G. H. KELLOGG.

BALANCING DEVICE FOR AIRSHIPS.

APPLICATION FILED AUG. 6, 1909.

1,035,795.

Patented Aug. 13, 1912.

2 SHEETS—SHEET 1.

Fig. 1.

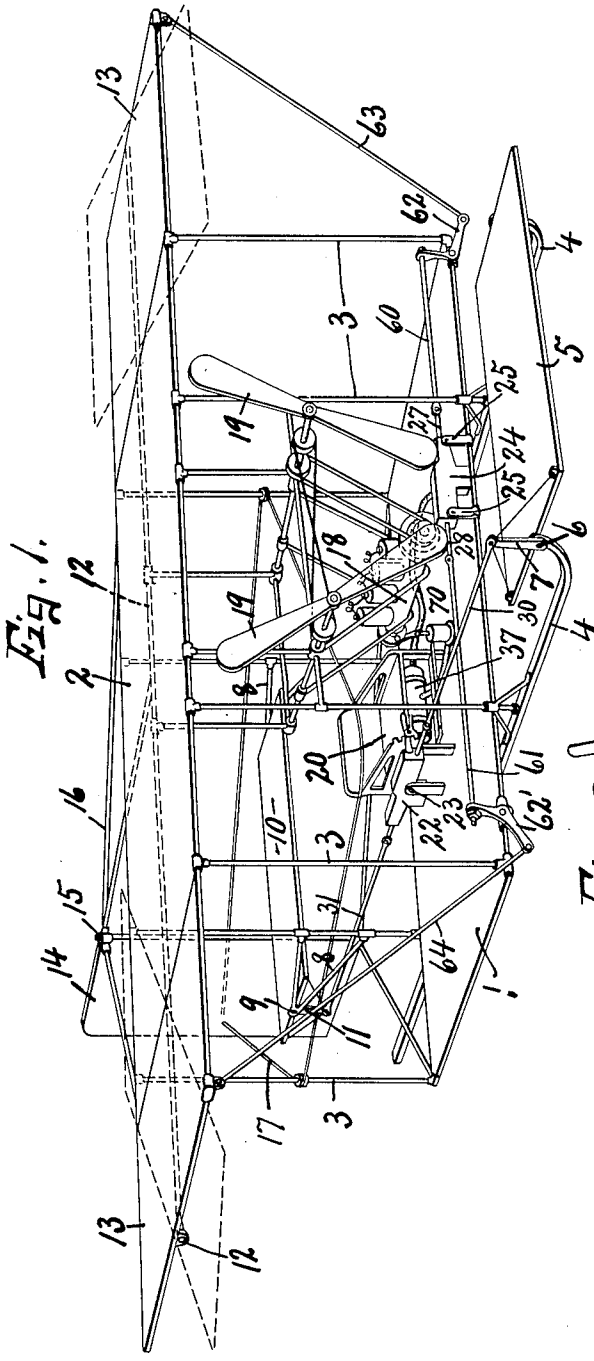
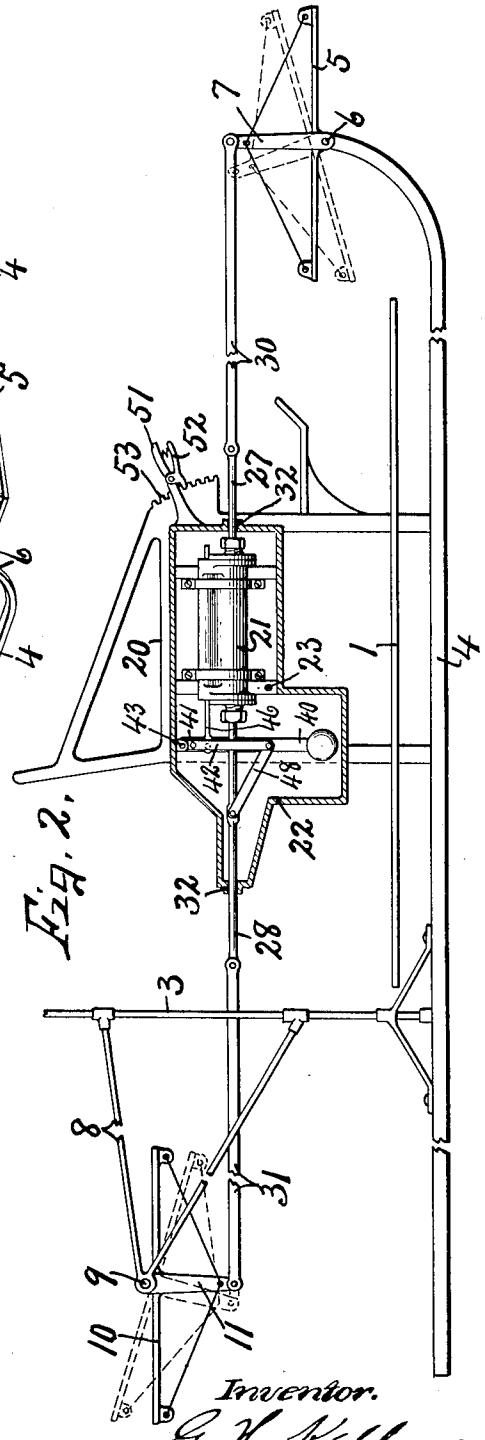


