A. J. MACY.

STABILIZER.

APPLICATION FILED JULY 28, 1913.

1,187,439.

Patented June 13, 1916.

5 SHEETS—SHEET 1.

Fig. 1

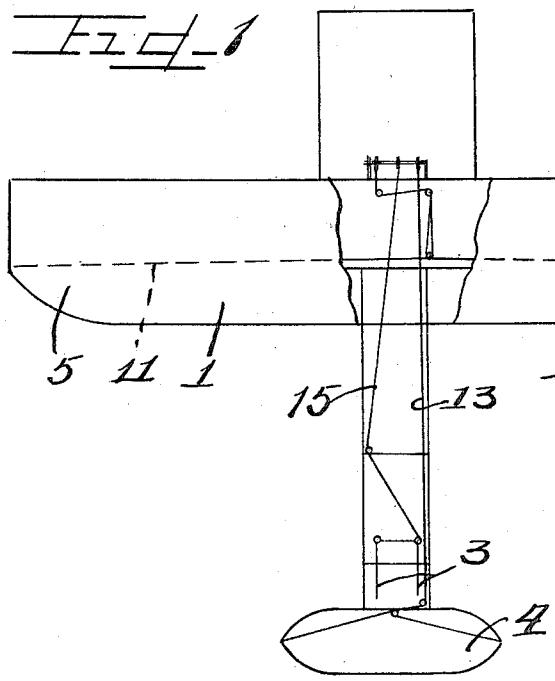


Fig. 17

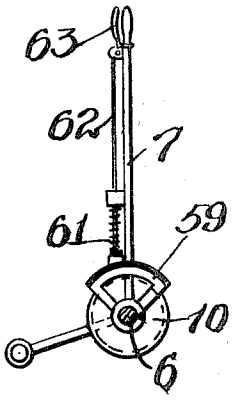


Fig. 18

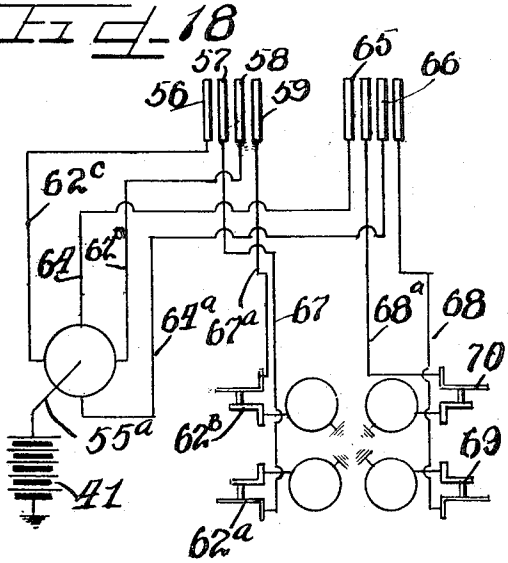
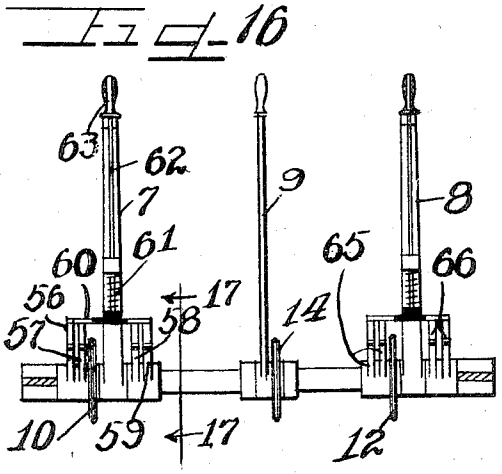


Fig. 16



Witnesses

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5 SHEETS—SHEET 2.

Fig. 2.

