J. S. LANG.

FLYING MACHINE.

APPLICATION FILED AUG. 23, 1912.

1,216,577.

Patented Feb. 20, 1917.

10 SHEETS—SHEET 1.

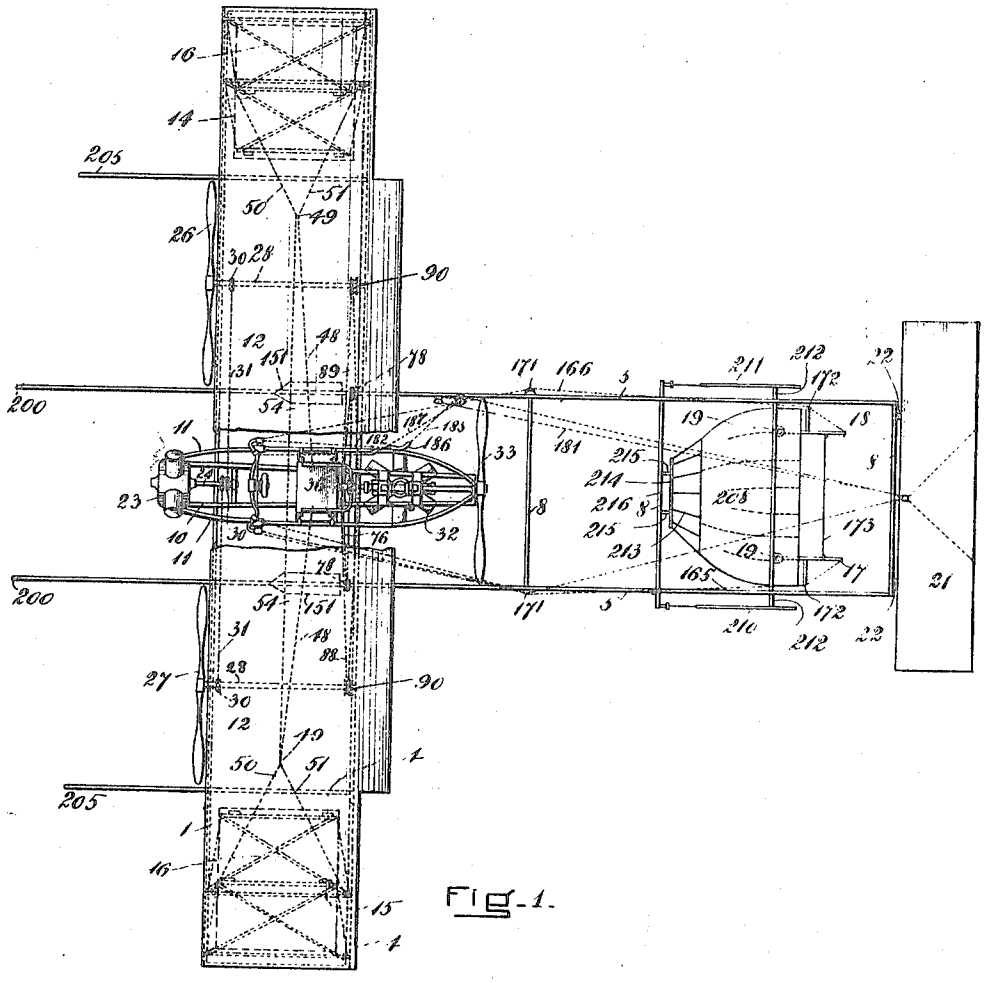


Fig. 1.

WITNESSES:

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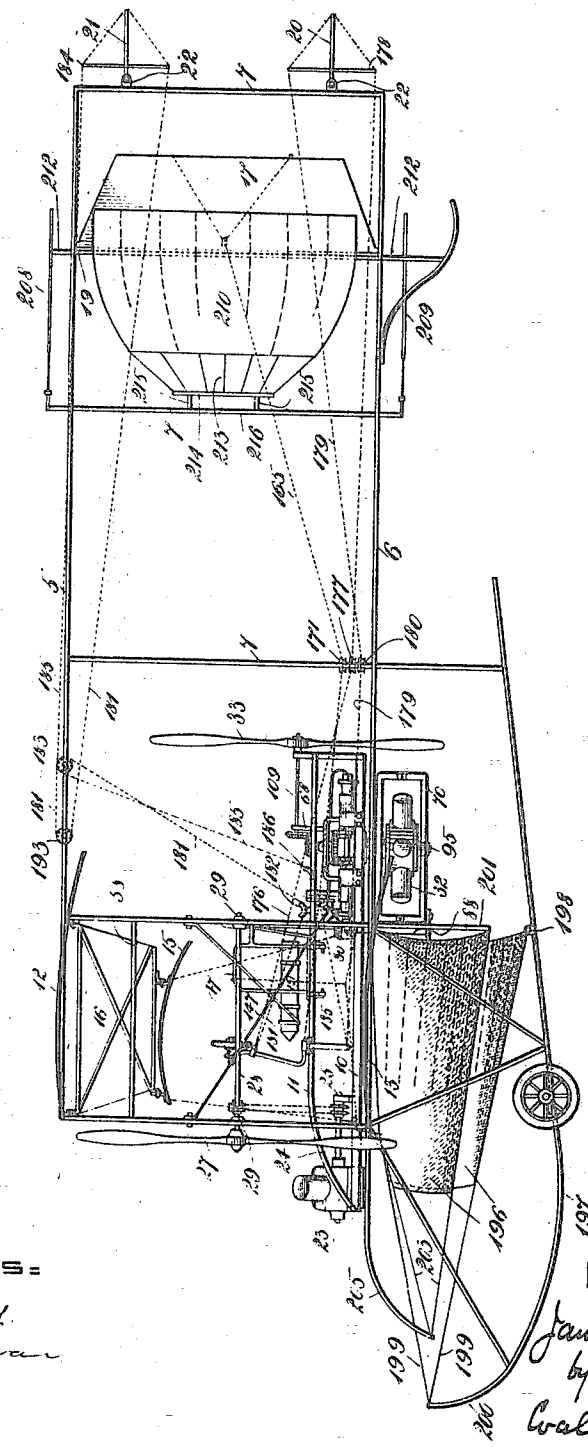


Fig. 2.

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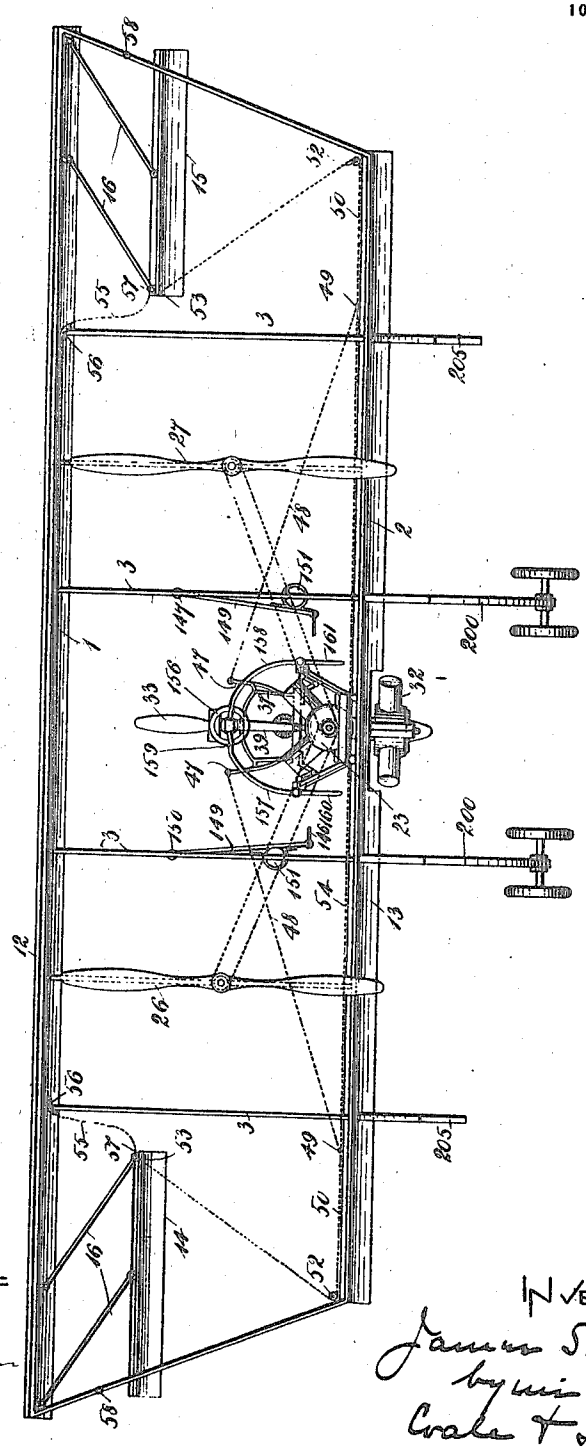


FIG. 3.

