G. H. KELLOGG.

AEROPLANE.

APPLICATION FILED JAN. 27, 1909.

1,035,794. Patented Aug. 13, 1912.

3 SHEETS—SHEET 1.

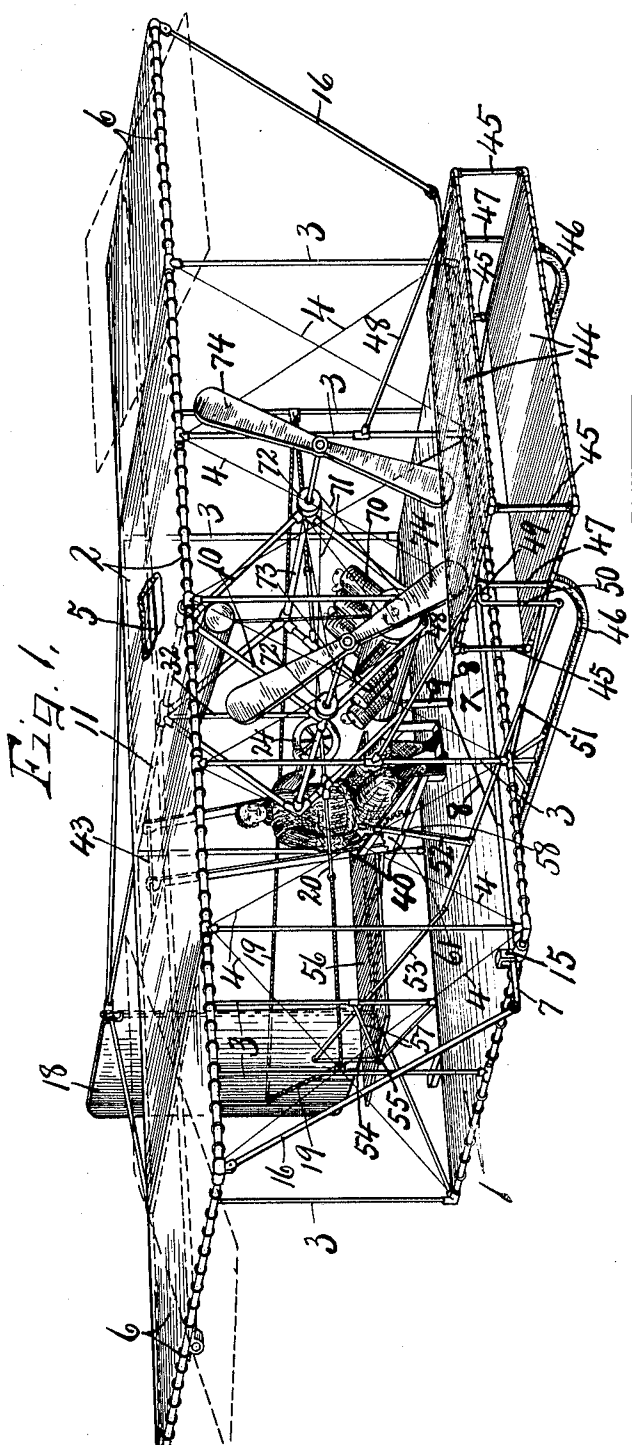

Fig. 1.

