

March 27, 1945.

S. GAGAS

2,372,481

HELICOPTER

Filed Oct. 12, 1942

2 Sheets-Sheet 1

Fig. 1.

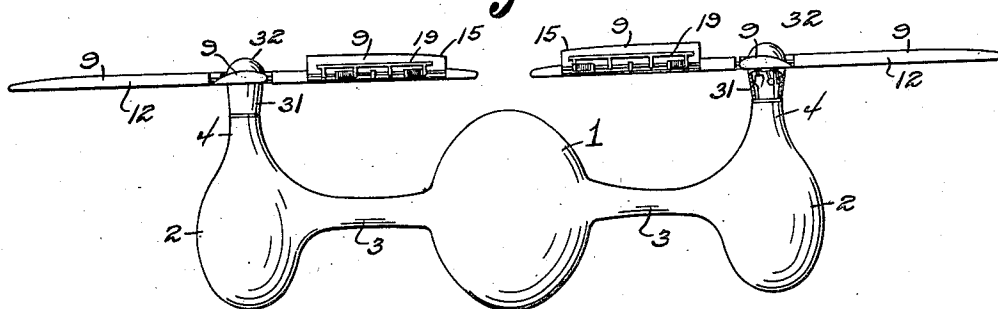
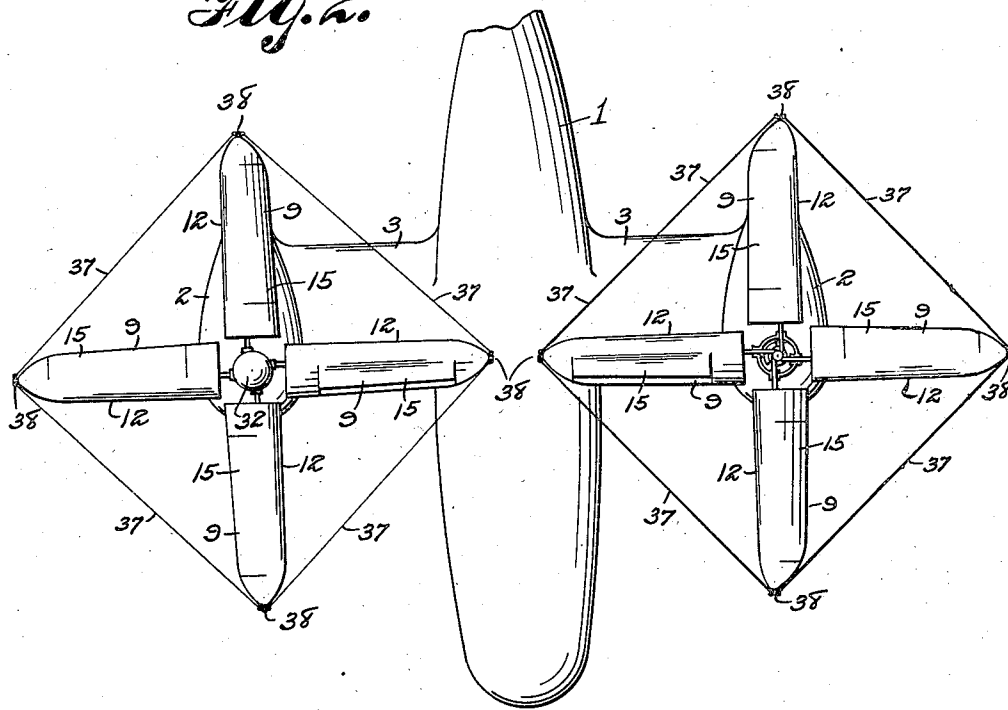


Fig. 2.



