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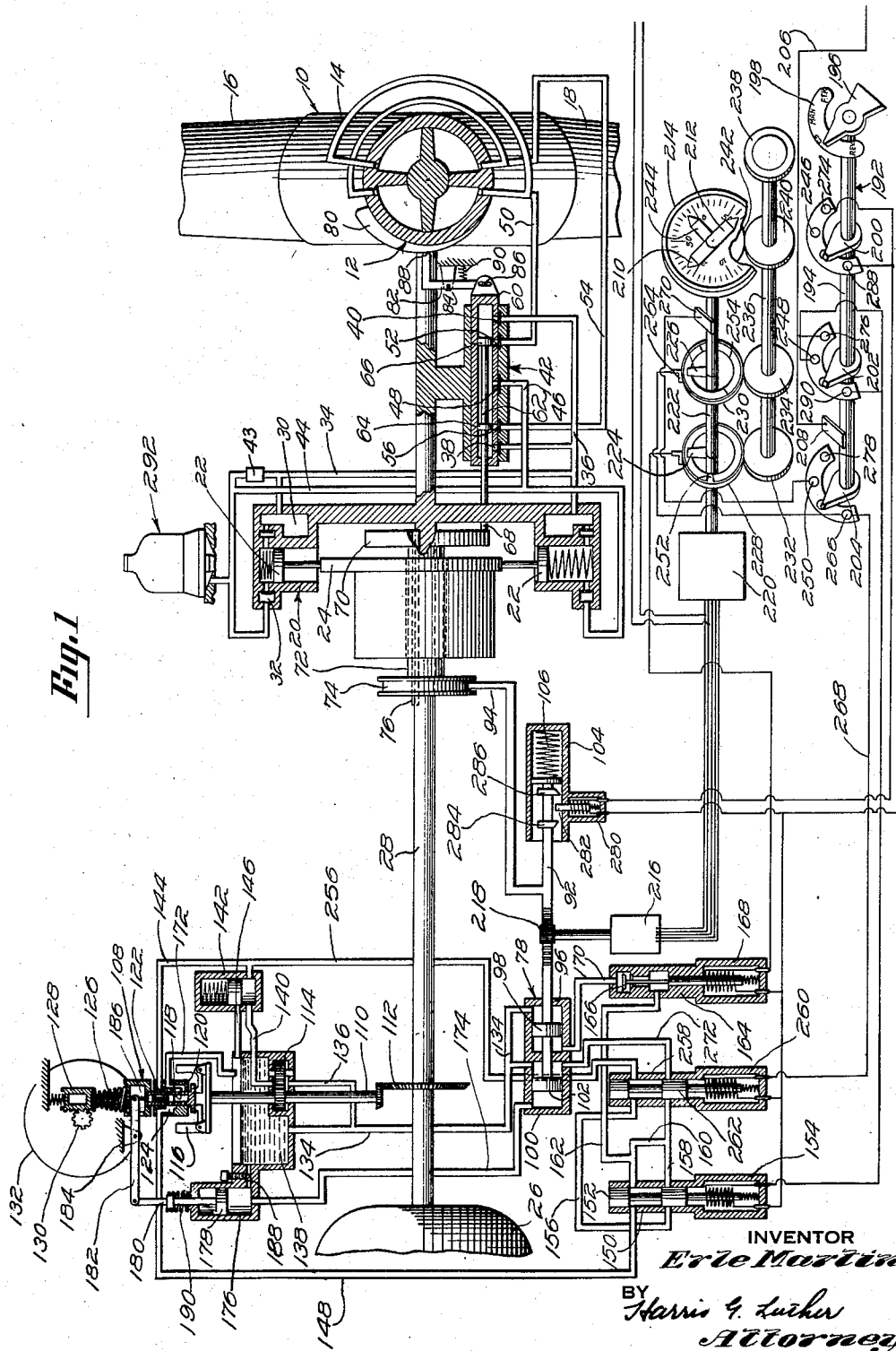
E. MARTIN
PROPELLER CONTROL

2,635,700

Filed Nov. 5, 1942

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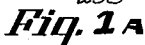
Fig. 1