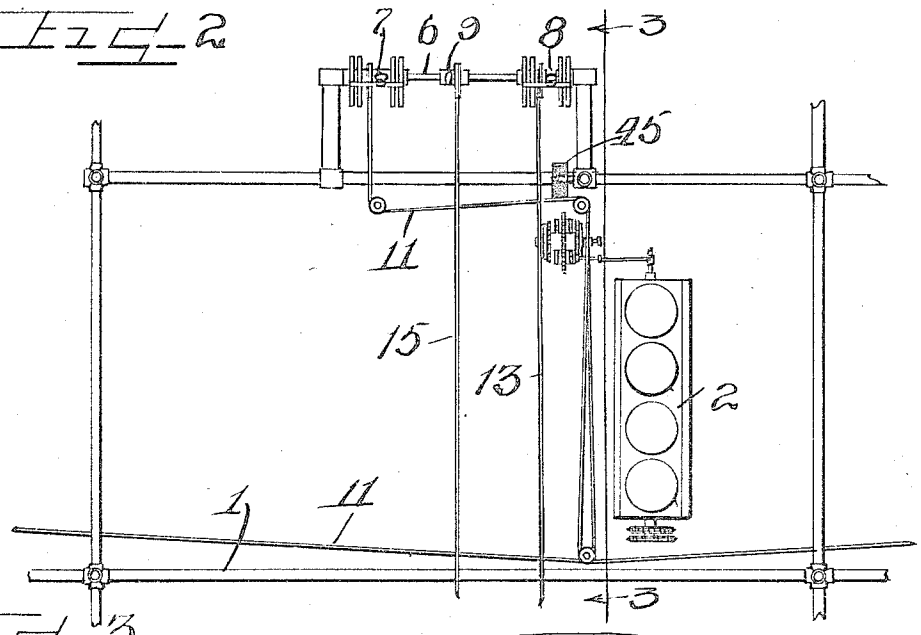
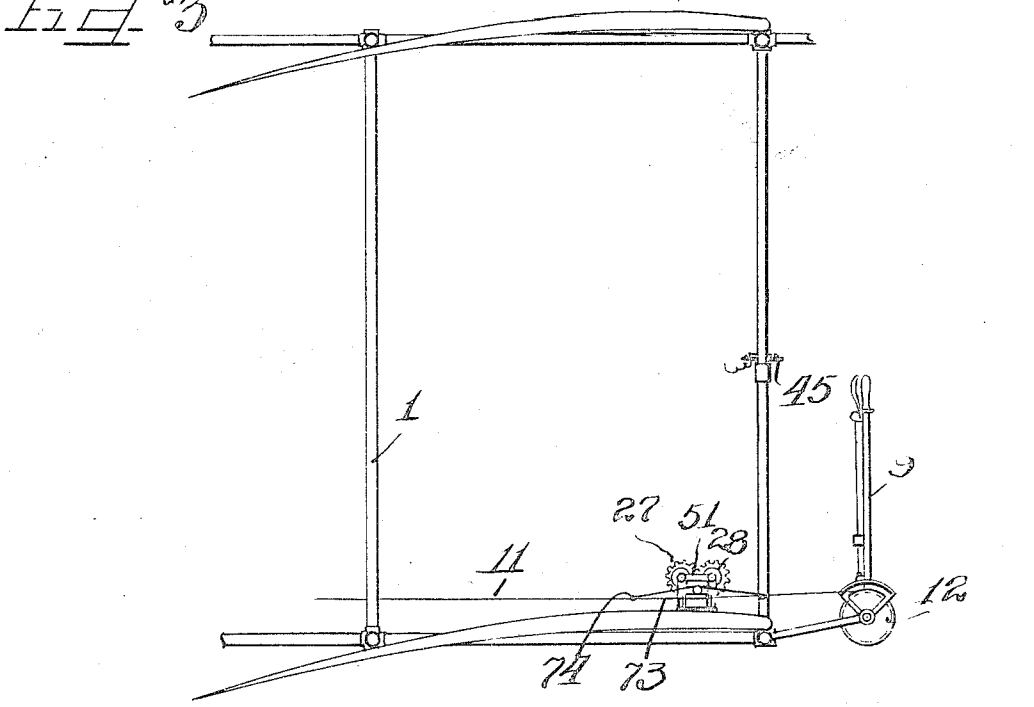


Fig. 3.



Witnesses

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5 SHEETS—SHEET 3.

