Dec. 30, 1952 E. M. FRANKLAND 2,623,601

PROPELLER BLADE PRELOADING AND FLUID TRANSFER MECHANISM

Filed March 14, 1950 2 SHEETS—SHEET 1

Fig. 1.

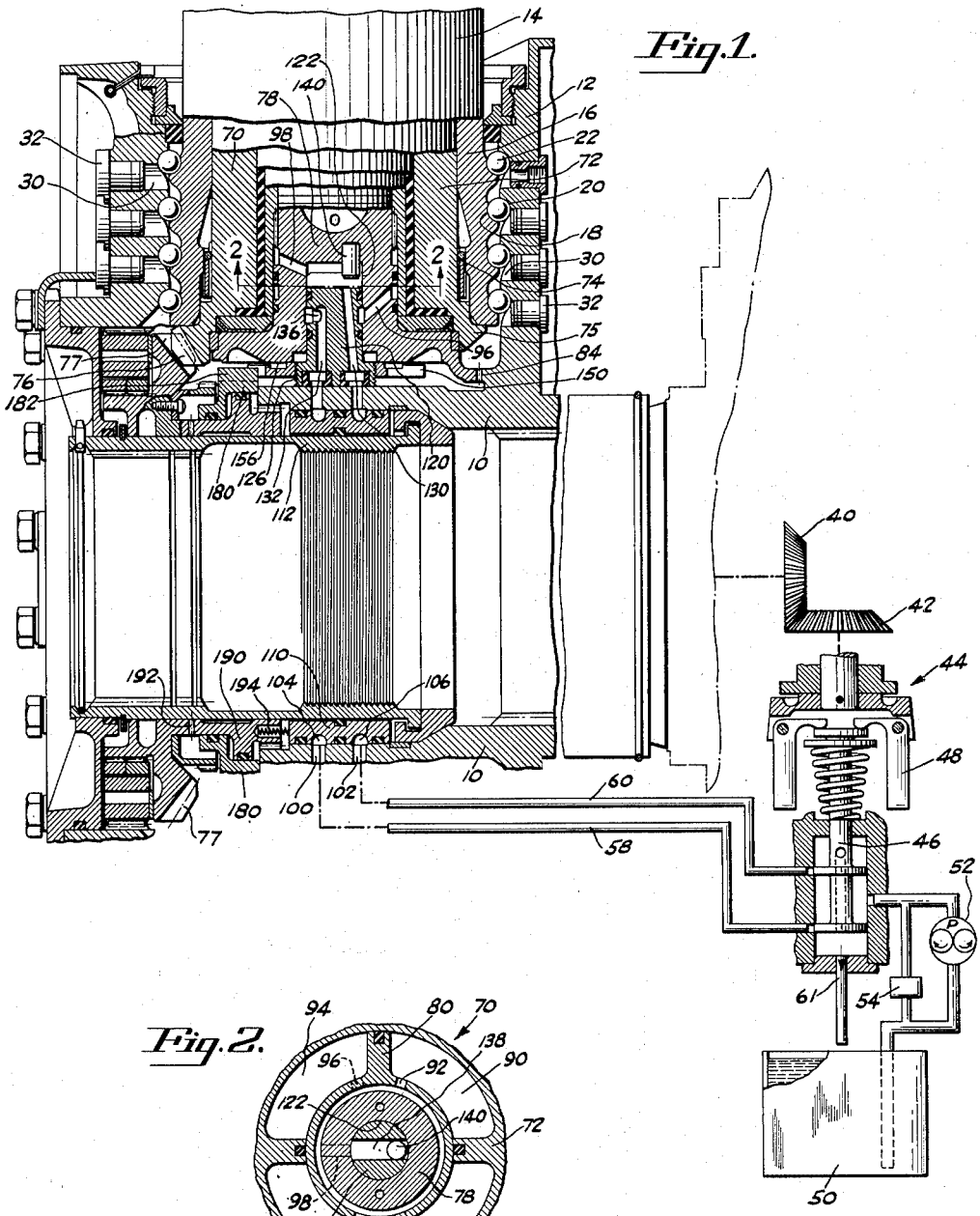


Fig. 2.

