C. M. HEIG.

FLYING MACHINE.

APPLICATION FILED FEB. 13, 1919.

1,310,619.

Patented July 22, 1919.

3 SHEETS—SHEET 1.

Fig. 1.

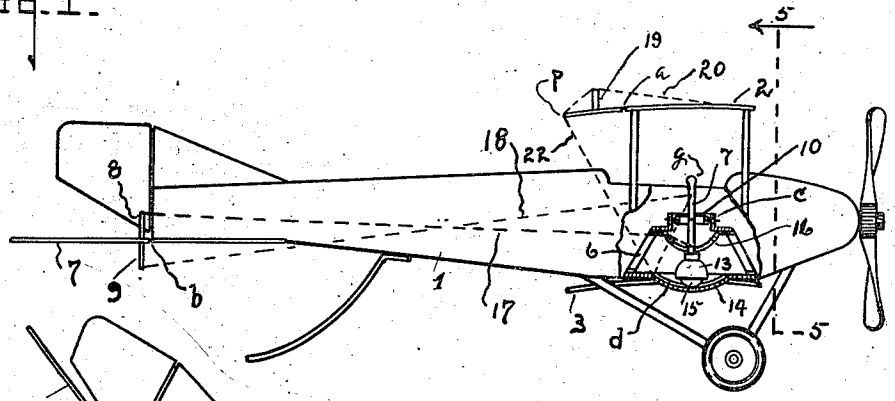


Fig. 2.

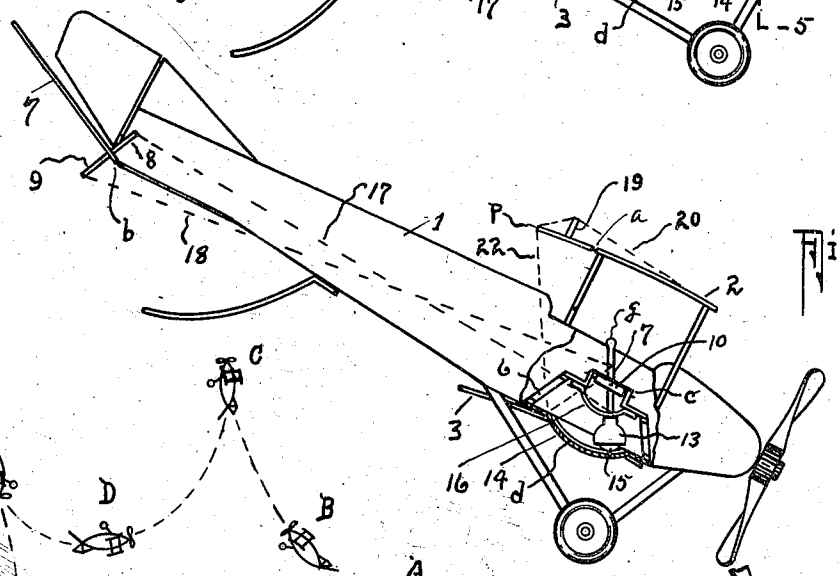


Fig. 4.