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PROPELLER CONTROL

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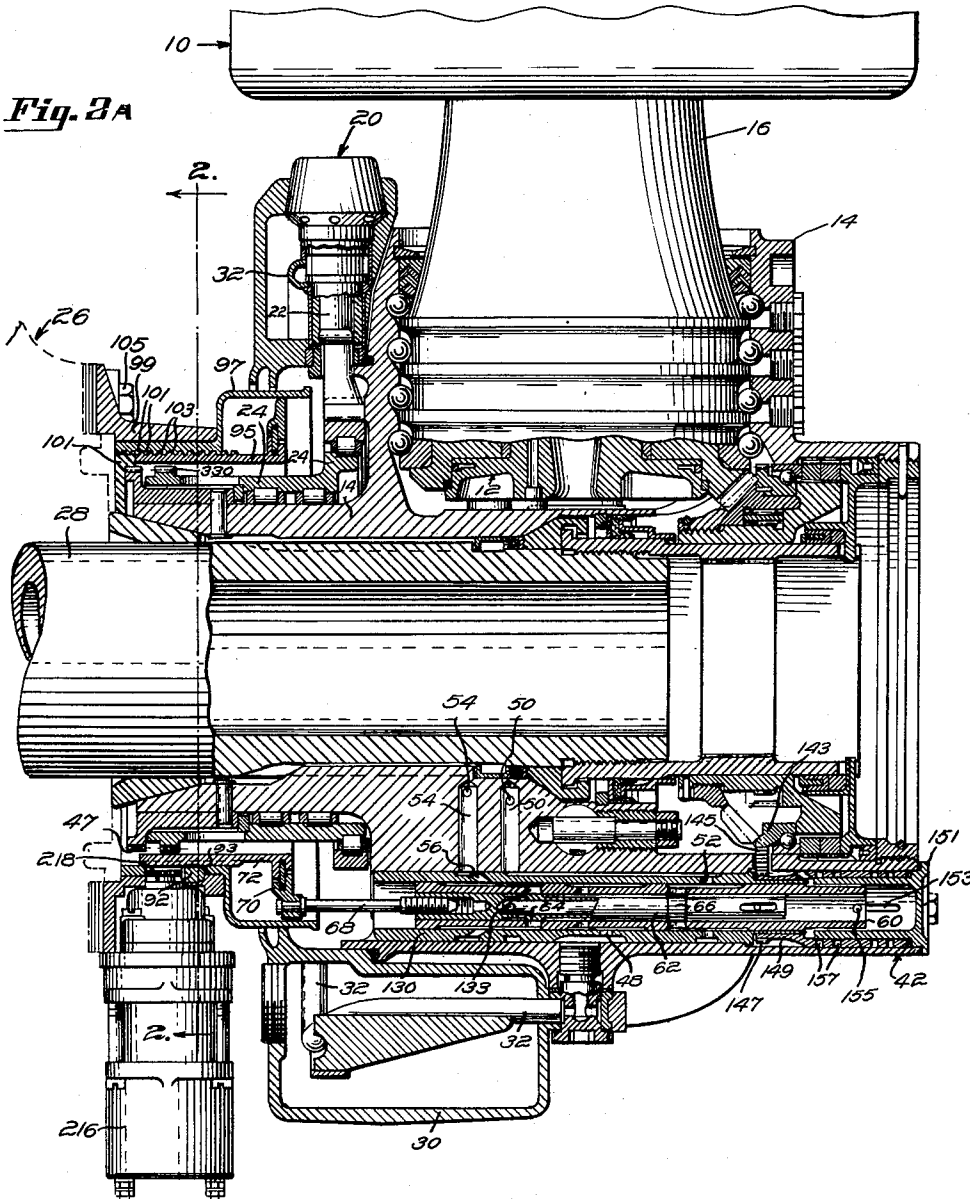
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Fig. 3A



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PROPELLER CONTROL

4 Sheets-Sheet 4

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UNITED STATES PATENT OFFICE

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PROPELLER CONTROL

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Application November 5, 1942, Serial No. 464,620

24 Claims. (Cl. 170—160.2)

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This invention relates to hydro-controllable aeronautical propellers and an object of the invention is the provision of devices which may be selectively rendered effective for either automatic or manual pitch control.

Another object is the provision of a control incorporating means for continuously providing a visible indication of the pitch angle of the propeller.

A further object of the invention resides in the provision of a more accurate and sensitive control means for a propeller.

A still further object resides in the provision of an improved propeller control means which does not require a hydraulic connection between the speed responsive governor and the pitch changing mechanism of the propeller.

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

In the accompanying drawing, there is diagrammatically illustrated one embodiment of a control apparatus for the purpose of disclosing the invention. The drawing, however, is for the purpose of illustration only and is not to be taken as limiting or restricting the invention since it will be apparent to those skilled in the art that various changes in the illustrated embodiment may be resorted to without in any way exceeding the scope of the invention.

Fig. 1 is a diagrammatic view of the improved propeller pitch control means.

Fig. 1A is a schematic view of a portion of the device shown in Fig. 1 showing a different propeller oil supply.

Fig. 2 is a transverse sectional view at the front end of the propeller drive engine taken along the lines 2—2 of Fig. 2A with the control housing shown in full and showing the arrangement of the major elements of the control apparatus around the front or nose piece of the engine.

Fig. 2A is a longitudinal sectional view of the assembled propeller engine and control section.

Fig. 3 is a longitudinal sectional view on an enlarged scale of a speed responsive governor constituting one of the elements of the improved control apparatus.

