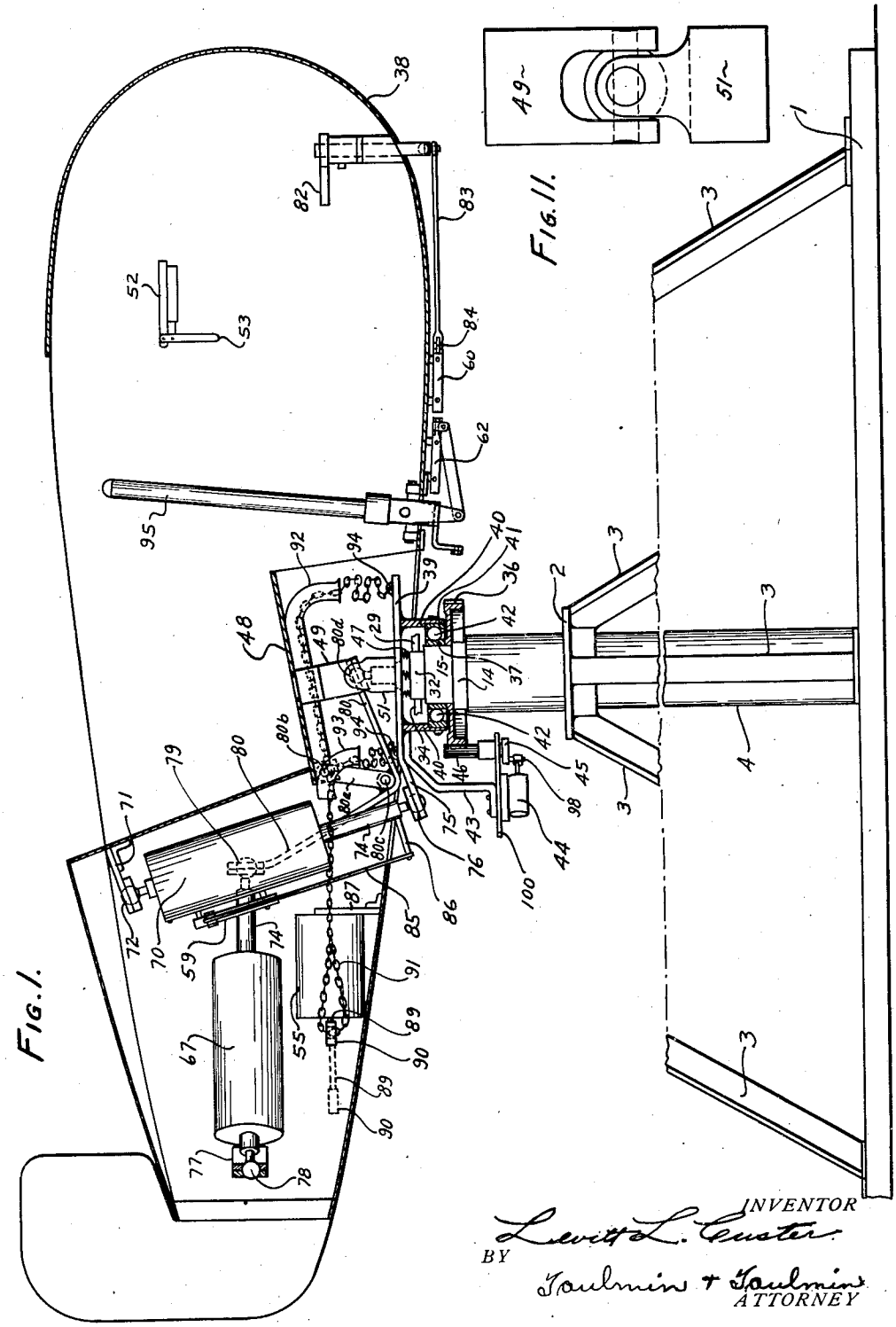
Dec. 8, 1936. L. L. CUSTER 2,063,231

AVIATION TRAINING MACHINE

Filed Sept. 15, 1930 5 Sheets-Sheet 1



Dec. 8, 1936. L. L. CUSTER 2,063,231

AVIATION TRAINING MACHINE

Filed Sept. 15, 1930 5 Sheets-Sheet 2

