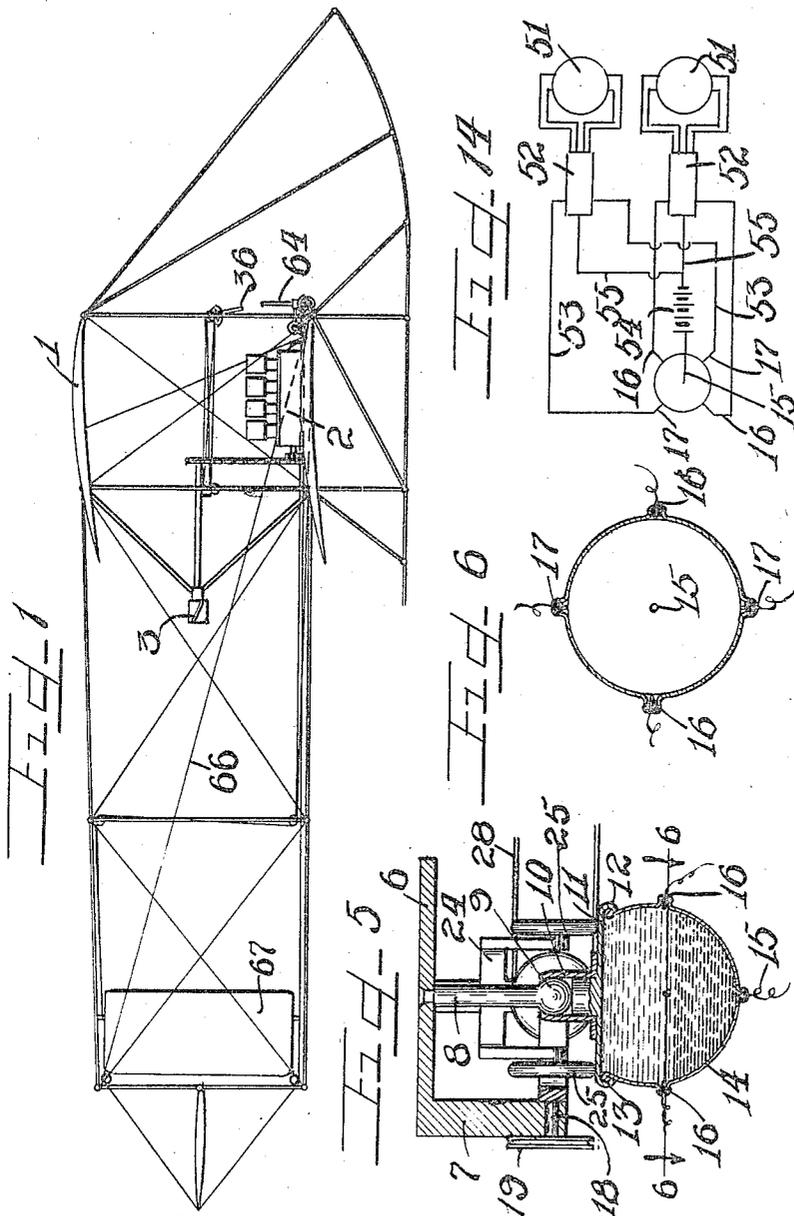


A. J. MACY.
 AUTOMATIC STABILIZING DEVICE.
 APPLICATION FILED JAN. 27, 1913.

1,203,219.

Patented Oct. 31, 1916.

