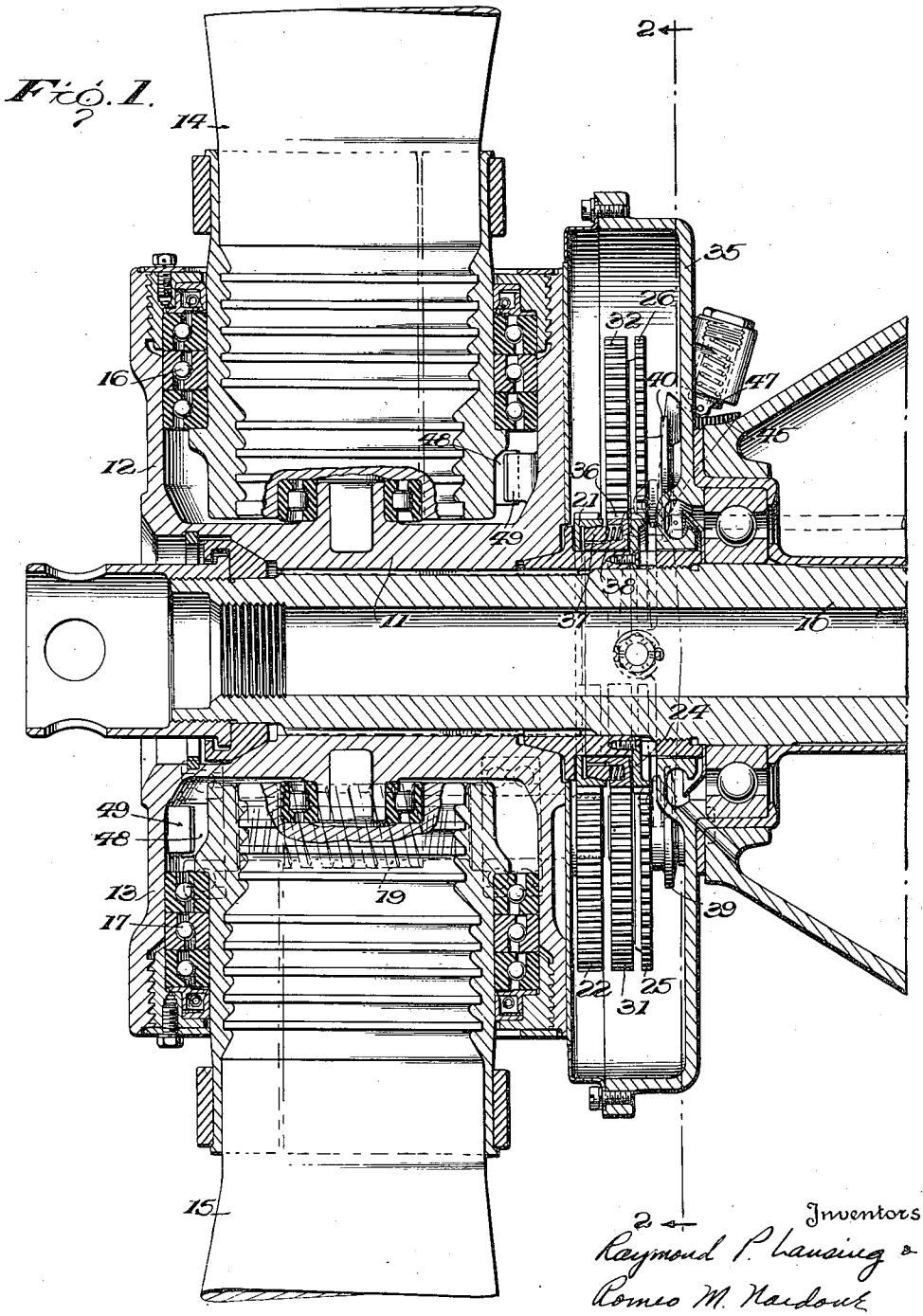
March 10, 1936. R. P. LANSING ET AL 2,033,342

VARIABLE PITCH PROPELLER

Filed March 16, 1934 6 Sheets-Sheet 1

Fig. 1.



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VARIABLE PITCH PROPELLER

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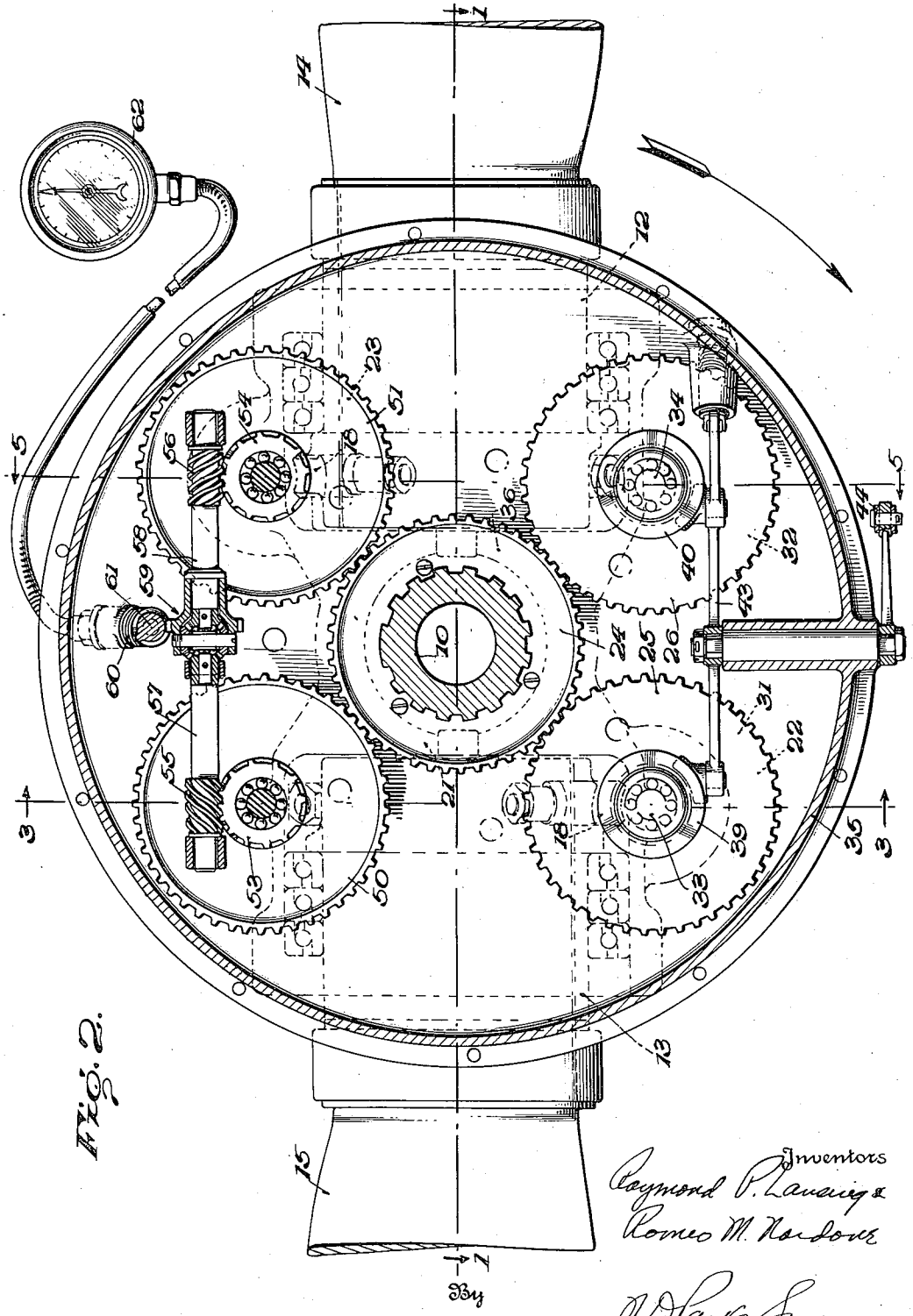