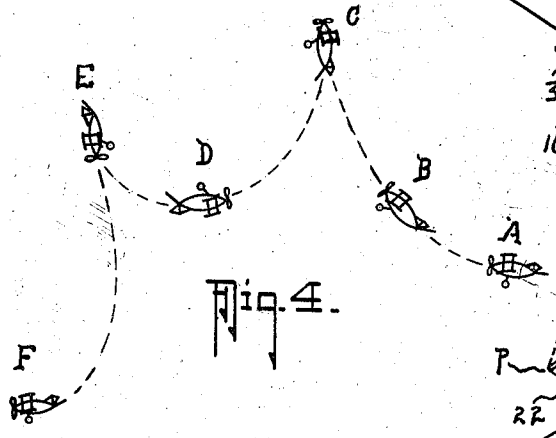
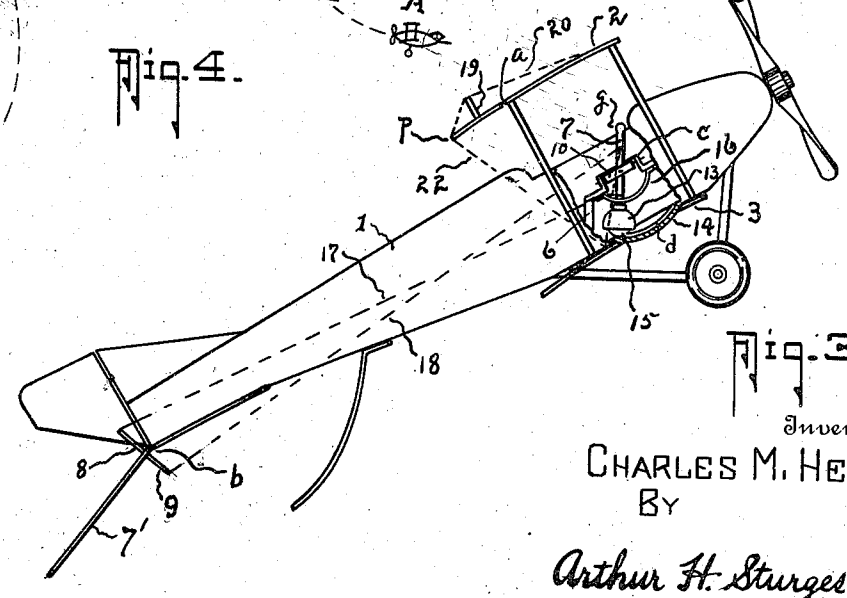


Fig. 3.



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Attorney

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3 SHEETS—SHEET 2.

Fig. 5.

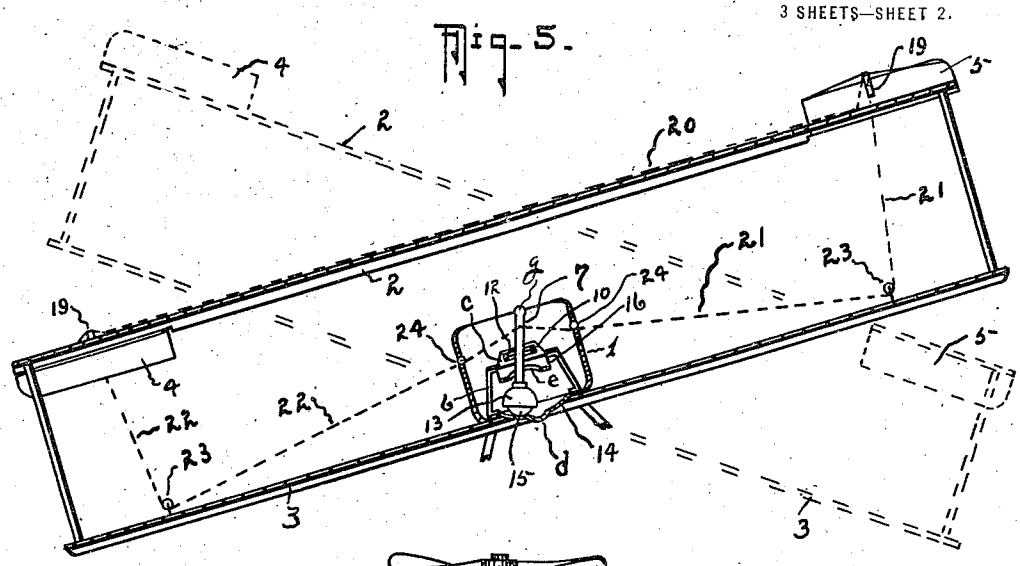


Fig. 6.

