July 16, 1946. H. R. NOYES 2,403,946

PROPELLER

Filed March 7, 1944 2 Sheets-Sheet 1

Fig. 1

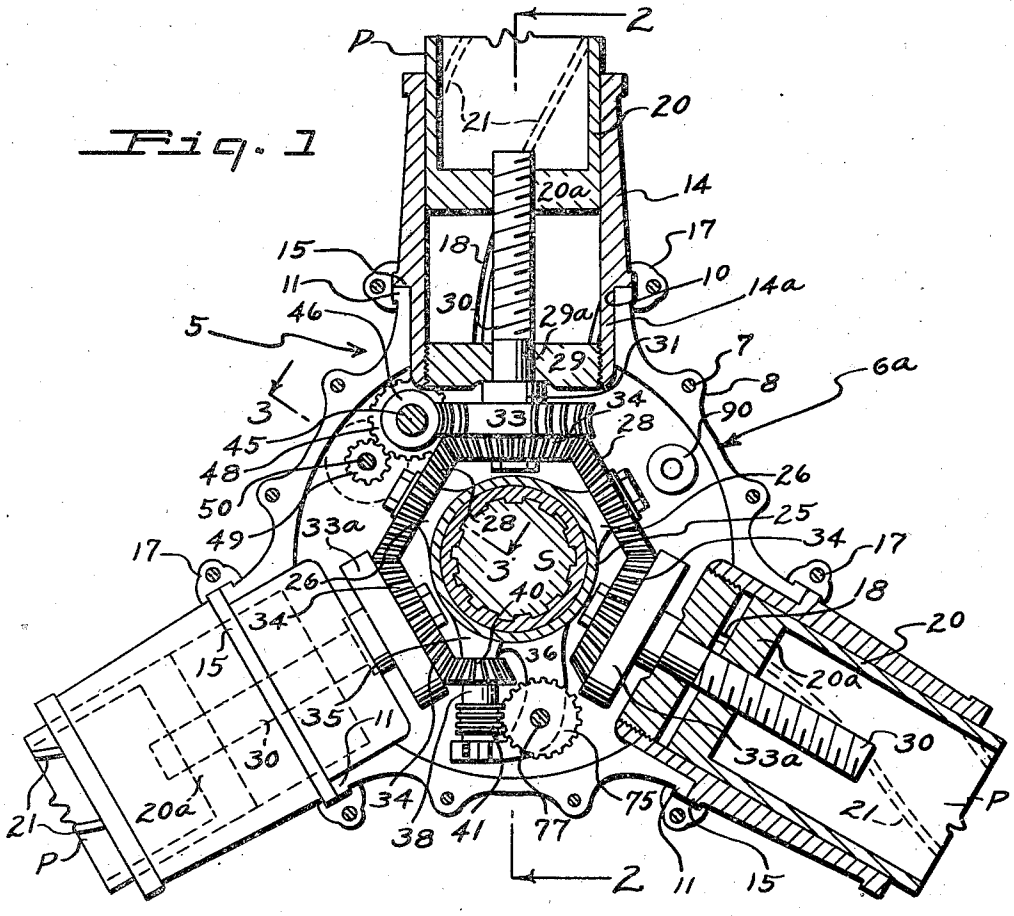
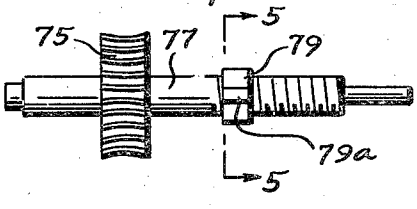


Fig. 4



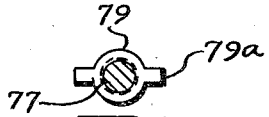


Fig. 5

Fig. 6

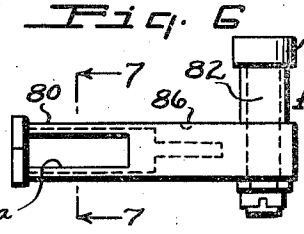
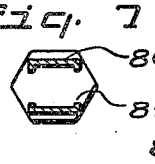


Fig. 7



Inventor
Hazlehurst R. Noyes
Atty.