Fig. 7

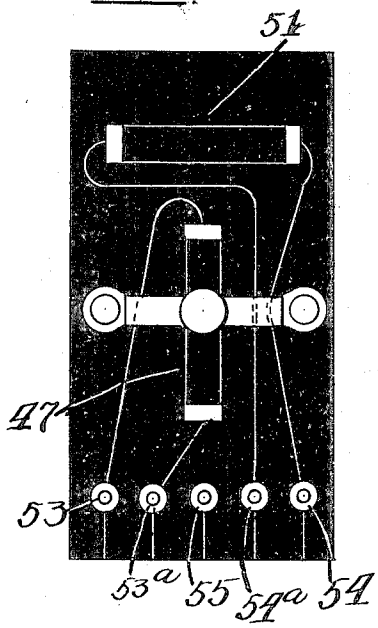


Fig. 4

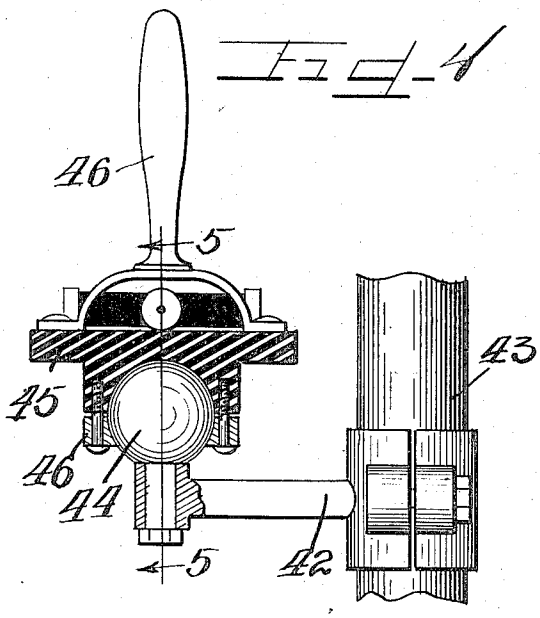


Fig. 5

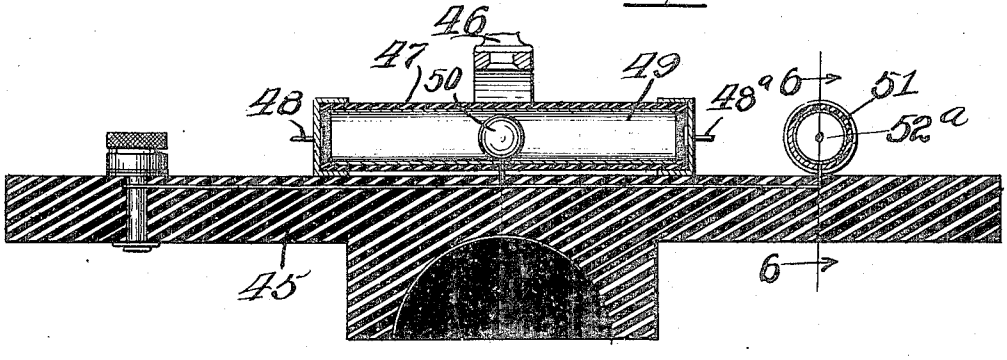
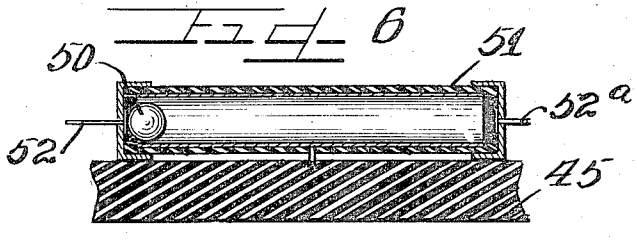


Fig. 6



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5 SHEETS—SHEET 4.