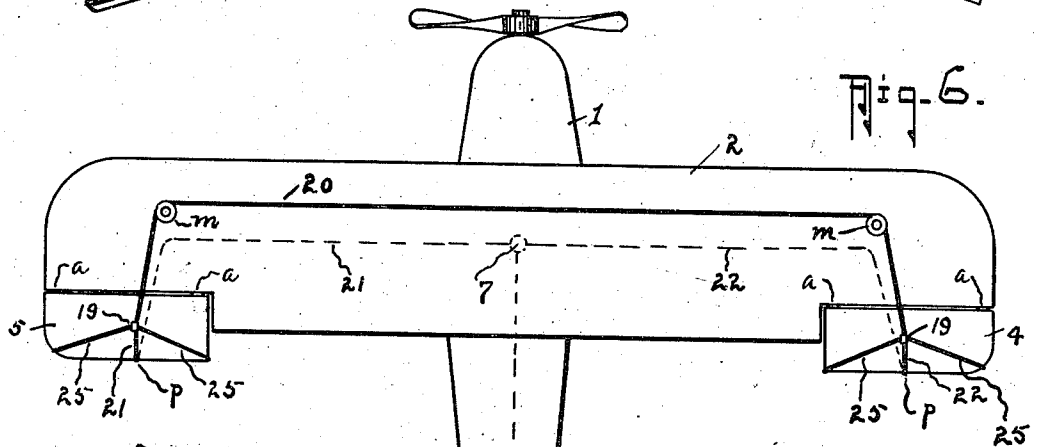
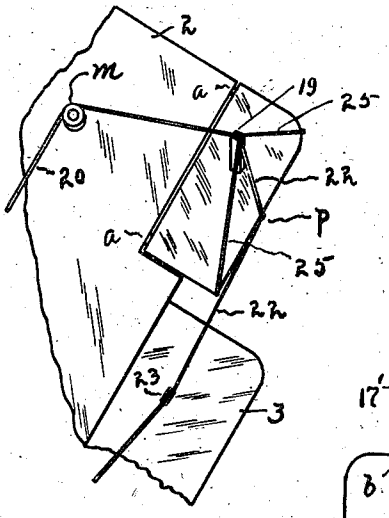


Fig. 7.



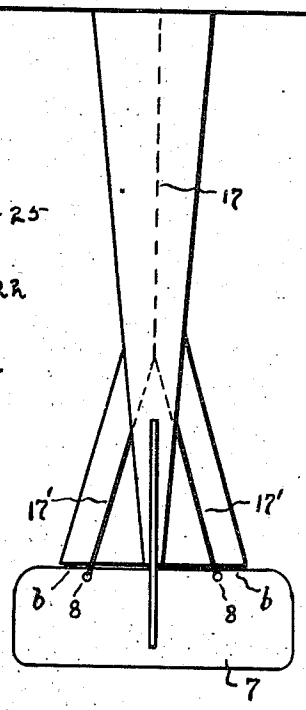
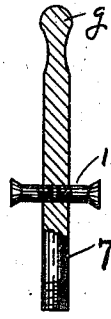


Fig. 8.



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3 SHEETS—SHEET 3.

Fig. 9.

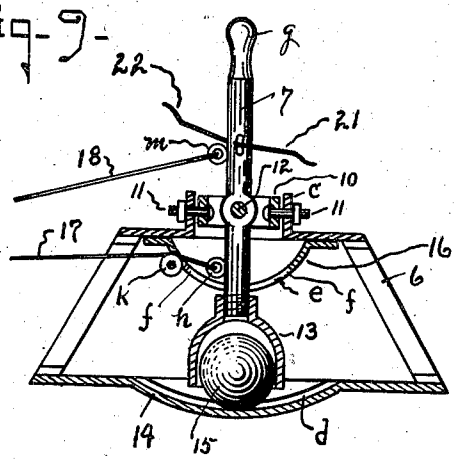


Fig. 10.

