May 30, 1933. R. P. PESCARA 1,912,354

SINGLE CONTROL WITH REFLEX ACTION FOR HELICOPTER TYPE FLYING APPARATUS

Filed Dec. 24, 1930 2 Sheets-Sheet 1

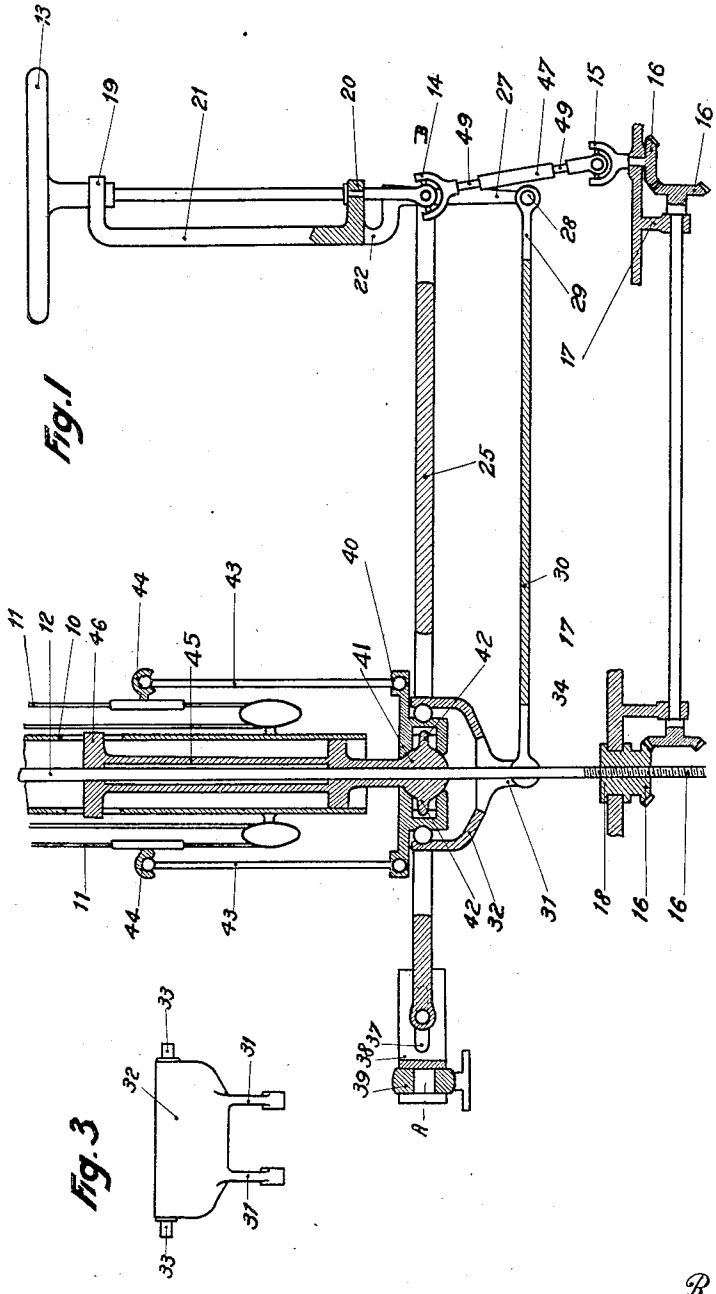

