

Nov. 18, 1930.

C. K. GREENE

1,782,167

VARIABLE PITCH PROPELLER

Filed Nov. 20, 1928

2 Sheets-Sheet 1

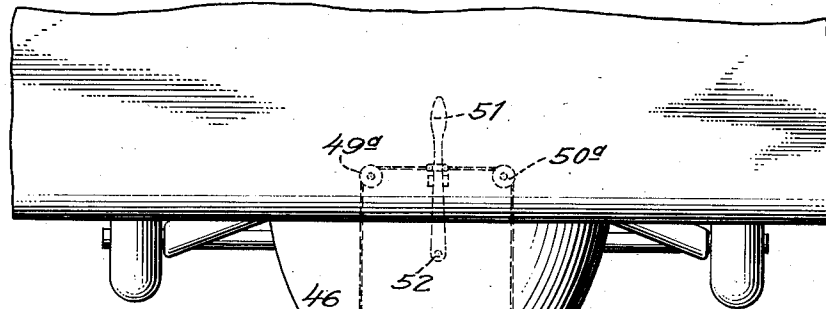


Fig. 1.

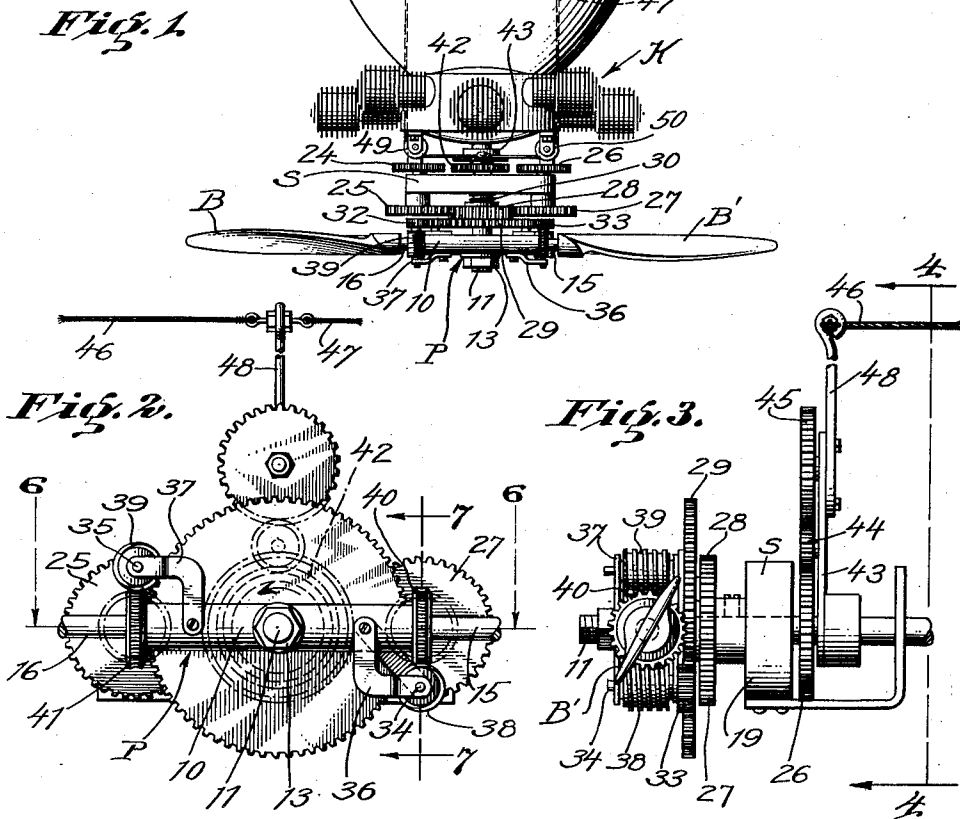
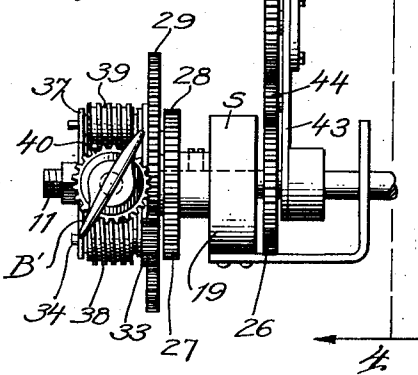


Fig. 2.