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Fig. 7.

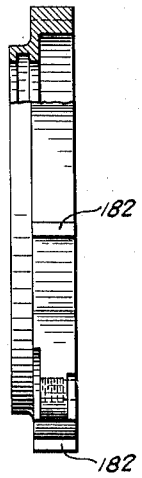


Fig. 8.

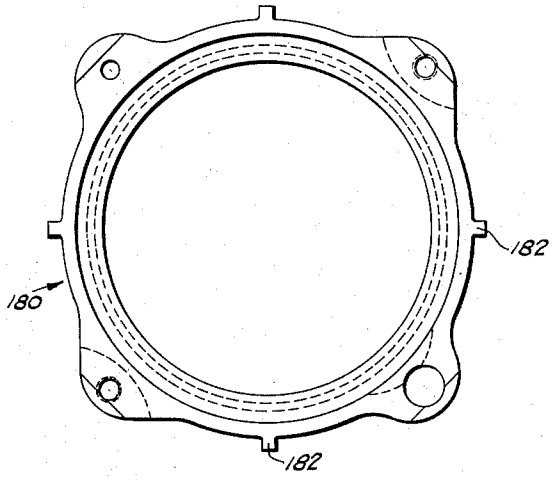


Fig. 5.

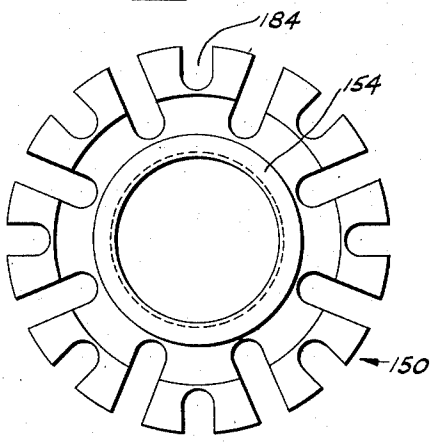


Fig. 3.

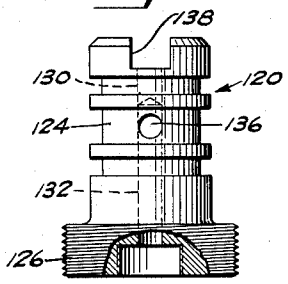


Fig. 4.

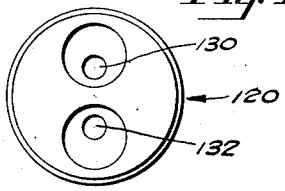
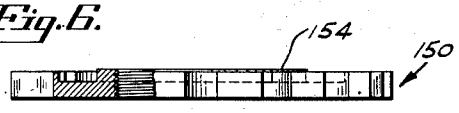


Fig. 6.



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2,623,601

PROPELLER BLADE PRELOADING AND FLUID TRANSFER MECHANISM

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Application March 14, 1950, Serial No. 149,545

8 Claims. (Cl. 170—160.33)

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This invention relates to hydraulically operated variable pitch propellers and more specifically to blade preloading and fluid transfer mechanisms for propellers having hydraulic pitch changing motors mounted in the blades.

It is an object of this invention to provide a combined fluid transfer and preload mechanism for variable pitch propeller blades having hydraulic pitch changing motors carried in the blades which motors receive fluid under pressure from a source carried by the hub of the propeller or carried externally thereof.

Another object of this invention is to provide a mechanism of the type described including a fluid transfer unit communicating with the hub and the hydraulic motor in the blade which unit may be installed in either of two positions for use in either propeller of counter-rotating or dual rotation propellers.

A further object of this invention is to provide a transfer unit as described herein which engages the hub and the fluid motor in the propeller blade and includes a preloading member engaging the motor for loading the blade and its retention bearings in an outboard direction.