Fig. 2.

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VARIABLE PITCH PROPELLER

Filed March 16, 1934 6 Sheets-Sheet 3

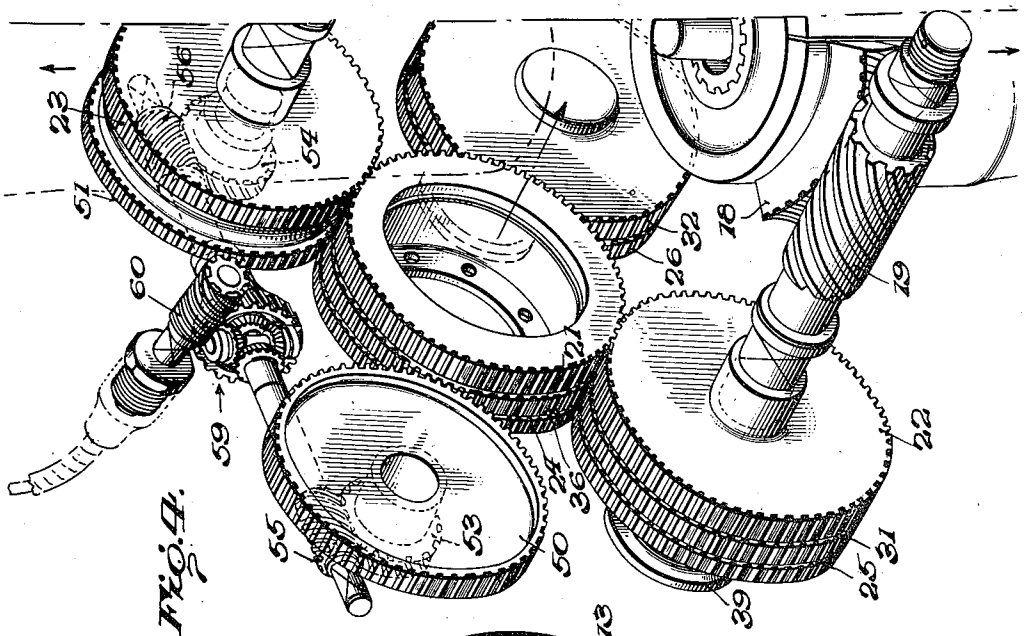


Fig. 4.

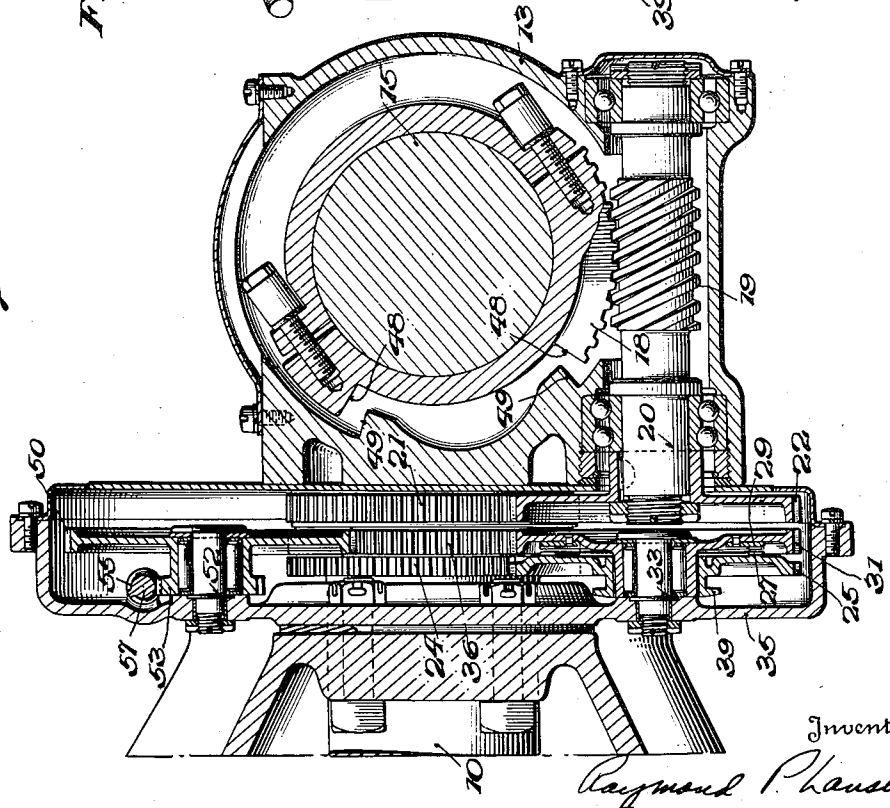


Fig. 3.