The propeller, generally indicated at 10, has three blades, each provided in its shank with a vane motor of the type generally indicated at 12, and mounted in hub 14. Two of the blades are indicated at 16 and 18. Fluid under pressure is delivered by a multi-cylinder pump, generally indicated at 20, mounted on, and rotatable with, the propeller hub and having plungers 22 actuated

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by a stationary cam 24 supported on a member such as the engine nosepiece 26 through which the propeller shaft 28 extends. With this arrangement, as the propeller rotates relatively to cam 24 the plungers will be actuated to withdraw fluid from the annular sump or reservoir 30 and deliver it under pressure to annular manifold 32. Sump 30 is connected through channels 34 and 36 with two ports 38 and 40 in a cylindrical distributing valve 42 carried by the propeller hub. Manifold 32 is connected through channels 44 and 46 with a port 48 located at the mid-length of valve 42. The usual pressure relief valve 43 is provided between the inlet and the outlet of the pump. One side of vane motor 12 is connected through channel 50 with a port 52 in valve 42 adjacent port 40, and the opposite side of the motor is connected through a channel 54 with a port 56 adjacent to port 38. Within valve 42 is a follow-up valve in the form of a sleeve 60 slidable in the casing and provided with ports which can register with the above-mentioned ports in the casing. Within follow-up sleeve 60 is a slidable pilot valve 62 having a pair of pistons 64 and 66. Piston 64 controls the connections within the sleeve between port 56 and ports 38 and 48, while piston 66 controls the connection between port 52 and ports 40 and 48.

Pilot valve 62 is connected by its stem 68 to a flange 70 mounted on a hub 72 passing through stationary cam 24 and having on its other end a shifter ring 74. Elements 70, 72 and 74 form a unit constrained to rotate with shaft 28 by a feather key 76 which, however, permits longitudinal adjustment of the unit (and of pilot valve 62) by a servo-motor generally indicated at 78.

The movable outer portion of pitch-changing motor 12 is provided with a cam 80 which serves to move sleeve 60 longitudinally by means of a lever 82, pivoted at 84, attached to sleeve 60 at 86, and having a contact shoe 88 held against cam 80 by a spring 90.

In Fig. 2A the ports 38 and 40 of Fig. 1 are represented by the open right-hand end of the sleeve 60 and a hole through the interior of plunger 62 and a hole 133 through the side of the plunger. The connection between the sleeve member 60 and the propeller pitch changing mechanism is represented by gears 143, 145 and 147, rotatable spiral cam 149, stationary member 151, slotted at 153 and by pin 155 passing through sleeve 60, slot 153 and cam slots 157 of spiral cam 149. For a more complete description, reference may be had to application Serial No. 686,298, filed July 26, 1946, by John E. Anderscn

for Pitch Changing Mechanism as a continuation of application Serial No. 482,265, filed April 8, 1943.

If now servo-motor 78, acting through shaft 92, finger 94 and shifter ring 74, moves valve 62 to the left, port 56 will be connected with port 48 permitting fluid under pressure to flow through channel 54 to the chambers of motor 12 connected therewith, and port 52 will be connected with port 40 permitting fluid to drain from the opposite side of the motor through channels 50 and 36 to sump 30. As the motor rotates under these conditions to change the propeller pitch, cam 80 and lever 82 will move sleeve 60 to follow-up the movement of pilot valve 62, and when the pitch has been changed by an amount corresponding to the movement of the pilot valve, the ports of sleeve valve 60 will be brought into registry with pistons 64 and 66 thereby blocking channels 50 and 54 and locking the pitch changing motor against further movement. If, because of leakage of fluid in the motor or valve, the pitch tends to change, the follow-up valve 60 will be moved to reopen its ports, admitting sufficient fluid under pressure to restore the pitch to the angle corresponding to the position of pilot valve 62. If the servo-motor again moves pilot valve 62, motor 12 will again be operated to change the pitch to an angle corresponding to the new position of the pilot valve, so that the pitch angle of the propeller has at all times a value corresponding to the position of pilot valve 62 as determined by servo-motor 78.

Servo-motor 78 comprises a cylinder 96 containing a piston 98 secured on shaft 92 and movable in both directions from its center position, and a positioning cylinder 100 arranged in tandem with cylinder 96 and containing a piston 102 also secured on shaft 92. The end of shaft 92 opposite piston 102 extends into a cylindrical casing 104 and bears against a compression spring 106 which urges shaft 92 towards the left.

As shown in Figs. 2 and 2A, the displacement mechanism schematically shown at 78 in Fig. 1 comprises rack teeth 91 cut into shaft 92 and meshing with teeth 93 cut in a small portion of the circumference of sleeve 95 forming a portion of slip joint 74. Sleeve 95 is supported inside of an oil guard 97 which is secured to the control support 99 by any suitable means. Oil guard 97 has spiral teeth 101 cut in a portion of its inner circumference and sleeve 95 has mating spiral teeth 103 cut in a portion of its external circumference so that longitudinal movement of shaft 92 will cause rotation of sleeve 95 and the spiral teeth 101, 103 will cause longitudinal reciprocation of the sleeve and hence of the slip joint 74. Control support 99 is secured to the nose of the engine by means of cap screws 105.