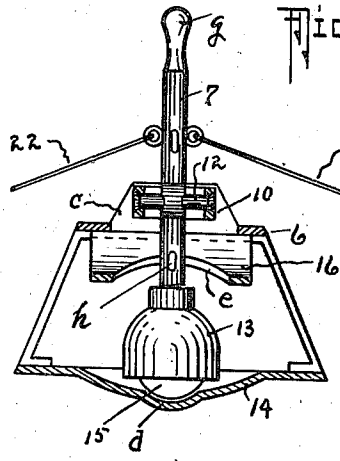


Fig. 11.

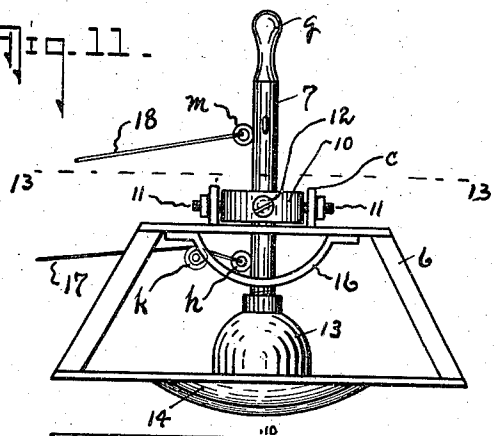


Fig. 12.

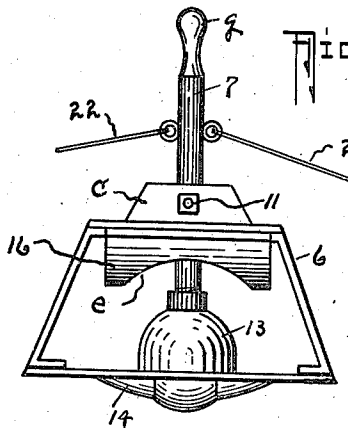


Fig. 13.

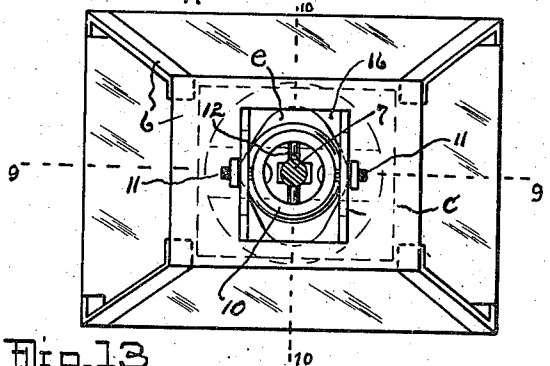


Fig. 14.

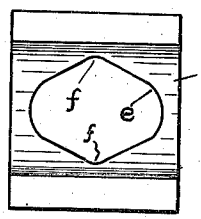


Fig. 15.



Fig. 16.

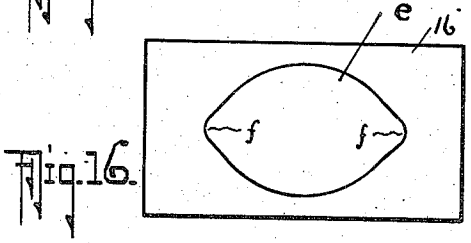
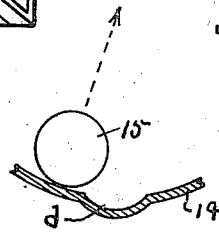


Fig. 17.



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UNITED STATES PATENT OFFICE.

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FLYING-MACHINE.

1,310,619. Specification of Letters Patent. **Patented July 22, 1919.**

Application filed February 13, 1919. Serial No. 276,707.

To all whom it may concern:

Be it known that I, CHARLES M. HEIG, a citizen of the United States, residing at Omaha, in the county of Douglas and State of Nebraska, have invented certain new and useful Improvements in Flying-Machines, of which the following is a specification.