Fig. 3.



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2 Sheets-Sheet 2

Fig. 4.

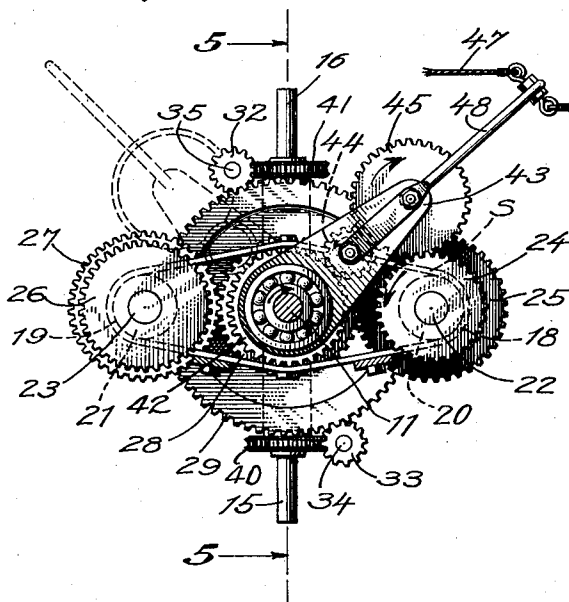


Fig. 5.

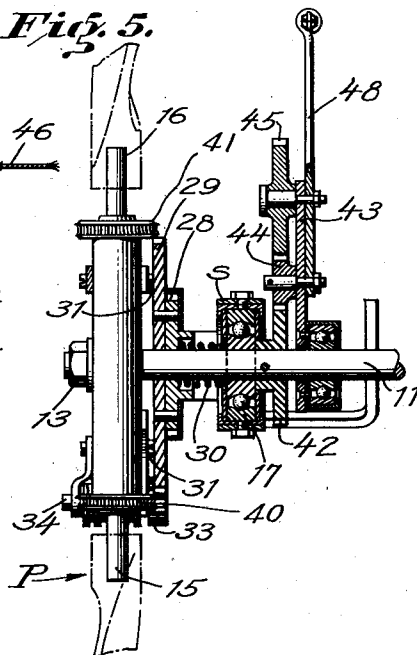


Fig. 6.

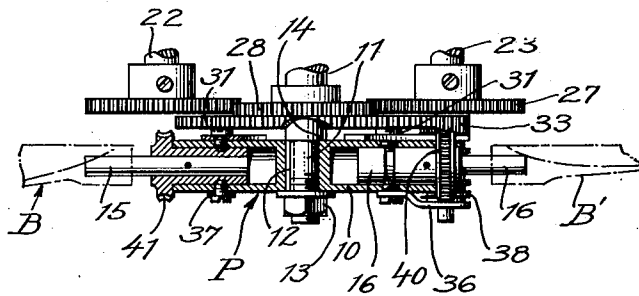
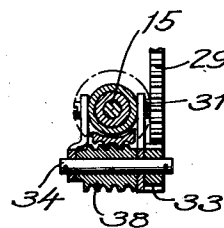


Fig. 7.



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CLARENCE KIRK GREENE, OF CANANEA, MEXICO

VARIABLE-PITCH PROPELLER

Application filed November 20, 1928. Serial No. 320,640.

My invention relates generally to propellers, and it is a purpose of my invention to provide a propeller having blades adjustable to vary the thrust exerted thereby when the propeller is in operation, and hence vary the propelling force exerted by the propeller.

It is a further purpose of my invention to provide a propeller of the above described character, particularly adapted, although not necessarily, for aircraft use, and capable of being readily adjusted when in operation, to vary the angle of incidence of its blades to such extent that either forward or rearward propelling forces varying from a minimum to a maximum in either direction can be obtained from the blades, to the end that by suitable adjustment of the blades, maximum efficiency can be obtained from the propeller regardless of variations in atmospheric conditions, variations in the gradient at which the craft is traveling, and variations in load carried by the craft, as well as providing an effective brake for checking the speed of the craft when landing so that the craft can be brought to a standstill in a relatively short distance of travel.