Fig. 2.



Witnesses.

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2 SHEETS—SHEET 2.

Fig. 3.

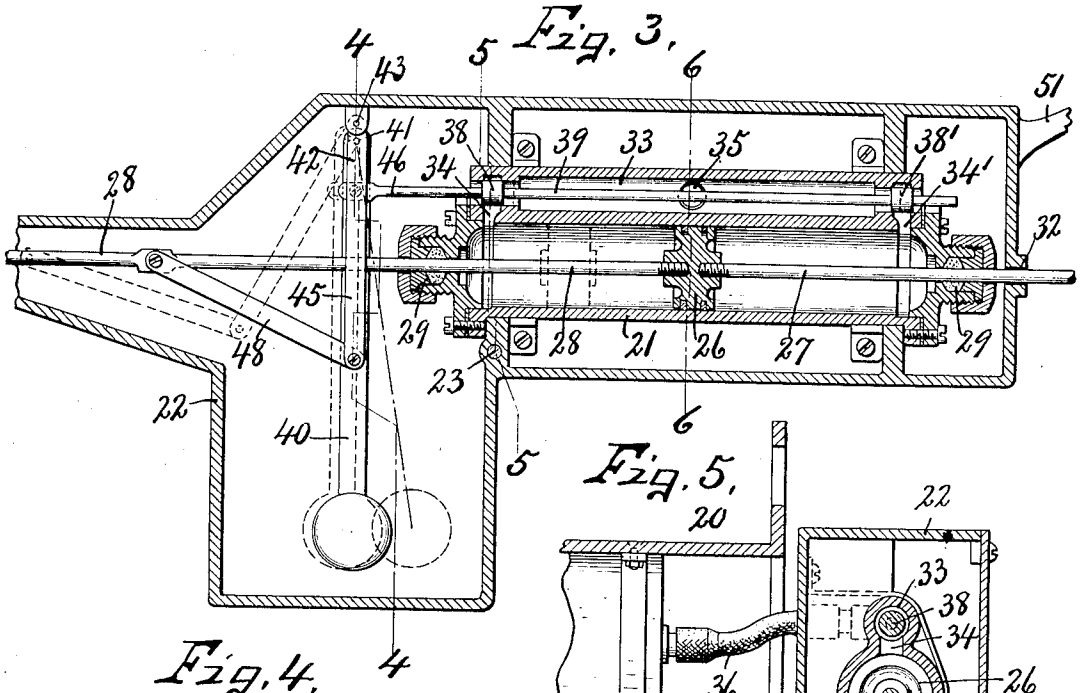


Fig. 5.

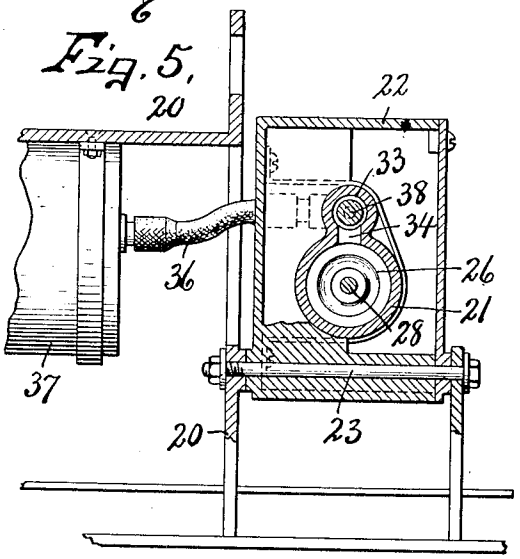


Fig. 4.

