

July 18, 1933.

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1,919,089

FLYING MACHINE HAVING REVOLVING SUPPORTING SURFACES

Filed May 14, 1931.

6 Sheets-Sheet 1

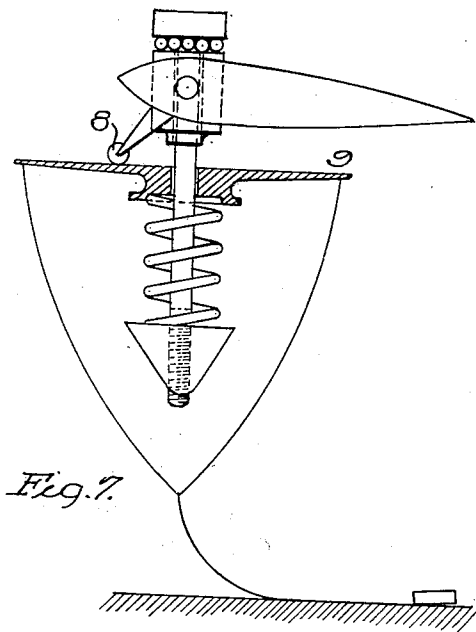


Fig. 7.

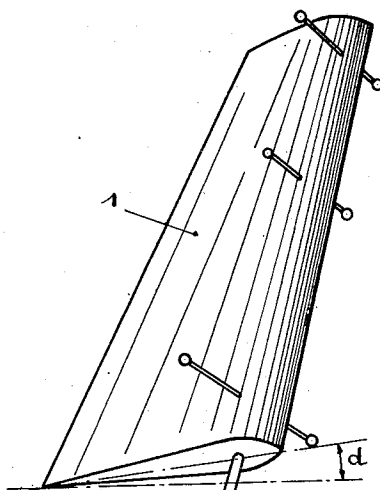
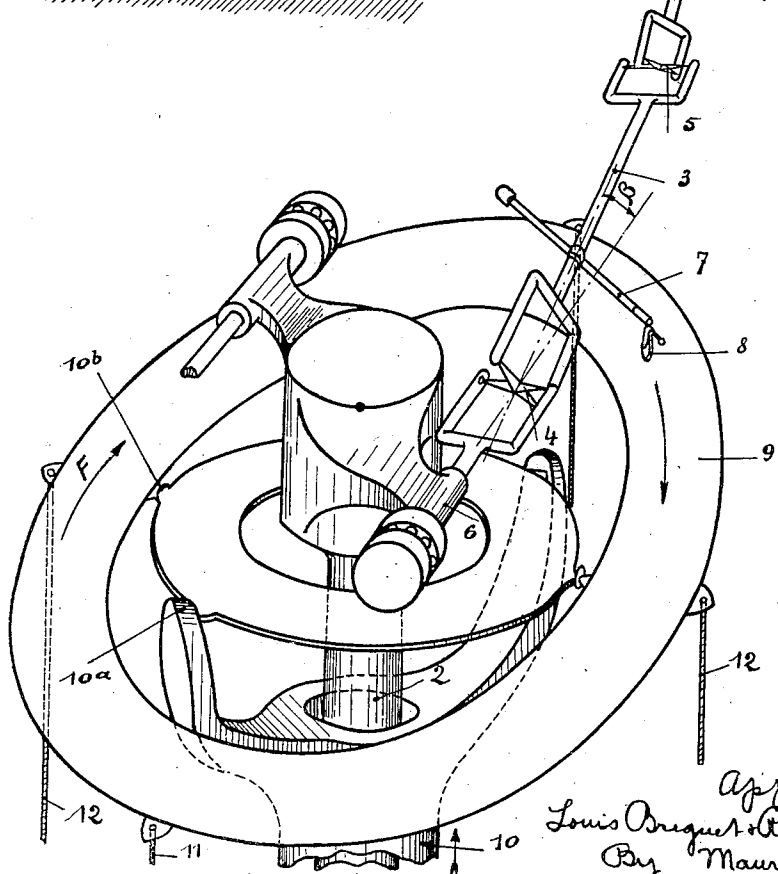


Fig. 1.



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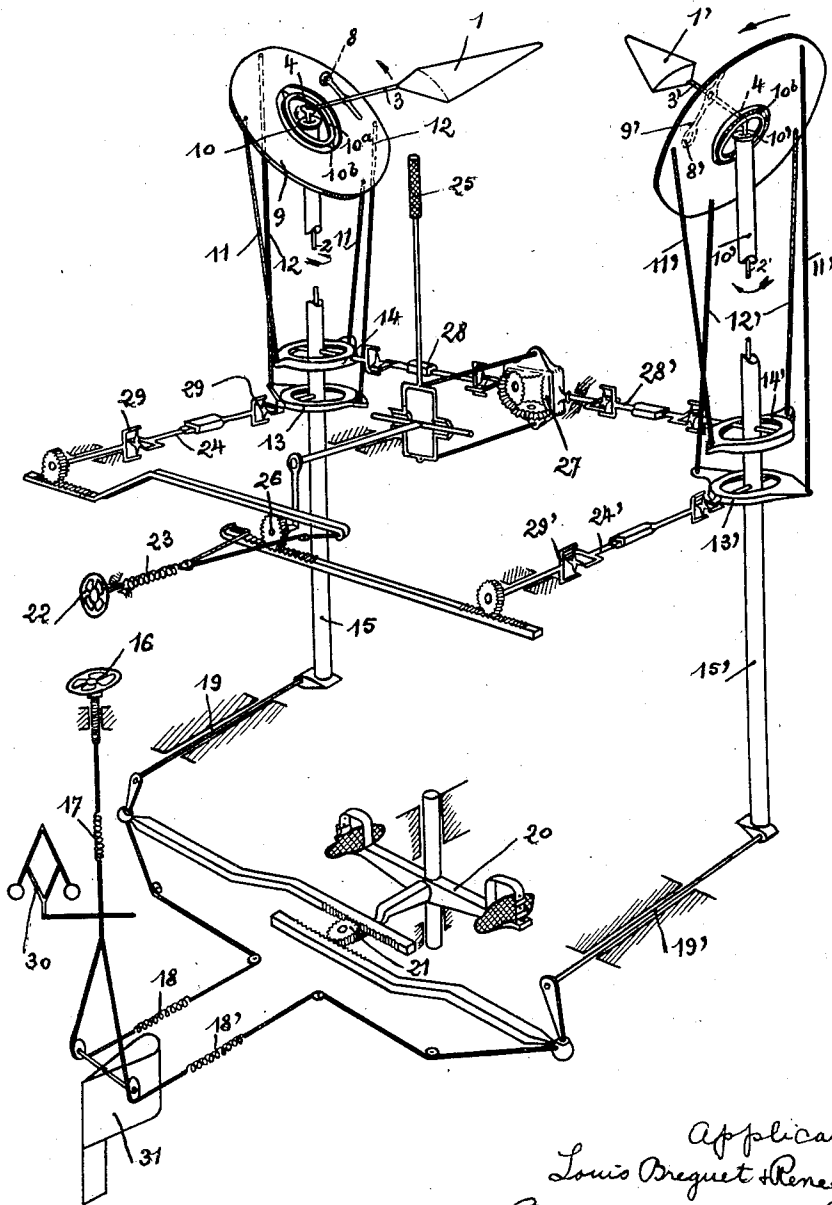
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Fig. 2