I will describe only one form of variable pitch propeller embodying my invention, and will then point out the novel features thereof in claims.

In the accompanying drawings—

Fig. 1 is a view showing in plan the forward end of a conventional heavier-than-aircraft with one form of variable pitch propeller embodying my invention applied thereto;

Fig. 2 is a view in front elevation of the variable pitch propeller shown in Fig. 1, with the blades of the propeller broken away;

Fig. 3 is a view of the variable pitch propeller in side elevation;

Fig. 4 is a vertical sectional view taken on the line 4—4 of Fig. 3 and looking in the direction of the arrows;

Fig. 5 is a vertical sectional view taken on the line 5—5 of Fig. 4 and looking in the direction of the arrows;

Fig. 6 is a horizontal sectional view taken on the line 6—6 of Fig. 2 and looking in the direction of the arrows; and

Fig. 7 is a fragmentary detail sectional

view taken on the line 7—7 of Fig. 2 and looking in the direction of the arrows.

Referring specifically to the drawings in which similar reference characters designate similar parts in each of the several views, my invention in its present embodiment comprises a propeller designated generally at P and including a hub 10 in the form of an elongated sleeve bored transversely medially between its ends to receive a shaft 11, which in a direct drive installation constitutes the crankshaft of a power plant K of an aircraft. The hub 10 is fixed to the shaft 11 so as to be rotated thereby, by means of a key 12, and is retained against displacement from the shaft by means of a nut 13 threaded on the shaft and co-operating with an annular shoulder 14 formed on the shaft to clamp the hub on the latter.

Journalled in the opposite ends of the hub 10 are a pair of stub shafts 15 and 16 to which are fixedly secured in any suitable manner blades B and B' respectively of conventional form. The blades B and B' are thus rotatably mounted in the hub 10 so that the angles of incidences or pitch of the blades, and hence the thrust exerted by the blades when the propeller is in operation, can be varied.

The shafts 15 and 16 and hence the blades B and B' are adapted to be rotated in opposed directions, and to this end a fixed support S in the form of a frame is rigidly secured to the aircraft in any suitable manner, and is provided with a central hub 17 in which is journalled the propeller shaft 11 at a point rearwardly of the propeller P. Projecting from the central hub 17 in opposed directions are arms 18 and 19 having sleeves 20 and 21 respectively in which are journalled stub shafts 22 and 23 respectively, disposed parallel to and at opposite sides of the propeller shaft 11. The shafts 22 and 23 project from opposite ends of their respective sleeves 20 and 21 and to the projecting ends of the shaft 22, a pair of idler gears 24 and 25 are fixed, while to the projecting ends of the shaft 23, a second pair of idler gears 26 and 27 are fixed.

The idler gears 25 and 27 constantly mesh with a single driven gear 28 which is fixed

to or formed integral with a relatively large gear 29. The driven gear 28 and the gear 29 are rotatably mounted on the propeller shaft 11, and to insure that these gears normally will rotate with the shaft yet can be rotated independently of the shaft, a spring 30 surrounds the shaft and bears against the driven gear 28 to urge the latter and the gear 29 towards the propeller hub 10 and maintain the gear 29 in engagement with suitable projections 31 on the hub.

The gear 29 constantly meshes with a pair of driven pinions 32 and 33 fixed to shafts 34 and 35 respectively, rotatably mounted respectively in brackets 36 and 37 secured to the hub 10. Also fixed to the shafts 34 and 35 are worms 38 and 39 respectively, constantly meshing with worm wheels 40 and 41 respectively, fixed to the stub shafts 15 and 16 respectively, of the propeller P.

