J. E. McWORTER.

FLYING MACHINE.

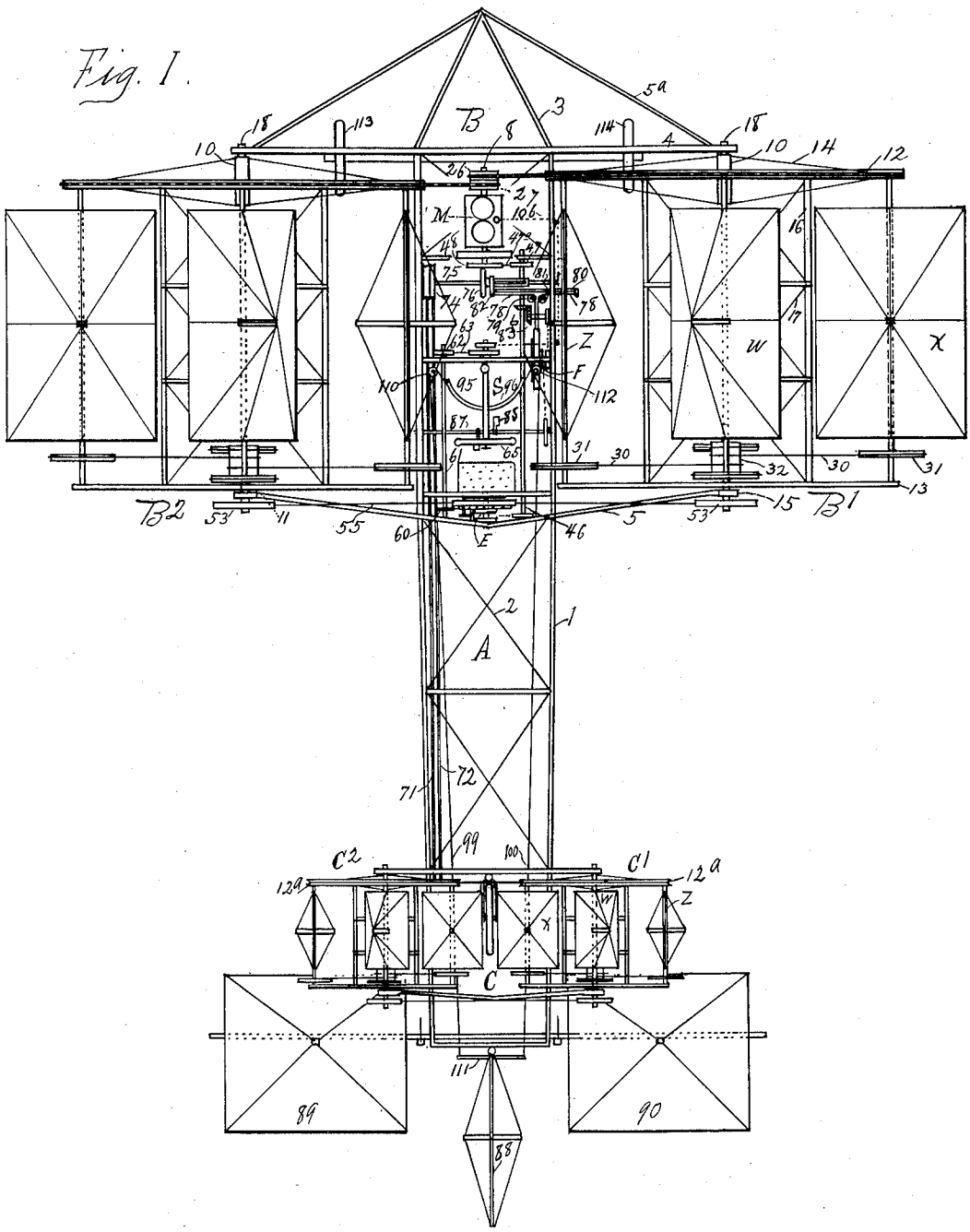
APPLICATION FILED MAY 9, 1913.

1,114,167.

Patented Oct. 20, 1914.

5 SHEETS—SHEET 1.

Fig. 1.



Witnesses:
Albert Burgess.
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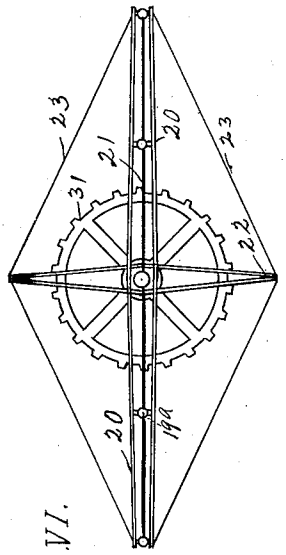

Fig. VI.

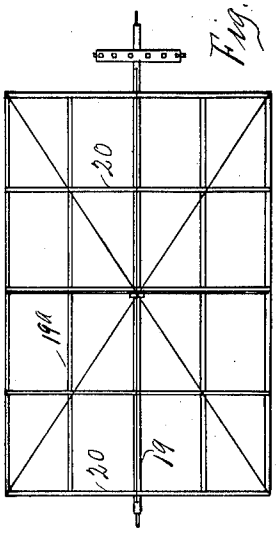

Fig. V.