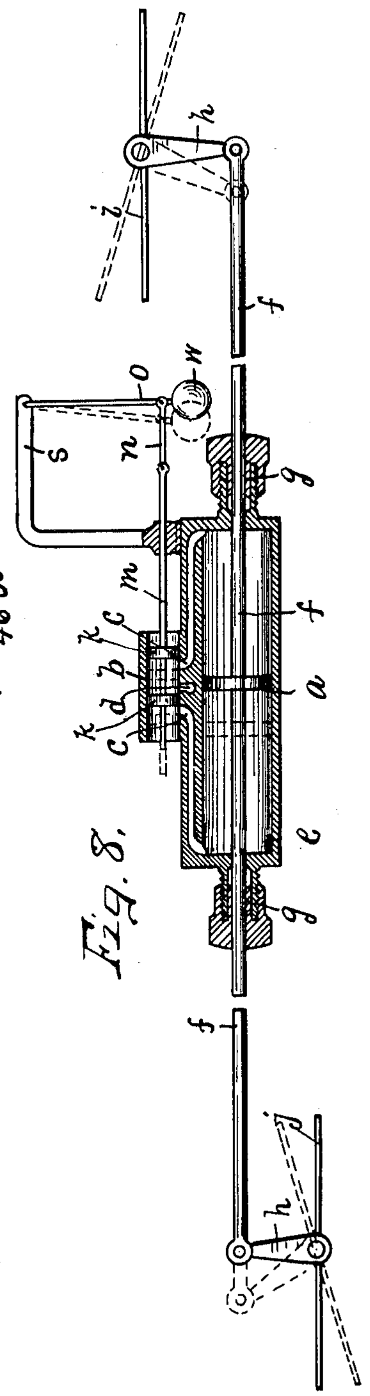

Fig. 8.

WITNESSES

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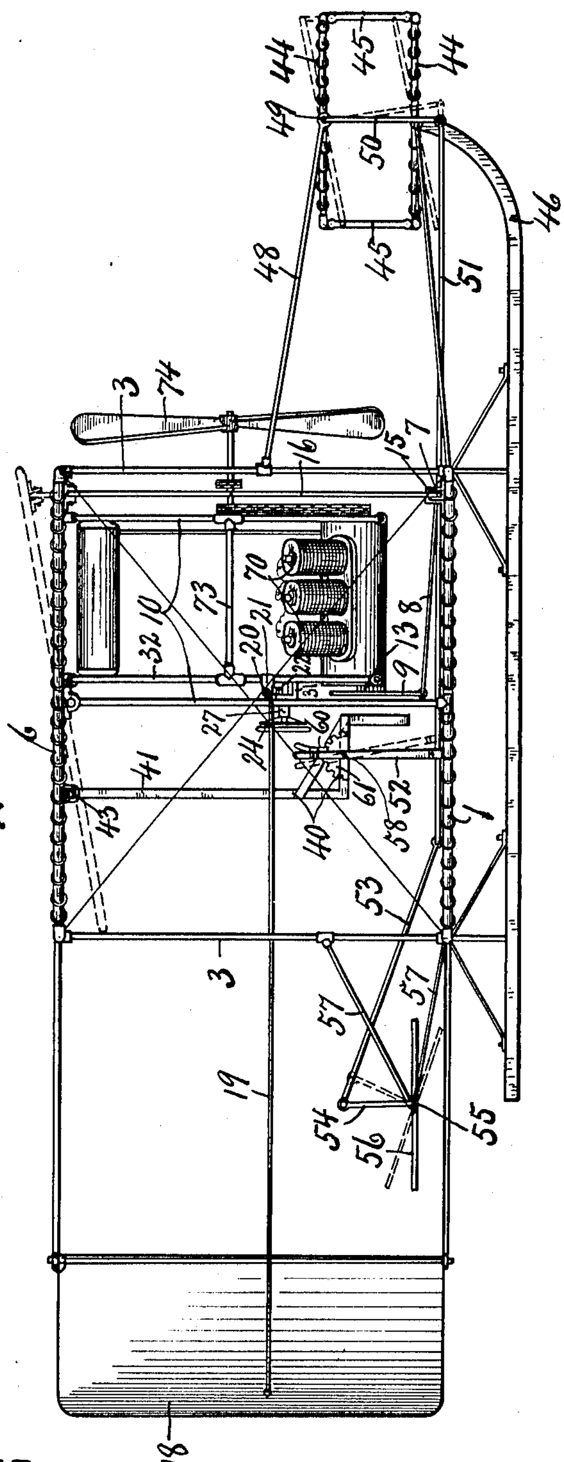

Fig. 2.