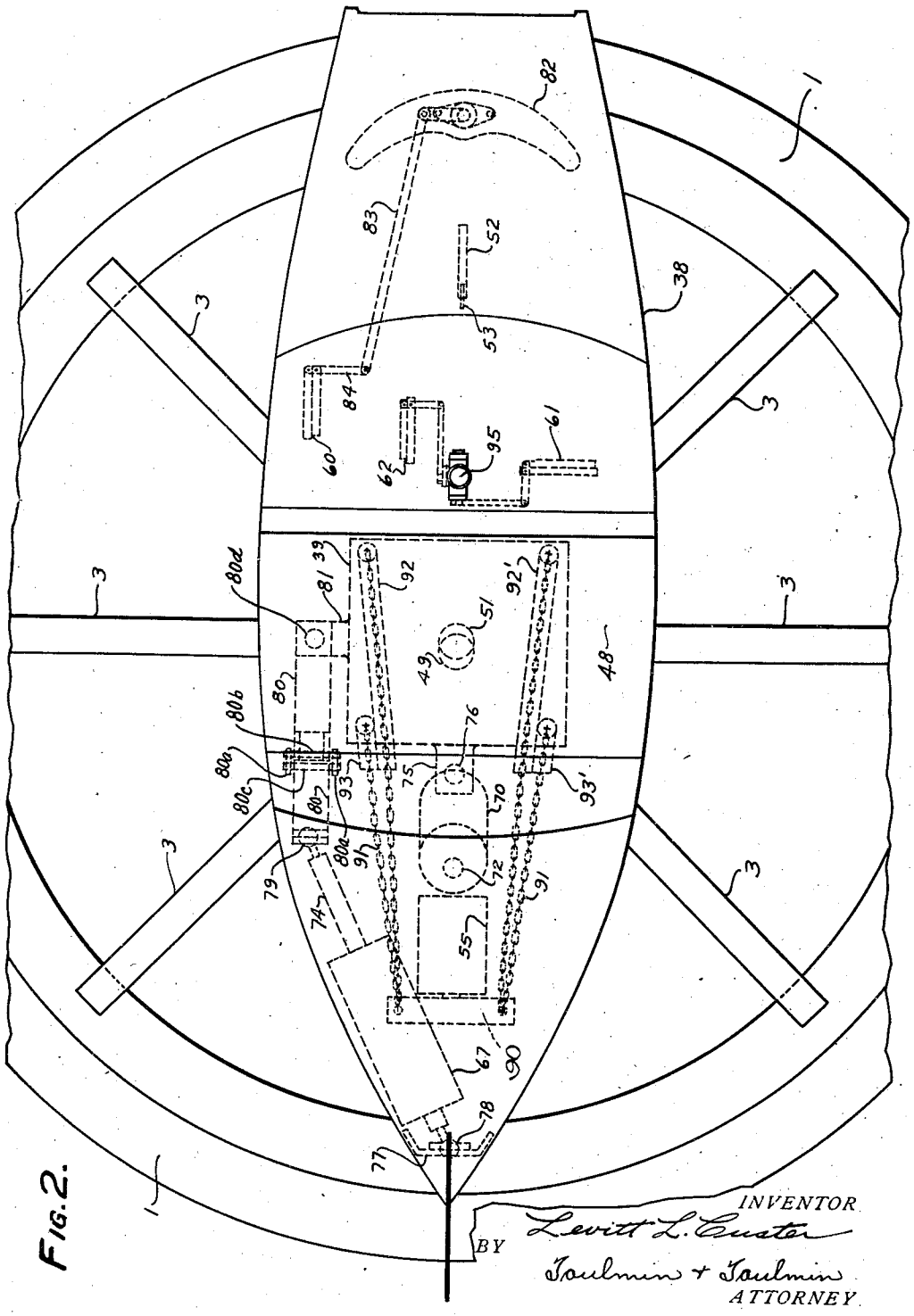


FIG. 2.

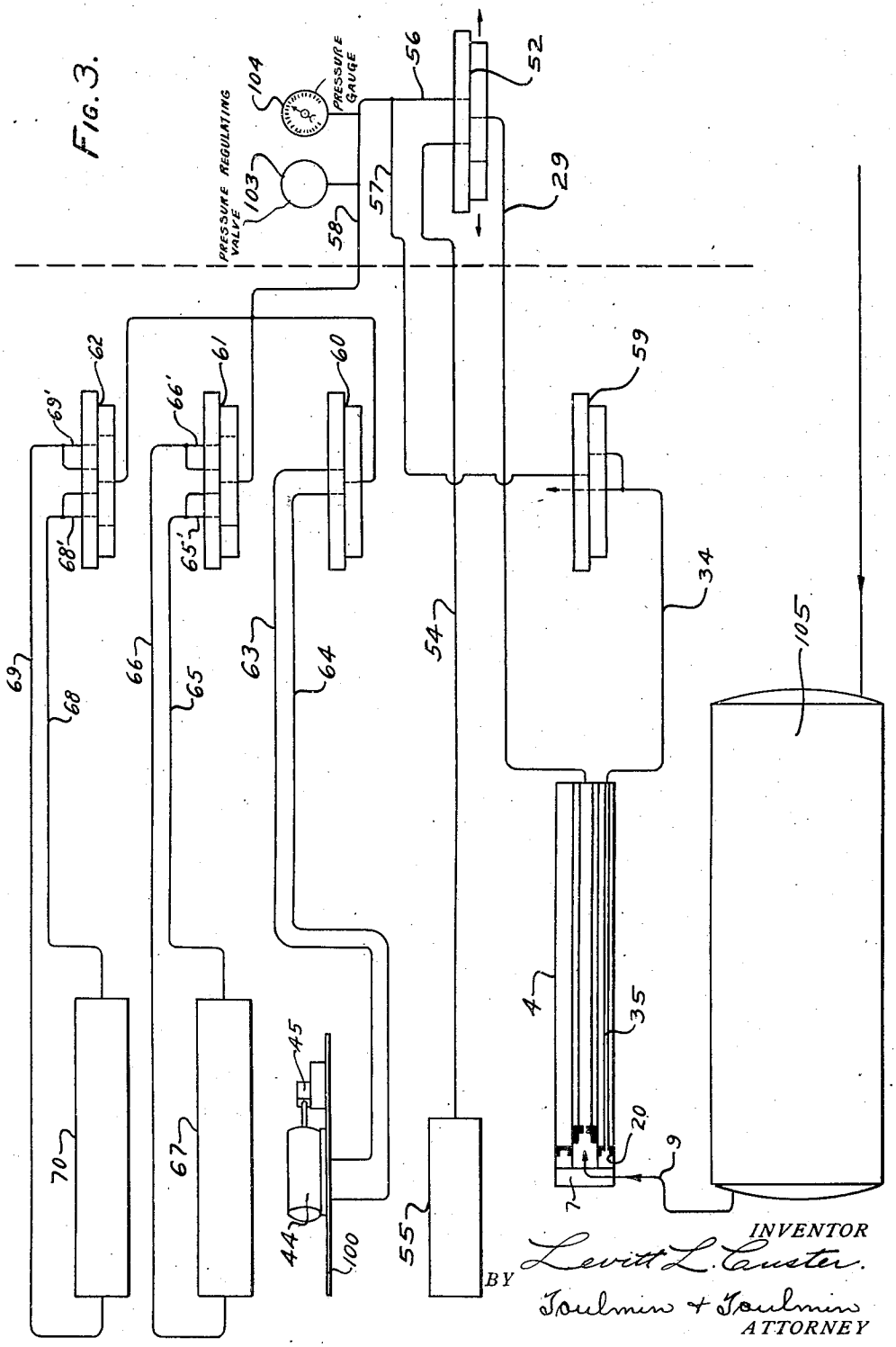
INVENTOR
Leavitt L. Custer
BY
Toulmin & Toulmin
ATTORNEY

Dec. 8, 1936. L. L. CUSTER 2,063,231

AVIATION TRAINING MACHINE

Filed Sept. 15, 1930 5 Sheets-Sheet 3

FIG. 3.