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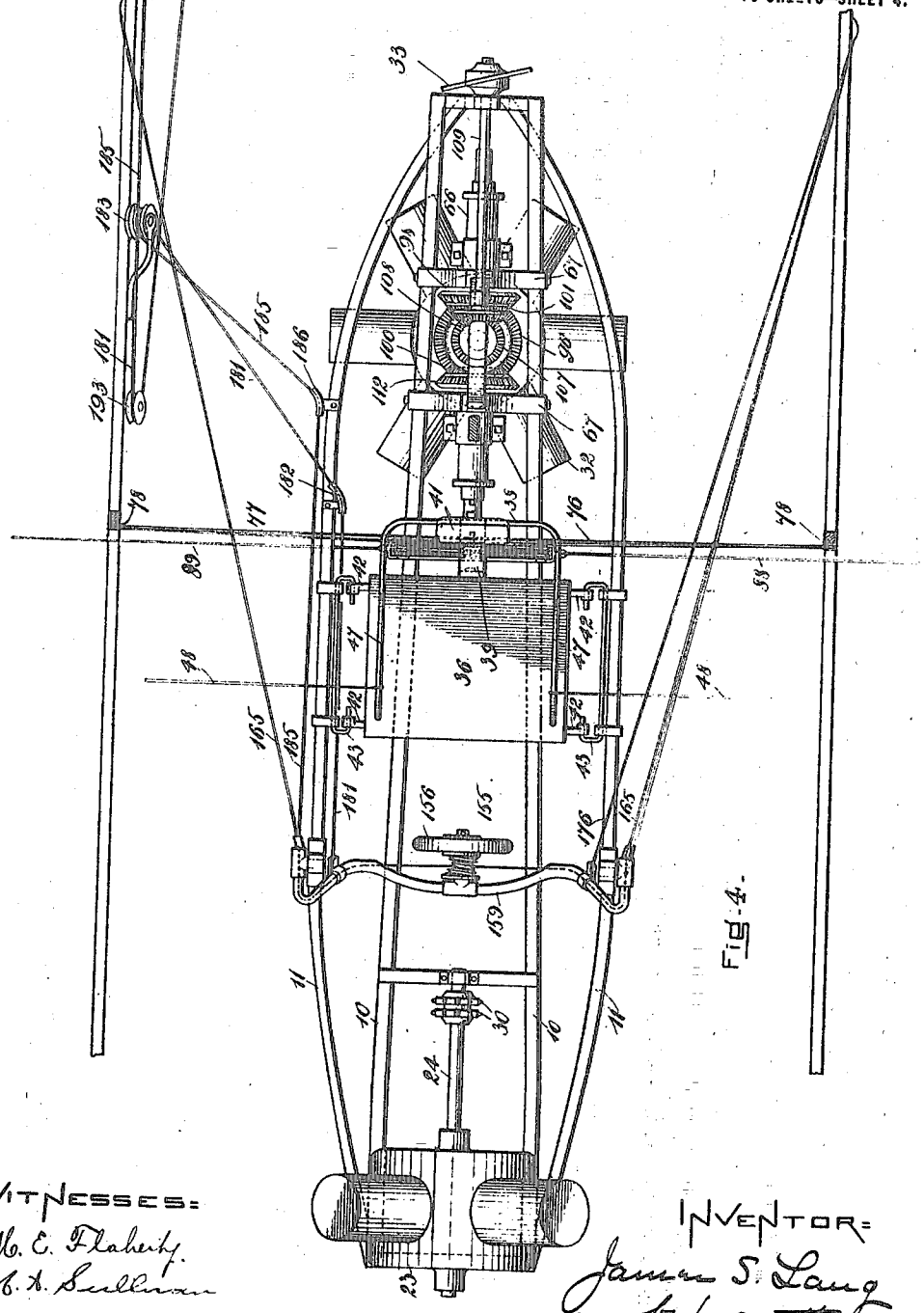


Fig. 4.

WITNESSES:

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10 SHEETS—SHEET 5.

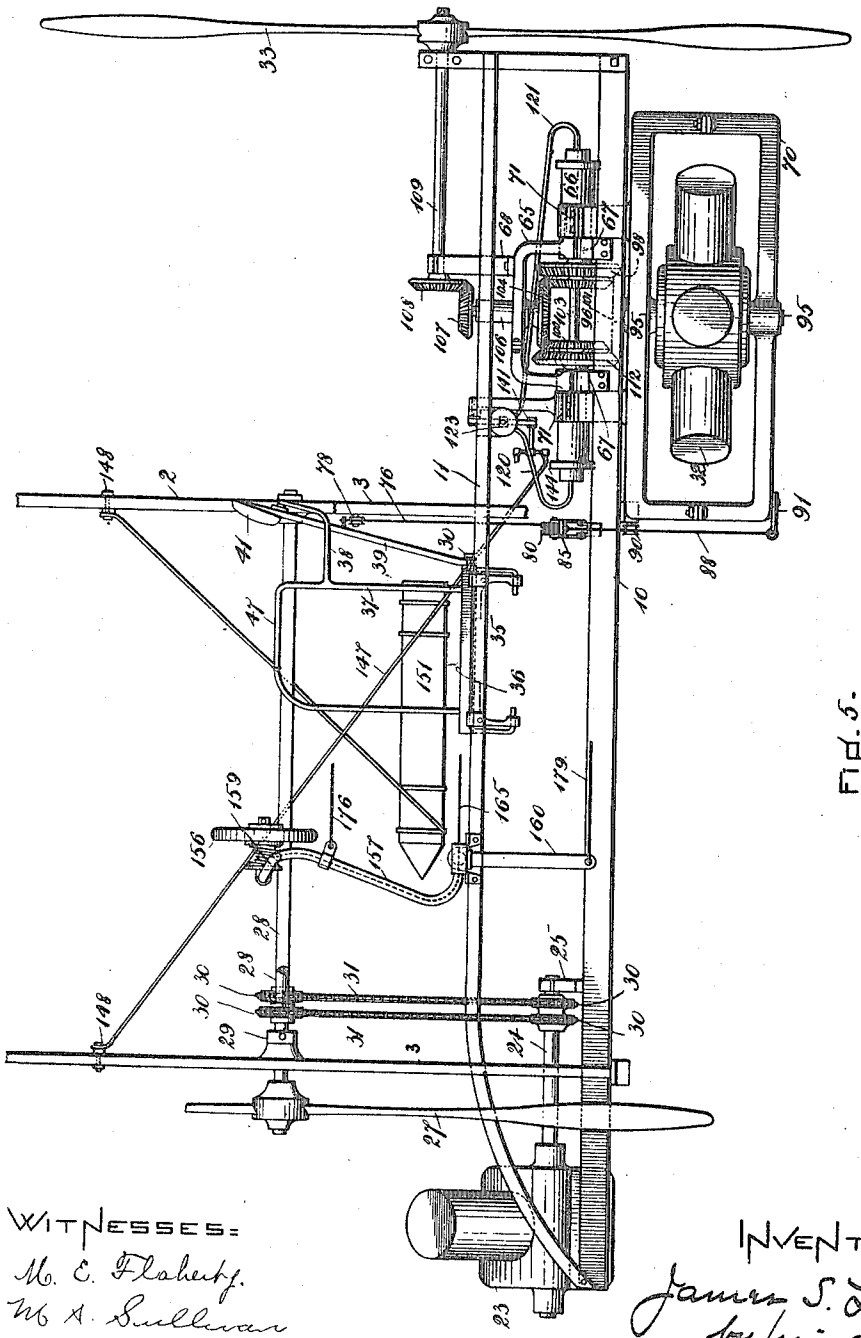


Fig. 5.

WITNESSES:

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10 SHEETS—SHEET 6.

Fig. 6.

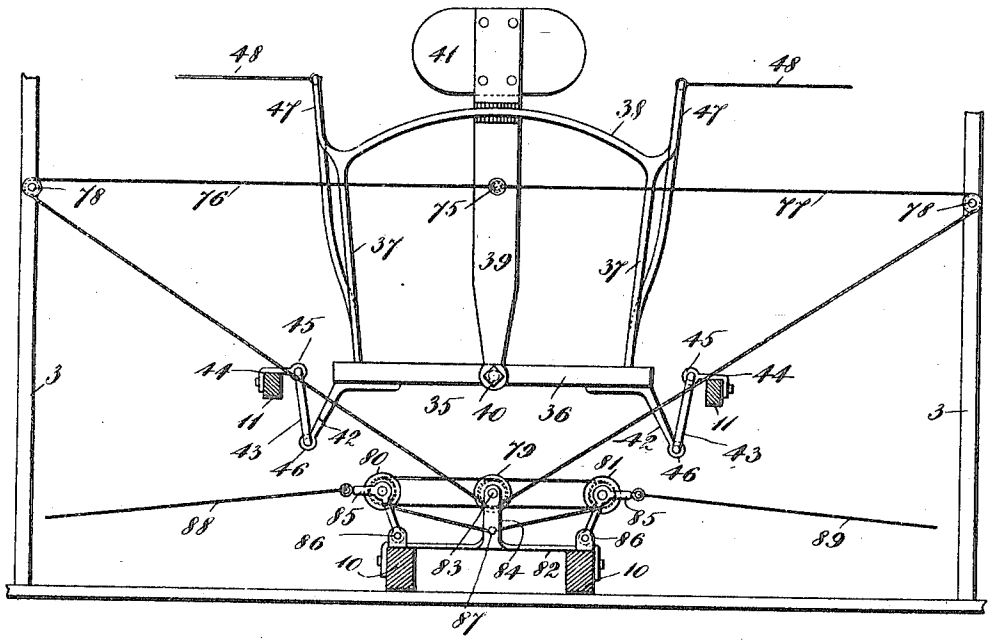


Fig. 7.

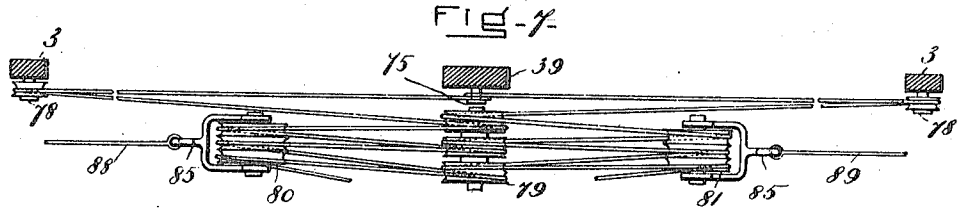


Fig. 8.



WITNESSES:

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10 SHEETS—SHEET 7.

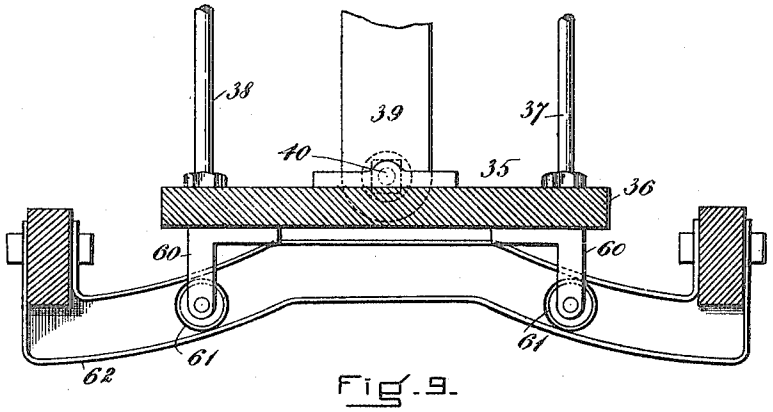


Fig. 9.

