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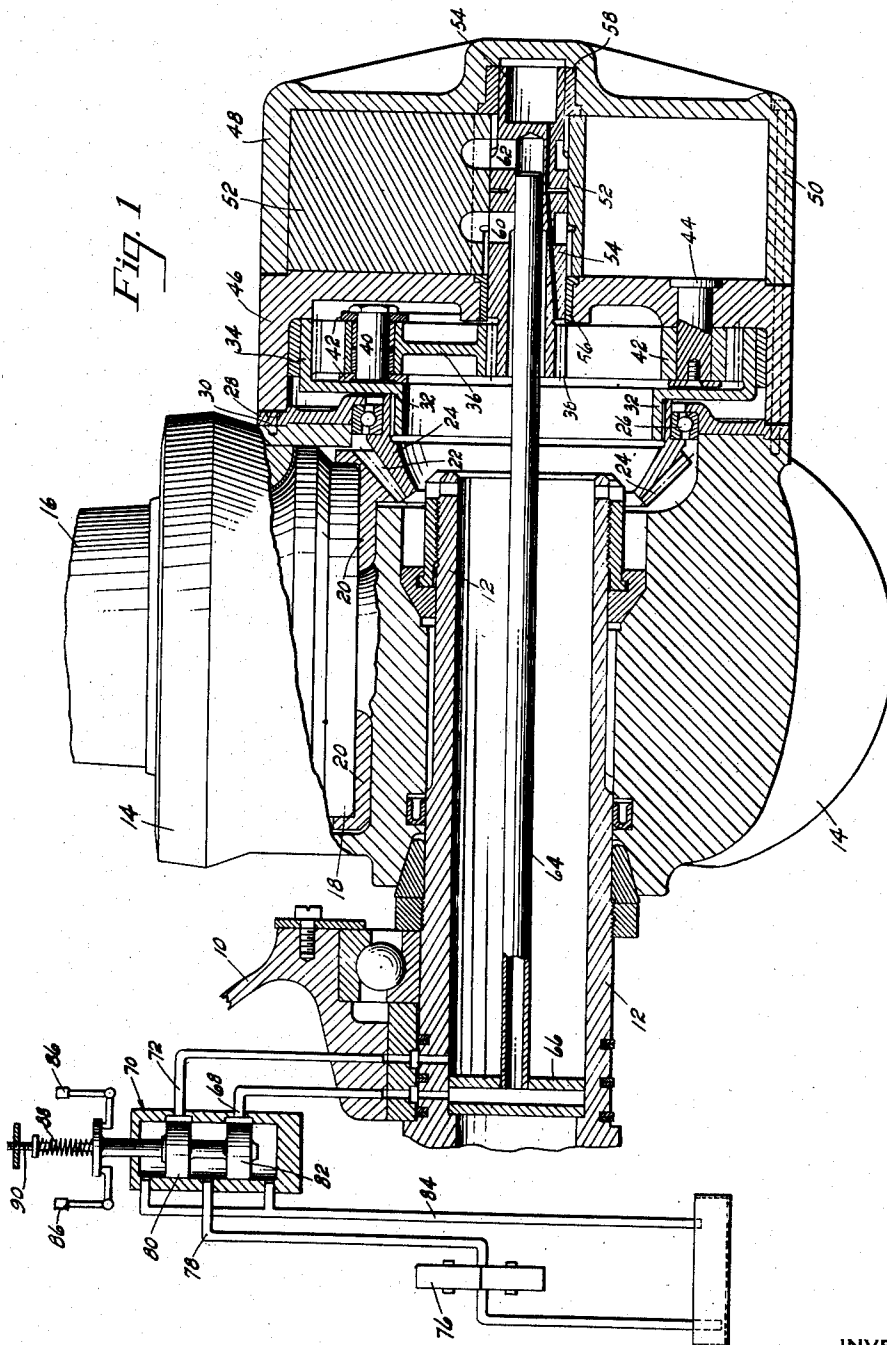
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2,296,348