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VARIABLE PITCH PROPELLER

Filed March 16, 1934 6 Sheets-Sheet 4

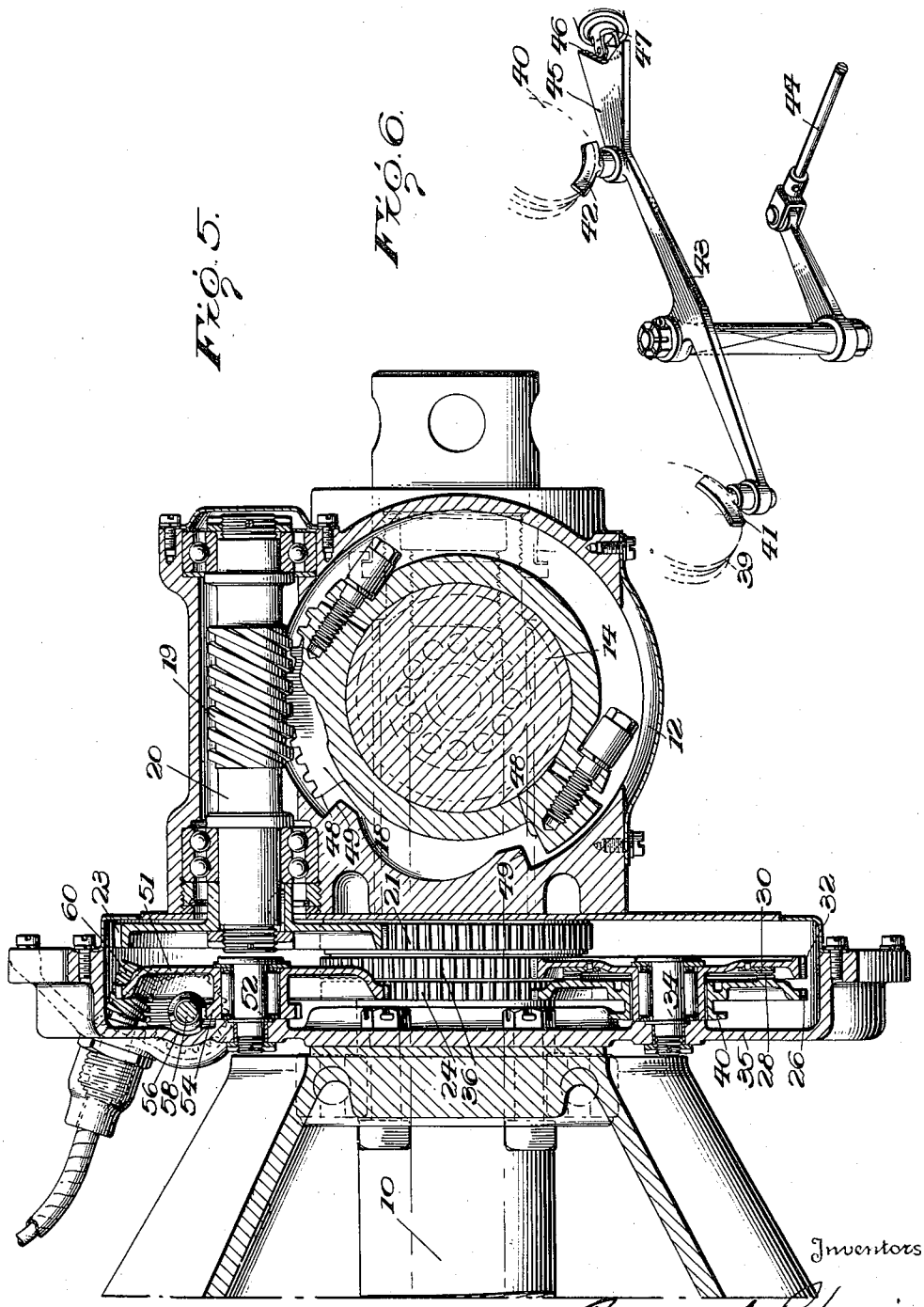


Fig. 5.

Fig. 6.

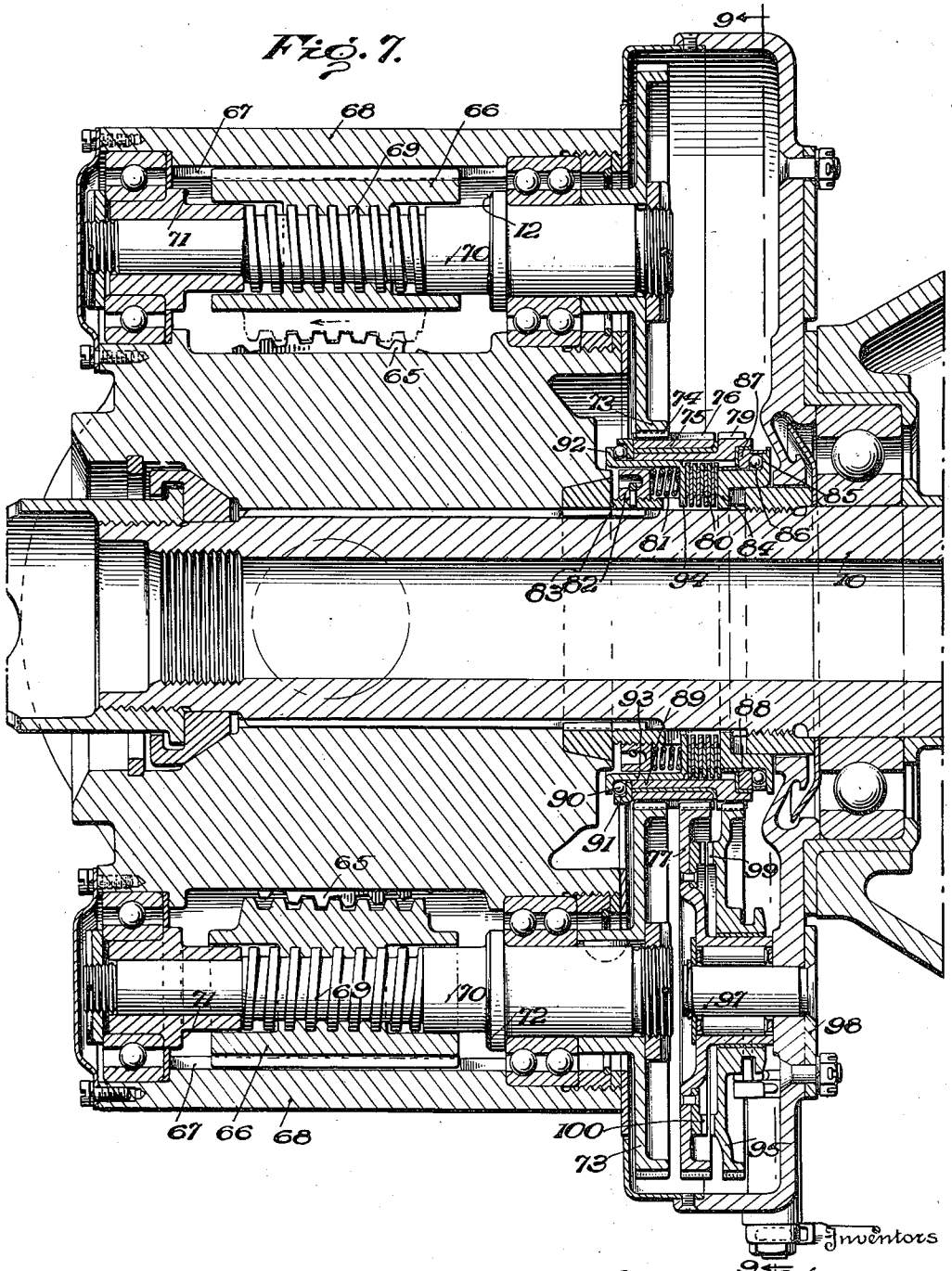
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VARIABLE PITCH PROPELLER

Filed March 16, 1934 6 Sheets-Sheet 5

Fig. 7.



