

July 9, 1946.

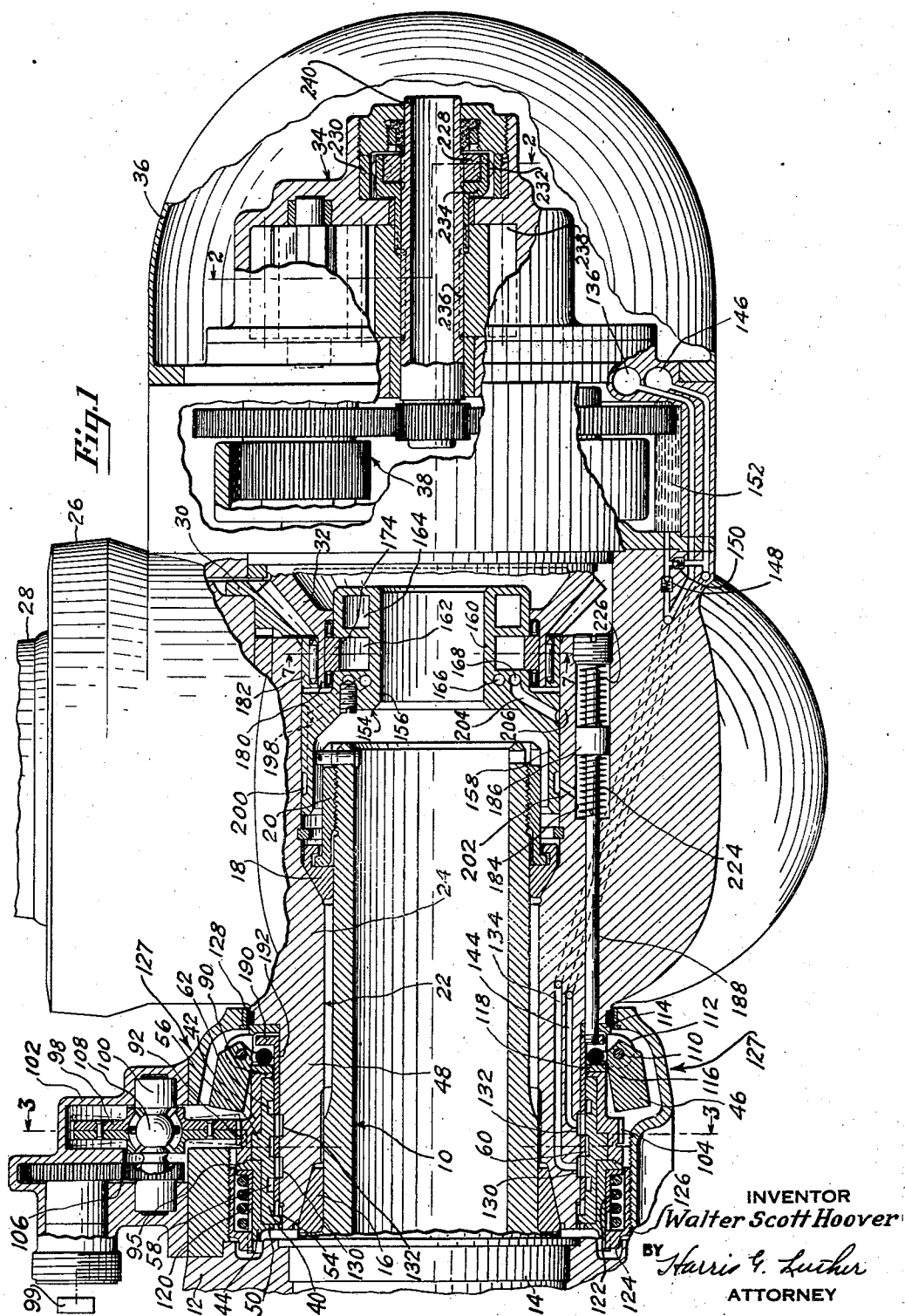
W. S. HOOVER

2,403,532

HYDRAULIC COMPENSATING PROPELLER

Filed March 14, 1941

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July 9, 1946.