PROPELLER PITCH CONTROL

Filed May 31, 1939

2 Sheets-Sheet 1



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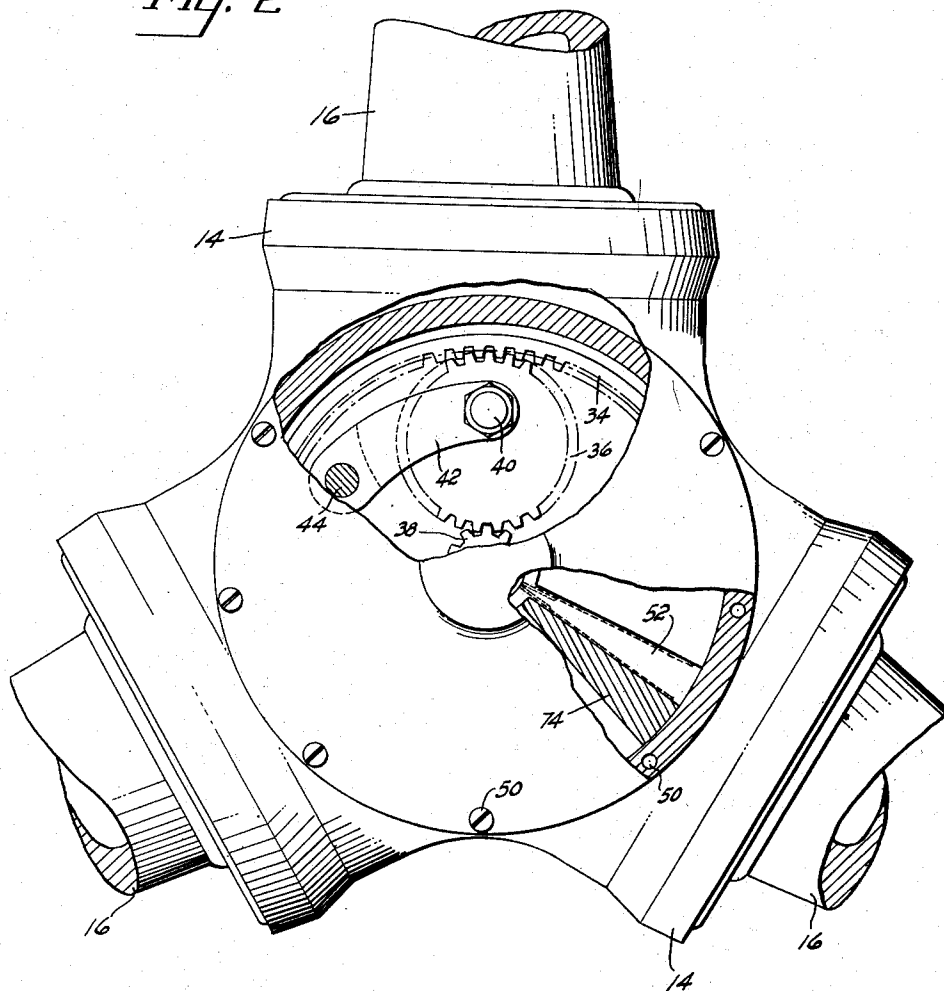
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Fig. 2



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2,296,348

PROPELLER PITCH CONTROL

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Application May 31, 1939, Serial No. 276,571

12 Claims. (Cl. 170-163)

This invention relates to improvements in controllable pitch propellers and has particular reference to an improved variable ratio gear arrangement in the pitch changing mechanism.

An object of the invention resides in the provision of an improved gear train.

A further object resides in the provision of a gear train in which the ratio between the driving and driven elements may be varied over a wide range.

A still further object resides in the provision of a propeller having a power-operated element for changing the propeller blade pitch in which a gear train is provided such that at selected positions a relatively large force and a small motion is transmitted to the blade from the power element and at other positions a relatively small force and a large movement is transmitted.

Other objects and advantages will be more particularly pointed out hereinafter or may become apparent as the description proceeds.

These objects are obtained by the mechanism illustrated in the accompanying drawings in which like reference numerals are used to designate similar parts throughout. The drawings, however are for the purpose of illustration only, and are not to be taken as limiting or restricting the scope of the invention.

In the drawings, Fig. 1 is a longitudinal view partly in section and partly schematic of a controllable pitch propeller and its operating mechanism, and

Fig. 2 is a front elevational view with portions broken away of the same propeller.

Referring to the drawings, the numeral 10 designates the front portion of an engine through which a propeller shaft 12 extends. This shaft may be either an extension of the crankshaft or may be a propeller shaft driven through a gear reduction. On this propeller shaft, there is mounted a propeller blade supporting hub 14 which in the device illustrated supports three propeller blades 16. There may of course be more or fewer blades as required. On the inner end 18 of the propeller blade, there is mounted in driving engagement therewith a flange member 20 carrying on one side thereof a bevel gear 22. This bevel gear meshes with a bevel gear 24 which acts to turn bevel gear 22 and the blade 16 secured thereto to change the blade pitch. Gear 24 is held in position by a bearing 26 positioned on the blade hub 14 by a disk-shaped member 28 fastened to the hub by screws 30. Splined to the gear 24 is an annular member 32 carrying an internal gear 34. Meshing with the internal gear 34

is a spur gear 36 which in turn meshes with a spur gear 38 driven by any device for supplying power to change the blade pitch.

Gear 36 is mounted on a pivot 40 eccentrically located in the gear 36. This pivot is carried on one end of a link 42, the other end of which is pivoted at 44 to a flanged member 46 secured to the propeller hub 14.