INVENTOR
Levitt L. Custer.
BY Toulmin & Toulmin
ATTORNEY

Dec. 8, 1936. L. L. CUSTER 2,063,231

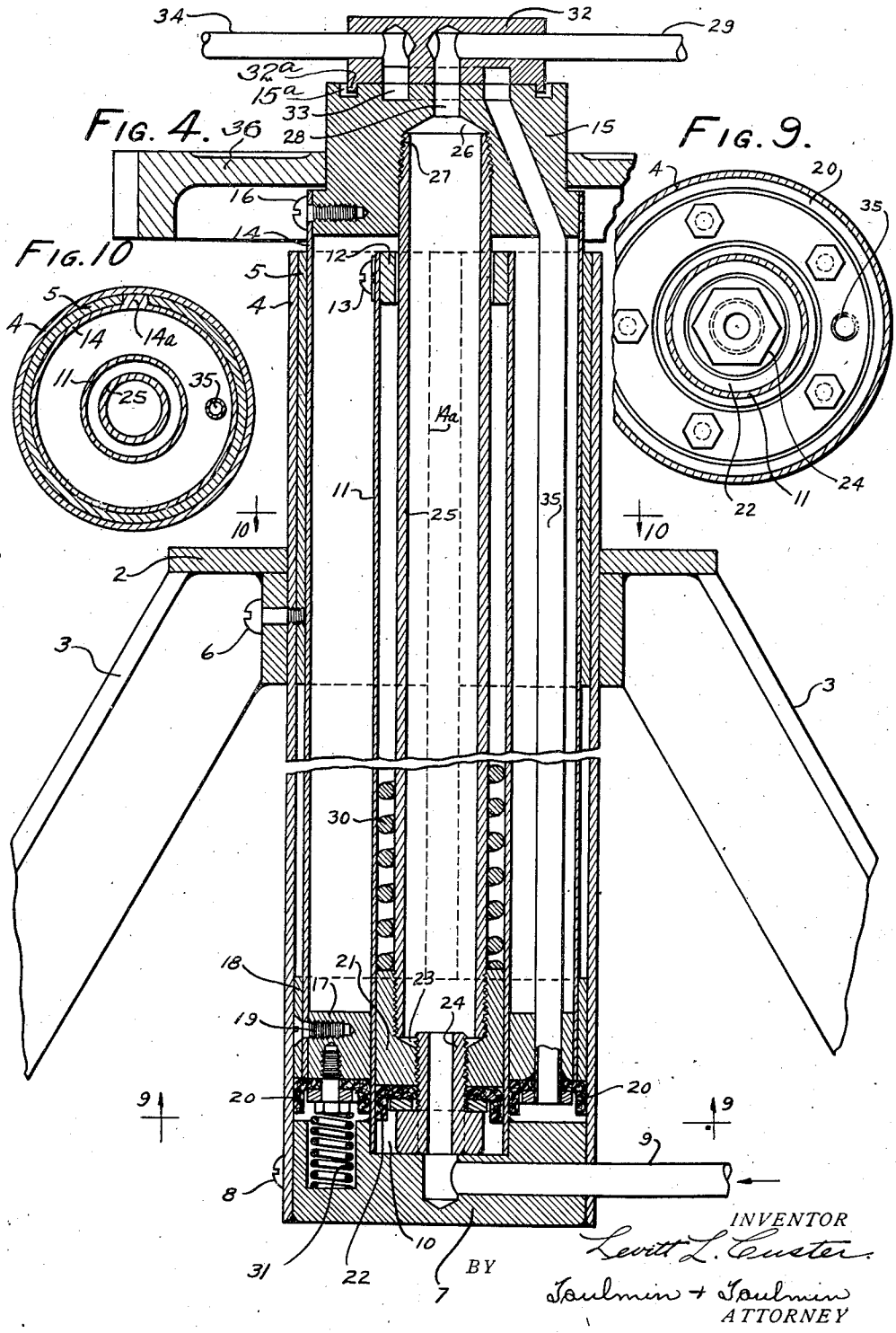
AVIATION TRAINING MACHINE

Filed Sept. 15, 1930 5 Sheets-Sheet 4

FIG. 4.

FIG. 9.

FIG. 10



INVENTOR
Levitt L. Custer
Toulmin & Toulmin
ATTORNEY

Dec. 8, 1936. L. L. CUSTER 2,063,231

AVIATION TRAINING MACHINE

Filed Sept. 15, 1930 5 Sheets-Sheet 5

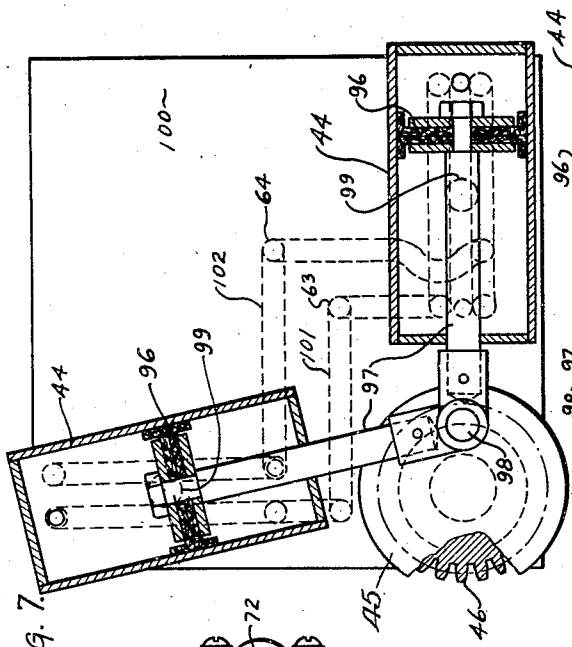


Fig. 7.

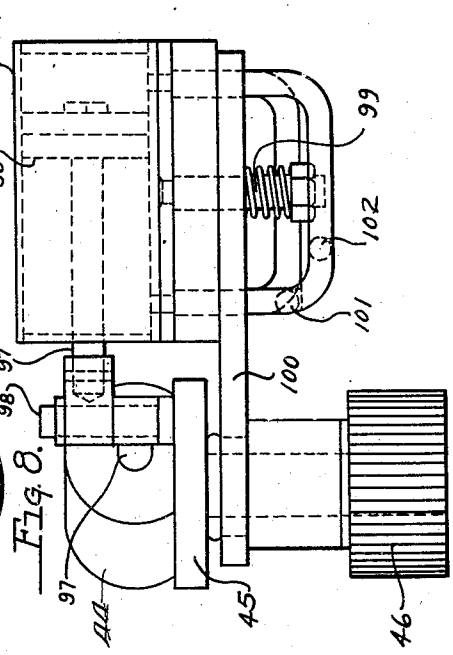


Fig. 8.

