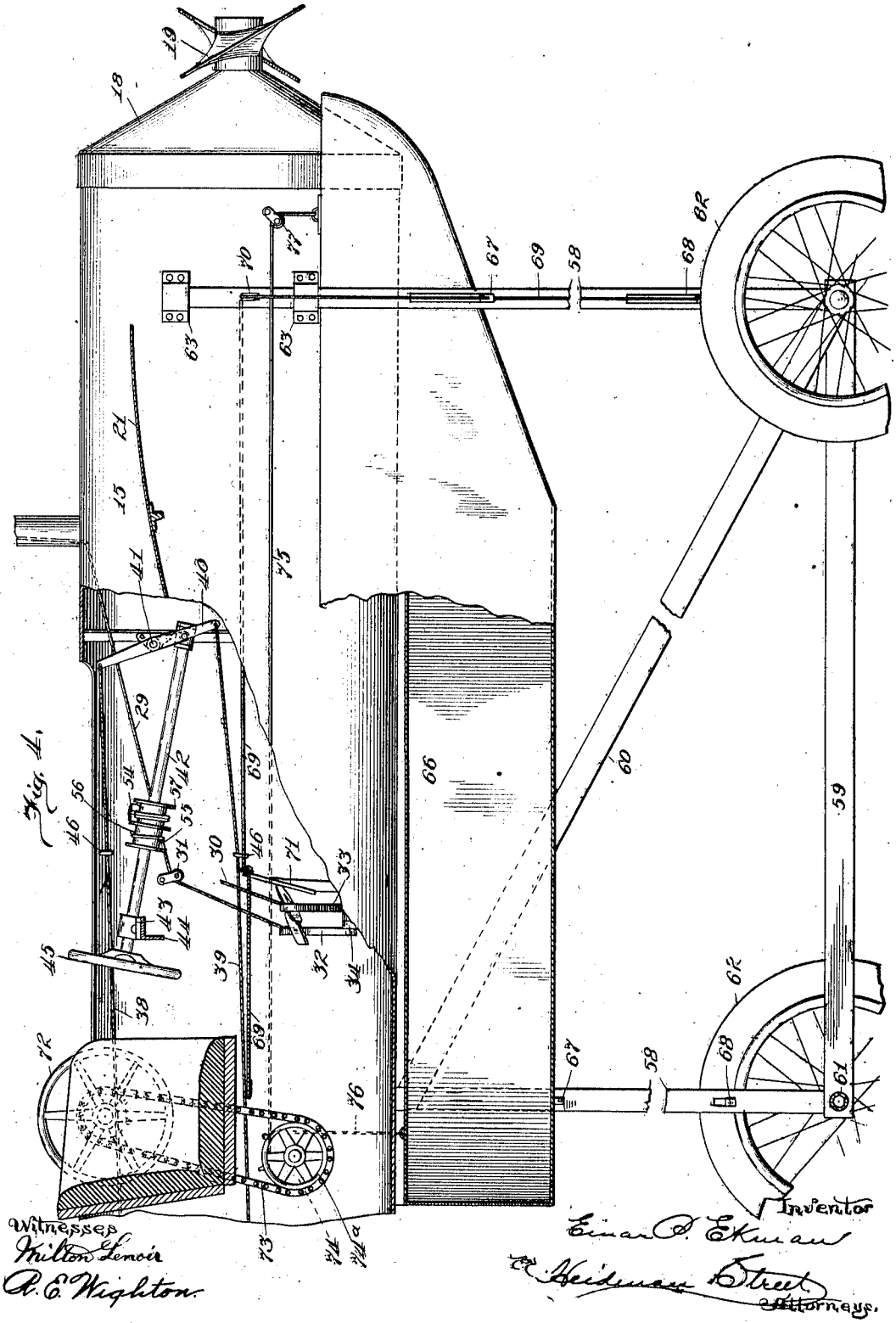

Fig. 4.

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4 SHEETS—SHEET 4.