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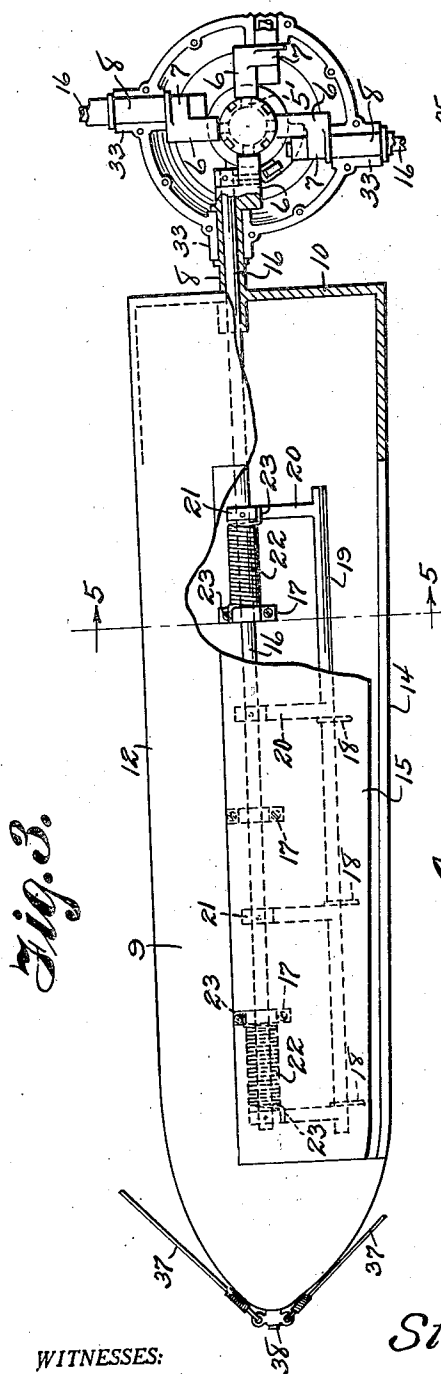
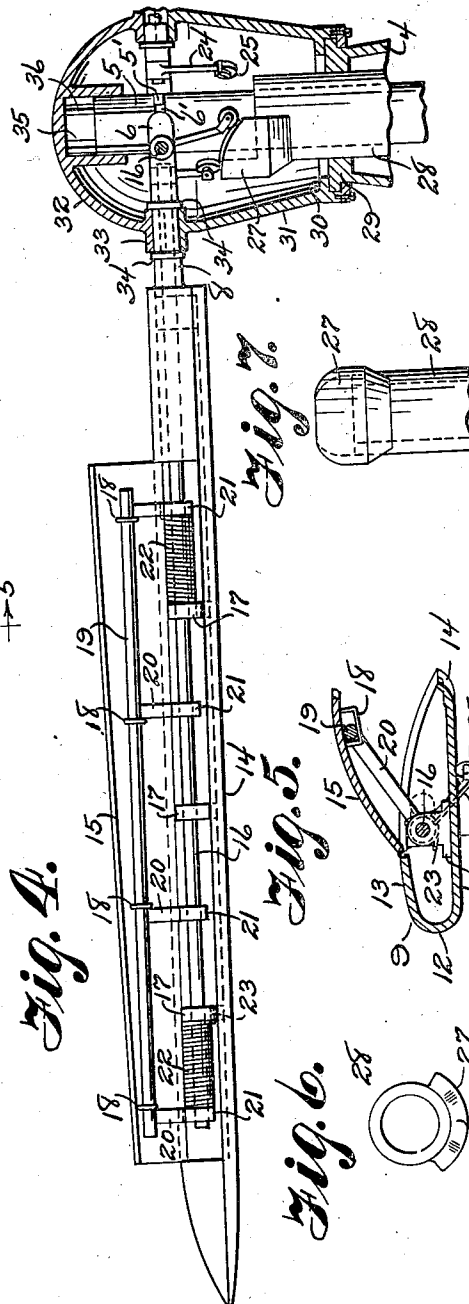
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UNITED STATES PATENT OFFICE

2,372,481

HELICOPTER

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Application October 12, 1942, Serial No. 461,751

5 Claims. (Cl. 244-17)

This invention relates to airplanes of the helicopter type, and an important object is to provide a helicopter in which each of the rotor blades or wings thereof include an aileron extending longitudinally of the trailing edge of the blade and for the major portion of the length and width thereof, the aileron being operable to impart forward motion to the ship, after the latter has been raised vertically by the action or rotation of the rotors, with the ailerons in closed or neutral position.

A further object is to provide a novel and simplified construction for operating and controlling the ailerons, to cause the same to move to open or elevated position at regular intervals during the rotation of the rotor, and the ailerons are spring pressed to lowered or closed position, as well as are held accordingly when not in use, the elevating and controlling means including a manually actuated cam movable into and out of the path of roller carrying arms that are connected to the rotor blade shafts, and the latter are in the form of cranks for changing the pitch of the blades to bring about hovering of the ship and to control the ascending and descending thereof.

Another object is to provide a helicopter that includes twin rotors, each having a motor for driving the same.

This invention also consists in certain other features of construction and in the combination and arrangement of the several parts, to be hereinafter fully described, illustrated in the accompanying drawings and specifically pointed out in the appended claims.

In describing the invention in detail, reference will be had to the accompanying drawings wherein like characters denote like or corresponding parts throughout the several views, and in which:

Figure 1 is a front view of a helicopter constructed in accordance with the present invention.

Figure 2 is a fragmentary top plan view thereof.