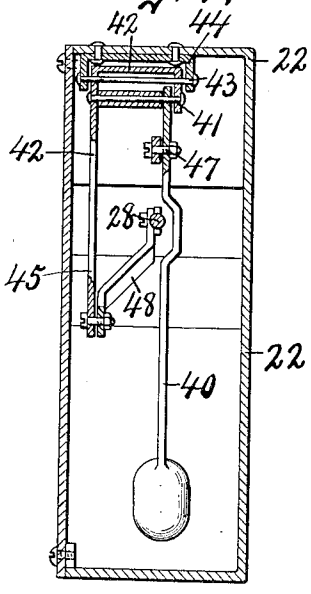
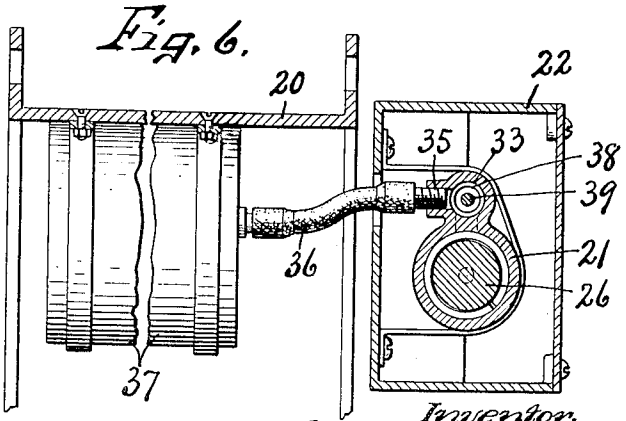


Fig. 6.



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UNITED STATES PATENT OFFICE.

GEORGE HERBERT KELLOGG, OF SYRACUSE, NEW YORK.

BALANCING DEVICE FOR AIRSHIPS.

1,035,795. Specification of Letters Patent. Patented Aug. 13, 1912.

Application filed August 6, 1909. Serial No. 511,583.

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 Balancing Devices for Airships, 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 balancing devices for air ships of the aeroplane or dirigible balloon type in which the angle of flight and horizontal position of the air ship are controlled by means of one or more horizontal rudders or wings.

The primary object is to automatically control the action of these rudders or wings through the medium of one or more pendulums and a suitable operating fluid under pressure for the purpose of maintaining the machine on a level keel, in or in a horizontal position, while in flight, and also for the purpose of operating the horizontal rudders to control the angle of flight or descent of such machine.

In my pending application No. 474,484, filed January 27th, 1909, is disclosed an aeroplane having lateral wings and front and rear rudders controlled by pendulums or frames swinging in planes at right angles to each other, and also discloses means controlled by a pendulum for operating the horizontal rudders under fluid pressure, while my present application refers exclusively to the means controlled by a pendulum for operating horizontal rudders or horizontal wings under fluid pressure, and while such mechanism is shown as applied to a machine similar to that set forth in my pending application referred to, it is applicable to any dirigible air ship in operating one or more of its guiding planes, rudders or wings.

Other objects and uses relating to specific parts of the rudder or wing-operating mechanism will be brought out in the following description.

In the drawings—Figure 1 is a perspective view of a dualplane air ship having horizontal front and rear rudders and opposite side wings tiltable on an axis running transversely of the machine. Fig. 2 is an enlarged side elevation partly broken away of the lower portion of the air ship shown in Fig. 1, showing the tiltable supporting case for the pressure cylinder in section. Fig. 3 is a still further enlarged lengthwise sectional view through the cylinder and its supporting case. Figs. 4, 5 and 6 are transverse sectional views taken respectively on lines 4—4, 5—5 and 6—6, Fig. 3.

The air ship shown in Figs. 1 and 2 comprises lower and upper parallel supporting planes —1— and —2— held in fixed relation some distance one above the other by upright supports —3— constituting a part of the main supporting frame for the planes —1— and —2—.

Secured to the main supporting frame some distance below the lower plane —1— are suitable shoes or runners —4— for supporting the machine upon the ground or other available support when not in use, or when leaving or returning to and from the ground during the ascent or descent of the machine, the front ends of the runners being turned upwardly in front of and above the lower horizontal plane —1—.