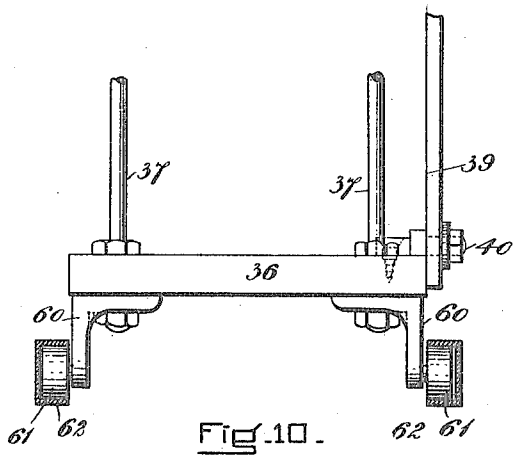


Fig. 10.

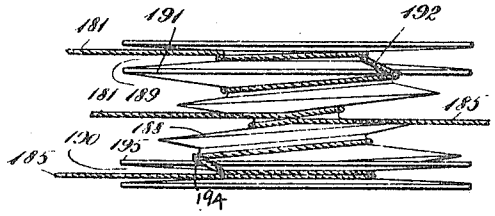


Fig. 11.

WITNESSES:

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10 SHEETS—SHEET 8.

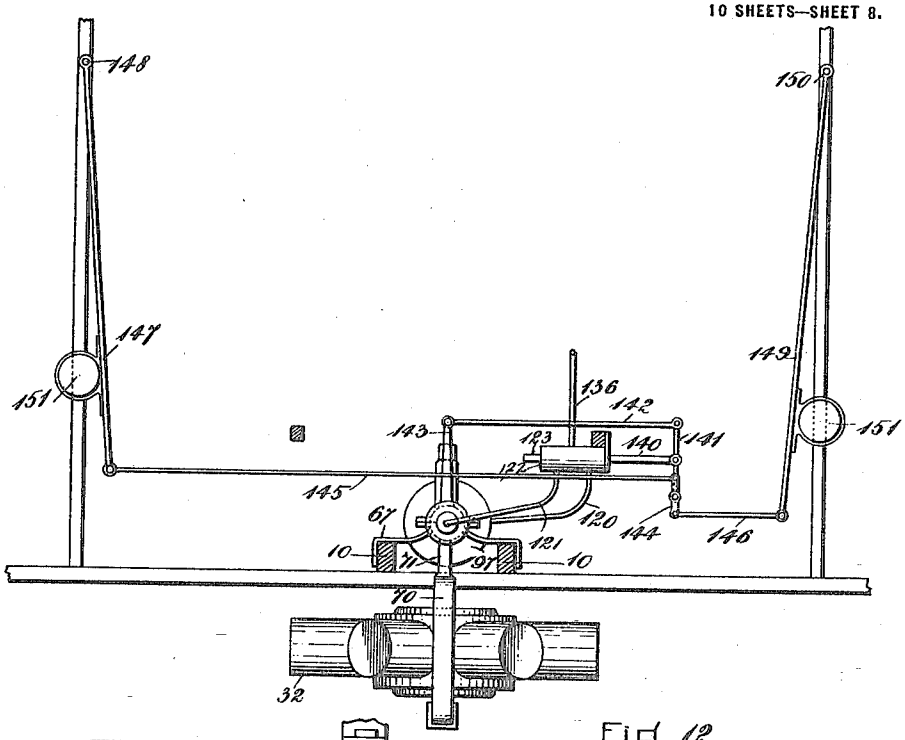


Fig. 12.

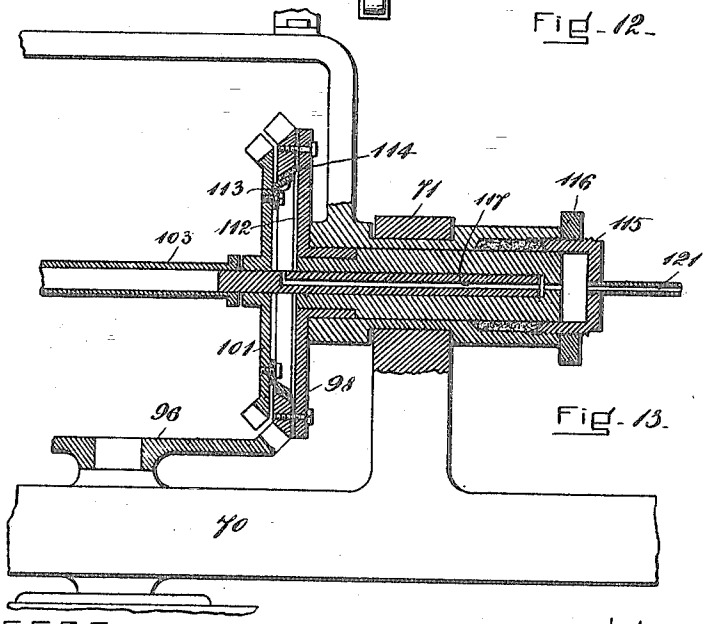


Fig. 13.

WITNESSES:

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10 SHEETS—SHEET 9.

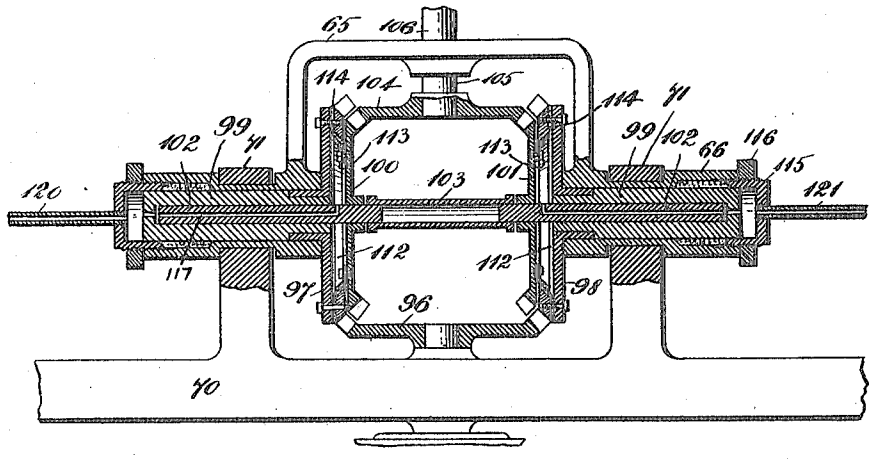


Fig. 14.

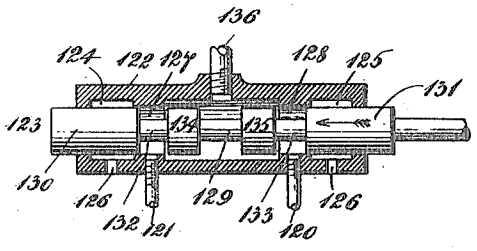


Fig. 15.

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10 SHEETS—SHEET 10.

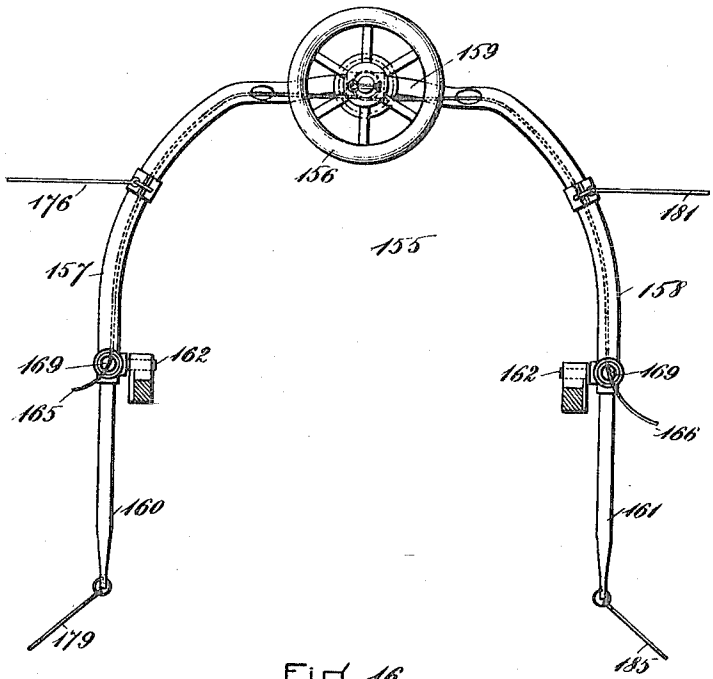


Fig. 16.

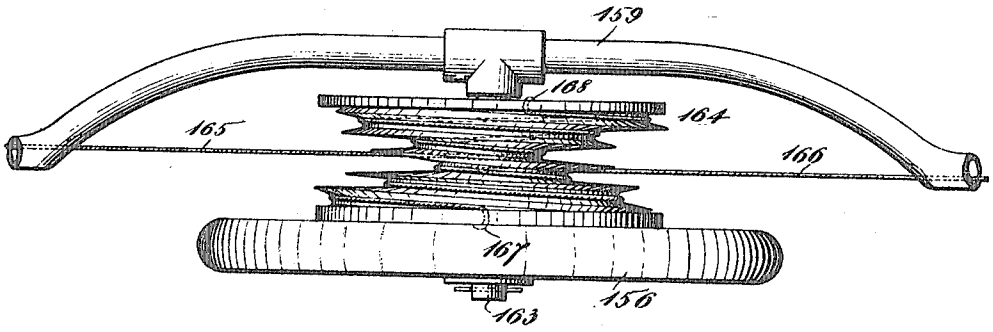


Fig. 17.

WITNESSES:

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M. A. Sullivan

INVENTOR:

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UNITED STATES PATENT OFFICE.