Fixed to the propeller shaft 11 at the rear of the support S and in the plane of the idler gears 24 and 26 is a driving gear 42 which is adapted to be operatively connected with either the idler gear 24 or the idler gear 26. To this end an arm 43 is mounted on the propeller shaft 11 at the rear of the driving gear 42, for rocking movement, and carries a pinion 44 constantly meshing with the driving gear 42, and a gear 45 constantly meshing with the pinion 44. The gear 45 is adapted to be brought into mesh with either the idler gear 24 or the idler gear 26 to cause one or the other of the latter gears to be driven in the opposite direction to the propeller shaft by the driving gear 42, according as the arm 43 is shifted from an inactive position shown in Fig. 2 to either the active position shown in full lines in Fig. 4 or the active position shown in broken lines in this figure; and to permit manual operation of the arm 43 by the pilot, any suitable control may be provided. For the purpose of illustration a form of control is shown and comprises flexible cables 46 and 47 connected at one of their ends to an extension 48 of the arm 43, and then trained over sheaves 49, 49^a, and 50, 50^a for connection at their other ends to an operating lever 51 pivoted at 52 in the cockpit of the aircraft in advance of the pilot's seat, to the end that rocking movement of the lever 51 will effect corresponding rocking movement of the arm 43.

The operation of the propeller is as follows:

With the arm 43 occupying the inactive position shown in Fig. 2, and assuming that the shaft 11 is rotating in a counter-clockwise direction as indicated by the arrow in this figure, the gears 28 and 29 will rotate with the shaft 11 and at the same speed as the latter due to the friction set up by the spring 30, the pairs of idler gears 24, 25 and 26, 27 being driven idly by the gear 28, and the pinion 44 and gear 45 being driven idly by the driving

gear 42. As the worm wheels 40, 41, worms 38, 39, and pinions 32, 33 rotate bodily with the propeller P, there will be no relative movement between the gear 29 and the pinions 32 and 33 so that the angles of incidences of the blades B and B' will remain constant. Furthermore it will be clearly evident that the air pressure acting against the blades will be ineffective to change their incidence angles due to the fact that the worm wheels 40 and 41 cannot drive their respective worms 38 and 39 so that the blades are locked in a selected position of adjustment.

However, when the arm 43 is rocked to the position shown in full lines in Fig. 4 by proper manipulation of the operating lever 51, the gear 45 on the arm 43 will be brought into mesh with the idler gear 24, so that the latter will be positively driven from the driving gear 42 in a counter-clockwise direction as viewed in Fig. 4, the ratios between the latter gear and the pinion 44, gear 45, idler gears 24 and 25, and driven gear 28 being such as to cause the driven gear 28 to be positively driven in the same direction as and at a speed slightly in excess of the speed of the propeller shaft 11, thus causing the gear 29 to drive the pinion gears 32 and 33, and hence drive the worms 38, 39 and worm wheels 40, 41 to rotate the stub shafts 15 and 16 and thereby vary the angles of incidences of the blades B and B' in one direction.

When the desired adjustment of the propeller blades has been effected, the arm 43 is again moved to its inactive position.

Upon rocking the arm 43 to the position shown in broken lines in Fig. 4, the gear 45 will be brought into mesh with the idler gear 26 which latter, it will be noted, is slightly larger than the idler gear 24. With a given propeller shaft speed the idler gear 26 will be driven at a sufficiently slower speed than would the idler gear 24, to cause the driven gear 28 to be positively driven in the same direction as, and at a speed slightly less than the speed of the propeller shaft 11, thus causing the pinion gears 32, 33, worms 38, 39, and worm wheels 40 and 41 to be driven in a direction reverse to that in which they were previously driven when the idler gear 24 was being driven from the driving gear 28, thus reversely rotating the stub shafts 15 and 16 and hence varying the angles of incidences of the blades B and B' in the reverse direction.

It will thus be clear that the incidence angles of the blades B and B' can be varied to cause the blades to exert thrust from a minimum to a maximum in either a forward or rearward direction, all while the propeller is in operation and under perfect control of the operator, so that maximum efficiency can be obtained from the blades under varied flying conditions, and that the blades when adjusted to exert a forward thrust produce an effective brake for the aircraft by which the

latter, when landing, can be brought to rest in a relatively short distance of travel.