These and other objects of this invention will become readily apparent from the following detail description of the drawings in which:

Fig. 1 is a partial cross-sectional view of a propeller including a schematic illustration of the hydraulic control and supply units which provide fluid under pressure to the blades;

Fig. 2 is a cross-sectional view taken along the line 2—2 of Fig. 1;

Figs. 3 and 4 are detailed views of the fluid transfer unit; and,

Figs. 5 and 6 are detailed views of the preloading nut;

Figs. 7 and 8 illustrate the propeller pitch lock cylinder including the portions thereon which engageably lock the preloading nut.

Referring to Fig. 1, a propeller assembly is shown having a main hub portion 10 and integral blade receiving socket 12 and a propeller blade 14 mounted for pitch changing movement within the socket 12.

The blade 14 includes a shank 16 having integral ball bearing races 18 on the outer periphery thereof which cooperate with similar races 20 integrally formed on the inner periphery of the hub socket 12 so as to receive a plurality of balls 22 for retaining the blade against centrifugal forces within the socket 12. A plurality of passages 30 are provided in the socket 12 in order to permit insertion of the balls 22 and these passages may

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be provided with closure members, as for example the plugs 32.

The propeller is rotated by a driving element, for example the gear 40, which gear also may engage a bevel gear 42 for rotating a centrifugal governor generally indicated at 44. Governors of this type are well-known in the art and may be provided with a pilot valve 46 which is reciprocably controlled by the flyweights 48. The pilot valve 46 is utilized to control fluid under pressure from the hydraulic system comprising a fluid reservoir 50, a pump 52 and a relief valve 54.

It is apparent then that movements of the pilot valve 46 will direct fluid under pressure to either of the lines 58 or 60 in order to vary the pitch of the propeller blades in a manner to be described hereinafter. In the event fluid under pressure is being directed into the line 58, the line 60 will conduct drain fluid back to the reservoir via the line 61.

Each of the blades 14 has a hydraulic vane motor 70 mounted centrally within the shank thereof. As seen better in Fig. 2, the vane motor 70 includes a movable outer portion 72 which is fixed to the blade 14 against relative rotation about the blade axis by means of splines 74 (Fig. 1). The outer vane motor portion 72 includes a flange 75 which engages the lowermost portion of the blade shank 16 and carries along a portion of its periphery a gear segment 76 adapted to engage a blade synchronizing gear 77 to insure simultaneous pitch change of all the blades in the usual manner. The vane motor 70 also includes a fixed inner portion 78 having vanes 80 which sealably engaged the outer vane motor portion 72. The inner portion 78 is fixed to the main hub portion 10 by means of a spline connection 84 (Fig. 1).

As seen in Fig. 2, fluid under pressure may be directed into the chamber 90 by means of passages 92 or into the chambers 94 by means of passages 96 in order to cause rotation of the outer vane motor portion 72 and the propeller blade 14 in either pitch changing direction. As better seen in Fig. 1, the passages 92 which lead to the chambers 90 are in fluid communication with the passage 96 in the inner vane motor portion 78 while the passages 96 leading to the vane motor chambers 94 communicate with the passage 98 in the inner vane motor portion 78.

As seen in Fig. 1, fluid under pressure, which is directed to the propeller from the hydraulic control system via the lines 58 and 60, flows through the passages 100 and 102 in the main hub portion 10 into the annular passages 104 and 106 formed

on the outer periphery of a header ring 110 in fluid sealing engagement with the hub portion 10. In order to provide a fluid tight transfer of high pressure fluid from the header ring into the vane motor 70 a fluid transfer unit 120 is located centrally of the inner vane motor portion 78 in sealing engagement with a circular bore 122. As better seen in Figs. 3 and 4, the fluid transfer unit 120 comprises a stem 124 having a threaded base 126. The transfer unit 120 also includes two diametrically opposed passages 130 and 132 which are disposed substantially axially of the base 126 and the stem 124. The passage 130 is a through passage while the passage 132 terminates intermediate the axial ends of the transfer unit 120 in a radial port 136. The outboard end of the stem 124 carries a slot 138 which cooperates with a dowel 140 (Fig. 1) fixed in the inner vane motor portion 78 to maintain the transfer unit in a position fixed against relative rotation. The dowel 140 acts as a lock and locator device since it is spaced from the longitudinal axis of the transfer unit.