4 SHEETS—SHEET 1.



WITNESSES

J. M. Angell
 Charles W. Fillep

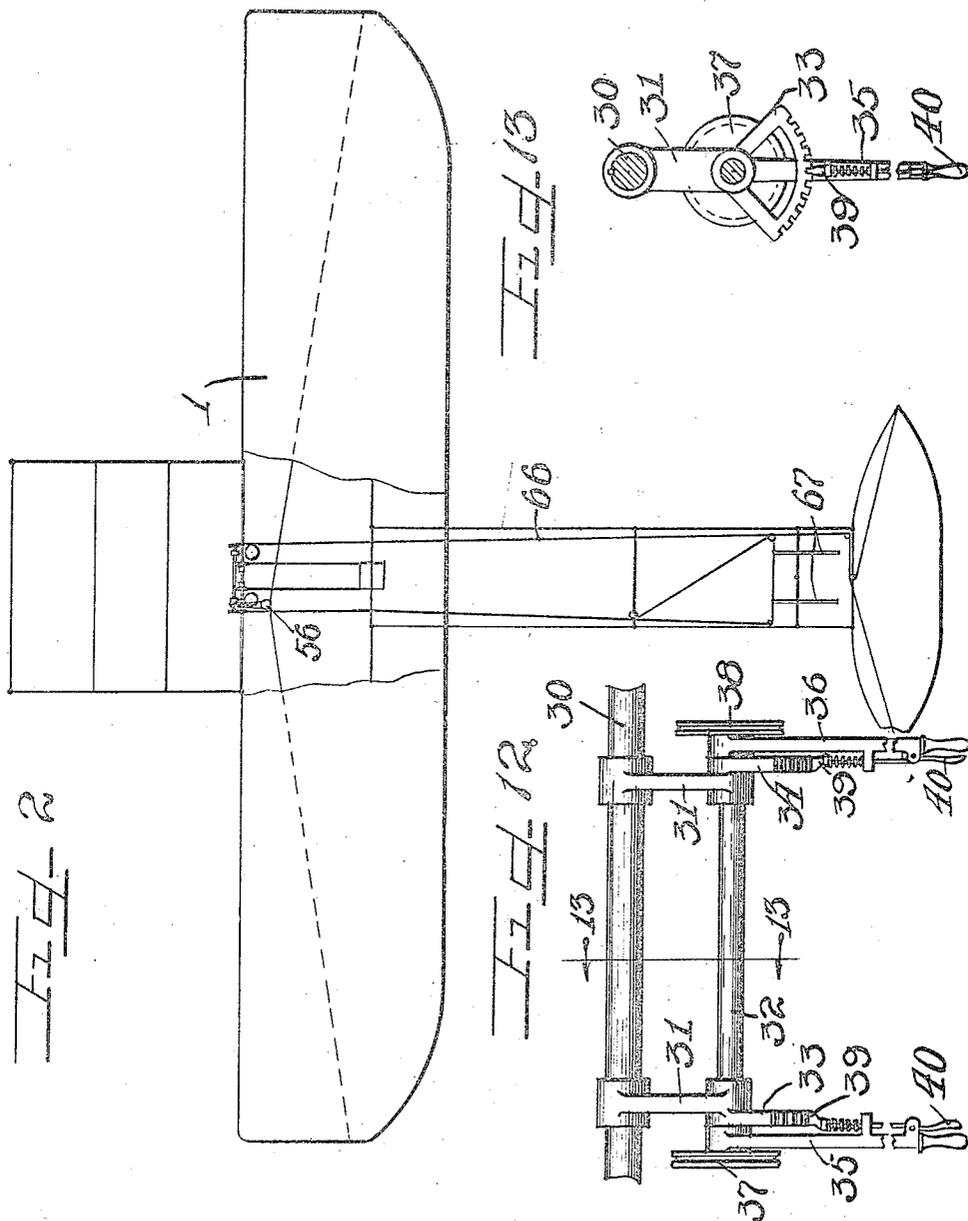
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WITNESSES

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4 SHEETS—SHEET 3.