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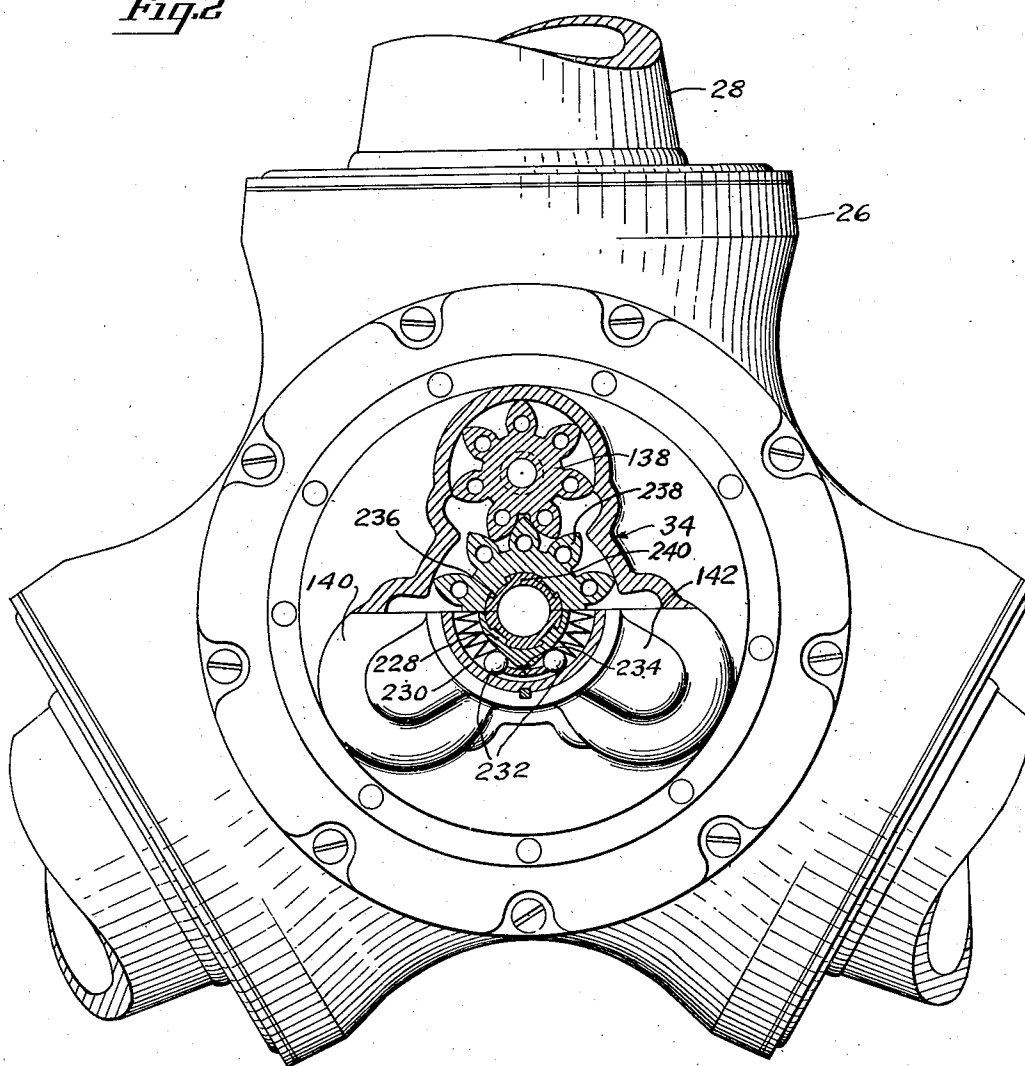
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HYDRAULIC COMPENSATING PROPELLER

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Fig. 2



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Fig. 3

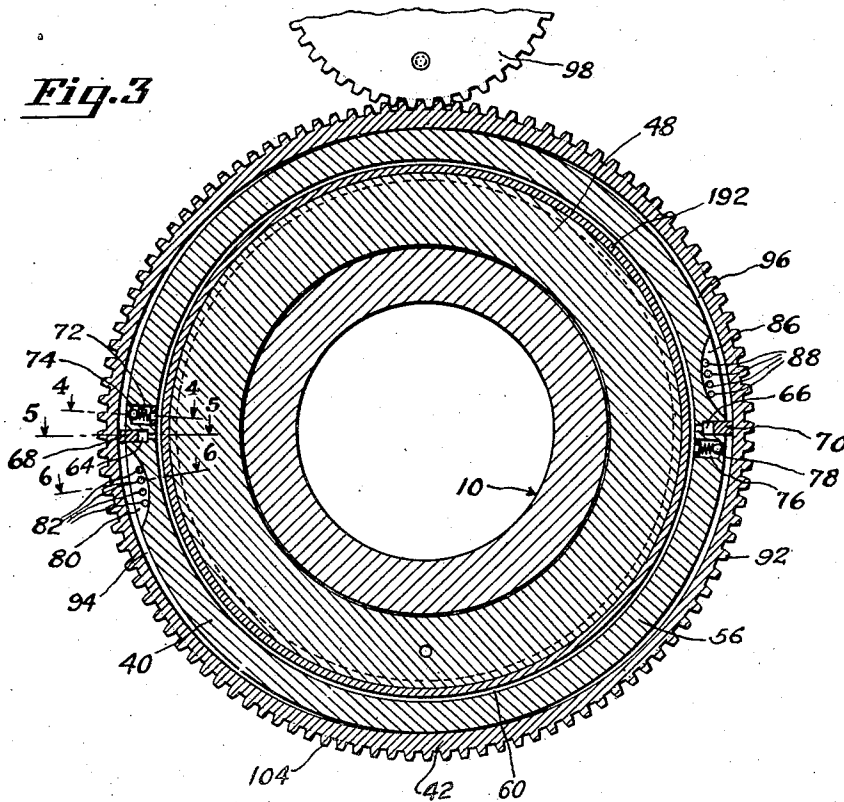


Fig. 4

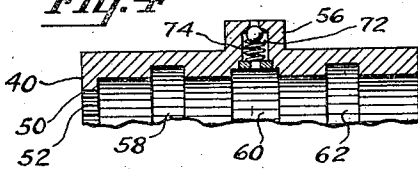


Fig. 5

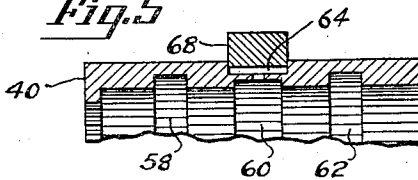


Fig. 6

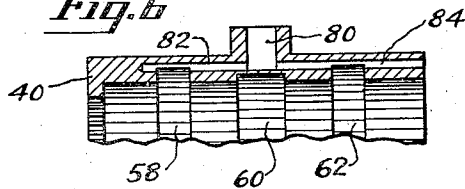
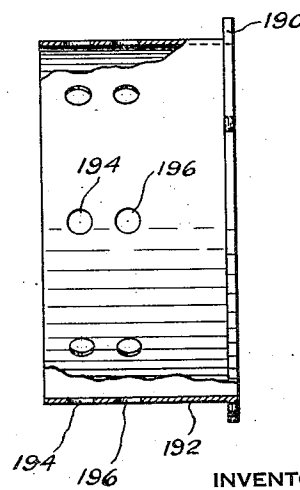