JAMES S. LANG, OF BOSTON, MASSACHUSETTS.

FLYING-MACHINE.

1,216,577. Specification of Letters Patent. Patented Feb. 20, 1917.

Application filed August 23, 1912. Serial No. 716,571.

To all whom it may concern:

Be it known that I, JAMES S. LANG, a citizen of the United States, residing at Boston, in the county of Suffolk and State of Massachusetts, have invented a new and useful Improvement in Flying-Machines, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, forming a part of this specification, in explaining its nature.

The essential object of my invention is to provide improved means for facilitating the control and balance of the machine during flight.

My invention can best be seen and understood by reference to the drawings, in which—

Figure 1 shows the machine in plan.

Fig. 2 shows the same in side elevation.

Fig. 3 shows the same in front elevation.

Fig. 4 shows a plan of a portion thereof in enlarged detail.

Fig. 5 is a side elevation of a portion thereof in enlarged detail.

Fig. 6 is a view in elevation of that portion of the apparatus which will hereinafter be referred to as the operator's seat, together with a portion of the gear for controlling the same.

Fig. 7 is a plan of a portion of the gear shown in Fig. 6.

Fig. 8 is a view partly in plan and partly in cross-section of a portion of the apparatus shown in Fig. 6.

Fig. 9 is a view mainly in elevation of a modified method of supporting the operator's seat.

Fig. 10 is a view in side elevation of the apparatus shown in Fig. 9.

Fig. 11 is a plan of a pulley forming an element of construction as will hereinafter be explained.

Fig. 12 is a view in end elevation of a portion of the apparatus shown in Fig. 5.

Figs. 13 and 14 are sections showing in enlarged detail another portion of the apparatus shown in Fig. 5.

Fig. 15 is a view mainly in cross vertical section of a still further portion of said apparatus.

Fig. 16 is an elevation showing in enlarged detail another portion of the apparatus to which especial reference will hereinafter be made.

Fig. 17 is a plan of a portion of the apparatus shown in Fig. 16.

The frame of the machine consists of two sections or parts, primary and secondary. The primary or main frame supports the body of the machine including the main lifting planes, the lateral balancing planes and other associated parts including a portion of the driving mechanism and controlling gear, while the secondary frame forms the tail portion of the machine and carries the vertical and horizontal steering planes or rudders and other parts as will hereinafter be explained.

The primary frame consists of top and bottom horizontally-extending beams 1 and 2, respectively. Connecting these sets of beams are stanchions 3 and struts 4.

The secondary frame consists of horizontal top beams 5 and bottom beams 6. Each of these sets of beams connect respectively with the top and bottom beams 1 and 2 of the primary frame to extend backwardly therefrom and at substantially right angles thereto. The horizontal beams 5 and 6 are also connected with one another by stanchions 7 and struts 8.

Built into the forward end of the machine and centrally disposed therein is a further auxiliary frame consisting of spaced beams 10 substantially parallelly arranged and with which connect elevated side rails 11. This auxiliary frame is one upon which various of the parts hereinafter mentioned are mounted, for which reason attention is directed to the elements of the frame at this point.

The machine shown embodying my present invention is of the well known biplane type, 12 representing the upper main lifting plane and 13 the lower main lifting plane, both these planes being built on the main or primary frame.

14 and 15 are laterally-controlling or balancing planes. The disposition, arrangement and operation of these balancing planes are substantially as described in my co-pending application for Letters Patent of the United States, filed May 29, 1911, Serial No. 630,115, excepting for certain improvements to which reference will hereinafter be made. Briefly these balancing planes are relatively small planes arranged beneath the upper plane 12 of the major planes, and cooperating therewith for effecting the lateral balance and control of the machine. The planes are arranged to occupy positions the same distance removed from the major plane 12 or be movable toward or away from this plane. They are pivotally supported

by means of hangers 16. These hangers connect at their upper ends with the top beams 1 of the primary frame. To the lower ends of the hangers the respective auxiliary planes are pivotally secured. As will later be explained, these auxiliary planes are controlled both manually or by the body of the operator, and also automatically through a gyroscopic control.

At the rear or tail end of the machine are arranged vertical guiding planes or rudders 17 and 18 respectively which act to laterally control the machine or direct its movement to the right or left. Each of these rudders is arranged to turn about a vertical axis the same being pivoted at their forward edges by hinged connections 19 to the struts 8 of the secondary frame just forward of the extreme rear end thereof. At the extreme rear end of the secondary frame are arranged horizontally-extending planes or rudders 20 and 21 respectively by which the rise and fall of the machine is controlled. Each of these rudders is pivoted to turn about a horizontal axis, the same being pivotally secured at their forward edges by hinged connections 22 to the stanchions 7 at the extreme rear end of the secondary frame.

The machine is driven preferably by means of separate engines by which power may be applied for propelling the machine in case either one should fail. Of these engines 23 represents an engine arranged upon the beams 10 of the auxiliary frame. These beams extend in part forward beyond the front horizontal beam 2 of the primary frame and upon the forward projecting portion of these beams the engine 23 is arranged. The engine operates a driving shaft 24 which projects horizontally backward in the machine and is supported to turn by a box or bearing 25 suitably arranged upon the beams 10 of the auxiliary frame. This engine acts to drive two propellers 26 and 27, respectively. These propellers are arranged at the front of the machine to exercise a drawing action thereon. Each of the propellers is provided with a shaft 28 journaled to turn within bearings 29 fixed in the primary frame. Power is applied for turning the respective propellers from the driving shaft 24 of the engine by means of sprockets 30 arranged upon the respective shafts and connecting chains 31.

The machine is also propelled by means of a gyroscopic engine 32 operating to drive a propeller 33. Both this engine and propeller driven by it are supported by the auxiliary frame, but inasmuch as the engine forms an essential part of the automatic control of the machine the particular manner in which the engine is supported and the manner also in which the power thereof is transmitted for turning the propeller 33 will be reserved until description is made of the particular phase of automatic control to which the engine pertains.

Referring now to the control of the machine, reference will first be made to that control effected by the auxiliary or lateral balancing planes 14 and 15. These planes as explained above, are arranged beneath and coöperate with the major plane 12 for effecting the lateral balance or lateral control of the machine. The normal disposition of these planes is a balanced position or one in which both planes are removed substantially the same distance away from the main plane. From their normal position the auxiliary planes are moved for increasing or diminishing the lifting efficiency of the main plane on opposite sides of the machine, the lifting efficiency of the auxiliary planes also being varied as these planes are moved. The support of the auxiliary planes by the hanger 16 is such that they will swing from their normal positions with both a lateral movement and also a movement of translation toward or away from the working surface of the main plane and this, moreover, without varying the angles of incidence to the atmosphere of the auxiliary planes. The movement given the auxiliary planes is also such that as one plane is moved with a lateral inward movement and combined movement of translation toward the working surface of the main plane, the other auxiliary plane is moved with an outward lateral movement and combined movement of translation away from the main plane. The resultant effect is accordingly obtained that as one of the auxiliary planes approaches the working surface of the main plane the air resistance against the main plane in that part approached by the auxiliary plane on one side of the machine is cut off as the machine is propelled through the air and at the same time the working efficiency of this auxiliary plane will be diminished because of its nearer proximity to the longitudinal center of the machine. On the other side of the machine that auxiliary plane which is being moved farther away from the working surface of the major plane does not diminish in any way the lifting efficiency of the major plane and its own lifting efficiency is increased because it is moved laterally farther away from the longitudinal center of the machine.

I prefer that the minor or auxiliary planes when occupying their normal positions shall have such adjacent proximity to the working surface of the main plane that both auxiliary planes will impair to a slight degree the working efficiency of those portions of the face of the main plane to which they are adjacent on opposite sides of the machine. The advantage of this is that as the one auxiliary plane on one side

of the machine is moved to more nearly approach the working face of the main plane, diminishing the efficiency of such portion of the main plane, the other auxiliary plane moved in a reverse direction away from the working face of the main plane will thereby leave the working face of the main plane to which it is adjacent unimpaired and with full working efficiency. It is also to be observed that whatever the positions of the auxiliary or minor planes may be the lifting efficiency of these planes will remain substantially constant, which is due to the fact that during their movement the angles of incidence of the auxiliary planes to the atmosphere are not changed.

The practical effect of the arrangement above described is that as the machine tends to become unduly unbalanced or elevated upon one side, the minor plane upon that side is moved inwardly into closer proximity to the major plane diminishing the lifting efficiency of the major plane for that side and also the efficiency of that minor plane, at the same time greater efficiency is given to the working surface of the major plane on the other side of the machine by the reverse movement of the other minor plane which is moved outwardly away from the major plane. The working efficiency of this minor plane is also increased. When the machine has been restored to a proper position of equilibrium then the two minor planes are restored to their original or normal positions.

I have arranged whereby the control of the minor planes may be effected either automatically or by hand as occasion may require. The machine often encounters sudden gusts of air tending to unbalance it. It then becomes desirable to provide means whereby the minor planes may be moved automatically to meet and overcome these conditions, after which they may be returned to their normal positions.

The minor planes are controlled as follows: Mounted upon the side rails 11 of the auxiliary frame is the operator's seat 35 (see Figs. 4 and 5). This seat comprises the seat proper 36, arms or sides 37, and a cross back connection or rib 38. The back of the seat otherwise comprises a movable upright or post 39 pivotally secured to the back of the seat 36 at point 40 to extend upwardly therefrom. This post carries a back rest 41 against which the operator may lean. This movable back piece or rest, it will be observed, is arranged in front of the back cross connection or rib 38 whereby it may engage this rib and become fixed thereto as the operator leans back against the rest 41. The engagement between the post 39 and rib 38 assists in effecting the automatic control of the respective minor planes and of this description will later be made, reference first being made however to the manner in which the manual control of the minor planes 14 and 15 may be effected from the seat.