Fig. 1

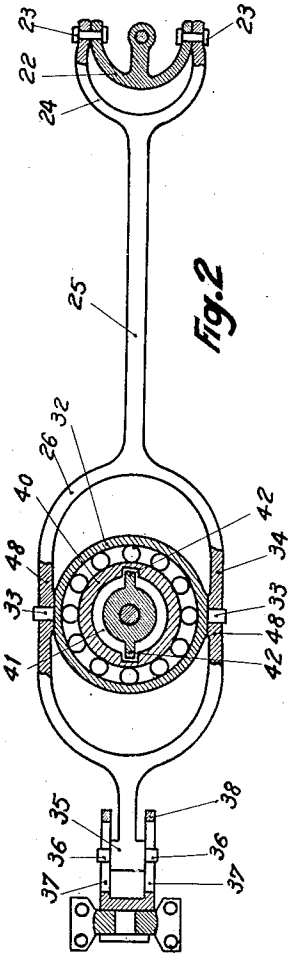

Fig. 2

Fig. 3

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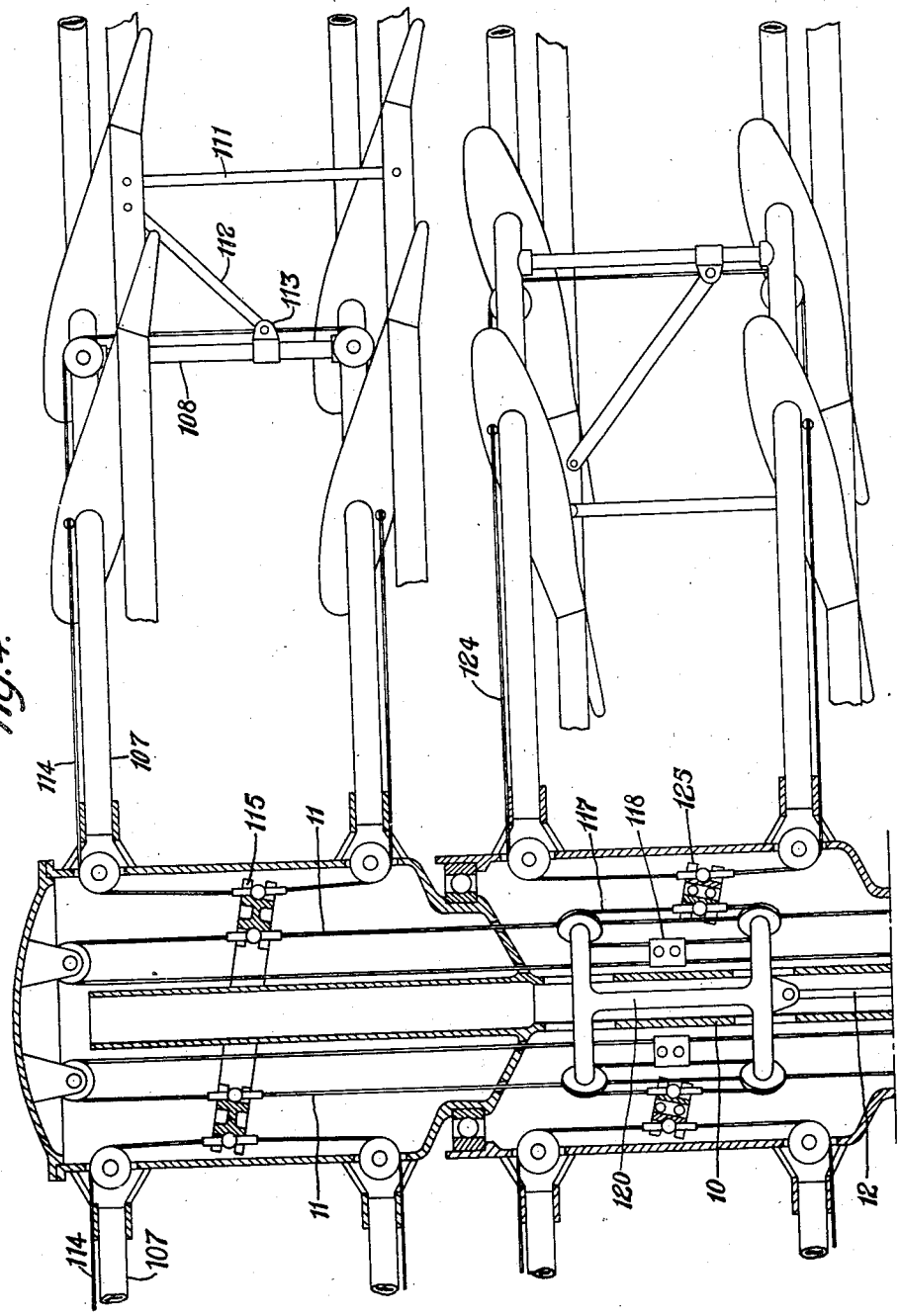

Fig. 4.