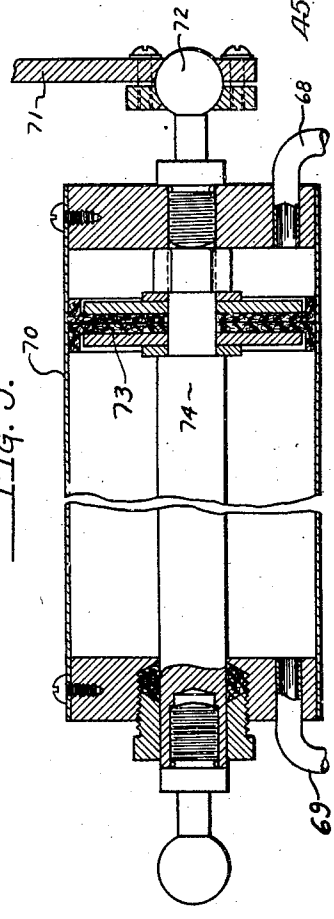


Fig. 5.

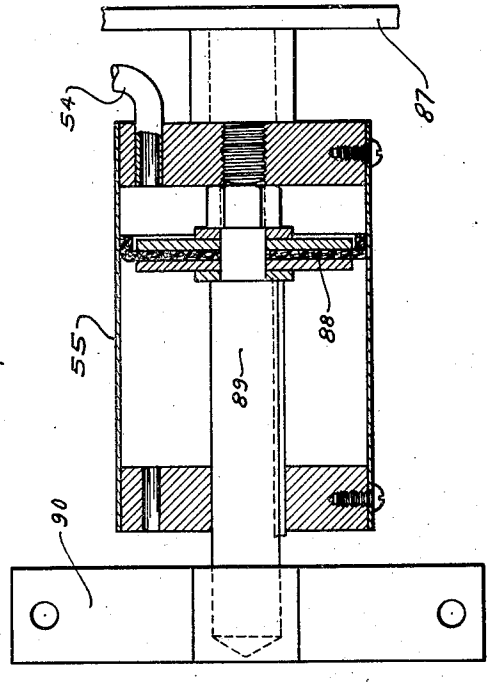


Fig. 6.

INVENTOR
Levitt L. Custer
BY
Toulmin & Toulmin
ATTORNEY

Patented Dec. 8, 1936 2,063,231

UNITED STATES PATENT OFFICE

2,063,231

AVIATION TRAINING MACHINE

Levitt L. Custer, Dayton, Ohio

Application September 15, 1930, Serial No. 481,831

33 Claims. (Cl. 35—12)

This invention relates to apparatus for use in connection with aviation training, and has for its object to provide a body member in the shape of a fuselage of an airplane, supported in such a manner that it may be elevated and tilted up and down, or caused to rock from one side to the other.

It is particularly the object of this invention to provide, in connection with the body member, a hand-operated lever located adjacent a seat, by which the different movements of the body are controlled.

It is also an object of this invention to provide, in connection with an apparatus of this kind, air pressure means for performing the different movements, and an air valve for controlling the direction of the air pressure.

It is a further object of this invention to provide, in connection with the elevating means, means for operating a climb valve. When this valve is operated air pressure is discharged from the supporting cylinder for lowering the body of the apparatus as a whole when the tilt fore and aft is too great and is at a dangerous flying angle.

It is a further object of this invention to provide, in connection with an apparatus of this kind, a single valve for the initial control of the air pressure. This valve has two positions, in one of which the body of the apparatus is brought into a horizontal resting position. In the other position of this valve the direction of the air pressure is such that the body as a whole is raised and by the operation of the hand lever the different movements of the body may be effected.

It is a further object of this invention to provide with the body an air-operated motor, operated from a rudder and rudder control valve for rotating the body on its support.

These and other advantages will appear from the description taken in connection with the drawings.

Referring to the drawings:

Figure 1 is a side elevation of the apparatus as a whole, showing the body partly in section and the supporting standard partly broken away.

Figure 2 is a top plan view.

Figure 3 is a diagrammatic view showing the air pressure tank, the various valves and cylinders and the air pressure lines running from the valves to the cylinders in neutral, inoperative position.

Figure 4 is a longitudinal section through the climb cylinder.

Figure 5 is a longitudinal section through the elevating cylinder, and the bank cylinder.

Figure 6 is a longitudinal section through the elevating cylinder.

Figure 7 is a bottom plan view of the engine or motor with the cylinders in section.

Figure 8 is a side elevation of the engine upside down.

Figure 9 is a section on the line 9—9 of Figure 4.

Figure 10 is a section on the line 10—10 of Figure 4.

Figure 11 is a view showing the universal joint between the body and supporting plate.

In Figure 1 there is shown the general formation of this apparatus. A support 1 is provided in the form of a circular base member, which has an upper base member or head 2 connected to the lower base member 1 by means of legs 3. These members constitute the frame part of the support for the body of the apparatus. This frame part may be stationary or may be carried on some moving member.

Resting upon the lower base at the central part thereof is a cylinder 4 which extends up through the head 2 and is supported thereby. Within the upper end of the cylinder 4 is a sleeve 5 fastened to the cylinder and the head member 2 by means of screws 6. In the bottom of the cylinder 4 is a member 7 fastened thereto by means of screws 8. In the lower end of the cylinder, passing through the bottom 7, is an air inlet 9 which leads from a suitable tank and opens into the inside part of the cylinder directly into a cavity 10 formed on the upper side of the bottom of the cylinder. Within this cavity 10 is a smaller cylinder 11. This cylinder is attached to the bottom 7 by some suitable means so that it forms an integral part of the cylinder structure, of which 4 is a part.

On the upper end of the cylinder 11, within the cylinder, is a cuff or ring member 12 fastened thereto by means of screws 13. Within the cylinder 4 and engaging the sleeve 5 is a cylindrical piston 14, which has a head 15 attached in the upper end thereof by means of screws 16. In the upper surface of the head 15 is an annular groove 15a. In the lower end of the cylindrical piston is an annular member 17 which fits between the walls of the cylindrical piston 14 and the cylinder 11, and is fastened to the cylindrical piston 14 by means of screws 19. Surrounding the lower end of the cylindrical piston and between the piston and the lower end of the cylinder 4 is a sleeve 18, held in position by means of the screws 19.

In order that there might be a close fit between the cylindrical piston and the walls of the cylin-

der 4 and the cylinder 11, packing 20 is provided. There is also provided in the cylinder 11 a piston member 21, which has on the lower end thereof packing 22 so as to make an airtight fit between the piston and the walls of the cylinder. In the upper end of this piston 21 is a cavity 23 which ends in a screw threaded passageway for a hollow plug 24. The opening through the plug 24 connects with the cavity 10 and the passageway 9 for the admission of air into the cylinders here described.

