Jan. 26, 1932. H. M. SALISBURY ET AL 1,842,952

AUTOMATIC STABILIZER FOR AIRPLANE CONTROL LEVERS

Original Filed Jan. 21, 1929

Fig. 1

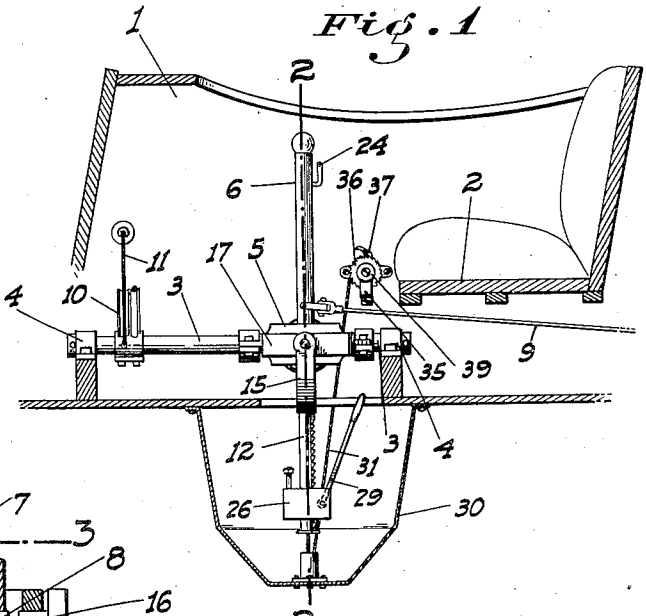


Fig. 2

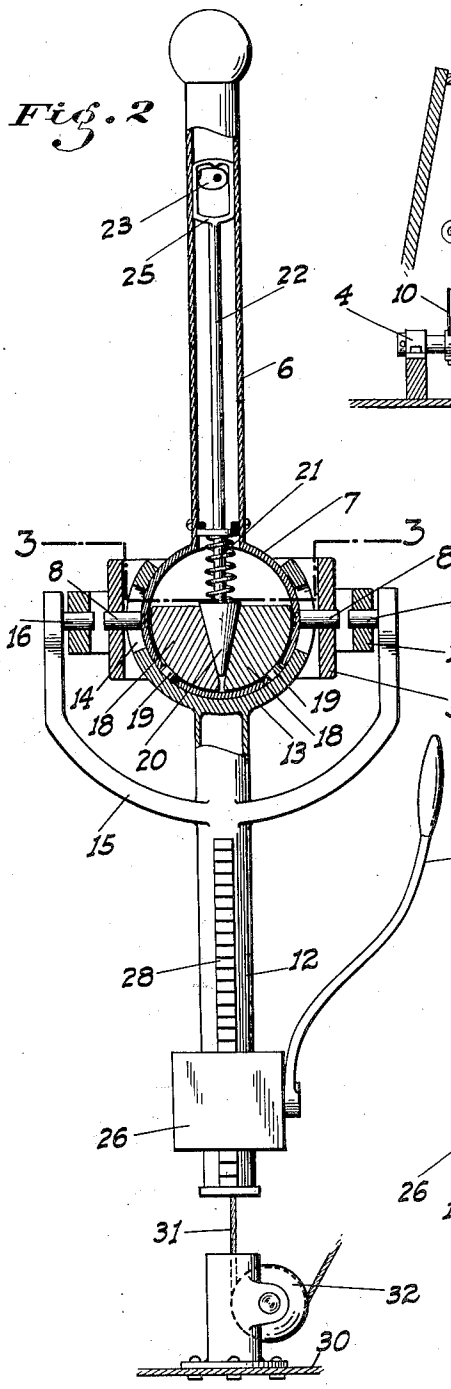


Fig. 3

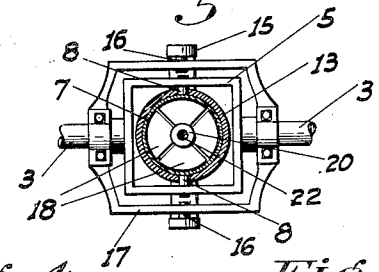


Fig. 4

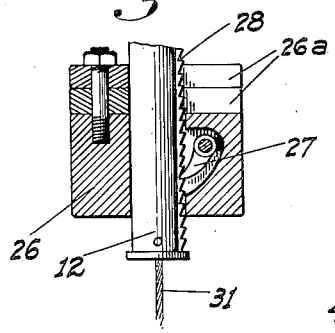
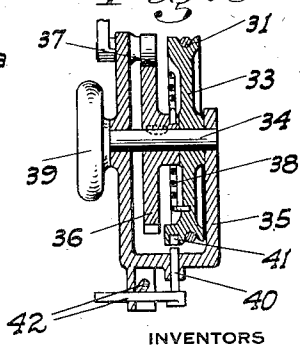


Fig. 5



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UNITED STATES PATENT OFFICE

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AUTOMATIC STABILIZER FOR AIRPLANE CONTROL LEVERS

Application filed January 21, 1929, Serial No. 333,914. Renewed December 18, 1931.

This invention relates to airplanes, and especially to the control lever or stick by which the movement of the ailerons and elevator are controlled by the pilot.

The present invention particularly represents improvements over our co-pending application for patent, Serial No. 250,760 filed January 31st, 1928, in which a weight was associated with the lever in such a manner as to form a pendulum arrangement to cause the lever to be automatically maintained in a substantially vertical position at all times so that the airplane would be likewise maintained in an upright and level flying position independently of the manipulation of said lever by the pilot.

In the previous device the weight supported member, while slidable relative to the lever so that the effectiveness of the weight could be altered, could not be used to maintain the lever in all of the various operative positions to which said lever may be shifted when flying.

The principal object of the present invention is to maintain the advantages of said previous device, while mounting the weight supporting member in connection with the lever so that in addition, the lever may be selectively set and automatically maintained not only in a vertical position but in any operative position to which it may be shifted. At the same time the lever may be easily freed from being influenced by the weight in any degree, when desiring to operate the lever solely by hand. To do this an instantly operable release and clamping means, controlled at the will of the pilot, is provided for controlling the setting of the weight supporting member relative to the lever.