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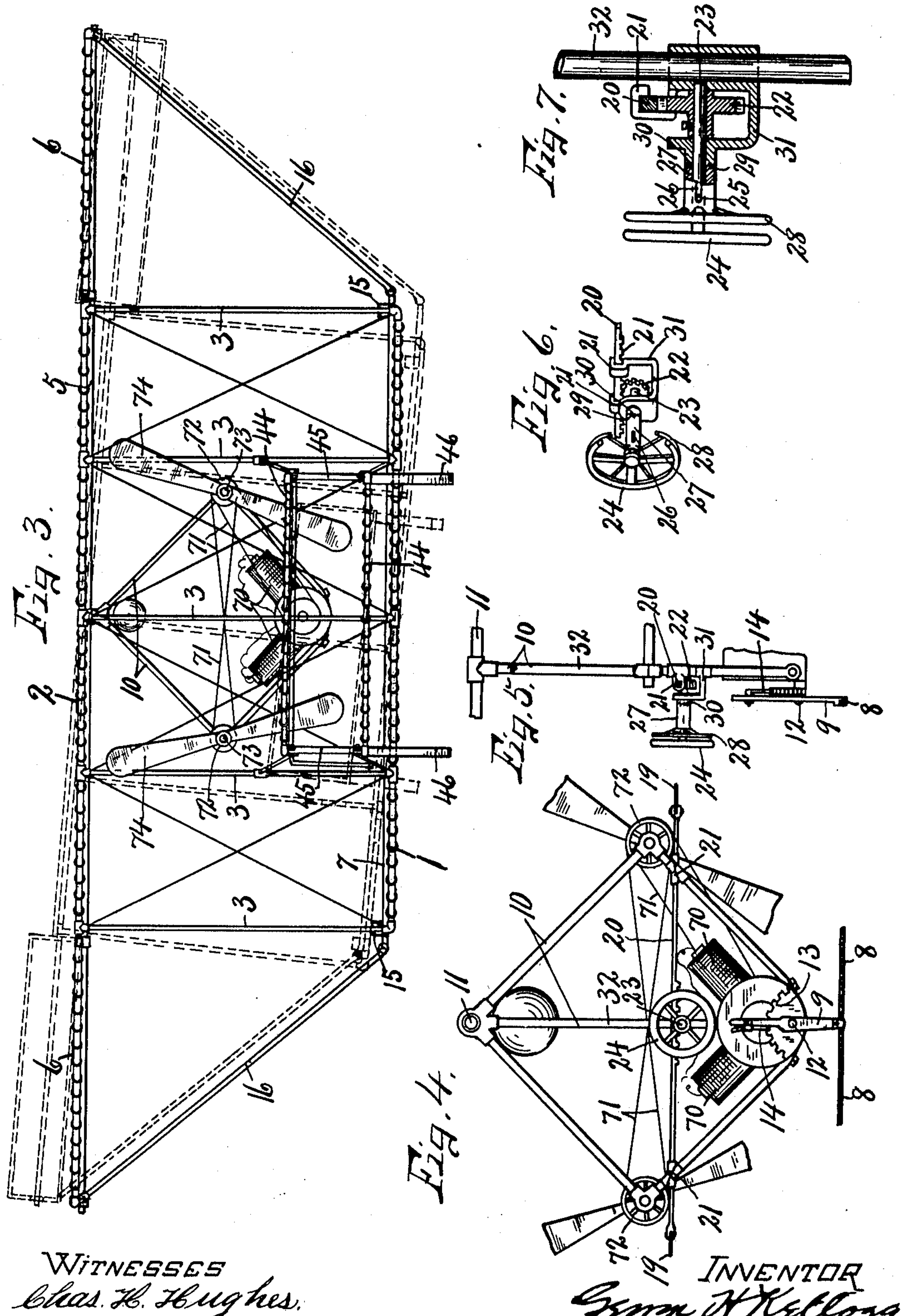

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UNITED STATES PATENT OFFICE.

GEORGE HERBERT KELLOGG, OF SYRACUSE, NEW YORK.

AEROPLANE.