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6 Sheets-Sheet 3

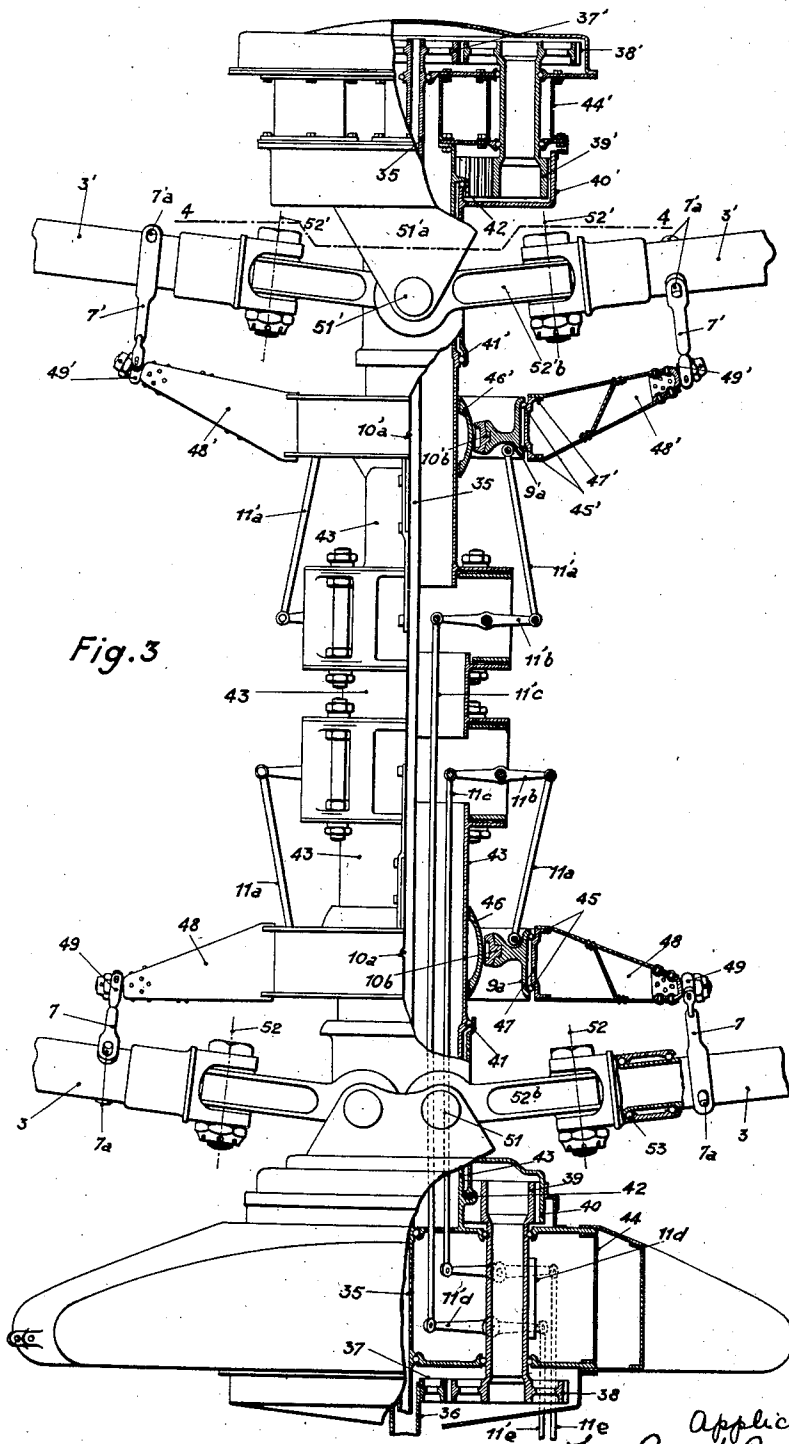


Fig. 3

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6 Sheets-Sheet 4

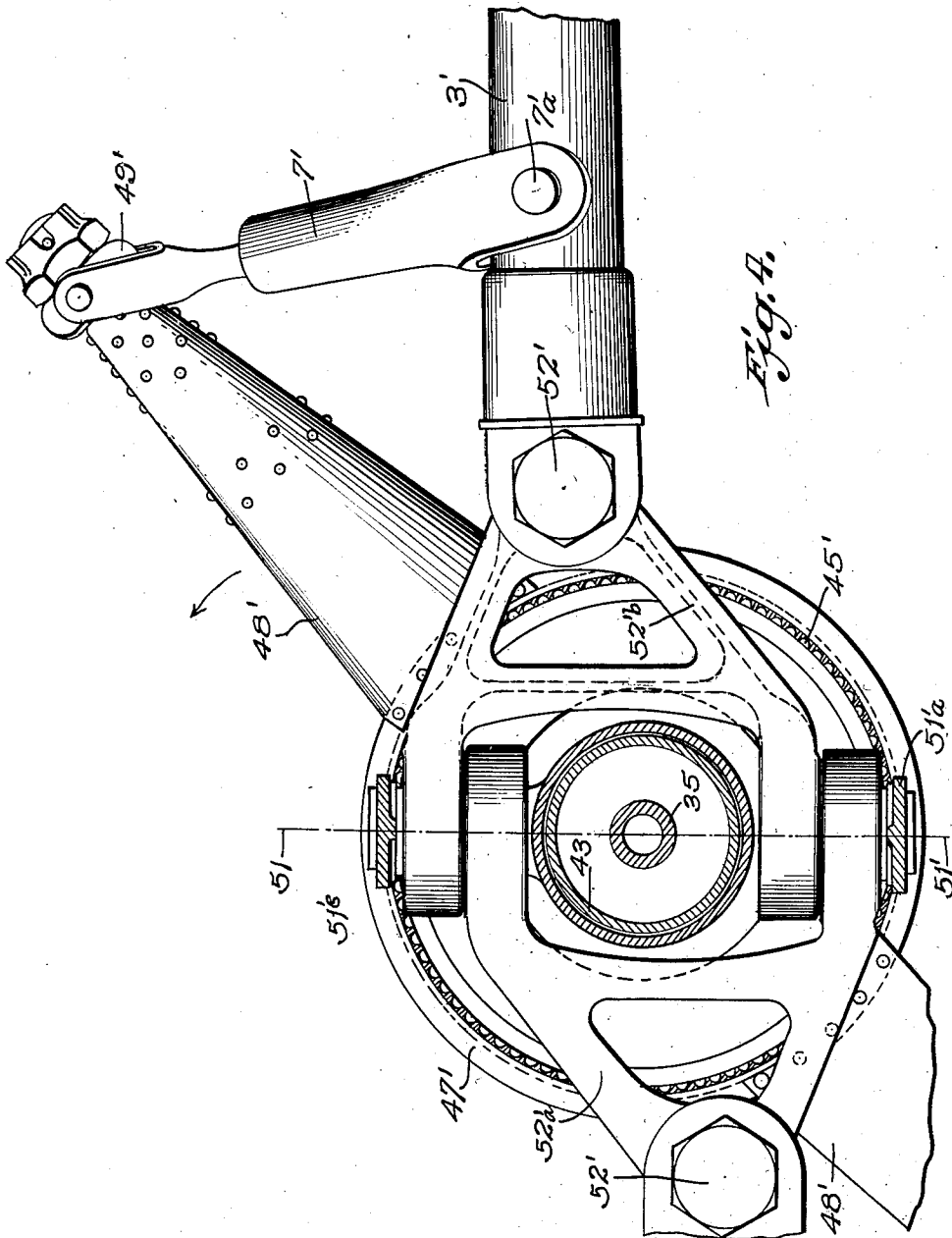


Fig. 4.

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Fig. 5