A further object of the invention is to provide an adjustable dampening means to control and vary the swinging of the weight attached lever, and also a means for holding the weight, when disconnected from the lever, from movement relative to the fuselage.

A further object of the invention is to produce a simple and inexpensive device and yet one which will be exceedingly effective for the purpose for which it is designed.

These objects we accomplish by means of such structure and relative arrangement of parts as will fully appear by a perusal of the following specification and claims.

In the drawings similar characters of reference indicate corresponding parts in the several views:

Fig. 1 is a fragmentary longitudinal section of the fuselage of an airplane showing our improved lever control means applied thereto.

Fig. 2 is an enlarged cross section of the control unit taken on the line 2—2 of Fig. 1.

Fig. 3 is a fragmentary sectional plan of said unit taken on the line 3—3 of Fig. 2.

Fig. 4 is a fragmentary view showing the adjustable mounting of the weight on its supporting member.

Fig. 5 is a cross section of an adjustable dampening unit.

Referring now more particularly to the characters of reference the numeral 1 denotes the fuselage of an airplane having a pilot's seat 2 in front of which the aileron and elevator control mechanism is mounted as usual, and which will now be described.

Extending longitudinally in the fuselage near the floor are axially alined shaft sections 3 which are supported adjacent their opposite ends in suitable bearings 4 secured to the fuselage. The adjacent ends of the shaft sections are separated somewhat and are rigidly connected by a preferably rectangular and normally horizontally disposed frame 5, so that said frame and the shaft sections form a single inseparable unit and will be so considered hereafter. The control lever or stick 6 is of tubular form, on the lower end of which is secured a symmetrically disposed hollow spherical ball 7. This ball depends into the frame 5 and has opposed trunnions 8 alined with the central axis thereof which extend transversely of the fuselage and are turnable in the opposite side elements of the frame in the horizontal plane of the shaft axis.