Fig 3

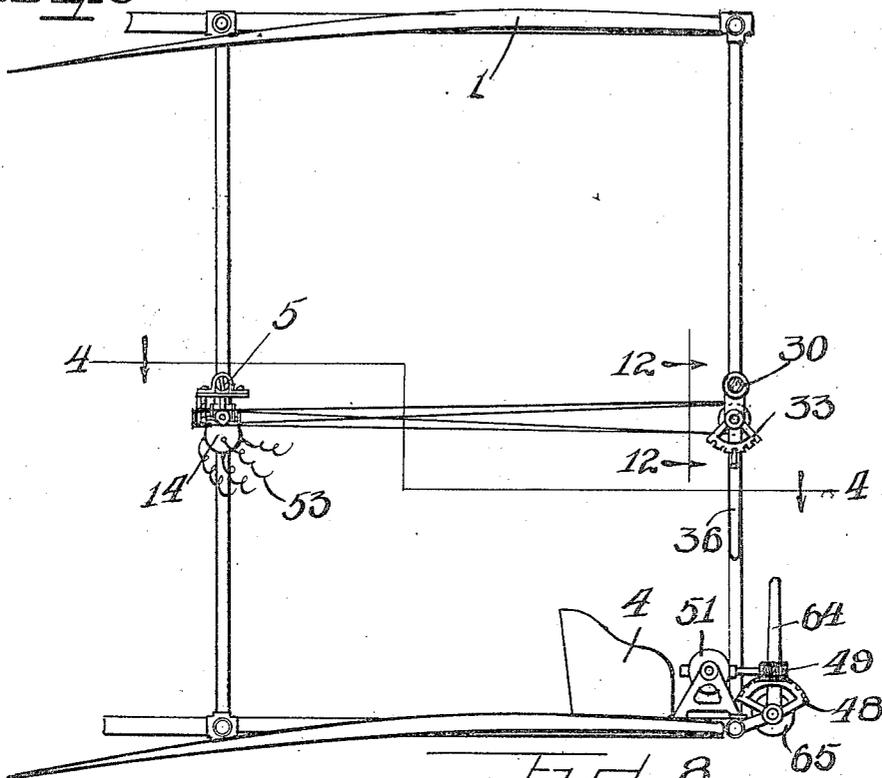


Fig 8

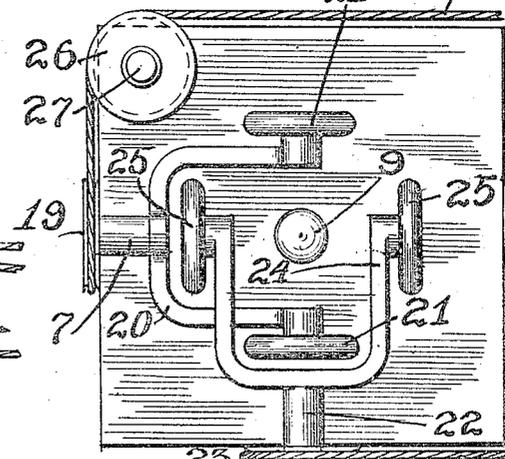
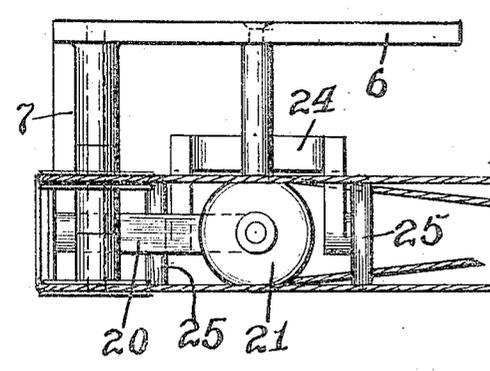


Fig 7



WITNESSES

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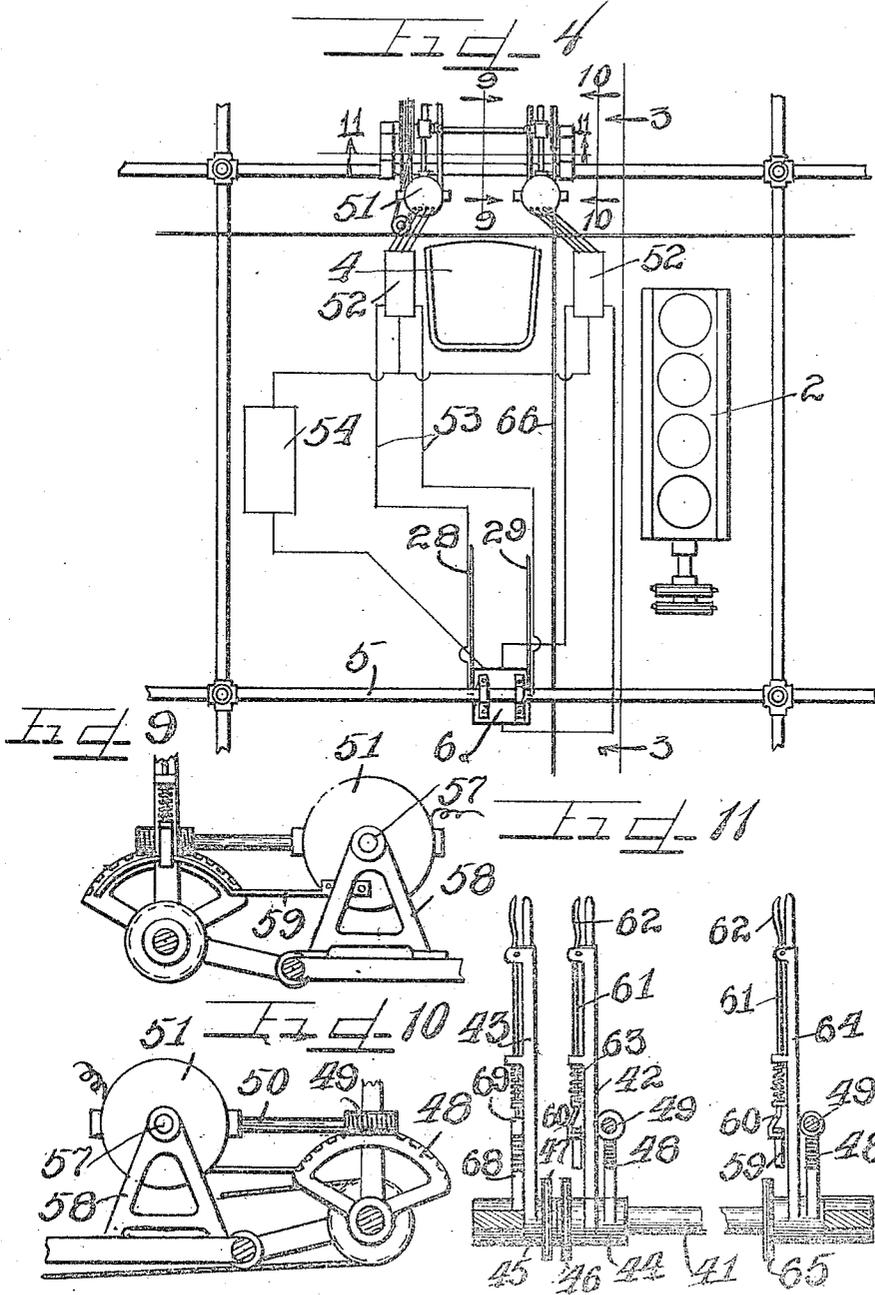
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 4 SHEETS—SHEET 4.