1,035,794. Specification of Letters Patent. Patented Aug. 13, 1912.

Application filed January 27, 1909. Serial No. 474,484.

To all whom it may concern:

Be it known that I, GEORGE H. KELLOGG, of Syracuse, in the county of Onondaga, in the State of New York, have invented new and useful Improvements in Aeroplanes, of which the following, taken in connection with the accompanying drawings, is a full, clear, and exact description.

This invention relates to certain improvements in aeroplanes or navigable air ships, carrying their own motive power, and involving the use of one or more horizontal supporting planes and movable guiding planes for directing the course of flight and maintaining their equilibrium and steadiness of action in varying movements of the air or shifting of the center of gravity of the machine, and refers more particularly to means for automatically positioning the movable planes so as to maintain the balance or equilibrium of the machine without special attention from the operator.

In other words the primary object of my invention is to automatically prevent sudden or excessive dipping of the machine in either direction through the medium of swinging weights or pendulums connected to the guiding mediums, and of sufficient gravity to automatically position such guiding mediums to counteract any tendency of the machine to dip or deflect from a safe course or equilibrium, and at the same time to enable said guiding mediums to be operated manually at the will of the operator.

Other objects and uses relating to the specific parts of the machine will be brought out in the following description.

In the drawings—Figure 1 is a perspective view of a bi-plane airship, involving the various features of my invention. Figs. 2 and 3 are respectively, a side elevation and a front elevation of the same machine. Fig. 4 is a rear elevation of the swinging weight or pendulum for automatically controlling the position of the side wings and rudder, showing the motor and propelling mechanism mounted thereon, the motor serving in this instance as a weight to maintain the vertical position of the pendulum. Fig. 5 is a side elevation of the rear portion of the swinging weight or pendulum, showing particularly the manually operated means for controlling the position of the side wings and rudder. Fig. 6 is a perspective view, partly broken away, of a portion of the rudder operating mechanism, including the steering wheel. Fig. 7 is an enlarged sectional view of the steering mechanism shown in Fig. 5. Fig. 8 is a sectional view of a modified form of mechanism for automatically controlling the movement of the front and rear planes, which determines the vertical angle of the flight.

In order that my invention may be clearly understood I have shown what is commonly known as a bi-plane machine comprising a lower horizontal plane —1— and an upper horizontal plane —2—, spaced a sufficient distance above the lower plane —1— to allow free movement of the operator and one or more passengers in the intervening space, and also for the reception of the swinging pendulums, motor, seat and other mechanisms which may be necessary to control the movement of the guiding planes, the main supporting planes —1 and 2— being held in fixed relation to each other by suitable upright posts or rods —3— and diagonal truss rods —4— which, together with the upright posts or rods —3— constitute a portion of the main supporting frame to resist torsional strains and hold the lower and upper planes —1 and 2— in parallelism.

The lower and upper planes —1 and 2— as well as the various guiding and steering planes, hereinafter described, are made up of any suitable but light tenacious material such as water proof fabric, which are secured in suitable, more or less, rigid frames capable of maintaining the form of the planes, such frames being reinforced at intervals when necessary.

The frame for the upper plane —2— is provided with a central lengthwise bar —5— extending laterally some distance beyond the sides of the lower and upper planes —1 and 2— for receiving and supporting vertically balancing wings —6— of uniform area, which when disposed in a horizontal plane form continuations of the upper plane —2—, and are centrally pivoted upon transverse horizontal pivots forming the opposite ends of the frame bar —5—. These wings —6— therefore constitute the movable ends of the upper supporting plane —2—, but are tiltable upon their swinging axes manually and also automatically by suitable mechanism hereinafter described for the purpose of changing the angle of deflection of said wings with the direction of flight in such manner as to produce added lifting resistance to the dip side and additional lowering resistance to the opposite side of the machine until the latter is brought to a horizontal or level keel, both wings being operated simultaneously but in opposite directions to more quickly restore the equilibrium or balance of the machine. For example, assuming that the machine should dip sidewise in the direction indicated by dotted lines in Fig. 3, while in flight, then by tilting the wings —6— in opposite directions from a horizontal plane so that the wing at the low side is inclined downwardly from its front edge while that at the high side is inclined upwardly from its front edge, then the increased resistance of the air operating against the under side of the low wing would tend to lift this end of the machine, while similar air resistance against the upper side of the opposite wing would tend to lower that end of the machine thus quickly restoring the machine to its normal equilibrium. As previously stated, this shifting of the planes or wings —6— may be accomplished manually or automatically through the medium of a sliding bar —7— and suitable connections as rods or cables —8— and a hand lever —9—, which is mounted upon a swinging frame or pendulum —10—, the latter being pivotally suspended at its upper end upon a forwardly and rearwardly extending frame bar —11—, which is secured to the frame of the upper plane —2—, as best seen in Figs. 1—2 and 4.

