

July 29, 1947.

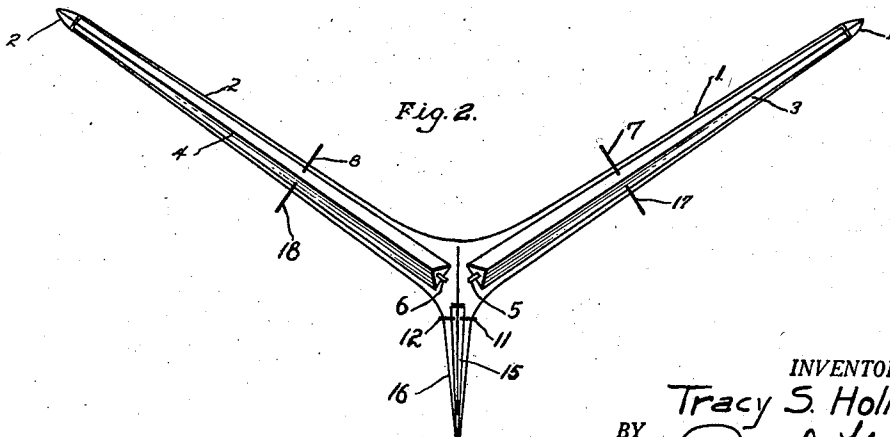
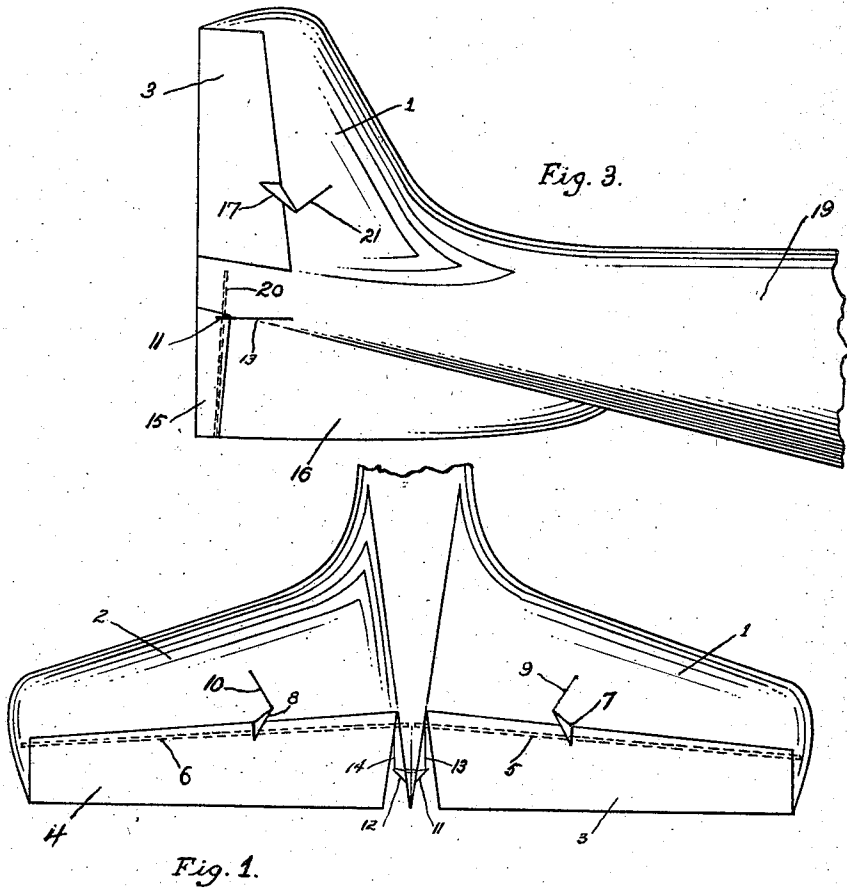
T. S. HOLMES