This invention relates to an improvement in flying machines of the class employing stabilizers, and has for one of its objects to provide a pendulum of such construction and mounting that it will not cause any appreciable resistance to the air when the machine is moving at great speed. Another object is to provide a stabilizer which will operate automatically to cause the machine to return to a normal horizontal position when, for any reason, it is deflected from its course, said stabilizer also to be adapted for use by a pilot for manually steering the machine. Still another object is to provide a stabilizer of such construction that "spinning" will be prevented, and to consist of such few and simple parts that it may be practically manufactured, and may be applied to monoplanes or to flying machines having any required number of planes. Other objects of the invention will be mentioned hereinafter.

In the accompanying drawing which illustrates one embodiment of the invention, Figures 1, 2 and 3 are side views, partly broken away, showing flying machines in different positions with my stabilizing attachment applied. Fig. 4 is a diagrammatic view illustrating movements of a flying machine under automatic operation of the herein described stabilizer. Fig. 5 is a view in transverse section of the body of the flying machine substantially on line 5—5 of Fig. 1 to illustrate the use of the stabilizer for the automatic control of ailerons. Fig. 6 is a plan view of the flying machine shown in Fig. 1. Fig. 7 is a detail in perspective to clearly show the strands and their mounting upon an upper and a lower plane for a control of an aileron. Fig. 8 is a side view, partly in section, of a pendulum. Fig. 9 is a sectional view on line 9—9 of Fig. 13 through the pendulum frame. Fig. 10 is a sectional view on line 10—10 of Fig. 13. Fig. 11 is a side view of the pendulum frame and pendulum. Fig. 12 is a view of parts taken at right angles to the view shown in Fig. 11. Fig. 13 is a sectional view on line 13—13 of Fig. 11. Fig. 14 is a plan view of an apertured detaining-plate. Fig. 15 is an end view of the plate shown in Fig. 14. Fig. 16 is a view of the apertured plate before it has been bent to the form shown in Figs. 14 and 15. Fig. 17 is a detail showing a ball and groove.

Referring now to the drawings, numeral 1 indicates the body of a flying machine of conventional type provided with an upper stationary transversely disposed horizontal plane 2 and a similar lower plane 3, the upper plane being provided, adjacent to its ends, with wings or ailerons respectively indicated at 4 and 5, these being connected by suitable hinges *a* to the rear part of said plane. Numeral 6 indicates a suitable frame for a mounting therein of a pendulum 7 and the devices to be discribed, said frame being disposed midway between the ends of the planes 2 and 3, within the body of the machine; and at 7′ is indicated a horizontal plane or elevator of conventional form, its pivotal connection with the body of the machine being indicated at *b*, and its pairs of opposed arms being indicated at 8 and 9.

In order that the body of the machine and planes 2 and 3 will automatically move to a horizontal position when deflected, certain devices are provided, consisting, in part, of a ring 10 adapted to swing from opposed pivots 11 disposed in the plane of the longitudinal axis of the machine with mountings in suitable upstanding flanges *c* of the frame 6, the pendulum being provided with a pivot-pin 12 disposed at right-angles to the pivots 11, for a mounting in the ring 10, whereby a universal joint is provided for the pendulum between the ends thereof, the lower end of the pendulum being provided with a hood 13 operating as a weight.

Numeral 14 indicates a circular concavo-convex bottom for the frame 6 having a groove *d* formed therein which is disposed in the longitudinal plane of the machine body, a ball 15 being disposed somewhat loosely within the hood; and it will be understood that if the pendulum is moved from its normal vertical position, it will return by operation of gravity, to dispose the ball 15 upon the lowermost part of the circular concaved bottom 14 in the groove *d*, the momentum of the ball aiding in this movement. Also it will be understood that when the machine body has endwise swinging movements, the ball will readily move in the groove *d*, and that if the machine body has a transverse swinging movement the side walls of the

groove *d* will tend to resist such movement in a limited degree, depending upon the depth of the groove.