A governor, generally indicated at 108, is driven by shaft 110 through gears 112, 113, 47 and 49. Shaft 110 drives a booster pump 114 and a pair of governor flyballs 116 which act in an upward direction on a sleeve 118 slidable in a fixed casing 120 having ports 122 and 124 therein registerable with spaced ports provided in sleeve 118. Upward movement of sleeve 118 by flyballs 116 is resisted by a speeder spring 126, the loading on which may be adjusted by manually or automatically controllable means such as the movable abutment 128 and pinion 130 rotatable by a lever, or by pulley 132. As such governor adjusting devices are well known a detailed description thereof is not necessary for the purposes of the present disclosure. The intake of pump 114 is through fluid

channels 134 and 136, reservoir 138, and the outlet of the pump passes through channel 140 containing the pressure relief valve 142 and through channel 144 to port 122, the overflow from the relief valve 142 being returned to the sump through a channel 146. A channel 148 leads from governor port 124 to a valve 150 containing a plunger 152 movable by solenoid 154 from the normal position illustrated in the drawing to a position in which it closes channel 148 and connects a channel 156 with a channel 158 for a purpose to be presently described. From valve 150 a channel 160 continues from channel 148 and connects with channel 162 which leads to a valve 164 having a plunger valve 166 movable from the open position, shown in the drawing, to a closed position by the solenoid 168. From valve 164 a channel 170 leads to the left hand end of a servo-motor cylinder 96 to force piston 98 to the right against spring 106, or to vent fluid from this end of the cylinder to permit spring 106 to move piston 98 and shaft 92 to the left. Whether fluid is supplied to cylinder 96, or vented therefrom, depends upon the position of the governor valve sleeve 118 which in one position connects pressure line 144 with channel 148 and in a different position connects channel 148 with sump 138 through drain 172.

The right hand ends of cylinders 96 and 100 are connected by channel 134 with reservoir 138 and the left end of cylinder 100 is connected through channel 174 with the closed end of a cylinder 176 containing a piston 178 from which projects a rod 180 pivotally connected to the end of a lever 182 fulcrumed at 184, and connected at its opposite end to a pilot valve 186 slidable in valve sleeve 118. Valve 186 has spaced pistons cooperating with the ports in sleeve 118 in a manner such that the fluid connection between the governor operated valve and the servo-motor is increasingly restricted as the servo-motor piston moves away from the position it assumes when the governor is in its onspeed position thereby gradually slowing down the movement of the servo-motor piston to avoid overshooting or "hunting" of the control apparatus.

An adjustable bleed 188 is provided between cylinder 176 and reservoir 138 which permits spring 190 to return valve 186 to a centered position relative to the governor operated sleeve 118. As the change in propeller pitch corrects the speed deviation of the propeller and engine, the governor returns sleeve 118 to its neutral or "onspeed" condition in which the sleeve blocks line 148 and holds shaft 92 of the servo-motor in adjusted position. After the governor sleeve 118 and the pilot valve plunger 186 have returned to their neutral positions a new "on-speed" condition will have been established with the propeller blades at a new pitch angle required to maintain the speed of the engine and propeller at the speed for which the governor is set.

In addition to the above described governor controlled or constant-speed operation of the propeller, means are provided for manually controlling the propeller to maintain the pitch at a selected pitch angle, or to feather, unfeather, or reverse the propeller, as may be desired.

The manual control includes a multiple switch, generally indicated at 192, having a shaft 194 carrying a manually movable selector knob 196 cooperating with a dial 198 having indications thereon designated "REV" (reverse), "CS" (constant speed), "MAN" (manual pitch selection) and "FTH" (feathering). Shaft 194 also carries

a plurality of contact arms as indicated at 200, 202, and 204, and is electrically connected with one side 206 of a power circuit by a brush 208.

When knob 196 is set for constant-speed control, as shown in the drawing, arms 200, 202, and 204 are all on dead contact points and the control of the propeller pitch is accomplished entirely by the governor in the manner described above. During such governor control, however, and at all other times during operation of the propeller, the propeller pitch angle is visually indicated by pointers 210 and 212 on a dial 214. These pointers are actuated by means such as the "Autosyn," schematically illustrated in the drawing, including an electrical unit 216 having a generator rotor mechanically connected with shaft 92 by the rack and pinion arrangement 218, and a second electrical unit 220 electrically connected with unit 216 and having a motor rotor driving shaft 222 carrying pointers 210 and 212.

Shaft 222 carries a pair of arms 224 and 226 in contact with the sides of discs 228 and 230 which are provided with peripheral gear teeth and are mounted to rotate independently of shaft 222. Discs 228 and 230 are rotated by gears 232 and 234 mounted on a shaft 236 rotatably by a hand knob 238. This shaft 236 also carries a gear 240 which engages a gear 242 concentric with shaft 222 and carrying a pointer 244.

When it is desired to manually control the pitch, knob 196 is moved to the manual control position. This moves contact arms 200, 202, and 204 bringing arm 200 into contact with the dead contact point 246, arm 202 into contact with point 248 and arm 204 into contact with point 250. Manual knob 238 will then be rotated until pointer 244 is brought to the position on dial 214 indicating the desired pitch angle and will simultaneously rotate discs 228 and 230 to bring the contact area 252 of disc 228 and contact area 254 of disc 230 to a particular angular position relative to dial 214.