A longitudinally and rearwardly extending rod 9 is connected as usual to the elevator of

the airplane and to the lever at a suitable point. Sheaves 10 are mounted on the forward shaft section, and secured to and extending laterally in opposite directions from said sheaves are cables 11 which lead to connections with the ailerons of the airplane as usual.

By means of the above arrangement it will be seen that if the lever is shifted lengthwise of the airplane about the trunnions 8 as an axis the elevator will be manipulated; and if said lever is turned transversely of the airplane about the longitudinal shaft unit as an axis, said shaft and frame unit will be turned and the ailerons will be manipulated.

A selectively controlled weight supporting unit is constructed and associated with the lever in the following manner:

Depending from the lever but independent thereof is a stem 12 which is radially disposed relative to a spherical socket member 13 formed on its upper end and which turnably engages the ball 7, so that a ball and socket joint is formed and the lever and stem are normally longitudinally alined with each other This socket is formed with vertical slots 14 through which the trunnions 8 pass so that the stem and socket may have lateral swinging movement within certain limits relative to the ball and lever. Fixed with the stem below the socket is an upwardly projecting and transversely extending yoke 15, whose upper ends are disposed outwardly of the frame 5 as shown in Fig. 2, and carry opposed trunnions 16 which are transversely alined with but separated from the trunnions 8. These trunnions 16 are turnable in the longitudinally extending side bars of a frame 17 which at its ends is turnably mounted on the shaft sections 3 just beyond the frame 5 as clearly shown in Fig. 3.

By means of this construction it will be seen that the stem may have independent longitudinal or lateral movement relative to the lever without any load being taken at any time by the ball and socket joint itself.

The ball is locked to the socket at will so as to cause the lever to be rigid with the stem regardless of the relative longitudinal or lateral setting of the one relative to the other by a mechanism as follows:

Disposed in the ball is a plurality of segmental and symmetrically disposed blocks 18 having pins 19 projecting radially therefrom and through the side walls of the ball, and adapted when said blocks are spread apart to frictionally engage the inner surface of the socket at any point in its area. To enable the blocks to be thus spread to cause such frictional engagement to be had said blocks at their central meeting points are provided with a common tapered socket axially alined with the lever, into which socket a taper plug or pin 20 slidably projects. This plug is normally forced down so as to press the blocks apart to the above end by a compression spring 21. The plug is raised against the action of the spring so as to clear the blocks and allow them to approach each other and release the frictional engagement of the pins 19 with the socket, by means of a rod 22 attached to and projecting upwardly from the plug to the lever. To the upper end of this rod a suitable raising means, operable from the outside of the lever, is connected. Such raising means in the present instance is shown as being a cam 23 inside the lever connected to an operating handle 24 on the outside of the lever, said cam engaging a yoke 25 formed on the upper end of the rod 22. The cam and yoke are so arranged that upon turning the handle 24 through a certain arc the rod 22 and the plug will not only be raised but will be locked against downward movement unless the handle is positively moved in the necessary releasing direction.

The stem 12, which depends a sufficient distance below the fuselage to have the desired pendulum effect on the lever, has a weight 26 slidable thereon. This weight is supported from the stem and held at any position thereon by means of a pawl 27 engaging any one of a row of ratchet teeth 28 provided down one side of the stem. This pawl is released and the weight raised or lowered by means of an arm or lever 29 connected to said pawl and projecting upwardly to a point convenient for the operation of the pilot occupying the seat 2; the fuselage having a bottom opening of sufficient size to enable this arm to be readily grasped and manipulated from above. The vertical adjustment of the weight thus had of course enables the effectiveness of the same on the lever to be altered as conditions may require.

If desired we may increase the effectiveness of the weight independent of its raising and lowering by additional weight elements 26*a* as shown in Fig. 4, which are removably mounted on the main weight.