Numeral 16 indicates a detaining-plate having an aperture *e* formed therein of substantially elliptical form, said plate, however, being provided with recesses *f* opening upon its aperture *e*, these recesses being disposed in the plane of the longitudinal axis of the machine, and it will be understood that when the pendulum has a swinging movement or swings circularly, which may be caused by movements of the machine from a horizontal position, the plate 16 will limit said movements of the pendulum since the latter may engage the walls of the aperture *e*, and it will be understood that when the machine swings upwardly or downwardly in a sufficient degree, the pendulum will normally be maintained in the plane of the longitudinal axis of the machine since it will then be disposed in a recess *f*.

On account of the construction as described, the elevator 7 and ailerons 4 and 5 may be under automatic control to cause the machine body or the planes 2 and 3 to return to a horizontal position when, for any reason, they have been swung longitudinally or transversely, said construction also tending to maintain these parts in a horizontal position, and not interfering with the pilot's manual control, who, by use of the handle *g* of the pendulum may effectively steer the machine whenever desired.

The automatic control for the elevator is provided by a pair of strands 17 and 18, the strand 17 being provided with a pair of terminal leaders 17′ for a connection with the pair of arms 8 of said elevator, the opposite end of the strand 17 being connected with the pendulum below its universal joint, as upon the eyelet *h* and supported by a pulley *k*, the strand 18 being connected to the eyelet *m* of the pendulum above its universal joint and having a connection for its outer end upon the arms 9, and it will be understood that, as shown in Fig. 1, when the machine is disposed horizontally the pendulum will operate to dispose the elevator 7 in a horizontal position; and if the machine is disposed with a downward inclination, as shown in Fig. 2, the elevator will be swung upwardly so that the air, during the forward movement of the machine, will impinge against the upper surface of the elevator to cause the machine to assume a horizontal position. And as shown in Fig. 3 the resistance of the air when encountering the lower side of the elevator during the movement of the machine, will cause the latter to assume a horizontal position, said elevator being moved to the inclined position, by operation of the pendulum, the ball 15 moving in the groove *d*.

The automatic control for the ailerons is also provided by certain strands connected therewith and with the pendulum. Each aileron is provided with an arm 19, these arms being connected by means of a strand 20, in engagement with pulleys *m* mounted upon the plane 2. Numerals 21 and 22 indicate a pair of strands each being mounted upon the pendulum above the universal joint, said strands at their outer ends being mounted upon an arm 19 of an aileron and engaging suitable pulleys 23 mounted upon the plane 2 and engaging suitable rollers 24 which are mounted upon the machine body to provide a suitable direction of movement for said strands, the latter being suitably secured, as indicated at *p*, to an outer longitudinal edge of an aileron. Numerals 25 indicate braces for maintaining the arms 9 substantially at right angles to the ailerons.

If the machine while moving swings sidewise to the position shown in full lines in Fig. 5, the pendulum, since it will be disposed in a vertical position will cause coincident movements of the ailerons, the aileron 5 moving so that its upper surface will impinge against the air and the aileron 4 moving so that its lower surface will impinge against the air, the result being that the machine will return to its normal position, the pendulum operating as a rock-lever fulcrumed on pivots 11 for moving the strand 22 toward the body of the machine, the strand 21 moving in an opposite direction, the movement of the arm 19 of the aileron 4 causing a simultaneous movement of the arm 19 of the aileron 4 on account of the connection of said arms by the strand 20.

It will be appreciated that if the machine tends to drop nose foremost or tail foremost the pendulum will be guided to one of recesses *f* of the plate 16 at the medial plane of the machine body, and thereby the ailerons will be maintained parallel with the plane 2, to prevent the machine from spinning.

Since the ball 13 will normally remain in the groove *d* while the machine is disposed horizontally, transverse undulations of the machine will be resisted, this being of gre t advantage while moving through air of varying density, the side walls of the groove resisting a movement of the ball from its groove; and as the planes move laterally with a reciprocated swinging movement the undulations are resisted by the provision of the ball and groove.