Fig. 5

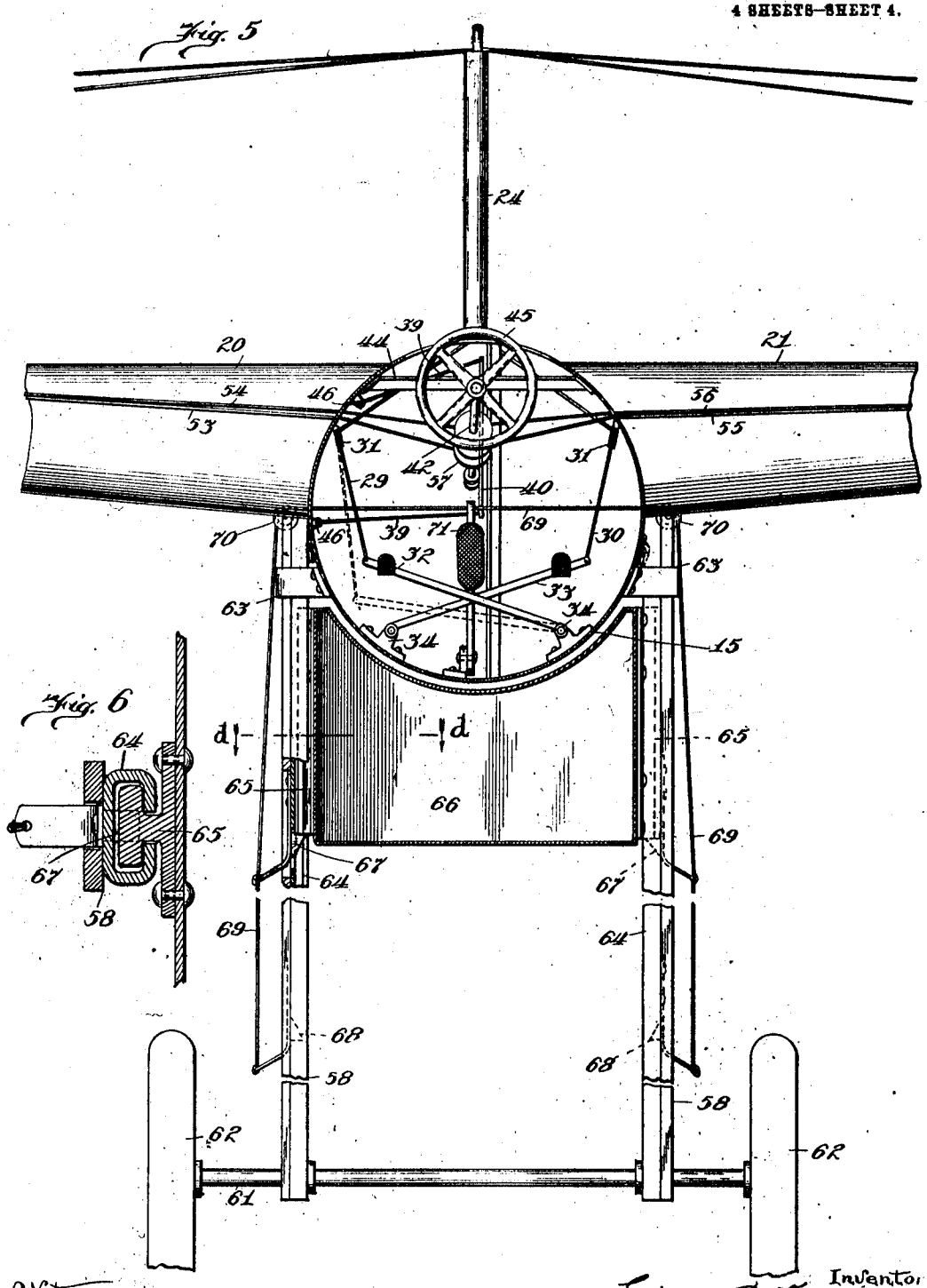

Fig. 6

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UNITED STATES PATENT OFFICE.

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HYDROAEROPLANE.

1,026,304. Specification of Letters Patent. Patented May 14, 1912.

Application filed September 15, 1911. Serial No. 649,526.