Contact of arm 202 with point 248 will energize solenoid 154 moving valve plunger 152 to a position to intercept the governor line 148 and connect line 156 with line 158 thus putting the governor out of operation. Fluid under pressure may now be supplied to cylinder 96 of servo-motor 78 through line 256, valve 258, lines 156, 158, 160, and 162, valve 164 and line 170. Solenoid 260 controlling plunger 262 of valve 258 is controlled by contact of arm 226 with the contact area 254 of disc 230. This contact area overlies approximately one-half the circumference of the disc and is connected through brush 264, button 266 and conduit 268 with solenoid 260. Current is supplied to arm 226 through a brush 270 bearing on shaft 222 and connected through switch points 250 and arm 204 with shaft 194 which is supplied with current through brush 208 from circuit 206. When arm 226 is out of contact with contact area 254 solenoid 260 is de-energized and valve plunger 262 occupies the position shown in the drawing with fluid passing from the line 256 into cylinder 96 of the hydraulic motor. When arm 226 is on contact area 254 solenoid 260 will be energized and plunger 262 will occupy a position in which it intersects line 256 thereby cutting off the supply of fluid to the servo-motor and at the same time connecting lines 162 and 160 with a line 272 which is connected through the right of piston 102 with line 134 leading to reservoir 138, thus allowing fluid to drain out of cylinder 96 of the servo-motor and the piston 98 to be moved by spring 106.

Assuming that pointer 244 has been manually set at the desired pitch angle and that this angle does not coincide with the existing pitch angle of the propeller, the servo-motor will be operated either by the admission of fluid under pressure thereto or by spring 106, depending upon whether arm 226 is in or out of contact with area 254. This operation of the servo-motor will operate the Autosyn unit to rotate shaft 222 and arms 224 and 226, the direction of rotation being controlled by whether the arm 226 is in or out of contact with area 254. This rotation will continue until arm 224 comes in contact with the short contact area 252 on disc 228. Engagement of arm 224 with area 252 will energize solenoid 168 of valve 164, moving plunger 166 to a valve-closing position and thereby cutting off line 170 to prevent fluid from either entering or leaving the left hand end of the servo-motor cylinder 96. The rotational position of shaft 222 at which arm 224 contacts area 252 coincides with the position at which pointers 210 and 212 are brought by the Autosyn into coincidence with the pitch angle selecting pointer 244. The closing of valve 164 tends to lock the servo-motor in the position corresponding to the selected pitch angle. However, if there is any leakage in the servo-motor which permits piston 98 to move, arm 224 will be moved by the Autosyn out of contact with the contact area 252 thus opening valve 164 and causing additional fluid to be admitted to the servo-motor to replenish that lost by leakage and thus the propeller will be automatically maintained at the pitch angle manually selected.

When it is desired to feather the propeller the manual selector knob 196 is moved to the indicated feathering position bringing arm 200 into contact with point 274, arm 202 into contact with point 276 and arm 204 into contact with the dead point 278. Movement of arm 204 to dead point 278, out of contact with button 250, breaks the circuit through arms 224 and 226 and throws the manual selecting mechanism out of operation. Contact of arm 202 with point 276 energizes solenoid 154 and maintains valve 150 in position to keep the governor out of operation, with the fluid connection from pump 114 through line 256 open to valve 164. Since solenoid 168 of valve 164 is connected to the contact areas of discs 228 and 230 the breaking of this circuit will maintain solenoid 168 de-energized and valve 164 open so there is a continuous supply of fluid under pressure to the left end of cylinder 96. Contact of arm 200 with point 274 energizes solenoid 280 and retracts the limit stop detent 282 from its illustrated position, in which it cooperates with spaced limit stops 284 and 286 to positively limit the range of pitch angles by limiting the possible movement of shaft 92 of servo-motor 78. With detent 282 out of the way the servo-motor can move to its limiting right hand position thereby moving pilot 62 of valve 42 to its limiting high pitch position which will cause the pitch changing motors to feather the blades.

When it is desired to return the propeller from feathered condition, knob 196 can be moved either to the manual control position, and a pitch angle within the operating range selected, or knob 196 may be returned to the constant-speed position, permitting the governor to again take over the control of the propeller pitch. Such movement of knob 196 will release limit stop detent 282 and will return the control mechanism to the selected one of the two modes of operation just mentioned. However, as the propeller does not rotate when

feathered, a source of fluid under pressure, or other means described below, is required to return the propeller from its feathered condition to a pitch angle at which rotation is resumed with consequent resumption of operation of the pumps 20 and 114.

When it is desired to reverse the propeller the manual selector knob 196 is moved to the reverse position causing arm 200 to contact point 288 and energize solenoid 280 thus retracting limit stop detent 282; causing arm 202 to contact point 290 energizing solenoid 154 to move valve plunger 152 to cut off governor line 148; and causing arm 204 to contact point 266 to energize solenoid 260 to move valve plunger 262 to a position connecting the left end of cylinder 96 with sump 138. Spring 106 will then move the servo-motor to its limiting left hand position which will in turn move pilot valve 62 of valve 42 to its limiting low pitch position and cause pitch changing motors 12 to rotate the blades to a low pitch position past the low pitch limit stop 286, thereby reversing the pitch.

According to one method the unfeathering operation mentioned above may be accomplished by connecting the pitch changing mechanism to a high pressure hydraulic system carried by the airplane for operating such instrumentalities as the landing gear, high lift flap, etc.