By reference to Fig. 6 it will be seen that the seat is mounted upon and between the side rails 11 of the auxiliary frame by a link connection consisting of links 42 and 43, respectively, and brackets 44. Of these links the links 42 are secured respectively to the under sides of the seat 36 and extend downwardly and outwardly therefrom. The links 43 are pivotally secured to the rails 11 by the brackets 44 fixed thereto, the links 43 pivotally connecting with the brackets 44 at points 45 to extend downwardly therefrom and pivotally connect with the links 42 at points 46. Thus mounted, the seat is capable of having lateral movement in the direction of one side of the machine or the other, and this may be effected by the operator, any suitable brace for his feet being provided for this purpose. Connecting with the sides 37 of the seat, or more accurately, with arms 47 extending upwardly therefrom, are connections 48 which extend from the respective arms and connect respectively with the respective minor planes. The disposition and arrangement of these connections may be seen by reference to Figs. 1 and 3 where it will be observed that the connections extend laterally between the major planes and downwardly in the direction of the under plane 13 to points 49 where the extension is provided with separate branches 50 and 51. These branches are further extended in the direction of the ends of the under major plane and at the outer corners thereof are passed around pulleys 52 and thence upwardly to connect with the respective minor planes at points 53. The respective connections 48 are bound together by a further connection 54 which connects with the respective connections 48 at the points 49, or where the connections 48 meet the branch connections 50 and 51, respectively, as aforesaid.

Assuming that the operator's seat 35 is in its normal position of suspension, the arrangement of these various connections is such that the minor planes will be allowed to assume a position each equidistant from the major planes 12 with which they are cooperating. Such position of the minor planes will be assumed in the operation of the machine, for after the machine has started the force of the air acting against the minor planes will tend to lift the same into their normal positions when all slack in the connections running between the minor planes and the seat will be taken up. I prefer, however, that the minor planes may be maintained in an approximate normal position by means of a connection 55. This connection runs along beneath the major plane 12 and renders over guides 56 suitably secured to the primary frame, and thence

downwardly to connect with minor planes at points 57. This connection, as said above, holds the minor planes in an approximate normal position or one slightly below their desired normal position which is attained by the force of the air as aforesaid during the operation of the machine. When the minor planes have assumed their normal position the connection 55 will become slightly slack in order that it may not interfere with the reverse movement of the minor planes for controlling the balance of the machine.

The minor planes are operated for balancing the machine from the seat. In other words, assuming the machine has tipped laterally in one direction or the other, then that minor plane upon the raised side of the machine is moved in a direction inwardly toward the major plane 12 diminishing the efficiency of the planes on the raised side of the machine. At the same time the other minor plane on the lower or tipped side of the machine is moved outwardly and farther away from the major plane increasing the efficiency of the planes on this side of the machine. The machine accordingly tends to become restored to a normal position. These movements of the respective minor planes are effected by the operator simply moving the seat laterally in one direction or the other. In other words, the operation is effected by moving the seat in a direction reverse to that in which the machine has become tipped and which operation continues until the machine has been restored to a position of equilibrium when both of the minor planes by the return of the seat become restored to their normal positions.

I prefer that the minor planes shall not be moved too far away from the major plane 12 with which they are coöperating and accordingly there are provided stops 58 upon the primary frame which the links 16 of the minor planes are adapted to engage for preventing this.

It is evident that the operator's seat in order to have proper lateral movement for effecting the operation above described may be mounted other than as above described, and in Figs. 9 and 10 there is shown another mode of accomplishing this. Here the seat is provided on the under side thereof with angle pieces 60 bearing wheels or rollers 61 which are arranged to run within channeled bars 62 secured respectively to the side rails 11 of the auxiliary frame. The disposition and arrangement of these bars is, also, such that as the operator moves the seat to overcome the unbalanced position of the machine the seat will tend to maintain at all times as nearly a horizontal position as possible, this being effected simply by inclining the grooves or races in which the wheels 61 of the seat are adapted to run.

The automatic control of the respective minor planes 14 and 15 may, also, be effected by automatically moving the seat in the manner above described. This is accomplished primarily through the influence of the gyroscopic engine 32 and a frame carrying the same which are pivotally mounted and controlled to maintain at all times a normal position of suspension irrespective of the lateral unbalanced position of the machine. This is accomplished in the following manner:

Fixed to the auxiliary frame at the rear end portion thereof is what may be termed a yoke 65 provided with trunnions 66. The arrangement of this yoke is such that its trunnions will extend in alinement with one another and lie within or parallel to the longitudinal axis of the machine. According to the drawings an attempt is made to show these trunnions lying within the longitudinal axis of the machine. The yoke is supported in the body of the machine by mounting the trunnions 66 thereof in crossbars 67 extending between the beams 10 of the auxiliary frame. The yoke is otherwise braced and fixedly held in place in any suitable manner as by a brace bar 68 which connects with the yoke and with the rails 11 of the auxiliary frame.

The engine 32 is arranged to turn in a frame 70 preferably rectangular in form. This frame is pivotally suspended from the trunnions 66 of the yoke by means of hangers 71 pivotally mounted to turn upon the respective trunnions. With this arrangement the engine and frame carrying the same become pivotally suspended and will assume a normal gravitated position. Owing to the pivotal arrangement, however, the yoke and body of the machine to which the yoke is secured may turn on the longitudinal axis of the machine independently of the engine and its frame 70. In other words, with the engine and frame carrying it occupying their normal gravitated positions the body of the machine carrying the respective auxiliary lateral controlling planes 14 and 15 may turn on the longitudinal axis of the machine relatively to the engine and its frame by the trunnions 66 of the yoke turning in the hangers 71 supporting the engine frame; or the engine and frame may turn independently of the yoke and body of the machine by the hangers 71 turning on the respective trunnions. It is the tendency of the engine, however, by reason of its being a gyroscopic engine, to maintain its normal gravitated position and it will tend to hold its frame in such position irrespective of the laterally-turned position of the machine.

The engine 32 and frame carrying the same thus becomes a part tending to maintain a constant position as other parts or

body of the machine become laterally changed or unbalanced with relation thereto. The changed relationship or position of the parts accordingly becomes a means by which force may be applied for stabilizing the machine as is well known to those skilled in the art. In the present instance this is accomplished through movement automatically applied to the operator's seat for laterally moving the same in one direction or the other and controlling the minor balancing planes 14, 15, therethrough in the manner above described. As was before explained, also, the post 39 pivotally secured to the back of the seat 36 is adapted to be moved, by the operator resting against the same, backwardly against the back connection or rib 38 of the seat. Where this engagement takes place both the post and cross rib are made serrated or toothed (see Fig. 8) so that as long as the post is held in contact with the rib the parts will become joined to move laterally in unison and any force applied to the post for laterally moving the same will impart a like lateral movement to the operator's seat.

Connecting with the post 39 on the rear side thereof at the point 75 are connections 76, 77, respectively (see Fig. 6). These connections extend laterally from the post and pass around pulleys 78, respectively, secured to the stanchions 3 of the primary frame. From the pulleys 78 the respective connections, 76 and 77, are passed downwardly and inwardly around a series of sets of pulleys 79, 80 and 81, respectively. The respective sets of pulleys are mounted upon a plate 82 extending crosswise between the beams 10 of the auxiliary frame and affixed thereto. Of these sets of pulleys the set 79 is arranged between the sets of pulleys 80 and 81 and is mounted to turn upon a spindle 83 secured to a stationary bracket 84 fixed to the plate 82. The respective sets of pulleys 80 and 81, however, are mounted to turn in carriers 85 pivotally secured at points 86 to the plate 82 at opposite ends thereof and in a manner whereby either set of pulleys 80, 81 may move toward or away from the set of pulleys 79.

It will be observed that each set of pulleys is compounded or made up of three simple pulleys independently rotated. The separate pulleys of the set 79, however, are each provided with duplicate grooves in order that separate cords passed around each of these pulleys in its respective grooves may render onto and off the same in opposite directions as the pulley is turned. The connections 76 and 77 are passed around the respective sets of pulleys, first passing around one of the pulleys of the set 79 and then around one of the pulleys of each of the sets 80 and 81, respectively, thence returning to pass around another one of the pulleys of the set 79, thence around another one of the pulleys of each of the other sets of pulleys and so on until the connections have been passed around the pulleys of all the sets in proper sequence when the ends of the cords are brought in and secured to the fixture or bracket 84 at the point 87.

Connecting with the carriers 85 bearing the respective sets of pulleys 80 and 81 are connections 88 and 89, respectively, which extend laterally in opposite directions around pulleys 90 arranged at the bottom of the primary frame in any suitable manner and preferably some considerable distance removed from the longitudinal center of the machine and equidistant therefrom. After rendering around these pulleys the respective connections 88 and 89 are passed downwardly and inwardly to connect with an arm 91 fixed to project from the bottom end of the frame 70 carrying the gyroscopic engine 32.

The operation of these connections is as follows:

As the machine becomes unbalanced to turn laterally to one side or the other draft will be exerted upon one or the other of the connections 88 or 89 depending upon the direction of displacement, with the effect that one or the other of the sets of pulleys 80 or 81 will be drawn away from the set of pulleys 79 and the tackle running between the same lengthened with the effect of drawing in the end of one or the other of the connections 76 or 77 connecting with the operator's seat, and moving the same laterally in one direction or the other, thereby automatically controlling the minor lateral balancing planes as before described. In other words, assuming that the machine has become laterally unbalanced or tipped to the right, the gyroscopic engine and frame carrying the same maintaining their normal position, thereupon draft will be exerted upon the connection 88. The set of pulleys 80 will then be drawn laterally away from the pulleys 79 lengthening the tackle or that portion of the connection 76 running between these pulleys. This has the effect of drawing in the end of the connection 76 connecting with the operator's seat or rather with the post 39 in engagement therewith as aforesaid, when the operator's seat will be moved laterally toward the left or in a direction reverse to that of its displacement. At the same time as the seat thus becomes laterally moved draft will be exerted upon the connection 77 which tends to draw in the set of pulleys 81 toward the set of pulleys 79 by shortening the tackle running between these pulleys. This has the effect of taking up the slack which develops in the connection 89 by reason of the displacement of the machine. As the machine becomes restored to its normal balance or po-

sition of equilibrium draft will be restored upon the connection 89, thereby tending to exert a pull upon the connection 77 drawing back the operator's seat to its normal position which has the effect of exerting draft upon the connection 76, thereby restoring the set of pulleys 80 to their normal position with respect to the set of pulleys 79 when all of the parts will have assumed their original positions.