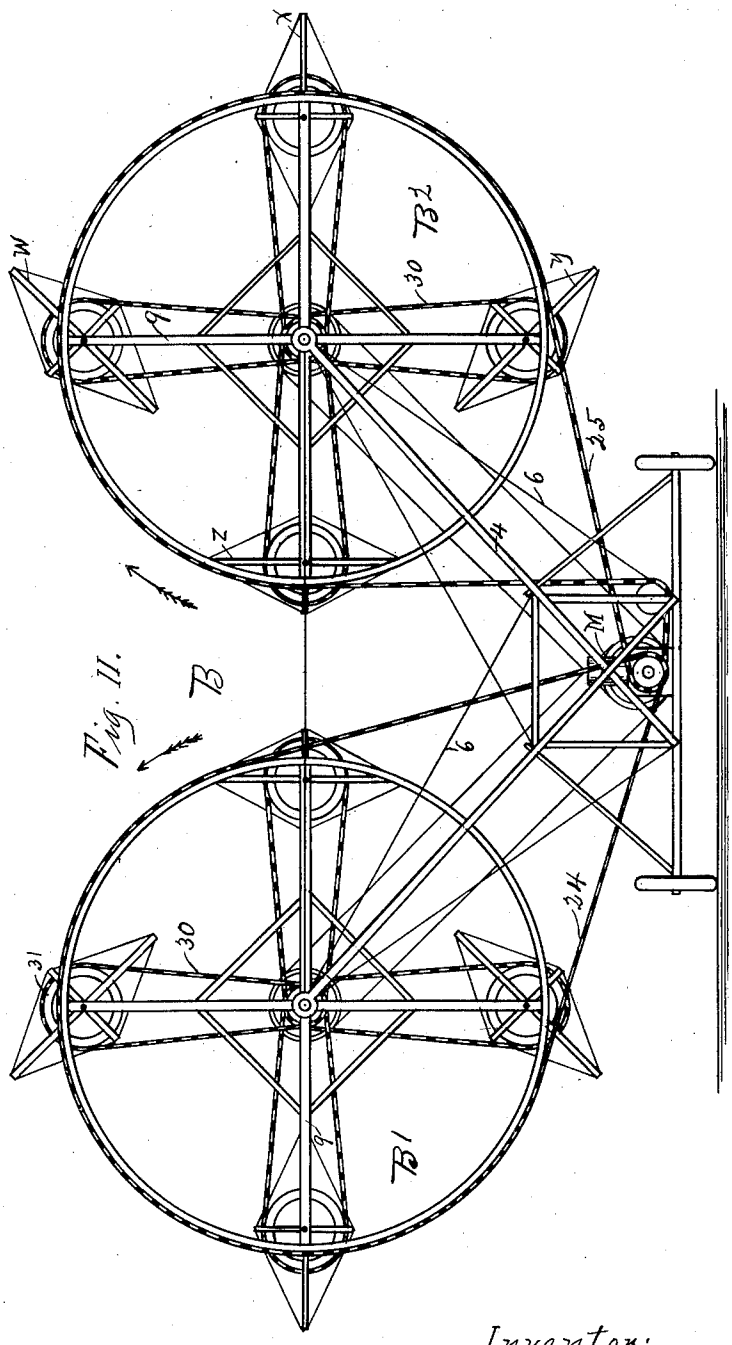

Fig. II.

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6 SHEETS—SHEET 3.

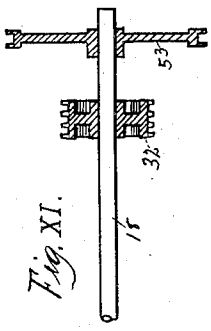

Fig. XI.

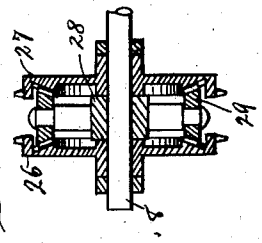

Fig. IV.

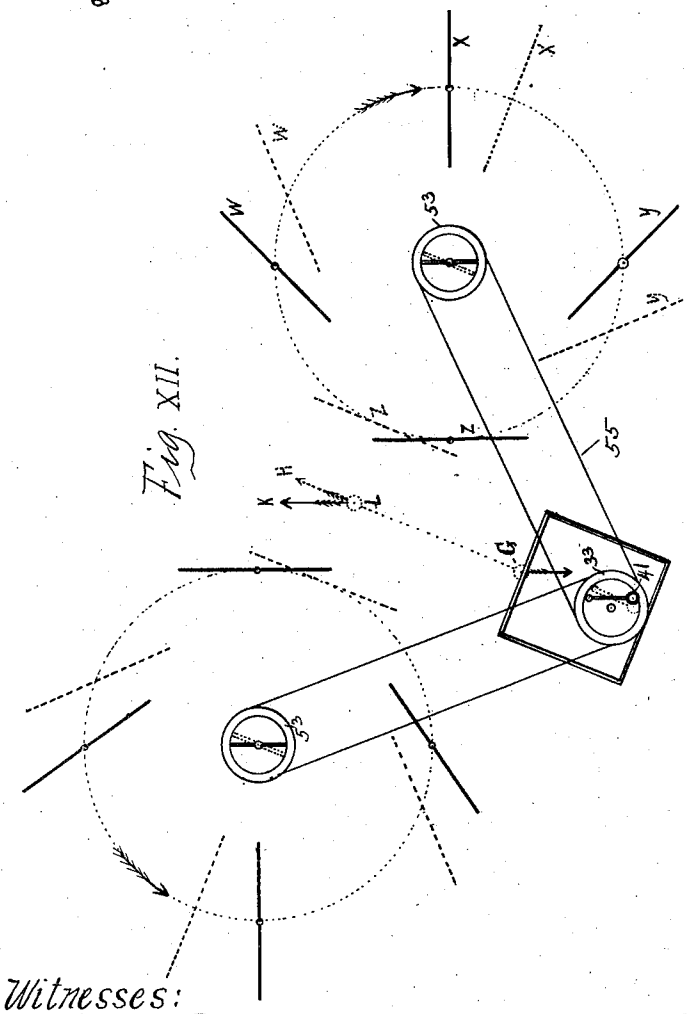

Fig. XII.

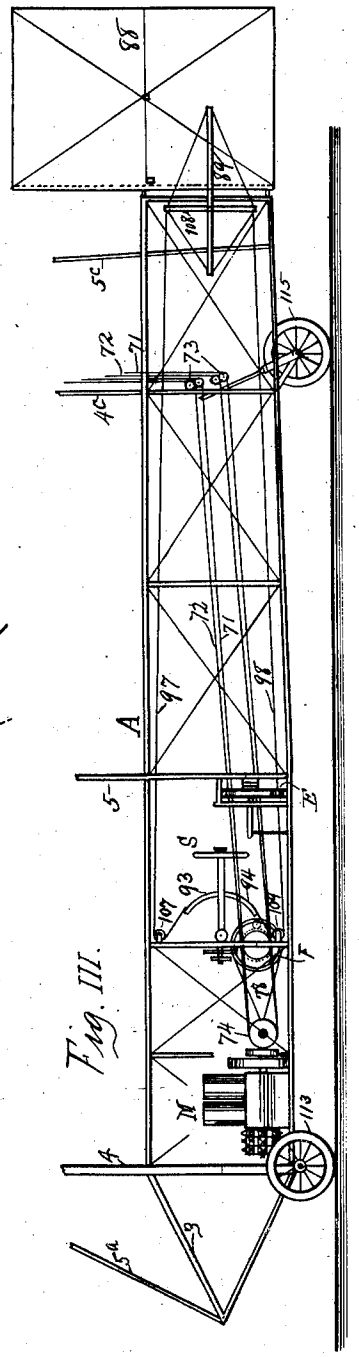

Fig. III.

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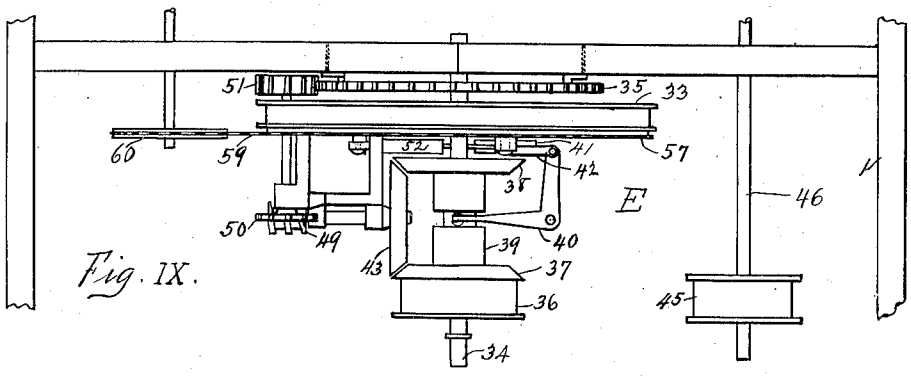

Fig. IX.