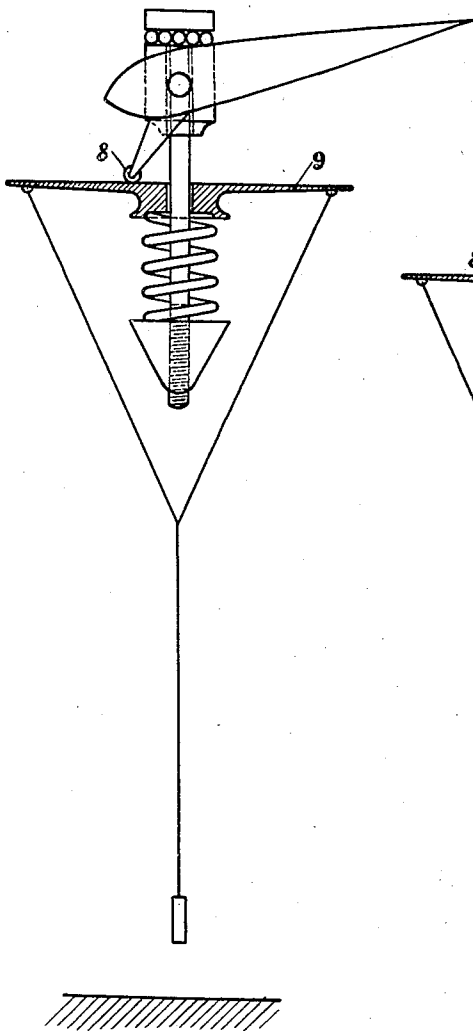
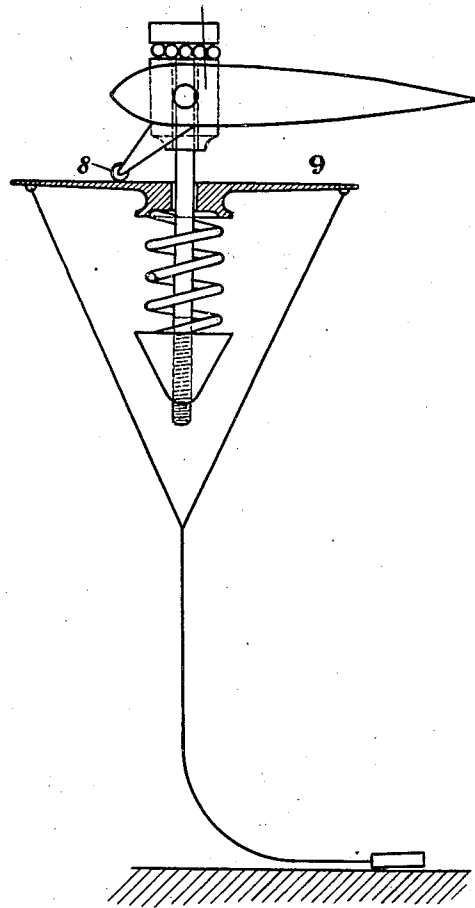


Fig. 6



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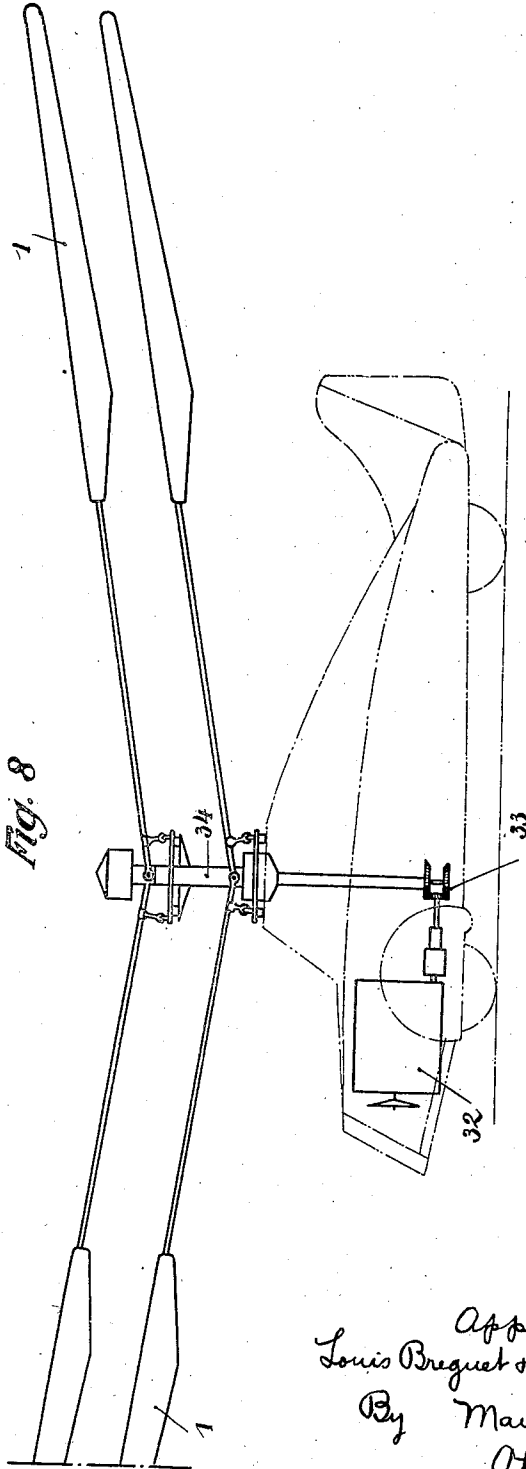
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UNITED STATES PATENT OFFICE