According to another method, operation of pump 20 may be resumed, with the propeller stopped, by providing a manually controllable electric motor 326 for driving the pump as shown in Fig. 1A. Such an arrangement is particularly illustrated and described in United States Application Serial No. 77,644, filed February 21, 1949, as a continuation of application Serial No. 664,640, filed April 24, 1946, which is a continuation of application Serial No. 422,252, filed December 9, 1941, by Donald W. Perin and Nelson R. Richmond for Propeller Control Mechanism. The unfeathering action in this structure is obtained by closing the switch 324 to energize the auxiliary pump driving electric motor 326. This motor, through its gear connections 328 and 330 will rotate the pump cam member 24 which will operate the main pump 20 to supply fluid under pressure to the distributing valve 42 and through this valve to the pitch changing motor 12. By a sufficient interval of operation of the motor 326 the propeller can be brought to its unfeathered condition without initial rotation of the engine or the propeller. It is to be noted that the gear connection including the gears 328 and 330 which is actually an irreversible worm gear drive including an additional idler gear 335, as particularly illustrated in Fig. 2, is utilized to prevent rotation of cam member 332 when the engine and propeller are operating and the motor 326 is de-energized. As shown in Fig. 2, rotation of cam member 24 is also prevented by cam teeth 333 projecting from cam member 24 beyond gear 330 and contacting pivoted dog 339.

According to the method diagrammatically illustrated in the drawing, one or more pressure fluid accumulators, as indicated at 292, are connected between pump 20 and the pitch changing mechanism and arranged to be filled with fluid under pressure from the pump and to maintain this fluid under pressure. When the propeller is feathered the pressure fluid is trapped in the accumulators and retained therein until it is desired to unfeather the propeller. When the selector knob 196 is moved away from the feathering position this fluid is released from the

accumulators and applied to the pitch changing mechanism in a manner to start the propeller blades out of their feathering position. As soon as the unfeathering operation has been thus started the propeller will begin to rotate and drive pump 20, so the operation may be completed by fluid from that pump.

While a suitable mechanical embodiment for the purpose of disclosing the invention has been hereinabove described and illustrated in the accompanying drawing, it is to be understood that the invention is not limited to the particular embodiment so 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 sub-joined 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. A control for a hydraulically-actuated variable-pitch propeller providing four modes of propeller operation including, constant-speed operation, operation at manually selected pitch angles, reverse operation and feathering operation, comprising automatically operating speed responsive means for adjusting the propeller pitch, a valve actuated by said speed responsive means and controlling the flow of fluid to and from the hydraulically actuated pitch changing mechanism of said propeller when said propeller is operating in said constant speed mode, and manually operable means for actuating said valve and regulating the propeller pitch when the propeller is operating in any of the other of said modes of operation including means for locking said valve during the manually controlled mode.

2. A control for a variable pitch propeller having blades and a propeller hub, comprising, pitch changing means in the propeller hub, said means including a valve in said hub, said valve having a follow-up connection with said blades to give said blades a definite and different position for each valve position, speed responsive means, including a governor connected with a servo-motor and operatively associated with said pitch changing means, for adjusting said follow-up valve to adjust the pitch to maintain the propeller speed at a selected value, manually operable means for disconnecting said governor from said servo-motor and said pitch changing means and manually controlling said servo-motor and maintaining the propeller pitch at a manually selected pitch angle.

3. A control for a variable pitch propeller having blades and a propeller hub, comprising, pitch changing means in the propeller hub, said means including a valve in said hub, said valve having a follow-up connection with said blades to give said blades a definite and different position for each valve position, speed responsive means, including a governor connected with a servo-motor and operatively associated with said pitch changing means, for adjusting said follow-up valve to select the pitch to maintain the propeller speed at a selected value, manually operable means for disconnecting said governor from said servo-motor and said pitch changing means and manually controlling said servo-motor and maintaining the propeller pitch at a manually selected pitch angle, means operatively connected with said valve for indicating the propeller pitch.

4. In a control providing various modes of operation for a hydro-controllable propeller including constant speed operation and feathering, a

propeller including pitch changing mechanisms, a follow-up valve carried by said propeller for controlling the application of hydraulic fluid to the pitch changing mechanism of said propeller in all of its operative modes, said valve having two parts, one part being operatively connected with the propeller and another part controlled by control mechanism, said control mechanism including a servo-motor operatively connected with said other part of said follow-up valve for operating said valve, and speed responsive means, and manually operable means operatively connected with said servo-motor for selectively operating said servo-motor.

5. In a control for a hydraulically actuated variable pitch propeller providing several modes of propeller operation including constant speed operation, operation at manually selected pitch angles, reverse operation and feathering operation; automatically operating speed responsive means for adjusting the propeller pitch, and valve means actuated by said speed responsive means and controlling the flow of fluid to and from the hydraulically actuated pitch changing mechanism of said propeller when said propeller is operating in said constant speed mode, means for limiting the extent of pitch change possible under speed responsive control, manually operable means for actuating said valve means and regulating the propeller pitch when the propeller is operating in any of the other of said modes of operation, including means for disabling said limiting means.