Threaded into the cavity 23 is the lower end of a tube 25, which extends upwardly through the cylinder 11 and into a cavity 26 in the head 15, and has its end 27 threaded therein. Extending upwardly from the cavity 26 is an air passage 28 leading to and connected with an air pipe 29, which leads to the aviator body air supply which is controlled by a master valve. The cylinder 11 and the tube 25 form an extensible air passageway through the cylinder 4 and its piston 14.

Located within the cylinder 11 and resting upon the piston member 21 is a coil shock-absorbing spring 30. When the head 15 is forced upwardly by means of the admission of air in the lower part of the cylinder, the pistons all move upwardly and as they reach the upward limit of their movement the spring 30 will engage the ring or cuff 12 and limit the upward movement, and have a shock absorbing effect. In the downward movement of the head and the pistons connected thereto springs 31 are provided for absorbing the shock when these parts reach the lower limit of their movement. This spring is located in a cavity in the bottom 7 of the cylinder 4.

The parts herebefore described are stationary with regard to each other except for the vertical movements by reason of spline 14*a* on piston 14 fitting in slot 5*a* in sleeve 5. Located on top of the head 15 is a cap member 32 which has a tongue 32*a* fitting in the groove 15*a*. In this cap member is the heretofore described pipe 29, which connects with the passageway 28. There is also provided in this cap member a cavity 33, which connects with a pipe 34 leading to the automatic climb valve. There is also leading from the cavity 33 a pipe 35, which extends down through the head 15, through the cylinder 4, down through the annular member 17 so that air may pass from the pipe 34 into the cylinder beneath the pistons, whereby the head 15 and the parts supported thereby are elevated or raised. It is for this reason that the cylinder 4 is called the climb cylinder, and air is admitted thereto through the normally open climb valve which is located on the elevating piston and is automatically operated by the operation of the elevating piston.

On the lower edge of the head 15 is a gear 36 for turning or rotating the body of the apparatus. Surrounding the head 15 above the gear 36 is a bearing ring 37, which cooperates with a later described bearing ring in the rotation of the body 38 of the apparatus. This body is supported upon the climb cylinder by means of a supporting plate 39, which has downwardly extending therefrom a bracket or brackets 40. The brackets 40 have on the lower ends thereof a bearing ring 41, which cooperates with the bearing 37 to form a runway for balls 42. It is by means of these bearing rings and balls that the body is easily rotated upon the upper end of the climb cylinder.

There extends rearwardly and downwardly from the plate 39 a bracket 43 which has supported thereon an air motor 44 for rotating the body of the apparatus. This motor has pistons connected to a crank 45 for rotating a pinion 46 which engages the gear 36. Since the gear 36 is stationary any rotation of the pinion 46 will cause the pinion to travel around the gear and through the bracket 43 will rotate the body of the apparatus upon the climb cylinder. In order to further aid in supporting the plate 39 upon the climb cylinder there is located between the plate and the cap 32 one or more springs 47. By means of these springs the cap 32 is held firmly against the head 15, thereby forming a sealed rotating joint.

Within the body and suitably attached thereto is a seat 48 which has extending downwardly therefrom a bracket 49 which engages and supports the seat and the body on a bracket 51, extending upwardly from the plate 39. The connection between the bracket 51 and the bracket 49 is a universal joint, as shown in Figure 11. In normal conditions the body is in a horizontally supported position but may be easily tilted forward or rocked to one side. In other words, the body may have an elevating movement or a banking movement transmitted thereto by providing proper means located within the body.

For the purpose of operating and giving the body its different movements air pressure is provided and a system of pipes and valves for controlling and directing the air pressure to different cylinders or parts of the body. The main valve for controlling the air pressure initially is a master valve 52, located in the front part of the body. This valve is connected to pipe 29 and through that pipe receives air under pressure from a reservoir or tank. This valve has two positions controlled by the handle 53. In one position the air pressure is directed through a pipe 54 to a leveling cylinder 55, the purpose of which and the detail structure of which will be described later. When the valve 52 is in its other and second position the air pressure is directed through pipe 56. While the valve is in this position the operation and use of the apparatus is carried out.

Pipe 56 branches or forms into two branches or pipes 57 and 58. Pipe 57 leads to an automatic climb valve 59, which is normally open when the apparatus is operating normally and up or going up. The other branch 58 further subdivides into three branches, one leading to a turn valve 60, another to a bank valve 61, and the third to an elevating valve 62. The air pressure directed to the turn valve is conducted therefrom by means of pipes 63 and 64 to a turn engine 44, heretofore described. From the bank valve 61 the air pressure is directed by means of pipes 65 and 66 to and from a bank cylinder 67.

Valve 61, as shown in Figure 3 is in inoperative position. By shifting this valve by means of the rudder member 82 the pipe 58 is put in connection with either pipe 63 or 64 for operating the motor to rotate the plate 39 and therethrough the body. The direction of rotation is determined by which pipe 63 or 64 is connected with the pipe 58. The arrangement of the parts of valve 61 is such that in one position the air will be directed to one end of the bank cylinder and the air exhausted from the other end. In the reverse position of this valve the air will be directed to the other end and exhausted from the opposite end. The exhausts in connection with this cylinder are indicated by the numerals 65′ and 66′. The elevating valve is constructed similarly to the banking valve and has extending therefrom two pipes 68 and 69, one to one end of an elevating cylinder 70 and the other to the other end there-

of. When this valve is in one position air pressure is directed to one end of the cylinder and allowed to escape from the other, while in the other position the valve directs the air in the opposite direction. The exhaust lines are indicated by the numerals 68' and 69'.

The cylinders and valves shown in Figure 3 are located in the body of the apparatus, as particularly shown in Figures 1 and 2. As shown in Figure 1 the elevating cylinder is supported at one end by means of a bracket 71 attached to the frame part of the body immediately back of the seat back. One end of the cylinder is attached to this bracket by means of a ball and socket structure 72 so that the cylinder may have a free swinging movement within certain limits. The form of this cylinder is shown in Figure 5 and has a piston 73 therein, which has extending therefrom and out one end of the cylinder, a piston rod 74. For the purpose of connecting the free end of the piston rod to some part of the plate 39 there is provided a bracket 75, extending rearwardly from the plate. This bracket has a ball and socket connection 76 with the free end of the piston rod 74.