Fig. 4 illustrates the use of the pendulum in instances where an engine has been stalled or a pilot has lost control of the machine after passing through the position B from the position A to the position C. It will be seen that when arriving at the position C, the control of the machine being lost, the pendulum will swing downwardly and will

cause the elevator 7 to swing into the position shown at C and D and thereby causing the machine to move in the curve indicated, passing through the position D, in which position the machine will be substantially inverted at the position E. When the machine reaches the position E the pendulum will swing downwardly or forwardly of the machine, thereby tilting the elevator 7 upwardly and causing the machine to make a nose dive substantially along the dotted line as indicated, and to right itself as indicated at F.

When the pilot loses control of the machine in the position shown at C, the usual result would be that the machine would fall, the movement being a "tail spin". It will be appreciated from the description that the stabilizing device obviates all danger of such a fall and that in ordinary use, while the machine is moving, it will be maintained in a horizontal position without any attention of a pilot. In instances when the machine is inverted the weight of the pendulum will be increased for the reason that it will sustain the weight of the ball 15, this being of great advantage in case of emergency.

While I have described construction in detail I do not wish to be understood as limiting myself in this respect, and changes in form, size, proportion and minor details made, as may be found to be of advantage, said changes being determined by the invention as claimed.

I claim,—

1. An improvement in a flying machine having an elongated body provided transversely with a stationary plane having a pair of wings pivotally mounted thereon, and also provided transversely with a pivotally mounted plane rearwardly of said stationary plane, a pendulum provided at its distal end with a hood, said pendulum being mounted between its ends within and adapted to swing transversely or longitudinally from the medial plane of said body, an annular, concaved bearing-plate below the mounting of the pendulum, a ball on said bearing-plate within the hood, means connected with the pendulum and wings of the stationary plane whereby said wings will be moved by a swinging movement of the pendulum transversely of said body, and means connected with the pendulum and pivotally mounted plane whereby said last named plane will be moved by a swinging movement of the pendulum longitudinally of said body.

2. An improvement in a flying machine having a body provided transversely with a stationary plane having a pair of wings pivotally mounted thereon, and also provided transversely with a pivotally mounted plane rearwardly of said stationary plane, a pendulum provided at its distal end with a hood, said pendulum being mounted within and adapted to swing transversely or longitudinally from the medial plane of said body, an annular, concaved bearing-plate below the mounting of the pendulum, a ball on said bearing-plate within the hood, means connected with the pendulum and wings of the stationary plane whereby said wings will be moved by a swinging movement of the pendulum transversely of said body, means connected with the pendulum and pivotally mounted plane whereby said last named plane will be moved by a swinging movement of the pendulum longitudinally of said body, and a detaining plate circumscribing the pendulum for maintaining the pendulum in line with the longitudinal axis of said body after said pendulum has performed one of its swinging movements.

3. In stabilizing mechanism, the combination with the body of a flying machine having a stationary, transversely disposed horizontal plane with connected, pivotally mounted wings, said body also being provided with a pivotally mounted, horizontal plane rearwardly of said first named plane, of a pendulum provided at its distal end with a hood and pivotally mounted in the medial plane of said body, a concaved bearing-plate in the vertical plane of the pivotal mounting of the pendulum, a ball within the hood engaging the bearing-plate, strands connecting the pendulum at points above and below its pivotal mounting with said pivotally mounted plane, a pair of strands connecting the wings of said first named plane with the pendulum, a detaining-plate stationary with the machine body said detaining-plate having an elongated aperture receiving the pendulum and having a pair of recesses disposed in the medial plane of the machine body opening on its aperture.

4. In stabilizing mechanism for controlling the movements of the wings of the transverse, stationary plane and the pivotally mounted elevator-plane of a flying machine, a pendulum on said machine, said pendulum being pivotally mounted between its ends and provided at its lower end with a hood, a bearing-plate having a circular, concaved area disposed below the pivotal mounting of the pendulum, a ball within the hood in engagement with said concave area, a detaining-plate between the hood and the pivotal mounting of the pendulum and having an elongated aperture traversed by said pendulum, flexible members connecting the elevator-plane with the pendulum, and a pair of connected flexible members for connecting the wings of the stationary plane with said pendulum.