July 16, 1946. H. R. NOYES 2,403,946

PROPELLER

Filed March 7, 1944 2 Sheets-Sheet 2

Fig. 2

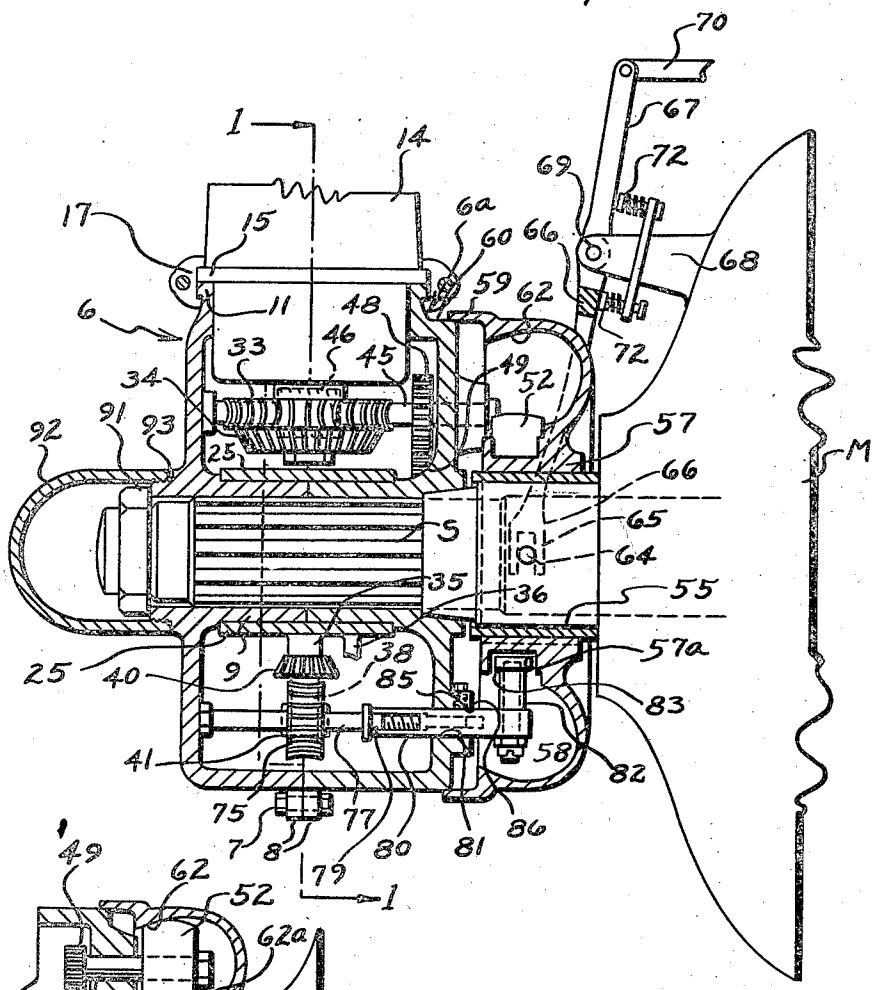


Fig. 3

Inventor
Hazlehurst R. Noyes

By

Atty.

Patented July 16, 1946

2,403,946

UNITED STATES PATENT OFFICE

2,403,946

PROPELLER

Hazlehurst R. Noyes, Los Angeles, Calif.

Application March 7, 1944, Serial No. 525,382

6 Claims. (Cl. 170—163)

1

My invention has to do with propellers and, in its more particular aspects, relates to propellers for airplanes. It is among the objects of the invention to provide a propeller embodying simple and efficient means for varying the diameter and pitch angle of the blades during flight.

It is also among the objects to provide a propeller embodying means for increasing or decreasing the tip diameter of the propeller in predetermined relation to variations in the pitch angle.

Another object is the provision in such a propeller of a novel, simple and efficient manual control.

A still further object is the provision, in a propeller of this type, of means for utilizing the rotative force of the propeller to actuate the pitch and diameter changing mechanisms.

Still further objects and corresponding advantages are inherent in the invention and how those as well as the objects hereinabove specifically pointed out are achieved will be understood from the following detailed description of one embodiment which I have selected for purposes of explanation. I wish it understood, however, that I do not intend to confine the invention, in its broader aspects as defined by the appended claims, to the specific details of construction and arrangement now to be described, since the invention is capable of being embodied in other and different physical forms which the following description will readily suggest to those working in the art.