Fig. 8



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Fig. 7

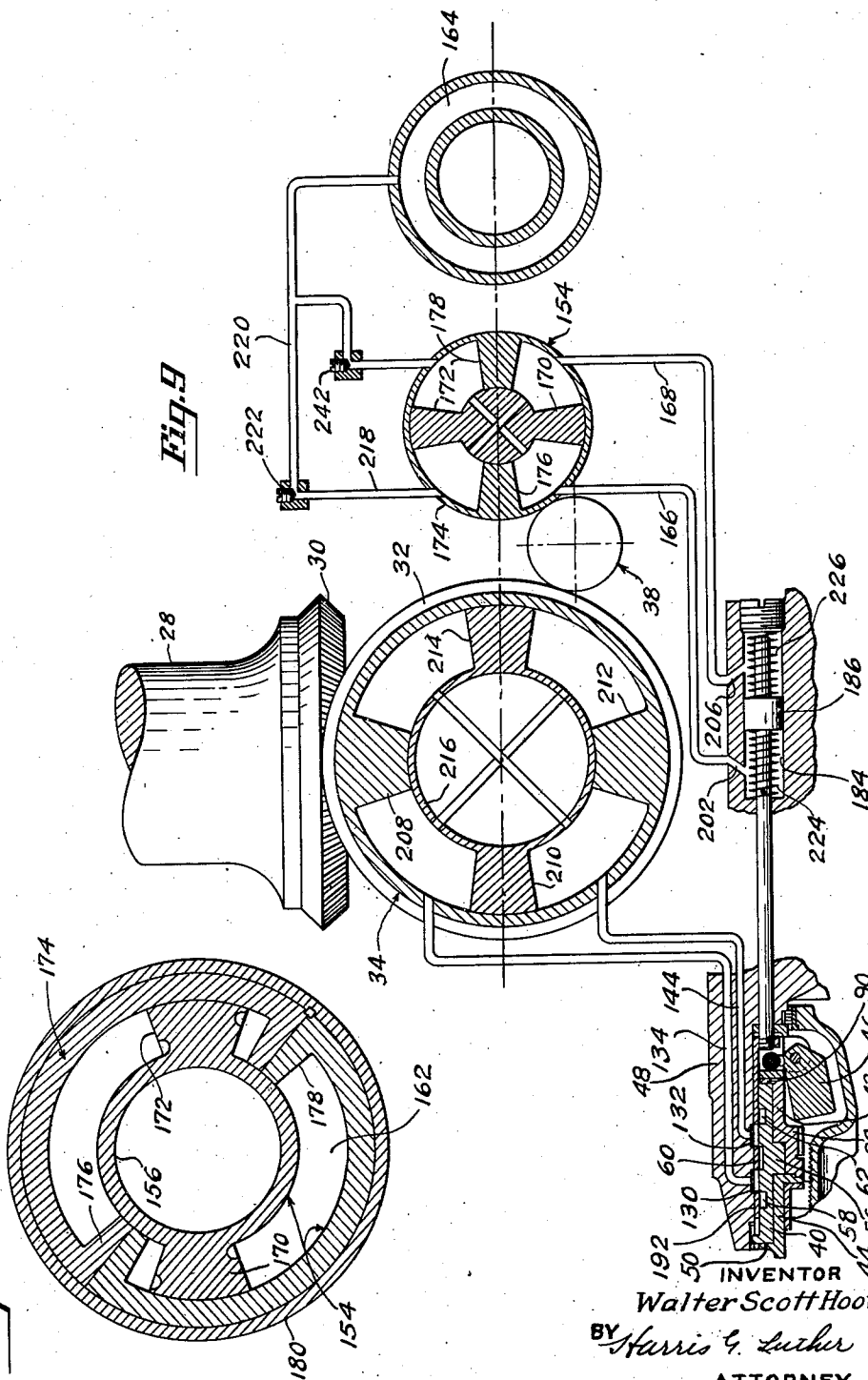


Fig. 9

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UNITED STATES PATENT OFFICE

2,403,532

HYDRAULIC COMPENSATING PROPELLER

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Application March 14, 1941, Serial No. 383,391

21 Claims. (Cl. 170-163)

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This invention relates to improvements in aeronautical propellers and has particular reference to an improved unitary construction embodying a controllable-pitch aeronautical propeller and control mechanism therefor.

An object of the invention resides in the provision of a combined controllable-pitch aeronautical propeller and self-contained control apparatus therefor arranged in a compact unitary structure.

A further object resides in the provision, in a controllable-pitch propeller and control apparatus therefor including a speed responsive governor, of means for compensating the action of the governor to provide a more accurate and sensitive response of the propeller to speed variations.

Another object resides in the provision of an improved governor and more specifically a combined pump and governor valve mounted on the propeller hub.

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

In the accompanying drawings, in which like reference numerals are used to designate similar parts throughout, there is illustrated a suitable mechanical embodiment for the purpose of disclosing the invention. The drawings, however, are for the purpose of illustration only and are 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 construction may be resorted to without in any way exceeding the scope of the invention.

In the drawings:

Fig. 1 is a longitudinal sectional view through a propeller and control apparatus constructed according to the invention.

Fig. 2 is a front-elevation view of the propeller shown in Fig. 1 a portion being broken away on the line 2-2 of Fig. 1 and shown in section to better illustrate the construction of the propeller mechanism.

Fig. 3 is a sectional view of a fluid pressure pump taken on the line 3-3 of Fig. 1.

Fig. 4 is a longitudinal sectional view of the annular pump and oil distributing members shown in Fig. 3 taken on the line 4-4 of Fig. 3.

