PROCEDURE FOR UTILIZING THE LIFT AND THRUST FORCES OF ORNITHOPTERS

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16. Abstract

This procedure is distinguished by two beating wings which together describe, in space, a succession of interlaced triangles. On these wings, whose incidence varies automatically, identical forces are exerted: simultaneous lift and thrust when they make their descent, which is inclined toward the front of the craft, and lift alone when they make their ascent, which is inclined toward the rear of the craft and follows a slide horizontal movement. A mechanical device makes these movements possible. It includes: two wings with hollow profiles, connected by a framework located above a rigid frame and attached to it by bars with joints. These bars are moved with control rods which gear down the drive force. A mechanism with elastic bands or springs automatically varies the incidence of the wings.

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The principal goal of this invention is a new procedure /1* for utilizing the lift and thrust forces inherent to the wings of ornithopter-type aircraft, characterized by the various movements made by two beating wings which together describe, in space, a trajectory representing a succession of interlaced triangles. During these various movements, identical forces are applied equally to each of the two beating wings, depending on the variation of this trajectory. The incidence of these two beating wings varies automatically as the craft functions; as they make their descent, which is inclined slightly toward the front of the craft with respect to the vertical, these wings permit simultaneous lift and thrust. Then, when they make their ascent, which is also slightly inclined and follows a slight horizontal movement toward the rear of the craft, these two beating wings allow lift without thrust. This new procedure permits an increase in the efficiency of the lift and thrust forces of the aforementioned craft while sufficiently reducing the detrimental rolling and pitching effects and also improving their flights, due to a considerable reduction in the drive power which is usually necessary for their operation. To make these various movements of the two beating wings, this invention uses several mechanical elements whose combination makes it possible to achieve the desired results. Thus, in order to achieve its goals, the procedure involves two beating wings connected to a rigid frame where the pilot is placed. These beating wings are placed horizontal and parallel to each other above the rigid frame, so that the center of gravity of the assembly is always located below them. A light framework connects each of these two wings by appropriate joints. A

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*Numbers in the margin indicate pagination in the foreign text.

mechanism with elastic bands or springs allows automatic variation of the incidence of each of these wings during operation. Jointed bars or tubes permit descending or ascending movements of these wings, since these jointed bars or tubes are connected to the aforementioned light framework and also to the rigid frame by several control rods used to gear down the /2 drive power of the craft, supported on the rigid frame by appropriate joints. These are some of the principle mechanical elements used in the invented procedure to achieve its goal. The status of technology in the sector considered is currently such that the known combinations which permit utilization of the lift and thrust forces of aircraft require very high consumption of drive energy for takeoff and to stabilize their flight; craft of precisely the ornithopter type have the principal inconveniences of significant detrimental rolling and pitching effects during operation which prevent them even from flying. The invented procedure consists of a new way to use the lift and thrust forces inherent to the wings of ornithopter-type aircraft. It is characterized principally by the various movements made by two beating wings which together describe, in space, a trajectory representing a succession of interlaced triangles.

During this trajectory, identical forces are exerted equally on each wing. The incidence of these two beating wings varies automatically as the craft functions; as they make their descent, which is inclined slightly toward the front of the craft with respect to the vertical, these wings permit simultaneous lift and thrust. Then, when they make their ascent, which is also slightly inclined and follows a slight horizontal movement toward the rear of the craft, these two beating wings allow lift without thrust. This new procedure thus permits an increase in the efficiency of the lift and thrust forces of the aforementioned craft.

The invented procedure makes it possible to considerably

reduce the drive power necessary for flights of the aircraft, which is an important advantage. This procedure also permits, for example, building and flying a machine heavier than air, possibly powered by human muscular force or by a very low power motor. The aforementioned procedure uses, in effect, all /3 movements and functions necessary for obtaining a maximum positive result with respect to the lift and thrust of an aircraft with low drive power. Another advantage of this procedure is its mechanical construction, principally taken from an original design which sufficiently reduces the pitching and rolling effects which are detrimental to the operation of the craft, making it possible and easy to pilot the craft to which it is applied.

This original mechanical design includes, among other necessary elements, two beating wings which together make two particular movements, descending and ascending, slightly inclined with respect to the vertical.