To all whom it may concern:

Be it known that I, EINAR P. EKMAN, a subject of the Kingdom of Sweden, and resident of Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Hydroaeroplanes, of which the following is a description, reference being had to the accompanying drawings, which form a part of my specification.

My invention relates to that class of flying machines wherein the planes are arranged substantially in the same horizontal plane, thus producing the monoplane type of machine, which is also adapted to float on the water; as will be more fully understood from the following detailed description; the object of the invention being to provide a machine that will present as little resisting surface in the direction of travel as possible, and also to provide means whereby the machine may be readily and quickly operated and its direction controlled, as well as to provide mechanism whereby the means, which enables the machine to float, may be readily manipulated and the relative position thereof controlled, as will be more fully hereinafter set forth.

In the drawings:—Figure 1 is a side elevation of my improved machine. Fig. 2 is a top plan view of the same. Fig. 3 is a front elevation thereof. Fig. 4 is a partial sectional view of the machine intermediate of the cock-pit and the mast; the extreme front end of the body portion of the machine being shown in side elevation, with a portion of the mechanism broken away. Fig. 5 is a sectional view taken on the *a*—*a* of Fig. 2 through the cock-pit, and looking forward as indicated by the arrows. Fig. 6 is a detail view of the means employed for maintaining the pontoon or air chamber in proper relation with the frame of the machine. Fig. 7 is a sectional view taken on the line *b*—*b* of Fig. 1. Fig. 8 is a sectional view taken on the line *c*—*c* of Fig. 1. Fig. 9 is a detail view in elevation of a modification of the ailerons; and Fig. 10 is an end view of same showing same in effective position.

In the exemplification of my invention, I show the body 15 made torpedo shape or cylindrical in form tapering toward the rear end thereof; the taper being accomplished by a gradual reduction of the vertical diameter, thereby increasing the horizontal diameter at the rear end as clearly indicated by Fig. 8. The rear end of the body portion 15 is provided with a top and bottom keel 16 and 17 respectively, which are firmly secured thereto. The body portion may be of any suitable material such as thin sheet metal; the keels 16 and 17 being constructed of similar material. The keels are made gradually increasing in a vertical direction, with their rear edges curved toward the end of the body portion as clearly shown in Fig. 1. The front end of the body portion 15 is preferably provided with the conical shaped hood or cap portion 18, see Fig. 1, which provides a bearing for the shaft of propeller 19, to be driven by any suitable type of engine or motor and which may be mounted within the fore part of the body portion 15.

Secured in a convenient manner to opposite sides of the body portion 15, are the supporting planes 20 and 21; both planes being similar in construction and curved toward the rear side thereof as clearly shown in Figs. 1 and 2; the planes being preferably reinforced longitudinally by the angle irons or T-shaped ribs 22. In order to prevent the outer ends of the planes bending downward, I prefer to provide the tie wires 23 which pass over or are secured to the mast 24, thereby giving support to the outer ends of the planes. At a short distance from the free ends of the planes, I provide the rigidly braced, downwardly extending members 25 and 26, said members being intended to extend at right angles to the planes and be held against any lateral movement. The lower edges of the members 25 and 26 are preferably made to incline upwardly toward the rear as more clearly shown in Fig. 1.

Hinged to the lower edges of members 25 and 26 are the ailerons 27 and 28; the rear portion of the ailerons being of larger dimensions vertically, corresponding with the incline of the lower edges of members 25 and 26, see Fig. 1. The ailerons 27 and 28 are maintained in their normal vertical positions by the springs 28ª secured to the free ends of the planes, see Fig. 3, while the opposite sides of the ailerons are provided with controlling cables or wires 29 and 30;—pref-

erably ramified so as to exert a pull on both lower corners of the ailerons,—these cables are in turn passed through the planes and up over a pulley or pulleys at the top of the mast, leading down through the mast 24, into the body of the machine where they are passed over pulleys 31, and secured to foot levers 32 and 33, respectively, the levers 32 and 33 being pivotally mounted as at 34. With the cables or wires 29 and 30 made just long enough to reach from the end of the foot levers to the ailerons, when both the levers and the ailerons are in normal position, it is apparent that the ailerons cannot be drawn toward the springs beyond the vertical plane occupied by them as shown in Fig. 3.