2,424,889

AIRPLANE CONTROL SYSTEM

Filed Aug. 20, 1943

3 Sheets-Sheet 1



INVENTOR.
Tracy S. Holmes
BY Paul D. Fisher
Attorney

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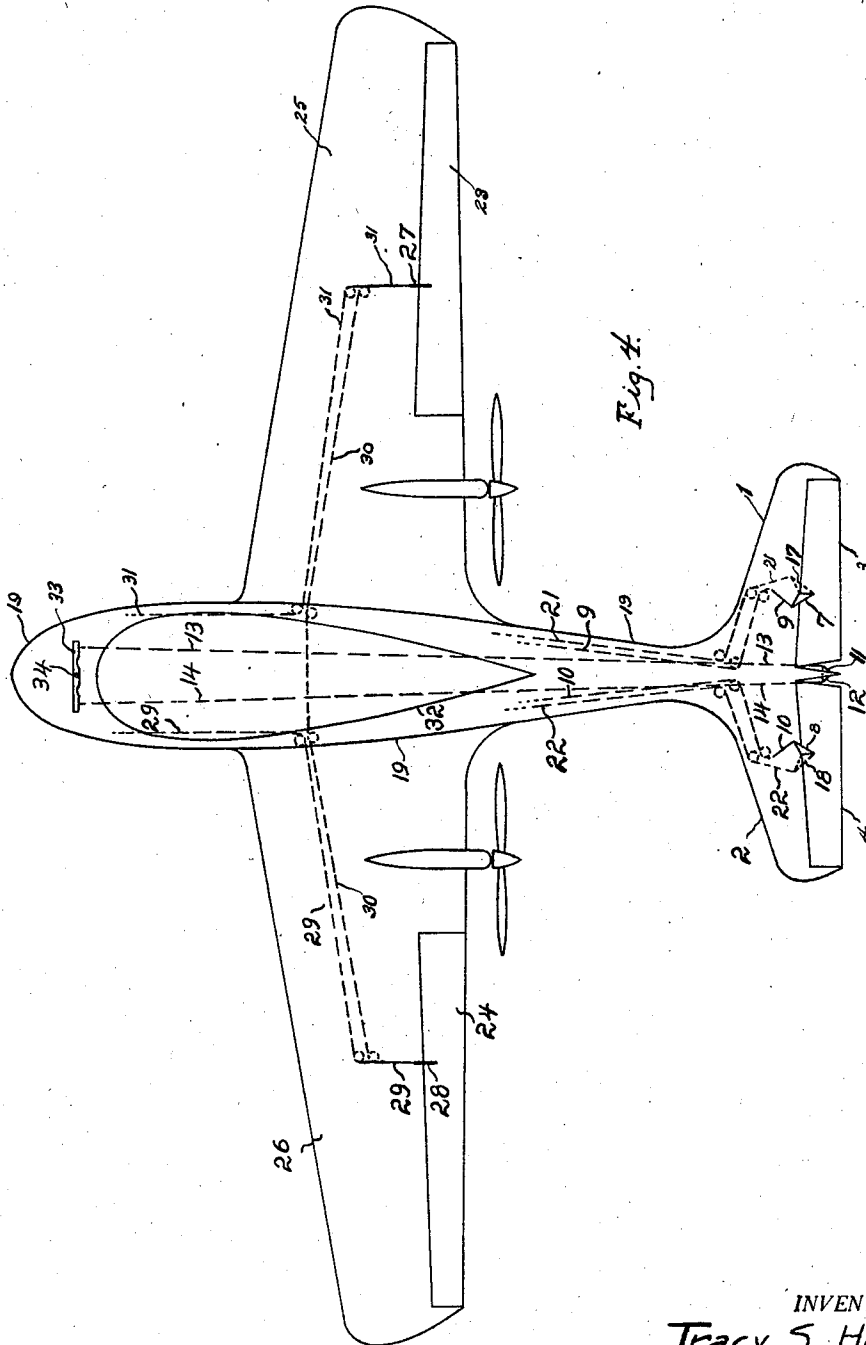
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3 Sheets-Sheet 2



INVENTOR.
Tracy S. Holmes
BY Paul D. Fisher
Attorney

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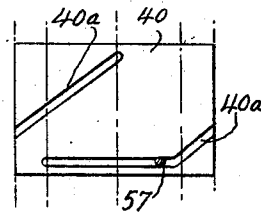
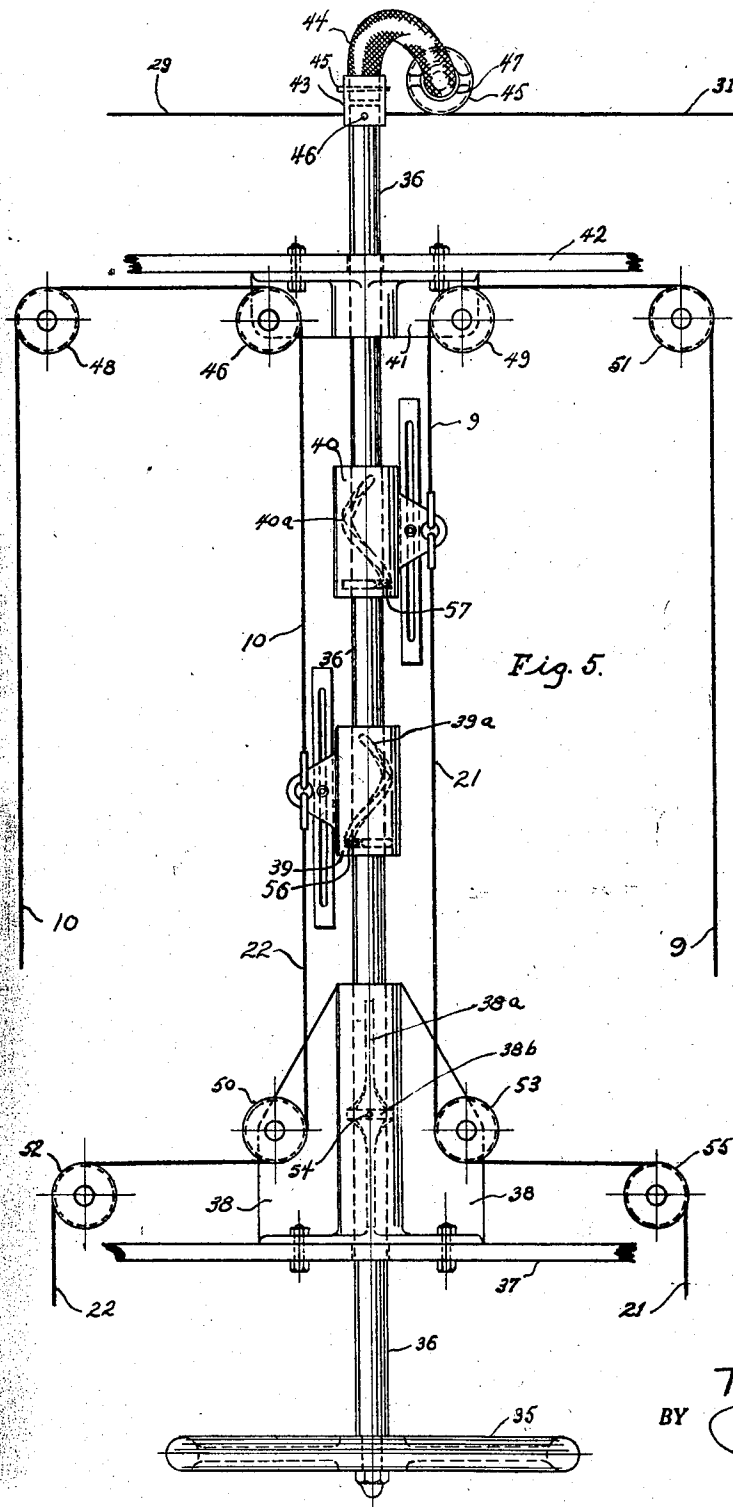
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AIRPLANE CONTROL SYSTEM