Thus, these two wings make specific and alternating movements--first descent, then ascent--each having two directions. During descent, their movement is from the top to the bottom of the craft with a slight inclination toward the front of it. This movement is positive for the two wings, due to the air streams caused by the fact that their incidence varies automatically during operation. It is positive because it permits these two wings to rationally use the laws of fluid mechanics and aerodynamics by creating pressure on the inner section and lack of pressure on the outer section, as well as simultaneous lift and thrust, assuring efficient takeoff and vertical flight of the craft. During this descent of the two wings, the simultaneous realization of lift and thrust following a variable angular trajectory toward the top and front of the craft is comparable to (and advantageously replaces) the action of several propeller blades, each with a large pitch angle and wide thrust. During the descent of these two wings, another

advantage is that, if the craft is propelled, for example, by human muscular force or some other very low-power force, energy is saved during significant acceleration. In effect, this phenomenon can be compared with that produced by a dump-car sliding on an inclined rail and under which is suspended, by a cable directly fastened to this car, a man who is constantly /4 making the muscular effort to lift himself toward it; this increases the weight effect, and by transformation of this weight effect, causes an increase in the downward speed of the car, which has a base sliding on the rail. Thus, to make its vertical flight, the craft according to the invention constantly uses the force of weight like the aforementioned dump-car, in addition to its means of lift and thrust. As for the movement of these two beating wings during ascent, after they have positively made a slight horizontal movement toward the rear of the craft, notwithstanding automatic and appropriate variation of their incidence, these two wings follow directions inverse to those followed previously during their descent. At this time, these two beating wings achieve only lift without thrust, which maintains the craft at its altitude for an instant, like a simple glider which maintains its altitude for as long as possible until its descent, gliding on the ambient air; this also permits an acceleration of the craft following the importance of its angle of descent. These two beating wings, during ascent, thus have a function comparable to that of simple gliding wings, with a slightly positive incidence and enough lift to maintain the craft as long as possible at and as close as possible to the altitude reached by the preceding descent of the wings.

According to certain methods of using the invented procedure, and in order to create the best thrust conditions, each of the two beating wings of the craft has a hollow profile. However, according to other methods, these two beating wings can be covered with just a simple solid cloth which forms a sort of hollow sack and whose bearing surface, seen from above, has a

trapezoidal shape with three edges. Two of these edges have triangular shapes, and the third, to which the other two are connected, also has a trapezoidal shape. When this cloth is stretched by an appropriate rigid and light framework, a wing surface with a hollow inner section is formed. /5

These two mobile wings are placed horizontally, one behind the other, and parallel and are each connected by joints to the assembly of a rigid and light framework made partially of a tube. These two wings also have the following characteristic: they are placed in such a way that they are always located above a rigid frame where the pilot is placed. One wing is set toward the front, the other toward the rear of this rigid frame, so that the center of gravity of the craft is always located below these mobile wings.

During operation, each of these wings nears the front of this rigid frame when descending and moves away from it when ascending. Each of the two beating wings also has a device which permits automatic variation of its incidence or curvature.

This device is necessary so that, during operation of the craft, these two wings achieve simultaneous lift and thrust while descending and only lift without thrust while ascending. This device is composed of a mechanism with elastic bands or springs and automatically varies the incidence of these wings in addition to returning them to the original position they held before descent.

These elastic bands or springs are attached to the rigid frame of the craft and to several control rods fastened to it, and are also attached to the light framework to which the two beating wings are connected.

These elastic bands or springs are also attached to the jointed bars or tubes, which permit the ascending and descending

movements of the aforementioned light framework, and to each of the two wings.

A characteristic which is also very important is that these lift and thrust forces are obtained very easily by use of the effective action of several control rods included in the mechanical design of the aircraft to achieve the invented procedure. These control rods are supported on the rigid /6 frame of the craft; they activate and control the important elements of the design, which are composed of several bars or tubes linked to the light framework which supports the wings. These important elements are thus moved by the control rods from the top toward the bottom and then from the bottom toward the top of the assembly, which permits alternating movements, either descending or ascending, of the beating wings with respect to the rigid frame of the craft.