The rear end of the body portion 15 is provided with a horizontally pivoted rudder 35, which is provided with the vertically extending arms 36 and 37, to the free ends of which are secured the cables or wires 38 and 39, which lead forward into the body of the machine and are secured to the ends of lever 40, see Fig. 4, which is pivotally mounted at 41 and has pivoted connection with the shaft 42. Shaft 42 is slidably mounted in the collar 43, which in turn is secured to a cross member or bar 44. The shaft 42, whose outer end is provided with operating wheel 45, may be moved longitudinally thereby moving lever 40 on its pivotal point, causing the lever to rotate about its pivotal point and cause the wires or cables 38 and 39 to pull on the vertical arms 36 and 37 as the case may be. For example, if shaft 42 is pushed forward, it is evident that the lower end of lever 40 will be moved forward and pull on cable 39, the other end of which is secured to arm 37, and in turn cause rudder 35 to be declined rearwardly; the forward movement of the lower end of lever 40 necessarily moves the upper end thereof rearwardly giving sufficient slack to cable 38 to permit of movement of arm 36. A backward pull on shaft 42 will pull the lower part of lever 40 backward, thereby causing the upper end thereof to move forward, exerting a pull on cable 38, and incline rudder 35 upward. In order that the cables 38 and 39 may be held against the side of the body portion and out of the way of the operator, these cables or wires 38 and 39 are passed through suitable rings or loops 46, see Fig. 4.

Pivotally secured to the rear edges of both planes 20 and 21, and preferably near the outer ends thereof, are the vertically arranged rudders 47 and 48. Any suitable means for supporting and pivoting these rudders to the planes may be employed, so as to permit the rudders to swing in a lateral direction. The inner sides of the rudders are provided with brackets 49 of suitable construction, to which are pivotally secured links 50, the outer ends of which are preferably provided with a suitable number of perforations or holes whereby varying connections with levers 51 and 52 may be made. The levers 51 and 52 are pivotally secured to the planes 20 and 21 respectively, as clearly shown in Fig. 2. To both ends of the levers are secured wires or cables 53 and 54, and 55 and 56, which pass through suitable openings in the side of the body portion 15 and wind in the opposite directions about the double drum or spool 57, which is secured to the shaft 42 so as to revolve therewith. Of course, instead of having separate cables or wires leading to the same lever, a single cable or wire might be employed, wound several times about the drum and made taut so as to prevent slipping, so that when one end is wound up the other will be unwound. It is apparent from the construction shown and described that if hand wheel 45 is turned to the left in Fig. 2, wires or cables 54 and 55, will be wound up on the drum 57 thereby unwinding wires or cables 53 and 56, thus causing levers 51 and 52 to be swung on their pivots; this will cause link 50 to pull rudder 47 toward the body of the machine, while the pull of wire 55 will cause lever 52 to move adjacent link 50 outward thereby moving rudder 48 outward, as clearly indicated in dotted lines in Fig. 2. By reason of the relation between the pivotal points, it is apparent that the movement of rudder 48 outward will be greater than the movement inward of rudder 47. With the rudders 47 and 48 in the position shown in dotted lines in Fig. 2, greater resistance will be presented by rudder 48 which will cause the machine to swing about in a circle with the outer end of plane 21 describing a smaller circle than that described by plane 20.

The machine is provided with suitable alighting gear composed of the frame members 58, provided with suitable brace rods 59 and 60; the ends of the frame members providing bearings for the journals 61 to which the wheels 62 are secured. The frame members are suitably supported or secured to the sides of the body 15 by the brackets 63, and extended downwardly from both sides of the body portion as clearly shown. Each frame member 58 is provided with the vertically extending channel member 64, more clearly shown in Fig. 6, adapted to receive the head portion of the T-shaped members 65, which are secured to the sides of a pontoon or air chamber 66, and thus provide vertically extending slide ways for the pontoon. The air chamber or pontoon 66 may be of any suitable shape; it is shown provided with the upwardly sloping front end, while the sides thereof are made to extend beyond the top of the chamber or pontoon so as to envelop the lower portion of the body 15, see Figs. 1, 3, and 4.