It is obvious from an examination of the structure shown in Figure 1 that if air were admitted to the lower end of the cylinder 70 the rear end of the body would be caused to lower, whereas the front end would be raised so that there would be given to the body an elevating effect; whereas if air were admitted to the upper end of the cylinder the opposite action would take place, and there would be a dipping of the front end of the body. This action is controlled by the elevating valve 62.

The banking cylinder 67 is constructed in all parts as the elevating cylinder. It has one end attached to the rear of the body by means of a bracket 77, attached suitably to the body. Between the rear end of the banking cylinder and the bracket 77 there is a ball and socket connection 78, by which the banking cylinder has a limited amount of free swinging movement. This cylinder has the piston 73 and the piston rod 74, as described in connection with the elevating cylinder. The free end of the piston 74 used in connection with the banking cylinder has a ball and socket joint connection 79, with an arm 80 which is attached to a bracket 81 extending upwardly from the plate 39. This structure is shown in Figures 1 and 2.

The arm 80 is attached to the bracket 81 by means of a ball and socket connection 80*d*. Intermediate its ends the arm 80 is bent in the form of an elbow, in which there are brackets 80*c*, to which one end of a link 80*a* is pivoted. The other end of the link 80*a* is pivoted at 80*b* to the under side of the seat or an extension thereon. These parts are thus connected in order to permit the longitudinal oscillation of the body, while they are so connected that an operation of the banking cylinder will cause the body to oscillate from one side to the other.

As shown in Figure 2, if air were admitted to the front end of the banking cylinder the cylinder would be drawn toward the arm 80, thereby tilting the body in one direction, or giving the body a banking movement in one direction, whereas if air were admitted to the other end of the cylinder reverse actions would take place, causing the body to tilt in another direction and having an opposite banking action. These actions are controlled by means of the banking valve.

Located on the floor of the body in the front end thereof is a rudder member 82, which has extending therefrom a link 83 connected at one end to a lever or arm 84. This lever or arm is connected to the valve 60 which controls the admission of air to the turn motor. The rudder is pivotally located so that by rocking it the valve may be operated for the purposes herein described.

As before stated, the automatic climb valve, which is open during normal operation, is located on the elevating cylinder, as shown in Figure 1. For the purpose of operating this valve there is provided a link 85 connected by means of an arm 86 to the piston rod 74 of the elevating cylinder. It is obvious from this structure that any extreme movement of the piston rod will cause the valve to shift and this shifting of the valve will cause the air pressure to be exhausted through the pipe 34 from the cylinder so that the cylindrical piston is lowered and with it the body of the apparatus. This action takes place when the elevating position of the body of the apparatus has reached a limit so that at this point air is exhausted from the climb cylinder and the whole body is lowered, and remains in that position until the body again assumes an intermediate position. The leveling cylinder 55 is attached to the body by means of a bracket 87 and is held in a rigid fixed position with relation to the body by means of this bracket. In this cylinder there is a piston 88 which has extending therefrom a piston rod 89 projecting through one end of the cylinder, and has attached to the free end thereof a cross-head 90.

To each end of the cross-head 90 is attached a chain or cable 91 intermediate its ends. One end of one chain passes through a front guide member 92, while the other end passes through a rear guide member 93. The chain on the other end of the cross-head passes through similar guide members 92' and 93'. The chains passing through the front guide members are attached to the front end of the plate 39, while those passing through the rear guide members are attached to the rear of the plate 39.

By means of this cross-head and chain structure whenever air is admitted through pipe 54 to the front end of the leveling cylinder, the piston 88, piston rod 89 and the cross head 90 are moved rearwardly so that the rear ends of the chains are moved backward, thereby producing a tension on the chains, the other ends of which are attached to the plate 39. The lengths of these chains are so adjusted that whenever the chains are tight the body is brought into a horizontal or resting position, whereas when the body is to be elevated or banked the air is exhausted from the front end of the leveling cylinder so that the chains are loose, whereby the body may be easily moved. These chains are attached to the plate 39 at points indicated by the numeral 94.

The banking and elevating valves 61 and 62 are operated from a common control stick or lever 95, as shown in Figure 1. These parts are so arranged that a proper movement of the stick will direct the air pressure to either the elevating cylinder or to the banking cylinder, whenever the master valve is in the proper one of its two positions.

In Figure 7 there is shown a horizontal section through the cylinders of the turn engine. In this figure there are shown two cylinders, each having a piston 96 and a piston rod 97 extending therefrom through one end of each cylin-

der. These piston rods have their other ends attached to a spindle or crank pin 98 on the crank 45. In the present instance the crank is in the form of a disc mounted on one end of the shaft that carries on its other end the pinion 46 which engages the gear 36. The pistons are pivotally mounted at a point 99 on the support plate 100, which forms a support for the engine as a whole. For the purpose of operating the engine there is provided for each cylinder an intake 101. There is provided also for each cylinder an exhaust 102. The intakes have a common connection with the pipes 63 and 64, while the exhausts have a common outlet.

In Figure 3 there is shown a pressure regulating valve 103 and a pressure gauge 104. For the purpose of supplying air under pressure to the different parts of the apparatus, there is provided at some suitable point an air pressure tank 105. This tank is connected to some suitable air compressor. The air from this tank passes through the pipe 9 into the inner cylinder 23, and by pipe 29 into the master valve, where it is distributed to the different control valves. This inner cylinder serves two purposes, one to furnish a constant supply of air to the elevating mechanism, and second, to form a constant assistance in supporting the weight to prevent wasting air.

In the operation of the apparatus the valves are to start all in an inoperative or closed position, except the automatic climb valve which is open to the cylinder 4. Air pressure is not admitted to any part of the apparatus. By movement of the master valve air may be directed either to the leveling cylinder, bringing the body to a level or condition of equilibrium, or through pipe 56 into pipes 57 and 58 for producing the various motions desired by operating the different valves. When the air pressure is created in pipe 58, by operating the rudder, the pressure is admitted through valve 60 to pipes 63 or 64 and the engine 44 is operated so that the body will rotate around the climb cylinder. At the same time the body is raised and the valves 61 and 62 may be operated to produce a banking effect or an elevating effect, or both, and when the extreme tilting positions have been produced, the climb valve 59 is shifted to close the line to the cylinder 4 and the air is exhausted through pipe 34 from the climb cylinder for the purpose of lowering the body as a whole. This condition exists until the elevating action is reversed and the automatic climb valve is opened so that the body will again rise.