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UNITED STATES PATENT OFFICE

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SINGLE CONTROL WITH REFLEX ACTION FOR HELICOPTER TYPE FLYING APPARATUS

Application filed December 24, 1930, Serial No. 504,588, and in Spain December 30, 1929.

The invention relates to a single control, with reflex action, for apparatus of the "Helicopter" type, and more particularly for apparatus of this kind which are fitted with two co-axially arranged sustaining helices, with variable incidence, turning in opposite directions.

It has for its principal object to simplify the controls of the said apparatus.

It consists essentially in combining in one single control device the three following actions, which must be exercised on the sustaining helices by means of either fixed or turnable elements.

1. The general simultaneous variation of the angle of incidence of all the helices, for the rising operations, the descent and for remaining without movement in a fixed point of space, that is hovering.

2. The periodic differential variation of incidence of the sustaining helices, to create in any plane passing through the axis of gyration of the said helices a warping couple serving to effect the stabilization of the inclination of the apparatus.

3. The differential variation of the incidence of the helices turning in opposite directions, which creates a disparity of the resisting couples of these helices, a disparity which, transmitted to the nacelle or body which they support, cause it to turn around the axis of gyration of the said helices, thus producing stability of tilting.

The invention consists furthermore in rendering reflex the actions which the pilot exercises on the single controlling device, imparting to it a rising movement for the ascent, a downward movement for the descent, and of tilting parallel to the subsequent plane to which it is suitable to incline the apparatus and in the direction of this inclination; finally in making it turn on itself in the direction which the nacelle or body of the apparatus must turn.

In addition to these general arrangements; the invention consists more especially in diverse other arrangements particularly described hereafter, to which, as well as to all devices utilizing its principles or its elements, the protection of the present patent must extend.

In every way, the invention will be easily understood with the aid of the explanations which follow and from the annexed drawings, which must be considered only as examples of its application.

Fig. 1 represents the arrangement of the controlling apparatus, seen from the front and partly in section.

Fig. 2 represents the same arrangement seen in plan and partly in section through A B, omitting several parts for greater clearness of drawings.

Fig. 3 is a detail of an important element.

Fig. 4 diagrammatically illustrates the two superposed helices with their connections to the control mechanism shown in Fig. 1.

According to the invention and more particularly to the most complicated constructional embodiment which can be shown, assuming that one has an helicopter lifted by two superposed helices turning in opposite directions, the control of said helices consisting for example of circuits turning with one of said helices.

In the drawings, 10 is the shaft which turns with the upper helix, 11 two of the circuits which impart at the same time to the blades of both helices, the movements of equal or differential variation of incidence and 12 a sliding rod which imparts to the blades of one helix only movements of equal variation of incidence, and so gives rise to a difference between the resultant couples of both of the helices, a difference which causes the aircraft to execute a turning movement.

I will fit a control wheel (13), that the pilot can turn in all directions, which communicates its movement of gyration by means of cardans 14 and 15, connected respectively by 47 and 49 which slide one upon the other when the said cardans 14 and 15 approach or recede the one from the other, to a system of bevel gearing 16, supported by brackets 17 fixed to the nacelle of the apparatus. One of the bevelled pinions is integral with a piece 18 provided with a groove which supported by the bracket can only have a movement of

rotation. The said piece 18 is screw threaded on the interior and traversed by the screw threaded rod 12 already referred to.