Secured to the different frame members 58 and at suitable points, are the spring catches 67, 67, and 68, 68, the construction whereof is more clearly set forth in Fig. 5; it being understood, of course, that each frame member 58 is provided with a spring catch 67 and catch 68. These catches are arranged to extend into the path of the head portion of the T-shaped members 65, and have the cables or wires 69, 69, secured to the outer or free arms thereof, see Fig. 5. These cables or wires 69 extend from the lower catches 68,—being also secured to the free arms of catches 67—up over pulleys 70 secured at the upper part of the frame portions 58 and pass into the body of the machine, where they are secured to the foot lever 71.

Instead of employing separate cables 69, it is apparent that a single cable may be employed, extending from the catches on one side of the machine to those directly opposite on the other side of the machine, and so arranged that when foot lever 71 is depressed a pull will be exerted on the cables 69 thereby pulling catches 67 and 68 outward, until the head portion of the catches will be drawn out of the path and from beneath the members 65 secured to the sides of the pontoon 66. When this is done, it is evident that the pontoon will slide downwardly as far as the channel or slide ways 64 will permit. Catches 68 have their head portions face in the opposite direction from those of catches 67, so that after the pontoon has been dropped, catches 68 will lock it in its lowered position and thus maintain the pontoon or air chamber in proper position to float the machine on water. In order to return the pontoon or air chamber 66 to its normal position adjacent to the body portion 15 of the machine, foot lever 71 must be again depressed to exert a pull on cable or cables 69 which will draw the catches 67 and 68 out of the path or slide ways in frame members 58. While the lever is still depressed, hand wheel 72 is then operated which, by reason of the sprocket chain 73, will rotate the drum 74, 74, see Fig. 2, mounted on the same shaft with sprocket wheel 74^a, and wind cables 75 and 76,—of which there are two sets, one to each side of the machine—and draw the pontoon upward to its normal position. As shown in Fig. 4, cables 75 extend forward from the drum, which is mounted near the cock-pit of the machine, over pulleys 77 secured to the front or body 15 of the machine.

In the operation of my machine when it is desired to ascend, the propeller of course being in operation, shaft 42 is drawn toward the operator, thereby swinging lever 40, pulling on cable or wire 38 which will tilt rudder 35 upward; to descend, shaft 42 should be pushed from the operator thereby reversing the operation of lever 40, exerting a pull on cable or wire 39 and tilting rudder 35 downwardly.

In order to prevent any skidding of the machine, I provide the vertically extending members 25 and 26, which enable the machine being held to its course.

Should the equilibrium of the machine be disturbed, that is, for example, should the plane to the left of Fig. 3 be below the horizontal plane occupied by the plane to the right of said figure, and it is desired to right the machine, the operator will press on foot lever 32, exerting a pull on cable or wire 29, which will move aileron 27 against the action of its spring into the position shown in dotted lines in Fig. 3. By reason of the fact that the aileron is of greater vertical dimension at the rear, with the rear portion in a higher horizontal plane than the front edge thereof, it is apparent that the resistance offered will tend to pull that side of the machine downward until the aileron is released and the spring restores it to its vertical or normal position. Should the operator desire to lower the opposite side or plane of the machine, he will press foot lever 33, exerting a pull on cable or wire 30, and move aileron 28 toward the body of the machine. If the operator desires to change his course in a horizontal direction, as for example should he desire to turn the machine to the left, in Fig. 2, he will turn the shaft 42 toward the left in Fig. 2, thereby winding up cables or strands 53 and 55, which will move rudders 47 and 48 into the position shown in dotted lines in said figure. With the construction of mechanism heretofore described, it is evident that greater resistance will be offered by rudder 48 to the direction of flight and compel the machine to turn to the left, in Fig. 2.