When the apparatus is in an active condition, owing to the operation of the various valves, and the user desires to stop the movement of the body, the handle or stick 95 is moved to a neutral position and the master valve is operated to cut off the air from all of the valves and direct it to the leveling cylinder. By this means tension is brought upon the cables so that the body is brought to a horizontal position. In order to effect this it is not necessary even to adjust the handle 95. Since the master valve is placed in position so that air pressure is directed to the leveling cylinder, air pressure is cut off from all other parts of the apparatus.

I desire to comprehend within my invention such modifications as may be clearly embraced within my claims and the scope of my invention.

Having thus fully described my invention, what I claim is new and desire to secure by Letters Patent, is:

1. In an apparatus of the class described, a seat, means to tilt the seat, and means operated by the tilting of the seat to lower it.

2. In an apparatus of the class described, in combination with a source of air pressure, a seat, means for tilting the seat, air pressure operated means for raising the seat, and a valve operated by the tilting of the seat for exhausting the air to lower the seat.

3. In an apparatus of the class described, a support, a seat pivotally mounted on said support, a guide member attached to the seat, a cable attached at one end to the support and passing through the guide member, and tensioning means on the other end of the cable, whereby the cable may be drawn tight and the seat brought to and maintained in a substantially horizontal position.

4. In an apparatus of the class described, a support, a seat pivotally mounted on said support, a guide member on the front end and on the rear end of said seat, a cable extending through each guide member and attached at one end to the support, and tensioning means attached to the other ends of said cables, whereby the cables may be tightened and the seat brought to and maintained in a substantially horizontal position.

5. In an apparatus of the class described, in combination with a source of air pressure, a support, a seat pivotally mounted on said support, air pressure operated means for tilting the seat laterally, air pressure operated means for tilting the seat longitudinally, means for directing air pressure from said source to either of said air-operated means, and an air pressure operated means for moving the seat from either tilted position to a substantially horizontal position and holding it in said position.

6. In an apparatus of the class described, in combination with a source of air pressure, a support, a body member pivotally mounted on said support, a cylinder attached at one end to said body, a piston and piston rod in said cylinder, one end of said rod being attached to the support, means to control the admission of air pressure from said source to said cylinder to tilt the body, and means to bring the body from a tilted to a substantially horizontal position, said last means including a cylinder having an air connection with said source and attached to the body, a piston and piston rod in said last-named cylinder connected to the support, and a valve to control the connection between the source of air pressure and the last-named cylinder.

7. In an apparatus of the class described, in combination with a source of air pressure, a support, a body member pivotally supported by said support, a pair of cylinders attached to said body member, a piston and piston rod for each cylinder, each piston being connected to said support, means for the admission of air pressure from said source to said cylinders to elevate and bank the body, and means operated by one of said piston rods to lower the body vertically.

8. In an apparatus of the class described, in combination with a source of air pressure, a cylinder having a connection with said source, a piston in said cylinder, a body member pivotally supported by said piston, a second cylinder pivoted to said body and having a connection with said source, a piston and piston rod in said second cylinder and pivotally connected to the first piston, means in the second connection to admit air pressure to the second cylinder to tilt the body, and a valve in the first connection supported by the second cylinder and operated by the second

piston rod to discharge air pressure from the first cylinder to lower the body vertically.

9. In an apparatus of the class described, in combination with a source of air pressure, a cylinder, a piston in said cylinder, a body member supported by said piston, a master valve in said body member, an air pressure connection between said source and said valve, an air pressure connection between said master valve and said cylinder, and a valve in said last connection operated by the tilting of the body to discharge air pressure from the cylinder to lower the body vertically.

10. In an apparatus of the class described, in combination with a source of air pressure, a cylinder, a piston in said cylinder, a body member supported by said piston, a valve in said body member, an air pressure connection leading from said source through the cylinder and the piston to the valve, and a second air pressure connection leading from the valve through the piston to admit air pressure to the cylinder below the piston to move the body bodily.

11. In an apparatus of the class described, in combination with a source of air pressure, a cylinder, a piston in said cylinder, a body member pivotally supported by said piston, a valve in said body member, an air pressure connection leading from said source through the cylinder and piston to the valve, a second air pressure connection leading from the valve through the piston to admit air pressure to the cylinder below the piston to move the body bodily, and means to tilt the body and operate the valve to discharge air pressure from the cylinder.

12. In an apparatus of the class described, in combination with a source of air pressure, a cylinder, a piston in said cylinder, a support member rotatably supported on said piston, air pressure means supported by said member and engaging the piston to rotate the support member, a body member pivotally supported on said support member, air pressure operated means for tilting the body, and means to control the admission of air pressure from said source to both of said means.

13. In an apparatus of the class described, in combination with a source of air pressure, a cylinder, a piston having a gear thereon in said cylinder, a plate rotatably supported on said piston, and air motor operatively connected to said source and supported by said plate, a pinion operated by said motor and in mesh with the gear for rotating the plate, a body member pivotally supported on said plate, a cylinder attached to said body member, a piston and piston rod in said cylinder, a pivotal connection between said piston rod and the plate, and means for supplying air pressure to the cylinder to tilt the body.

14. In an apparatus of the class described, in combination with a source of air pressure, a cylinder, a piston having a gear thereon in said cylinder, a plate member rotatably mounted on said piston, an air motor operatively connected to said source and supported by said plate member in operative engagement with the gear for rotating the plate, a body member pivotally supported on said plate member, means on the body connected to the plate for tilting the body, and means operated by said means for moving the body member from a tilted to a substantially horizontal position and maintaining said position.

15. In an apparatus of the class described, in combination with a source of air pressure, a cylinder, a piston having a gear thereon in said cylinder, a plate member rotatably mounted on said piston, an air motor operatively connected to said source and supported by said plate member in operative engagement with the gear for rotating the plate, a body member pivotally supported on said plate member, means on the body connected to the plate for tilting the body, and air pressure operated means operated by said means for moving the body member from a tilted to a substantially horizontal position and maintaining said position.

16. In an apparatus of the class described, in combination with a source of air pressure, a cylinder, a piston having a gear thereon in said cylinder, a plate member rotatably mounted on said piston, an air motor operatively connected to said source and supported by said plate member in operative engagement with the gear for rotating the plate, a body member pivotally supported on said plate member, air pressure operated means on the body connected to the plate for tilting the body, and means operated by said means for moving the body member from a tilted to a substantially horizontal position and maintaining said position.