Figure 3 is a top plan view, partially in section and illustrates one of the rotor blades, the means for connecting the blades to the drive shaft and the means for operating the ailerons of the blades.

Figure 4 is a front view of the structure of Figure 3, with the cap of the casing, for housing the rotor driving and blade pitch changing means, and aileron elevating mechanism, in place.

Figure 5 is a sectional view taken approximately on line 5-5 of Figure 3, looking in the direction of the arrows.

Figure 6 is a top plan view of the cam member

to bring about opening or elevation of the ailerons.

Figure 7 is a fragmentary side elevation of the cam member.

Referring to the drawings in detail, the reference numeral 1 indicates the fuselage of the helicopter, 2 the motor housings and 3 the abbreviated wing structure which supports the motor housings an equal distance upon the opposite sides of the fuselage, as best shown in Figure 1.

The motor housings are formed with uprights 4 through which extend the drive shafts 5, the latter terminating a considerable distance above the upper ends of the uprights, as best shown in Figure 4, and extending radially from each of the drive shafts 5, adjacent to the upper end thereof are four equally spaced crank shafts 6. Each crank shaft includes an inner solid portion terminating in a reduced inner end providing a trunnion 5' mounted in an annular groove 6' in the drive shaft, while the outer end of the solid portion is formed with a right angle extending lug 7, providing a crank. Formed on the lug is a sleeve or tubular portion 8 extending outwardly therefrom in a plane paralleling the point of connection of the solid portion with the crank shaft, as shown in Figure 3. The tubular portions 8 are fixed to rotor blades 9, and each blade is of hollow elongated formation with a flat vertical inner wall 10 through which extends the sleeve portion 8, and the blade gradually decreases in width toward its outer curved end, by inclining the trailing edge thereof inwardly toward said end. The bottom wall 11 of the blade is flat and the leading edge 12 is rounded transversely, as best shown in Figure 5, while the top wall 13 is likewise rounded and slopes downwardly at its rear portion to connect with the rear edge of the bottom wall to provide a substantially sharp trailing edge 14. The top wall 13 is cut to provide an elongated opening for the major portion of its length, and the width of the opening extends from the trailing edge 14 to adjacent the rounded leading edge 12. The portion cut from the top wall to provide the opening forms a flap or aileron 15 that has its upper longitudinal edge hinged to the corresponding edge of the opening, thus it will be seen that the aileron fits the opening for closing the same, and is movable to open and closed positions on the hinges thereof, and in a manner which will be presently described. While it has been stated that the aileron is provided by the portion cut from the top wall of the blade, and such will save material, it will be obvious that the aileron

may be made from material that differentiates from that of the remaining portion of the blade.

Mounted in and extending through the sleeve portion 8 of the shaft 6 is a rock shaft 16 of a length to extend for the major portion of the length of the blade, and is supported in the latter by parallel bearings 17 that are fixed to the bottom wall 11. Secured transversely of the inner face of the aileron are parallel loop brackets 18 and loosely mounted therein for free sliding movement is a rod 19 that extends along the length of the aileron and is connected to the rock shaft by cross bars 20, the latter being integral with the rod in the form shown, but are removably fixed to the rock shaft by collars 21 which have set screws therein for that purpose. Sleeved on the rock shaft for disposal between the end bearings 17 and the end collars 21, are coil springs 22 that terminate in fingers 23 engaged respectively with the bearings 17 and the collars 21, in a manner to urge and hold the aileron in closed or lowered position.

In order to open or elevate the ailerons, each rock shaft has fixed to its outer end that extends through the inner end of the sleeve portion 8, a depending arm 24 having a roller 25 journaled in the bifurcated lower end thereof, to engage and travel along the upper cammed face 26 of an arcuate cam lug 27, that is formed laterally on and rises from the upper end of a sleeve 28, the latter being slidably mounted for vertical movement on the drive shaft 5, as best shown in Figure 4. The intermediate portion of the cammed face is flat and the end portions are sloped so that the ailerons will gradually open and close, and the cam lug is arranged relative to the sleeve to bring about the opening or elevation of the ailerons just prior to the time the trailing edges of the blades reach a position at a forty-five degree angle relative to the fuselage, when moving rearwardly as shown in Figure 2, and the ailerons remain open for approximately one hundred and twenty degrees of the rotation of the blades, then they are closed by the springs 22 as will be apparent. The sleeve 28 is manually actuated for movement of the cam lug into and out of the path of the rollers, and suitable means within the cockpit of the ship is provided for that purpose.