Fig. 8

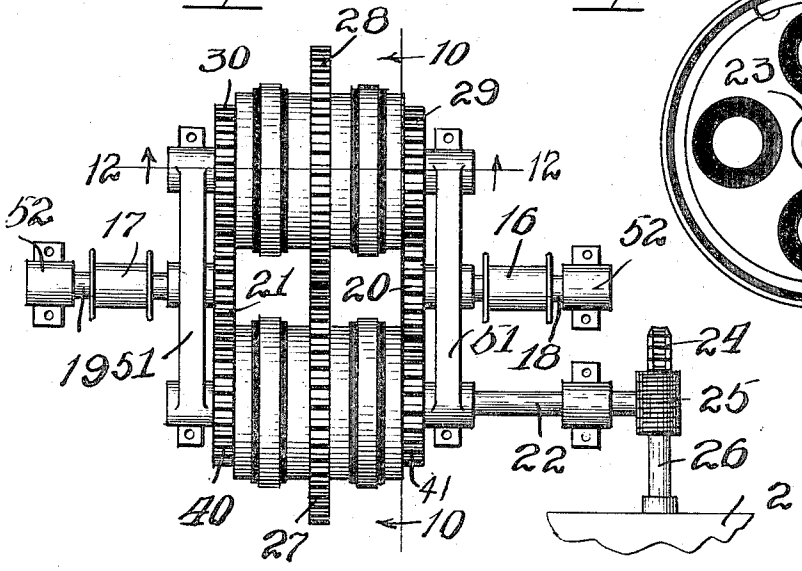


Fig. 13

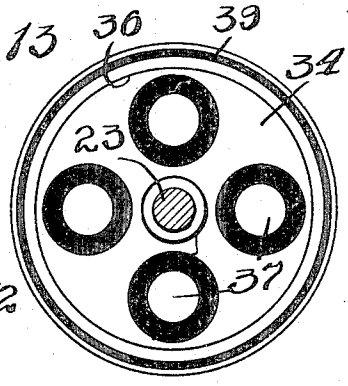


Fig. 9

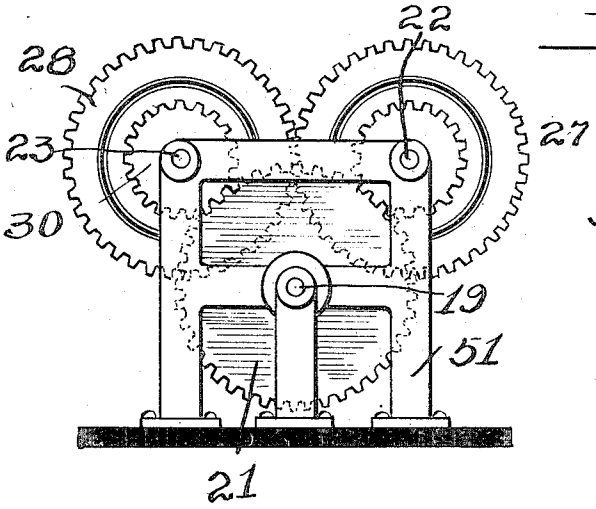
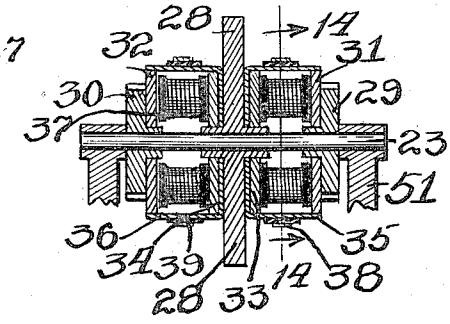


Fig. 12



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5 SHEETS—SHEET 5.

Fig. 11

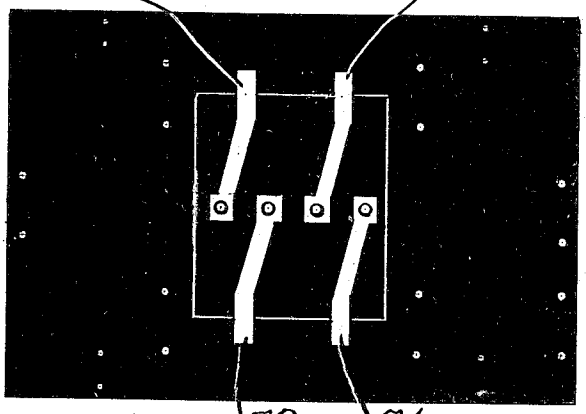


Fig. 15

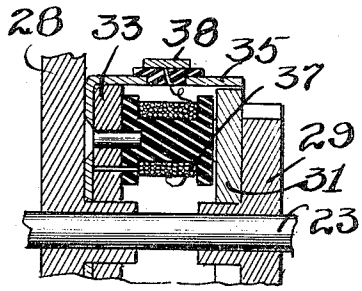


Fig. 10

Fig. 20

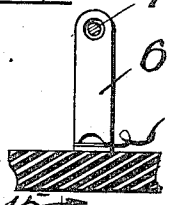
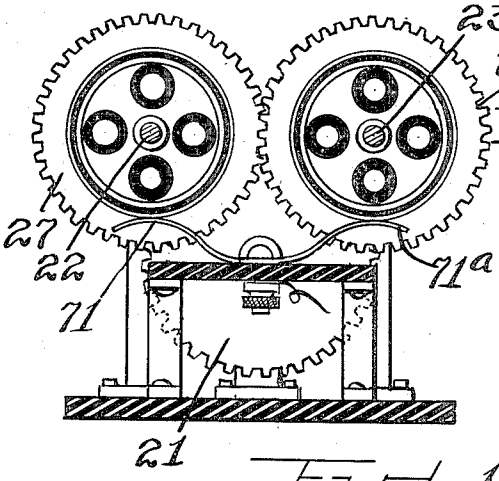


Fig. 14



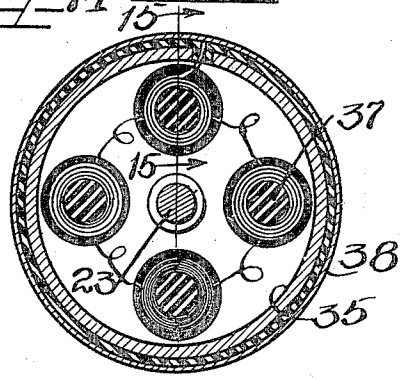
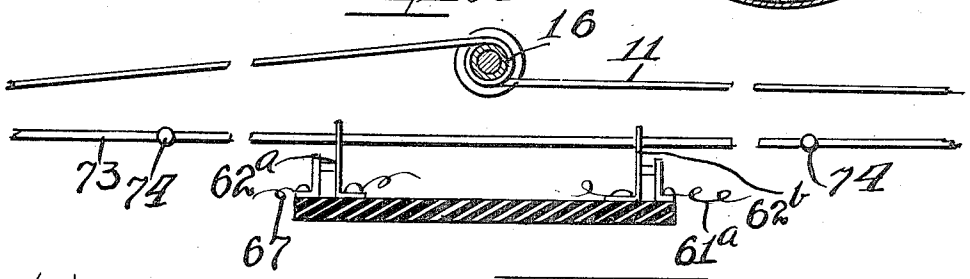


Fig. 19



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ALFRED J MACY, OF CHICAGO, ILLINOIS.