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3 Sheets-Sheet 3



INVENTOR.
Tracy S. Holmes
BY Paul D. Flehr
Attorney

UNITED STATES PATENT OFFICE

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AIRPLANE CONTROL SYSTEM

Tracy S. Holmes, Vallejo, Calif.

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13 Claims. (Cl. 244—83)

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This invention relates to the control surfaces of airplanes and relates more particularly to providing an improved and simplified construction of the same.

The conventional airplane control surfaces consist of ailerons on the trailing edges of each wing, and tail surfaces consisting of a horizontal structure composed of a stationary stabilizer and movable elevators, and a vertical structure composed of a stationary stabilizer and a rudder member. Operation of the ailerons and elevators and rudder surfaces for the purpose of increasing or decreasing the altitude or changing the course of an airplane are well known to those skilled in the art.

Ordinarily, the ailerons and elevators are controlled by one mechanism and the rudder is controlled by another.

In the past various attempts have been made to interconnect the various controlling media in order that they may be controlled by a single mechanism. In order to accomplish this purpose several ideas have been advanced.

One prior method of simplifying the control of airplanes has been to eliminate the movable rudder surface and supplant the same by one or more stationary vertical stabilizers. The elevators used in this type of structure are substantially conventional. The ailerons and elevator surfaces are interconnected in such a manner that a change of direction is obtained by banking the plane by the raising and lowering of the appropriate ailerons and changing the course by the proper operation of the elevator. In such an instance the elevator is raised while the plane is banked in the same manner as the elevator would be raised to gain altitude when the plane is in level flight. Operation of the elevator in this manner while the plane is banked tends to force the tail down and the nose of the plane up, and one difficulty of this method of controlling an airplane has been that all turns, made without adjustment of engine speed, are climbing turns.

Another method of simplifying the operation of airplane control has been to eliminate the movable elevator and supplant the same with a large horizontal stationary stabilizer. The conventional rudder is preserved. Change in elevation is obtained by increasing or decreasing the engine speed. The ailerons and rudder are interconnected and in order to turn, the plane is banked and the rudder is used as conventionally used. This generally results in a skidding turn in which the tail of the plane rises and swings

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away from the turn. If such a maneuver is accomplished without increasing engine speed, elevation is lost.

It is obvious that the above attempted solutions are unsatisfactory in that they sacrifice maneuverability.

The object of my invention is to provide simplified tail surfaces, the movable elements of which have both horizontal and vertical components when the airplane is on an even keel.

It is a further object of the invention to provide an airplane in which neither of the aforesaid turning difficulties is present.

It is a further object of the present invention to provide an airplane in which the ailerons and tail surfaces are connected in such a manner that the tendency to spin is eliminated.

It is a further object of the present invention to provide an airplane control system whereby the airplane may be operated entirely by a single mechanism and where no maneuverability is lost, which airplane is easy to operate and in which the opportunity of error by the pilot is reduced to a minimum.

Other objects and advantages of the invention will be apparent from the following description of certain preferred embodiments thereof as illustrated in the accompanying drawing.

Referring to the drawing:

Fig. 1 is a top plan view of the tail surfaces or empennage of an airplane,

Fig. 2 is a rear elevational view of tail surfaces or empennage of an airplane,

Fig. 3 is a side elevational view of the tail surfaces or empennage of an airplane,

Fig. 4 is a plan view of an airplane showing the control surfaces and control cables of an airplane, and

Fig. 5 is a plan view of the mechanism for operating the control surfaces of an airplane.

Fig. 6 is an expanded view of a portion of the operating mechanism.

As shown in Figs. 1, 2 and 3, the empennage or tail surfaces of my airplane consist generally of stabilizers 1 and 2 and their complementary movable tail surfaces 3 and 4. Members 3 and 4 are mounted upon members 1 and 2 respectively by virtue of rods 5 and 6 which pass through members 3 and 4 and the abutting ends of which may be journaled in stationary stabilizers 1 and 2 respectively in any convenient manner allowing movement of surfaces 3 and 4 about the axes of rods 5 and 6. Extending perpendicularly from the upper surfaces of members 3 and 4 are provided brackets 7 and 8 respectively, to which are

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connected control cables 9 and 10 respectively. Extending perpendicularly from the lower surfaces of members 3 and 4 are provided brackets 17 and 18 to which are connected control cables 21 and 22 respectively. Operation of the cables 9 and 10 and 21 and 22 will be explained hereafter.