Fig. 5 is a sectional view similar to Fig. 4 taken on the line 5-5 of Fig. 3.

Fig. 6 is a sectional view similar to Figs. 4 and 5 taken on the line 6-6 of Fig. 3.

Fig. 7 is a sectional view of a portion of a gov-

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ernor compensating device taken on the line 7-7 of Fig. 1.

Fig. 8 is an elevational view of another portion of the governor compensation device which fits within the annular pump and distributing members shown in Figs. 3 to 6, inclusive, a portion of the compensating device being broken away and shown in section to better illustrate the construction thereof, and

Fig. 9 is a schematic view illustrating the operation of the governor pitch changing and control apparatus shown in Fig. 1.

Referring to the drawings in detail, and particularly to Fig. 1, the numeral 10 generally indicates a propeller shaft projecting from an engine nose 12 through an outboard bearing 14 in a manner well known to the art. Mounted on the projecting end of the shaft 10 by suitable means, such as the cones 16 and 18 and the end nut 20, is a propeller hub, generally indicated at 22. This hub may conveniently be a one piece structure having a shaft surrounding portion 24 and a plurality of blade sockets, one of which is indicated at 26, within which are rotatably mounted respective propeller blades, as indicated at 28, by means of suitable abutments and thrust bearings in a manner well known to the art.

Each blade has attached to its end within the hub structure a pitch changing gear, as indicated at 30, which gears or gear structures are rotated by a common master gear 32, mounted to rotate about the axis of the shaft 10. The gear 32 may be driven by a suitable motor such as the gear type oil motor, generally indicated at 34, which is secured to the front end of the hub 22 within an enclosing spinner 36 and connected to the gear 32 through a suitable reduction gear train, generally indicated at 38. While a gear type oil motor has been illustrated for the purpose of disclosing the invention, it is to be understood that various other types of oil motors, such as vane or piston type motors, may be utilized without in any way exceeding the scope of the invention.

Where a hydraulic motor, such as the gear type oil motor 34, is utilized, suitable governor and valve means are provided to control the operation of the motor in its pitch changing action in a manner such that the propeller pitch will be adjusted to compensate any tendency of the engine speed to vary from a selected rate to thereby maintain the speed of the propeller driving engine substantially constant at a selected value at which the speed responsive governor is set. Such means may conveniently comprise a plu-

ality of annular members, as indicated at 40, 42 and 44 and a plurality of centrifugally actuated flyballs as indicated at 46, surrounding an annular extension 48 provided on the shaft surrounding portion 24 of the hub 22 between the blade sockets and the adjacent portion of the engine nose.

The member 40 is particularly illustrated in Figs. 3, 4, 5 and 6 and comprises a generally cylindrical member having at one end a shallow internal flange 50 provided with splines 52 which engage with splines 54 on the end portion of the hub extension 48 to provide a driving connection between the hub portion and the member 40 which will constrain the member 40 to rotate with the hub but will permit axial sliding movements of the member 40 relative to the hub portion upon which it is mounted. The member 40 is also provided intermediate its length with an external annular extension 56 and with three spaced internal grooves or channels 58, 60 and 62. The member 56 is provided with a pair of diametrically opposed transverse slots 64 and 66 within which are disposed radially slidable vanes 68 and 70 respectively. Adjacent to the vane 68 the portion 56 is provided with a radial aperture 72 which leads from the periphery of this portion to the channel 60 disposed immediately within the portion 56 and within which aperture there is disposed a ball check valve 74 arranged to permit passage of fluid from the periphery of the member 56 into the groove 60 but to block any flow of fluid from the groove 60 to the periphery of the member 56. Adjacent to the vane 70 is a similar aperture 76 diametrically opposed to the aperture 72 and containing a check valve 78 which also operates to permit flow of fluid from the periphery of the portion 56 into the channel 60 and to block any flow of fluid from the channel 60 to the periphery of the portion 56. On the opposite side of the vane 68 from the aperture 72 the portion 56 is provided with a peripheral groove 80 which opens to the periphery of the portion 56 and extends a short circumferential distance from the vane 68 on the side thereof opposite the aperture 72 and is connected by channels 82 with the internal groove 58 and by similar channels 84 with the internal groove 62. Adjacent to the vane 70 and diametrically opposite the depression 80 there is disposed a similar depression 86 in the periphery of the portion 56 connected at its bottom by channels 88, similar to the channels 82, with the annular groove or channel 58 and with channels, not illustrated but similar to the channels 84, with the annular groove or channel 62. The annular member 42 which overlies the right hand portion of the member 40, as viewed in Fig. 1, is provided with an end flange 90 which overlaps the adjacent end of the member 40 and with an annular radial enlargement 92 at its opposite end which enlargement overlies the portion 56 of the member 40. Referring to Fig. 3, it will be observed that the interior surface of the enlargement 92 is somewhat elliptical in form to provide semi-circumferential spaces 94 and 96 between the interior surface of this enlargement and the adjacent peripheral surface of the circular portion 56 of the member 40. The annular member 44 has at its end adjacent the member 42 an external annular flange 98 which closes that side of the annular space within which the portion 56 rotates and has at its opposite end an internal flange 100 which overlaps the adjacent end of the member 40. The members 42 and 44 are se-

cured together against relative rotation at their abutting surface and both members are normally held as a unit against rotation by a gear 98 drivingly mounted on an axle 100 secured in bearings in a casing, generally indicated at 102, and meshing with teeth 104 provided on the exterior of the member 42.