If the machine becomes tipped or unbalanced to the left precisely a reverse action takes place, a pull first being effected in the connection 89 which tends through the connection 77 to draw the seat toward the right and through the connection 76 to take up slack in the connection 88 and as the machine becomes restored to its normal position draft upon the connection 88 will, through the connection 76, tend to restore the seat to its original and normal position and likewise other connecting parts.

It will be further observed with respect to the connections above described that the compounding of the pulleys acts to control the seat to have movement commensurate with the displaced position of the machine, the arrangement being capable of considerable variation in disposition, length of tackle, number of pulleys and other respects whereby just the proper movement of the seat and adjustment of the minor planes may be obtained as occasion may require.

One difficulty with the employment of a gyroscopic engine for the purposes of automatic control resides in the fact that the engine may become displaced from its normal position of operation which tends to so disarrange the entire automatic control that it no longer is capable of operating properly. According to the construction shown, however, the engine 32 is retained in its normal position of operation or restored thereto in the event of its displacement from such position automatically and through the force or forces developed by it, and this moreover through the principles of operation described in my co-pending application for Letters Patent of the United States, filed November 16, 1909, Serial No. 528,318. In the present case, however, the construction is somewhat modified and simplified. It will be observed that the engine connects with the propeller 33 through a transmission consisting in part of a series of gears a portion of which, as will be explained, have clutch-forming engagement with one another. In Fig. 5 it will be seen that the engine shaft 94 turns within bearings 95 formed in the respective upper and lower bars of the engine frame. This shaft extends upwardly beyond the upper frame bar of the engine frame and bears upon its end a beveled gear 96. This gear meshes with beveled gears 97 and 98, respectively, carried by the yoke 65 and arranged to engage the gear 96 on opposite sides thereof that it may become turned thereby in reverse directions. The gears 97 and 98 are each arranged within the yoke upon the end of a shaft 99 (see Fig. 14). These respective shafts are journaled to turn within the respective trunnions 66 of the yoke which are made hollow and form bearings therefor.

Arranged concentric with the gears 97 and 98 adjacent the inner faces thereof and parallel therewith are other gears 100 and 101, respectively. These gears are fixed to shafts 102, socketed to turn within the shafts 99 of the gears 97 and 98, respectively, and have also slight longitudinal movement therein by which the gears 100 and 101 may move toward and away from the gears 97, 98, to which they are adjacent. For the purpose of holding the gears 100 and 101 in place and to prevent undue displacement thereof away from the gears 97, 98, they are separated and held by a hollow space bar 103 which fits over the inner projecting ends of the shafts 102 and against the ends of which bar the gears are adapted to bear. (See Figs. 13 and 14.)

Interposed between and meshing with the gears 100 and 101 is a beveled gear 104. This gear is arranged upon a shaft 105 that extends upwardly through the head of the yoke 65 and is journaled to turn therein and in a bearing or sleeve 106 affixed to the yoke. The shaft 105 carries upon its end a beveled gear 107 which meshes with a beveled gear 108 arranged upon a shaft 109 bearing the propeller 33. This shaft is supported by the brace 68 which assists in the support of the yoke and is otherwise supported from the auxiliary frame in any suitable manner as by a brace 110 forming a part of the auxiliary frame.

It is through the gears above referred to that the force generated by the engine is transmitted for turning the propeller 33, engagement between the gears 97, 100 and 98, 101 being effected in the following manner:

The gears comprising each of these respective sets of gears are arranged so far separated from one another as to leave a chamber 112 between the same. This chamber is closed by means of annular clutch-forming members 113, 114, respectively, secured to the respective gears and coöperating with one another in a manner whereby they may form a clutch engagement connecting the respective gears to rotate in unison upon separating the gears.

Each of the respective sets of gears are separated from one another to form a clutch engagement between the same by the admission of compressed air to the chamber 112 between them. It will be observed by reference to Fig. 13 that the end of each of the

hollow trunnions is closed by a packed gland or plug 115 having threaded engagement therewith and held in place by a locking nut 116. Compressed air is introduced through the plugs 115 into the hollow or chamber of the plugs adjacent the outer ends of the shafts 99 of the respective gears 97 and 98. From thence the passages are continued through the ends of these shafts and through the shafts 102 of the gears 100 and 101, respectively, by passages 117 which connect with the respective chambers 112. When compressed air is thus admitted to the chambers 112 between the respective sets of gears the gears 100 and 101 are forced inwardly, the shafts of these gears having as above described a slight longitudinal movement in their respective bearings.

When compressed air is admitted into the chambers 112 between both sets of gears it is evident that a clutch-forming engagement will be effected between these sets and the force generated by the engine will be transmitted to the propeller shaft through all of the gears. If, however, air be admitted between but one of said respective sets of gears then a clutch-forming engagement will be effected only between that set of gears, the other set of gears being out of clutch-forming engagement with one another and accordingly will no longer assist in transmitting the force generated by the engine. This according to the principles described in my said application is of essential importance inasmuch as the position of the gyroscopic engine and frame carrying the same will depend upon whether the force generated by the engine is being transmitted through both sets of clutch-forming gears or only one set.

This may be understood from the fact that the respective sets of gears 97, 100 and 98, 101 are being turned in reverse directions by the gear 96 arranged upon the engine shaft. They will accordingly set up or create forces against the gear 96 tending to move this gear, the frame 70 and engine carried by it in a direction reverse to that in which the sets of gears are turning. These forces, however, being in reverse and opposite directions neutralize one another when both sets of gears are transmitting the force generated by the engine and accordingly have no effect upon the gear 96, through the engine shaft, to change the normal suspended position of the engine and frame carrying it. When, however, the force generated by the engine is transmitted through one only of the respective sets of gears, the reactive influence thereof being no longer neutralized, the tendency will be for such reactive force or influence upon the gear 96, through the engine shaft, to turn the gyroscope and frame carrying the same in a direction reverse to that in which the gears are turning, or, in other words, around the trunnions by which they are supported, which effect continues so long as the one set of gears is transmitting the entire force generated by the engine. Such controlling influence is accordingly availed of for the purpose of holding the gyroscope and frame carrying the same in its normal position of suspension or restoring the same thereto in case of displacement from such position, and this is effected automatically in the following manner:

The air under compression is admitted through the ends of the trunnions to the chambers 112 formed between the respective clutch-forming gears by means of pipes 120, 121, respectively, the pipe 120 connecting with the air compression chamber located between the gears 97, 100 and the pipe 121 with the compression chamber between the gears 98, 101. Both the pipes 120, 121, connect with a valve casing 122 affixed to one of the rails 11 of the auxiliary frame and having preferably a disposition crosswise the machine. This casing contains a sliding valve 123 which acts to control the air under compression admitted to the pipes 120, 121, which connect with the respective compression chambers as aforesaid. The valve casing 122 is an elongated casing, the ends thereof being designed to provide exhaust chambers 124, 125, respectively, which connect with the atmosphere through openings 126 leading through the wall of the casing. Extending inwardly from the chambers 124, 125, the casing is formed to provide ports 127, 128, respectively, while between these ports the casing is enlarged to form a central air-receiving chamber 129.

The valve 123 consists of the respective head or end portions 130, 131, respectively, contracted portions 132, 133, and interior portions 134, 135, respectively. The head or end portions 130, 131, of the valve are arranged to slide into and out of the ports 127, 128 and control these ports from the exhaust chambers 124, 125 in communication with the atmosphere as aforesaid. The interior portions 134, 135, of the valve are arranged to slide, respectively, into and out of the ports 127, 128, and control these ports with respect to the central chamber 129 of the valve casing. Air under compression is admitted to the chamber 129 through an inlet pipe 136 from any suitable source of supply.

The pipes 120, 121, which connect with the respective compression chambers as aforesaid connect also with the valve casing at the points of the respective ports therein, the pipe 120 connecting with the valve casing at the point of the port 128 and the pipe 121 connecting with the valve casing at the point of the port 127.

The length of the valve is such that when

it is in a balanced central position as shown in Fig. 15 both of the heads 124, 125, of the valve will lie within the outer ends of the ports 127, 128, closing these ports from the respective exhaust chambers 124, 125, and from the atmosphere. The interior portions 134, 135, of the valve will then be in a position where they will lie just adjacent the inner ends of the ports 127, 128, but in a position whereby air admitted to the chamber 129 will enter the respective ports and thence be admitted to both pipes 120, 121, and accordingly pass to both of the compression chambers 112.

When, however, the relative position of the valve becomes changed within the casing as by moving the valve in the direction of the arrow indicated on it, or in a reverse direction, either one or the other of the portions 134, 135, of the valve will be moved into the port to which it is adjacent, closing the port from the chamber 129 and consequently preventing the passage of compressed air from one to the other of the pipes 120, 121, and compression chamber 112 with which these pipes connect. For example, if the valve be moved in the direction of the arrow indicated thereon the portion 134 of the valve will be moved to close the port 127 and shut off the admission of air to the pipe 121 which connects with the compression chamber 112 between the set of gears 97, 100, when the force of the engine will no longer be transmitted through this set of gears. On the other hand, if the valve be moved in a direction reverse to that of the arrow indicated upon it the portion 135 of the valve will be moved to close the port 128 and shut off the admission of air to the pipe 120 and compression chamber 112 between the gears 98, 101 when the force developed by the engine will no longer be transmitted through this set of gears.

The valve 123 is controlled as follows: Extending from the valve is a stem 140. This stem connects with a link 141. To the upper end of this link there pivotally connects a link 142 which pivotally connects in turn with an arm 143 that extends upwardly from one of the hangers 71, bearing the engine frame 70 and which is fixed thereto to turn therewith. To the other end of the link 141 there is pivotally secured a link 144. Pivotally connecting with the ends of this link are rods 145 and 146, respectively. The rod 145 pivotally connects with the lower end of a suspended frame 147 that is pivotally secured at points 148 to stanchions 3 of the main frame to hang suspended therefrom and between the same on one side of the machine adjacent to the operator's seat. The rod 146 pivotally connects with the lower end of a suspended frame 149 pivotally secured at points 150 to stanchions of the main frame and which hangs suspended therefrom and between the stanchions on the other side of the machine adjacent to the operator's seat.