WITNESSES

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UNITED STATES PATENT OFFICE.

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AUTOMATIC STABILIZING DEVICE.

1,203,219.

Specification of Letters Patent.

Patented Oct. 31, 1916.

Application filed January 27, 1913. Serial No. 744,557.

To all whom it may concern:

Be it known that I, ALFRED J. MACY, a citizen of the United States, and a resident of the city of Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Automatic Stabilizing Devices; and I do hereby declare that the following is a full, clear, and exact description of the same, reference being had to the accompanying drawings, and to the numbers of reference marked thereon, which form a part of this specification.

This invention relates to improvements in devices for insuring stability and maintaining equilibrium of self-propelled devices such, for example, as aeroplanes or flying machines of any type, or even submarine vessels and torpedo boats.

The invention (for convenience of illustration) is shown embodied and installed upon a bi-plane although it will be evident that it is applicable to many other devices and uses.

The operation of all flying machines has, of course, up to the present time, been accompanied with numerous dangers, both to the structure and the operator, to which other than air supported vehicles are not subjected. The loss of life in the last few years has been enormous among the operators and users of aeroplane devices in proportion to the number of men so employed. Accidents are frequent and numerous and almost invariably result in fatalities. These accidents are occasioned in various ways. Sometimes, it is true, by structural failure or the recklessness or inexperience of the operator, but more frequently they are occasioned by causes beyond the operator's control. Sometimes momentary faintness of the operator causes him to lose control of the machine with fatal results; sometimes fatigue, due to the excessive nervous and muscular strain necessary to maintain the stability and equilibrium of the machine causes a moment's lapse or release, with fatal results. In numerous instances, the operator when in air, finds it necessary to effect some adjustment of the engine or some part of the machine, but is unable to do so because unable to vary his position, or to release the controlling levers to permit him so to do, and in such cases, the operator is indeed fortunate who has within the range

of volplaning flight, a landing place to which he may descend without destruction.

The object of this invention is to afford a device adapted to be set by the operator to determine and control the angle of inclination when ascending, or when volplaning in descent, and which, when once set, will act to positively hold and retain the angle of inclination determined upon by the operator until readjustment is effected by the operator.

It is an object of the invention also to afford a construction whereby the device may be set to afford a lateral adjustment either in wing warping or in adjusting the ailerons or the tail for spiral flight, the machine on such adjustment maintaining the desired inclination and lateral adjustment due to the automatic action of the stabilizing device.

It is a further object of the invention to afford operative means whereby the stabilizing mechanism may at the will of the operator, be released from control to permit the operator to control the machine manually as he sees fit, said stabilizing device, however, immediately coming into action again upon the operator releasing the controlling levers.