STABILIZER.

1,187,439. Specification of Letters Patent. Patented June 13, 1916.

Application filed July 28, 1913. Serial No. 781,507.

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, county of Cook, and State of Illinois, have invented certain new and useful Improvements in Stabilizers; 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 numerals of reference marked thereon, which form a part of this specification.

Heavier than air flying machines, which depend upon their movement through the air for support, have proved to be difficult of manipulation, owing to the fact that all of the controls must necessarily be operated from the same source, inasmuch as each of the operations are generally related to, and dependent upon one another. Thus an aviator must maintain his attention concentrated at all times on the various controls, and must operate the same in the proper relation to one another, in order to maintain the machine in equilibrium. The numerous controlling operations effected by an aviator during flight are more or less instinctive, but should for any reason his attention be distracted, even momentarily, a release of the controls is more than likely to prove disastrous.

This invention relates to a means for automatically controlling the balancing mechanism of an aeroplane, thus relieving the operator of practically all manipulation of the controls other than the simple steering of the machine.

It is an object of this invention to provide an automatically acting mechanism adapted to immediately sense an unbalancing of the machine and to set means in operation to correct the same.

It is also an object of this invention to provide a plurality of independently acting mechanisms, one controlling the lateral stability of an aeroplane, and another the longitudinal stability thereof, each acting individually or simultaneously to correct the slightest deviation therefrom.

It is also an object of this invention to provide a stabilizing device having a plurality of independently acting means for controlling the lateral and longitudinal inclination of the machine, and with one of said means acting to properly bank the machine during a turn.

It is also an object of this invention to provide a stabilizing mechanism having a plurality of independently operatable elements adapted to control actuating means for different controlling mechanisms of an aeroplane and both mounted upon a unitary base which is connected to the machine by a ball and socket joint, thus permitting movement of the stabilizing mechanism into various positions of adjustment.

It is also an object of this invention to provide a stabilizing device having a plurality of freely movable balls therein, each adapted to move independently of the other, and by such movement serving to close electrical circuits to set in operation controlling mechanisms for preserving the equilibrium of an aeroplane or other device.

It is also an object of this invention to provide a controlling device for the guiding mechanisms of a vehicle which is capable of adjustment through various angles, and when so adjusted will serve to operate the guiding mechanisms of a vehicle to maintain the same in a predetermined path of flight, determined by the adjustment of said device.

It is furthermore an object of this invention to provide a device embodying a plurality of freely movable elements operating independently of one another or in conjunction therewith to preserve the equilibrium of a vehicle and counteract all tendencies thereof to deviate from a predetermined path.

It is finally an object of this invention to provide an adjustable device consisting of few parts of simple construction, and acting mechanically to set in operation the proper guiding mechanisms ordinarily effected instinctively by an operator.

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

In the drawings: Figure 1 is a fragmentary diagrammatic top plan view of an aeroplane illustrating the controlling cables thereon. Fig. 2 is an enlarged fragmentary top plan view showing the position of the power plant and the controlling levers of an aeroplane. Fig. 3 is a section taken on line 3—3 of Fig. 2, with parts omitted. Fig. 4 is a view partly in section of a stabilizing element shown connected on one of the uprights of an aeroplane frame. Fig. 5 is a section taken on line 5—5 of Fig. 4. Fig. 6

is an enlarged section taken on line 6—6 of Fig. 5. Fig. 7 is a diagrammatic top plan view of a stabilizing device. Fig. 8 is a top plan view of the magnetically driven drums for actuating the respective controlling cables of a vehicle. Fig. 9 is an end elevation thereof. Fig. 10 is a section taken on line 10—10 of Fig. 8. Fig. 11 is a top plan view of the insulated bases for said magnetic clutch members and showing the contact brushes thereon. Fig. 12 is a section taken on line 12—12 of Fig. 8. Fig. 13 is an enlarged inner face view of one of the clutch members, showing the electro-magnets thereon. Fig. 14 is a section taken on line 14—14 of Fig. 12. Fig. 15 is a section taken on line 15—15 of Fig. 14. Fig. 16 is a rear elevation of the controlling levers of an aeroplane. Fig. 17 is a section on line 17—17 of Fig. 16. Fig. 18 is a diagrammatic view showing the electrical connection between a stabilizing element, magnetic clutches, and the controlling levers of an aeroplane. Fig. 19 is a fragmentary view showing an auxiliary cable connected to a controlling cable of an aeroplane. Fig. 20 is an end elevation of a spring switch through which said auxiliary cable extends.