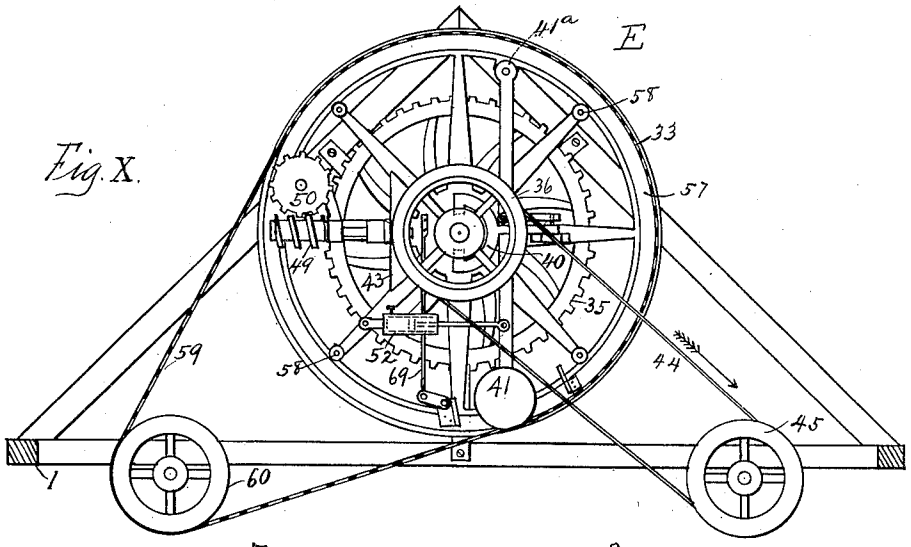

Fig. X.

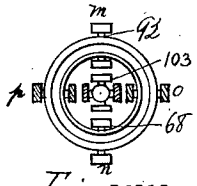

Fig. VIII.

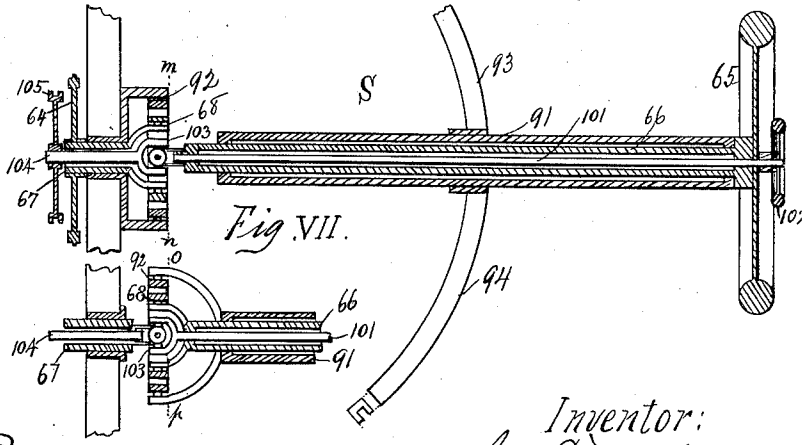

Fig. VII.

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5 SHEETS—SHEET 5.

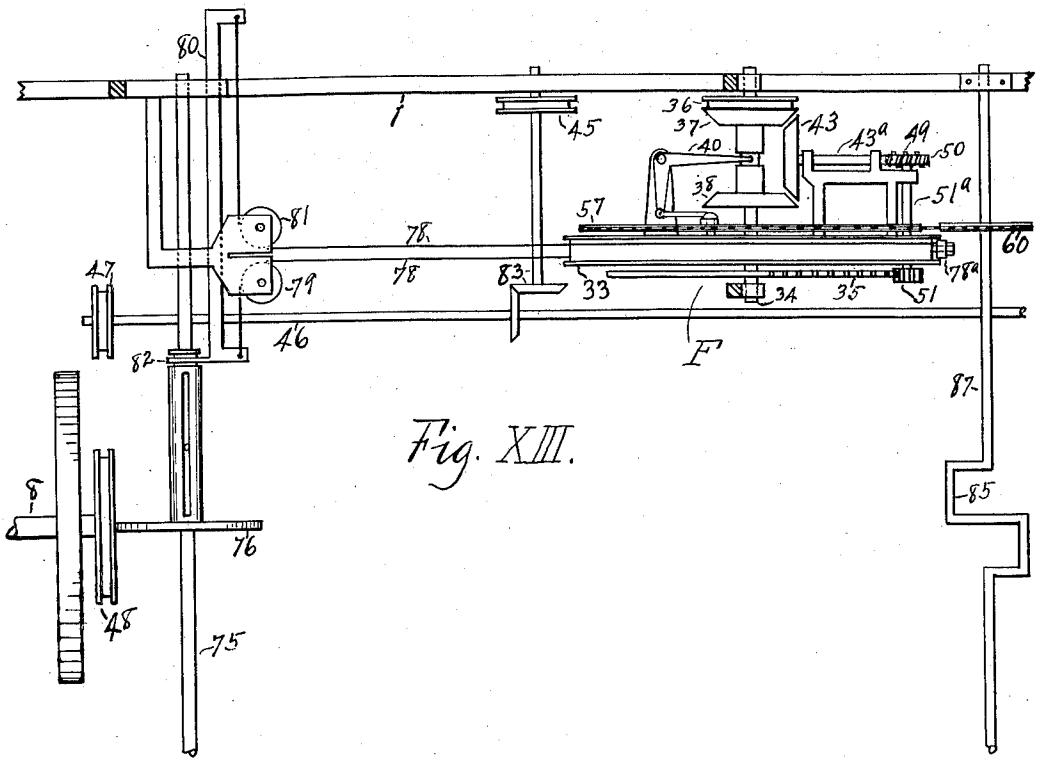
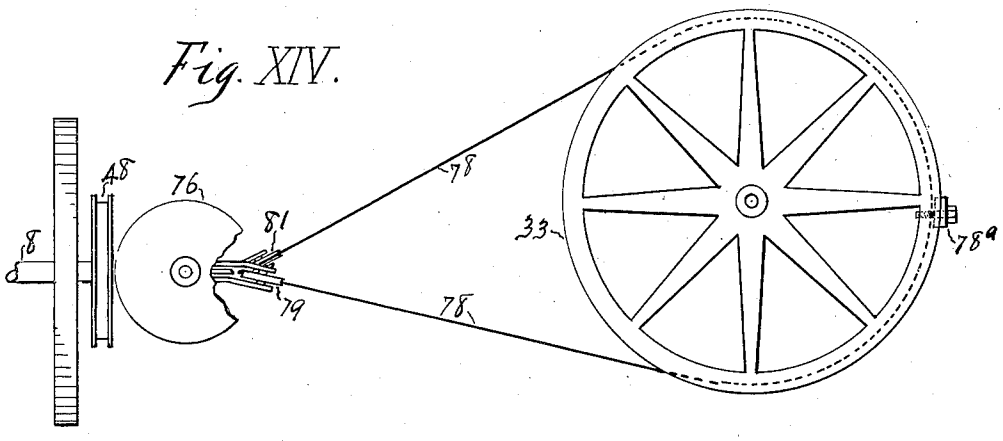


Fig. XIII.