A front horizontal rudder —5— is centrally pivoted at —6— to the front ends of the runners —4—, preferably above and in front of the horizontal plane —1—, and is provided with a crank arm —7— extending upwardly from its tilting axis or pivot —6— for tilting the blade in one direction or the other to control the angle of flight or descent.

Secured to the rear portion of the main supporting frame and preferably to two or more of the rear upright bars —3— is a rearwardly projecting bracket —8—, upon the rear ends of which is centrally pivoted at —9— a rear horizontal rudder —10— having a crank arm —11— extending downwardly from its tilting axis or pivot —9— for tilting the blade —10— and additionally controlling the angle of flight.

A frame bar —12— is secured to, and runs centrally across and some distance beyond, the opposite sides of the upper supporting plane —2— and upon these oppositely extending ends are centrally mounted tiltable side wings —13— which are normally disposed in substantially the same plane as the supporting plane —2—, but are adapted to be tilted transversely on the pivotal bar —12— in a manner presently described.

A vertical steering rudder —14— is journaled upon an upright support —15— which in turn is supported by suitable brace bars —16— to the main supporting frame, said

steering rudder being preferably disposed substantially midway between the opposite sides of the plane —2—, and at the rear of the rear horizontal rudder —10— so as to have free lateral movement. This rudder —14— may be operated by any suitable mechanism, as cables —17—, not necessary to herein further illustrate or describe.

The machine is adapted to be propelled by means of an engine —18— and propeller blades —19—, the engine being mounted in suitable framework just above the lower plane —1—, while the propeller blades —19— are mounted upon suitable shafts on the main supporting frame, preferably at the front of the machine and adapted to be driven by belts or other power-transmitting mechanism from the engine.

A suitable seat —20— for the operator is provided on the lower plane —1— within easy reaching distance from the engine, where the operator may readily control the action of such engine.

The operation of the front and rear horizontal rudders —5— and —10— is controlled from a fluid pressure cylinder —21— which is located in a suitable casing —22— extending forwardly and rearwardly of the machine, and preferably pivoted at —23— to one side of the seat —20— or other suitable support.

The blades —13— are controlled from a similar cylinder which is mounted in a separate casing —24— running transversely of the machine and rigidly mounted upon suitable supports —25— near the front edge of the lower plane —1—.

Each cylinder —21— is rigidly secured lengthwise of and within its corresponding case, and, therefore, the cylinder which is mounted within the case —22— is tiltable and extends lengthwise of the machine, or forwardly and rearwardly with respect to the direction of flight, while the casing —24— is rigid on the frame of the machine and extends at right angles to the line of flight, or transversely of the machine in a plane at substantially right angles to that of the casing —22—.

Aside from the tilting action of the casing —22— and cylinder —21— inclosed therein, and means for tilting the same, the cylinders and mechanisms directly associated therewith are identical, and I will now proceed to describe the cylinder in the casing —22— and its connections for controlling the operation for the front and rear horizontal rudders —5— and —10—.

As best seen in Fig. 3, each cylinder contains a closely fitting sliding piston —26— having coaxial oppositely extending piston rods —27— and —28—, which project through suitable glands or stuffing-boxes —29— in opposite ends of the cylinder —21—, and are connected by links —30— and —31—, respectively, to the crank arms —7— and —11— of the corresponding horizontal rudders —5— and —10—, the outer ends of the piston rods —27— and —28— being guided in suitable bearings —32— in the opposite ends of the corresponding casing —22—, as best seen in Figs. 2 and 3. Associated with each cylinder is a valve chamber —33— running lengthwise of the cylinder and communicating therewith through suitable ports —34— and —34'— which are located near the ends of the cylinder and also near the ends of the valve chamber, said valve chamber being provided with an inlet —35— which is connected by a conduit —36— to a storage reservoir —37— containing fluid, such as air, under pressure. The opposite ends of the valve chamber —33— are open to the atmosphere.

The ports —34— and —34'— are normally closed by sliding valves —38— and —38'— which are of just sufficient length to normally cover their respective ports and are connected by a rod —39— for simultaneous movement in one direction or the other for permitting the entrance of the pressure fluid at one end of the cylinder and allowing the exhaust of air from the opposite end of the cylinder to atmosphere, thereby operating the piston —26— toward the port which is open to atmosphere.