With this arrangement, when the propeller shaft 10 is rotating, the member 40 will be rotated relative to the surrounding members 42 and 44 and fluid will be drawn into the portions of the annular spaces 94 and 96 on the sides of the vanes 68 and 70 on which the respective intake depressions 80 and 86 are located and will be expelled by the vanes 68 and 70 through the apertures 72 and 76 into the middle or pressure channel 60. The intake will be from one of the end channels 58 or 62 depending upon the position of the member 40 on the hub extension 48 as will be presently explained. This construction provides a fluid pump which will maintain fluid under pressure in the middle channel 60 and will intake fluid from one of the end channels 58 or 62, to operate the pitch changing motor 34. If desired, a pressure relief valve may be placed between the channel 60 and the intake side of the pump preferably adjacent the intake depressions, to limit the maximum pump pressure and prevent breakage. The gear 98 is connected with a suitable motor 99, through suitable means, such as the gear train 106, so that, when the shaft 10 is not rotating the pump can be operated independently to furnish fluid under pressure for changing the pitch of the propeller and particularly for feathering or unfeathering the propeller in the event it is desired to accomplish either of these operations with the engine stopped. It has been found convenient to mount the gear 98 on a spherical bearing 108 so that the gear may tilt relative to its axle when the members 40, 42 and 44 are moved axially of the hub extension 48 in order that the movement of these members may be accomplished without unnecessary friction or drag.

The governor flyballs 46 are mounted on respective axles, one of which is indicated at 110, the ends of which are received in respective apertured lugs, as indicated at 112, provided on a ring 114 which surrounds the hub extension 48 at its end adjacent to the blade sockets and these flyballs are provided with bell crank arms carrying respective contact members, which may conveniently be in the form of small anti-friction bearings, as indicated at 116, which bear against a thrust washer 118 disposed against the end of the member 42. With this arrangement, whenever the flyballs 46 swing outwardly incident to an increase in propeller speed the unit comprising the members 40, 42 and 44 will be moved to the left, as viewed in Fig. 1. The action of centrifugal force on the flyballs 46 tending to move the above-mentioned unit to the left is opposed by a governor speeder spring 120 disposed within a flanged bushing 122 the end flange of which bears against the external flange 94 of the member 44, the opposite end of the speeder spring bearing against the interior of the end flange 124 of a nut 126 screw threaded into the end of the cover member 127 which cover member is rigidly secured to the engine nose 12 and encloses the governor flyballs 46, the pump and valve unit comprising the members 40, 42 and 44 and the nut 126 which in turn encloses the speeder spring 120. If desired, suitable means may be provided in the engine nose 12 for rotating the nut 126 to change

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the loading on the speeder spring 120 and thereby adjust the speed setting of the governor. No particular means have been illustrated since it would be obvious to utilize some well known device such as a worm and gear mechanism or spur gear device for accomplishing this function. Preferably an oil seal 128 is provided between the right hand end of the cover member 127 and a shoulder provided on the hub 22 between the extension 48 and the blade sockets in order that lubricant for the governor and valve mechanism may be retained in the cover member against leakage.

The hub extension 48 is provided with a pair of external grooves 130 and 132 which are spaced to lie between the groove 60 and the groove 58 and between the groove 60 and the groove 62, respectively, when the member 40 is in its center or neutral position. The groove 130 is connected through a suitable channel 134 with a manifold 136 leading to one side of the various oil motor elements, as indicated at 138, 140 and 142, and the groove 132 is connected by a similar channel 144 with a manifold 146 leading to the opposite side of the oil motor elements. Both channels 134 and 144 are connected through respective check valves 148 and 150 with an oil reservoir 152 within the hub space surrounding the reduction gear unit 38.

With this arrangement, when the governor flyballs 46 swing outwardly in response to an increase in propeller speed, the pump and valve unit will be moved to the left as viewed in Fig. 1. This movement will connect the pressure groove 60 with the end groove 130 so that fluid under pressure will be supplied through the channel 134 and manifold 136 to the oil motor 34, to actuate the motor to move the propeller blades in a pitch increasing direction, to thereby place additional load on the propeller driving engine and reduce its speed. If the engine and propeller speed falls below the speed for which the governor is set, the speeder spring 120 will force the pump and valve unit to the right as viewed in Fig. 1, overcoming the decreased centrifugal force acting on the flyballs 46, and will connect the pressure groove 60 with the groove 132 thereby supplying oil through the channel 144 and manifold 146 to the oil motor 34, to operate the motor to move the propeller blades in a pitch decreasing direction, to thereby reduce the load on the engine and permit its speed to increase. Whenever the groove 60 is connected with the groove 130 the pump will intake through the channel 134 from the manifold 146 and from the reservoir 152 through the check valve 150 in case it becomes necessary to supply make up oil to the pump and motor system and similarly, when the groove 60 is connected with the groove 132 the pump will intake from the groove 130 and the channel 134 and manifold 136 and, if necessary, from the reservoir 152 through the check valve 148.

This construction provides an arrangement by which the pitch changing motor 34 is under the full control of the speed responsive governor to adjust the propeller blades in a manner to maintain the speed of the propeller substantially constant by varying the load on the propeller driving engine. It has been found, however, that such an arrangement, while fully operative, is not always as stable and sensitive as might be desired and it is among the objects of this invention to provide stabilizing means for such a governor-propeller combination to render the control of the propeller by the governor more accurate and sensitive and to avoid the tendency of the governor