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VARIABLE PITCH PROPELLER

Filed March 16, 1934 6 Sheets-Sheet 6

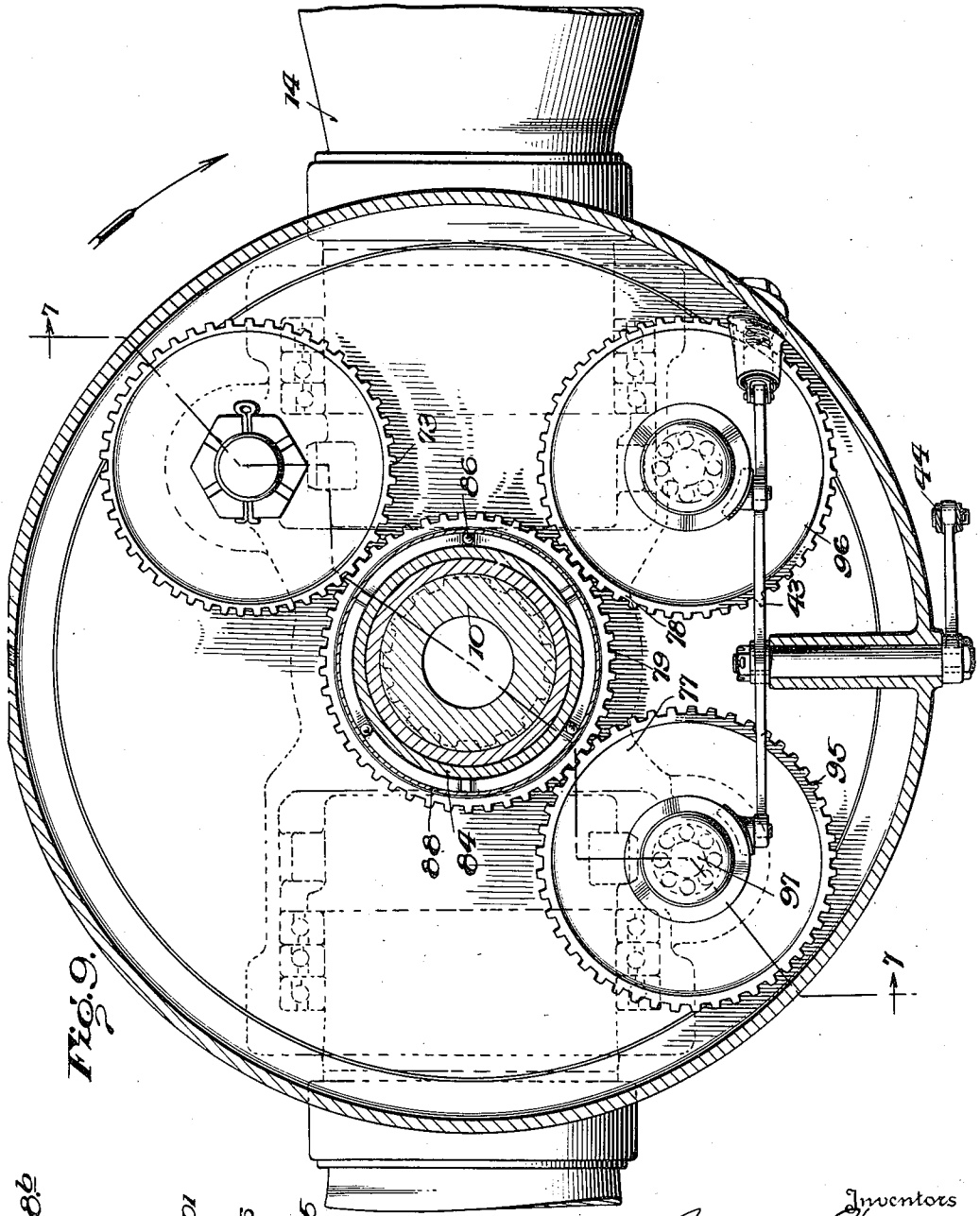


Fig. 9.

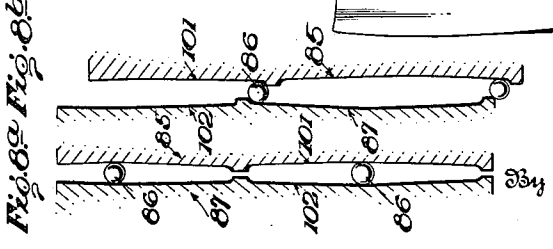


Fig. 8a Fig. 8b

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UNITED STATES PATENT OFFICE

2,033,342

VARIABLE PITCH PROPELLER

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Application March 16, 1934, Serial No. 715,964

18 Claims. (Cl. 170—163)

This invention relates to propellers and more particularly to propellers of the type having blades provided with means whereby the pitch of the blades may be varied during operation of the propellers.

One of the objects of the present invention is to provide a novel pitch-varying mechanism for the blades of a propeller.

Another object of the invention is to provide a variable pitch propeller embodying power-operated pitch-changing mechanism so constituted that the mechanism derives its power for varying the pitch of the propeller blades from the rotating propeller shaft.

Still another object is to provide in a variable pitch propeller, a novel pitch-changing and control mechanism so constructed and arranged that the pitch-changing operation will be automatically arrested after the pitch of the blades has attained a predetermined limit and this irrespective of continued application of the pitch control mechanism.

A further object is to provide in a variable pitch propeller, a novel and compact pitch-changing mechanism of the power-operated type embodying relatively rotatable members so arranged as to be readily engageable by operator-controlled means to effect an increase or decrease in the propeller blade pitch.

A still further object is to provide in a mechanism of the above character, a novel pitch-changing arrangement embodying a clutch device so constituted as to automatically interrupt the pitch-changing operation after the propeller blade pitch has attained a predetermined value.

A still further object is to provide a novel light-weight, compact structure which is not only positive and efficient in operation but which is automatically discontinued after a predetermined propeller blade pitch has been attained, thus avoiding the possibility of injury to the mechanism in the event that the operator inadvertently continues the operation of the pitch-changing mechanism.