The spindle of the wheel 13 turns in two bearings 19 and 20 which form part of a lever 21 terminated by a fork 22 jointed at 23 on another fork 24 forming part of a lever 25, of which mention will be made hereafter. The centre of the cardan 14 will be disposed advantageously at the point of intersection of 25 and of the axis of the control wheel. The fork 22 is extended by 27 and is jointed at 28 with another fork 29 of a connecting rod 30, which carries at its other extremity another fork 34 jointed at 31 on a bell shaped casing 32 hereafter referred to.

The lever 25 comprises a ring 26 provided with two bearings 48 in which pivot the stub axles 33 of the bell shaped casing 32.

On an extension of the ring 26 of the lever 25 is the piece 35, provided with stub axles 36 which can turn and slide in the guides 37, of a piece 38 adapted to turn in a bearing 39 and having a groove to support the piece 38 at its extremity. The said bearing 39 is fixed to the nacelle or body.

The bell shaped casing 32 carries on its interior a piece 40 supported by a ball bearing. This piece is provided with a groove in which is adapted to be housed a sphere 41 adjusted so as only to take up movements of rotation, in reference to 40. To maintain it in position, the cylindrical stub axles 42 are introduced in grooves disposed in 40. It is to be understood that the bell shaped casing can tilt into various positions by turning around the centre of the sphere 41.

The sphere is prolonged by a body 45 which slides on the interior of the shaft 10 and carries projecting parts 46 which are introduced into the slots of the said shaft. The sphere and this body can only be displaced vertically with relation to the shaft 10.

To the piece 40 are connected rods 43, which carry a ball at each of their extremities. These balls are introduced into housings of the piece 40 for the lower balls and of the piece 44 for the upper balls, and constitute elbow joints.

The pieces 44 are connected to the cables 11 hereinbefore referred to.

The circuits 11 which turn with the upper helix control, by the intermediary of a piece 115, pivoted to the cardan, the blades 114 of the upper helix. Each of these circuits causes pieces 113 to slide on the uprights 108. On the pieces 113 are articulated cranks 112, themselves articulated on the rear part of the blades. Pivoted uprights 111 conjugate the upper and lower blades of a single helix forming with them and with the uprights 108 articulated parallelograms. The blades themselves being able to turn on the tubular longerons 107, it will be understood that all displacement of the circuits 114 causes a variation of incidence of the blades.

This variation will be simultaneous in all the blades if the ring 115 is perpendicular to the axis of the helicopter, it will be on the contrary, periodic if the ring is oblique as is represented in Fig. 4.

The circuits 124 of the lower blades control in the same way these latter, but, turning in a contrary direction from the upper helix, these circuits are controlled by an intermediary piece 125 composed of two rings articulated to the cardan and being able to turn the one on the other.

The piece 125 is controlled by intermediary circuits 117, mounted on a chassis 120 controlled by the rod 12; the circuits 117 are fixed to a blade of the circuits 11, in such a way that if the rod 12, and consequently the chassis 120, are fixed, the circuits 114 transmit the same movements to the upper and lower blades.

On the contrary, if the circuits 11 are fixed and if the chassis 120 is displaced by means of the rod 12, the piece 125 will be displaced twice as much as the piece 12, only driving the circuits of the lower helix.

The following explains how the three operations indicated are effected.

1. The pilot raises or lowers vertically the control wheel 13, and moves 25 which pivots on the axles 36 which in their turn slide in 37, and the bell shaped casing 32 which forms with the levers 27, 25, 30 an articulated parallelogram, can only be displaced vertically.

The bell impelled in a vertical trajectory; communicates its movement to the pieces 44 which move equally the cables of all circuits 11 causing a general variation of incidence of the blades of the helices, increasing in order to rise, raising the control wheel 13, and diminishing to descend, lowering it, constituting thus a control of reflex action.