As shown in the drawings: A conventional type of Wright biplane is shown indicated by the reference numeral 1, and is equipped with a power plant 2, vertical guiding rudders 3, an elevator 4, and warping tips or ailerons 5. The controlling levers of the machine are mounted conveniently for an operator on the front end of the machine on a transverse shaft 6, and consist of an aileron control lever 7, an elevator control lever 8, and a guiding or rudder lever 9. A sheave 10, is rigidly connected to said lever 7, and has wound thereabout a cable 11, which is connected to the warping tips 5, of the biplane. Likewise a sheave 12, is rigidly connected to said lever 8, and has wound thereabout a cable 13, connected to the elevator 4, of the biplane. A sheave 14, is rigidly connected to said lever 9, and has wound thereabout a cable 15, which is connected to the guiding rudders 3, of the aeroplane. Said cables 11 and 13, at points intermediate the controlling levers and the controlling surfaces to which the cables are attached, are wound about power driven actuating drums 16 and 17, respectively. Said drums are secured upon shafts 18, and 19, which have rigidly secured thereon gears 20, and 21, respectively, said shafts being journaled at their ends in a frame 51, and outer bearings 52. Likewise supported in said frame 51, are shafts 22 and 23, respectively, of which said shaft 22, is extended at one of its ends and provided with a worm gear 24, adapted to be driven by a worm 25, secured on a crank shaft 26, of said power plant 2. Rigidly secured centrally on each of said shafts are intermeshing gears 27 and 28, respectively, so that each of said shafts 22 and 23, are constrained to rotate at all times when said power plant 2, is in operation. For the purpose of driving said respective drums 16 and 17, a pair of gears 29 and 30, are each slidably and rotatably mounted upon said shaft 23, and have rigidly secured on the inner face thereof respectively, magnetic disks 31 and 32. Disks 33 and 34, are rigidly secured on the hub of said gear 28, and cup members 35 and 36, respectively are secured between said disks and said gear and project outwardly over, and substantially flush with the outer surface of said disks 31 and 32, respectively. A plurality of electro-magnets 37, are secured on each of said disks 33 and 34, and act when energized to attract the respective magnetic disks 31 and 32, thus constraining the gears attached thereto to move with the clutch gears 28. Said electro-magnets in each of said clutch members are connected in multiple, one terminal thereof being grounded, and the others led to a suitable insulated contact ring 38 and 39, one each mounted respectively on said cup members 35 and 36. Gears 40 and 41, respectively, similar to said gears 29 and 30, are likewise mounted upon said shaft 22, and magnetic clutch mechanism is provided, operating to constrain the former gears to move simultaneously with said large gear 27, identical with the construction already described with respect to said gears 28, 29 and 30. It is obvious that either or both of said drum shafts 18 and 19, may be caused to rotate either simultaneously or alone, and in either direction, dependent upon whether or not the respective slidably mounted gears, for instance 29 and 41, meshing with said drum shaft gear 20, are magnetically connected to said gears 27 and 28, respectively, and of course the same is true with respect to said drum shaft 19, and said gear 21, mounted thereon. For the purpose of energizing the respective magnetic clutches, a source of E. M. F. 41′, which may be a storage battery or generator, is provided, and electrical communication is effected by the closure of contacts within a stabilizing device hereinafter described.

An adjustable bracket 42, is secured upon one of the upright struts 43, of an aeroplane frame, and secured in the end thereof is a ball shaped member 44. An insulating base member 45, having a hemi-spherical recess in the bottom thereof, rests upon said ball 44, and is retained thereon in close contact therewith by a friction clamping ring 46, having bolts extending therethrough and threaded into said base 45. An actuating handle 46′, is rigidly secured on the upper surface of said base 45, and due to the relatively tight connection on said ball 44, of said base 45, by said clamping ring 46, said

base may be moved into practically any position and will be retained in such position by the frictional contact with said ball 44. Mounted longitudinally of said base and said aeroplane, is an insulating tubular receptacle or cylinder 47, which has secured in the ends thereof, electrical contact members 48 and 48ª, respectively. A metallic lining 49, is provided on the interior of said tubular member 47, and freely rotatable therein, and movable from end to end, is a metallic ball 50, which, when in position at either end of said cylinder 47, affords electrical communication between the respective contacts in the end thereof, and said tubular liner 49. An exactly similar tubular receptacle is mounted on said base transversely of the machine and is denoted by the reference numeral 51, the electrical contacts in the respective ends thereof being denoted by the reference numerals 52 and 52ª, respectively. Each of said respective terminals 48, 48ª, 52 and 52ª, are connected to terminals 53, 53ª, 54 and 54ª, and 55, is connected to said inner liner 49. Thus as said base is inclined into any position the freely movable balls 50, in either one of said receptacles 47 or 51, roll to one end or the other of the respective receptacles, and thereby close an electrical contact, which serves to energize the electro-magnets in one of the respective magnetic clutches already described.