6. A feathering variable pitch propeller having blades, comprising in combination a motor for changing the pitch of the propeller blades, a pump carried by said propeller and operated by rotation of said propeller for supplying fluid under pressure, a fluid line connecting said pump with said motor, a two-part follow-up valve carried by said propeller and located in the line between said pump and said motor for controlling the flow of fluid to said motor, and having one part operatively connected with the blades of said propeller and another part connected with means movable with respect to said propeller, a servo-motor mounted on a fixed support and operatively connected with said means for moving said other part of said valve, a governor controlling the operation of said servo-motor and manually actuated means for disconnecting said governor from said servo-motor and manually controlling said servo-motor.

7. A feathering variable pitch propeller having blades, comprising in combination a motor for changing the pitch of the propeller blades, a pump carried by said propeller and operated by rotation of said propeller for supplying fluid under pressure, a fluid line connecting said pump with said motor, a two-part follow-up valve carried by said propeller and located in the line between said pump and said motor for controlling the flow of fluid to said motor, and having one part operatively connected with the blades of said propeller and another part connected with means movable with respect to said propeller, means connected with said movable means for indicating the pitch of said propeller blades, a servo-motor mounted on a fixed support and operatively connected with said movable means for moving said other part of said valve, a governor controlling the operation of said servo-motor and manually actuated means for disconnecting said governor from said servo-motor and manually controlling said servo-motor.

8. A feathering variable pitch propeller having blades, comprising in combination a motor for changing the pitch of the propeller blades, a self-contained fluid system carried by said propeller comprising, a chamber in said propeller for storing fluid, a pump connected with said chamber and carried by said propeller and operated by rotation of said propeller for placing fluid under pressure, a fluid line connecting said pump and said motor and a two-part follow-up valve carried by said propeller and located in the line between said pump and said motor for controlling the flow of fluid to said motor, said valve having one part operatively connected with the blades of said propeller and another part connected with means movable with respect to said propeller, means for moving said movable means and said other part of said valve for controlling the pitch of said propeller and means for supplying said motor with fluid under pressure from said fluid system when the propeller is not rotating.

9. A feathering variable pitch propeller having blades, comprising in combination a motor for changing the pitch of the propeller blades, a self-contained fluid system carried by said propeller comprising, a chamber in said propeller for storing fluid, a pump connected with said chamber and carried by said propeller and operated by rotation of said propeller for placing fluid under pressure, a fluid line connecting said pump and said motor and a two-part follow-up valve carried by said propeller and located in the line between said pump and said motor for controlling the flow of fluid to said motor, said valve having one part operatively connected with the blades of said propeller and another part connected with means movable with respect to said propeller, means for moving said movable means and said other part of said valve for controlling the pitch of said propeller, and means carried by the propeller for supplying fluid under pressure to the pitch changing motor when the propeller is not rotating and means for energizing said fluid supplying means.

10. In combination with a controllable-pitch propeller having a hydraulically operated pitch changing motor, a control comprising, a valve in said propeller controlling the application of hydraulic fluid to and the venting of hydraulic fluid from said motor, a cut-off element for said valve movable in accordance with all propeller pitch changes, a servo-motor for actuating said valve having an element movable in both directions, a speed responsive governor controlling said servo-motor and having a normal onspeed position, and means movable by said servo-motor operative to temporarily reset said governor and slow down the operation of said servo-motor as the movable element thereof moves in either direction.

11. A control for a controllable-pitch propeller having a hydraulically operated pitch changing motor comprising, a valve controlling the application of hydraulic fluid to and the venting of hydraulic fluid from said motor, a cut-off element for said valve movable in accordance with propeller pitch changes, a servo-motor mechanically connected with said valve for actuating the valve and having an element movable in both directions, a source of hydraulic fluid under pressure for operating said servo-motor, a governor operated valve having a normal onspeed position and located between said source and said servo-motor, and an element associated

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with said governor actuated valve and moved by movement of said servo-motor to temporarily reset said governor and restrict the fluid connection between said governor operated valve and said servo-motor as the movable element of said servo-motor moves.

12. In combination with a hydro-controllable propeller, a propeller-carried hydraulic system including a hydraulic pitch changing motor, a pump operated by rotation of said propeller for supplying hydraulic fluid to said motor, and pump operating means including a normally stationary element, a separate hydraulic system including a speed regulating governor and a servo-motor, means operatively connecting said two hydraulic systems whereby said system including said speed regulating governor controls said system including said pitch changing motor, and an electric motor for said element and operating said pump independently of the rotation of said propeller.

13. A control for a variable-pitch propeller having a propeller hub, comprising, hydraulic pitch changing means in the propeller hub, speed responsive means, including a governor connected with a servo-motor and operably associated with said pitch changing means for adjusting the pitch changing means to adjust the propeller pitch to maintain the propeller speed at a selected value, manually operable means for disconnecting said governor from said pitch changing means and manually controlling said pitch changing means and including means for maintaining the propeller pitch at any of a plurality of manually selected intermediate pitch angles.

14. In combination with a hydro-controllable propeller having a propeller-carried hydraulic system, including a hydraulic pitch changing motor and a pump, pump operating means comprising two relatively movable elements, means for driving one element with respect to the other element by rotation of said propeller to continuously actuate said pump by rotation of said propeller for supplying hydraulic operating fluid to said motor, a separate hydraulic system having a separate source of hydraulic pressure and including a speed regulating governor and a servo-motor, means operatively connecting said two hydraulic systems whereby said system including said speed regulating governor controls said system including said pitch changing motor, and an electric motor operatively connected with said other element for moving said other element with respect to said one element and operating said pump independently of the rotation of said propeller.