Other novel features and advantages of the invention will appear more fully hereinafter from the following detailed description when taken in connection with the accompanying drawings which are illustrative of several forms of the invention. It is to be expressly understood, however, that the drawings are for purposes of illustration only and are not designed as a definition of the limits of the invention, reference being had for this purpose to the appended claims.

In the drawings, wherein similar reference characters denote similar parts throughout the several views:

Fig. 1 is an axial sectional view of a propeller constructed in accordance with the present invention;

Fig. 2 is a sectional view of certain of the propeller control mechanism illustrated in Fig. 1 and is taken along line 2—2 of Fig. 1;

Fig. 3 is a sectional view of that form of the invention shown in Fig. 1 and is taken along line 3—3 of Fig. 2;

Fig. 4 is a perspective view of the control mechanism of Fig. 1 and illustrates the relationship of the various control elements;

Fig. 5 is a sectional view of the propeller taken along line 5—5 of Fig. 2 and illustrates a portion of the pitch-indicating mechanism;

Fig. 6 is a perspective view of a portion of the control mechanism;

Fig. 7 is an axial sectional view of a propeller embodying a modified form of the invention;

Figs. 8a and 8b are diagrammatic views of the clutch-releasing device associated with the propeller shown in Fig. 7, and

Fig. 9 is a partial sectional view taken at right angles to the propeller shaft shown in Fig. 7 and illustrates in plan the arrangement of the pitch-controlling mechanism shown in said figure.

Referring more particularly to Figs. 1 to 5, a variable pitch propeller embodying the principles of the present invention is illustrated therein as comprising a power-driven propeller shaft 10 having a hub 11 suitably secured thereto, said hub being provided with a pair of radially-extending sockets 12 and 13 in which propeller blades 14 and 15 are rotatably mounted as by means of bearings 16 and 17 respectively, in order that the angularity or pitch of the blades may be varied during operation of the propeller. Suitable means, as will be more particularly referred to hereinafter and including a worm gear segment 18 secured to each blade and meshing with a worm 19 carried by worm shaft 20, are provided for rotating each blade about its longitudinal axis to change the pitch thereof.

In the form shown, the pitch-changing mechanism is power operated by means of power derived from the propeller shaft 10 and includes suitable gear means in the form of a gear 21 surrounding but rotatable with respect to the propeller shaft, such gear being in constant meshing engagement with laterally-spaced gears 22 and

23 suitably rotatably mounted in the hub sockets and secured to the worm shafts 20. By reason of the above construction, that is with gear 21 meshing with gears 22 and 23, which latter are in turn connected with each blade, the said gears, hub and propeller blades normally rotate as a unit with the propeller shaft. However, it will be observed that if relative rotation between gear 21 and shaft 10 occurs, then gears 22 and 23 will be rotated relative to each other which will effect a rotation of each blade in its respective socket.

One of the features of the present invention resides in the rotation of the gear 21 in the same direction at either a speed in excess of the speed of rotation of the propeller shaft or at a speed less than the speed of rotation of said shaft in order to effect an increase or decrease in the propeller blade pitch. In the form of the invention illustrated, the above is effected by connecting the gear 21 with the propeller shaft 10 in a novel manner. For this purpose, a driving gear 24 concentrically arranged with respect to the propeller shaft 10 and suitably secured thereto is in constant meshing engagement with laterally-spaced gears 25 and 26, the former having a less number of teeth than the gear 24 while the latter has a greater number of teeth than the gear 24. Preferably, the difference in the number of gear teeth is the same and, for example, one or two. Formed on one of the surfaces of each of the gears 25 and 26 are clutch teeth 27 and 28 respectively which are normally disengaged but which are adapted to be brought into driving engagement with corresponding clutch teeth 29 and 30 formed on opposing faces of gears 31 and 32 respectively, each of these last mentioned gears being suitably rotatably supported on stub shafts 33 and 34 carried by a portion of the stationary engine casing 35, it being observed that the gears 25 and 26 are also suitably supported on said stub shafts. From the above construction, it will be appreciated that during normal operation, the gear 25 will rotate at a speed slightly faster than the propeller shaft speed, while the gear 26 will rotate at a rate slightly less than the propeller shaft speed.

In order to transmit the motion of either of the gears 25 or 26 to the gear 21, a driving element in the form of a gear 36 is concentrically arranged with respect to the propeller shaft and is in constant meshing engagement with each of the gears 31 and 32, and as shown, Fig. 1, the gears 36 and 21 are drivably connected as by means of a suitable clutch device such as a friction clutch ring 37 splined upon an axial extension of the gear 36 and constantly urged as by means of spring 38 into frictional engagement with gear 21. With this arrangement, the gears 21 and 36 rotate as a unit with the propeller during normal operation, while gears 31 and 32 rotate about the stub shafts 33 and 34, the gears 31, 32 and 36 preferably all having the same number of teeth as gears 24 and 21. Thus, during normal operation, the gear 25 will rotate relative to gear 31 while the gear 26 will rotate relative to gear 32.

Means are provided for drivably connecting the relatively-rotating gears 25, 31 or 26, 32 in order to transmit the power from the propeller shaft through the various gears above described in order to vary the pitch of the blades in one direction or the other. In the form of the invention illustrated, this result is effected by so mounting the gears 25 and 26 as to be capable of longitudinal movement in order to effect a driving engagement between clutch teeth 27, 29 or 28, 30. As shown, the gears 25 and 26 are provided with suitable collars 39 and 40 respectively which are adapted to receive suitable shifting devices 41 and 42 carried at the extremities of a lever 43 suitably oscillatably mounted in a portion of the engine casing 35, Fig. 6. Preferably, the oscillation of the control lever 43 is effected by means readily accessible to the operator such as control rod 44. Means are also preferably associated with the controlling lever 43 for resiliently urging the same to such a position that each of the gears 25 and 26 will be inoperative to transmit pitch-changing movement to the propeller blades, and as shown, such means include an extension 45 having a notched end 46 with which a spring-pressed stop device 47 is adapted to coact, the construction being such, Figs. 1 and 6, that the device 47 is adapted to coact, the construction being such, Figs. 1 and 6, that the device 47 normally maintains the control lever 43 in a neutral position.