Fig. XIV.



Witnesses:

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JOHN E. McWORTER, OF ST. LOUIS, MISSOURI.

FLYING-MACHINE.

1,114,167. Specification of Letters Patent. Patented Oct. 20, 1914.

Application filed May 9, 1913. Serial No. 766,632.

To all whom it may concern:

Be it known that I, JOHN E. McWORTER, a citizen of the United States, residing at 4531 Garfield avenue, in the city of St. Louis and State of Missouri, have invented a new and useful Improvement in Flying-Machines, of which the following is a specification.

This invention relates to flying-machines.

One object of this invention is to provide a flying-machine having propelling and sustaining devices or wings of comparatively large area of blade surface and so constructed and operated that a machine of practical size may ascend vertically from the ground.

Another object of this invention is to provide a flying-machine which will maintain its lateral and also its longitudinal equilibrium automatically under all ordinary variations and changes in the velocity of the wind.

Another object is to provide a flying-machine the automatic stabilizing action of which may at any time be supplemented or controlled by the operator.

Another object is to provide a flying-machine whose lateral motion may be controlled by the operator even when the machine is hovering.

Another object of this invention is to provide a flying-machine in which the direction of lift of the propelling and sustaining devices may be automatically or manually controlled.

Another object is to provide a flying-machine which will automatically maintain the direction of lift of its propelling and sustaining devices in an approximately vertical direction however far the machine may tilt over in a lateral direction.

Another object is to provide a flying-machine which will automatically maintain the center of lift of its propelling and sustaining devices at the highest practical point above the center of weight so that the vertical stability of the machine may be easily maintained.

Another object is to provide a flying-machine having propeller planes or blades which are so designed, arranged and operated that a machine of practical size may be equipped with a relatively great area of propeller blade surface thereby greatly increasing the propeller thrust per applied horsepower above that obtained by the ordinary screw form of propeller under usual working conditions.

Another object of this invention is to provide a flying-machine which will automatically maintain its forward tilt for forward flight.

Another object is to provide a flying-machine the longitudinal inclination of which is also under control of the operator, who thereby controls the speed of flight.

Other objects and desirable features of my invention will be hereinafter pointed out.

Figure I. of the drawings is a top plan view of a flying-machine constructed in accordance with my invention; Fig. II. is a front elevation of this machine showing the position of the lifting and sustaining propellers and the position of the propeller blades at certain points in their rotation around their central shaft, the means by which the blades are feathered and the means by which each propeller is rotated; Fig. III. is a side elevational view of the body of the machine; Fig. IV. is a sectional view of the gears and sprocket wheels on the shaft of the motor which coöperate with the driving means that actuate the propellers; Fig. V. is a plan view and Fig. VI. an end view of one of the propeller planes or blades; Fig. VII. shows two sectional views of the combined steering device at right angles to each other; Fig. VIII. is a cross sectional view on the line *m*—*n* showing the three universal joints which have one common center of motion; Fig. IX. is a plan view of the automatic stabilizing devices; Fig. X. is a side elevational view of the automatic stabilizing devices; Fig. XI. is a sectional view of the rear end of a central propeller shaft and that part of the feathering means and adjusting means which is attached thereto; and Fig. XII. is a diagrammatic view showing the change in the direction of lift of the propelling and sustaining devices which results from the automatic action of the stabilizing device. Fig. XIII. is a plan view and Fig. XIV. a side elevational view of the longitudinal stabilizing device and the driving means of the rotative rudders.

Briefly described my improved flying machine consists of a body or framework of any preferred design arranged to carry the operator, the motor and the devices for con-

trolling and guiding the machine, one or more pairs of combined propelling and sustaining devices each of which comprises a plurality of planes or propeller blades which are so disposed that the combined resistances which the air offers to the rotary movement of same is in one general direction, means for causing said blades to feather or turn from a horizontal position when moving downward to a vertical position when moving upward in their rotation around the central axle of each device, automatic means for adjusting and controlling said feathering means so that that general direction of lift will be maintained approximately vertical however for the machine may tilt over in a lateral direction, one or more pairs of rudder propellers which are smaller but of the same essential construction as the propelling and sustaining devices, automatic means for controlling the speed and direction of rotation of said rudder propellers so that the rear end of the machine will be depressed or elevated as circumstances may require to maintain the normal longitudinal stability of the machine; manual means for controlling the direction of lift of the propelling and sustaining means, the rotatable rudder means and the horizontal and vertical plane rudder means; it is flying machine that will automatically maintain both its lateral and horizontal equilibrium and at all times be subject to or under the immediate control of the operator.

The machine herein shown, which represents the preferred form of my invention is provided with only one pair of propelling and sustaining devices, one pair of rotatable rudder devices, a pair of horizontal plane rudders and a vertical plane rudder, it being understood that so far as my invention is concerned it is immaterial how many pairs of propelling devices are used as propelling and sustaining means or as rotatable rudder means.

Referring to the drawings which illustrate the prefered form of my invention A designates the body or supporting frame of the machine which carries the operator and the motor, B designates a pair of combined propelling and sustaining devices arranged above the frame A and on opposite sides of same as shown in Fig. I. B^1 designates the right propeller and B^2 the left propeller.

The frame A may be constructed in various ways but I prefer to build it from light weight bars or rods 1 and stay wires 2 which are so combined and arranged that a light weight trussed skeleton structure is produced which has sufficient strength to carry the operator, the motor and the various other elements used in the construction of the machine.

The body A of the machine herein shown is substantially box shaped and is provided at its front end with forwardly projecting members 3 which converge at a common point and thus form a pyramidal shaped extension on the front of body A.