The invention is also distinguished by the effects of lift and thrust obtained simultaneously when the two mobile wings of the craft descend, because these effects produce a more advantageous result than those produced by current methods whereby most craft have low drive power and a propeller and are seeking the same goal, i.e. lift and thrust. This is because the two aforementioned mobile wings eliminate the negative effect of the resistant control arms which a rotating propeller normally has. These two mobile wings thus produce a better result than a propeller, due to a better-balanced redistribution of the usable forces; the wings themselves, when descending, achieve the effects of lift and thrust. The rigid frame of the craft has a mechanism which activates the various control rods and which can be powered by human muscular force in some applications and by a low-power motor in others. This mechanism is either a pedal assembly or device with similar function, or a crankshaft. This mechanism also includes several small connecting rods which link the pedal assembly, crankshaft, or similar device to the various control rods. This mechanism can

also have a system of grooves to better guide the connecting rods in their back-and-forth movement.

This mechanism is powered by human muscular force or by a low-power motor. A standard device, including depth and direction controls for better maneuverability of the aircraft during flight, can be linked to the aforementioned rigid frame and fastened behind it. Wheels can also be attached to this rigid frame to act as landing gear. Other goals and /7
characteristics of the invention will be revealed in the following description, with reference to the attached schematic drawings which represent a non-limiting example of one method for using this invention, as well as two different models of usable wings.

Figure 1 is a schematic profile view of an example of the mechanical device which permits application of the invented procedure.

Figures 2 and 3 schematically show two different models of wings which can be used for the invented procedure. In Figure 1 we see the schematic assembly of the mechanical device which permits application of the invented procedure, viewed in profile.

This device includes a rigid frame A on which the pilot is placed and on which are installed all of the other elements of the device which permit the assembly to fly.

B and B' show two beating wings which are placed one behind the other, horizontal and parallel. A light framework C links the wings B and B' by appropriate joints D. The light framework C here is partially made from a tube. Bars or tubes E are attached to the framework C and to the control rods F by appropriate joints D. They permit movement, either descending or ascending, of the wings B and B' linked to the framework C.

These bars or tubes E are placed perpendicular to the rigid frame A and to the light framework C.

The control rods F are attached by appropriate joints D to the rigid frame A and are used to gear down the drive power of the craft. These control rods F are supported on the rigid frame A.

A mobile mechanism G with elastic bands or springs H is attached here to the bars E, to two ends of the control rods F, to the rigid frame A, and to the wings B and B' and the framework C. During operation, the mobile mechanism G permits automatic variation of the incidence of both wings B and B'.

A type of long pedal I, attached by an appropriate joint D to the rigid frame A and to the control rods F by several small connecting rods J, is activated by any driving force: either /8 the muscular force of the pilot or a low-power motor. This pedal I activates the control rods F, and thus the craft, through the connecting rods J.

In Figure 2 we see a view from above of the two beating wings B and B' linked by the light framework C.

The shape of each of these wings B and B' here is trapezoidal on the outer section. Each wing obviously has three edges which are not shown here, of which two are triangular in shape and the third, to which the other two connect, is also trapezoidal in shape. After the cloth is stretched by the appropriate framework C, this forms a wing with a hollow inner section permitting excellent thrust.

In Figure 3 we see a profile view of another method of building the two wings which can be used for the invented procedure. Here these two beating wings B and B' are ordinary wings, each with a hollow profile. For more appropriate

automatic variation of the incidence of these two wings B and B', they have elastic bands or springs H and joints D, which are also attached to the light framework C.

The invented procedure can be applied to new aircraft such as ornithopters.

CLAIMS /9

1. New procedure for utilization of the lift and thrust forces inherent to the wings of ornithopter-type aircraft, distinguished by the various movements made by two beating wings which together describe, in space, a trajectory representing a succession of interlaced triangles. During this trajectory, identical forces are exerted equally on both wings. The incidence of these two beating wings varies automatically as the craft functions; as they make their descent, which is inclined slightly toward the front of the craft with respect to the vertical, these wings permit simultaneous lift and thrust. Then, when they make their ascent, which is also slightly inclined and follows a slight horizontal movement toward the rear of the craft, these two beating wings allow lift without thrust. This new procedure permits an increase in the efficiency of the lift and thrust forces of the aforementioned craft while sufficiently reducing the detrimental rolling and pitching effects and also improving their flights, due to a considerable reduction in the drive power which is usually necessary for their operation.

