

March 4, 1958

H. C. J. FOCKE

2,825,514

COMBINED AIRPLANE-HELICOPTER FLYING MACHINE

Filed Feb. 19, 1954

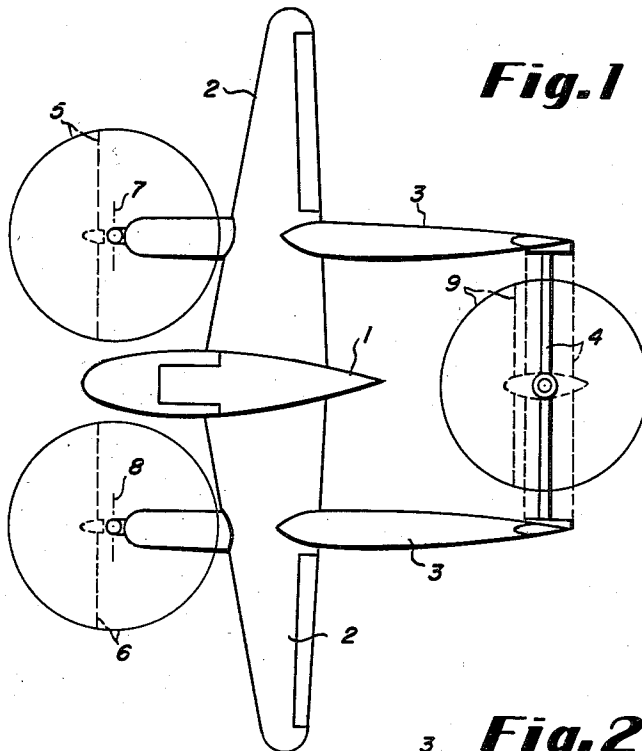


Fig. 1

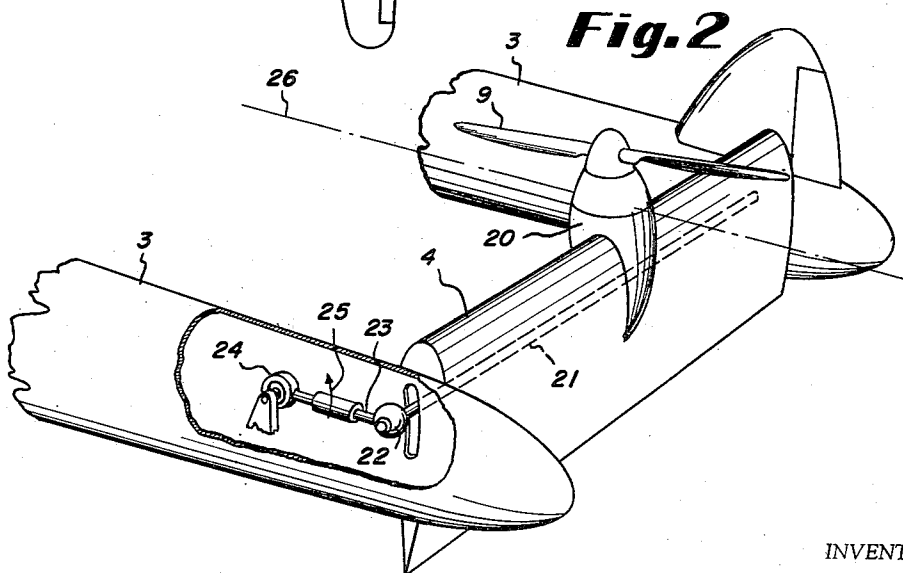


Fig. 2

INVENTOR

HENRICH C.J. FOCKE

Taulmin & Taulmin

BY

ATTORNEYS

1

2,825,514

COMBINED AIRPLANE-HELICOPTER FLYING MACHINE

Henrich Carl Johann Focke, Sao Joze dos Campos, Brazil, assignor to Ministerio da Aeronautica, Director do Material, Aeroporto Santos-Dumont, Rio de Janeiro, Brazil

Application February 19, 1954, Serial No. 411,503

3 Claims. (Cl. 244—7)

The present invention relates to an improved combined airplane-helicopter flying machine. Machines of this kind are known having at least one propeller of which the propeller shaft is angularly movable about an axis extending transverse to the centre line of said shaft and transverse to the longitudinal axis of the machine, for transforming the machine from the condition to operate as a helicopter, into the condition for rapid forward flight and vice versa. In order to prevent the wings unfavourably influencing the air flow produced by the propeller or propellers, it has been proposed in the case of a combined airplane-helicopter flying machine having two propellers, to rigidly mount said propellers on the respective wings, and to swing said wings together with the propellers mounted thereon about an axis at right angles to the longitudinal vertical central plane of the machine, in order to transform the machine from one position into the other. This of course involves a complication of the construction of the machine.