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FLYING MACHINE HAVING REVOLVING SUPPORTING SURFACES

Application filed May 14, 1931, Serial No. 537,438, and in France May 21, 1930.

Our invention has for its object improvements in the method and device for stabilizing, controlling and propelling flying machines having revolving supporting surfaces which may be either driven by an engine or adapted to rotate freely (gyroplane) as described in the U. S. patent application Ser. No. 436,144 filed March 15, 1930 in the name of Louis Breguet, said improvements making it possible to modify the angle of incidence of the wings of the supporting surfaces.

Said surfaces are given a rotary motion about a substantially vertical axis which may be orientable or not and passes close to the center of gravity of the flying machine. Furthermore, each of the wings or blades of the supporting surface is adapted to pivot about an axis at right angles to the main axis of revolution, this articulation being intended to allow each wing in particular to oscillate freely in a plane passing through it and through the main axis of revolution.

These revolving wings may oscillate about a radial axis of their frame according to an arrangement which is known and described in particular in the French Patent No. 395,756, filed October 28, 1908, in the name of Louis Breguet (page 2, lines 73 and following).

Finally the connection between said wings and the main axis of revolution may also comprise a third joint about an axis at right angles to the first one, so as to give them a further degree of freedom allowing them to pivot about three rectangular axes in space.

The principle of our present invention consists in guiding the motion of these wings and in varying their incidence with a view to obtaining in particular the following advantages:

1. Utilization of the power of the engine with the best possible efficiency for all conditions of flight.

2. Good equilibrium and stability of the machine for all conditions of flight.

3. Propulsion without need of tractor or pusher propellers.

4. As good a handiness as may be re-

quired without need of controlling surfaces or servo-motors.

5. Damping of atmospheric perturbations. Preferred embodiments of our invention will be hereinafter described with reference to the appended drawings, given merely by way of example, in which:

Fig. 1 is a diagrammatic partial perspective view illustrating the principle of our invention;

Fig. 2 is a diagrammatic view of the controls in the case of an apparatus having two sets of wings adapted to rotate about different axes of rotation;

Fig. 3 is a vertical section of a practical embodiment of the controlling system for the wings;

Fig. 4 is a partial horizontal section on the line 4—4 of Fig. 3, shown at an enlarged scale;

Figs. 5, 6 and 7 are diagrammatic views illustrating the action of a guide-rope adapted to be used for landing;

Fig. 8 is a side view of a flying machine provided with a system of revolving wings according to our invention.

The flying machine comprises a plurality of couples of wings or blades 1 each of which is rotated by a vertical shaft 2. In Fig. 1, only one blade 1 has been shown, and shaft 2 rotates in the direction of arrow F.

Shaft 2 may be driven by an engine or be adapted to rotate freely. Blades 1 are connected to shaft 2 by means of arms 3 articulated at 4 and disposed in a direction parallel to the edge of the wing. Articulation 4 may consist of a Cardan joint, a ball and socket joint or any other similar joint. In Fig. 1 we have shown another articulation 5 which may optionally be provided and serves to illustrate the possibility of folding the blades when the machine is at rest.

The end of arm 3 is horizontally journaled in a boss 6 of shaft 2. Blade 1 can thus pivot about a radial axis parallel to its leading edge and that rotary movement is controlled by a lever 7 carrying a roller 8 adapted to run on an annular plate 9 or engaged in a groove of said plate. The lat-

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ter, which can be actuated by the pilot, is adapted to move up and down along shaft 2 and to be inclined in any azimuth whatever. Any other mechanical system playing the same part as the roller running on a circular path or in a circular groove might as well be made use of. Lever 7 is located on the same side of joint 4 as blade 1. Furthermore roller 8 is ahead of arm 3 in the direction of the rotation of the latter.

1. Servo-motor effect of the driven plate.

The plate that serves to control the incidence is adapted to oscillate in any direction whatever about a sleeve 15 (Fig. 2) concentrically disposed with respect to the axis of rotation of the blades. Special controlling means make it possible to move up and down said sleeve in a direction parallel to said axis.

The blades being revolving in calm air with a given speed of revolution of the engine, the values for each azimuth of angles α (incidence of the blades) and β (inclination of arms 3 of the blades to the horizontal plane) depend merely on the reaction exerted by plate 9 (which is controlled by the pilot) on roller 8.

For the torque produced by the aerodynamic forces acting on the blade with respect to the axis of rotation formed by supporting arm 3 of the blade causes the roller to press down against the plate. Arm 3 will take a resultant position, its inclination β being proportional to the ratio of the vertical component of the aerodynamic resultant exerted on blade 1 to the centrifugal force. The pressure exerted by the roller on the plate will be a function of the aerodynamic reaction on the blade.

Each of the two opposed blades presses down on the plate at the ends of the same diameter. If the pilot lets the plate oscillate, said plate will oscillate in synchronism with the speed of revolution of the revolving blades so that the reactions exerted on the plate at opposite ends of one diameter may constantly balance each other, that is be equal.

It results therefrom that the thrusts on each of the blades are constantly equal, whatever the translatory speed of the system. The only reaction that will subsist will be the one exerted on the supporting sleeve, which is the sum of the elementary reactions of the rollers. The means through which the pilot can control the motion of said sleeve may include motion reducing arrangements with a ratio of reduction as great as will be required. Furthermore, if the arm of the roller carrying lever is long enough with respect to the distance between the center of thrust of the relative wind on the blade and the supporting axis of said blade, the forces and moments applied to the plate

by the controlling organs will be small, the efforts being reduced in the same ratio as that of the lever arms.

The reactions exerted on the hand of the pilot will be as small as it will be desired, as well for controlling the inclination of the plate as for controlling the vertical displacements of the sleeve.