Two means are provided for breaking the curcuit in each of the conductors leading from the contact members in said stabilizing bowl to said magnetic clutches, and one of these comprises arc shaped contact members, a pair 56 and 57, of which are mounted on one side of said controlling lever 7, and a pair 58 and 59, of which are connected on the other side of said controlling lever 7, of course each one of said contact members being isolated from the other. Slidably mounted on said lever 7, is a bridge contact member 60, which is insulated in two portions, one portion of which is adapted to normally bear upon said contact members 56 and 57, and the other portion upon said contact members 58 and 59, to thus maintain the circuit therebetween normally closed. A spiral spring 61, serves to impel said bridge member downwardly into contact with said members, and a pull rod 62, connected to a grip 63, at the upper end of said lever affords a means of withdrawing said bridge member to break the electrical contact between said bridge members. Spring switches 62ª, and 62ᵇ, are also provided in the line between said lever contact members and the respective magnetic clutches as a second means of breaking the electrical circuit. A conductor 62ᶜ, leads from the terminal post 53, to said contact member 56. Similarly a conductor 62ᵈ, leads from said terminal post 53ª, to the contact member 58, and also a conductor 55ª, is connected to one terminal of the source of E. M. F. 41′, and to the central terminal post 55, on said stabilizing element. Conductors 64 and 64ª, connected to terminal posts 54, and 54ª, respectively, also lead to arc shaped contact members 65, and 66, respectively, each of which forms one of a pair similar to those already described, but in this case disposed on each side of the controlling lever 8. The respective clutches are connected to certain of the arc shaped contact members by conductors 67, 67ª, 68, and 68ª, in the case of said former two conductors, the spring switches 62ª, and 62ᵇ, already mentioned, being connected in the line thereof, and in the latter case, spring switches 69, and 70, being connected respectively in the line of said conductors 68, and 68ª.

Of course, as already pointed out, one terminal of each of the respective clutches is grounded, and likewise one terminal of the source of E. M. F., so that, for instance when the ball 50, rests against the contact 48, in said cylinder 47, the electric current passes through said conductor 55ª, conductor 62ᶜ, thence through said bridge member 60, and conductor 67, through said spring switch 62ª, to a contact brush 71, which permits passage of the current to the respective clutch member for actuating the drum 16, in the proper direction. The purpose of said spring switches mounted adjacent the clutch members is to permit a breaking of the electrical circuit when the magnetic clutch member has driven the controlling means of the vehicle into an extreme position. For this purpose, as shown in Fig. 19, one of the main cables 11, has secured thereto on each side of the drum 16, an auxiliary cable 73, which slides through apertures in each of the respective spring switches 62ª and 62ᵇ, and is provided with stops 74, one for each of said switches, which, when the controlling mechanism has been driven to an extreme position, strikes the spring switch member and breaks the electrical circuit.

The operation is as follows: When an aviator desires to fly in a straight horizontal path the handle 46, of the stabilizing element, is moved to position said element with the respective transverse and longitudinal axes thereof coincident with those of the machine to which it is attached. Any tendency for the machine to deviate from its course, that is by a lateral or longitudinal inclination therefrom, will cause one or the other or both of the respective balls in the cylindrical containers 47, and 51, to roll to either one end thereof, to thereby close an electrical contact and set in operation the proper drum or drums through the intermediation of the magnetic clutches, thus

actuating the controlling cables for the aeroplane to counteract the deviation of the machine from its course. The stabilizing device also acts to properly bank or incline the aeroplane when a turn or curve is made laterally through the air, for the reason that the centrifugal force created will cause the ball within the cylinder 51, to travel toward the outer end of the cylinder, thereby closing an electrical contact and, due to the energizing of the proper magnetic clutch, actuation of the cable 11, to properly warp the tips of the main plane until the machine is banked at the proper angle, determined by the speed of the aeroplane and radius of curvature of the turn.

It is obvious that when the machine is banked at the proper angle the resultant of the centrifugal force and force of gravity acting upon the ball will cause the same to maintain a neutral position out of contact with the end terminal in the cylinder, thus cutting off the driving means for the actuation of the controlling cable and leaving the machine banked at such an angle for the particular turn being made, and until a change therefrom is made. Of course, when the machine is straightened out upon its course, and still being inclined, the ball will roll to the opposite end of the cylinder and by closing the contacts energize the proper magnetic clutch to actuate the controlling cable, thereby warping the tips of the plane to restore the plane to a proper horizontal position for a straight-away flight.