15. In combination with a hydro-controllable propeller having a propeller-carried hydraulic system, including a hydraulic pitch changing motor and a pump, pump operating means comprising means rotatable with the propeller, normally stationary means operatively associated with said rotatable means and means for holding said normally stationary means stationary in pump operating position at all times during propeller rotation for continuously operating said pump by rotation of said propeller to maintain a continuously energized source of hydraulic operating fluid for said motor, a separate hydraulic system including a speed regulating governor and a servo-motor, means operatively connecting said two hydraulic systems whereby said system including said speed regulating governor controls said system including said pitch changing motor.

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16. In combination with a hydro-controllable propeller having a propeller-carried hydraulic system, including a hydraulic pitch changing motor and a pump, means for continuously operating said pump by rotation of said propeller, and means for operating said pump independently of the rotation of said propeller for supplying hydraulic operating fluid for said motor, a separate hydraulic system including a speed regulating governor and a servo-motor, means operably connecting said two hydraulic systems whereby said system including said speed regulating governor controls said system including said pitch changing motor.

17. In combination with a hydro-controllable propeller comprising, a propeller-carried hydraulic system including a hydraulic pitch changing motor and a pump, means actuated by rotation of said propeller continuously actuating said pump and supplying hydraulic operating fluid for said motor, and means connecting said pump and said pitch changing motor including means for controlling the flow of operating fluid between said continuously actuated pump and said motor, a separate hydraulic system including a speed regulating governor and a servo-motor, means operatively connecting said two hydraulic systems including means connecting said servo-motor and said operating fluid controlling means whereby said system including said speed regulating governor controls said system including and pitch changing motor.

18. A feathering variable-pitch propeller having blades, comprising, in combination a self-contained fluid system carried by said propeller comprising, a chamber in said propeller for storing fluid, a pump connected with said chamber, carried by said propeller and operated by rotation of said propeller for placing fluid under pressure, a motor for changing the pitch of said blades, a fluid line connecting said pump and said motor, and a valve carried by said propeller and located in said line between said pump and said motor for controlling the flow of fluid to said motor, valve operating mechanism including a two-part follow-up device having one part operatively connected with said blades, a separate hydraulic system for controlling said propeller-carried fluid system including means for controlling the position of said valve through the other part of said follow-up device.

19. In combination with a hydro-controllable propeller, a propeller-carried hydraulic system including a hydraulic pitch changing motor and a pump for supplying hydraulic fluid to said motor, means for operating said pump by rotation of said propeller and means for operating said pump independently of the rotation of said propeller, a separate hydraulic system including a speed regulating governor and a servo-motor, means operatively connecting said two hydraulic systems whereby said system including said speed regulating governor controls said system including said pitch changing motor.

20. In combination with a hydro-controllable propeller, a propeller-carried hydraulic system including a control valve for changing the propeller pitch, a separate hydraulic system including a speed governor for controlling said propeller-carried hydraulic system by actuating said valve, means operatively connecting said two hydraulic systems including means operatively connecting said governor and said valve, means for controlling said speed governor and a manual control independent of said governor for controlling said separate hydraulic system.

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21. In combination with a hydro-controllable propeller, a propeller-carried hydraulic system for changing the propeller pitch including a propeller-carried source of hydraulic pressure and a control valve having a follow-up connection with the blades of said propeller, a separate hydraulic system having a separate source of hydraulic pressure remote from said propeller for controlling said propeller-carried hydraulic system, means operatively connecting said separate hydraulic system and said valve and means remote from said propeller for controlling said hydraulic system remote from said propeller.

22. A propeller control comprising a propeller-carried hydraulic system including a pitch changing motor and a control valve therefor, a hydraulic system separate from said propeller-carried hydraulic system comprising a servo-motor and a control therefor, including a speed governor and a separate manual control for manually adjusting the position of said servo-motor, and means operatively connecting said servo-motor with said pitch changing motor control valve.

23. A propeller control comprising a propeller-carried hydraulic system including a pitch changing motor and a control valve therefor having a follow-up connection with the blades of said propeller, a separate hydraulic system comprising a servo-motor and a control therefor, including a speed governor, having a speed selecting control, for automatically adjusting the position of said servo-motor, and separate means for disconnecting said governor from said servo-motor and manually adjusting the position of said servo-motor and means operatively connecting said servo-motor and said control valve so that each position of said servo-motor has a corresponding blade pitch position.

24. A propeller control comprising a propeller-carried hydraulic system including a pitch changing motor and a control valve therefor having a follow-up connection with the blades

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of said propeller, a separate hydraulic system comprising a servo-motor and a speed governor having a speed selecting control and a normal on-speed position for each selected speed, means connecting said speed governor and said servo-motor for automatically adjusting the position of said servo-motor to any position for each on-speed position of said governor, and separate means for manually adjusting the position of said servo-motor and means operatively connecting said servo-motor and said control valve so that each position of said servo-motor has a corresponding blade pitch position.

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