As shown in Fig. 1, the passage 130 in the transfer unit 120 communicates with the passage 98 in the inner vane motor portion 78 while the passage 132 communicates with the passage 96 in this same vane motor portion. It is then apparent that if it is desirable to reverse the pitch changing direction of the vane motor and the propeller blade in response to the fluid controlling directions of the governor and hydraulic system, the fluid transfer unit 120 may be withdrawn from the bore 122 rotated 180° and then reinserted in engaging and rotatably locked position with the dowel 140. In this manner, in the event that dual rotation propellers are utilized, the same fluid transfer unit can be used for both propellers in order to get the proper pitch changing movements in response to the fluid directing movements of the single governor pilot valve 46. The governor and pilot valve shown herein are used only for convenient illustration, it being understood that any number of fluid controlling mechanisms may be utilized as for example a fluid directing system and valve as shown in Patent No. 2,462,932—Pitch Changing Mechanism, issued March 1, 1949, to John E. Anderson.

In order to seal the fluid transfer unit 120 against the main hub portion 10 and in order to properly preload the blade retention bearings 22, a preloading nut 150 is threaded onto the flanged portion 126 of the fluid transfer unit 120. As the preload nut 150 is rotated onto the threaded flanged portion 126 of the fluid transfer unit 120 (in an outboard direction) its upper surface portion 154 (Figs. 5 and 6) abuts the lowermost surface 156 of the inner vane motor portion 78. As the nut 150 is tightened against surface 156 the fluid transfer unit 120 is forced inboard in positive engagement with the main hub portion 10 while the vane motor is forced in an outboard direction to the extent that the flange 75 on the outer periphery of the vane motor outer portion 72 will force the blade shank 16 in an outboard direction so as to preload the balls 22.

When the preload force has been properly adjusted by rotation of the preload nut 150, it is locked in position by means of a pitch lock cylinder 180 which carries a plurality of teeth 182 (better seen in Figs. 7 and 8) for engagement with one of the serrations 184 of the preload nut 150.

The pitch lock cylinder 180 is fastened by means of bolts (not shown) to the hub main portion 10 and encloses a pitch lock piston 190 (Fig. 1) which does not form a specific part of this invention; however, it should suffice to mention that the pitch lock piston 190 includes ratchet type teeth 192 which engage similar teeth on the blade synchronizing gear 77 for locking the blades against pitch changing movements. Fluid under pressure normally keeps the piston in an aft disengaged position against the bias of a plurality of springs 194. Thus a loss of pressure acting on the pitch lock piston will permit the springs 194 to force the piston 190 into a lock engaging position. The pitch lock system may be of the type more fully described and claimed in patent application Serial No. 128,955, filed November 23, 1949, by John E. Anderson and patent application Serial No. 129,082, filed November 23, 1949, by Erle Martin and Thomas B. Rhines.

It is therefore apparent that as a result of this invention a combination fluid transfer unit and blade preload mechanism has been provided for providing a fluid tight communication between the propeller hub and pitch changing motors carried in the blades.

Also, as a result of this invention, a novel, simple and interchangeable mechanism has been provided whereby the unit is adaptable for use in single propellers or in either propeller of dual rotation assembly.

Although only one embodiment of this invention has been illustrated or described herein, it is apparent that various changes and modifications may be made in the construction and arrangement of the various parts without departing from the scope of this novel concept.