To keep wind from entering the fuselage through the bottom opening and also to prevent such wind from having any action on the weight device, said opening is surrounded by a housing 30 of suitable form and secured to the fuselage, which housing also encloses the stem 12 and the parts attached thereto.

In order to prevent too free swinging of the stem and lever we preferably provide an adjustable dampening means for such movement. Such means is constructed as follows: Depending a short distance from the bottom of the stem 12 and secured thereto is a cable 31, which then passes about a fixed pulley 32 and up into the fuselage to one side thereof. At its upper end this cable is secured to and wound about a sheave 33 which is turnable on a shaft 34 mounted in a bracket 35 secured to the fuselage. Fixed on the shaft is a ratchet wheel 36 engaged by a pawl 37, a

spiral spring 38 being fixed at one end to the wheel and at the other end to the sheave. This spring is normally under tension and is so arranged that with the rotation of the sheave had by reason of the pull on the cable as the stem 12 swings to one side or the other, the tension of the spring is increased and the swinging movement of the stem is correspondingly restrained or dampened.

The spring also pulls against the pawl so that the shaft cannot normally turn. The shaft however is provided with a handle 39 so that it can be manually turned to increase the normal tension of the spring, or said tension can be reduced by releasing the pawl and allowing the ratchet wheel to rotate somewhat.

This unit is positioned where it is convenient to the pilot at all times, such as is shown in Fig. 1.

The purpose of thus automatically controlling the position of the lever has been fully set forth in our previous application and will be obvious to any skilled pilot. It is therefore not felt necessary to make any further statement as to the advantages of the improved construction herein described.

It will be evident however that said construction enables the weight device to be instantly locked to the lever regardless of the setting of the latter, and as instantly released when it is desired to control the movements of the lever by hand alone.

It is of course absolutely necessary, in stunt flying and the like, that the control lever be manually operated without the influence of the weight. In order therefore to prevent the weight under such conditions from having any movement relative to the fuselage, and without disturbing any desired setting of the spring, we may mount a locking pin 40 in connection with the bracket 35 to enter a socket 41 provided on the sheave 33 at its periphery. This pin is normally disengaged from the socket, and is arranged in connection with a handle and guide structure 42 so as to be advanced into the socket when the handle is turned. The socket of course is positioned to register with the pin when the weight-stem 12 is in a normal vertical position. The sheave is thus held immovable, and the weight and stem are likewise held against movement. The same result may be obtained by winding up the spring 38 so tight that its resistance to the turning of the sheave more than offsets the tendency of the weight to pull on the cable and turn the sheave.

From the foregoing description it will be readily seen that we have produced such a device as substantially fulfills the objects of the invention as set forth herein.

Having thus described our invention what we claim as new and useful and desire to secure by Letters Patent is:

1. In an airplane, a substantially vertical hand control lever for the ailerons and elevator of the airplane, a weight supporting stem depending therefrom and normally movable relative thereto in any direction, and means for selectively locking the stem against movement relative to the lever irrespective of the angular positioning of the lever relative to the stem.

2. In an airplane, a substantially vertical control lever, a universal pivotal mounting for the lower end of the lever, a weight-supporting stem depending from the lever, a universal pivotal mounting for the upper end of the stem separate from but arranged in common central conjunction with the lever mounting whereby said lever and stem will swing about a common point, and means releasable at will for locking said mountings against movement relative to each other.

3. In an airplane, a substantially vertical control lever, pivot mounting means for the lower end of the lever to enable the same to be swung longitudinally or laterally of the airplane independently, a weight-supporting stem below the lever, pivot mounting means for the upper end of the stem supported from the lever mounting means in a manner to enable the stem to remain in a vertical position regardless of the movement of the lever, and means for locking said stem against movement relative to the lever irrespective of the angular positioning of the lever relative to the stem.

4. In an airplane, a substantially vertical control lever, a stem depending therefrom, a weight supported by the stem, interconnected pivot means for the lever and stem to enable them to swing together as a unit, yieldably resisting means connected to the stem for dampening the freedom of swinging of the weighted stem, and means including a single element for altering the resistance of such dampening means at will.