Both frames 147 and 149 are freely suspended to turn upon axes parallel with the longitudinal axis of the machine and to occupy normal suspended positions irrespective of the laterally turned positions of the machine. For assisting in giving a normal stability to the respective frames by the addition of weight thereto, each of the frames carries a fuel supply tank 151. It is also to be observed that the frames are of unequal lengths and that the tanks carried by them occupy different suspended positions. Accordingly any tendency upon the part of the frames to a pendulous movement owing to the motion of the machine will be broken up and reduced to a minimum. The frames 147 and 149 by reason of their maintaining a normal gravitated position as aforesaid will through the rods 145, 146 and link 144 operate to hold the lower end of the link 141 which connects with the valve stem in a constant position irrespective of the turned position of the frame. In this they cooperate with the gyroscopic engine itself and frame carrying the same which connects with the valve stem through the arm 143 and links 142, 141, as aforesaid. Just as long as the engine and frame carrying the same occupy their proper normal gravitated positions or positions of suspension the valve 123 will be held in a normal balanced position within the valve casing and compressed air will be admitted through both of the pipes 120, 121, to both of the compression chambers 112 between the respective gears 97, 100, 98, 101. The force of the engine will then be transmitted through both these sets of gears and, accordingly, has for reasons above explained, no effect to disturb the position of the engine and frame. When, however, the engine and frame carrying the same become displaced from their normal positions and the engine continues to rotate in such displaced position thereupon the engine will, through the engine frame and linkage above described, operate to move the valve stem in the valve casing and cut off the supply of air from either one or the other of the pipes 120 or 121. The force of the engine will then be transmitted through one or the other of the sets of gears 97, 100, 98, 101, or that set the reactive influence of which will operate to return the engine to its normal position of suspension when all the parts will resume their original or normal positions with the valve 123 occupying a balanced position within its casing.

Reference will now be made to the manner in which the rudders 17 and 18, 20 and 21 are controlled or those by which the machine may be turned horizontally to the

right or left or vertically up and down. Both these sets of rudders are manually controlled by a lever 155 and wheel 156 carried by it which are arranged just in front of the operator's seat. The lever 155 comprises a hollow tubular member or pipe bent into the form of an arch to form side portions 157, 158 and connecting head portion 159, and provided with separate downwardly extending portions or ends 160, 161. The lever is mounted to turn on the rails 11 of the auxiliary frame, pivotal connection being made between the lever and the rails of the frame at the points 162 with the hollow portions 157, 158, of the lever extending above the points of fulcrumage and the portions or ends 160, 161, of the lever below the same whereby said respective portions will move in reverse directions longitudinally of the machine as the lever is turned about its axis. The wheel 156 carried by the lever is mounted upon a shaft 163 secured centrally to the head portion 159 of the lever, the arrangement of the parts being such that the wheel will turn upon a horizontal axis and be easily accessible to the operator.

Secured to the wheel and concentric therewith is a pulley 164. It will be observed by reference to Fig. 17 that that portion 159 of the head of the lever to which the wheel is secured is curved in a manner whereby the pulley 164 will lie within the hollow of the bend formed therein or so that the side portions 157, 158 of the lever on opposite sides of the pulley and adjacent thereto will lie substantially in line with the grooves formed in the pulley. The pulley 164 possesses certain peculiar characteristics in that it is provided with a spiral groove, those portions of the pulley also in which the groove is formed rapidly diminishing in diameter from its opposite sides toward the center. Wrapped around the pulley are connections 165 and 166, respectively. These connections are secured to the opposite sides of the pulley at the respective points 167 and 168, from whence the connections pass around the pulley in the groove thereof to its center and thence pass laterally in opposite directions to enter the hollow of the respective portions 157, 158, of the lever and pass through the same to emerge therefrom at the points 169 just adjacent to the points 162 where the lever turns. Thence the respective connections pass backwardly through the tail portion of the machine, first extending downwardly and around pulleys or guides 171 (see Figs. 1 and 2) secured to the stanchions of the secondary frame and then upwardly to connect with the ends of arms 172 projecting at right angles from the outer sides of the respective rudders 17 and 18 by which they may be turned, and thence forward by branch connections to connect with the rear edges of these rudders. The rudders 17 and 18 are coupled by means of a connection 173 (see Fig. 1) by which the rudders when turned will turn in unison. They are operated simply by turning the wheel 156, the rudders being turned in one direction or the other, depending as the wheel is turned to the right or left. During the turning of the wheel the connections will be kept taut and the rudders with which they connect held to maintain the same relative positions, for, as pull is exerted by the wheel upon one of the connections 165, 166, the slack developed in the other connection will be immediately taken up and in a commensurate amount by the pulley. It is also to be observed that owing to the difference in diametrical size of the pulley the connections and rudders controlled by them will be moved very slowly at first but with gradually increasing rapidity as the wheel becomes further turned.

The rudders 20 and 21 are controlled by means of the lever 155 and this by pivotally turning the same backward or forward. The motion of the lever is transmitted to the respective rudders 20 and 21 in the following manner:

Connecting with the arm 157 of the lever is a connection 176 which extends downwardly and backwardly through the tail portion of the machine and over a pulley or guide 177 and thence backwardly to engage the lower end of a bar 178 which extends crosswise through the rudder 20 at right angles thereto by which the rudder may be turned, and thence backward by branch connections to connect with the rear edge of said rudder. Connecting with the arm 160 of the lever is a connection 179 which extends backwardly through the tail portion of the machine and over a pulley or guide 180 fixed to one of the stanchions of the secondary frame, thence backwardly and upwardly to connect with the upper end of the bar 178 fixed to the rudder 20 as aforesaid, and thence by branch connections to connect with the rear edge of this rudder. Through these connections 176 and 179 the rudder 20 can be moved or turned upon its axis of support in one direction or the other simply by moving the lever in reverse directions. Arrangement is made whereby the rudder 21 will be moved simultaneously with the rudder 20 but will have a different rate of movement, this rudder moving more slowly than the rudder 20 during the initial movement of the lever but gradually increasing in movement until such time as the lever has been moved to the limit of its swing when the rudder 21 will have been moved to an angular position, the same as that attained by the rudder 20. This is effected as follows:

Connecting with the arm 158 of the lever is a connection 181 which extends backwardly and downwardly around a pulley or guide 182 fixed to one of the side rails 11 of the auxiliary frame, thence upwardly and around a pulley 183 fixed to one of the upper beams 6 of the secondary frame, thence forward and around a pulley 193 fixed to the same beam and thence backwardly to connect below the rudder 21 with the end of a bar 184 that extends crosswise through the rudder at right angles thereto by which the rudder may be turned. From the end of this bar the connection further extends by branch connections to connect with the rear edge of the rudder. Connecting with the arm 161 of the lever is a connection185 that extends backwardly and upwardly over a pulley or guide 186 secured to one of the rails 11 of the auxiliary frame, thence upwardly and around the pulley 183 and thence backwardly to connect with the upper end of the bar 184 at a point above the rudder 21, thence extending by branch connections to the rear end of the rudder.

It is apparent that as the lever 155 is moved backward or forward that the motion thereof will be transmitted through the connections 181 and 185 to the rudder and give it the same movement as that imparted to the rudder 20 excepting however that the rudder 21 will have a different rate of movement as aforesaid and this by reason of the passing of the said connections 182, 185 around the pulley 183. This pulley is very much like the pulley 164 secured to the wheel 156, inasmuch as the diameter of the pulley rapidly diminishes from the sides thereof to the center. (See Fig. 11.) Running around this portion of the pulley is a spiral groove 188. The pulley is also provided adjacent the sides thereof with grooves 189, 190, respectively. The connection 181 is first wrapped or wound around the pulley by several turns of the groove 189, the wrappings first being made in a direction counter to the movement of the hands of a clock, and thence continued through that portion 191 of the pulley forming the inner side of the groove 189 therein by an opening 192 therein, the connection thence entering the spiral groove 188 and the wrapping continued in the same direction to about the center of the pulley, where the connection then leaves the same to pass forward and around the pulley 193, thence backward to connect with the bar 184 as aforesaid. The connection 185 is first passed around the pulley in the annular groove 190 with several windings in a direction just reverse to that of the windings of the connection 181 in the groove 189, thence passing through an opening 194 formed in the portion 195 of the pulley which forms the inner side of the groove 190 into the spiral groove 188 in a direction reverse to the connection 182 to about the center of the pulley where it leaves the same to connect with the upper end of the bar 184 as aforesaid. In the operation of this pulley 183, owing to its size, form, and the disposition and arrangement of its grooves including the manner in which the connections 182 and 185 connect therewith, it is obvious that as the lever is turned the said connections will render onto and off the pulley in opposite directions for operating the rudder 21. Owing to the fact that these connections are rendering onto and off the pulley at about the center thereof, or at a point where it is of the least diameter when the lever is initially moved, the rudder will accordingly have a relatively slow rate of movement at such a time. As the lever, however, becomes further turned and owing to the fact that the connections will gradually render onto and off those portions of the pulley having an increasing diameter, the rudder will accordingly have a gradually increasing rate of movement and such rate that when the lever has been moved to the limit of its stroke, then the rudder 21 will have attained an angular position substantially the same as that to which the rudder 20 has been moved.