5. An improvement in a flying machine

having its body provided transversely with a stationary plane having a pair of pivotally mounted wings, said body also being provided transversely with a pivotally mounted plane rearwardly of the stationary plane, a pendulum mounted between its ends upon and adapted to swing transversely or longitudinally from the medial plane of said body, an annular concaved bearing-plate below the mounting of the pendulum, a ball normally pressed against the bearing plate and movable by the movement of the pendulum, means connected with the pendulum and wings of the stationary plane whereby said wings will be moved by the swinging movements of the pendulum transversely of said body, and means connected with the pendulum and pivotally mounted plane whereby said pivotally mounted plane will be moved by a swinging movement of the pendulum longitudinally of said body.

6. In stabilizing mechanism, the combination with the body of a flying machine having a stationary, transversely disposed, horizontal plane with connected, pivotally mounted wings, and provided with a pivotally mounted, horizontal plane rearwardly of said first named plane, a pendulum pivotally mounted in the medial plane of said body, a concaved bearing-plate in the vertical plane of the pivotal mounting of the pendulum, a ball on the bearing plate disconnected from and movable by the movement of the pendulum, a pair of strands having connections with the pendulum above and below its pivotal mounting and connected with the pivotally mounted plane, a pair of strands connecting the wings of said first named plane with the pendulum, a detaining-plate stationary with the body of the machine, said plate having an elongated aperture receiving the pendulum and having a pair of recesses disposed in the medial plane of the machine body opening on said elongated aperture.

7. In stabilizing mechanism for controlling the wings of the transverse, stationary plane and the pivotally mounted elevator plane of a flying machine, a pendulum on the machine having a pivotal mounting between its ends, a bearing-plate having a circular, concaved area disposed below the pivotal mounting of the pendulum, a ball disengaged from the pendulum engaging said concaved area and movable by the movement of said pendulum, a detaining-plate between the bearing-plate and the pivotal mounting of the pendulum and having an elongated aperture traversed by said pendulum, flexible members connecting the elevator-plane with the pendulum, and flexible members connecting the wings of the stationary plane with said pendulum.

8. In stabilizing mechanism for controlling the movements of the wings of the transverse, stationary plane and the pivotally mounted elevator-plane of a flying machine, a pendulum on said machine, said pendulum being pivotally mounted and provided with a hood, a concaved bearing-plate having a groove disposed in the plane of the longitudinal axis of the flying machine and in the vertical plane of the pivotal mounting of the pendulum, a ball within the hood normally engaging in said groove, a detaining-plate between the hood and the pivotal mounting of the pendulum and having an aperture substantially elliptical in form traversed by said pendulum whereby when the latter swings to either end of said aperture it will be automatically guided to the central vertical plane of the machine, flexible members connecting the elevator-plane with the pendulum, and a pair of connected flexible members for connecting the wings of the stationary plane with said pendulum whereby when the latter swings transversely of the machine to a side of said aperture the ball will be removed from said groove.

9. In stabilizing mechanism, the combination with the body of a flying machine having a stationary, transversely disposed horizontal plane with pivotally mounted wings, said body also being provided with a pivotally mounted, horizontal plane rearwardly of said first named plane, of a pendulum pivotally mounted in the medial plane of said body, a pair of strands connecting the pivotally mounted plane with the pendulum, a pair of strands connecting the wings of said first named plane with the pendulum, a detaining-plate stationary with the machine body having an aperture substantially of elliptical form receiving the pendulum, whereby when the latter swings to either end of said aperture it will be guided automatically to the central, vertical plane of said body, and means for automatically increasing the weight of the pendulum when the flying machine is inverted.

In testimony whereof, I have affixed my signature in presence of two witnesses.

CHARLES M. HEIG.

Witnesses:
ARTHUR H. STURGES,
HIRAM A. STURGES.