The propelling and sustaining device B is supported or connected to the body A by suitable braces 4 and 5 and truss-wires 6 and each of the propelling and supporting devices B^1 and B^2 comprises a horizontally disposed shaft 18, and a box shaped frame provided with radially projecting blade supports 9 in which the propeller blades are pivotally mounted. Each of the propellers of the machine herein shown has four blades W, X, Y and Z, whose longitudinal axes extend parallel to the center shaft 18. The X shaped blade supports 9 extend from the propeller hubs 10 and 11 to outer rims 12 and 13 which with their wire spokes 14 form a head at each end of the propeller. The two heads are connected by a box shaped axle constructed of bars or rods 16 and truss-wires 17 arranged a sufficient distance from the center of rotation to safely withstand a torsional strain which if carried by a solid central axle would be very great. The ends of the central shafts 18 are journaled in suitable bearings 15 attached to braces 5.

Each of the planes or blades W, X, Y and Z preferably consists of a rigid rectangular shaped frame which comprises a central axle 19 and a plurality of rods or bars 19^a on each side of said central axle and parallel thereto, and cross bars 20 attached to members 19 and 19^a as shown, in Figs. V and VI, wherein it will be seen that a set of truss-wires 23 are provided for each side of the plane to resist and carry the strain to which the blade is subjected when either face is moving against the air. Each blade presents one face against the air during one revolution of the propeller and the other face during the next, etc. The plane material or fabric 21 is attached to the blade axle and to the rods or bars parallel thereto. A central strut 22 projects from either face of the blade to which the truss-wires 23 lead from the corners, sides, ends and other suitable points of the blade frame.

The propelling and sustaining devices B^1 and B^2 are rotated in opposite directions, preferably over outwardly from the body A as indicated by the arrows in Fig. II. Any suitable means may be used for this purpose such for example as a motor M and driving members 24 and 25 which transmit rotary movement from the motor to the rotary propellers B^1 and B^2. The driving members as shown here are sprocket chains which run over sprocket wheels 26 and 27 on the motor shaft and over the propeller heads 12 which are provided with sprocket teeth on the outer rims. The chain 25 is crossed so that propeller B^2 will revolve in the opposite direction from B^1.

A differential is combined with the sprocket wheels 26 and 27 as shown in Fig. IV of the drawings. Said gearing consists of a member 28 securely fastened to the shaft of the motor 8 and provided with a plurality of rotatably mounted beveled gears 29 that mesh with beveled gears on the inner faces of sprocket wheels 26 and 27. Said sprocket wheels are loosely mounted on the shaft of the motor so that the member which carries the pinions 29 transmits rotary movement from the motor shaft to the sprocket wheels 26 and 27. Such a construction gives an equal pull to the two sprocket chains 24 and 25 and drives the propellers B^1 and B^2 at the same speed of rotation when the respective air resistances which they meet are equal and also drives the propeller on one side at a sufficiently greater speed than the propeller on the other side to cause said air resistances to be equal when variations in air currents would tend to make the lift of the two devices unequal. When brakes are used in connection with a differential gearing to vary the respective rotative speeds of the two devices it results in a great waste of energy. When the lifting forces of each of the two devices are equal the center of lift will be maintained at a point midway between the two propellers as shown by the small circle L in Fig. XII.

It will of course be understood that power could be applied to both heads of the propellers and that more than one motor may be used.

The means which I prefer to use for causing the planes or propeller blades to feather or turn from a vertical to a horizontal position and back again to a vertical position during each cycle of operations of the device B consists of driving members such, for example, as sprocket chains 30 which pass over sprocket wheels 31 rigidly attached to the rear ends of the propeller blades and also over sprocket wheels 32 which are rigidly attached to the propeller shaft 18. The sprocket wheels 32 on each propeller shaft may be combined into one with four rows of sprocket teeth on its outer rim as shown in Fig. XI. A separate driving member or chain is provided for each propeller blade.

The shaft 18 and the sprocket wheels thereon remain normally at rest while the propeller is rotating. The sprocket wheels 31 are twice as large and have twice as many teeth as sprocket wheels 32 therefore the blades W, X, Y and Z will make one half revolution while the propeller, as a whole, is making one revolution.

The operation of this form of propeller is fully described in my former application for patent on flying machines, Serial No. 592,541, filed November 15, 1910, and also in my application for patent on aeroplanes, Serial No. 635,440, filed June 26, 1911. It will be understood from these and from this description that the general direction of lift of each propeller is approximately parallel to the vertical blade position designated as Z and also parallel to a line perpendicular to the plane position designated by X so that, when the propeller shaft 18 is rotated to a new position the Z position and each of the other successive blade positions are rotated in the same direction and to the same degree, and if the shafts 18 of the devices B^1 and B^2 are uniformly rotated the combined direction of lift is rotated in the same direction and to the same degree as illustrated in the diagrammatic Fig. XII wherein the dotted lines show blade positions W, X, Y and Z when the machine is tilted over to the right—the feathering means remaining stationary—and the heavy full lines show the same relative blade positions when the feathering means is rotated with respect to the machine, to the same degree in a counter clockwise direction so that the direction of lift of the device B, remains vertical however far the machine may turn over in a lateral direction as indicated by the arrow L K. The arrow L H indicates the direction of lift of device B when the feathering means remain stationary.

In the diagrammatic Fig. XII the small circle L indicates approximately the center of lift and the small circle G the center of weight of the machine. The pull of gravity is always in a vertical line downward and if the direction of lift be vertically upward at the point L the machine as a whole will tend to rotate in a lateral direction until the center of gravity is brought to a point immediately below the center of lift.

In order to maintain the direction of lift of the device B always approximately vertical, I have provided an automatic stabilizing device E which is placed in the body of the machine in such a position that the pendulum controlling means with which it is provided swings in a lateral direction. I prefer to construct said device as shown in Figs. IX and X of the drawings. Said device comprises a rotative member as for example, drum 33 which is mounted on a horizontally disposed shaft 34, one end of which rests in the hub of the stationary gear wheel 35 and the other in a suitable bearing attached to the body of the machine. On shaft 34 is also loosely mounted a motor driven member which comprises the belt wheel 36 and two beveled friction drive wheels 37 and 38, all three of which have one common hub 39. Said hub has a groove around its middle portion into which projects the point of the bell crank lever 40. Said lever is pivoted at its angle point to a lug projecting from the drum 33. The other end of said lever is attached to the pendulum 41 by means of the link 42. The

pendulum 41 is hung from shaft 41ª attached to the drum 33 so that, for example, when the machine tilts over to the right the pendulum swings to the right and through the action of connecting members 42 and 40 the beveled wheel 37 is forced against the beveled friction wheel 43.