From the above, it will be readily seen that when clutches 27, 29 and 28, 30 are disengaged as illustrated in Figs. 3 and 5, the gears 21 and 36 will rotate as a unit during rotation of the propeller and no change in the pitch of the blades will be effected. However, upon engagement of the clutch 27, 29, the gears 36 and 21 will be rotated in the same direction as, but at a speed slightly greater than, the speed of the propeller, and the relative rotation between the gear 21 and the propeller shaft 10 will effect, for example, an increase in the pitch of the blades depending upon the direction of rotation of the propeller and the direction of the thread on worms 19. It will also be apparent that upon disengagement of the clutch 27, 29 and engagement of the clutch 28, 30, the gear 21 will be rotated in the same direction as the direction of rotation of the power shaft 10, but at a speed slightly less than the speed of the latter and that the relative rotation between gear 21 and the propeller shaft 10 will effect a decrease in the pitch of the blades, dependent upon the conditions above set forth. This construction thus far described enables the pitch of the propeller blades to be readily controlled in a positive manner and by means of power derived from the propeller shaft.

In order that the operation of a portion of the pitch-changing mechanism may be interrupted when the pitch of the propeller blades attains a predetermined value, the worm segments 18 associated with each of the blades are provided with spaced stops 48 which are adapted to cooperate with abutments 49 formed in each blade socket and the construction of the clutch 37 frictionally connecting gears 21 and 36 is such that when either of the stops 48 engages the cooperating abutment 49 at one of the limits of blade adjustment, the clutch 37 will slip and the driving engagement between gears 21 and 36 will thus be interrupted. This action is effected notwithstanding continued operation of the pitch-changing operation between gear 36 and gear 24 through one of the engaged clutches 27, 29 or 28, 30. In this manner, the possibility of the pitch of the blades being changed to a dangerously low or high value is avoided without any thought on the part of the operator and without any danger to the pitch-changing mechanism.

Means are also provided for remotely indicating the pitch of the blades at all times, and in the form of the invention illustrated, Figs. 1 to 5, such means include a pair of laterally-spaced

gears 50 and 51, the former being in constant engagement with gear 36 while the latter is constantly driven by gear 24, all of said aforementioned gears having the same number of teeth and having the same pitch diameters. Each of the gears 50 and 51 is suitably rotatably mounted upon stub shafts 52 secured in the stationary casing 35 and has integrally formed thereon worm gears 53 and 54 which are respectively engaged with worms 55 and 56. Each of the last mentioned worms is carried by worm shafts 57 and 58 respectively which are interconnected by a suitable differential transmission mechanism 59 which is in turn geared through worm 60 to a flexible shaft 61 provided with a remotely-positioned indicator 62. With the above described construction, when the pitch of the blades is not being changed, gears 36 and 24 rotate at the same speed as the propeller shaft, and no relative motion will occur between gears 50 and 51 respectively meshing with the above mentioned gears. However, in the event that either of the clutches 27, 29 or 28, 30 is engaged to increase or decrease the pitch of the blades, gear 36 will rotate slightly faster or slower than the gear 24, thus effecting a relative rotation between the indicator gears 50 and 51 which will be transmitted to the indicator 62 through the differential transmission mechanism 59. In this manner, the pitch of the blades will be registered on the indicator 62 at all times.

In operation, gears 24, 36 and 21 all rotate at the same angular velocity as the propeller shaft 10 and no relative movement occurs between worms 19 and gear segments 18. If it is desired to effect an increase in the pitch of the blades for example, the operator-controlled rod 44 is moved in the proper direction to effect engagement between clutches 27 and 29 which causes a rotation of gears 25 and 31 in unison and at a speed slightly greater than the speed of rotation of the propeller shaft, this being due to the fact that the gear 25 has a less number of teeth than the driving gear 24. This increased speed of rotation will be imparted to gear 36 and to gear 21 clutched thereto which latter will effect a rotation of the worms 19 through gears 22 and 23 thereby rotating the blades 14 and 15 in their respective sockets to increase their pitch. Further increase in the pitch of the blades may be arrested at any time prior to engagement between the stops 48 and abutments 49 by merely disengaging the clutch 27, 29. However, if this last mentioned clutch is still engaged when the blades reach the limit of their adjustments, determined by the engagement between stops 48 and abutments 49, further increase in the pitch of the blades will be arrested and no danger will occur to the pitch-changing mechanism by reason of the fact that driving engagement between gears 21 and 36 is interrupted by the slipping of the clutch 37.

If it is desired, on the other hand, to decrease the pitch of the blades, it is merely necessary to move the control rod 44 in the opposite direction to engage clutch 28, 30 whereupon gears 26 and 32 will rotate in unison at a speed slightly less than the speed of the propeller shaft due to the fact that the gear 26 is provided with a greater number of teeth than the driving gear 24. Since gear 32 is in constant engagement with gear 36, the latter will be slowed up slightly relative to the propeller speed and the worms 19 will be rotated in an opposite direction to decrease the pitch of the blades. As heretofore, further decrease in the pitch of the blades may be discontinued by disengaging the clutch 28, 30, or if said clutch is in engagement when the other pair of stops 48 and 49 are engaged, the clutch 37 will slip, thus effectively disconnecting the gears 24 and 21.

In either case, that is upon a decrease or increase in the pitch of the blades, it will be observed that a relative rotation occurs between gears 24 and 36. This relative rotation will be communicated to the indicating mechanism 62 through gears 51 and 50, respectively engaged with gears 24 and 36, thus indicating the pitch of the blades to the operator under all conditions.

A slightly modified form of the invention is disclosed in Figs. 7, 8 and 9 and in this modification there is included means for positively disconnecting the power mechanism from the blades when the pitch of the latter has reached a predetermined limit in either direction. Referring more particularly to Fig. 7, each of the propeller blades 14 and 15 is provided adjacent its root end with a gear segment 65 which is in constant meshing engagement with a rack 66 exteriorly splined as at 67 to a portion of the hub sockets 68 and interiorly threaded upon a worm 69 of worm shaft 70, the latter being suitably rotatably mounted in the hub sockets. As shown, the worm shaft 70 is provided with a pair of abutments 71 and 72 which are adapted to limit the travel of rack 66 in opposite directions to thereby limit changes in the pitch of the blades in either direction. Each of the worm shafts 70 is also provided with a gear 73 which is in constant meshing engagement with a gear 74 forming one gear portion of a double gear 75, the other portion 76 of said double gear being in constant meshing engagement with gears 77 and 78. It will be observed that gear 75 is concentrically arranged with respect to the propeller shaft 10 and that during normal operation, that is when the pitch of the blades remains fixed, the gear 75 will rotate at the same speed of rotation as the propeller shaft.