In order that the machine may be made as simple as possible it is preferable that the same mechanism be employed to operate both rudders, although as a matter of fact, it is evident that rudders 47 and 48 might be made to operate independently of each other, but I believe the construction shown and described to be a simple one. Also, instead of employing a pair of large ailerons, as illustrated in Figs. 1 and 3, it is evident that a number of smaller ailerons could be pivotally secured one beneath the other, with the ailerons to one side of the machine being operated simultaneously and thereby affording a greater resistance; for example in Figs. 9 and 10, I illustrate a modification wherein a vertically extending frame 78 depends from members 25 and 26, between which a number af ailerons 27, 27^a, 27^b, are pivoted. The wire or cable 29 in this construction is secured to the different

sections or separate ailerons so that all of the ailerons on that side of the machine will operate together. Furthermore, the machine may be modified in certain other details without departing however from the spirit of my invention, as for example instead of having the extra chamber or pontoon 66, a section or part of the lower half of the tubular body between the alighting gear may be made into an air chamber and detachably secured in place; and I do not wish to be understood therefore as limiting myself to the exact construction shown and described, but

What I claim and wish to secure by Letters Patent is:—

1. A machine of the class described, comprising a tapering tubular body, the rear end of which is flattened in a horizontal direction, a pair of laterally extending sustaining surfaces or planes secured to opposite sides of the forward end of the body, ailerons pivotally secured to the under sides of the planes and normally at right angles thereto, means operatively connected with the ailerons whereby the relative position of the ailerons to the planes may be determined, rudders pivotally mounted to the rear sides of the planes and arranged to swing about vertical axes, a rudder pivotally mounted at the rear end of the tubular body and arranged to swing about a horizontal axis, and means whereby the rudders may be controlled.

2. A machine of the class described comprising a tapering tubular body, a pair of laterally extending sustaining surfaces or planes secured to opposite sides of the forward end of the body, ailerons pivotally mounted beneath the planes and normally held in vertical position, means whereby the ailerons may be moved out of their vertical planes, a pair of rudders pivotally secured to the rear sides of the planes and arranged to move about vertical axes, and a pontoon slidably mounted to the body portion.

3. A machine of the class described, comprising a tapering tubular body, a pair of sustaining surfaces or planes rigidly secured to opposite sides of the forward portion of the body, rigidly held members depending from the planes at right angles thereto, ailerons pivotally secured to the lower ends of said members, means whereby the ailerons may be moved at an angle to the perpendicular plane of said members, rudders arranged to move about vertical axes at the rear sides of the planes, an ascending or descending rudder pivotally secured to the rear end of the body, means whereby the rudders may be manipulated, and a pontoon slidably mounted beneath the body of the machine.

4. A machine of the class described, comprising a tapering tubular body, a pair of sustaining surfaces or planes rigidly secured at opposite sides to the forward part of the body, said planes being bowed downwardly toward the rear, anti-skidding members secured at right angles to the under surfaces of the planes, said members being of greater dimensions vertically at the front than at the rear, ailerons pivotally mounted at the lower edges of said members, means whereby the ailerons may be manipulated, a pair of vertically disposed rudders mounted to the rear of the planes, means whereby said rudders are controlled, and a horizontally disposed rudder pivotally mounted at the rear end of the tubular body.

5. In a machine of the class described, the combination of a tapering tubular body provided with sustaining surfaces or planes rigidly secured to opposite sides of the forward portion thereof, with a pontoon slidably mounted beneath the body portion thereof and means whereby the pontoon may be locked in its adjusted positions.

6. In a machine of the class described, the combination of a tapering tubular body provided with sustaining surfaces or planes, means secured to the under surfaces of said planes whereby the equilibrium of the machine may be restored, means secured to the rear of said planes whereby the horizontal direction of the machine may be determined and means arranged at the rear end of the tubular body whereby movement of the machine in a vertical direction may be determined, with a pontoon adjustably mounted beneath the body portion thereof.

7. A machine of the class described, comprising a tapering tubular body, the rear of which is flattened in a horizontal direction, a pair of sustaining surfaces or planes rigidly secured to the forward part of the body, vertically disposed members secured to the under surfaces of the planes and in proximity to their ends, ailerons pivotally secured to the lower edges of said members, means whereby said ailerons may be manipulated and maintained in normal position, a pair of vertically disposed rudders secured to the rear of each of said planes and in proximity to the outer ends thereof, means whereby said rudders are simultaneously operated, a horizontally disposed rudder pivotally secured to the rear end of the body portion, alighting gear secured to the body portion and depending therefrom, and a pontoon slidably mounted in the alighting gear beneath said body portion.