It will be understood that wheels 36, 37 and 38 are in continuous high-speed rotation in the direction indicated by the arrow near belt 44 which runs over wheel 36 and over belt-wheel 45 on shaft 46, said shaft 46 being rotated by the motor M by means of the belt 47ª running over belt wheels 47 on shaft 46, and 48 on the shaft of the motor, so that when wheel 37 is brought into contact with wheel 43 which is rigidly attached to the same shaft 43ª as the worm 49, said right threaded worm 49 as shown in Fig. 10 will therefore rotate, over to the left, gear wheel 50 which is rigidly attached to the same shaft 51ª as gear wheel 51; and as said worm and gear 49 and 50 are suitably journaled by their shafts to a frame attached to the drum 33 and as the gear wheel 51 meshes with the stationary gear wheel 35 the drum is thereby rotated over to the left until the pendulum attached thereto is permitted to swing vertically in its normal position as shown in Fig. X. The beveled wheel 37 is thereby withdrawn from contact with wheel 43 and the rotation of drum 33 ceases and it is held in position by said worm and gear. When the machine tilts over to the left the beveled wheel 38 is likewise brought into contact with wheel 43 which in like manner rotates said drum 33 over to the right. I have also provided an air-check 52 to prevent the pendulum from making regular periodic and undue oscillations. The wheels or drums 53 which are rigidly attached to the propeller shafts 18 are connected to the wheel or drum 33 by means of wire cables or sprocket chains 55. Said wheels 53 have the same diameter as the wheel 33 so that their rotation will be uniform and equal, that is the uppermost point on each of these three wheels or drums is automatically maintained in its uppermost position and the lift of device B is thereby maintained approximately vertical even if the machine should turn completely over in a lateral direction.

In order to enable the operator to control the direction of lift of the propelling and supporting device B I have provided an annular rim 57 which is rotatably mounted on the side of the drum 33 by loosely mounted guide-wheels 58. Said rim is rotated in one direction or the other by the steering wheel 65 of the combined steering device shown in Fig. VII. Said wheel 65 is attached to shaft 66 which is connected to shaft 67 by the universal gimbal joint 68. Attached to shaft 67 is sprocket wheel 64. The members which connect sprocket wheel 64 to the annular rim 57 are the sprocket chain 63, sprocket wheel 62 on shaft 61, sprocket wheel 60 also attached to shaft 61, and sprocket chain 59 as shown in Fig. I and Fig. X. Said annular rim 57 is held in its normal rotative position by the spring 69, one end of which is rigidly attached to the hub of drum 33 and the other end suitably attached to the annular rim 57. Two lateral projections are attached to said annular rim, one on each side at a suitable distance from the pendulum, so that the operator may by turning the steering-wheel 65 force the pendulum in one direction or the other and cause said drum 33 to rotate the feathering means in whatever direction and to whatever degree he may desire. When the annular rim 57 is permitted to return to its normal position the automatic action of the stabilizing device E is immediately restored. This device E is therefore both a steering and stabilizing means. As a steering means it gives the operator control over the lateral motion of the machine whether hovering or in rapid flight.

The longitudinal automatic stabilizing device F is essentially the same in construction and operation as the lateral stabilizing device E' but its position in the body of the machine is at right angles to that of device E. The pendulum of device F swings in a longitudinal direction with respect to the machine. Said device F is provided to control the longitudinal equilibrium or the longitudinal inclination of the machine by controlling the direction, and speed of rotation of the rotative rudder device C constituted by the small rudder propellers C^1 and C^2 which rotate also in opposite directions with respect to each other, that is over toward the body A of the machine or over from the body A as determined by the action of the stabilizing device F.

The rotatable members C^1 and C^2 rotate on shafts parallel to the longitudinal axis of the body A and are attached above and on each side of the rear end of said body. In construction and operation they are essentially the same as the propelling and sustaining device B. C^1 and C^2 are rotated by some suitable driving means as rope belts 71 and 72 which run in grooved rims 12ª, loose pulleys 73 and grooved wheels 74 on shaft 75. Shaft 75 is journaled on the body A in such a position as to bring friction driven wheel 76 in contact with disk driving wheel 48 on the shaft of the motor. Said wheel 76 is suitably constructed to rotate shaft 75 and to permit wheel 76 to be brought in contact with disk wheel 48 at any point along a horizontal line across the center of its face. Fig. I shows wheel 76 in contact with wheel 48 at its center, at which point wheel 76 is not rotated in either direction,

but when forced to the right it will revolve in one direction and when forced to the left of this point it will revolve in the opposite direction and the speed of rotation will depend upon the distance of the point of contact from the center of disk wheel 48. Said point of contact is determined by the operation or action of the longitudinal stabilizing device F to which said wheel 76 is connected by means of wire cable 78 and bar 80, or if desired by some other suitable means which will accomplish the same purpose. As shown in the drawings the wire cable is passed around drum 33 of device F and adjustably attached thereto by means of stud bolt and clamp 78^a. The cable end from the under side of said drum passes over small pulley 79 and is attached to the left end of bar 80 and the cable end from the upper side of said drum passes over small pulley 81 and is attached to the right end of bar 80. To the left end of bar 80 is attached a collar 82 loosely fitted in a groove around the hub of wheel 76 so that when the machine tilts over forwardly too far the drum 33 rotates automatically over toward the rear of the machine which causes the upper end of cable 78 to move bar 80 over toward the left. By this means wheel 76 is forced to slide on shaft 75 to a position to the left of the center of disk wheel 48, the rotation of which by means of the connecting members described rotates the rudder propellers C upwardly and outwardly from the body of the machine. This action of device C depresses the rear end of the machine until its longitudinal normal position is restored. While the machine is being thus restored to its normal position the drum 33 automatically rotates to its normal position, with respect to the machine, causing the propellers of device C to gradually decrease their speed of rotation and come to a stop when the longitudinal equilibrium of the machine is restored. It is understood that the center of lift of the propelling and sustaining device B is vertically above the center of weight of the machine. And when the machine tilts backwardly too far the device F in like manner causes the propellers of device C to rotate over inwardly and downwardly. This action continues with greater or less speed until the rear end of the machine is lifted so that its normal longitudinal inclination is restored. The degree of said forward tilt for forward flight may be determined by suitably adjusting the respective lengths of the upper and lower ends of cable 78.

In forward flight, the forward motion of the machine is maintained by the propelling device B which, when the machine is tilted at a forward angle, will give an upward and forward driving impulse. The machine will therefore glide forwardly through the air at a rate of speed which is determined mainly by the extent of said forward tilt, the force and consequent direction of thrust of device B, and the resistance which the air offers to the forward motion of the machine.

It will be understood that the feathering means of device C is so adjusted that the propeller blades of C^1 and C^2 are brought to their respective maximum working positions, or X positions, at suitable points between the two so that their rotation will give the effect indicated above.

In device F as shown in Fig. I the wheel 45 is rotated by means of beveled gears and lateral shaft 83 so that both devices E and F are driven from the same shaft 46 rotated by the motor as indicated above.

For the purpose of enabling the operator to control the longitudinal inclination of the machine by means of the device F and the rotatable propellers C^1 and C^2 I have provided the horizontally disposed shaft 87 which is journaled to the body A and upon which are mounted pedals 85, and the sprocket wheel 60 of device F. The annular rim 57 of device F is rotated in one direction or the other by means of said pedals 85 thereby giving the operator control of the speed of flight and of the longitudinal inclination and the longitudinal equilibrium of the machine.