I have provided stabilizer 16 which in the preferred embodiment is shown as depending from the fuselage, although this is merely a preferred embodiment which may be placed above the fuselage in conventional position without altering the concept of my invention. Rudder member 15 is adapted to move with respect to stabilizer 16 and may be connected to said stabilizer and to the fuselage by means of a shaft 20 which I have shown extending the length of the rudder and into the fuselage. I have provided brackets 11 and 12 extending perpendicularly from said rudder surface 15 which brackets are connected to control cables 13 and 14 respectively. Operation of control cables 13 and 14 will be described hereinafter. Rudder 15 is used only while taking off and in landing and is not used while the plane is in ordinary flight. Rudder 15 and the enlarged stationary stabilizer 16 are for the purpose of lending directional stability to the plane.

It will be noted that stabilizers 1 and 2 and movable members 3 and 4 differ substantially from the conventional elevators and stabilizers. Conventional stabilizers and elevator surfaces are substantially parallel to the horizontal axis of the airplane, and conventional elevator surfaces have merely a vertical component.

It will be noted from Fig. 2 that stabilizers 1 and 2 and tail surfaces 3 and 4 are not parallel to the horizontal axis of the airplane but are set at an angle of approximately 30° to said axis. These surfaces have both a horizontal and vertical component and it will be clear that operation of either or both surfaces 3 and 4 affects both components and will affect the position of the airplane with respect to its horizontal and vertical axes rather than with respect to a single axis as is the case in previous control surfaces.

By virtue of their having both vertical and horizontal components, the tail surfaces also act as stabilizers with respect to the vertical and horizontal axes of the airplane. These surfaces can be so built that the projected surface of each of the tail surfaces will approximate the area of the conventional rudder and elevators.

The area of the conventional tail surfaces is determined by well known formulae which take into account among other things the size of the plane, the weight of the plane, the tail arm length, cruising speed, etc., and the size of the elevators or rudder may easily be determined. It will be recalled however that each of the conventional surfaces have but one component and control the plane with respect to only one of its three axes. The same factors, that is size, weight, tail arm length, cruising speed, etc., govern not only the size of the tail surfaces of the present invention, but also the dihedral angle of the surfaces. Since each of tail surfaces 3 and 4 have two components, it is clear that the dihedral angle of these surfaces is governed by the amount of control desired with respect to the vertical and horizontal axes of the plane. The size of the surfaces is easily determined as previously pointed out. The dihedral angle will be greater if greater control about a vertical axis is desired and will be less than shown if the great-

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est desired control is with respect to the horizontal axis.

When a plane equipped with my invention is banked to the right, for example, the horizontal projected surface of the tail surfaces decreases and the down force upon the tail surfaces is lessened. However upon the raising of tail surface 4, a compensating force is created against the surfaces of members 4 and 2 as well as on the more nearly horizontal fin 1 and the plane will maintain a level flight. The same result naturally occurs when the plane is banked to the left.

In Fig. 4 I have shown the adaptation of my invention to a conventional airplane. The empennage is constructed integrally with fuselage 19.

Other control surfaces are ailerons 23 and 24 on wings 25 and 26 respectively. Extending vertically from said ailerons are provided brackets 27 and 28 respectively which in turn are connected to cables 31 and 29 respectively. Bracket 27 is attached to cable 31 and bracket 28 is attached to cable 29. I have also provided similar brackets extending vertically downward from these ailerons, which brackets are interconnected by means of cable 30. It will be seen that when cable 31 is drawn aileron 23 is raised from its normal position with respect to wing 25. Raising of aileron 23 in turn draws cable 30 and lowers aileron 24 with respect to its normal position with respect to wing 26. It is also obvious that by drawing on cable 29 one will raise aileron 24. Raising of aileron 24 in turn draws on cable 30 and lowers aileron 23 with respect to its normal position to wing 25. While cables 29 and 31 can be actuated by any conventional means I prefer that they be operated by the device shown in Fig. 5 which I will explain in detail later in this specification.

As previously explained rudder 15 is used only in landing and in taking off and is controlled by cables 13 and 14. Cables 13 and 14 in turn are actuated by rudder bar 33 which is pivoted at point 34. This bar is operated by the feet and swinging of bar 33 about the point 34 urges rudder 15 from side to side as desired.

To change the course of the conventional airplane requires the proper operation of the ailerons, the elevators, and the rudder. They must be simultaneously operated, so that when the plane is thrown into a bank and when the correct angle of bank is attained the controls may be neutralized and the plane continues to swing in the turn. If the proper angle of bank has been attained the proper degree of turn will be attained, but if the angle of bank has been too great or too little, further operation of the controls will be necessary.

Change of direction of an airplane equipped with my invention may be briefly described as follows: In order to turn to the right, aileron 24 is lowered, aileron 23 is raised, tail surface 4 is raised, and tail surface 3 is allowed to remain in its neutral position. Lowering of aileron 24 and raising of aileron 23 raises wing 26 and lowers wing 25 and places the plane in what is known as a bank. This increases the horizontal component of tail surface 2 and when tail surface 4 is raised, the tail of the plane is forced to the left. In order to turn to the left, aileron 24 is raised, aileron 23 is lowered, tail surface 3 is raised, and tail surface 4 remains in neutral position. In this instance wing 25 is raised and wing 26 is lowered

and tail surface 1 acquires a greater horizontal component.