By thus mounting the gear 36 eccentrically a force supplied to the gear 38 is multiplied in its application to the gear 34 when the gear 36 is in the position shown in Fig. 2. When, however, gear 36 has rotated through 180 degrees and the eccentric pivot is then located nearer gear 38 than to the gear 34 then force applied to the gear 38 will be reduced in its application to the gear 34, because of the mechanical disadvantage but the distance through which gear 34 will be moved will be greater than the distance through which gear 38 is moved. It will thus be seen that this gear provides a construction in which the ratio of movement between gears 38 and gears 34 may be varied as the gear 36 rotates. By positioning the gear 36 so that its greatest mechanical advantage occurs at the point where the blade offers the greatest resistance to being turned, it becomes possible to use a small power unit for turning the blade. By decreasing this mechanical advantage as the blade moves into positions where the resistance offered to turning the blade is less, it is possible to utilize this small power unit to the best advantage and obtain much larger movement of the blade. This latter feature attains particular usefulness as the blades approach a feathered condition where centrifugal forces acting on the blades become less, both due to the position of the blade and to the necessarily reduced speed because of the greater force required to rotate the propeller in the feathered position.

As stated above the gear 38 may be driven by any desired source of power. In the mechanism illustrated, a vane type motor is shown having a housing 48 secured to the flange member 46 and the hub 14 by means of bolts 50. Movable vanes 52 fit inside of the housing 48 and are splined to a shaft 54 secured to or formed integral with gear 38. This shaft may be supported in suitable bushings such as 56 in member 46 and 58 in housing 48. Each side of the movable vane 52 is recessed to allow oil to flow across the face thereof. Oil is admitted to the recess on one side through an orifice 62. Orifice 62 is connected by means of a tube 64 to a channel in plug 66 which chan-

nel is in turn connected with a conduit 68 leading to a governor generally indicated at 70.

Orifice 60 is connected by means of a channel outside of tube 64 to the area inside of crankshaft 12 and with a conduit 72 also leading to governor 70. There are as many stationary vanes 74 provided inside of the housing 48 as there are movable vanes 52. It is obvious that by admitting oil under pressure to one side of the vane 52 and connecting the other side with a drain, the vane may be moved in one direction, thus causing movement of the gear 38, while admission of oil under pressure to the other side of the vane 52 and connecting said one side with drain will move the vane 52 in the opposite direction, thus causing gear 38 to move in the opposite direction, thus of course changing the blade pitch in one direction or the other as desired.

The flow of oil to and from the vane motor or other source of power may be controlled by a manually operated valve (not shown) or may be controlled automatically by any suitable governor such as that diagrammatically shown in Fig. 1.

In the structure shown in Fig. 1 a pump 76 which may be the normal engine lubricating pump or may be a pump for boosting the engine pressure or may be any suitable source of fluid under pressure supplies fluid pressure to the conduit 78 and hence to the space between the partitions 80 and 82 of the governor valve. The spaces on the opposite sides of the partitions are connected with the conduit 84 to a drain. The governor valve connecting the partitions 80 and 82 is actuated by the centrifugal weights 86 and the spring 88 in accordance with the speed of the propeller. It is obvious that movement of the governor valve in one direction will cause one of the conduits 68, 72 to be connected with pressure and the other with drain while movement of the valve in the opposite direction will in effect reverse the connections. The setting of the governor may be changed by a screw 90 or any other suitable means.

It is of course obvious that, if desired, a different form of hydraulic motor might be used so that more than 360 degrees of movement might be imparted to the gear 38, thus reducing the size of the motor required or the pressure of the fluid required, or both, to produce any desired amount of pitch-changing movement of the blades.

It is to be understood that the invention is not limited to the particular construction illustrated and described but that such changes in the size, shape and arrangement of the various parts may be resorted to as come within the scope of the subjoined claims.

Having now described the invention so that others skilled in the art may clearly understand the same what it is desired to secure by Letters Patent is as follows:

1. In combination with a controllable pitch propeller having movably mounted blades, means for moving said blades to change their pitch angle, said means comprising a motor, and a toothed gear train having a variable gear ratio continuously drivingly connected and mechanism continuously, positively and drivingly connecting said gear train with said motor and said blades, said mechanism forming, with said gear train, a positive and direct drive between said motor and said blades.

2. Propeller pitch changing means comprising a motor driving a gear, another gear meshing with said first mentioned gear and eccentrically and rotatably mounted on a pivot, means for restrain-

ing said pivot from free circumferential movement about said first mentioned gear, means for maintaining said gears in mesh comprising a third gear meshing with said another gear and a propeller blade drivingly connected with said third gear.

3. In combination with a controllable pitch propeller having blades rotatably held by a hub for pitch changing movements, a motor carried by said hub for changing the blade pitch and a gear train connecting said motor and said blades, said gear train comprising one gear driven by said motor, a second gear driving said blade and a third gear connecting said one and said second gears, a support for said third gear comprising, a pivot eccentrically located in said third gear and means connecting said pivot with said hub.