   To make these various movements of the two beating wings, this invention uses several mechanical elements whose combination makes it possible to achieve the desired results. Thus, in order to achieve its goals, the invented procedure involves two beating wings B and B' connected to a

rigid frame A where the pilot is placed. These beating wings B and B' are placed horizontal and parallel to each other above the rigid frame A, so that the center of gravity of the assembly is always located below them. A light framework C connects each of these two wings B and B' by joints D and elastic bands or springs H. A mechanism G with elastic bands or springs H permits automatic variation of the incidence of each wing during operation. Jointed bars or tubes E permit descending or ascending movements of these wings, since these jointed bars or tubes E are connected to the aforementioned light framework C and also to the rigid frame A by several control rods F used to gear down the /10
drive power of the craft, supported on the rigid frame A by joints D. These are the principle mechanical elements used in the invented procedure to achieve its goal.

2. Procedure as in claim 1, distinguished by the use of a mechanism G with elastic bands or springs H, permitting automatic variation of the incidence of each of the beating wings B and B' during their descending or ascending movements, and returning them to the original position they held before descending.

These elastic bands or springs H are connected to the rigid frame A and to the control rods F of the craft and also to the light framework C, to which the two beating wings B and B' are connected. They are also connected to the jointed bars or tubes E, which permit descending or ascending movements of the aforementioned light framework C, and to each of the beating wings B and B'.

This mechanism G which permits automatic variation of the incidence of these two wings B and B' is necessary to achieve the various lift and thrust effects which must be exerted on the wings depending on their descending or ascending movements.

3. Procedure as in claim 1, distinguished by the achievement of the lift and thrust forces inherent to two beating wings B and B' which are moved by utilizing the effective and simple action of several control rods F, which are supported on the rigid frame A of the craft where the pilot is placed. These control rods F activate the jointed bars or tubes E connected to the light framework C which supports the two wings, thereby permitting the alternating descending and ascending movements of the wings with respect to the rigid framework A.

4. Procedure as in claim 1, distinguished by the utilization of beating wings whose profile must be hollow or have the same advantages as a hollow profile with regard to thrust.

5. Procedure as in claim 1, distinguished by the original /11
effects of lift and thrust exerted simultaneously on two beating wings B and B' during their descent. This eliminates the detrimental effects of resistant control arms caused by the use of a propeller in other cases. This is due to a redistribution of these lift and thrust forces on the two wings, exactly balanced with the human muscular or low-power motor drive force of the aircraft.

