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2,385,392

CREWLESS GLIDER

Filed June 14, 1944

FIG. 1

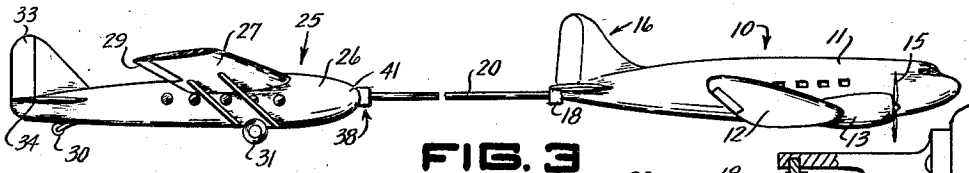


FIG. 3

FIG. 2

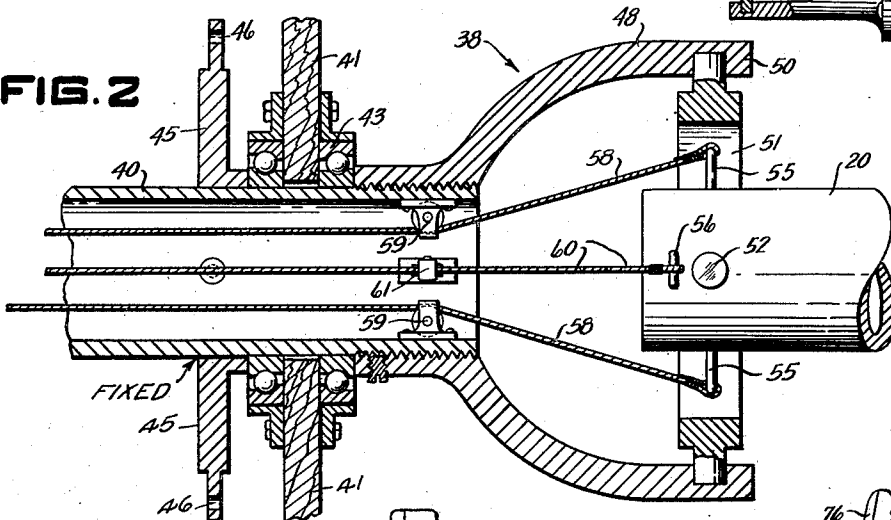


FIG. 4

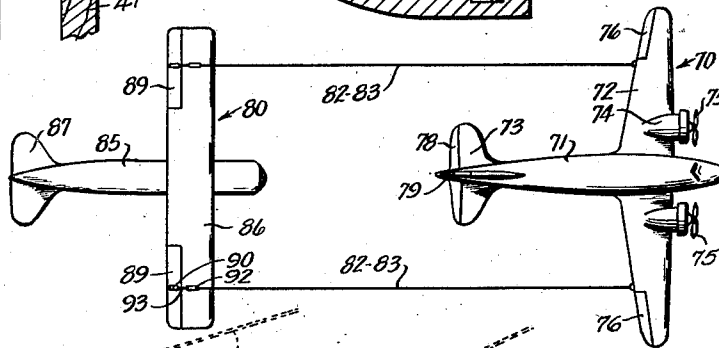
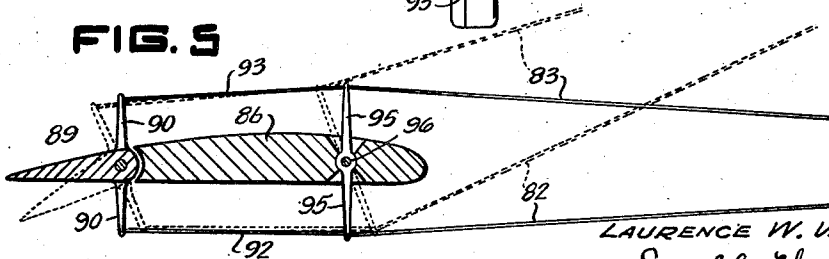


FIG. 5



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CREWLESS GLIDER

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4 Claims. (Cl. 244—3)

(Granted under the act of March 3, 1883, as amended April 30, 1928; 370 O. G. 757)

The invention described herein may be manufactured and used by or for the Government for governmental purposes, without the payment to me of any royalty thereon.

This invention relates to gliders, and more particularly to a crewless glider adapted to be towed by an airplane.

It is common practice at present to tow gliders from airplanes in which the towed glider is either controlled by a pilot in the glider, or is guided by manual controls actuated from the tow airplane by the pilot thereof. It will be apparent that if a glider were built with a lower factor of safety it could be built both cheaper and lighter for any given "pay load." Where there is no glider crew necessary, such a low safety factor becomes possible since, in case of emergency, the glider could be jettisoned without endangering life, the only loss being the glider and cargo. Furthermore, elimination of the glider pilot would enable the glider to carry additional pay load equal to the weight of the pilot plus the weight of any special equipment which may be provided for his safety and comfort.