4. In combination with a controllable pitch propeller having blades rotatably held for pitch changing movements in a hub, a motor carried by said hub for changing the blade pitch and a gear train connecting said motor and said blades, said gear train comprising one gear driven by said motor, a second gear driving said blade and a third gear connecting said one and said second gears, a support for said third gear comprising a pivot eccentrically located in said third gear and a link attached adjacent one end to said pivot and pivoted adjacent the other end to said hub to permit substantially free movement of said pivot substantially radially of said one gear but preventing free movement of said pivot circumferentially of said one gear.

5. In combination with a controllable pitch propeller having movably mounted blades, a motor rotatable with said propeller, a gear train connecting said motor and said propeller, said gear train comprising an internal and an external gear and a third gear meshing with said internal and external gears, a pivot rotatable with said propeller, means for preventing said pivot from moving freely circumferentially of said internal and external gears but permitting movement of said pivot between said internal and external gears and means eccentric to said third gear rotatably connecting said pivot and said gear.

6. In combination with a controllable pitch propeller having blades rotatably held by a hub for pitch changing movements, constructed and arranged so that as the blade pitch changes the force required to turn the blade changes, means for supplying a substantially uniform force for turning said blades and a variable ratio gear train carried entirely by said hub and continuously drivingly connecting said force supplying means and said blades for varying the effective force applied to said blades by said means during pitch changing movements.

7. In combination with a controllable pitch propeller having blades rotatably held in a hub for pitch changing movements, constructed and arranged so that as the blade pitch changes the force required to turn the blade changes, means for supplying a substantially uniform force for turning said blades and a variable ratio gear train for continuously varying the effective force applied to said blades by said means during pitch changing movements said variable ratio gear train comprising an external gear, an internal gear, concentric with said external gear, and a third gear connecting said internal and external gears, said third gear rotatably mounted to turn about a point eccentric to its circumference and means connecting said gear mounting with said

hub to restrain said gear from free bodily movement relative to said hub and to cause said external gear when turned to transmit force through said third gear to said internal gear.

8. In combination with a controllable pitch propeller having blades held by a hub for pitch changing movements, constructed and arranged so that as the blades change pitch from a predetermined position the force required to turn them becomes less, a motor for supplying force to change the blade pitch, a gear train with a variable ratio connecting said motor and said blades, said gear train having a drive gear, a driven gear and a third gear mounted on a pivot and connecting said drive and driven gears, said pivot arranged eccentric of said third gear and movable toward and from said drive and driven gears as said third gear is rotated, said gears and said blades relatively positioned so that when the blade is in said predetermined position said pivot is in a position toward said driven gears.

9. In combination with a controllable pitch propeller having movably mounted blades, an hydraulic motor for moving said blades to change their pitch angle, a source of hydraulic fluid under substantially constant pressure for supplying said motor with a substantially uniform turning force and a gear train having an automatically variable gear ratio drivingly connected between said motor and said blades, said gear ratio being varied automatically as the gears are turned and means movable by the rotation of the gears for varying said ratio.

10. In combination, propeller blades rotatably held by a hub for pitch changing movements, and constructed and arranged so that as the blade pitch angle is changed during operation of the propeller, the force required to turn the blades to change their pitch angle varies, a motor for moving said blades to change their pitch angle, said motor exerting a substantially uniform force, a variable ratio gear train, having a definite and different ratio for each successive position of the gears of said train and the blades

moved thereby, connecting said motor and said blades for varying the effective force exerted by said motor on said blades as the blades are turned by said motor, said gear train constructed and arranged so that said effective force varies in the same direction as the force required to turn said blades to thereby give a large effective turning force when a large force is required to turn said blades.

11. In combination, propeller blades movably mounted for pitch changing movements, constructed and arranged so that as the blade pitch angle is changed from one pitch to another such as from substantially flat pitch to substantially feathered position the force required to move the blades first increases and then decreases, a motor for exerting a substantially uniform force for moving said blades, a gear train continuously connecting said motor with said blades and moving said blades whenever said motor moves, means for automatically varying the ratio and mechanical advantage of said gear train as the gears turn, said means constructed and arranged so that as the gears are turned to move the blades the uniform force of said motor is transformed through said variable ratio gear train to a force at said blade which first increases and then decreases substantially in time with the increase and decrease of the force required to move said blades.

12. In combination with a controllable pitch propeller having blades rotatably held by a hub for pitch changing movements, constructed and arranged so that as the blade pitch changes the force required to turn the blade changes, means for supplying a substantially uniform force for turning said blades and a variable ratio gear train having a different ratio for each successive position of the gears of said train and connecting said force supplying means and said blades for continuously varying the effective force applied to said blades by said means during pitch changing movements.

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