The lever —9— is fulcrumed intermediate of its ends at —12— to a toothed segment —13— on the lower side of the swinging frame or pendulum —10— and is provided with a pawl —14— movable into and out of engagement with the rack to lock the lever —9— in its adjusted position.

The rods or cables —8— are attached to the lower end of the lever —9— and diverge forwardly from each other to the sliding rod —7— to which they are secured in any suitable manner, not necessary to herein illustrate or describe, preferably an equal distance from the longitudinal center of the machine in which the lever —9— is normally located.

The swinging frame or pendulum —10— preferably consists of an equilateral quadrangle in front elevation and is pivotally suspended at one of its corners upon and from the bar —11—, so that in elevation the lower side of the apex which is weighted will always tend to assume a position in the same vertical plane as, or directly under the swinging axis of the frame, even though the supporting planes of the machine may dip laterally in one direction or another from a horizontal position. This independent movement of the frame of the machine relative to the swinging frame or pendulum —10— is utilized to automatically control the tilting of the planes or wings —6— in the manner previously described to right the machine to a level keel, and in order to establish this automatic control, the sliding bar —7— is guided in suitable ways —15— Figs. 1, 2 and 3 on the opposite ends of the front side of the lower plane —1— and is provided with upwardly inclined ends —16— which are connected, in this instance, to the extreme outer front corners of the wings —6— as clearly shown in Fig. 1 so that by shifting the sliding bar —7— in one direction or the other, the wings —6— in the direction of such shift will be tilted so as to incline downwardly and rearwardly from its front edge, while the opposite wing will be tilted to the same incline in the opposite direction, or upwardly and rearwardly from its front edge. This shifting of the wings —6— may be accomplished mechanically at the will of the operator whenever necessary as in lateral deflections of the machine in flight by simply rocking the lever —9— upon its fulcrum around the toothed segment —13— where it may be temporarily held by hand or locked by the pawl —14—, such movement of the lever being transmitted to the sliding bar —7— through the mediums of the rods or cables —8—. On the other hand this action may be entirely automatic by simply locking the lever —9— in its normal position centrally of the segment —13— whereupon the lateral dip of the machine, in either direction, will bring the dipping edge of the machine closer to the center of gravity of the weighted frame or pendulum —10—, so that the inertia of said swinging frame, acting through the medium of the lever —9— and connections —8—, will shift the sliding rod —7— endwise in the direction of the dipping end of the machine, thereby rocking the front edge of the dipping wing —6— upwardly and at the same time depressing the front edge of the opposite wing, thus adding additional lifting power to the lower end of the machine and corresponding depressing power to the higher end of the machine, and quickly restoring said machine to its normal equilibrium. This increased angle of resistance at the low side of the machine tends to retard the velocity of flight of such side, thereby causing the machine to move in the arc of a circle toward that side until the machine regains a level keel, and in order to overcome this tendency, and at the same time to enable the machine to be guided in its horizontal direction of flight, I provide a vertical rudder or steering blade —18—, which is connected by opposite cables —19— to the opposite ends of a sliding rack —20—, the latter being mounted in suitable bearings —21— on the swinging frame or pendulum —10— a considerable distance below the swinging axis —11— and just above the rack —13—. This sliding bar —20— is provided with suitable teeth which mesh with the pinion —22—, the latter being mounted upon a rearwardly extending shaft —23—, having at its rear end a steering wheel —24—.