One object of the present invention is to provide a crewless glider which will automatically follow the tow airplane.

Another object is to reduce the factor of safety used in building gliders.

A further object is to provide a crewless glider in which the controls are automatically actuated to conform to movements of the tow plane.

A still further object is to provide a glider that can be jettisoned without risking personnel.

Still another object is to reduce the cost of gliders.

Another object is to provide a glider which will carry a greater dead load than gliders now being made.

Other objects will become apparent upon considering the following specification, which, when taken in connection with the accompanying drawing discloses two forms of the invention.

In its broad aspect, the invention comprises a crewless glider towed by a tow plane, with the connecting means joining the tow plane with the glider automatically operating the controls of the glider to cause the glider to follow the tow plane.

In the drawing:

Fig. 1 is an elevational view of a tow plane, a glider, and the tow bar connecting the two;

Fig. 2 is a cross-sectional elevational view through the head of the glider;

Fig. 3 is a view partly in cross-section through

the universal joint in the tail of the tow plane shown in Fig. 1;

Fig. 4 is a plan view of a modified form of the invention; and

Fig. 5 is a cross-sectional elevational view through the glider wing showing the control illustrated in Fig. 4.

Referring first to Figs. 1, 2, and 3, a tow plane, generally designated 10, may comprise a body 11, wings 12, a tail structure 16, and one or more motor nacelles 13 which contain engines (not shown) to drive propellers 15.

The end of the tail structure 16 is provided with a universal joint 18, shown in detail in Fig. 3, which supports the tow bar 20 and secures it to the airplane. The bar 20 is preferably made tubular to lend the requisite stiffness, and of light weight material to cut the weight to a minimum.

The tow bar 20 joins the tow plane 10 with a glider, generally designated 25, in a manner more fully set forth below. The glider may comprise a body 26, wings 27 having ailerons 29, a landing gear 30—31, and a tail comprising a vertical rudder 33 and an elevator 34.

The control of the rudder, the elevator, as well as the ailerons, is effected through a universal connection 38 which joins the tow bar 20 to the glider 25.

As best seen in Fig. 2, the universal connection 38 comprises a tube 40 mounted for rotation in the nose 41 of the glider 25. The tube 40, while free to rotate in the nose 41, is restrained from longitudinal movement by a bearing 43. The tube 40 may carry a pair of control horns 45 fixed thereto to rotate therewith. Control cables (not shown) are connected to apertures 46—46 in the ends of the horns 45 and actuate the ailerons 29 in the usual manner.

The outer end of the tube 40 carries a universal joint 48, which comprises a yoke 50 having a collar 51 pivotally mounted in the outer end. A pair of pins 52 are pivotally mounted in the collar 51 and on an axis at right angles to the pivotal axis of the collar 51. The pins 52 carry the tow bar 20, which has, as a result of the joint 48, a universal movement relative to the nose 41 of the glider 25.

The glider end of the tow bar 20 has control cable mountings 55—55 fixed on the top and bottom thereof and a second pair of control cable mountings 56 at right angles thereto, the cable mountings 55 being in alignment with the axis of the collar 51 while cable mountings 56 are slightly spaced from pins 52 though in the same horizontal plane. Control cables 58—58 are con-

nected to the cable mountings 55—55 and pass through the tube 40 to the elevator 34 to control the elevation of the glider 25. The cables 58—58 may pass over one or more guide pulleys 59 between the ends of the tow bar.

Similarly cables 60 join the tow bar 20 with the vertical rudder 33 through the cable mountings 56, with one or more guide pulleys 61 being placed where necessary in order to insure the cable working freely. The cable 60 controls the rudder 33 and hence the direction of the glider in a horizontal plane.

Referring to the form of the invention shown in Figs. 4 and 5, a tow plane 70 may comprise a body 71, having a wing 72 fixed on the forward end and a tail structure 73 on the rear or trailing end thereof. The wing may carry one or more motor nacelles 74—74 containing motors which drive propellers 75—75. Ailerons 76—76 are formed on the outer trailing ends of the wing 72 to impart a rolling motion to the airplane. The tail structure 73 includes an elevator 78 and a vertical rudder 79.

The plane 70 may tow a glider 80, which is both towed and automatically controlled in a manner to be described below, through a plurality of cables 82—82, and 83—83.

The glider 80 may comprise a body portion 85 adapted to carry a cargo, a wing or wings 86 and a tail 87 which may consist solely of a horizontal stabilizer.

The wing 86 is provided with ailerons 88—88 at the outer ends thereof, the ailerons also acting simultaneously to serve as elevators for the glider. The movement of each of the ailerons is controlled by a pair of control horns 90 fixed to each aileron and projecting from opposite sides thereof so that turning the horns 90 through any angle causes the aileron to turn through a corresponding angle.