The action of the valves —38— and —38'— and consequent action of the piston —26— and horizontal blades —5— and —10— connected thereto, are controlled by means of a weighted pendulum —40— which is located at one end of the cylinder —21— within the casing —22— and is pivoted at its upper end at —41— to an oscillatory supporting frame —42—, the latter being in turn pivoted at —43— upon a suitable bracket —44— on the interior of the upper side of the casing —22—, as best seen in Figs. 3 and 4. Both of the pivots —41— and —43— constituting the swinging axes of the pendulum —40— and frame —42— are located some distance above the line of movement of the piston rod —28— and valve rod —39—, the pendulum —40— and one side of the swinging frame, as —45—, extending downwardly from their respective pivots some distance below the line of movement of the piston rod —28—.

The valve rod —39— is provided with an extension —46— which is pivotally connected at —47— to the pendulum bar —40— between the lower pivot —41— and line of movement of the piston rod —28— so that any change in the normal relation between the pendulum and cylinder, as, for example, by the tilting of the machine from a horizontal plane, will transmit, through the extension —46—, motion to the valves —38— and —38'—, thereby opening one of the ports to the atmosphere and the other port

to the valve chamber —33— for admitting the pressure fluid to the corresponding end of the piston and thereby operating the piston toward the high end of the machine or cylinder. This action of the piston imparts a tilting motion in opposite directions to the horizontal rudders for automatically restoring the machine to a level keel or horizontal position.

As best seen in Figs. 2, 3 and 4, the lower end of the extension arm —45— of the swinging supporting frame —42— for the pendulum —40— is connected by a link —48— to the piston rod —28— some distance beyond the adjacent end of the cylinder and also some distance beyond the planes of intersection of the pendulum and said piston rod for the purpose of more quickly restoring the valves to their closed positions through the medium of the swinging frame —42— and pendulum —40— to prevent excessive movement of the piston and tilting movement of the horizontal rudders connected thereto.

The connections between the pendulum —40— and valve rod —46— and swinging frame —42—, and also the connections between the swinging frame and piston rod, and between the piston rod and horizontal planes, are adjusted so that the dip or tilt of the machine to any angle from a horizontal plane will automatically produce a proportionate tilting angle, in this instance about 6°, of said rudders, to 1° of the machine in such direction as to oppose the tilting angle of flight and quickly restore the machine to a level keel or horizontal position. For example, assuming that during flight it was desired to maintain the machine on a level keel or horizontal line of flight, and the front end of the machine should from any cause dip downwardly, the pendulum would maintain its vertical position by swinging toward the low end of the machine, thereby opening the valve —38— to the atmosphere and opening the valve —38′— to admit the fluid, as air, under pressure to the opposite end of the cylinder, thereby moving the piston and rods connected thereto toward the high end of the machine, which would tilt the front and rear rudders —5— and —10— in opposite directions, or to the positions shown by dotted lines in Fig. 2. That is, the front edge of the front rudder would be tilted upwardly, while the front edge of the rear rudder would be tilted downwardly, the front rudder exerting a lifting power upon the front end of the machine, while the rear rudder would exert a depressing power upon the rear end of the machine, thus quickly restoring the machine to a level keel or horizontal position, the reverse action taking place should the front end of the machine tend to tilt upwardly.

The valves —38— and —38′— are of just sufficient length to cover their respective ports —34— and —34′— when in their closed positions, and, therefore, the slightest degree of movement of the pendulum from its normal position, caused by the longitudinal tilting of the cylinder or machine, will instantly shift the valves to open said ports and allow the fluid under pressure to operate the piston and rudders connected thereto for the purpose of restoring the machine to its normal balance, but as soon as the piston begins to move, it begins immediately to restore the valves to their normally closed positions through the medium of the link —48— and rocking frame —42— connected thereto, so that by the time the machine is brought to its normal balance, the valves will be closed.

It is now apparent that although the pendulum controls the opening of the valves, and thereby controls the operation of the piston and front and rear rudders connected thereto, the degree of movement of the valves, and, therefore, the degree of movement of the piston and rudders is in turn controlled by the degree of movement of the piston.