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to hunt on opposite sides of the particular speed for which the governor is set. In order to accomplish this function there is provided in the shaft bore of the propeller hub adjacent to the end of the shaft 10 a hydraulic device generally indicated at 154 and particularly illustrated in Figs. 1 and 7, and a connection is provided between this device and the governor for imposing a compensating action on the governor mechanism. The device 154 may conveniently comprise a member 156 secured against rotation relative to the propeller hub and having a skirt portion 158 surrounding the end of the propeller shaft within the shaft bore of the propeller hub and a thick cylindrical end portion 160 having a diameter smaller than the skirt portion 158 and having a central aperture therethrough substantially coaxial with the axis of the shaft 10. Within the cylindrical portion 160 there are provided a substantially centrally disposed annular groove 162 of substantially rectangular cross-section, an annular chamber 164 and a pair of annular fluid manifolds 166 and 168. The groove 162 is divided into two substantially equal portions by a pair of diametrically opposed integral vanes 170 and 172. An annular member 174 surrounds the groove 162 and is also provided with a pair of diametrically opposed internal radial vanes 176 and 178 which cooperate with the vanes 170 and 172 to divide the groove 162 into four separate chambers. For convenience in assembly the member 174 is diametrically split and the two parts are mounted within an annular extension 180 formed on the gear 32. This extension 180 may also constitute the inner race for the gear bearing, the outer race 182 of which is secured in the end of the shaft bore of the propeller hub 22. The member 174 is secured to the cylindrical extension 180 in such a manner that whenever the gear 32 is rotated to change the pitch of the propeller the member 174 will be rotated relative to the member 154 to change the dimensions of the chambers between the vanes 170, 172, 176 and 178.

Adjacent to the hydraulic device 154 the hub is provided with a cylindrical bore 184 within which is disposed a piston 186 mounted on a shaft 188 which extends through a passage in the hub to a connection with the end flange 190 of a sleeve member 192 disposed between the member 40 and the hub extension 48 and particularly illustrated in Fig. 8. This sleeve member is slidable on the hub extension 48 and is provided with two rows of apertures, as indicated at 194 and 196, spaced apart the same distance as the grooves 130 and 132 in the hub extension. The manifold 166 in the member 156 is connected with the chambers between the vanes 176 and 170 and the vanes 178 and 172 and with the left hand end of the cylinder bore 184 through suitable channels as indicated at 198, 200 and 202 while the manifold 168 is connected with the chambers between the vanes 172 and 176 and 178 and 170 and with the right hand end of the cylinder bore 184 through suitable channels as indicated at 204 and 206.

The operation of the compensating mechanism is schematically illustrated in Fig. 9 in which the blade turning motor 34 has been shown as a vane type motor rather than a gear motor, as shown in Fig. 1, for the sake of simplicity in the illustration. If we assume that the governor flyballs 46 have moved outwardly in response to an increase in speed and have consequently connected the annular pressure chamber 60 with the annular channel 130, hydraulic fluid under pressure will then be supplied through the channel 134 to the

motor 34, to the spaces between the motor vanes 208 and 210, and between the vanes 212 and 214. Now, since the vanes 210 and 214 connected to the inner member 216 are relatively fixed, the vanes 208 and 212 will be rotated in a clockwise direction as viewed in Fig. 9, to turn the propeller blades 28 toward a higher pitch condition. As the motor device 34 turns the gear 32 through a suitable reduction gear, such as is indicated at 38 in Fig. 1, the portion 174 of the hydraulic mechanism 154 will also be rotated in a clockwise direction carrying the vane 176 towards the vane 172 and the vane 178 toward the vane 170. This will cause hydraulic pressure to be exerted on the line 168 leading to the right hand end of the cylinder 184. The chambers between the above-mentioned vanes are, however, also connected with the annular reservoir 164 through channels 218 and 220 and the adjustable restricted orifice 222. If the speed increase is relatively small so that the groove 130 is connected with the pressure chamber 60 by a restricted amount such that the movement of the motor 34 and hydraulic device 154 will produce a flow through the channel 218 within the capacity of the orifice 222, oil will be transferred between the opposed chambers of the device 154 and the reservoir 164 but will not move the piston 186 which will be maintained in its centered position, as illustrated by the centering springs 224 and 226, since it has been found that for such small and relatively slow pitch changes the governor does not need to be compensated. However, if the governor acts strongly incident to a rapid change in speed so that the flow from the device 154 cannot be accommodated by the orifice 222 the piston 186 will be moved to the left, as viewed in Figs. 1 and 9, and will move the sleeve 192 to the left following the similar movements of the member 40. This movement of the sleeve following the member 40 will maintain a certain degree of restriction between the pressure chamber 60 and the channel 130 which restriction will gradually increase as the propeller blades approach the pitch condition necessary to restore the engine and propeller to the selected speed and the sleeve 192 will be in position to substantially block the flow of fluid from the pressure chamber to the channel 130 when the propeller has reached the proper pitch setting although the engine speed is still above the selected speed. As the speed of the engine and propeller slows down and the governor returns to its neutral position, the sleeve 192 will maintain the connection between the pressure chamber 60 and the groove 130 blocked so that no further change in the propeller pitch will take place during the movement of the member 40 back to its centered position in which it obstructs this connection. As the member 40 moves back toward its center position under the influence of the speeder spring 120 the sleeve 192 will follow as the fluid bleeds out of the right hand end of the cylinder 184 through the device 154 and through the restriction 222 to the reservoir 164 and, under the influence of the centering springs 224 and 226 will also reach a centered or neutral position about the same time that the member 40 reaches its centered position leaving the propeller pitch at the correct angle to maintain the selected speed and the governor in condition to act to change the pitch in case the speed again varies.