It will be manifest that broadly speaking the worm wheels 40, 41, worms 38, 39, and pinions 32 and 33 constitute a means for moving the blades B and B' to vary their incidence angles; that the gears 28 and 29 broadly constitute rotatable means and the gear 28 a rotatable member for driving the blades moving means to cause the incidence angles of the blades to be varied, when the rotatable member is driven at a speed different than the propeller speed, and more specifically to cause the incidence angles of the blades to be varied in one direction or the reverse direction according as the rotatable member is driven at a speed in excess of or less than the propeller speed. Furthermore, it will be understood that the two pairs of idler gears 24, 25 and 26, 27 respectively broadly constitute two means, one for driving the rotatable member (the gear 28) at a speed in excess of the propeller speed, and the other for driving the rotatable member at a speed less than the propeller speed; that the driving gear 42 broadly constitutes a driving means for the above two means; and that the pinion 44 and gear 45 broadly constitute a means for operatively connecting the driving means to either of the above mentioned two means independently of the other.

Although I have herein shown and described only one form of variable pitch propeller embodying my invention, it is to be understood that various changes and modifications may be made herein without departing from the spirit of the invention and the spirit and scope of the appended claims.

I claim:

1. A rotary propeller having blades adjustable to vary the angles of incidences thereof, means including a gear rotatably mounted on the propeller shaft, for moving the blades to vary their angles of incidences in response to driving of said gear at a speed different from the propeller speed, means for driving said gear at a speed different from the propeller speed including a driving gear fixed to the propeller shaft, and means for operatively connecting the driving gear to and disconnecting it from the first mentioned gear.

2. A rotary propeller having blades adjustable to vary the angles of incidences thereof, means including a gear rotatably mounted on the propeller shaft, for moving the blades to vary their angles of incidences in response to driving of said gear at a speed different from the propeller speed, a pair of idler gears mounted for rotation as a unit about a fixed axis and one of which constantly meshes with said gear, a driving gear fixed to the propeller shaft, and means for operatively connecting the driving gear to the other of the pair of idler gears to cause said

one of the latter to rotate the first mentioned gear at a speed different from the rotational speed of the propeller.

3. A rotary propeller having blades adjustable to vary the angles of incidences thereof, means including a gear rotatably mounted on the propeller shaft, for moving the blades to vary their angles of incidences in response to driving of said gear at a speed different from the propeller speed, a pair of idler gears mounted for rotation as a unit about a fixed axis and one of which constantly meshes with said gear, a driving gear fixed to the propeller shaft, and means for operatively connecting the driving gear to the other of the pair of idler gears to cause said one of the latter to rotate the first mentioned gear at a speed different from the rotational speed of the propeller, said last means comprising a gear constantly driven by the driving gear, and mounted for movement bodily to one position wherein it meshes with the other of said pair of idler gears, and to another position wherein it is out of mesh with the other of said pair of idler gears.

4. A rotary propeller having blades adjustable to vary the angles of incidences thereof, means including a gear rotatably mounted on the propeller shaft, for moving the blades to vary their angles of incidences in response to driving of said gear at a speed different from the propeller speed, a pair of idler gears mounted for rotation as a unit about a fixed axis and one of which constantly meshes with said gear, a driving gear fixed to the propeller shaft, and means for operatively connecting the driving gear to the other of the pair of idler gears to cause said one of the latter to rotate the first mentioned gear at a speed different from the rotational speed of the propeller, said last means comprising an arm mounted on the propeller shaft for rocking movement and having a pinion constantly meshing with the driving gear, and a gear mounted on the arm, constantly meshing with the pinion and adapted to be brought into or out of mesh with the other of the pair of idler gears according as the arm is rocked to one position or another.

5. A rotary propeller having blades adjustable to vary the angles of incidences thereof, means, including a gear rotatably mounted on the propeller shaft, for moving the blades to vary their angles of incidences in one direction or the reverse direction, according as said gear is driven at a speed in excess of the propeller speed or at a speed less than the propeller speed, two gear means, one for driving said gear at a speed in excess of the propeller speed and the other for driving said gear at a speed less than the propeller speed, a driving gear fixed to the propeller shaft, and means for operatively con-

necting the driving gear to either of the two gear means independently of the other.