As the bell shaped casing moves without taking a new tilt, the circuits or cables 11 move the same amount and the variation of incidence is the same for all the blades. On the other hand, the cardans do not turn, and the only thing which is produced is the sliding of the rods 47 and 49.

2. In setting or turning the lever 21 in any direction the bell 32 is set in a direction normal to this latter, causing a periodic differential warping in the blades of the helices, giving rise to a stabilization couple for the inclination of the apparatus, which makes it turn into a plane passing through the axis of gyration of the sustaining helices and parallel to the lever 21, in the same direction in which the lever has been turned, constituting thus a control by means of reflex action.

3. The pilot turns the control wheel 13, 14 and 15 turning also, the gearing 16 communicates to 18 a movement of rotation and, as

this piece is supported by its groove, the piece 12 which traverses it in the form of a screw is caused to rise or descend, making the incidence of a single helix vary in accordance with the description of Fig. 4 before referred to. There is given to the screw 12 a right or left thread according to the case for which the variation of incidence is made in the direction necessary in order that the nacelle is tilted in the direction in which the control wheel turns, in order to constitute a control by reflex.

These operations do not involve a change in the position of the bell shaped casing, this latter does not transmit any movement to the circuits or cables 11.

Naturally, the invention is not limited strictly to the constructional embodiment above described, but on the contrary, in its application admits of every kind of variation.

What I claim and desire to secure by Letters Patent of the United States of America is:—

1. Control means for helicopter type flying machines having a plurality of coaxially arranged sustaining helices with variable incidence, rotating in opposite directions, said means including a single control member supported by a lever pivotally attached to a fixed part of the machine, said member having associated therewith means to vary the incidence of a single helix on rotary movement of the control member, additional means being associated with said control member to cause a general variation of incidence of the blades of both helices upon a vertical movement of the control member.

2. Control means for helicopter type flying machines having a plurality of co-axially arranged sustaining helices with variable incidence rotating in opposite directions, including a lever pivotally attached to a fixed part of the machine, a single control member pivoted on said lever, said control member being connected to a vertically slidable rod for transmitting movement to vary the angle of incidence of the blades of one of the helices upon rotary movement of the control member which latter is also connected to a bell-shaped casing pivotally mounted in the lever supporting the control member, movement of the bell-shaped casing operating circuits to simultaneously impart to the blades of both helices movements of equal or different variations of incidence in accordance with vertical movement of the control member.

3. Control means as claimed in claim 2, in which the control member is connected to the bell-shaped casing by a connecting rod, which control member with the sliding rod and pivotally mounted supporting lever constitutes an articulated parallelogram.

4. Control means for helicopter type flying machines having a plurality of coaxially arranged sustaining helices with variable incidence, rotating in opposite directions, such means consisting of a single control member supported by a lever attached to a fixed part of the machine, said lever also supporting a shaft which rotates with the upper helix, said shaft having associated therewith circuits to control the variation of incidence of the said helix, the shaft being supported by a bell-shaped casing pivotally mounted on the lever supporting the control member, means being provided to vary the angle of incidence of the blades of the said helix in accordance with rotary movement of the control member.

5. Control means as claimed in claim 4 in which the bell-shaped casing supports a member attached to the circuits by rods, which latter displace the circuits in accordance with angular movement of the bell-shaped casing, for the purposes described.

6. Control means as claimed in claim 2, in which the vertically slidable rod has associated therewith a chassis for operating the circuits for controlling the movements of the blades of the helices, the said circuits imparting tilting movements to the sustaining helices through the intermediary of rings articulated within the supports for said helices.

7. Control means as claimed in claim 2, in which the means for imparting a vertical movement to the sliding rod in accordance with rotary movement of the control member, includes an internally threaded bevel wheel co-operating with a screw thread on one end of the slidable rod, said bevel wheel being driven by a further bevel wheel rotatably connected with said control member.

In witness whereof I affix my signature.

RAUL PATERAS PESCARA.