The swinging axes of the pendulum and its oscillatory supporting frame are comparatively close together, while the connection between the piston rod and swinging frame is a considerable distance from the lower swinging axis of the pendulum, thereby permitting a much greater movement of the piston and rudders connected thereto than that of the valves, and by pivotally supporting the pendulum upon a swinging frame and connecting said swinging frame to the piston rod in the manner described, it is evident that as the pendulum swings in one direction, or toward the low side of the tilting cylinder or machine, the valves will be moved in the same direction to admit atmospheric air to the cylinder to move the piston in the opposite direction, and that such movement of the piston will rock the frame—42—, thereby shifting the pendulum bodily in the same direction as the moving piston to restore the valves to their closed position, thus checking the movement of the piston and rudders connected thereto. This automatic regulation of the degree of movement of the rudders is one of the most important features of my invention, especially the means brought into action by the movement of the piston for restoring the valves to their closed positions and thereby limiting the degree of movement of the piston and said rudders, although it is clearly evident that the tilt of the rudders will always be proportionate to the tilting angle of the machine or cylinder.

In order that the angle of flight either in ascent or descent may be easily controlled

at will, the casing or suppport —22— for its inclosed cylinder —2— is tiltably balanced or mounted upon a swinging axis or pivot —23—, as best seen in Figs. 1, 2 and 3, preferably located just below the rear end of the cylinder, said casing being provided on its front end with a handle —51— having a catch —52— movable into and out of engagement with a toothed rack or segment —53—, as best seen in Figs. 1 and 2, said handle —51— and rack —53— being located within easy reaching distance from the seat —20— so that the operator may readily tilt the casing —22— and cylinder therein at an angle with the plane of the machine or supporting planes —1— and —2—. This cylinder —21— and supporting casing —22— is normally disposed horizontally in flight at the desired altitude, but in ascending to such altitude it is, of course, necessary to cause the machine to assume some predetermined safe angle of flight, during which time the operator simply disengages the catch —52— from the rack —53— and depresses the front end of the casing —22— and its cylinder —21— by means of the handle —51—, which causes the pendulum to swing toward the low end of the cylinder, thus opening the valves —38— and —38′— and allowing the pressure fluid to enter the cylinder and force the piston rearwardly, thereby tilting the front edge of the front blade upwardly and the front edge of the rear blade downwardly somewhat as shown by dotted lines in Fig. 2, the tilting angle of the rudders and, therefore, the angle of flight of the machine depending upon the degree of tilt of the casing —22— and its cylinder —21—, for it is clearly evident that as soon as the machine assumes an angle which will bring the cylinder to a horizontal position, the pendulum —40— will immediately return to a position at right angles with the cylinder, and thereby close the valves —38— and —38′—, thereby automatically maintaining a uniform angle of flight until the desired altitude is reached, at which time the operator again restores the cylinder and supporting case —22— to its normal position, or parallel with the supporting planes —1— and —2—, thereby causing the pendulum, in effect, to swing toward the opposite or rear low end of the machine, which opens the valve —38— to admit the pressure fluid to the corresponding end of the cylinder and thereby move the piston in the opposite direction until the rudders connected thereto assume a horizontal plane, thereby operating to depress the front end of the machine and elevate the rear end of the machine until the latter also assumes a horizontal plane, in which position the machine will be automatically maintained or balanced at a predetermined altitude until it is desired to descend. In the descent of the machine the operator again disengages the catch —52— from the toothed rack —53— and rocks the front end of the casing or support —22— for the cylinder —21— upwardly, thereby causing the pendulum to swing away from the rear end of the cylinder and open the valve —38—, permitting the pressure fluid to enter the adjacent end of the cylinder and move the piston forwardly to throw the front edge of the front rudder downwardly and the front edge of the rear rudder —10— upwardly, thus causing the machine to assume a predetermined angle of descent which is automatically maintained by the pendulum —40— until the machine approaches the ground or other level where it may be desired to again bring the machine to a horizontal position, at which time the operator simply restores the casing —22— and cylinder —21— to a plane substantially parallel with the planes —1— and —2—, whereupon the pendulum —40— automatically causes the restoration of the front and rear rudders —5— and —6— to a horizontal plane through the medium of the piston and connection with the rudders.