Since tail surfaces 3 and 4 have vertical components it is clear that in order to gain altitude both tail surfaces 3 and 4 are raised, while, in order to lose altitude, tail surfaces 3 and 4 are depressed. In discussing the aforesaid maneuvers I have assumed a constant engine speed. However it is possible, as with conventional airplanes, to gain or lose altitude by increasing or decreasing the engine speed. Stabilizers 1 and 2 of my airplane have a slight negative angle of attack. This negative angle is designed to keep the tail of the airplane down while at cruising speed. Increased speed increases the downward force applied to the tail surfaces and forces the tail of the plane down thereby causing the plane to rise.

It is also possible to lose elevation merely by decreasing the engine speed of the airplane. Decrease of speed decreases the downward force exerted on the surfaces of the stabilizers and allows the tail of the plane to rise.

I have previously pointed out that it is an object of my invention to provide an airplane with the minimum number of control surfaces and the minimum number of control mechanisms. As I have stated use of rudder 15 and its control by rudder bar 33 is limited to taking off and landing operations. Its use is not contemplated during normal flight. Therefore its use generally as a control media may be ignored.

This restricts the essential control surfaces of my airplane to four; tail surfaces 3 and 4 and ailerons 23 and 24. As I have previously pointed out increasing and decreasing altitude and a change of course to the right or to the left may be attained by the proper use of these four control surfaces. Furthermore, to promote safety, it is my desire that the operator of the plane should not be able to increase or decrease his elevation while turning, except for such increases or decreases of elevation as may be attained by increasing or decreasing the engine speed. Further it is my desire that at cruising speed, the pilot may change his course to the right or left but may not increase or decrease his elevation or he may increase or decrease his elevation but may not change his course to the right or to the left. I have provided a simple single mechanism which permits increasing or decreasing elevation without permitting the turning to the right or left and which permits turning to the right or left without allowing an increase or decrease in elevation.

An airplane controlled with my mechanism in such a manner that one cannot turn while gaining altitude, will not spin as it will fall out of a stall along its longitudinal axis and not to one side.

This single control mechanism consists generally of steering wheel 35 mounted upon longitudinal shaft 36. Shaft 36 passes through control panel 37 and is suitably journaled within block 38 for rotation and for longitudinal movement with respect thereto. The lower end of shaft 36 is suitably journaled for longitudinal and rotational movement within block 41 which in turn is affixed to bulkhead 42. Between stationary blocks 38 and 41 are provided blocks 39 and 40 which are adapted for longitudinal movement with respect to the shaft 36.

On the lower end of shaft 36 I have provided a sleeve 43 which is adapted to fit over both shaft

36 and a flexible shaft 44. Pins 45 and 46 are adapted to pass through members 44, 36 and 43 to insure their coordinated rotational movement with respect to each other. Affixed to the lower end of a flexible shaft 44 I have provided sheave 45. Rotation of steering wheel 35 causes like rotation of sheave 45. Cables 29 and 31 are adapted for frictional engagement with sheave 45 and are operated thereby. For example, clockwise rotation of steering wheel 35 imparts clockwise rotation to sheave 45 and winds cable 31 upon sheave 45 and unwinds cable 29. Winding up of cable 31 raises aileron 23 which, as previously pointed out, exerts a pull upon cable 30 and consequently lowers aileron 24. Counterclockwise rotation of wheel 35 imparts counterclockwise movement to sheave 45 and winds cable 29 upon sheave 45 and unwinds cable 31. Winding up of cable 29 raises aileron 24 which exerts a pull upon cable 30 and lowers aileron 23. It is obvious from the above that clockwise rotation of steering wheel 35 banks the plane to the right while counterclockwise rotation of steering wheel 35 banks the plane to the left.

Also journaled upon shaft 36 I have provided blocks 39 and 40 which are adapted for longitudinal movement with respect thereto. Rotation of blocks 39 and 40 may be prevented by any conventional guide means such as a cooperating pin adapted to slide within a slot in a stationary member. I have provided a keyway 39a in block 39, the forward portion of which is spiral and the rear portion of which is annular. Pin 56 on shaft 36 is adapted to lie within keyway 39a. Rotation of shaft 36 in a clockwise direction causes pin 56 to follow the spiral portion of keyway 39a and results in camming action of pin 56 in said keyway which camming action urges block 39 rearwardly. Rearward movement of block 39 draws cable 10 which is reeved about suitable sheaves 46 and 48 to raise tail surface 4. It will be noted that cable 22 which is connected to downwardly extending bracket 18 on tail surface 4 is also connected to block 39 and movement of block 39 in a rearward direction releases cable 22 sufficiently to allow the raising of tail surface 4. Counterclockwise rotation of shaft 36 causes camming action in the spiral portion of keyway 39a and forces block 39 forwardly until tail surface 4 is in its conventional position with respect to stabilizer 2. Continued counterclockwise rotation causes pin 56 to follow the annular portion of keyway 39a and imparts no motion whatsoever to block 39.