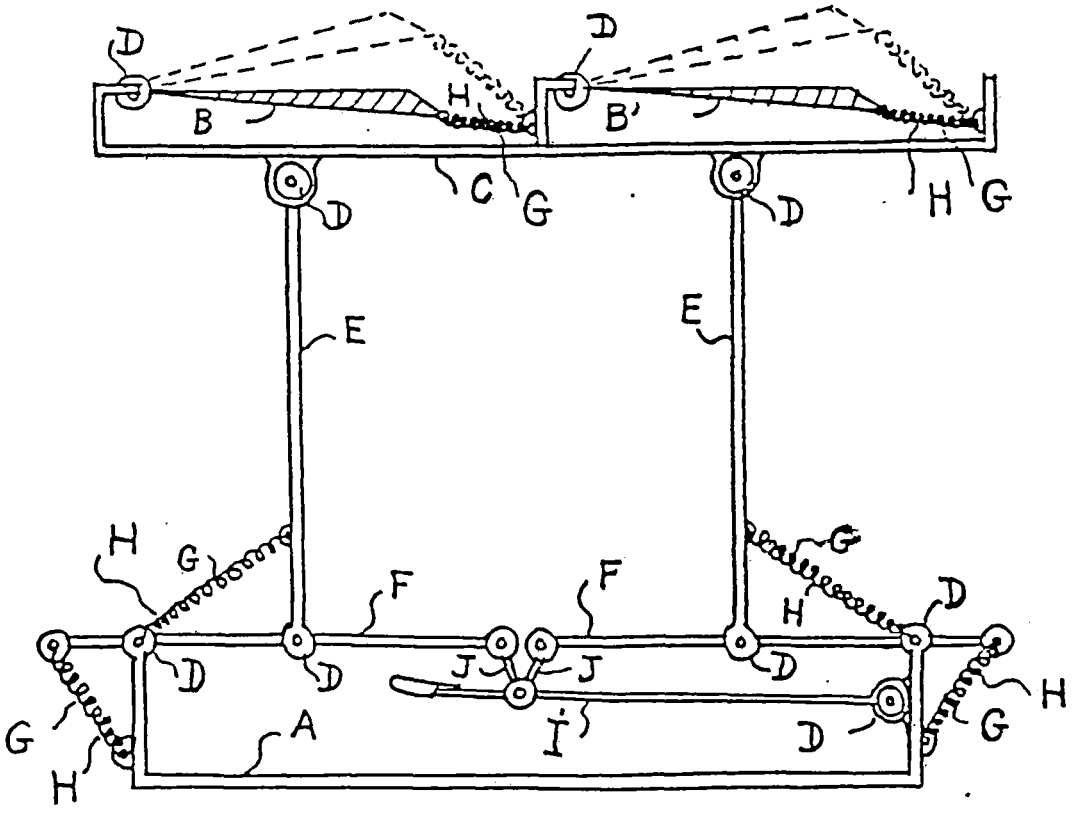

FIG.1

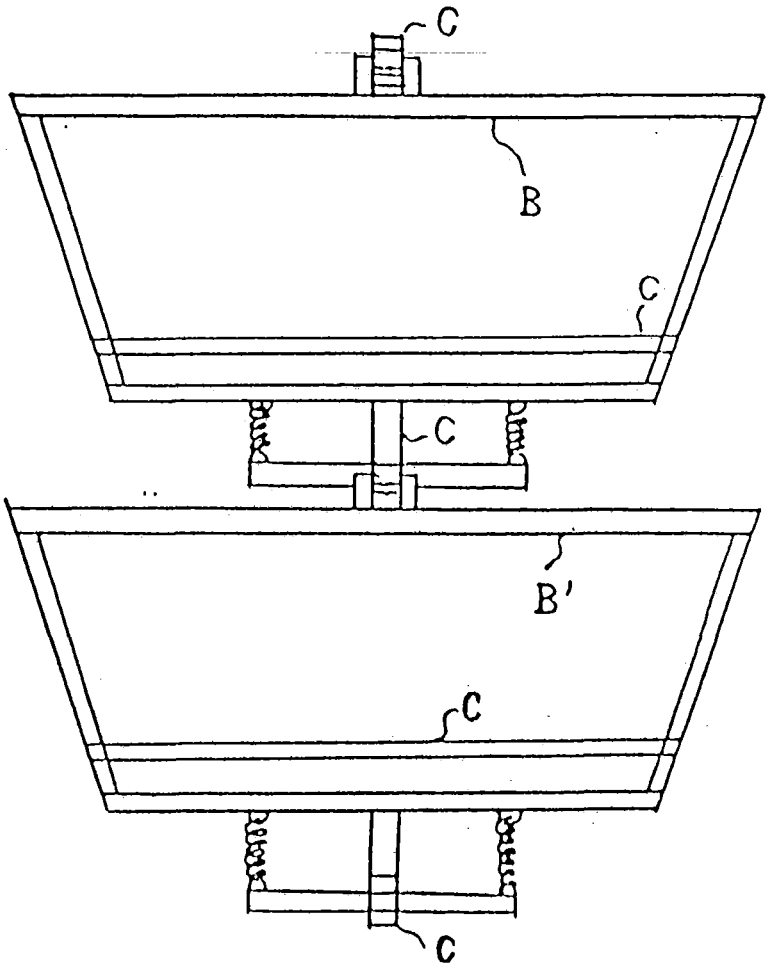

FIG.2

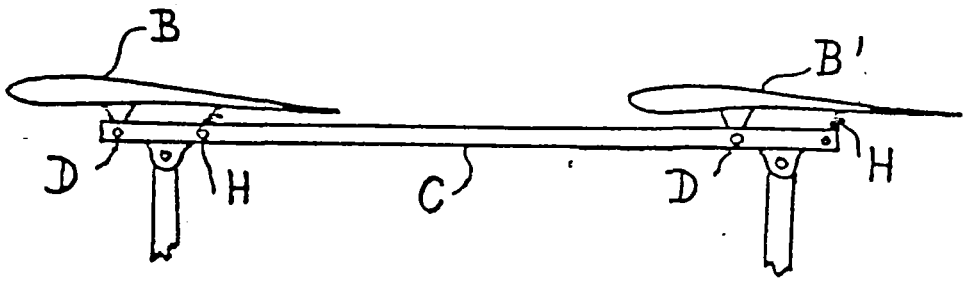

FIG.3