Our system thus forms a servo-motor arrangement through which the pilot constantly feels the reactions of the air on the revolving blades, said reactions being considerably reduced, while on the other hand the blades transmit to the air the motions imparted by the pilot to the controlling organs, said motions being considerably amplified.

2. Adjustment of the working conditions.

The upward and downward movements of sleeve 15 about which plate 9 is adapted to oscillate make it possible to modify the pitch of the blades and thus to regulate the revolutions per minute of the engine by adapting the resistant torque applied to the blades to the torque of the engine which is controlled through the gas throttle.

Obviously that regulation of the revolutions per minute of the engine makes it possible to make use of the whole power that can be supplied by the engine running with the throttle wide open, whatever the conditions of flight may be, an advantage which can be obtained with ordinary airplanes only by providing them with a variable pitch propeller.

3. Stability with a variable wind.

The effect of accidental variations in the speed and the direction of the wind is greatly reduced because a variation of the angle of incidence of the blades automatically takes place, which opposes the detrimental effect that tends to occur.

If for instance an eddy, by increasing the air pressure on the under side of a wing, tends to cause it to move upwardly, the above described blade supporting mechanism is such that angle β increases, while angle α diminishes, these two variations having separately for their effect to reduce the angle of incidence of the blade and to nearly entirely compensate for the effect produced by the ascending eddy.

Furthermore, if plate 9, instead of being controlled through rigid means, is submitted to an elastic reaction from the control organs which opposes the action of roller 8, then, obviously, if the blade is given a supplementary thrust caused by an eddy, roller 8 is pressed against the plate, which is pushed down, and it results therefrom that the angle of incidence of the blade further diminishes, and the effect of the eddy is neutralized both by the elasticity of the sup-

ports of plate 9 and by the oscillation of arm 3.

4. *Gliding flight.*

Stoppage of the engine must not involve any risk of stalling of the blades, owing to a disconnecting system, which may be either controlled or preferably automatic, comprising catches or wedging rollers or any other suitable mechanisms, and their free rotation ensures an aerodynamic braking of the free downward motion. For if it is supposed that, following a decrease of the revolutions per minute of the engine, the blades have lost a part of their speed, the thrusts become stronger than the centrifugal force, and consequently angle β increases, and, as it has been already explained, owing to the position of the roller, angle α diminishes until it becomes negative.

Under these conditions, the wing is favorably disposed, in a position similar to that of a windmill wing, and the speed of revolution of the blades increases. Furthermore, the pilot has the possibility, by moving down plate 9, to reverse the inclination of the blades and to adjust them in the best possible position for the downward motion of the flying machine.

In order to obtain a braking of said downward motion at the time of landing, it suffices to push the plate upwardly. The vertical downward motion is thus braked due to the increase of the angle of attack of the blades, the driving torque at that time being produced by the living speed of revolution, that is by the inertia of the blades. That operation may be automatically performed by means of a guide-rope of given length (Figs. 5, 6 and 7) which is released during the downward motion when the flying machine is still far from the ground and whose weight acts in a downward direction on the plate. It will readily be understood that when the guide-rope comes in contact with the ground, the weight applied upon plate 9 begins to diminish, and consequently, owing to the above mentioned servomotor effect, a strong vertical reaction on the revolving blades takes place at the suitable height, which depends on the length of the guide-rope.

5. *Facility of handling the flying machine*

The moments applied by the organs that serve to control plate 9 being, as it has been explained, transmitted with a certain amplification to the circle swept over by the blades, it will be readily understood that any inclination given to the plate by the pilot will create a dissymmetry of the aerodynamic forces which will result in creating a horizontal force applied at the centre of the above mentioned circle and parallel to the direction of the inclination of the plate.

The couple generated by said force with

respect to the center of gravity of the flying machine produces an inclination of the latter which can be readily controlled by the pilot so as to enable him to maintain or modify the longitudinal and lateral equilibrium of the machine, while the horizontal force may be used either for propulsion or for balancing the centrifugal force in a turn.

6. *Case of two sets of wings revolving in opposite directions driven by an engine.*

When the revolving blades are driven by one or more engines, it is necessary to use a combination of two sets of blades constructed according to the above described arrangement, and rotating in opposite directions.

These blades may for instance be driven by two concentric shafts and are controlled through two independent plates.

The use of these two sets of blades rotating in opposite directions and directly driven through gear wheels, without necessitating the provision of a special organ for balancing the torque makes it possible:

A—To obtain the aerodynamic balancing of the resisting torques exerted by air on the blades. When it is desired to fly in a straight line, it suffices, by vertically operating in a differential manner the two sleeves 15 and 15' of Fig. 2 which carry the plates, to obtain the equality of the resistant torques of the two sets of blades.

B—To place the apparatus in the required direction as with a rudder.

For this purpose, a torque adapted to rotate the flying machine will be created by giving a smaller pitch to the set of blades which rotate in the direction of rotation that is desired.

C—To obtain propulsion by the action of the blade that rotates in the backward direction.

It suffices to incline the plates laterally in opposite directions so that the highest point of each plate may be on the side where the blades move backwards, in the vicinity of a plane at right angles to the direction of the motion and passing through the axis, the plates being thus laterally inclined in opposite directions.

It will be readily understood that when the roller passes on the highest part of the plate, it causes angle α to increase, and the blade which moves backwards strikes the air at a greater angle, thus giving rise to a greater horizontal component, which has for its effect to create a propulsion effect due to said blade.

Arrangement of the controlling organs.

The flying machine may be piloted and its conditions of flight regulated by operating plate 9 through rigid or elastic controls.

Our present invention preferably comprises a control arrangement such that the apparatus can be piloted in the same way as an airplane, by maneuvering levers such as a control stick or wheel, and an equalizing bar as are usually utilized in airplanes for controlling rolling and pitching, and direction.

Furthermore, two supplementary controls are provided in order to regulate during the flight the working conditions and the strength of the propelling force. One of these controls serves to actuate the sleeves that support the plates, and the other acts in a differential manner on the inclination of the plates, the differential control of the sleeves being connected to the direction control.

Fig. 2 diagrammatically shows by way of example a controlling system comprising elastic connections, adapted to be used with a flying machine having two sets of revolving blades adapted to rotate in opposite directions, said two sets of blades being preferably coaxial but being shown in Fig. 2 as mounted on separate axes, for the sake of clearness.

Plates 9 and 9' are supported through a Cardan suspension by sleeves 10 and 10' which surround the driving shafts.