The propeller blades are preferably locked in the adjusted pitch position against turning under the effect of centrifugal or aerodynamic forces by a suitable locking device such as the well known lock disclosed in United States Patent Number

1,668,971, issued May 8, 1928, to Ernest G. McCauley for Screw mechanism for adjustable and reversible pitch propellers, and particularly illustrated in Figs. 1 and 2 of this application. As shown this lock includes the cam member 228 rotatable within the relatively fixed sleeve member 230 and held against rotation relative to the sleeve member by the locking balls 232 as long as the motor 34 is not exerting a pitch changing effort, the balls being releasable by the element 234 and lost motion connection 236 whenever the motor acts to change the propeller pitch. Application of power by the motor 34 will, because of the lost motion connection, first turn the gear 238 on the shaft 240 thereby moving the element 234 which is keyed fast to gear 238. This will unlock one ball 232 and permit the shaft 240 with its attached cam 228 to be freely rotated. As soon as the pump gear 238 takes up the lost motion in connection 236, the motor will drive the shaft 240 and through the gear train 38 change the propeller pitch. If, however, the propeller attempts to drive the motor the cam 228 driven by the shaft 240 will catch up with and will be locked by one of the balls 232.

If the speed of the propeller should be below that for which the governor is set, the governor spring would act to move the member 40 to the right as viewed in Fig. 9 and actuate the motor 34 to decrease the pitch angle of the propeller. This movement of the motor 34 will cause a movement of the hydraulic device 154 which would apply hydraulic pressure through the line 166 to the left hand end of the cylinder 184 to move the sleeve 192 toward the right to follow the similar movements of the member 40 and the compensating action would be the same as that described above in connection with a speed increase above the governor setting. After the proper pitch angle has been attained and the member 40 moves back to its centered position the sleeve 192 would follow this movement toward the left as viewed in Fig. 9 as the fluid was bled from the left hand end of the piston 184 through the adjustable restricted orifice 242 to the reservoir 164. Thus, the propeller would again be left at the proper pitch position to maintain the selected speed and the governor would be brought back to its neutral position and in condition to act to change the propeller pitch in case the speed again varies in either direction from the selected value.

While a suitable mechanical embodiment has been hereinabove described and illustrated in the accompanying drawings for the purpose of disclosing the invention, it is to be understood that the invention is not limited to the particular construction 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. In a hydro-controllable propeller, a hub, a plurality of blades carried by said hub and mounted for pitch changing movements, a fluid motor operatively connected with said blades for changing the pitch thereof, a fluid pump carried by said hub for supplying pressure fluid to said motor, connections from both sides of said motor to said pump, and means for varying said connections to control the operation of said motor, said pump including a rotor member surrounding one end of said hub and rotatable therewith, and a relatively

non-rotatable member surrounding said rotor member, said rotor member and said hub end having grooves constituting intake and outlet channels for said pump said rotor member and said hub end being relatively movable to control said intake and outlet channels.

2. A fluid pump for a hydro-controllable propeller having a blade carrying hub structure comprising, a portion encircling one end of said hub structure and provided with an annular external ring rotatable with said hub structure, a relatively fixed annular portion surrounding said rotatable portion and having an annular groove receiving said ring, said groove being non-circular in shape to provide pump chambers between the periphery of said ring and the bottom of said groove, intake and outlet ports in said ring, a vane carried by said ring between each adjacent intake and outlet port, and annular grooves in the interior of said rotatable portion connected one with said outlet ports and two, located one on each side of said outlet port connected groove, with said intake ports.

3. Pitch control means for a hydro-controllable propeller having a blade carrying hub structure comprising, a pitch changing fluid motor, a pump rotor carried by and rotatable with said hub structure, a pump casing surrounding said rotor and held against rotation, grooves in the interior of said rotor constituting a pressure channel and a pair of intake channels, a pair of grooves in said hub, separate means connecting one of said hub grooves with one side of said motor and the other hub groove with the other side of said motor, and speed responsive means operative to connect said pressure channel with either of said hub grooves to connect either side of said motor with the pump outlet while connecting the alternative side with the pump intake through the other hub groove and an intake channel to operate said motor in either direction depending upon the speed change demand of said speed responsive means.

4. Pitch control means for a hydro-controllable propeller having a blade carrying hub structure comprising, a pitch changing fluid motor, a pump rotor carried by and rotatable with said hub structure, a pump casing surrounding said rotor and held against rotation, grooves in the interior of said rotor structure constituting a pressure channel and a pair of alternatively operative intake channels for said pump, a pair of grooves in said hub structure, separate means connecting one of said hub grooves with one side of said motor and the other hub groove with the other side of said motor, a governor mechanism carried by said hub structure, and a connection between said governor mechanism and said pump rotor for shifting said rotor axially of said hub structure to connect said pressure channel with either of said hub grooves to connect either side of said motor with said pump outlet and the alternative side with said pump intake by connecting one intake channel with the other hub groove to thereby operate said motor in response to the speed change demands of said governor.

5. Pitch control means for a hydro-controllable propeller having a blade carrying hub structure comprising, a hub carried fluid motor for changing the pitch of said blades, a hub carried pump for supplying pressure fluid to said motor, a valve combined with said pump and having at least one movable portion common with said pump for controlling the application of said fluid to said motor and a speed controlling governor connected with said common mov-

able portion for regulating the propeller speed by moving said common portion.

6. Pitch control means for a hydro-controllable propeller having a blade carrying hub structure comprising, a hub carried fluid motor for changing the pitch of said blades, a hub carried pump for supplying pressure fluid to said motor, one portion of said pump forming a portion of a valve, said valve portion being movable, for controlling the application of said fluid to said motor, propeller speed regulating means connected with said movable valve portion and including a governor for actuating said valve portion and a hub carried supply of fluid.

7. Pitch control means for a hydro-controllable propeller having a blade carrying hub structure comprising, a hub carried fluid motor for changing the pitch of said blades, a hub carried pump for supplying pressure fluid to said motor, a hub carried governor for controlling the application of said fluid to said motor, and a hub carried governor compensator having a central position but movable, by changes in propeller pitch, temporarily away from said central position to temporarily change the governor setting and retard the pitch changing action of said governor as the propeller pitch approaches a condition consistent with the speed change demands of said governor means, independent of propeller pitch, restoring said compensator to said central position.