As best seen in Fig. —7— the shaft —23— is provided with a radial pin —25—, which projects through an elongated slot —26— in a sleeve —27—. This sleeve is movable lengthwise of the shaft —23— and for this purpose is provided at its rear end with a hand wheel —28— within easy reaching distance of the hand wheel —24— and is operated endwise, by the fingers, while the hand is resting upon the steering wheel.

The inner or front end of the sleeve —27— is provided with clutch teeth —29—, which are movable into and out of locking engagement with similar clutch teeth —30— on the adjacent end of a fixed bracket —31—, the latter being secured to one of the central upright bars —32— of the swing frame —10—, as best seen in Figs. 4—5— and 7.

When it is desired to operate the rudder —18— to steer the machine manually in the course desired, it is simply necessary for the operator to engage the hand wheel —28— and draw the same, together with the sleeve —27— toward the steering wheel —24— thereby withdrawing the clutch section —29— from locking engagement with the fixed clutch section —30—, and permitting the shaft —23— to be rotated by simply rotating the steering wheel, in the desired direction. This latter operation rotates the pinion —22— and imparts endwise movement in one direction or the other, according to the direction of the rotation of the steering wheel to the sliding bar or toothed rack —20—.

The cables or cords —19—, which lead from opposite ends of the sliding bar —20— are passed around suitable sheaves or guides in the central upright end posts —3— of the main supporting frame and are then connected to opposite sides of the steering rudder —18—, so that when the steering wheel —24— is operated in one direction the sliding bar —20— is moved in the same direction, preferably sidewise of the machine and thereby swings the steering rudder or blade —18— in the same direction.

The automatic control of the rudder is regulated by the same mechanism, exclusive of the steering wheel, by simply moving the hand wheel —28— inwardly so as to engage the clutch section —29— with the clutch section —30—, thereby locking the steering shaft —23— against rotation and preventing sliding movement of the bar —20— relatively to the swinging frame —10—. Under such conditions any lateral dip of either side of the frame will bring such side nearer to the base of the swinging frame —10—, thus causing the wing —6— at such side to tilt downwardly and rearwardly from its front edge, while the opposite wing will be tilted in the opposite direction as previously described, and the additional resistance to forward flight offered by the increased angle of the wing at the low side tends to turn the machine in that direction, thus shifting the rudder blade —18— in the opposite direction to automatically offset such tendency until the machine returns to its equilibrium or balance, thus permitting the rudder to automatically return to its normal position.

It will be seen from the foregoing description that the inertia of the pendulum, together with its connections with the wings —6— and rudder —18— automatically and instantly counteracts any tendency of the machine to dip laterally in either direction, and also counteracts any tendency of the machine to turn from its direct course of flight during such dip.

I have now described the means for mechanically and automatically preventing excessive lateral dip of the machine, or rather have mechanically or automatically restored such machine to its equilibrium, or balance.

I will now proceed to describe the means for mechanically and automatically controlling the dipping motion in the direction of the line of flight as distinguished from the lateral dipping action. In order to accomplish this I provide a second and independent weighted pendulum —40— consisting, in this instance, of a swinging seat for the operator suspended by suitable bars —41—, which are pivoted at their upper ends to one of the frame bars —43— of the upper plane —2— and with its swinging axis at substantially right angles to the line of flight, so that the weighted end of the pendulum may swing backwardly and forwardly relative to the machine, or rather the latter may dip backwardly and forwardly relatively to the pendulum, which normally remains in the same vertical position. The frame of the lower plane or support —1— extends forwardly some distance beyond the front edge of such plane and upon this extension is mounted a pair of planes or horizontal blades —44— of substantially the same area, and superposed one above the other for regulating the angle or dip of the vertical flight of the machine, said planes being, in this instance, pivotally connected at their four corners to links —45—, the lower plane —44— being centrally pivoted upon the free ends of the forward extension —46— of the main supporting frame. The upper plane —44— is also centrally pivoted upon the upper ends of the upright frame bars —47— which are connected to the upright posts —3— of the main supporting frame by brace bars —48— as best seen in Figs. 1 and 2.