Said plates can be inclined in a longitudinal or transverse direction by means of rigid controlling members 11, 11' and 12, 12' actuated through pivoting rings 13, 14 and 13', 14'.

According to the above explained properties of revolving blades according to our invention, the engine controlling means and the direction controlling means must act on the vertical displacement of the plates, while the propulsion controlling means and the rolling controls must act on the lateral inclination of the plates; only the means for controlling the pitching motion act on the longitudinal inclination of the plates.

The controlling arrangement according to our invention which is shown by way of example is characterized by the use of elastic devices and differential organs which make it possible to obtain a complete independence of the different controls that act on the plates.

Thus the elastic controlling means serving to regulate the working conditions of the engine, diagrammatically indicated in Fig. 2 by wheel 16, and springs 17, 18 and 18', which act on rods 19 and 19', exert on the two sets of blades a vertical action which is not modified by the differential action of the direction controlling means acting through differential 21.

Likewise, the elastic direction controlling means comprising wheel 22 and spring 23 acting on pivoted rings 13, 13' through adjustable rods 24, 24' exert on the plates

torques tending to incline them laterally in opposite directions so as to increase the angle of attack of the blades when they are moving in a backward direction, and the total action of said means is not modified by the differential action of the rolling controlling means operated through control stick 25 acting on rods 24, 24' through differential 26.

Finally, the pitching controlling means operated through control stick 25 act on differential 27 which applies to axes 28, 28' and to rings 14, 14' equal torques tending to incline the plates in the longitudinal direction.

It will be readily understood that the different rigid members such as 24, 24' and 28, 28' may be made in such manner as to render compatible the simultaneous operation of the various controlling means.

Articulations 29, 29' show in Fig. 2 the various degrees of freedom that must be given to these controlling means.

Accessorily, we may provide servo-regulating organs interposed in said controlling means.

For instance, in order to stabilize the working conditions of the engine, we may utilize a governor 30 the adjustment of which depends on the position of wheel 16 and spring 17, as shown in the figure. It will be readily understood that when the engine races, the governor increases the tension of springs 18 and 18' and consequently the angle of attack of the blades, which tends to counteract the initial racing.

Likewise, in order to ensure stability of direction, we may make use of an auxiliary vertical plane 31 whose angular displacements, produced by the reactions of the air when the flying machine is starting a curve, act in the required direction on springs 18 and 18' for producing a relative modification of the pitches of the blades which opposes said curve.

Figs. 3 and 4—4a show, by way of example, how the combination of mechanisms transmitting the power to the revolving blades can be so arranged as not to interfere with the displacement of the controlling elements acting on the plate.

Two concentric shafts rotating in opposite directions receive the power from engine 32 through a bevel gear 33, as shown in the general view of Fig. 8.

Fig. 3 is a detail view of the whole mechanism shown at 34 in Fig. 8.

Inner shaft 35 serves to transmit power to the upper set of blades.

Outer shaft 36 serves to transmit power to the lower set of revolving blades.

Pinions 37—37', 38—38' and 39—39' serve to transmit the rotary movement of said shafts to drums 40, 40' provided with internal teeth, and which serve to drive the upper and lower sets of blades.

Said drums or barrels are journaled,

through ball bearings and thrust bearings 41-41', 42-42' about hollow column 43 which is integral with the frame of the flying machine and which contains driving shafts 35 and 36 and forms a stationary support for the casings 44 and 44' of pinions 37, 38, 39 and 37', 38', 39' respectively.

Spherical members 46-46' (playing the same part as sleeves 10-10' of Figs. 1 and 2) are adapted to slide on column 43 and are provided each with a pivot 10a-10'a, about which can pivot a collar 46a-46'a. Said collars in their turn carry pivots 10b-10'b, at right angles to 10a-10'a so as to form a universal connection, and about which is pivotally mounted plate 9a-9'a (which plays the same part as plate 9 of Figs. 1 and 2). Each of said plates is connected through ball bearings 45-45' (playing the same part as rollers 8 of Figs. 1 and 2) to a jointed lever 7-48 and 7'-48', the two arms of which are connected through a swivel 49-49' (said jointed lever playing the same part as lever 7 of Figs. 1 and 2). The arms 7-7' are pivoted at 7a-7'a to the arms 3-3' of the blades. The upward displacement of plate 9a is obtained through four small rods such as 11a-11'a which are disposed by pairs at the ends of diameters at right angles and play the same part as cables 11', 12' of Fig. 2. Said rods are actuated by the pilot through suitable transmission means 11b-11'b, 11c-11'c, 11d-11'd, 11e-11'e. Bearings 45-45' upon which act the various control organs are thus capable of being inclined in any direction whatever, and can also be moved in a direction parallel to the axis of piece 43.

The outer elements 47-47' of bearings 45-45' carry the arms 48-48' which are jointed to arms 7-7' through swivels 49-49', the angle of attack of the blades depending on the position of said arms 7-7'.

The control organs are disposed inside column 43 so that they can extend through the plane of rotation of the lower set of blades. They act on bearings 45-45' through articulated systems such as 50-50', their arrangement being in accordance with the above description more particularly with reference to Fig. 2.

Arms 3-3' of the blades are secured to barrels 44-44' through axes at right angles 51-51' and 52-52' forming a universal joint for each arm (Figs. 3 and 4-4a) and playing the same part as joint 4 of Fig. 1. Axis 51-51', which is integral with barrel 40' extends through two projections 51a-51'a and 51b-51'b which serve to support it. On said axis 51-51' are pivotally mounted two stirrups 51a-52'a and 52b-52'b (Fig. 4-4a) which support the axes 52-52' of the arms 3-3' of the blades.

Arm 3 is pivoted about its own axis through a thrust ball bearing 53.

It should be well understood that the flying machine according to our invention may comprise additional fixed surfaces which are only subjected to the aerodynamic action of the relative wind which strikes them during their translation, the position of these surfaces being adjustable by the pilot in order to increase the stability of the system.

The two embodiments of the means for controlling the angle of attack of the blades, to wit the roller of Fig. 1 and the ball bearing with articulated arms of Fig. 4-4a have been given merely by way of example. They might be replaced by any other device ensuring a positive guiding of one end of the organ that serves to control the angle of attack of the revolving blades or wings.

While we have described what we deem to be preferred embodiments of our invention, it should be well understood that we do not wish to be limited thereto as there might be changes made in the arrangement, disposition and form of the parts without departing from the principle of our invention as comprehended within the scope of the appended claims.