By means of the pedals 85 and the annular rim 57 of device F the operator may swing the pendulum of said device toward the rear or toward the front end of the machine and thereby, through the operation of device F and the rotatable rudders C, give the machine any desired degree of forward inclination or tilt, that is, the front end of the machine may be tilted downwardly for forward flight and upwardly to retard forward flight as for example to make a landing.

In addition to the above steering means I have provided the ordinary vertical and horizontal plane rudders 88, 89, and 90 which are of similar construction to the blades of the propellers. These ordinary plane rudders are of no service when the machine is hovering and may be dispensed with by suitably mounting the rotatable rudder device C so that it may be swung, substantially in the manner, laterally and vertically by the steering device. As the rudder blades W and Y of device C are always at right angles to each other in the relative position of their planes, as are also X and Z of each rudder propeller whatever may be their speed or direction of rotation, said rotatable rudder device will thus perform every function of the ordinary plane rudders and more as indicated above.

Within the body A I have provided a combined steering device S which enables

the operator to control the machine by a comparatively small number of simple, easily acquired automatic muscular movements. It is a combination of means by which the operator controls the vertical and horizontal plane rudders, the direction of lift of the propelling and sustaining device and the speed of the motor.

The steering device S comprises the hollow shaft 91 which is connected to the frame of body A by means of the universal joint 92. Attached to shaft 91 are four arms 93, 94, 95 and 96 to which are attached the wire ropes 97, 98, 99 and 100 which control the position of the vertical and horizontal plane rudders. Within the hollow shaft 91 is the hollow shaft 66 to which is attached the steering wheel 65, described above, by which the operator controls the direction of lift of the propelling and sustaining device B. Within the hollow shaft 66 is the shaft 101 to which is attached the wheel 102 by which the operator controls the motor M. As shown in Figs. VII and VIII of these drawings shaft 101 is connected to shaft 104 by means of the universal joint 103. Upon shaft 104 is rigidly mounted drum 105 from which run wire ropes 106 to the throttle controlling device of the motor M. It will be noted that the three universal joints 68, 92 and 103 have one common center of motion so that the operation of one does not in any way affect the operation or position of the others.

The horizontal rudders are operated by lifting or depressing the steering-wheel 65. Wire ropes 97 attached to the arm 93 run over pulleys 107 and to the upper ends of the arms 108 of the horizontal rudders, and wire ropes 98 attached to arm 94 run over pulley 109 and to the lower ends of the arms 108 of the horizontal rudders. The vertical rudder is operated by swinging the steering device in a horizontal direction. The wire rope 99 attached to arm 95 runs over pulley 110 and to the left end of arm 111 of the vertical rudder, and wire rope 100 attached to arm 96 runs over pulley 112 and to the right end of vertical rudder arm 111.

The machine is supported when on the ground by three wheels, two of which 113 and 114 are mounted on arms extending laterally from the front end of body A, and the third wheel 115 is suitably attached under the rear end of the machine.

I am now aware that rotative propellers having feathering blades are not new but

What I claim as new and desire to secure by Letters Patent is:—

1. In a flying machine the combination with combined propelling and sustaining devices arranged above the center of weight of the machine and rotatable on axles which extend approximately parallel to the direction of flight, and rotatable motor driven rudder means; of automatic means adapted to maintain, approximately vertical, the direction of lift of said propelling and sustaining means and thereby maintain the lateral equilibrium of the machine, and automatic means adapted to control the speed and direction of rotation of said rudder means and thereby maintain the longitudinal inclination or longitudinal equilibrium of the machine.

2. In a flying machine the combination with combined propelling and sustaining devices arranged above the center of weight of the machine and rotatable on axles which extend approximately parallel to the direction of flight, rotatable motor driven rudder means, and combined steering and controlling means; of manually controlled, automatic means adapted to maintain approximately vertical the direction of lift of said propelling and sustaining means and thereby control the lateral movement and lateral equilibrium of the machine, and manually controlled, automatic means adapted to control the speed and direction of rotation of said rotatable rudder means and thereby control the longitudinal inclination of the machine, and the speed of flight.

3. In a flying-machine the combination with a body or frame-work for carrying the operator, a pair of combined propelling and sustaining devices rotatable on axles parallel to the longitudinal axis of said body and arranged above and on opposite sides thereof, each of said devices comprising a rotatable frame in which are pivotally mounted planes or blades on axles parallel to the central axle, means to rotate said devices in opposite directions, means to cause said blades to feather during their rotary movement around the central axle, and automatic means to so adjust and control said feathering means that the "direction of lift" of said propelling and sustaining means will be maintained approximately vertical however far the machine may tilt over in a lateral direction.

4. In a flying-machine the combination with a body or frame-work for carrying the operator, a pair of combined propelling and sustaining devices rotatable on axles parallel to the longitudinal axis of said body part, combined automatic and manual means to control the lateral movement and lateral equilibrium of the machine, a pair of rotatable rudder devices arranged above the rear end of the machine, means to rotate said rudder devices in opposite directions with respect to each other, and automatic means to vary the speed and direction of rotation of said rudder devices so that they will sufficiently lift or depress the rear end of the machine to maintain its longitudinal equilibrium.

5. In a flying-machine the combination with a body or frame-work for carrying the operator, a pair of combined propelling and sustaining devices rotatable on axles parallel to the longitudinal axis of said body part, each of said devices comprising a center portion and pivotally mounted planes or blades arranged outside of said center portion and extending longitudinally thereof, means for causing the blades to feather during the rotative movement of said device so that each device will exert downward pressure on the air; automatic, motor driven means to control said feathering means so that the "direction of lift" of said devices will be maintained in an approximately vertical direction; a pair of rotatable rudder means arranged above the rear end of said body, automatic, motor driven means to control the direction and speed of rotation of said rudder devices and thereby control the longitudinal inclination or the longitudinal equilibrium of the machine, and means to rotate the propelling and sustaining devices in opposite directions with respect to each other and means to rotate the rudder devices in opposite directions with respect to each other.

6. In a flying-machine the combination with a body or frame-work for supporting the operator, a pair of combined propelling and sustaining devices having feathering blades, means for rotating said devices in opposite directions, automatic means associated with the driving means to cause the device on one side to exert the same lifting and propelling force as the device on the opposite side, means for causing the blades to feather during the rotative movement of said devices so that the combined resistance which the air offers to said devices will be in one general direction; and an automatic stabilizing means to maintain said general direction of lift approximately vertical, said automatic stabilizing means comprising a rotatable member or drum, worm and gear means for rotating said drum, motor driven means arranged to coöperate with said worm and gear means, pendulum means pivotally mounted to the upper portion of said drum and arranged to so control the coöperation of the motor driven means and the worm and gear means that said upper portion of said drum will be maintained in its uppermost position and thereby control the direction of lift of said combined propelling and sustaining devices.