What it is desired by Letters Patent is:

1. In a propeller, a hub including a blade receiving socket, a propeller blade positioned in said socket for pitch changing movements, anti-friction bearing interposed between said blade and socket for retaining said blade therein, means responsive to fluid under pressure for varying the pitch of said blade comprising a fluid motor positioned in said blade having fluid receiving passages therein, said motor including a supporting member engaging said blade to prevent relative movement of the motor in an outboard direction, high pressure and drain pressure fluid conducting passages in said hub, and a fluid transfer member positioned axially of said motor for interconnecting the passages in said hub with the passages in said motor, said transfer member having a fluid tight engagement with said hub and motor and including adjustable means engaging said motor for axially adjusting said transfer member and said blade to preload said blade bearings.

2. In a propeller having a hub, a blade mounted for pitch changing movement in said hub including ball bearing means interposed between said blade and hub, the combination of a fluid motor carried by said blade for varying the pitch thereof including an element fixing said blade and motor against relative movement of the latter in an outboard direction, high pressure and drain pressure fluid passages carried by said hub, and a fluid transfer unit having a fluid tight sealing engagement with said fluid motor and said hub and providing fluid communication therebetween including means adjustably connected to said unit and engaging said motor for imparting a force therethrough and to said blade to preload said bearing means.

3. In a propeller having a hub, a blade mounted for pitch changing movement in said hub including ball bearing means interposed between said blade and hub, the combination of, a fluid motor

carried by said blade for varying the pitch thereof including an element fixing said blade and motor against relative movement of the latter in an outboard direction, high pressure and drain pressure fluid passages carried by said hub, a fluid transfer unit having a fluid tight sealing engagement with said fluid motor and said hub and providing fluid communication between said pump and said passages, and an adjustable member threaded to said unit and engaging said motor for forcing said blade in an outboard direction and preloading said bearing including an abutment engaging said motor.

4. In a propeller, a hub including a blade receiving socket, a propeller blade positioned in said socket for pitch changing movements, anti-friction bearing means interposed between said blade and socket for retaining said blade therein, means responsive to fluid under pressure for varying the pitch of said blade comprising a fluid motor positioned in said blade having fluid receiving passages therein, said motor including a supporting member engaging said blade, high pressure and drain pressure fluid conducting passages in said hub, and a fluid transfer member operatively engageable with said motor in two positions angularly displaced 180° including passage means interconnecting said hub passages and the passages in said motor, said transfer member engaging said hub and having abutment means adjustable thereon and engaging said motor for imparting a preloading force to said motor and blade in an outboard direction.

5. In a propeller according to claim 4 including means for fixing said transfer member in either of said two positions comprising cooperating elements carried by said motor and said transfer member.

6. In a propeller, a hub including a blade receiving socket, a propeller blade positioned in said socket for pitch changing movements, bearing means interposed between said blade and socket for retaining said blade therein comprising integral cooperating races carried by said blade and socket, means responsive to fluid under pressure for varying the pitch of said blade comprising a fluid motor positioned coaxially in said blade having fluid receiving passages therein, said motor including a rotatable portion having a supporting member engaging said blade and a cooperating relatively non-rotatable portion fixed to said hub having a central recess along its axis, high pressure and drain pressure fluid conducting passages in said hub, and a fluid transfer member operatively positionable in said recess in two positions displaced angularly about its axis including passage means interconnecting said hub passages and the fluid receiving passages in said motor, said transfer member sealably engaging said hub and including abutment means adjustable thereon and engaging said rotatable motor portion for imparting a preload to said blade in an outboard direction.

7. A propeller according to claim 6 including cooperating lock means carried by said non-rotatable motor portion and said transfer unit for predeterminately defining said two positions.

8. In a variable pitch propeller comprising a hub, a blade receiving socket, a blade mounted for pitch changing movements in said socket, and bearing means for retaining said blade in said socket, the combination of, a fluid motor carried by said blade for varying the pitch thereof in any of two directions, means limiting the movement of said motor axially of said blade, passage means in said hub for conducting fluid under pressure, and a member engaging said motor and said hub and having a sealing engagement with said hub including means providing fluid communication between said passage means and said motor, said member including adjustable means engaging said motor for axially adjusting said member and said blade to preload said blade bearings.

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