Means are provided for rotating the gear 75 in the same direction at speeds greater or less than the speed of rotation of the propeller shaft in order to vary the pitch of the blades in opposite directions, and preferably such means are drivably connected with the propeller shaft in such a manner as to permit such drivable connection to be interrupted when the pitch of the blades has attained a predetermined value. In the form shown, such driving means are constituted by a gear 79 surrounding the propeller shaft and drivably connected thereto through an interleaved friction disk clutch 80, adjacent disks of which are respectively splined to the interior of the gear 79 and the exterior of the propeller shaft 10. The frictional loading of the disks of the clutch 80 is predetermined by means of a plurality of springs 81, the tension of which may be regulated by the adjustable screw collar 82 threadedly received by a sleeve 83 suitably secured to the propeller shaft. The opposite end of the clutch abuts a thrust ring 84, secured to the propeller shaft 10 in any suitable manner, the said ring being provided with a flanged extension 85 which cooperates with a plurality of cam balls 86 which in turn cooperate with a cam ring 87 frictionally received within a recess provided in the gear 79, a suitable bronze packing 88 being interposed between said gear and the cam ring. The gear 79 is provided with

a flanged portion 89 which cooperates with a thrust bearing 90 interposed between a retaining ring 91 and an outwardly-turned flange 92 provided upon clutch-releasing ring 93, the latter being integrally formed with a pressure plate 94 interposed between the springs 81 and the clutch 80.

In order to transmit power from gear 79 to gear 75 for the purpose of effecting a variation in the pitch of the blades, a pair of laterally-spaced gears 95 and 96 are provided, which gears are suitably journaled upon the hub portions of gears 77 and 78 respectively, the latter being suitably rotatably mounted on stub shafts 97 secured to a housing portion 98 suitably secured to the stationary engine casing. The gear 95 has preferably a less number of teeth than the driving gear 79, while the gear 96 has a greater number of teeth than the driving gear so that in normal operation gears 95 and 96 rotate at speeds slightly greater than and less than the propeller speed.

Formed on the surfaces of gears 95 and 96 are clutch teeth 99 which are normally disconnected from but which are adapted to be drivably connected to corresponding clutch teeth 100 formed on the surfaces of gears 77 and 78. Since gears 73, 74, 76, 77, 78 and 79 are all provided with the same number of teeth and have the same pitch diameters, these gears will all have the same rate of rotation during normal operation of the propeller. However, if gears 95 and 77 are drivably connected through engagement of the clutch 99, 100, the double gear 75 will be rotated at a speed slightly greater than the speed of the propeller shaft thus effecting an increase in the pitch of the blades, while if gears 96 and 78 are drivably connected, the double gear 75 will be rotated at a speed slower than the rate of rotation of the propeller shaft and the pitch of the blades will be decreased. Suitable shifting mechanism as disclosed in connection with the form of the invention first described may be employed for shifting the gears 95 and 96 through suitable clutch collars to effect the aforementioned drivable connections.

As heretofore stated, one of the features of the present modification resides in the disconnection of the power source for changing the propeller blade pitch after the latter has reached a predetermined limit. In the form shown, Figs. 7 and 8, the flanged extensions 85 and the cam ring 87 are provided with cam surfaces 101 and 102 respectively, a portion of these surfaces being shown in plan form in Figs. 8^a and 8^b. In Fig. 8^a, the clutch comprising members 87, 86 and 85 is shown closed which is the normal position, while in Fig. 8^b the clutch is shown open which effects a decrease in the loading of clutch 80 and a constant opening thereof as will appear hereinafter.

In operation, assuming that gears 95 and 77 are drivably connected and that the pitch of the blades has been varied to such an extent that the rack 66 engages the abutment 71, it will be observed that further rotation of gears 73 about their own axes will be arrested but that due to revolution of these gears about the propeller axes, power will be transmitted therefrom through the double gear 75, interconnected gears 77 and 95, to the propeller shaft driven gear 79, which latter will be rotated through the above mentioned train of gearing at a speed slightly less than the propeller speed, this being permitted by a slipping of the clutch 80. As soon, however, as such relative rotation between the gear 79 and the member 84 occurs, since the cam ring 87 is frictionally secured to the gear 79, there will be a relative movement between the cam surfaces 101 and 102 associated with the cam balls 86, thus causing the said balls to roll along the cam surfaces until they reach the high points of such surfaces, thus effecting a separation of the members 87 and 85, Fig. 8^a. This will effect a movement of the assembly comprising gears 79 and 75 to the left as viewed in Fig. 7, which movement through the thrust bearing 90 will effect a corresponding movement of sleeve 93 and pressure plate 94, thus compressing springs 81 and relieving tension on the clutch 80 to open the same and effectively disconnect the gear 79 from the propeller shaft 10. During continued operation of the propeller with the clutch 80 disengaged, the gear 79 will rotate relatively to the propeller shaft as long as gears 77 and 95 are engaged. No further relative movement between the cam surfaces 101 and 102 will occur, however, since the angularity of the cams on such surfaces as compared with the coefficient of friction between the cam ring 87 and the packing member 88 is such that the latter will slip in said ring under these conditions.

In the event that it is now desired to decrease the pitch of the blades, gears 96 and 78 will be drivably connected through the clutch 99, 100, and since gear 96 is provided with a slightly greater number of teeth than the gear 79, the latter through the power derived from the revolving gear 73 will be moved at a speed slightly in excess of the propeller speed, whereupon the relative movement between cam surfaces 101 and 102 will be reversed and the cam balls 86 will be returned to their original position. The clutch 80 will then be engaged through movement of the sleeve 93 to the right as viewed in Fig. 7 and consequent expansion of springs 81 in order to connect gear 79 to the driving shaft and effect a movement of gears 75 and 73 in such a manner as to decrease the pitch of the blades. It will thus be observed that when either limit of pitch adjustment is reached, the clutch drivably connecting the gear 79 with the propeller shaft will be positively opened and will not be closed until pitch-changing operation in the opposite direction is initiated.

There is thus provided by the present invention a novel variable pitch propeller wherein the variation in the pitch of the blades is secured by mechanism deriving its power from the propeller shaft. The change in pitch is thus positively and efficiently effected and in view of the provision of the pitch-limiting devices, the change in pitch is automatically arrested without any attention on the part of the operator. The mechanism not only secures the above advantages but also that of compactness and lightness in weight, which features are highly desirable in instances of aircraft installations.

While two embodiments of the invention have been shown and described herein, it is to be understood that various changes and rearrangements of the component parts may be resorted to as will appear to those skilled in the art, without departing from the spirit of the invention. Reference will therefore be had to the appended claims for a definition of the limits of the invention.

What is claimed is:

1. A variable pitch propeller having a shaft

and a plurality of blades adjustable to vary the pitch thereof, gear means rotatably carried by the shaft for adjusting the blades to vary the pitch thereof in response to driving of said gear means at speeds greater than and less than the propeller speed, means for so driving said gear means including a single driving gear secured to said shaft, and means including a pair of selectively operable independent clutches for operatively connecting and disconnecting said driving gear to and from said gear means.