If such complication is to be avoided the main planes will have to be fixed stationary with respect to the machine, but in that case the propeller, or propellers should be arranged so far in front of said planes, that the air flow from the propellers passes the front edge of the respective wings. This, however again results therein that the force of the propeller or propellers no longer passes through the centre of gravity of the machine but at a considerable distance therefrom so that a free moment is set up which has to be opposed by a counter moment.

According to the invention at least one additional propeller is arranged at some distance behind the wings, such additional propeller being so connected to the machine that it may be swung about an axis transverse to the axis of its shaft and to the longitudinal axis of the machine.

In the case of an embodiment having three propellers, according to the invention, two of such propellers may be arranged one on either side of the longitudinal vertical central plane of the machine and in front of the wings, whilst a third propeller is arranged in said central plane on an elevator carried by two tail beams, the various distances being so chosen, that the resultant of the propeller force passes through the centre of gravity of the machine.

In this manner however, at least when the three propellers are of equal dimension and have equal torque, it is not possible to obtain complete equalisation of all torque reactions since in that case the torque reaction of one of said propellers remains.

For this reason, according to the invention it is proposed to arrange, either the transverse axes for the angular movement of the two propellers in front of the wings, or the transverse axis for the angular movement of the rear propeller, to be at an inclination with respect to the horizontal plane.

Thus in the position of the propeller for vertical or substantially vertical flight, the axis of such propeller or

2

propellers has a small lateral inclination, and this may be so chosen that the influence of the free torque reaction on the machine is cancelled out.

The invention will hereinafter be further described with reference to the accompanying drawing in which:

Figure 1 is a diagrammatic plan view of an embodiment of a flying machine according to the invention, having three propellers.

Figure 2 is a perspective view of the elevator as inclined with portions of the tail beam removed to show details of the mechanism involved.

In these figures the propellers are diagrammatically shown in full lines when in position for vertical flight and in dotted lines in the position for rapid forward flight.

Referring to Figure 1 the flying machine comprises a central fuselage 1 having wings 2, from which fuselage two parallel tail beams 3 extend rearwardly, such beams being arranged one on either side of the vertical longitudinal centre plane of the fuselage. An elevator 4 is arranged between said beams at the rear end thereof and swingable about an axis transverse to said longitudinal centre plane, the dotted lines showing the position of said elevator with the machine arranged for forward flight.

Where the tail beams 3 project forwardly beyond the wings 2, each beam carries a propeller 5, 6 of which the shaft is adapted to be swung about an axis 7 and 8 respectively these being diagrammatically shown in the figure; these axes 7, 8 both transversely to the respective propeller shaft and to the longitudinal axis of the machine in such a manner that the propellers, by swinging about said axes, may be adjusted from the position for substantially vertical flight into the position for rapid forward flight and vice versa, or into any intermediate position.

The length of the forwardly projecting portions of the tail beams 3 is so chosen, that in the position of the propellers for substantially vertical flight the air flow produced by the propellers entirely passes beyond the forward edge of the respective wings, and therefore is not disturbed or does not produce increased air resistance.

It will be noted that the resultant of the lifting forces of both propellers 5, 6 does not pass through the centre of gravity of the machine, so that without further provisions the machine will turn about a horizontal transverse axis. To take up this free moment I provide on said elevator 4 and in the vertical longitudinal centre plane of the machine, a third propeller 9, which is also swingable about an axis transverse to the propeller shaft and to said centre plane, said additional propeller being placed at a distance from the centre of gravity of the machine such that in the condition of the machine for operating as a helicopter, the propeller 9 produces a counteracting moment about the transverse axis through the centre of gravity, which moment therefore cancels out the moment of the two propellers 5 and 6.

In this embodiment with three propellers, however, if all propellers are of equal dimensions and have the same torque, there still remains the free torque reaction of one of such propellers which causes the machine to rotate about an axis which is located in the vertical longitudinal centre plane of the machine and is at right angles to the longitudinal axis of the machine, because always two propellers may rotate in different directions and therefore compensate for their mutual torque reaction but then the torque reaction of the third propeller remains. It is necessary to compensate for this free torque reaction by an opposite torque. Very often a special small propeller having a horizontal axis and mounted preferably at the tail of the plane is used therefor, but if there are more than one lifting propellers as in this case it is not necessary to add that special small propeller for counteracting the torque. In the case mentioned it is possi-

ble to give one or more of the lifting propellers a somewhat inclined position which means that their axis includes a small angle with the vertical in a plane perpendicular to the longitudinal axis of the machine. Due to this the propeller will not exert a vertical force on the plane but will also produce a small horizontal force component. This horizontal force component may be used for counteracting the free torque reaction on the plane above referred to. For this purpose the vertical axis of the rear propeller 9 in Fig. 1 may be somewhat inclined in a plane perpendicular to the longitudinal axis of the machine. Of course also both axes of the forward propellers 5, 6 could be inclined relative to the vertical and in the same plane for the same purpose. They must be inclined, however, in the same sense.