For the purposes of the following description I shall refer to the accompanying drawings, in which:

Fig. 1 is a section taken on line 1—1 of Fig. 2, showing some parts in elevation;

Fig. 2 is a section on line 2—2 of Fig. 1;

Fig. 3 is a section taken on line 3—3 of Fig. 1;

Fig. 4 is an enlarged elevation of an element of the automatic stop mechanism;

Fig. 5 is a section on line 5—5 of Fig. 4;

Fig. 6 is an enlarged elevation of another part of the automatic stop mechanism; and

Fig. 7 is a section on line 7—7 of Fig. 6.

Referring now to the drawings, I show a hub assembly generally designated by the numeral 5 and comprising opposed concaved face members 6, 6a secured together by bolts 7 passing through the securing flanges 8. Each of the members 6, 6a has a cylindric axial portion 9, which portions are internally splined and together receive the drive spindle S rotated by the motor M. Members 6, 6a together provide symmetrically ar-

2

ranged circular radial openings 10 around each of which openings there is an annular flange 11. A cylindric blade shank housing 14 fits into each opening 10 and has a reduced diameter inner end portion 14a extending into the hub, thus providing an annular shoulder 15 which abuts flange 11. The respective housing members 14 are held against longitudinal escape from the hub by grooved rings 17. Each of the housing members 14 has internal spiral splines 18 for the purpose to be described.

The shank 20 of a propeller blade P is mounted to rotate about its longitudinal axis and to slide longitudinally in each of the housings 14, each blade shank being exteriorly spirally splined at 21 coordinate with the splines of the housings 14, and thereby rotation of the shanks takes place by virtue of the shanks moving longitudinally relative to the housings.

Affixed to the cylindric member 9 there is a collar 25 presenting two radial bosses 26 on each of which a beveled idler gear 28 is rotatably mounted.

An end plug 29 is threaded or otherwise suitably secured in the inner end of each of the housing members 14, each of said plugs having an axial opening 29a journaling a screw 30, which respective screws threadedly engage the inner ends 20a of the respective cylindric shanks 20. Each screw has an annular stop flange 31 and has secured on its inner end a beveled gear 34. One of the screws 30 also has secured on its inner end, behind the beveled gear, a worm gear 33, and the remaining screws 30 have a blank disc 33a mounted in the same relative position as worm 33, which discs act as counterweights.

Collar 25 also carries bosses 35 and 36 in which are journaled a shaft 38. A bevel gear 40 is secured on one end of shaft 38 and meshes with one of the idler gears 34 for operating the automatic stop mechanism to be described.

A worm 41 is secured on the shaft 38 adjacent its outer end.

A spindle 45 is journaled in the member 6a and carries a worm 46 meshing with worm 33 and it also carries a gear 48 which latter gear meshes with a gear 49. Gear 49 is secured on a shaft 50 journaled in member 6a parallel with shaft 45 and having secured to its inner end a friction roller 52 for the purpose to be described.

The front end of the motor M presents a fixed sleeve 55 around the spindle 5, which sleeve slidably carries a collar 57. The latter collar is hollowed to provide an annular recess 58 opening towards the hub and has an annular flange 59

which encircles a flange 60 carried by member 6a so as to be slidable longitudinally relative thereto. The inner surface of collar 57 is curved as shown to provide oppositely disposed friction surfaces 62, 62a for selective engagement against roller 52.

Collar 57 has trunnions 64 over which the bifurcations 65 of the forks 66 of a lever 67 engage. Lever 67 is pivotally mounted at the front end of the motor as by the bracket 68 and pin 69, and an operating link 70 pivotally connected at its outer end to the top end of the lever may extend into the cockpit of the airplane for manual operation by the pilot to slide collar 57 towards and away from the hub. By means of the spring-pressed plungers 72, lever 67 will assume a neutral position when not subjected to pressure. In the position of the parts shown in the drawings, the top end of the lever has been slightly moved to the left to cause friction surface 62 to engage friction roller 52 (see Fig. 3).