The uprights 4 each have an inturned flange 29 formed thereon, as best shown in Figure 4, to provide a bearing for the upper end of the sleeve 28 and the latter provides a bearing for the drive shaft. Surrounding the upper end of the sleeve and resting upon the flange 29 for rotation thereon is a ring member 30 that has formed thereon and rising therefrom the lower section 31 of a substantially dome-shaped casing that houses the upper end of the drive shaft, the inner ends of the crank shafts and the cam mechanism for opening the ailerons. The upper section or cap 32 of the casing is detachably secured to the lower section 31 to allow removal thereof, and the confronting edges of the sections have bearings 33 formed thereon for the sleeve portions 8 of the crank shafts, the sleeve portions having annular ribs 34 formed thereon and engaging the ends of the bearings 33 to hold the crank shafts against endwise movement and consequently the trunnions 5' in the groove 6' of the drive shaft.

Formed on and depending centrally from the cap 3 is a cylinder 35 having the upper end portion of the drive shaft 5 splined therein, and for that purpose, the shaft 5 is provided with

grooves within which are slidably mounted ribs or keys 36 formed along the length of the cylinder. The drive shafts are of course suitably connected to the motors, to be driven thereby, and upon rotation of the drive shafts, it will be apparent that the casings will be rotated, due to the splined connection of the drive shafts with the cylinders, and the rotation of the casings will rotate the blades, through the medium of the sleeve portions 8 being mounted in the bearings 33.

The drive shafts are also movable vertically by suitable means operated within the cockpit of the ship and such movement changes the pitch of the blades through the medium of the crank shafts, thus it will be seen that the ship can be caused to hover, and the ascent and descent thereof is under the constant control of the pilot.

In view of the fact that the ailerons create a drag on the blades when they are in open position, and tend to twist the same along the longitudinal axes thereof, I provide brace wires 37 extending between and connected to the blades at the ends thereof, the wires being connected to eyed members 38 that are fixed to the blades, as shown in Figure 3.

From the above description and disclosure in the drawings, it will be obvious that the rotors will impart an upward or vertical movement to the ship and after the latter has reached the desired height, the cam lugs are moved into the path of the rollers 25, to cause the ailerons to open and close at the intervals previously mentioned, and such movement of the ailerons will impart a forward movement to the ship, due to the air resistance against the same, brought about by the rotation of the rotors. It will be further obvious that the ailerons will be in closed position during the ascent and descent of the ship and that the pitch of the blades can be varied for the purpose set forth.

It is thought from the foregoing description that the advantages and novel features of the invention will be readily apparent.

It is to be understood that changes may be made in the construction and in the combination and arrangement of the several parts, provided that such changes fall within the scope of the appended claims.

What I claim is:

1. In a helicopter, a vertical drive shaft, a rotor including blades, each blade being hollow and having an elongated opening extending for the major portion of the length of its upper wall, a hinged aileron for closing the opening, crank shafts connected to the blades and mounted in and having connection with the drive shaft for rotating the blades, each crank shaft being hollow for a portion of its length, rock shafts for the ailerons and extending through the hollow portions of the crank shafts for disposal within the blades, bearings within the blades and having the rock shafts mounted therein, a rod for each aileron and secured to its under face for movement transversely thereof, the rod of each aileron paralleling the rock shaft thereof and secured thereto for disposal in spaced relation therewith, springs sleeved on the rock shafts for urging and normally holding the ailerons in closed position, arms secured to and depending from the rock shafts, a sleeve mounted for movement on the drive shaft, an arcuate lug fixed to the upper end of the sleeve and extending for a portion of the circumference thereof, said lug

having an upper cammed face for disposal in the path of the arms for opening the ailerons at intervals during the rotation of the rotor, and said drive shaft being movable along its vertical axis to act on the crank shafts for changing the pitch of the blades.

2. In a helicopter, a rotary and axially movable drive shaft, a plurality of crank shafts rotatably connected with and extending radially from the drive shaft, a tubular shaft extending from each crank shaft for connection to a rotor blade, a bearing rotatably supporting each tubular shaft, a rock shaft mounted axially in the tubular shaft for extension into the blade, an arm fixed to and extending transversely from each rock shaft, an axially adjustable sleeve mounted concentrically about the drive shaft,

and a cam carried on the sleeve and engageable by the arms for rocking the rock shafts.

3. The invention as described in claim 2 wherein said rotor blade is provided with a hinged aileron having the free edge thereof disposed flush with the trailing edge of said rotor blade.

4. The invention as described in claim 2 having the additional feature wherein the aileron is provided with means for moving said aileron to opened and closed position and means for retaining said aileron in closed position.

5. The invention as described in claim 2 having the additional feature wherein an elongated opening is provided in said rotor blade for housing said aileron.

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