7. A flying-machine comprising a body or frame-work for carrying the operator, rotatable propelling and sustaining devices arranged above the center of weight of the machine and on opposite sides of said body, each of said devices provided with a plurality of planes or blades, means for rotating said devices in opposite directions and in such a manner that the planes or blades thereof exert downward pressure on the air, rotatable rudder devices arranged above and on opposite sides of the rear end of said body, means for rotating said rudder devices in opposite directions and in such a manner that the blades thereof will exert downward pressure on the air or upward pressure against the air according to the direction of rotation of said devices; and automatic means to control the direction and speed of rotation of said rudder devices and thereby automatically maintain the longitudinal equilibrium of the machine, and manual means in coöperation with said automatic means to enable the operator to control the longitudinal inclination of the machine and thereby control the speed of flight.

8. A flying-machine provided with a body or supporting frame-work, a plurality of combined propelling and sustaining devices arranged above the center of weight of the machine and each having a box-shaped center portion of skeleton construction, pivotally mounted planes or blades arranged outside said center portion and extending longitudinally thereof, means for rotating said devices in opposite directions and means for causing the rotative velocity of the device on one side of the machine to be accelerated automatically when the rotative velocity of the device on the other side is retarded by varying air currents, and means for causing the planes or blades to feather or move edgewise upwardly through the air during the rotative movement of said devices, automatic pendulum means to adjust and so control said feathering means that the direction of lift of said devices will be maintained in an approximately vertical direction; and manual means in coöperation with said automatic means by which the operator may control the lateral movement of the machine or supplement the pendulum means for controlling the lateral equilibrium of the machine.

9. In a flying-machine the combination with a body or frame-work for carrying the operator, combined propelling and sustaining devices arranged above and on opposite sides of said body, each of said devices comprising a rotatable center portion mounted on an axle parallel to the longitudinal axis of said body, pivotally mounted planes or blades arranged outside said center portion and extending longitudinally thereof, means for rotating said devices in opposite directions, automatic means associated with the driving means to cause the device on one side to exert the same lifting and propelling force as the device on the opposite side, means for causing said planes or blades to feather during the rotative movement of said devices so that the combined resistances which the air offers to said planes or blades

will result in one general direction of lift, automatic means to maintain said direction of lift in an approximately vertical direction, manual means in coöperation with said automatic means by which the operator may control said "direction of lift"; combined rotatable rudder means for elevating or depressing the rear end of said body portion of the machine to maintain the longitudinal equilibrium of the machine, automatic means to control the speed and direction of rotation of said rudder devices, manual means in coöperation with said longitudinal automatic stabilizing means by which the operator may control the longitudinal inclination of the machine and the speed of flight; and horizontal and vertical plane rudders arranged adjacent to the rear end of said body portion, and a combined steering means under control of the operator for varying the positoin of said rudders for guiding the machine and also for varying the longitudinal inclination of the machine to control the speed of flight.

10. In a flying-machine the combination with a body or frame-work for carrying the operator, combined propelling and sustaining devices, substantially as described, arranged above and on opposite sides of said body, means for rotating said devices in opposite directions, automatic means associated with the driving means to cause the device on one side to exert the same propelling and sustaining force as the device on the opposite side, manual means associated with pendulum controlled, motor driven means, to control the direction of flight and to maintain the lateral equilibrium of the machine, combined rotatable rudder means, manual means associated with pendulum controlled, motor driven means, to control the longitudinal inclination of the machine and the speed of flight, and a combined steering means, substantially as described, to control the motor and thereby the vertical elevation of the machine and the direction and speed of flight.

11. In a flying-machine the combination with combined propelling and sustaining members whose direction of lift is adjustable in a lateral direction, motor driven means, automatically or manually controlled, for controlling said "direction of lift", a combined steering means coöperable with said motor driven means; said combined steering means consisting of the hollow shaft 91 connected with the body of the machine by universal gimbal joint 92, four arms extending from the middle portion of shaft 91 and spaced 90° apart adapted to control the position of the horizontal and vertical rudders, a hollow shaft 66, within hollow shaft 91, to which is attached steering wheel 65, said shaft 66 being attached to shaft 67 by universal gimbal joint 68 within gimbal joint 92, a sprocket wheel 64 mounted upon shaft 67 and adapted, by means of steering wheel 65 to control the direction of lift of the propelling and sustaining means, a shaft 101 within hollow shaft 66, said shaft 101 being connected to shaft 104 by universal joint 103 within universal joint 68, a motor control wheel 102 attached to shaft 101, drum means 105 mounted upon shaft 104 adapted to control the speed or power of the motor, universal joints 92, 68, and 103 having one common center of motion, all substantially as described and for the purpose set forth.

12. In a flying-machine the combination with combined propelling and sustaining means the direction of lift of which is adjustable in a lateral direction, motor driven means for controlling said direction of lift, said motor driven means automatically controlled by pendulum means and manually controlled by combined steering means S, said combined controlling means comprising a motor driven member consisting of belt wheel 36, and friction driving wheels 37 and 38, worm and gear 49 and 50, a pendulum 41 and members connected therewith to control the coöperation of said worm and gear means and said motor driven member, a member or drum 33 rotatable by said worm and gear means, an annular rim 57 rotatable to a limited degree by steering device S to manually control the coöperation of said motor driven means and said worm and gear means, and driving means 55 to transmit rotary movement from said member 33 to members 53 of the propeller blade-feathering means, all substantially as described and for the purpose set forth.

13. In a flying-machine the combination with combined propelling and sustaining means, whose "direction of lift" is adjustable in a lateral direction, means for controlling the "direction of lift" of said propelling and sustaining means, rotatable rudder means to control the longitudinal inclination of the machine, means for rotating said rudder means, automatic, motor driven means adapted to control the direction and speed of rotation to said rudder means and means coöperative with said motor driven means by which the operator may give the machine any desired longitudinal inclination; said motor driven, controlling means comprising a rotative member or drum 33, worm and gear means 49 and 50 for rotating said drum 33, a motor driven member comprising belt wheel 36, and friction driving wheels 37 and 38, pendulum controlling means 41 and manual means adapted to control the coöperation of said worm and gear means and said motor driven member, means adapted to transmit the rotary movement of drum 33 in such a manner that the driven wheel 76, of the means for rotat-

ing said rudder means, will be brought into operative contact with the disk face of motor driving wheel 48 at a greater or less distance from its center, either to the right or to the left, as determined by the direction and extent of rotation of said driving drum or wheel 33 of the longitudinal stabilizing means, substantially as and for the purpose set forth.

JOHN E. McWORTER.

Witnesses:
ALBERT BURGESS,
ANDREW J. GOSSIN.