2. A variable pitch propeller having a shaft and a plurality of blades adjustable to vary the pitch thereof, gear means rotatably carried by the shaft for adjusting the blades to vary the pitch in response to driving of said gear means at speeds different from the propeller speed, means for driving said gear means at speeds different from the propeller speed including a single gear fixed to the shaft, and means including a pair of selectively operable independent clutches for operatively connecting said single gear to and from said gear means.

3. A variable pitch propeller having a shaft and a plurality of blades adjustable to vary the pitch thereof, gear means rotatably mounted on the shaft for adjusting the blades to vary the pitch thereof in either direction according as said means is driven at a speed in excess of the propeller speed or at a speed less than the propeller speed, a single gear drivably connected to and carried by said shaft, means for connecting said single gear to said gear means to drive the same at a speed in excess of the propeller speed, and means independent of said first named connecting means for connecting said single gear to said gear means to drive the latter at a speed less than the propeller speed.

4. A variable pitch propeller having a shaft and a plurality of blades adjustable to vary the pitch thereof, gear means rotatably mounted on the shaft for adjusting the blades to vary the pitch thereof in either direction according as said means is driven at a speed in excess of the propeller speed or at a speed less than the propeller speed, a single gear drivably connected to and carried by said shaft, means for connecting said single gear to said gear means to drive the same at a speed in excess of the propeller speed, and independent means for connecting said single gear to said gear means to drive the latter at a speed less than the propeller speed, said last two named connecting means comprising a pair of independently operable clutches.

5. In a variable pitch propeller having a rotatable shaft, a hub drivably connected with said shaft, a plurality of propeller blades rotatably mounted in said hub, pitch-changing mechanism for said blades operable in the same direction at different speeds for increasing or decreasing the pitch of the blades, and means for selectively actuating said mechanism at said different speeds comprising a single gear drivably connected with and carried by said shaft, together with a pair of selectively operable independent clutches for drivably connecting said single gear and said mechanism.

6. In a variable pitch propeller having a rotatable shaft, a hub drivably connected therewith, a plurality of propeller blades rotatably mounted in said hub, means operable to vary the pitch of the blades, a single gear secured to said shaft, means including a rotatable clutch driven by said gear for driving said first named means, and means operable irrespective of continued rotation of said clutch and included in said first named means for automatically discontinuing operation of said pitch-varying means after the pitch of the blades has attained a predetermined value.

7. In a variable pitch propeller having a rotatable shaft, a hub drivably connected therewith, a plurality of propeller blades rotatably mounted in said hub, means operable to vary the pitch of the blades, means including a power driven clutch for driving said first named means, and means comprising a second clutch surrounding said shaft for automatically discontinuing operation of said first named means after the pitch of the blades has attained a predetermined value.

8. In a variable pitch propeller having a rotatable shaft, a hub drivably connected therewith, a plurality of propeller blades rotatably mounted in said hub, and power means operable to vary the pitch of the blades including normally engaged clutch means surrounding said shaft for interrupting the variation in pitch when the pitch of the blades has attained a predetermined value.

9. In a variable pitch propeller having a rotatable shaft, a hub drivably connected therewith, a plurality of propeller blades rotatably mounted in said hub, means for varying the pitch of said blades comprising a power operated mechanism including a friction clutch, said clutch being concentrically arranged with respect to the propeller shaft, and means to disengage said clutch when the pitch of the blades reaches a predetermined limit.

10. In a variable pitch propeller having a rotatable shaft, a hub drivably connected therewith, a plurality of propeller blades rotatably mounted in said hub, means including a gear carried by said shaft for varying the pitch of the blades, a friction clutch surrounding said shaft and associated with said means, and means operable when the pitch of the blades has attained a predetermined value for disengaging said clutch.

11. In a variable pitch propeller having a rotatable shaft, a hub drivably connected therewith, a plurality of propeller blades rotatably mounted in said hub, means including a gear rotatably mounted on said shaft and operatively connected with said blades for varying the pitch of the latter, a driving gear secured to said shaft, and means for connecting said driving gear to said first named gear to rotate the latter in the same direction at different speeds to increase or decrease the pitch of the blades, said last named means including a friction clutch operable to interrupt said connecting means when the pitch of the blades has reached a predetermined limit.

12. The combination with a propeller having angularly-adjustable blades, of mechanism for adjusting said blades while the propeller is rotating, said mechanism including normally disengaged members relatively rotatable with respect to each other, means operable to engage said members to effect rotation thereof in unison for actuating said adjusting mechanism, and means including a clutch for interrupting operation of said mechanism when a predetermined degree of angular adjustment of said blades is reached.

13. In a variable pitch propeller having a rotatable shaft, a hub drivably connected therewith, a plurality of propeller blades rotatably

mounted in said hub, a gear secured to said shaft, a second gear rotatably mounted on said shaft, means connecting said second gear with said blades, and means including a friction clutch surrounding said shaft for drivably connecting said gears to effect rotation of said second gear at a rate slower or faster than said shaft.

14. In a variable pitch propeller having a rotatable shaft, a plurality of pitch variable blades carried thereby, means operable for varying the pitch of the blades including a gear rotatably mounted on said shaft, a friction clutch positioned between said gear and said blades, a pair of gears separately meshing with said first named gear, a driving member secured to said shaft, a second pair of gears separately driven by said member, and means for selectively connecting a gear of said second pair with a gear of said first pair.

15. In a variable pitch propeller having a plurality of pitch variable blades, a rotatable shaft, power operated means for varying the pitch of the blades during operation of the propeller, a clutch surrounding said shaft and normally drivably connected thereto, means for drivably connecting said clutch to said first named means, and means for positively disengaging said clutch after the pitch of the blades has reached a predetermined limit.

16. In a variable pitch propeller having a plurality of pitch variable blades, a rotatable shaft, power operated means for varying the pitch of the blades during operation of the propeller, a clutch surrounding said shaft, a pair of driving members spaced laterally of said shaft, said members being drivably connected through said clutch with said shaft, means for selectively connecting either of said members with said means for varying the pitch of the blades in one direction or the other, and means for disengaging said clutch after the pitch of the blades has reached a predetermined limit.

17. In a variable pitch propeller having a plurality of pitch variable blades, a rotatable shaft, power operated means including a shaft driven gear for varying the pitch of the blades in either direction, a clutch interposed between said gear and shaft, and means for disengaging said clutch after the pitch of the blades has reached a predetermined limit.

18. In a variable pitch propeller having a plurality of pitch variable blades, a rotatable shaft, power operated means including a shaft driven gear for varying the pitch of the blades in either direction, a clutch interposed between said gear and shaft, and means dependent upon relative rotation between said gear and shaft after the pitch of the blades has reached a predetermined limit for disengaging said clutch.

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