17. In an apparatus of the class described, in combination with a source of air pressure, a cylinder, a piston having a gear thereon in said cylinder, a plate member rotatably mounted on said piston, an air motor operatively connected to said source and supported by said plate member in operative engagement with the gear for rotating the plate, a body member pivotally supported on said plate member, air pressure operated means on the body connected to the plate for tilting the body, and air pressure operated means operated by said means for moving the body member from a tilted to a substantially horizontal position and maintaining said position.

18. In an apparatus of the class described, in combination with a source of air pressure, a cylinder, a piston in said cylinder, a body member supported on said piston for rotation and lateral and longitudinal tilting, an air operated means for rotating the body member, a pair of air-operated means for tilting the body member, air operated means for bringing the body from a tilted position to a horizontal one, air operated means for raising the body, a two position master valve on the body, an air connection leading from said source through the piston and the cylinder to said valve, an air connection between said valve and the horizontaling means, another air connection leading from said valve having one branch leading through the piston to the cylinder, an automatic valve in said last connection, and another branch having other branches leading to the tilting means and the rotating means and valves in the branches for controlling the admission of air to the tilting means and the rotating means when the master valve is in one position, said leveling means being operated when said master valve is in the other position.

19. In an apparatus of the class described, in combination with a source of air pressure, a cylinder, a piston in said cylinder, a body member supported on said piston for rotation and lateral and longitudinal tilting, an air operated means for rotating the body member, a pair of air operated means for tilting the body member, air operated means for bringing the body from a tilting position to a horizontal one, air operated means for raising the body, a two position master valve on the body, an air connection leading from said source through the piston and the cylinder to said valve, an air connection between said valve and the horizontaling means, another air connection

leading from said valve having one branch leading through the piston to the cylinder, an automatic valve in said last connection, and another branch having other branches leading to the tilting means and the rotating means and valves in the branches for controlling the admission of air to the tilting means and the rotating means when the master valve is in one position, said leveling means being operated when said master valve is in the other position, said automatic valve being operated by one of the tilting means.

20. In combination, a fuselage, a source of air pressure, means to raise and lower said fuselage operated by the air pressure, means to rotate the fuselage in a position of elevation operated by the air pressure, and means to bank and tilt fore and aft the fuselage by said air pressure.

21. In combination, a fuselage, a source of air pressure, means to raise and lower said fuselage operated by the air pressure, means to rotate the fuselage in a position of elevation operated by the air pressure, means to bank and tilt fore and aft the fuselage by said air pressure, and means interconnected with the air operated tilting means for controlling the elevation of the fuselage according to the tilting thereof.

22. In combination, a fuselage, a source of air pressure, means to raise and lower said fuselage operated by the air pressure, means to rotate the fuselage in a position of elevation operated by the air pressure, means to bank and tilt fore and aft the fuselage by said air pressure, means interconnected with the air-operated tilting means for controlling the elevation of the fuselage according to the tilting thereof, hand-operated means for controlling the banking, tilting and elevation, and foot-operated means for controlling the rotation of the fuselage.

23. In combination, a fuselage, a source of air pressure, means to raise and lower said fuselage operated by the air pressure, means to rotate the fuselage in a position of elevation operated by the air pressure, means to bank and tilt fore and aft the fuselage by said air pressure, means interconnected with the air-operated tilting means for controlling the elevation of the fuselage according to the tilting thereof, hand-operated means for controlling the banking, tilting and elevation, foot-operated means for controlling the rotation of the fuselage, and means to render the elevating, tilting and banking means inoperative and to render a leveling means operative by said source of air supply, and a leveling means operated thereby connecting said fuselage and its support.

24. In combination, a raising and lowering means, a fuselage mounted thereon for universal movement and for rotation thereon at the same time, means controllable from the fuselage for determining the degree of universal movement of the fuselage and its elevation, and the degree of rotation of the fuselage.

25. In combination, a raising and lowering means, a fuselage mounted thereon for universal movement and for rotation thereon at the same time, means controllable from the fuselage for determining the degree of universal movement of the fuselage and its elevation and the degree of rotation of the fuselage, and means for automatically determining the elevation of the fuselage according to the degree of its universal movement in certain directions.

26. In combination, a raising and lowering means, a fuselage mounted thereon for universal movement and for rotation thereon at the same time, means controllable from the fuselage for determining the degree of universal movement of the fuselage and its elevation and the degree of rotation of the fuselage, and means to restore the fuselage to its lowered normal horizontal inoperative position.

27. In combination, a fuselage, an elevating and lowering air cylinder, a tilting air cylinder, and means for controlling the application of air to the raising and lowering cylinder according to the degree of tilt imparted by the tilting cylinder.

28. In combination, a fuselage, an air-operated raising and lowering cylinder, an air-operated fore and aft tilting cylinder, a valve for the tilting cylinder and a valve for the raising and lowering cylinder interconnected with the tilting cylinder, and means for admitting air to said cylinders comprising a control valve for the tilting cylinder whereby excessive movement of the tilting cylinder will modify the application of the air to the elevating cylinder and change its operation.

29. In an apparatus of the class described, in combination with a head, a support for the head comprising members telescoping one within another, an air passage through the support and the head and back through the support, and means cooperating with said members to move the head.

30. In an apparatus of the class described, in combination with a head, a support for the head comprising members telescoping one within another, an air passageway through the support comprising telescoping members, and an air passageway leading into said support through the first-named passageway, through the head and through one of the first-named members to extend the first-named members and move the head.

31. In an apparatus of the class described, in combination with a head, a support therefor comprising a cylinder having an air inlet at one end and an internal cylinder surrounding the air inlet and inside the first cylinder and forming an air passageway, a cylindrical piston supporting said head and fitting between said cylinders, and means to admit air from the air passageway into the first cylinder behind the cylindrical piston to raise the head.

32. In an apparatus of the class described, in combination with a head, a support therefor, comprising a cylinder closed at one end and having an air inlet, a cylindrical piston in said cylinder for supporting said head, and a telescopic air passageway attached to the head and to the end of the cylinder around the air inlet and means for conducting air from the air passageway to the cylinder.

33. In an apparatus of the class described, a pair of concentrically arranged cylinders, a closure for one end of each cylinder having an air inlet leading into the inner cylinder, a head having an air passageway therein, a pipe having one end in said passageway and extending into the inner cylinder, a piston member on the other end of said pipe and engaging the walls of the inner cylinder, said piston having an air passageway therein to receive air from the inlet, a cylindrical piston for supporting said head extending into the outer cylinder, a piston head on said piston closely engaging both of said cylinders, and means to admit air into the cylinders to raise the head.

LEVITT L. CUSTER.