As shown in Fig. 1, the upper plane —44— is centrally secured to a rock shaft, —49—, having at one end a crank arm —50—, which is connected by a link —51— to a lever —52— and is also extended some distance to the rear of said lever where it is connected by a link —53— to a crank arm —54— of a rock shaft —55— upon which latter is centrally mounted a rear horizontal rudder or plane —56. The rock shaft —55— upon which the rear horizontal rudder or plane —56— is centrally mounted is journaled in the rear ends of suitable braces —57— projecting from two of the rear upright posts —3— of the main supporting frame. The lever —52— is fulcrumed intermediate its ends at —58— to one side of the base or seat of the pendulum —40— within easy reaching distance of the operator when sitting upon the seat and is provided with a suitable pawl —60— movable around and adapted to interlock with the teeth of a toothed segment —61— which is concentric with the axis or fulcrum of the lever. It is now clear that the operator sitting upon the seat of the pendulum —40— may by simply withdrawing the pawl —60— from locking engagement with the rack —61— and rocking said lever by hand, tilt or rock the guiding planes —44— and —56— to direct the vertical inclination of flight of the machine, the connections between the lever —52— and said front and rear horizontal planes being arranged so as to tilt the planes in opposite directions in order to more speedily bring the machine to the desired level without excessive tilting of such blades. Now by locking the pawl —60— to the rack —61—, which also locks the lever —52— against movement relatively to the swinging seat or pendulum —40— the blades —44— and —56— may be controlled automatically to prevent excessive dip of the front or rear end of the machine, such automatic control being effected through the same connections between the blades and swinging pendulum —40—. For example, assuming that the front end of the machine should suddenly dip or tilt downwardly, under these conditions the weighted pendulum —40— would maintain a vertical position by its own inertia, thereby bringing the front end of the machine nearer to the base of the pendulum and through the medium of the links —51— and —53— and lever —52— the front blades —44— would be tilted upwardly and rearwardly, thus increasing the lifting angle of resistance of the front blades to the air and at the same time increasing the depressing angle of resistance of the rear blades —56— which quickly restores the machine to its normal balance or equilibrium. The reverse action of the front and rear blades takes place, when the machine tilts or dips in the opposite direction.

The pendulum —10—, which automatically controls the lateral dip and deflection of the machine through its course of flight through the medium of the wings —6— and rudder —18— is weighted by suitable motors —70—, which are secured in the lower portion of the swinging frame —10— and are connected by suitable belts and pulleys —71— and —72— to propellers —74— by which the machine is driven forwardly, the propeller shafts —73— being journaled in suitable bearings in the lateral corners or apexes of the quadrangle frames —10— and being therefore located at equal distance from and at opposite sides of the plane of the swinging axis of said frame.

The engine or motor —70— which may consist of one or more combustion engines is disposed so that the center of gravity is in a vertical plane directly under the swinging axis of the frame —10—, and it will be readily seen that the entire motor and propeller mechanism is mounted upon this swinging frame —10—, which maintains at all times a substantially vertical position while the body of the machine, exclusive of the frame —10— and parts carried thereon, is free to swing or dip laterally about the axis of said frame. In like manner the pendulum —40— is, in this instance weighted by the operator sitting therein, but it is evident that the swinging frames may be otherwise weighted and the motor and seat for the operator located in other parts of the machine if desired, but the arrangement of the motor and propeller mechanisms upon the swinging frame —10— simplifies and reduces the weight of the machine and at the same time the weight of the operator in the swinging pendulum performs the same function.