It is a further object of the invention to afford a construction whereby lateral stability is positively and automatically assured at all times, without the assistance of the operator by affording means for suitably warping the wings, operating the ailerons or other mechanisms for maintaining lateral stability without the aid of the operator, and which may be immediately thrown out of action by the operator when desired, to vary the flight.

It is an object of the invention to afford a construction adapted for use in maintaining automatic and longitudinal stability automatically on any device or vehicle in which longitudinal and lateral stability is desirable.

The invention is illustrated (in a preferred form) in the drawings and is hereinafter more fully described.

In the drawings: Figure 1 is a side elevation of a bi-plane equipped with mechanism embodying my invention. Fig. 2 is a top plan view thereof, with parts omitted. Fig. 3 is an enlarged, fragmentary central section broken away, on line 3—3 of Fig. 4.

Fig. 4 is a section on line 4—4 of Fig. 3. Fig. 5 is an enlarged central vertical section of a device embodying my invention. Fig. 6 is a section taken on line 6—6 of Fig. 5. Fig. 7 is an enlarged side elevation thereof with the equilibrium member removed. Fig. 8 is a bottom plan view thereof, with the equilibrating or stabilizing member omitted. Fig. 9 is an enlarged section on line 9—9 of Fig. 4. Fig. 10 is an enlarged section on line 10—10 of Fig. 4. Fig. 11 is an enlarged section on line 11—11 of Fig. 4. Fig. 12 is an enlarged section on line 12—12 of Fig. 3, illustrating the shifting levers for the stabilizing element. Fig. 13 is a section on line 13—13 of Fig. 12. Fig. 14 is a diagrammatic view of a wiring plan embodying my invention.

As shown in the drawings, the bi-plane indicated as a whole by 1, (which is only intended for conventional illustration, as obviously the invention may be used successfully on any type of heavier than air machine) is of the Wright type, equipped with an engine 2, driving the usual propeller or propellers 3. The operator's seat 4, is located as usual for the particular type of machine used, and in convenient access thereto are the usual operating and controlling levers, which, in the particular embodiment of the structure illustrated in the drawings, will be hereinafter more fully described.

Mounted upon any convenient (but preferably centrally disposed) part of the machine frame, for example, the horizontal frame bar 5, is the stabilizing device. As shown, a supporting plate or frame 6, is secured on said bar and provided with a downwardly directed bracket or flange 7, at one side thereof. Rigidly secured on said plate or frame 6, and extending downwardly therefrom is a shaft 8, the lower extremity of which is rounded to afford a spherical head conveniently of somewhat larger diameter than that of the shaft.

Supported and swiveled thereon by means of a socket member 10, is the cover plate 11, as shown circular in shape, and provided with flanges 12, turned downwardly and inwardly to receive therein the outwardly turned flanges or bead 13, of the cup 14, which is constructed of any suitable non-conducting material such as glass or hard rubber, and is provided in its bottom with an electrical conductor 15, which extends upwardly thereinto, and is provided on the forward part thereof and at the rear, with similar conductors extending through the walls of the cup at about half the height of the cup, as indicated by 16. Arranged ninety degrees of the forward and aft contacts 16, and on each side of said cup and at the same height as said forward and aft conductors, are contact members which pro-

ject into the cup, as shown in Figs. 5 and 6. The cup is filled with mercury to near the contact members 16 and 17, and is filled above the mercury with a lighter liquid, for instance, oil or glycerin, as shown in Fig. 5, the arrangement being such that the forward and aft and lateral contacts are normally immersed in the non-conducting fluid while the bottom contact member at all times is in electrical contact with the conducting fluid, so that when the cup is inclined in any direction an electrical circuit is established between the bottom contact member 15, and one of the forward or aft contacts 16, or one of the lateral contacts 17, or with one each of the contacts 16 and 17.