Assuming the hub to be rotating clockwise, movement of the lever 67 to the left to the position shown in the drawings causes the relatively larger diameter friction surface 62 to engage the periphery of friction roller 52 and to rotate the latter roller counterclockwise. The rotation of shaft 50, gear 49, gear 48, worm 46 and worm 33 thus effected, causes rotation of the screws 30, causing the blades P to move longitudinally outwardly. Such longitudinal movement of the blade shanks causes them to rotate about their longitudinal axes by virtue of the coordinate spiral splines.

Release of pressure on lever 67 will permit it to automatically return to neutral position under the influence of the spring-pressed plungers 72, thus disengaging the friction surface of the collar from the roller 52.

By pulling to the right on the top end of the lever 67, collar 57 is pushed forward, causing the periphery of roller 52 to be engaged by the relatively smaller diameter friction surface 62a of the collar and thus to cause rotation of collar 52 clockwise to rotate shaft 50, gears 49, 48, and worms 46, 33 in a direction to rotate screws 30 in a direction reverse to that before described, drawing the blades inwardly of the housing members 14 to reduce their pitch diameter and commensurately to change their pitch angle in the direction opposite to that before described.

Since, in the absence of complicated indicating mechanisms, there is no way for the pilot to know when the limits of movement of the propellers relative to the hub have been reached, I provide a simple stop mechanism automatically operable in consonance with the number of revolutions of the roller 52.

Meshed with one of the beveled gears 34 there is the smaller beveled gear 40 before described, gear 40 and worm 41 being fixed on shaft 38. Worm 41 members with a gear 75 secured on a shaft 77 journaled at one end in boss 36 and having its free end threaded and extending into and threadedly engaging the interiorly threaded traveling lug nut 79.

Loosely fitting over the free end of shaft 77 and lug nut 79 there is a partly bored slide bar 80 which slides through an opening 81 in member 6a, carrying, on a spindle 82 projecting radially from its free end, a roller 83. Roller 83 is disposed in an annular recess 57a in collar 57 so that the roller rotates circumferentially along the recess. Longitudinal slots 85a in bar 80 pass the radial lug 79a of the nut 79, the ends of the slot providing stops for said lugs.

Operation of this automatic stop mechanism is as follows: When the blades P reach a predetermined limit of their outward movement, the lugs 79a reach an end of the slots 85 causing bar 80 thereafter to move inward and moving the offset roller 83 into engagement with the side wall of the recess 57a, thus pulling collar 57 along with it until the collar friction surface 62 is moved out of contact with the friction roller 52. The limit of retractive movement of the blades is controlled in the same manner except that the operation of the stop mechanism is in the reverse direction. When the stop mechanism has thus functioned, there is, of course, no further operation of the friction roller 52 since it is out of engagement with the friction surfaces of the roller, and the collar will automatically assume a neutral position by action of the plungers 72 against the lever 67.

To normally maintain the rod 80 in neutral position, I provide a spring-pressed detent 85 which engages in a recess 86 in rod 80 when the element is in neutral position.

Of course, it is desirable to have symmetric balance of the hub assembly as to weight as far as possible and therefore where at one radial point there is a weight which normally has no gear or other element counterbalancing it at another point, I find it desirable to provide counterweights for the purpose. For instance, at 90 I show such a counterweight.

The hub is secured on the spindle by a nut 91 normally enclosed within a spinner 92 threaded onto the flange 93 of member 6.

From the foregoing description it will be observed that there is necessarily complete unity and balance in operation and positioning of the propellers, screws 30 providing a self-locking element to positively maintain the parts in any adjusted position. While I have described and illustrated a three-bladed propeller, it will be apparent from the description that propellers having a greater or lesser number of blades may be employed in accordance with the teachings of my invention.