In Fig. 8 I have shown a modified form of device for automatically controlling any one, or more, of the tilting blades or rudders of flying machines of this character and it consists of a cylinder —*e*— and a valve chamber —*b*— which is connected by ports —*c*— to opposite ends of the cylinder and by an additional port —*d*— to any suitable fluid pressure device capable of supplying air or other fluid under pressure sufficient to operate a piston —*a*— which is movable in the cylinder —*e*—. The piston —*a*— is secured to a piston rod —*f*— extending through suitable glands —*g*— in the ends of the cylinder —*e*— and connected to one or more crank arms —*h*— for operating corresponding blades —*i*— and —*j*—. Movable in the valve chamber —*b*— are suitable valves or pistons —*k*—, which are connected by a stem —*m*— and are spaced apart a sufficient distance to include between them the inlet ports and one of the ports

—c—, somewhat similar to the slide valve of a steam engine. One end of the valve rod —m— is connected by a link —n— to a weighted pendulum —o—, having at its lower end a weight —w—, while its upper end is pivoted to a bracket —s— on the cylinder —a—. This cylinder may be rigidly secured in any desired manner to the frame of the machine in such relation as may be most convenient to operate one or more of the guide wings or rudders. The opposite ends of the piston chamber —b— are open to the atmosphere, but the intervening space between valves —k— is also in connection with the inlet —d— and one of the ports —c—, thereby admitting the fluid under pressure into one or the other ends of the cylinder, which is preferably placed in a horizontal position in the machine. The valves —k— are spaced apart corresponding to the distance between ports —c— and are of sufficient face width to cover said ports when the flying machine is in its normally horizontal position, but any deviation or dip from such horizontal position will cause the weighted pendulum —o— to swing in the corresponding direction thereby moving the valves —k— to connect the port —c— at the low side of the machine with the inlet port —d—, which allows the fluid under pressure to flow into the corresponding end of the cylinder and thereby shift the piston to the opposite end of the cylinder for tilting the blades —i— and —j— to the desired incline to restore the equilibrium of the machine, the tilting of said wings or blades depending upon the degree of dip of the machine.

What I claim is:—

1. In a navigable air ship, a horizontal plane, tiltable wings at opposite sides of the plane, a vertical rudder at the rear of the plane, a swinging frame pivotally suspended from said plane, connections between the swinging frame and wings for tilting the latter, and additional connections between the swinging frame and rudder.

2. In a navigable air ship, a main supporting plane, wings at opposite sides of and movable relatively to the supporting plane, a vertical rudder, a pendulum, separate devices movable independently of the pendulum for operating the wings and rudder at will, and additional separate devices for locking the first named devices to the pendulum for operating the wings and rudder automatically as the plane and pendulum move relatively to each other.

3. In a navigable air ship, a main supporting plane, wings mounted upon and movable relatively to the supporting plane at opposite sides thereof, a laterally movable steering rudder also connected to the supporting plane, tiltable blades at the front and rear of and connected to the supporting plane, a swinging frame hinged to and depending from the main supporting plane and having its swinging axis extending in the direction of flight of the machine, connections between said swinging frame and wings for automatically moving the latter as the plane tilts laterally, additional connections between said swinging frame and rudder, a swinging seat hinged to and depending from the plane and having its axis disposed at substantially right angles to that of the swinging frame, and connections between said swinging seat and blades for automatically tilting the latter as the angle of the plane is varied relatively to the swinging seat, and propelling mechanism for the machine mounted upon and movable with the swinging frame.

4. In a flying machine and in combination, a main plane provided with a tip on each side, automatic gravity means for inclining said tips, the one reverse to the other and in relation to said main planes, means for operating said tips independent of said automatic means, propellers for propelling said machine, smaller guide planes in the front and rear of said plane adapted to be tilted to different angles from that of said main plane, automatic gravity means for tilting said smaller planes simultaneously with the tilting of the machine endwise, and means for operating said smaller planes independent of said automatic means.

In witness whereof I have hereunto set my hand this 23d day of January, 1909.

GEORGE HERBERT KELLOGG.

Witnesses:

H. E. Chase,

Zoe Miller.