What we claim is:

1. A flying machine of the type described comprising in combination, an upright shaft, two blades or airfoils radially disposed on either side of said shaft, an arm for supporting each of said blades substantially parallel to the leading edge thereof, two joints at right angles and a bearing for connecting said arm to said shaft, whereby said arm can rotate in any direction whatever with respect to said shaft and can revolve about its own longitudinal axis, and mechanical means for controlling during the flight the angular position of said arm about its own longitudinal axis.

2. A flying machine of the type described comprising in combination, an upright shaft, two blades or airfoils radially disposed on either side of said shaft, an arm for supporting each of said blades substantially parallel to the leading edge thereof, two joints at right angles and a bearing for connecting said arm to said shaft, whereby said arm can rotate in any direction whatever with respect to said shaft and can revolve about its own longitudinal axis, a guiding member slidably and pivotally mounted on said shaft, means for causing said member to slide along said shaft, and means for causing said member to oscillate about any axis passing through said shaft, and means connected to said arm and adapted to cooperate with said guiding member for controlling the angle of incidence of the blade.

3. A flying machine of the type described

comprising in combination, an upright shaft, two blades or airfoils radially disposed on either side of said shaft, an arm for supporting each of said blades substantially parallel to the leading edge thereof, two joints at right angles and a bearing for connecting said arm to said shaft, whereby said arm can rotate in any direction whatever with respect to said shaft and can revolve about its own longitudinal axis, a guiding member slidably and pivotally mounted on said shaft, means for causing said member to slide along said shaft, and means for causing said member to oscillate about any axis passing through said shaft, a lever rigidly connected to said arm, and one end of which is adapted to cooperate with said guiding surface for controlling the angle of incidence of the blade.

4. A flying machine of the type described comprising in combination, an upright shaft, two blades or airfoils radially disposed on either side of said shaft, an arm for supporting each of said blades substantially parallel to the leading edge thereof, two joints at right angles to each other and a bearing for connecting said arm to said shaft, whereby said arm can rotate in any direction whatever with respect to said shaft and can revolve about its own longitudinal axis, an annular plate slidably and pivotally mounted on said shaft, means for causing said plate to slide along said shaft, means for causing said plate to oscillate about any axis passing through said shaft, a lever rigidly connected to said arm, and a roller at one end of said lever adapted to run on said annular plate for controlling the angle of incidence of the blade.

5. A flying machine of the type described comprising in combination, an upright shaft, two blades or airfoils radially disposed on either side of said shaft, an arm for supporting each of said blades substantially parallel to the leading edge thereof, two joints at right angles to each other and a bearing for connecting said arm to said shaft, whereby said arm can rotate in any direction whatever with respect to said shaft and can revolve about its own longitudinal axis, a guiding member surrounding said shaft, a sleeve adapted to slide along said shaft, a universal joint for connecting said member to said sleeve adapted to allow said member to oscillate about any axis passing through said shaft, and means connected to said arm and adapted to cooperate with said guiding member for controlling the angle of incidence of the blade.

6. A flying machine of the type described comprising in combination, an upright shaft, two blades or airfoils radially disposed on either side of said shaft, an arm for supporting each of said blades substantially parallel to the leading edge thereof,

two joints at right angles to each other and a bearing for connecting said arm to said shaft, whereby said arm can rotate in any direction whatever with respect to said shaft and can revolve about its own longitudinal axis, a guiding member slidably and pivotally mounted on said shaft, means for causing said member to slide along said shaft, means for causing said member to oscillate about a transversal axis with respect to the flying machine, means for causing said member to oscillate about a longitudinal axis with respect to the flying machine, the three last mentioned means being adapted to operate independently of each other, and means connected to said arm and adapted to cooperate with said guiding member for controlling the angle of incidence of the blade.

7. A flying machine of the type described comprising in combination, an upright shaft, two blades or airfoils radially disposed on either side of said shaft, an arm for supporting each of said blades rigidly connected thereto and substantially parallel to the leading edge thereof, means for connecting said arm to said shaft allowing said arm to rotate about both an axis at right angles to said shaft and an axis parallel thereto and to revolve about its own longitudinal axis, a lever for each arm pivoted at one end to said arm in an oblique direction with respect to said shaft, a ring slidably and pivotally mounted on said shaft, means for causing said ring to slide along said shaft, means for causing said ring to oscillate about any axis passing through said shaft, an arm rigidly fixed to said ring and projecting outwardly therefrom, and a universal joint for connecting the end of the last mentioned arm to the other end of said lever.

8. A flying machine of the type described comprising in combination, an upright shaft, two blades or airfoils radially disposed on either side of said shaft, an arm for supporting each of said blades rigidly connected thereto and substantially parallel to the leading edge thereof, a stirrup pivoted to said shaft about an axis at right angles thereto, a bearing pivoted to said stirrup about an axis parallel to said shaft and adapted to receive said arm, whereby said arm is allowed to rotate both about an axis at right angles to said shaft and about an axis parallel thereto and to revolve about its own longitudinal axis, a lever for each arm pivoted at one end to said arm in an oblique direction with respect to said shaft, a ring slidably and pivotally mounted on said shaft, means for causing said ring to slide along said shaft, means for causing said ring to oscillate about an axis passing through said shaft, an arm rigidly fixed to said ring and projecting outwardly therefrom, and a universal joint for connecting

the end of the last mentioned arm to the other end of said lever.

9. A flying machine of the type described comprising in combination an upright shaft, a set of two blades or airfoils radially disposed on either side of said shaft, an arm for supporting each of said blades substantially parallel to the leading edge thereof, two joints at right angles to each other and a bearing for connecting said arm to said shaft, whereby said arm can rotate in any direction whatever with respect to said shaft and can revolve about its own longitudinal axis, a guiding member slidably and pivotally mounted on said shaft, means connected to said arm and adapted to cooperate with said guiding member for controlling the angle of incidence of the blade, another shaft, a second set of two blades or airfoils radially disposed on either side of said shaft, an arm for supporting each of said last named blades substantially parallel to the leading edge thereof, two joints at right angles to each other and a bearing for connecting said last named arm to said shaft, whereby said last named arm can rotate in any direction whatever with respect to said shaft and can revolve about its own longitudinal axis, a guiding member slidably and pivotally mounted on said shaft, means connected to said last named arm and adapted to cooperate with said last named guiding member for controlling the angle of incidence of the last named blade, differential means for causing said guiding members to oscillate simultaneously about a transversal axis with respect to the flying machine, differential means for causing said members to oscillate simultaneously about a longitudinal axis with respect to the flying machine, and differential means for causing said guiding members to slide simultaneously along said shaft, the three last mentioned means being adapted to operate independently of each other.