I claim:

1. A propeller comprising in combination with an object being propelled, a drive shaft carried by the object, a hub secured on the drive shaft to rotate therewith, a blade longitudinally slidably mounted in and projecting radially from the hub, screw means in the hub longitudinally threadedly engaging the inner end of the blade, said screw means being rotatable relative to the blade whereby to effect longitudinal sliding movement of the blade relative to the hub, and means for so rotating said screw comprising a collar non-rotatably carried by the object for sliding movement towards and away from the hub, said collar presenting oppositely disposed concentric annular friction surfaces, a shaft journaled in the hub, a friction roller secured on the last-named shaft in position to be selectively engaged by the respective friction surfaces of the roller, a gear secured on the screw, gear means operatively connecting said last-named shaft to the last-named gear, manually controlled means operatively associated with the collar to slide the collar towards and away from the hub, whereby to selectively engage said friction surfaces with the friction roller, and means for arresting rotative movement of the screw after a predetermined number of revolutions thereof, comprising a gear operatively connected to the last-named shaft,

a shaft to which the last-named gear is secured, said last-named shaft being threaded at one end, a nut threadedly mounted on the threaded end of the last-named shaft, a slide bar having lost motion engagement with the nut, and means on the slide bar adapted to engage the collar and slide the latter relative to the hub.

2. A propeller comprising in combination with an object being propelled, a drive shaft carried by the object, a hub secured on the drive shaft to rotate therewith, a blade longitudinally slidably mounted in and projecting radially from the hub, screw means in the hub longitudinally threadedly engaging the inner end of the blade, said screw means being rotatable relative to the blade whereby to effect longitudinal sliding movement of the blade relative to the hub, means for so rotating said screw comprising a collar nonrotatably carried by the object for sliding movement towards and away from the hub, said collar presenting oppositely disposed concentric annular friction surfaces, a shaft journaled in the hub, a friction roller secured on the last-named shaft in position to be selectively engaged by the respective friction surfaces of the roller, a gear secured on the screw, gear means operatively connecting said last-named shaft to the last-named gear, manually controlled means operatively associated with the collar to slide the collar towards and away from the hub, whereby to selectively engage said friction surfaces with the friction roller, and means for arresting rotative movement of the screw after a predetermined number of revolutions thereof, comprising a gear operatively connected to the last-named shaft, a shaft to which the last-named gear is secured, said last-named shaft being threaded on one end, a nut threadedly mounted on the threaded end of the last-named shaft, a slide bar having lost motion engagement with the nut, an annular recess in the collar, a radial arm carried by the slide bar, and a roller carried by said radial arm and being disposed in the recess for selective engagement with the side walls thereof.

3. A propeller comprising in combination with a drive shaft, a hub secured on the drive shaft to rotate therewith and presenting symmetrically arranged radial sockets, blades having their respective shank ends longitudinally movably mounted in the respective sockets, screw members

journaled in the hub and having their outer ends axially threadedly engaging the shank ends of the respective blades, a bevel gear secured on the inner end of each of the screws, idler gears disposed respectively between and in intermeshing engagement with adjacent ones of the bevel gears and means for causing rotation of the screws in response to rotation of the hub.

4. A propeller comprising, in combination with a drive shaft, a hub having an axial shaft-receiving opening therethrough and radial blade-receiving sockets, blades having shanks disposed axially in the respective sockets for longitudinal movement relative thereto, radially disposed screws journaled in the hub and axially threadedly engaging the respective shanks, a gear secured axially on each of the screws, a worm gear journaled in the hub for operative connection with one of the first-mentioned gears, a beveled gear secured axially on each of the screws, beveled gear members journaled for rotation in the hub about axes radial to the shaft and operatively connecting the worm gear driven screw with the beveled gears secured on the other screws, and means for controllably rotating the worm gear in response to rotation of the hub.

5. The combination of claim 4 wherein the last-named means includes a hollow collar slidably mounted around the drive shaft, a spindle journaled in the hub and having one of its ends operatively engaging the worm gear, a friction roller secured on the other end of the spindle for selective engagement with opposed inner surfaces of the collar, and means for sliding the collar relative to the shaft and hub.

6. In a propeller, a drive shaft, a hub having an axial shaft-receiving opening therethrough and radially opening blade-receiving sockets, blades having shanks disposed in the respective sockets for axial movement relative thereto, radially disposed screws journaled to rotate about radial axes in the hub for axial threaded engagement with the respective shanks, drive means operatively engaging one of the screws, a train of beveled gears rotatable about radial axes in the hub disposed symmetrically around the drive shaft and operatively connecting the other screws with the last-mentioned screw, and means for controllably actuating the drive means.

HAZLEHURST R. NOYES.