When the operator wishes to make a landing, he seizes the respective levers 7, and 8, and by such action automatically raises the bridge contact members on each of said levers, breaking the electrical circuit, and permitting manual operation of the machine without fear of any counteracting effect due to the stabilizing elements. As already pointed out, should the magnetic clutches cause the actuating control cables of the aeroplane to be adjusted to an extreme position, the auxiliary cables thereon, such as a cable 73, with the stops 74, will contact one of the spring switches, to open the same and break the electric circuit, thus preventing further actuation of said controlling cable.

I am aware that various details of construction may be varied through a wide range without departing from the principles of this invention. I therefore do not purpose limiting the patent granted otherwise than necessitated by the prior art.

I claim as my invention:

1. The combination with an aeroplane of a stabilizing device comprising an adjustable base, a plurality of cylinders rigidly mounted thereon, a freely movable ball element in each thereof, electrical contacts in each end of each of said cylinders adapted to be closed by said movable element when the same rolls thereagainst, mechanism for adjusting said stabilizing device at any fixed angle by movement of said base, and means set in operation by the closure of said electrical contacts to operate the guiding means for the aeroplane.

2. In a device of the class described a stabilizing element comprising a plurality of cylinders mounted at right angles to one another, means adjusting said element and said cylinders therewith as a unit at any desired angle and retaining the same therein, balls freely movable, one in each of said cylinders, electrical contacts in each end of each of said cylinders, the contacts at each end of a cylinder adapted to be closed by the same ball, and controlling mechanism for the aeroplane adapted to be set in operation by the closure of said contact.

3. In a device of the class described a stabilizing element, a ball and socket support therefor, a friction clamping ring adapted to maintain the same in any adjusted position, a plurality of cylinders mounted thereon, movable elements in said cylinders, a plurality of electrical contacts in said cylinders adapted to be closed by said movable elements, and means set in operation by the closure of said electrical contacts to operate controlling means for a vehicle.

4. In a device of the class described the combination with an aeroplane of a stabilizing element comprising a base universally adjustable, a plurality of cylinders rigidly mounted thereon at right angles to one another, balls freely movable therein, one in each cylinder, electrical contacts in each end of each of said cylinders adapted to be closed by said balls, controlling cables for the aeroplane, magnetic clutch driven drums adapted to operate said controlling cables, and a source of E. M. F. adapted to energize said magnetic clutch means for said drums to cause movement of said drums when said electrical contacts are closed.

5. The combination with an aeroplane of an insulating base, a hemi-spherical recess in the lower portion thereof, a ball support therefor, an adjustable clamping ring adapted to maintain said base on said ball in any adjusted position, controlling cables for a vehicle, and means on said base adapted to set in operation actuating means for said cable when said base is tilted out of a predetermined position.

6. In a device of the class described an insulating base universally adjustable at any angle, a plurality of cylinders thereon mounted at right angles to one another, balls freely movable one in each of said cylinders, electrical contacts in each end of each of said cylinders, those in one cylinder adapted to be closed by a single ball, an actuating handle mounted on said base, each of

said cylinders and balls operatable independently of one another, controlling mechanisms for a vehicle, a plurality of constantly driven magnetic clutch members, and gears adapted to be driven by said clutch members when said electrical contacts are closed to energize said clutch members.

7. In a device of the class described an insulating base, an adjustable support therefor, a plurality of insulating cylinders mounted thereon, a metallic lining for said cylinders, electrical contacts in the ends of said cylinders, a metallic ball freely rotatable in said cylinders adapted to close said contacts, controlling means for a vehicle, and mechanism set in operation by the closure of said contacts to operate the controlling means of said vehicle.

8. In a controlling device for vehicles, an adjustable element adjustable both horizontally and vertically from one point of support, electrical mechanism for operating the guiding means of the aeroplane, a plurality of cylinders rigidly mounted on said adjustable element, said cylinders disposed at an angle to one another, electrical contacts in each end of each of said cylinders, a rolling ball in each of said cylinders adapted when rolled to one end of said cylinders to close the contact at that end and when rolled to the other end of said cylinders to close the contact at the other end thereof, said contacts connected to said mechanisms whereby when the circuit is closed by said ball said mechanisms are operated, and means for maintaining said adjustable element and associated cylinders in any adjusted position to determine a certain angle of flight for the vehicle.

9. In a device of the class described a base, a ball and socket mounting therefor, means maintaining the same in any adjusted position, a plurality of containers mounted on said base, movable elements in said containers, electrical contacts in said containers adapted to be closed by said movable elements, controlling mechanisms for a vehicle, and means set in operation by the closure of said electrical contacts to operate the controlling means of said vehicle.

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

ALFRED J. MACY.

Witnesses:
LAWRENCE REIBSTEIN,
EDWARD C. HUSBAND.