10. A flying machine of the type described comprising in combination an upright shaft, a set of two blades or airfoils radially disposed on either side of said shaft, an arm for supporting each of said blades substantially parallel to the leading edge thereof, two joints at right angles to each other and a bearing for connecting said arm to said shaft, whereby said arm can rotate in any direction whatever with respect to said shaft and can revolve about its own longitudinal axis, a guiding member, a sliding piece adapted to be moved along said shaft, two joints at right angles to each other for connecting said guiding member to said sliding piece, said joints being disposed in a longitudinal and in a transversal direction respectively, another shaft, a second set of two blades or airfoils radially disposed on either side of said shaft, an arm for sup-

porting each of said last named blades substantially parallel to the leading edge thereof, two joints at right angles to each other and a bearing for connecting said last named arm to said shaft, whereby said last named arm can rotate in any direction whatever with respect to said shaft and can revolve about its own longitudinal axis, a guiding member, a sliding piece adapted to be moved along said shaft, two joints at right angles to each other for connecting said last named guiding member to said last named sliding piece, said joints being disposed in a longitudinal and in a transversal direction respectively, adjustable means for causing said sliding pieces to move simultaneously in a vertical direction, a differential gear adapted to cooperate with said last mentioned means for exerting unequal actions on the two sliding pieces, adjustable means for causing said guiding members to pivot simultaneously about their longitudinal joint, a differential gear adapted to cooperate with the last mentioned means for causing unequal rotations of said guiding members about their longitudinal axes, means for causing said guiding members to pivot simultaneously about their transversal joints, and a differential gear adapted to cooperate with the last mentioned means for producing unequal rotations of said guiding members about their transversal axes.

11. A flying machine according to claim 10 further comprising a foot bar for operating the first mentioned differential gear, and a control stick for simultaneously operating the two last mentioned differential gears, so that the motion of said stick from side to side operates the second mentioned differential gear, while the fore-and-aft motion of said stick operates the third mentioned differential gear.

12. A flying machine of the type described comprising in combination, an upright shaft, two blades or airfoils radially disposed on either side of said shaft, an arm for supporting each of said blades substantially parallel to the leading edge thereof, two joints at right angles to each other and a bearing for connecting said arm to said shaft, whereby said arm can rotate in any direction whatever with respect to said shaft and can revolve about its own longitudinal axis, an annular guiding member slidably and pivotally mounted on said shaft, means for causing said member to slide along said shaft, means for causing said member to pivot about any axis passing through said shaft, a sleeve disposed in coaxial relation to said annular piece and adapted to rotate about its axis, a lever rigidly secured to said sleeve, a lever pivoted to the blade carrying arm about an axis at right angles to the longitudinal of said arm.

13. A flying machine of the type described

comprising in combination, an upright shaft, two blades or airfoils radially disposed on either side of said shaft, an arm for supporting each of said blades substantially parallel
 5 to the leading edge thereof, a drum provided with internal teeth coaxially disposed around said shaft, a plurality of gear wheels for transmitting the motion of said shaft to said drum, two joints at right angles to one
 10 another and a bearing for connecting said arm to said drum whereby said arm can rotate in any direction whatever with respect to said shaft and can revolve about its own longitudinal axis, a hollow column surrounding said shaft, a spherical member
 15 adapted to slide on said column, an annular guiding member, a universal joint for connecting said guiding member to said spherical member, means, passing through said
 20 column, for causing said guiding member to slide along said column and to pivot about any axis passing through said shaft, a sleeve disposed in coaxial relation to said annular
 25 piece and adapted to rotate about its axis, a lever rigidly secured to said sleeve, a lever pivoted to the blade carrying arm about an axis at right angles to the longitudinal axis of said arm, and a universal joint for connecting said two last mentioned levers.

14. A flying machine according to claim 13 further comprising a shaft coaxially disposed inside the first mentioned shaft and adapted to rotate in an opposite direction, and two blades or airfoils mounted on the
 35 last mentioned shaft in the same manner as the two first mentioned blades are connected to the first mentioned shaft.

15. A flying machine according to claim 2 further comprising a spring adapted to
 40 push said guiding member in an upward direction along said shaft, and a guide rope secured to said guiding member whereby the downward motion of the guiding machine is automatically braked when said machine
 45 is nearing the ground.

16. A flying machine of the type described comprising in combination, an upright shaft, a plurality of blades or airfoils radially
 50 disposed with respect to said shaft, an arm for supporting each of said blades rigidly secured thereto and substantially parallel to the leading edge thereof, means for connecting said arm to said shaft adapted to allow said arm, together with the corresponding
 55 blade, to rotate about an axis at right angles to said shaft and to revolve about its longitudinal axis, a lever for each arm operatively connected thereto so that its angular position is in fixed relation with the angular position of said blade about the
 60 longitudinal axis of said arm, and adjustable

means for causing the end of said lever that is ahead of said arm to describe a circle having its center on said shaft, means for varying the position of the plane of said circle in any direction, the angular relation between said lever and said blade being such that when the blade is rotated upwardly with respect to the shaft, the lever causes the angle of incidence of said blade to decrease.

17. A flying machine of the type described comprising in combination, an upright shaft, two blades or airfoils radially disposed on either side of said shaft, an arm for supporting each of said blades rigidly secured thereto and substantially parallel to the leading edge thereof, means for connecting said arms to said shaft adapted to allow said arm together with the corresponding blade to rotate about an axis at right angles to said shaft and to revolve about its longitudinal axis, a lever for each arm operatively connected thereto so that its angular position is in fixed relation with the angular position of the said blade about the longitudinal axis of said arm, and adjustable means for causing the end of said lever that is ahead of said arm to describe a circle having its center on said shaft, means for varying the position of the plane of said circle in any direction, the angular relation between said lever and said blade being such that when the blade is rotated upwardly with respect to the shaft, the lever causes the angle of incidence of said blade to increase.

18. A flying machine of the type described, comprising in combination, an upright shaft, two blades or airfoils radially disposed on either side of said shaft, an arm for supporting each of said blades rigidly connected thereto and substantially parallel to the leading edge thereof, means for connecting said arm to said shaft adapted to allow said arm to rotate about both an axis at right angles to said shaft and an axis parallel thereto and to revolve about its own longitudinal axis, a lever for each arm pivoted at one end to said arm in an oblique direction with respect to said shaft so as to extend in a downward direction in front of said arm, a ring slidably and pivotally mounted on said shaft, means for causing said ring to slide along said shaft, means for causing said ring to oscillate about any axis passing through said shaft, an arm rigidly secured to said ring in front of the first mentioned arm, and a universal joint for connecting the end of the last mentioned arm to the front end of said lever.

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