Journalled in the bracket 7, is a shaft 18, which projects toward the pivot shaft 8, and rigidly secured on the outer end of which is a sprocket wheel or sheave 19. A yoke 20, is rigidly secured on the inner end of said shaft and the arms thereof somewhat widely diverge and project one on each side of the central fillet shaft and are provided with rounded bearings or wheels 21, which bear upon the cover plate 11, of the stabilizing member, as shown in Figs. 5, 7 and 8. A similar bracket 22, is provided on one side of the plate or frame 6, and extending there-through at a right angle with the shaft 18, before described, is a corresponding shaft provided on its outer end with a sprocket wheel or sheave 23, and at its inner end having a yoke 24, rigidly secured thereon, as before described, and provided with rounded bodies or wheels 25, secured thereon, as shown in Fig. 8, which bear on the top of the cover 11, of the stabilizing member. Said shafts being directed at a right angle with each other, the rounded bearing members 21, which engage on the cover on opposite sides of the pivot bearing act to lock or incline the stabilizing member when the shaft 18, is slightly rotated by means of its sheave or sprocket wheel, the direction of inclination being to either side, dependent upon the direction of rotation of said shaft, and a suitable sheave 26, is rotatably secured on a shaft 27, secured on the under side of the frame plate to change the direction of the sheave line 28, to enable the operator seated in advance of the stabilizing element, to incline the same toward either side, dependent upon the direction of draft upon the line. In a similar manner a cable or sprocket chain 29, is trained about the sprocket wheels or sheave 23, on the other of said shafts to enable the operator who sits in advance thereof to incline the cup either forward or aft horizontally by the rotation of said shaft and the action of the round bodies or wheels 25, on the top of the stabilizing device. Said cables 28 and 29, lead forwardly in the construction shown.

and mounted upon a horizontal front frame bar 30, are depending brackets 31, in the lower ends of which is journaled a shaft 32. An integral segment 33, and 34, respectively, is provided at the under side of each of the brackets 31, and is directed downwardly. Rotatably mounted on the ends of the shaft 32, at the outer side of the corresponding brackets and at the extremities of the shaft are levers 35 and 36, adapted to swing on said shaft, and rigidly secured to each of which to move therewith, is a sheave 37 and 38, about which respectively the cables 28 and 29, or the sprocket chains (should such be used) are tightly drawn. A spring controlled detent 39, provided with a suitable grip release 40, at the handle of the lever, is provided on each of said levers to enable the operator by gripping the handle, to swing the lever on the shaft and adjusting the same relatively the detent and partly rotating the sheave 37 and 38, and, of course, the corresponding sheaves of the stabilizer device thereby, but permitting quick release for adjustment, when required, to any other desired position.

Mounted in advance of the operator's seat is a horizontal shaft 41, rotatably mounted upon which at one side of the operator, for example, the left side, is a lever 42, and a lever 43, each provided at its lower end with a transverse sleeve 44 and 45, respectively through which the shaft extends, and each having thereon a sprocket or sheave 46 and 47 respectively. As shown, a worm gear segment 48, is provided on the sleeve 44, of the lever 42, and meshing therewith is a horizontal worm 49, which is mounted upon the shaft 50, of an electric motor 51, said motor 51, being connected through a reversing box 52, with lead wires 53, which connect with the contacts 17, at each side of the stabilizing device. An accumulator, storage battery or any other source of current 54, is connected in the circuit with the reversing box 52, with the motor, through the reversing box 52, and with the bottom contact 15, of the stabilizing device, as shown in Fig. 14, by means of a lead wire 55.

Cables are led about the sheave 46, and thence about a fixed sheave 56, suitably mounted upon the frame, and thence lead to the extremities of the planes where the same are secured to permit warping of the respective planes, or operation of the ailerons should such be used when the motor is brought in circuit by the inclination of the machine laterally in either direction. The circuit being closed by the mercury immersing one of the laterally disposed contact members 17, the plane is now dependent, of course, upon the direction of inclination of the machine, the circuit when closed with one of said lateral contact members 17, acting to drive the motor ahead, while contact

effected by the closing with the other contact member 17, acts to reverse the motor, the worm in either instance, of course, shifting the segment proportionately and continuously until the warping has brought the machine back to the position for which the stabilizing device was normally set.

As shown, the motor 51, is mounted upon trunnions 57, one at each side thereof, upon a suitable A frame 58, and secured on the side of the motor casing, is a bar 59, which projects alongside the segment as shown in Fig. 9. A lifting finger 60, engages therebeneath and is carried upon a rod 61, slidably engaged upon the lever 42, and provided with a grip 62, at the upper end thereof adapted to be manually engaged simultaneously with the engagement of the handle of the lever, acting to hold the lever 63, normally depressed. This construction enables the operator to warp the wings manually by merely gripping the hand grip 62, engaging the lever, thus acting to tilt the motor upwardly sufficiently to shift the worm out of gear with the worm segment, and enabling the operator to operate the levers as usual when said stabilizers are not employed. Of course, immediately upon releasing the lever, however, the motor drops back to normal position, meshing the worm with the worm gear again and the stabilizing device acts to suitably adjust the planes in accordance with the setting of the stabilizer. At the right side of the operator is a corresponding motor 51, which drives a worm 49, which meshes with the worm segment 48, rigidly connected with a lever 64, with which also is rigidly connected a sheave or sprocket wheel 65. The mounting of the lever, the engagement of the worm 49, therewith, the tilting bar 59, lifting pinion 60, and all other parts thereof are identical with the construction heretofore described with reference to the lever 42, and the accessories for operating and driving the same. The cable 66, trained around the sheave 65, leads to the elevating mechanism or that for controlling the ascent and descent. As shown, the elevating motor 51, is connected through a reversing box 52, such as before mentioned, with the lead wire 55, from the battery or any other source of current and thence to the contact at the bottom of the stabilizing device, and also connected with the forward and aft contacts 16, before described.