I have provided a longitudinal keyway 40a in block 40, the forward portion of which is spiral and the rear portion of which is annular. Pin 57 on shaft 36 is adapted to lie within keyway 40a and rotation of shaft 36 in a counterclockwise direction causes pin 57 to follow the spiral portion of keyway 40a and results in a camming action of pin 57 in said keyway which camming action urges block 40 rearwardly. Clockwise rotation of shaft 36 from its extreme counterclockwise position to the position at which pin 57 enters the annular portion of keyway 40a results in the returning of tail surface 3 to its conventional position with respect to stabilizer 1. Continued clockwise rotation of shaft 36 causes pin 57 to follow the annular portion of keyway 40a and results in no movement whatsoever of member 40 with respect to shaft 36. Block 40 is suitably connected to cable 9 which is reeved about suitable sheaves 49 and 51 and is connected to the upper bracket 7 on tail surface 3. Also con-

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nected to block 40 is cable 21 which is suitably reaved about sheaves 53 and 55 to bracket 17 on the lower side of tail surface 3.

Thus it will be seen that counterclockwise rotation of shaft 36 causes pin 57 to follow the spiral portion of keyway 40a and force block 40 rearwardly thereby raising tail surface 3. The rearward movement of block 40 draws in cable 21 which raises tail surface 3. The slot 40a in the block 40 is shown in Figure 6 which, it will be appreciated, is an expanded view. The slot 39a in the block 39 is similar with the exception however that it lies in the opposite direction.

I have also provided pin 54 on shaft 36 which is adapted to lie within longitudinal keyway 38a an annular keyway 38b in stationary block 38. The restriction of pin 54 within these two keyways governs the longitudinal and rotational movement of shaft 36 with respect to stationary block 38.

Thus it will be seen that longitudinal movement of shaft 36 may take place only when pin 54 is adapted to lie within keyway 38a, and rotational movement of shaft 36 may take place only when pin 54 is adapted to lie within the annular keyway 38b. I have rounded the walls of keyways 38a and 38b where they intersect so that pin 54 at its median position is allowed some degree of movement beyond the strict confines of these two keyways. However very little combined rotational and longitudinal movement may be obtained. Generally speaking when longitudinal movement occurs rotational movement may not occur and when rotational movement occurs longitudinal movement is unobtainable.

Pins 56 and 57 and keyways 39a and 40a are so constructed that when key 54 lies within keyway 38a, pins 56 and 57 lie within the annular portion of keyways 39a and 40a respectively.

Operation of my simplified control system may briefly be described as follows: Longitudinal movement of shaft 36 may take place only while pin 54 lies within the confines of keyway 38a and as previously explained while pins 56 and 57 lie within the annular portion of keyways 39a and 40a respectively of blocks 39 and 40. Therefore longitudinal movement of shaft 36 operates cables 10 and 22 and 9 and 21 only. Longitudinal movement of shaft 36 forwardly lowers tail surfaces 3 and 4 and causes the plane to lose altitude. Rearward longitudinal movement of shaft 36 raises tail surfaces 3 and 4 and causes the airplane to gain altitude. By virtue of the fact that member 44 is flexible, longitudinal movement of shaft 36 has no effect upon sheave 47.

Rotational movement of shaft 36 may take place only while pin 54 lies within the confines of keyway 38b.

Clockwise rotation of shaft 36 causes block 39 to move rearwardly thereby raising tail surface 4 and also causes clockwise rotation of sheave 45 which raises aileron 23 and lowers aileron 24. This results in the plane being banked to the right and further results in the operation of tail surface 4 which by virtue of the bank has an increased horizontal component and which causes the tail of the plane to be moved to the left. Rotation of shaft 36 in a clockwise direction has no effect upon tail surface 3.

Counterclockwise rotation of shaft 36 results in counterclockwise rotation of sheave 45 which raises aileron 24 and lowers aileron 23. Furthermore counterclockwise rotation of shaft 36 results in a rearward movement of block 40 which

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raises tail surface 3. Operation of the ailerons 23 and 24 throws the plane in a bank to the left, which increases the horizontal component of tail surface 3. Raising of tail surface 3 causes the tail of the plane to be urged to the right and the turn is accomplished. It should be noted that counterclockwise rotation of shaft 36 has no effect whatsoever upon tail surface 4 and the same remains in its neutral position.

When making turns either right or left by turning control wheel 35 clockwise or counterclockwise, respectively, the control wheel is returned to neutral when the desired angle of bank, which governs the radius of the turn, is attained. When the desired angle of turn is accomplished the airplane is brought back to an even keel and a straight course by simply turning the wheel 35 in a direction opposite to that used to enter the turn and returning to neutral when on an even keel.

Gliding turns may be made by reducing the engine speed and operating the control wheel as described above. Climbing turns may be made by increasing the engine speed over normal cruising speed and operating the control wheel as described above for a normal turn in the horizontal plane at cruising speed.

I claim:

1. In an airplane having ailerons on the wings thereof and two complementary disposed tail surfaces, each tail surface being angularly disposed with respect to the horizontal transverse and vertical axes of the airplane to provide both vertical and horizontal components, a control member, means mounting the control member for both rotational and longitudinal movement, control means for said ailerons responsive to rotational movement of the control member for respectively elevating and depressing the respective ailerons in response to the direction of rotation of the control member, and control means for the tail surfaces selectively responsive to both rotational and longitudinal movement of the control member and including controlling connections responsive solely to rotational movement of the control member and effecting an individual operation of the responsive tail surfaces in response to the direction of rotation of the control member, and also including other controlling connections responsive to longitudinal movement of the control member to effect a simultaneous similar movement of the tail surfaces in one direction or the other in response to the longitudinal movement of the control member in one direction or the other and means for preventing simultaneous rotation and longitudinal movement of said control member.