6. A rotary propeller having blades adjustable to vary their angles of incidences, means including a rotatable member for moving the blades to vary their angles of incidences in one direction or the reverse direction, according as the rotatable member is driven at a speed in excess of the propeller speed or at a speed less than the propeller speed, two means, one for driving the rotatable member in one direction and at a speed in excess of the propeller speed and the other for driving the rotatable member in said one direction and at a speed less than the propeller speed, driving means for said two means, and means for operatively connecting the driving means to either of said two means independently of the other.

7. A rotary propeller having blades adjustable to vary their angles of incidences, means including a gear rotatably mounted on the propeller shaft, for moving the blades to vary their angles of incidences in one direction or the reverse direction, according as said gear is driven at a speed in excess of the propeller speed or at a speed less than the propeller speed, two means, one for driving said gear in one direction and at a speed in excess of the propeller speed and the other for driving said gear in said one direction and at a speed less than the propeller speed, driving means for said two means comprising a gear fixed to the propeller shaft, and means for operatively connecting the driving gear to either of said two means independently of the other.

8. A rotary propeller having blades adjustable to vary their angles of incidences, means including a gear rotatably mounted on the propeller shaft, for moving the blades to vary their angles of incidences in one direction or the reverse direction, according as said gear is driven at a speed in excess of the propeller speed or at a speed less than the propeller speed, two means, one for driving said gear at a speed in excess of the propeller speed and the other for driving said gear at a speed less than the propeller speed, driving means for said two means comprising a gear fixed to the propeller shaft, and means for operatively connecting the driving gear to either of said two means independently of the other, said two means comprising two pairs of idler gears of respectively different ratios with each pair mounted for rotation as a unit about a fixed axis and one gear of each pair constantly meshing with the first mentioned gear.

9. A rotary propeller having blades adjustable to vary their angles of incidences, means including a gear rotatably mounted on the propeller shaft, for moving the blades to vary their angles of incidences in one direction or the reverse direction, according as said gear is

driven at a speed in excess of the propeller speed or at a speed less than the propeller speed, two means, one for driving said gear at a speed in excess of the propeller speed and the other for driving said gear at a speed less than the propeller speed, driving means for said two means comprising a gear fixed to the propeller shaft, and means for operatively connecting the driving gear to either of said two means independently of the other, said two means comprising two pairs of idler gears of respectively different ratios with each pair mounted for rotation as a unit about a fixed axis and one gear of each pair constantly meshing with the first mentioned gear, and said means for operatively connecting the driving gear to either of the two means comprising a gear constantly driven from the driving gear and mounted for movement bodily to one position wherein it meshes with the other of one of said pairs of idler gears, a second position wherein it meshes with the other of the other of said pairs of idler gears, and a third position wherein it is out of mesh with both of the others of the pairs of idler gears.

10. A rotatably mounted propeller comprising a hub, stub shafts rotatably mounted in the hub, blades fixed to the stub shafts, worm wheels fixed to the shafts, worms constantly meshing with the worm wheels, means including a rotatable member for driving the worms in one direction or the other and thereby cause the angles of incidences of the blades to be varied in one direction or the reverse direction, according as the rotatable member is driven at a speed in excess of the propeller speed or driven at a speed less than the propeller speed, two means, one for driving the rotatable member in one direction and at a speed in excess of the propeller speed and the other for driving the rotatable member in said one direction and at a speed less than the propeller speed, driving means for said two means, and means for operatively connecting the driving means to either of said two means independently of the other.

11. A rotatably mounted propeller comprising a hub, stub shafts rotatably mounted in the hub, blades fixed to the stub shafts, worm wheels fixed to the shafts, worms constantly meshing with the worm wheels, means, including a gear rotatably mounted on the propeller shaft for driving the worms in one direction or the other and thereby cause the angles of incidences of the blades to be varied in one direction or the reverse direction according as said gear is driven at a speed in excess of the propeller speed or driven at a speed less than the propeller speed, two means, one for driving said gear in one direction and at a speed in excess of the propeller speed and the other for driving said gear in said one direction and at a speed less than the propeller speed, driving means for

said two means comprising a gear fixed to the propeller shaft, and means for operatively connecting the driving gear to either of said two means independently of the other.

5 Signed at Naco in the county of Cochise and State of Arizona this 6th day of November, A. D. 1928.

CLARENCE KIRK GREENE.

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