5. In an airplane, an upstanding control lever, a spherical ball on the lower end of the lever, supporting means for the ball to enable the lever to be swung in one direction about the ball as an axis and itself turnable in a plane at right angles to said one direction, a spherical socket turnably engaging the ball, a stem depending from the socket, a weight on the stem, and means for locking the ball and socket against relative movement.

6. In an airplane, an upstanding control lever, a spherical ball on the lower end of the lever, supporting means for the ball to enable the lever to be swung in one direction about the ball as an axis and itself turnable in a plane at right angles to said one direction, a spherical socket turnably engaging the ball, a stem depending from the socket, a weight on the stem, means in the ball and engageable with the socket to lock the two against relative movement, and means operable from ad-

jacent the upper end of the lever for controlling the operation of said locking means.

7. In an airplane, an upstanding control lever, a spherical ball on the lower end of the lever, supporting means for the ball to enable the lever to be swung in one direction about the ball as an axis and itself turnable in a plane at right angles to said one direction, a spherical socket turnably engaging the ball, a stem depending from the socket, a weight on the stem, opposed and separate blocks in the ball, pins projecting radially from the blocks and through the walls of the ball to frictionally engage the adjacent surface of the socket when said blocks are spread apart, means for thus spreading the blocks, and means for releasing such spreading means.

8. In an airplane, an upstanding control lever, a spherical ball on the lower end of the lever, supporting means for the ball to enable the lever to be swung in one direction about the ball as an axis and itself turnable in a plane at right angles to said one direction, a spherical socket turnably engaging the ball, a stem depending from the socket, a weight on the stem, opposed and separate blocks in the ball, pins projecting radially from the blocks and through the walls of the ball to frictionally engage the adjacent surface of the socket when said blocks are spread apart, a taper plug movable between the blocks to thus spread the same, means for thus moving the plug, and means operable from adjacent the upper end of the lever for retracting the plug.

9. In an airplane, a substantially vertical, control lever, a stem depending therefrom, a weight supported by the stem, interconnected pivot means for the lever and stem, means for disengageably locking the stem and lever together to enable them to swing together as a unit or to enable the lever to be unaffected by the weight, and means for dampening the freedom of swinging of the stem when locked to the lever or for holding the same against any movement when disengaged from the lever.

10. In an airplane, a substantially vertical control lever, a stem depending therefrom, a weight supported by the stem, interconnected pivot means for the lever and stem to enable them to swing together as a unit, yieldably resisting means connected to the stem for dampening the freedom of swinging of the weighted stem, and means including a single manually operated element for increasing the resistance of the dampening means to an extent greater than the force of the weight can overcome.

11. In an airplane, a control lever, a depending weighted stem, interconnected pivot means for the lever and stem to enable them to swing together as a unit, a flexible element connected at one end to and depending from the bottom of the stem, and spring means applied to the other end of the element to yieldably restrain the longitudinal movement of the same.

12. A structure as in claim 11, with means for adjusting the tension of the spring to enable restraining action on the element to be altered.

13. In an airplane, a control lever, a depending weighted stem, interconnected pivot means for the lever and stem to enable them to swing together as a unit, a cable connected at one end to and depending from the bottom of the stem a short distance, a direction changing pulley over which the cable then passes to allow said cable to extend upwardly to a termination near the lever, a spring applied to the upper termination of the lever to yieldably restrain the longitudinal movement of the same, and hand means applied to the spring for adjusting the tension of the same.

14. In an airplane, a control lever, a depending weighted stem, interconnected pivot means for the lever and stem to enable them to swing together as a unit, a flexible element connected at one end to and depending from the bottom of the stem, spring means applied to the other end of the element to yieldably restrain the longitudinal movement of the same, and means operable from a point near the lever for adjusting the tension of the spring means.

In testimony whereof we affix our signatures.

HERVEY M. SALISBURY.
ARTHUR E. MILLER.