2. In an airplane having ailerons on the wings thereof and two complementary disposed tail surfaces, each tail surface being angularly disposed with respect to the horizontal transverse and vertical axes of the airplane to provide both vertical and horizontal components, a control member, means mounting the control member for two types of movement, control means for said ailerons responsive to one type of movement of the control member for respectively elevating and depressing the respective ailerons in response to the first of said types of movement of the control member, and control means for the tail surfaces selectively responsive to both types of movement of the control member and including controlling connections responsive solely to the first type of movement of the control member and effecting individual operation of the respective tail sur-

faces in response to said first type of movement of the control member and also including other controlling connections responsive to the second type of movement of the control member to effect simultaneous similar operation of the tail surfaces in one direction or the other in response to said second type of movement of the control member, and means for preventing both types of movement of said control member simultaneously.

3. In an airplane having ailerons on the wings thereof and two complementary disposed tail surfaces, each tail surface being angularly disposed with respect to the horizontal and transverse axes of the airplane to provide both vertical and horizontal components, a control system in which said airplane is banked by the operation of the ailerons, is caused to lose or gain altitude by simultaneous operation of said tail surfaces, and is turned by the operation of one of said tail surfaces, a control member, means mounting the control member for both rotational and longitudinal movement, control means for said ailerons responsive to rotational movement of the control member for respectively elevating and depressing the respective ailerons in response to the direction of rotation of the control member, and control means for the tail surfaces selectively responsive to both rotational and longitudinal movement of the control member and including controlling connections responsive solely to rotational movement of the control member and effecting individual operation of the respective tail surfaces in response to the direction of rotation of the control member, and also including other controlling connections responsive to longitudinal movement of the control member to effect simultaneous similar movement of the tail surfaces in one direction or the other in response to longitudinal movement of the control member in one direction or the other, and means for preventing simultaneous rotation and longitudinal movement of said control member.

4. In an airplane having ailerons on the wings thereof and two complementary disposed tail surfaces, each tail surface being angularly disposed with respect to the horizontal transverse and vertical axes of the airplane to provide both vertical and horizontal components, a control system in which said airplane is banked by the operation of a plurality of ailerons, is caused to lose or gain altitude by the simultaneous operation of a plurality of tail surfaces each having a vertical and horizontal component, and is turned by the operation of one of said tail surfaces, a control member, means mounting the control member for two types of movement, control means for said ailerons responsive to one type of movement of the control member for respectively elevating and depressing the respective ailerons in response to said one type of movement of the control member, and control means for the tail surfaces selectively responsive to both of said types of movement of the control member and including controlling connections responsive solely to said one type of movement of the control member and effecting individual operation of the respective tail surfaces in response to said one type of movement of the control member, and also including other controlling connections responsive to the other type of movement of the control member to effect simultaneous similar movement of the tail surfaces in one direction or the other in response to said other type of movement of the control member, and means for preventing both of said

types of movement of said control member simultaneously.

5. In an airplane having ailerons on the wings thereof and two complementary disposed tail surfaces, each tail surface being angularly disposed with respect to the horizontal transverse and vertical axes of the airplane to provide both vertical and horizontal components, a control system for operating said ailerons and said tail surfaces in which said airplane is banked by the operation of said ailerons, is caused to lose or gain altitude by the simultaneous operation of both of said tail surfaces, and is turned by the operation of one of said tail surfaces, a control member mounted for rotational and longitudinal movement, means responsive to the rotation of said member for operating said ailerons, means responsive to rotation of said member for operating a single predetermined tail surface, and means responsive to longitudinal movement of said member for operating both of said tail surfaces simultaneously, whereby rotation of said member operates said ailerons and a predetermined tail surface and longitudinal movement of said member operates both said tail surfaces but not said ailerons, and means for preventing simultaneous rotation of said member and longitudinal movement thereof.

6. In an airplane having ailerons on the wings and two complementary disposed tail surfaces, each tail surface being angularly disposed with respect to the horizontal transverse and vertical axes of the airplane to provide both vertical and horizontal components, a control system in which the airplane is controlled about its vertical axis by the operation of one of said tail surfaces, and is controlled about its horizontal transverse axis by the operation of both of said tail surfaces, and is controlled about its longitudinal axis by the operation of said ailerons, a control member, said member being rotatable about its longitudinal axis and being movable along said axis, a controlling connection on said member responsive to rotation of the same in one direction to operate one of said tail surfaces, a second controlling connection responsive to rotation of the member in the opposite direction to operate the other of said tail surfaces, a third controlling connection responsive to rotation of said member in either direction but not responsive to movement of the member along its longitudinal axis to operate only said ailerons, a fourth controlling connection responsive to longitudinal movement of said member for operating both of said tail surfaces simultaneously, means on said member for preventing its movement along its longitudinal axis when the same is being rotated about said axis or for preventing its rotation about said axis when the same is moved longitudinally thereto, said means comprising a pin adapted to cooperate with an X slot in a stationary bearing in which said member is mounted, whereby when said member is used to control the airplane about its horizontal transverse axis the same may not be used to control the same about its vertical and longitudinal axes and whereby when the same is used to control the airplane about its longitudinal and vertical axes its use to control the operation of the plane about its horizontal transverse axis is prevented.