8. In a machine of the class described, the combination of a tapering tubular body having a pair of planes rigidly secured to opposite sides of the forward part thereof, said planes being provided with portions extending at right angles to the under surfaces thereof, and rudders vertically disposed and pivotally secured to the rear sides of the

planes in proximity to their outer ends, with a frame extending beneath the tubular body, a pontoon slidably mounted in said frame, and means whereby the relative position of the pontoon may be controlled.

9. A machine of the class described comprising a tapering tubular body provided with an air chamber, means whereby the air chamber may be released, a pair of sustaining surfaces or planes rigidly secured to opposite sides of the forward part of the body, members secured at right angles to the under sides of said planes, ailerons pivotally mounted beneath said members, means whereby the ailerons may be moved toward the body, a pair of rudders secured to vertically disposed axes at the rear of the planes and in proximity to the outer ends thereof, and a rudder secured to the horizontally disposed axis at the rear end of the body of the machine.

10. A machine of the class described comprising a tapering tubular body provided with an air chamber detachably secured thereto, means whereby the relative position of said chamber may be controlled, a pair of planes rigidly secured to opposite sides of said tubular body, ailerons pivotally mounted beneath the planes and in proximity to the outer ends thereof, means whereby said ailerons may be controlled, a pair of rudders arranged to swing about vertically disposed axes in proximity to the outer ends of the planes, and a rudder secured to a horizontally disposed axis at the rear of the machine.

11. A machine of the class described comprising a tapering tubular body provided with an air chamber detachably secured thereto, means for controlling the relative position of said chamber, a pair of sustaining surfaces or planes rigidly secured to opposite sides of the body, members secured at right angles to the under sides of said planes, ailerons secured beneath the planes and normally at right angles thereto, means whereby the ailerons may be manipulated and the quilibrium of the machine restored, a vertically disposed rudder secured to the rear edge of each of said planes and in proximity to the outer ends thereof, means whereby said rudders may be controlled so as to offer different degrees of resistance, a rudder horizontally disposed at the rear end of the body, and mechanism arranged to control the vertically disposed rudders when operated in one direction and arranged to control the horizontally disposed rudders when operated in another direction.

12. A machine of the class described, comprising a tapering tubular body provided with a removable air chamber, spring mechanism for maintaining said chamber in the desired position, a pair of planes rigidly secured to opposite sides of the body, a member secured at right angles to the outer ends thereof, one or more ailerons pivotally mounted beneath the planes and normally extending at right angles thereto, means whereby ailerons beneath one plane may be operated independently of those beneath the other, a rudder vertically disposed at the rear edge of each of the planes and in proximity to the other ends thereof, a horizontally disposed rudder mounted at the rear end of the body, and mechanism arranged to control the vertically disposed rudders when operated in one direction or to control the horizontally disposed rudders when operated in another direction.

13. A machine of the class described comprising a tapering tubular body provided with an upwardly extending mast, a pair of planes secured to opposite sides of the body, the outer ends thereof being supported by said mast, a wedge shaped member secured at right angles to the under sides of both of said planes and in proximity to the outer ends thereof, ailerons pivotally mounted beneath said members and adapted to move toward the body, a vertically disposed rudder secured to each of said planes at the rear edge of said wedge shaped member, a horizontally disposed rudder at the rear end of the body, means whereby the rudders may be controlled, and an air chamber detachably secured beneath the body.

14. A machine of the class described comprising a tapering tubular body provided with a detachable air chamber, means for guiding said chamber in its movements, a pair of planes rigidly secured to opposite sides of the body, means secured at right angles to the under sides of each of said planes, a pair of rudders vertically disposed at the rear of each of said planes and in proximity to the outer ends thereof, a horizontally disposed rudder pivotally secured to the rear end of the body, and means whereby said rudders may be manipulated.

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