Wing controlling mechanism.—The side wings —13— tilt upon a central axis running transversely of the machine, and the operation of said wings is automatically controlled by a cylinder —21— in the casing —24— which, as previously stated, extends transversely of the machine, or at substantially right angles to the direction of flight, and inasmuch as the cylinder and other mechanism associated therewith are the same as that which is inclosed in the casing —22— for controlling the front and rear rudders, it will be unnecessary to further describe these parts except to state that the extensions —27— and —28— of the piston rods are connected by links —60— and —61— to bell crank levers —62— and —62′— which are pivotally mounted upon the front edge of the bottom of the main supporting frame, said bell cranks or levers being connected by links —63— and —64— to the front edges of the respective wings —13—, as best seen in Fig. 1. It is now evident that if the machine should tilt laterally in one direction or the other, the pendulum in the inclosed case —24— would be shifted toward the low side of the machine, thereby admitting fluid under pressure to the corresponding end of the cylinder to force the piston toward the opposite side of the machine, which would elevate the front edge of the wing at the low side of the machine and correspondingly depress the front edge of the wing at the high side of the machine and cause a quick restoration of such machine to its normal balance or horizontal position.

In turning the air ship from a direct course, or in a circle, it is necessary to slightly depress the side of the machine toward the inside of the circle, or to elevate the outer side of the machine toward the outside of the circle in order to maintain proper balance and prevent skidding of the machine. This dipping movement of the machine toward the inside of the circle is produced by the inertia of the pendulum which tends to swing toward the outside of the circle, thereby opening the valve —38— and admitting the pressure fluid to the corresponding end of the cylinder for moving the piston toward the side of the machine which is to be depressed, which, by the connection shown in Fig. 1, operates to depress the front edge of the wing at the corresponding end of the machine and to elevate the front edge of the wing at the opposite end of the machine, thus producing the desired dip automatically and safely, because any excessive tilt of the blades will cause the automatic closing of the valves and prevent further movement of the wing operating piston, while the pendulum will immediately recover its vertical position as soon as the machine assumes a direct line of flight.

The operating fluid, as air, is compressed in the reservoir —37— by means of a compression pump —70— which, in this instance, is shown as operated directly from the crank shaft of the engine —18—.

If, for any cause, the air ship tilts either up or down in the direction of flight or laterally, the corresponding pendulum will, of course, remain in a vertical position, which will cause the corresponding valve to be moved toward the low end or side of the machine, thereby admitting the operating fluid to the low end of the cylinder, which will move the piston toward the high end or side of the machine and operate the tilting planes or rudders, as the case may be, to automatically check the further tilting of the machine and restore such machine to its normal balance. This shifting action of the piston operating through the medium of the swinging frame —42— will close the valves and thereby stop further movement of the piston, and consequently will temporarily hold the planes or rudders in their tilted position with the piston at one side of the center of the cylinder. Now as the machine is restored to a level keel the pendulum will, of course, swing in the opposite direction and thereby operate the valves to admit the operating fluid to the low end of the cylinder, which will immediately restore the piston to its central position and will also restore the valves, pendulum and swinging frame, as well as the planes or rudders, to their normal positions with the ship on a level keel.

What I claim is—

1. An automatic balancing device for air ships comprising opposite tiltable balancing planes, a pendulum pivoted to swing in the direction of extension of the balancing planes, a swinging support to which the pendulum is pivoted and adapted to swing in the same direction as the pendulum, and means controlled by the swinging of the pendulum and its swinging support for controlling the tilting action of the balancing planes.

2. An automatic balancing device for air ships comprising opposite tiltable balancing planes, a pendulum, a swinging support to which the pendulum is pivoted, the pivots for the pendulum and its support being parallel and arranged so as to cause them to swing in the direction of extension of the balancing planes, and fluid actuated means controlled by the pendulum and its swinging support for controlling the tilting action of the balancing planes.

3. In an automatic balancing device for aeroplanes, in combination with a supporting plane, a tiltable balancing plane, a cylinder tiltable relatively to the supporting plane, means operable at will for tilting said cylinder, a piston movable in the cylinder, connections between the piston and balancing plane, means for supplying fluid under pressure to the cylinder for operating the piston, and additional means brought into action by the tilting of the cylinder for controlling the supply of fluid to the cylinder.

4. In combination with a supporting plane of an aeroplane, a tiltable balancing plane, a housing tiltable relatively to the supporting plane, means operable at will for tilting said housing, a swinging support pivotally attached to the housing, a pendulum pivoted to the support and located entirely within the housing, and means controlled by the abnormal change to relative position between the pendulum and housing for operating the balancing plane.

5. In a dirigible air ship, means for automatically balancing the ship comprising a fluid-operated piston, valves for controlling the movement of the piston, a swinging support actuated by the piston, and a pendulum hinged to the support and controlling the action of said valves.