For assisting in otherwise stabilizing and supporting the machine it is provided with a system of stabilizing devices or keels. These keels are essential for the purpose of imparting stability to the machine at the times when it is subjected to abnormal influences tending to disturb its equilibrium, as, for example, sudden gusts of wind or other atmospheric conditions tending to overbalance the machine or disturb the proper position of the machine in the air, thereby tending to overturn the machine or change or otherwise improperly direct its course. These keels may be divided into several systems or sets, of which one set is provided at the forward end of the machine and arranged below its center of gravity for the purpose of resisting any atmospheric influence tending to overturn the machine by pressure applied to the main or other planes lying above the center of gravity of the machine. Other sets of planes are provided at the rear or the tail portion of the machine of which one set tends normally to assist in maintaining the tail in a proper upright position and prevent any tendency thereof to sag unduly or become unduly raised, which in the one instance might cause the machine to fall, and in the other instance tend to overturn the machine. The other set of keels acts normally to hold the tail of the machine in proper lateral relation to the head thereof in the air and also act to prevent the head swinging around the tail of the machine in case the machine becomes subjected to lateral disturbing influences

which would tend to change the course of the machine, these rudders, in other words, tending to maintain the tail in proper lateral relation to the head at all times and accordingly the entire machine upon its proper course as far as lateral direction is concerned. These keels are made of webbing such as canvas or other suitable flexible material and I have provided means whereby the keels may operate to perform their proper functions, though of relatively small size.

Referring first to the set of keels first mentioned, or those keels which lie below the center of gravity of the machine at the forward end thereof and tend to prevent the overturning of the machine. 196 represents these keels. It will be observed that they are arranged at the forward end of the body of the machine below the main lifting planes. They are vertically disposed or lie in vertical planes parallel or substantially parallel to the longitudinal line of the machine. They are supported in the following manner: Two of the keels are secured at the rear edges to the under side of the main frame and also to the skids 197 of the landing gear at points 198. From the forward edges of the keels so secured there extend connections 199 by which the keels are held taut and these connections are secured to the forward upturned ends 200 of the respective skids. These ends 200 of the skids are made flexible, or, in other words, so that they will bend upon the application of lateral pressure to the sides of the keels. Others of the keels or those of the keels lying outside the line of the skids are secured at their rear edges to the under side of the main plane and also to stanchions 3 thereof which are extended downwardly to support these keels. 201 representing such extensions. At their forward edges the keels thus secured are provided with connections 203 by which the keels may be held taut and which extend forward to connect with the end of downwardly curved bars 205 which extend forward from the front beam to the main frame. These bars are made flexible in order that the bars may bend upon the application of lateral pressure to the keels supported by them. The operation of these keels is as follows:

Under ordinary normal conditions the keels will remain passive. Upon the application, however, of any influence against the main planes lying above the center of gravity of the machine as by a gust of air tending to overturn the machine, these keels lying below the center of gravity of the machine will be subjected to the same influence thereby tending to counteract the overbalancing tendency of said influence. The counteracting action of the keels is materially increased, however, by the manner in which they are retained for as the gust of air becomes laterally applied thereto it will tend by reason of the yielding retention of the keels to arch the same or develop camber therein, thereby converting the keels into working planes when the headon resistance of the air during the propulsion of the machine acting against the same will operate to augment the lateral disturbing influence tending to curve the keels and thereby exert an exceedingly strong counteracting influence against that tending to overturn the machine.

Referring to the keels at the rear or tail end portion of the machine these keels comprise two sets 208, 209, and 210, 211, respectively. The keels 208, 209 are horizontally arranged one adjacent to the top of the machine and one adjacent to the bottom thereof at the rear end of the tail portion thereof. The keels 210, 211 are vertical keels arranged respectively at the rear end portion of the machine, one at the right side thereof and the other on the left side. Each keel is supported in the following manner: At the rear edge of the keel or at a point just adjacent thereto the keel is secured to a bar 212 and preferably in a manner whereby the keel may turn on or with respect to the bar as it may become arched in opposite directions. From the bar 212 the keel extends forward and from the front edge thereof there extend connections 213 which connect with a spreader 214. From this spreader other connections 215 extend forward and connect with another bar 216 preferably at about the middle of this bar. Each of the bars 215 is a flexible bar so made, in other words, that upon the application of wind pressure to one side or the other of the keel connecting therewith the bar will give slightly and permit the keel to become arched in one direction or the other dependent upon the side thereof to which the wind pressure is being applied. The bars carrying the respective keels are secured to the frame of the machine in any suitable manner.

In the drawings the bars to which are secured the keels 208, 209, are fixed crosswise in the machine by securing them to the ends of the stanchions 7 of the secondary frame which are extended slightly above and below the top and bottom side beams of this frame, while the bars carrying the keels 210, 211 are vertically fixed to the machine on opposite sides thereof by fixing the same to extend vertically between the struts 8 which are extended at the top and bottom of the tail portion of the machine slightly beyond the sides thereof. Other means of course may be resorted to for holding the keels in place although I prefer not to attach them directly to the stanchions and struts of the secondary frame as might otherwise be done

for I prefer that the strain of the keels may not come directly upon these parts.

The operation of the keels is as follows: Under ordinary normal conditions as the machine passes through the air the pressure thereon will act against the under sides of the keels 208, 209, and slightly arch the same, thereby converting these keels into lifting planes operating to maintain the tail end portion of the machine in a proper elevated position with respect to the head thereof. In case the tail portion of the machine sags unduly thereupon the pressure of the wind against the under sides of these keels increases. The keels will also become more inclined and more arched by the increasing pressure with the effect that their lifting efficiency will become increased and thereby operate to lift the tail and restore it to its proper position. Just the reverse happens if the tail of the machine tends to become unduly elevated or raised. In such case the pressure of the wind will bear against the upper sides of the keels, developing therein a downward arch or camber, thereby converting the keels into working planes operating by the pressure of the wind against the same to restore the tail to its proper and normal position when such depressing influence ceases by the restoration of the keels to their normal positions. The vertical keels 210, 211, upon the application of a lateral wind pressure to the side of the machine which might otherwise tend to turn the head of the machine around the tail thereof and change the direction of the machine will receive this same lateral pressure and thereby assist in preventing the head of the machine being turned around the tail, the tail, in other words, moving laterally even with the head and so maintaining the course of the machine. This action, however, is materially increased by the fact that the lateral wind pressure applied to the keels will arch the same to develop camber therein, thereby developing the keels into working planes when the headon resistance to the air during the propulsion of the machine acting against the same will augment the lateral disturbing influence tending to arch the keels and thereby move the tail laterally to maintain a proper relative position with relation to the head of the machine, or, in other words, prevent the head being turned around the tail by the lateral disturbing influence. It is of course immaterial which side of the machine the lateral influence is applied to inasmuch as these keels like the others are capable of bending or becoming arched in opposite directions depending upon the side to which the wind pressure is applied.

I claim—

1. In a flying machine, the combination with a movable plane, of an operator's seat, means of connection between the operator's seat and said plane, means for loosely supporting said seat to have movement in reverse directions for controlling said plane, a device adapted and arranged to the end that it may automatically move said seat in a direction dependent upon and commensurate with the displaced position of said machine, and means whereby said seat may be thrown by the operator into engagement with said device or out of engagement therewith as occasion may require.

2. In a flying machine, the combination with a movable plane of an operator's seat, means of connection between said seat and said plane, means for supporting said seat to have movement in reverse directions, a gyroscopic device and frame carrying the same, means for pivotally supporting the same, and means of connection running from the frame of said device to said seat whereby the position of said seat may become changed in a direction dependent upon and commensurate with the turned position of said machine, said connecting means comprising in part mechanism by which the operator may throw said seat into or out of engagement with said gyroscopic device as occasion may require.

3. In a flying machine, the combination with the body thereof, of an operator's seat, means for loosely supporting said seat to have movement in reverse directions, a gyroscopic device and frame carrying the same, means for loosely supporting said device and frame to assume a normal dependent position, a tackle connecting with said frame and comprising separate connections running in reverse directions to said seat whereby the position thereof may become changed dependent upon the turned position of the machine, the said tackle comprising in part sets of pulleys around which said connections are adapted to run.

4. In a flying machine, an operator's seat and means for loosely supporting the same to have movement in reverse directions, said seat having sides and a back connection, a post pivotally connecting with said seat, and forming a portion of the back thereof, said post being adapted and arranged also to the end that it may be thrown into and out of engagement with said back connection, substantially as and for the purposes set forth.

5. In a machine of the character specified, the combination with an engine of means for pivotally mounting the same, a gear driven by said engine, an ultimate driven object, duplicate sets of transmission comprising in part gears having a constant engagement with said driven gear on opposite sides thereof to be driven thereby in reverse directions, said sets of transmission comprising also in part other gears concentric

with the driven gears of said respective sets of gears, and means whereby a clutch engagement may be effected between the respective gears of said sets of gears upon the admission of fluid pressure between the same, means for mounting the gears of said respective sets of gears, and means for controlling the admission of fluid pressure to said respective sets of gears, or one or the other thereof dependent upon the position of said machine.

6. In a flying machine, the combination with the body of the machine, of a gyroscopic engine, a frame carrying said engine pivoted to said body of the machine, and means controlled by fluid pressure for restoring said engine to its original position of suspension in case of displacement therefrom, the same comprising in part a valvular mechanism fixed to said body of the machine and having a valve, and means for controlling the position of said valve dependent upon the position of said body of the machine, the same comprising a lever pivoted to said body of the machine to occupy a normal position of suspension, a connection between said lever and said valve whereby said lever may assist in controlling the position of said valve, and other connections coöperating therewith for assisting in controlling the position of said valve, said other connections connecting with said valve and with said engine frame in a manner whereby said valve may be influenced by the position of said frame.

7. In a flying machine, the combination with the body of the machine of a gyroscopic engine, a frame pivoted to said body of the machine and carrying said engine, means controlled by fluid pressure for restoring said engine to its original position of suspension in the event of displacement thereof, the same comprising in part a valvular mechanism fixed to said body of the machine and having a movable valve, and means for controlling the position of said valve dependent upon the position of said body of the machine, the same comprising a brace of overweighted levers adapted and arranged whereby they may have different rates of oscillation, connections between said levers and said valve whereby said levers may assist in controlling the position thereof, and other connections coöperating therewith for assisting in controlling the position of said valve, said other connections connecting with said valve and with said engine frame in a manner whereby said valve may be influenced by the position of said frame.

JAMES S. LANG.

Witnesses:
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