The extremities of the control horns 90 are connected by links 92 and 93, respectively, to the extremities of tow horns 95—95. The tow horns 95, which may be joined or integral, as shown, are pivotally mounted near the forward or leading edge of the wing 86 and at the center thereof, as indicated at 96.

The tow ropes 82—82 are connected from the trailing edges of the tow plane to the lower ends of the horns 95—95, while the tow ropes 83—83 are connected to the upper ends of the horns 95—95.

Operation

In the form of the invention shown in Figs. 1, 2, and 3 the glider 25 is attached to the tow plane 10 through the tow bar 20 and the plane 10 flown in the usual manner from the field. As the tow plane rises the tow bar slopes downwardly toward the glider, causing the tow bar to rotate about the pivots 52. Movement of the tow bar about the pivots 52 actuates the control cables 58—58 causing the glider to rise and follow the path of the tow plane.

Similarly if the plane makes a horizontal turn, the tow bar 20 causes the ring 51 to rotate on its pivot, which actuates the control cables 60 which actuate the rudder 33. As the plane 10 banks to make its turn the tow bar rotates, causing the tube 40 to rotate a corresponding amount. Rotating the tube 40 actuates the ailerons 29, causing the wing 27 to tip in accordance with that of the wing of the plane.

In the form of the invention shown in Figs. 4 and 5, the glider is towed by the tow plane 70

through the tow cables 82—83. As the plane 70 rises from the ground the pull on the lower cables 82—82 is increased and the pull on the upper cables 83—83 is decreased causing both the ailerons 88—88 to turn down. Movement of both ailerons downwardly causes a lift on the wing surface 86 causing the glider to rise to the same level as the plane 70. As the glider 80 arrives at the same elevation as the plane 70 the tension on the cables 82 and 83 becomes equal and the ailerons are returned to level flight position.

As the plane 70 banks one wing is lowered while the other wing is raised. Lowering of the one wing will cause the upper cable 83 on that side of the plane to exert greater pull than the lower cable 82, thus causing that side of the glider to lower an amount corresponding to the dip of the plane 70. At the same time the rise of the wing on the opposite side of the plane will cause the lower tow rope 82 on that side of the plane to exert a greater pull than the upper rope 83 causing the aileron to be actuated to raise that side of the glider 80 until the wings of the glider are parallel to the wings of the tow plane.

In turning the plane 70 the plane is banked at the same time that the rudder is actuated to turn the plane. Banking of the plane 70 causes a corresponding banking of the glider 80 as described above while turning of the plane 70 causes unequal tension in both sets of tow ropes 82—83, which causes the glider to turn and follow the plane. The banking prevents side slip and keeps the glider 80 in the path of the plane 70.

It is to be understood that the forms of the invention herein shown and described are to be taken merely as preferred examples of the same and that various changes in the shape, size, and arrangement of parts may be made as fall within the scope of the appended claims without departing from the spirit of the invention.

What is claimed as new and desired to secure by Letters Patent is:

1. In combination with a tow plane including a universal joint fixed in the tail thereof, a tow bar joined at one end thereof to said plane through said universal joint, a glider joined to the opposite end of said tow bar, control surfaces on said glider to vary the elevation and direction thereof, and means actuated by a change in the angular relationship between the tow bar and the glider to vary the control surfaces, whereby the glider will follow the tow plane.

2. In combination with a tow plane including a universal joint fixed in the tail thereof, a rigid tow bar joined at one end thereof to said tow plane through said universal joint, a glider joined to the opposite end of said tow bar, control surfaces on said glider to vary the elevation and direction thereof, and control cables fixed to the glider end of said tow bar and actuated by a change in the angular relationship between the tow bar and the glider to vary the control surfaces, whereby the glider will follow the tow plane.

3. In combination with a tow plane having a wing surface including a universal joint fixed in the tail thereof, a tow bar joined at one end thereof to said tow plane through said universal joint, a glider joined to the opposite end of said tow bar, said glider comprising, a body, wings fixed to said body, ailerons pivotally mounted on said wings, and a tail structure fixed to said body and adapted to vary the elevation and direction of said glider, means actuated by a change in

the angular relationship between the tow bar and the glider to actuate the control surfaces, whereby the glider will follow the tow plane, and means responsive to the angular difference between the wing on said tow plane and the ring on said glider to actuate the ailerons. 5

4. In combination, a tow plane, a glider, a rigid tow bar, universal joints secured to each end of the tow bar, means securing one of said

universal joints to the tow plane, means securing the other universal joint to the glider, control surfaces on the glider, and cables connecting said control surfaces with the end of the tow bar which is adjacent said glider, so that the glider will be controlled directly by pull of said cables responsive to movements of the tow plane.

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