The lever 43, mounted to swing on the shaft or frame member 41, is the controlling lever for the rudder 67. As shown, a notched segment 68, is rigidly secured on the frame adjacent said lever 43, and a spring controlled detent 69, is provided to engage said detent to hold the rudder in adjusted position.

The operation is as follows: When about

to start flight, the operator desiring to ascend adjusts the stabilizing bowl by means of the cable 29, so that the bottom contact 15, and the rear contact 16, are in circuit.

8 This starts the motor which drives the worm in the proper direction to adjust the elevators to a suitable angle, for the desired upward inclination of the machine. If the machine is now started, the motor will be

10 driven so long as the circuit remains closed, and will cease to operate when the desired angle of inclination is attained, and will begin to operate again immediately when the inclination falls below the desired angle.

15 Thus the machine is maintained in stability at an angle longitudinally predetermined by the operator. While so in flight, should the machine incline laterally in either direction, one of the lateral contacts 17, is brought into

20 circuit with the bottom contact of the other motor, said motor driving its worm characteristically to warp the wings to return the machine to an even keel or to the adjustment of lateral inclination, for example, in spiral

25 flight for which the stabilizing device may have been previously set. Should emergency for inclination require, the operator may at any time actuate the stabilizer by merely operating the machine as usual by means of

30 the hand levers. When so operating the machine, the hand grips actuated serve to elevate the tilting bars 59, bringing the respective worm out of mesh with the worm gear, and thus enabling the operator to operate

35 the machine independently as before described. Immediately upon releasing the levers, however, the worms drop back into place and will be operated characteristically, dependent upon the circuit closed to bring the

40 machine to the position required by the stabilizer. The operator may instantly adjust the stabilizer to permit the angle of longitudinal inclination or of lateral inclination, or both, to be varied, as the requirements of

45 the flight may necessitate or suggest, or the inclination of the operator may dictate. This is accomplished by means of the levers 35 and 36, the one of which acts to characteristically adjust the stabilizing device

50 upon its swiveled support, the one for longitudinal variation, the other for lateral variation.

Of course, it is to be understood that while I have described the invention with reference to an aeroplane or a heavier than air flying machine, the device is particularly appropriate and applicable to a submarine vessel or torpedo boat, and may even be

55 utilized to assist in preventing lateral and longitudinal rolling and plunging of a vessel at sea. Of course, when so installed, the particular mechanism operated by the stabilizing device will vary in accordance with the character of the installation, that is to

60 say, the invention, when installed on a flying

machine, is connected to operate the wings or the elevators or tail, while upon marine installations, for example, submarine vessels, the mechanism would vary, and lateral and longitudinal stabilizing propellers or rudders would be controlled thereby. I have not, however, deemed it necessary to illustrate all the manifold and various purposes to which my invention may be applied, inas-

70 much as its utility for such various purposes will be readily understood. I have therefore illustrated but a preferred form of the embodiment of my invention, and I do not purpose limiting the patent granted on this application, otherwise than necessitated by

80 the prior art.

I claim as my invention:

1. A stabilizing device for vehicles intended to move normally other than on the ground, and embracing a movable body adapted to remain in a fixed position relative the earth's surface, electrical contacts arranged about the same, one electrical contact at all times connected with said body and acting to form a part of various electrical circuits through said body dependent upon the direction of inclination of the vehicle, tiltably mounted motors operated by said circuits adapted to be tilted out of normal driving position, and mechanisms actuated by said motors when in normal driving position for counteracting the inclination of the vehicle to return the vehicle to normal.