7. In an airplane having ailerons on the wings thereof and a V tail assembly composed of a pair of tail surfaces mounted at an angle of between 20 and 40° with respect to the horizontal transverse axis of the airplane, each of said tail sur-

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faces having a vertical and horizontal component, a control system in which said airplane is banked by the operation of said ailerons, is caused to lose or gain altitude by the simultaneous operation of both of said tail surfaces, and is turned by the operation of one of said tail surfaces, a single control member, means mounting the control member for two types of movement, control means for said ailerons responsive to one type of movement of the control member for banking said airplane in response to one type of movement of the control member, and control means for the tail surfaces responsive to both types of movement of the control member and including controlling connections responsive solely to one type of movement of the control member and effecting individual operation of the respective tail surfaces for turning said airplane in one direction or the other in response to said movement of the control member, and also including other controlling connections responsive to the other type of movement of the control member to effect simultaneous similar movement of said tail surfaces in one direction or the other to cause the airplane to lose or gain altitude in response to said other type of movement of said control member, and means for preventing both types of movement of said control member simultaneously.

8. In an airplane having ailerons on the wings thereof and two complementary disposed tail surfaces, each tail surface being angularly disposed with respect to the horizontal transverse and vertical axes of the airplane to provide both vertical and horizontal components, a control member, control means for said ailerons responsive to one type of movement of the control member for respectively elevating and depressing the respective ailerons in response to said movement of the control member, control means for the tail surfaces selectively responsive to two types of movement of the control member and including controlling connections responsive solely to said first type of movement of the control member and effecting individual operation of the respective tail surfaces in response to said type of movement of the control member and also including other controlling connections responsive to the second type of movement of the control member to effect simultaneous similar movement of the tail surfaces in one direction or the other in response to said other type of movement of the control member and means for preventing more than one type of movement of said control member at a time.

9. In an airplane having ailerons on the wings thereof and two complementary disposed tail surfaces, each tail surface being angularly disposed with respect to the horizontal transverse and vertical axes of the airplane to provide both vertical and horizontal components, a single control member, control means operatively connected with said control member for respectively elevating and depressing the respective ailerons in response to operation of said control means, a second control means operatively connected with said control member, including controlling connections for effecting an individual operation of either one of said tail surfaces alone and also including other controlling connections for effecting simultaneous similar operation of said tail surfaces, and means associated with said control member for preventing simultaneous operation of said first named control means and said second named controlling connections.

10. In an airplane having ailerons on the wings thereof and two complementary disposed tail sur-

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faces, each tail surface being angularly disposed with respect to the horizontal transverse and vertical axes of the airplane to provide both vertical and horizontal components, a control member, control means associated with said control member for said ailerons for respectively elevating and depressing the respective ailerons in response to operation of said control means, a second control means associated with said control member for the operation of the tail surfaces, including controlling connections for effecting an individual operation of either one of said tail surfaces alone and also including other controlling connections for effecting simultaneous similar operation of said tail surfaces, and means associated with said control member for preventing simultaneous operation of said first named control means and said second named controlling connections.

11. In an airplane having ailerons on the wings thereof and a V tail assembly composed of a pair of tail surfaces mounted at an angle of between 20° and 40° with respect to the horizontal transverse axis of the airplane, each of said tail surfaces having a vertical and horizontal component, one control member, control means operable by said control member for respectively elevating and depressing the respective ailerons in response to operation of said control means, a second control means operable by said control member including controlling connections for effecting an individual operation of either one of said tail surfaces alone and also including other controlling connections for effecting simultaneous similar operation of said tail surfaces and means associated with said control member for preventing simultaneous operation of said first named control means and said second named controlling connections.

12. In an airplane having ailerons on the wings thereof and two complementary disposed tail surfaces, each tail surface being angularly disposed with respect to the horizontal and transverse axis of the airplane to provide both vertical and horizontal components, a control system in which said airplane is banked by the operation of the ailerons, is caused to lose or gain altitude by simultaneous operation of said tail surfaces, and is turned by the operation of one of said tail surfaces, one control member including control means for said ailerons for respectively elevating and depressing the respective ailerons in response to operation of said control member, a second control means for the tail surfaces including control connections for effecting an individual operation of either one of said tail surfaces alone and also including other controlling connections for effecting simultaneous similar operations of said tail surfaces in response to operation of said control member and means associated with said control member for preventing simultaneous operation of said first named control means and said second named controlling connections.

13. In an airplane having ailerons on the wings thereof and two complementary disposed tail surfaces, each tail surface being angularly disposed with respect to the horizontal and transverse axes of the airplane to provide both vertical and horizontal components, a control system in which said airplane is banked by the operation of the ailerons, is caused to lose or gain altitude by the simultaneous similar operation of both of said tail surfaces, and is turned by the operation of one of said tail surfaces, a control member, control means for said ailerons associated with said

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control member for respectively elevating and depressing the respective ailerons in response to operation of said control means, a second control means associated with said control member for the operation of the tail surfaces, including controlling connections for effecting an individual operation of either one of said tail surfaces alone and also including other controlling connections for effecting simultaneous similar operation of said tail surfaces, and means associated with said control member for preventing simultaneous operation of said first named control means and said second named controlling connections.

TRACY S. HOLMES.

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