It will be understood that of both propellers 5 and 6 in Fig. 1 only one could take the inclined position above referred to but then the horizontal force component necessary for compensation of the free torque would not act symmetrically on the fuselage which, however, is not an essential disadvantage.

Figure 2 illustrates the connection between a tail beam 3 of Fig. 1 and the elevator 4. This elevator is provided at its middle with an engine 20 carrying the propeller 9. The elevator 4 can be swung about the horizontal axis 21. The elevator 4 is shown in Figure 3 in the position in which the axis of the propeller 9 is vertical which means that the machine is in helicopter position.

The shaft incorporating the axis 21 is supported in bearings carried by the tail beams 3. The bearing is indicated by the number 22. It is carried by the free end of a lever 23. The other end of the lever 23 is rotatably supported on a pivot 24 fixed in the tail beam 3. If the lever 23 is swung in the direction of the arrow 25 about the pivot 24, the bearing 22 will rise. If at the same time the corresponding lever 23 in the other tail beam is swung in the opposite direction the bearing at the other end of the axis 21 will be lowered and that means that the elevator 4 will take an inclined position with respect to the horizontal plane, i. e., a plane perpendicular to the central plane of the machine and including the longitudinal axis 26 of the machine.

If the elevator 4 assumes the said inclined position, the axis of the propeller 9 will include an angle with the vertical direction and that will enable the propeller 9 to exert a horizontal force counteracting the torque about a vertical axis resulting from the three propellers if they are in the helicopter position.

What I claim is:

1. A combined airplane helicopter flying machine comprising a fuselage, wings rigidly attached to said fuselage on both sides thereof, supporting means rigidly attached to and extending forward of said wings, one on either side of said fuselage, a first propeller arranged in front of said wings on one side of the vertical longitudinal

central plane of the machine, a second propeller arranged on the opposite side of said central plane symmetrically with said first propeller, means for mounting said first and second propellers on said supporting means, so that the said propellers can be swung about an axis transverse to the longitudinal axis of the machine and perpendicular to said central plane, two spaced parallel tail beams rigidly attached to and rearwardly extending from said wings, one on either side of said fuselage, an elevator extending between said tail beams at the rear ends thereof, and a third propeller mounted on said elevator, with its axis of rotation in said central plane, and means pivotally connecting said elevator to said beams so that said elevator together with said third propeller may be swung about an axis transverse to the longitudinal axis of the machine and perpendicular to said central plane.

2. A combined airplane helicopter flying machine as claimed in claim 1, with means on at least one of the said mounting means for mounting the respective propeller on its supporting means with extra movability so that the propeller in question can be swung, apart from its swinging about an axis transverse to the longitudinal axis of the machine and perpendicular to said central plane, about a second axis parallel to said longitudinal axis to an angle sufficient to enable the propeller in question to counteract the free torque on the machine about a vertical axis remaining as a resultant of the torques of all propellers when in position for helicopter flight.

3. A combined airplane helicopter flying machine as claimed in claim 1, with means for mounting said elevator for a swinging movement about the longitudinal axis of the machine to assume an inclined position with respect to said central plane, the angle of maximum inclination being sufficient to enable the said third propeller on said elevator to exert a horizontal force to counteract the free torque on the machine about a vertical axis remaining as a resultant of the torques of all propellers when in position for helicopter flight.

References Cited in the file of this patent

UNITED STATES PATENTS

1,470,275	Ferrari	Oct. 9, 1923
1,817,651	Schroeder	Aug. 4, 1931
1,846,992	Decker	Feb. 23, 1932
2,023,334	Marmonier	Dec. 3, 1935
2,143,317	Horlacker	Jan. 10, 1939
2,193,448	David	Mar. 12, 1940
2,379,355	Hodgdon	June 26, 1945
2,621,001	Roman	Dec. 9, 1952

FOREIGN PATENTS

354,519	Italy	Nov. 25, 1937
666,491	Great Britain	Feb. 13, 1952
914,954	France	July 1, 1946