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2. A device of the class described, embracing a container supported on a vehicle, a conducting medium therein maintaining a normal level, electrical contacts extending into the container one at the bottom thereof at all times in contact with the medium, others arranged forward and aft and on each side of the container and normally above the surface of the conducting medium therein, mechanisms controlling longitudinal inclination and lateral inclination of the vehicle, motor driven worm shafts for actuating the same for such control, electrical connections between the various contacts on the container and the source of power for actuating said controlling means, means adapted for manual operation for disconnecting the worm shafts from said controlling mechanisms and means adjusting the container for a desired angle of longitudinal or lateral inclination of the vehicle.

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3. A device of the class described, embracing a gravity controlled element, an element moving in conformity with the vehicle and carrying electrical contacts, mechanisms for counteracting longitudinal and lateral inclinations of the vehicle, operative connections between said mechanisms and said controlling elements whereby inclination of the vehicle in any direction is counteracted by said mechanisms, and a plurality of tilttable

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motors normally in driving position forming a part of said operative connections and adapted to be set in operation by said elements to positively drive said mechanisms, said motors when tilted out of normal position being disconnected from said mechanisms.

4. A stabilizing device for aeroplanes embracing a movable body adapted to maintain a fixed position relative the earth, electrical contacts arranged about the same and one thereof at all times connected therewith, said body acting to establish electrical circuits through said electrical contacts dependent upon the direction of inclination of the aeroplane, and oscillatably mounted motors capable of being swung into position out of use, but normally positioned to be set in operation when said electrical contacts are closed to positively drive the guiding means on said aeroplane.

5. A device of the class described embracing a container, a conducting medium therein maintaining a normal level, electrical contacts extending into the container, one at the bottom thereof at all times in contact with the medium, others arranged forward and aft and on each side of the container and normally above the surface of the conducting medium therein, adapted to be electrically connected to the one at the bottom through said medium when said container is tilted, and pivotally mounted motors adapted to be set in operation when said contacts are closed, the pivotal mounting of said motors permitting the same to be moved into a position out of use.

6. A stabilizing device for aeroplanes embracing a body adapted to maintain a fixed position relative the earth's surface, electrical contacts arranged about the same and one thereof at all times connected therewith, said body acting to close various electrical circuits through said electrical contacts dependent upon the direction of inclination of the aeroplane, manually operated controlling means for the aeroplane, and oscillatable driving means controlled by said electrical circuits for counteracting the inclination of the aeroplane to return the same to normal, said driving means adapted to be swung out of operation automatically when the aeroplane is operated by said manually operated means.

7. A device of the class described embracing a container, a conducting medium therein maintaining a normal level, electrical contacts extending into the container, one at all times in contact with the medium, others normally above the surface of the conducting medium therein, mechanisms controlling longitudinal and lateral inclination of the vehicle upon which the container is sup-

ported, manually operated devices for control of said mechanisms, oscillatably mounted motors for actuating said devices to control the aeroplane, and electrical connections between the various contacts on the container and said motors for actuating said controlling mechanisms, said motors adapted to be swung out of operation automatically when said devices are manually operated.

8. The combination with an aeroplane and manually controlled operating devices therefor, of a stabilizing mechanism embracing a gravity control element, an element moving in conformity with the aeroplane, electrical contacts thereon, and electric motor driven mechanisms operated by said controlling elements for counteracting longitudinal and lateral inclinations of the aeroplane by actuation of said devices, said mechanisms adapted to be automatically swung out of use when the aeroplane is manually operated by means of said devices.

9. The combination with an aeroplane of a stabilizing bowl, electrical contacts therein adapted to be closed when said bowl is tilted, controlling means for said aeroplane, levers connected thereto for manual actuation thereof, and a plurality of oscillatably mounted motors adapted to actuate said levers when certain of said contacts in said stabilizing bowl are closed, said motors adapted to be swung out of actuating relation with said levers when the same are manually operated.

10. In a device of the class described, a stabilizing bowl, a plurality of electrical contacts therein, and a plurality of tiltable motors adapted to be set in operation when said contacts within said bowl are closed, said motors capable of being tilted into a position out of use.

11. In a device of the class described, the combination with an aeroplane, of stabilizing mechanism comprising a mercury bowl, electrical contacts therein, controlling levers for said aeroplane adapted to be manually actuated, worm gear segments associated therewith, a plurality of worm shafts engaging the same, and a plurality of motors adapted to be set in operation when the contacts within said mercury bowl are closed to drive said worm shafts and actuate said levers to guide the machine independently of manual actuation thereof.

In testimony whereof I have hereunto subscribed my name in the presence of two subscribing witnesses.

ALFRED J. MACY.

Witnesses:

LE ROY D. KILEY,
GEORGE R. MOORE.