6. In a dirigible air ship, mechanism for automatically balancing the air ship, including a cylinder, a piston, means for admitting fluid under pressure to the cylinder to operate the piston, valves controlling the passage of such fluid to the cylinder, a pendulum controlling the action of the valves, and connections between the piston and pendulum for modifying the movement of the valves, and a housing in which said pendulum vibrates.

7. In a dirigible air ship, mechanism for

determining the angle of flight of the machine, comprising a tiltable cylinder, a piston, means for introducing fluid under pressure to the cylinder to operate the piston, valves controlling the passage of the fluid to the cylinder, a pendulum controlling the action of the valves, and connections between the piston and pendulum for modifying the action of said pendulum, valves and piston, means for tilting the cylinder relatively to the machine, and additional means for holding the cylinder in its tilted position.

8. In a dirigible air ship, a horizontal rudder, a cylinder, a piston movable in the cylinder and connected to the rudder, means for admitting fluid under pressure to the cylinder to operate the piston and rudder connected thereto, means, including at least one valve and a pendulum connected thereto, for controlling the passage of fluid to the cylinder, means for shifting the normal position of the cylinder relatively to the pendulum and a housing in which said pendulum vibrates.

9. In a dirigible air ship, a supporting plane, a guide plane movable relatively to the supporting plane, fluid pressure operated means connected to the guide plane to control its action, automatic means including a shiftable support and a pendulum hinged thereto for controlling the action of said fluid pressure operated means and a housing in which said pendulum and its support are adapted to swing.

10. In a dirigible air ship, a supporting plane, balancing planes movable relatively to the supporting plane, fluid pressure operated means connected to and controlling the action of the balancing planes, automatic means comprising a shiftable support and a pendulum hinged thereto to partake of the motion of the support for controlling the action of the fluid pressure operated means and a housing in which said pendulum and its support are adapted to swing.

11. In a dirigible air ship, a supporting plane, a guide plane movable relatively to the supporting plane, fluid pressure operated means connected to and controlling the action of the guide plane, and automatic means including a swinging support and a pendulum hinged to the swinging support at one side of its swinging axis for controlling the action of the fluid pressure operated means.

12. In a dirigible air ship, a supporting plane, balancing planes movable relatively to the supporting plane, fluid pressure operated means connected to and controlling the action of the balancing planes, automatic means including a swinging support and a pendulum hinged thereto to swing on a different axis from that of the support for controlling the action of the fluid pressure operated means and a housing in which said pendulum and its swinging support are adapted to swing.

13. In an automatic balancing device for aeroplanes, in combination with a supporting plane and a tiltable balancing plane, a cylinder, a piston movable in the cylinder, connections between the piston and balancing plane, means for supplying fluid under pressure to the cylinder to operate the piston, valves for controlling the passage of such fluid to the cylinder, a pendulum, and connections between the pendulum and valves for operating the latter by abnormal tilting of the aeroplane, and a housing inclosing the cylinder and pendulum and in which the pendulum is adapted to vibrate.

14. In a dirigible air ship, a supporting plane, a guide plane movable relatively to the supporting plane, and automatic means controlling the action of the guide plane and comprising a cylinder tiltable relatively to the supporting plane, a piston movable in the cylinder and connected to the guide plane, means for admitting fluid under pressure to the cylinder to operate the piston, valves controlling the entrance of such fluid to the cylinder and a pendulum controlling the action of said valves.

15. An automatic controlling means for aeroplanes, comprising in combination, means angularly adjustable with relation to the horizontal plane of the aeroplane and forming a support, means carried by said support for adjusting the stability planes of the aeroplane, a motor connected to said plane adjusting means, means for supplying a fluid supply to said motor, means suspended to be displaced by the inclination of the aeroplane and mounted to actuate said fluid supply means, and a connection between said fluid supply means and said plane adjusting means for returning the former to its normal position.

16. An automatic means for maintaining the stability of aeroplanes, comprising in combination, an auxiliary motor, means for pivotally suspending the motor from said aeroplane, means for adjusting said suspending means manually, whereby to fix the normal position of said motor, and means to automatically maintain said normal position.

In witness whereof I have hereunto set my hand.

GEORGE HERBERT KELLOGG.

Witnesses:
H. E. CHASE,
J. M. HOES.