8. Pitch control means for a hydro-controllable propeller having a blade carrying hub structure comprising, a fluid motor for changing the pitch of said blades, a fluid pump for supplying pressure fluid to said motor, a reversing valve between said pump and said motor having a preselected closed position, a governor for operating said valve, and a governor compensator for changing the closed position of said valve in a direction to follow up the valve operating movements of said governor and means independent of the propeller pitch for restoring the closed position of said valve to said preselected position.

9. Pitch control means for a hydro-controllable propeller having a blade carrying hub structure comprising, a fluid motor for changing the pitch of said blades, a fluid pump for supplying pressure fluid to said motor, a reversing valve between said pump and said motor, a governor for operating said valve, and a governor compensator for changing the closed position of said valve in a direction to follow up the valve operating movements of said governor, said governor compensator comprising a fluid displacement device movable in proportion to the pitch changing movements of said blades and a fluid motor operated by said displacement device for shifting the closed position of said valve.

10. In combination, a reversible fluid motor, a pump for supplying pressure fluid to said motor, a two part reversing valve between said pump and said motor having a predetermined closed position, a governor for moving one part of said valve relative to the other part to control the operation of said motor, and a governor compensator comprising a perforated sleeve between the two parts of said valve and means operated by movement of said motor for moving said sleeve to shift the closed position of said valve proportional to the rate and extent of the movements of said motor and means independent of said motor for gradually restoring said compensator sleeve to said predetermined closed position of said valve.

11. In combination, a reversible fluid motor, a pump for supplying pressure fluid to said motor, a two part reversing valve between said pump and said motor, a governor for moving one part of said valve relative to the other part to control the operation of said motor, and a governor compensator comprising, a perforated sleeve between the two parts of said valve, a fluid displacement device operated by said motor, an expansible chamber device operated by the fluid displaced by said fluid displacement device and operatively connected with said sleeve for moving said sleeve to shift the closed position of said valve in proportion to the movements of said motor, resilient centering means associated with said expansible chamber device for returning said sleeve to its neutral position, and a fluid bleed for gradually relieving fluid pressure opposing the operation of said centering means.

12. In combination, a reversible fluid motor, a pump for supplying pressure fluid to said motor, a two part reversing valve between said pump and said motor, a governor for moving one part of said valve relative to the other part to control the operation of said motor, and a governor compensator comprising, a perforated sleeve between the two parts of said valve, a fluid displacement device operated by said motor, an expansible chamber device operated by the fluid displaced by said fluid displacement device and operatively connected with said sleeve for moving said sleeve to shift the closed position of said valve in proportion to the movements of said motor, resilient centering means associated with said expansible chamber device for returning said sleeve to its neutral position, a fluid bleed for gradually relieving fluid pressure opposing the operation of said centering means, and a reservoir for carrying a supply of fluid for said displacement device.

13. Pitch control means for a hydro-controllable propeller having a blade carrying hub structure, a pitch changing fluid motor, a pump rotor carried by and rotatable with said hub structure, a pump casing surrounding said rotor and held against rotation, grooves in the interior of said rotor constituting a pressure channel and a pair of alternatively operative intake channels for said pump, a pair of grooves in said hub structure, separate means connecting one of said hub grooves with one side of said motor and the other hub groove with the other side of said motor, a governor carried by said hub structure, and a connection between said governor and said pump rotor for shifting said rotor axially of said hub structure to connect said pressure channel with either of said hub grooves to connect either side of said motor with said pump outlet and the alternative side with said pump intake by connecting one of said intake channels with the other hub groove to thereby operate said motor in either direction in response to the speed change demands of said governor and a governor compensator comprising, a perforated sleeve disposed between said rotor and said hub, a fluid displacement device operated by said motor, an expansible chamber device operated by the fluid displaced by said fluid displacement device and operatively connected with said sleeve for moving said sleeve to gradually restrict the connections provided by said governor between said pump and said motor, resilient centering means associated with said expansible chamber device for returning said sleeve to its neutral position, and a fluid bleed for gradually relieving fluid

pressure opposing the action of said centering means.

14. In a structure including a support and a propeller rotatable with respect to said support, a pump having a rotor, a driving connection between said propeller and said rotor, a pump casing enclosing said rotor, a connection between said casing and said support comprising power supply means connected with said support and a power transmitting connection between said power supplying means and said casing, said power transmitting connection and said power supply means preventing rotation of said casing relative to said support when said propeller is rotating and said power supply means is deenergized and serving to rotate said casing relative to said rotor and said propeller when said propeller is not rotating and said power supply means is energized.

15. In a controllable-pitch propeller having hydraulically operated pitch changing means, an hydraulic pump having two relatively movable portions comprising one portion rotatable with said propeller and relative to another portion for supplying fluid under pressure to said pitch changing means during operation of said propeller, said other portion being rotatable relative to said propeller and said one portion for supplying fluid under pressure to said pitch changing means while said propeller is stationary and means for holding said other portion stationary while the propeller is rotating and for rotating said other portion while said propeller is stationary.

16. In a controllable-pitch propeller having hydraulically-operated pitch-changing means, an hydraulic pump having two relatively movable portions comprising one portion rotatable with said propeller and relative to another portion for supplying fluid under pressure to said pitch-changing means during operation of said propeller, said other portion being rotatable relative to said propeller and said one portion for supplying fluid under pressure to said pitch-changing means while said propeller is stationary and means including an electric motor for holding said other portion stationary while the propeller is rotating and for rotating said other portion while said propeller is stationary.

17. In a controllable-pitch propeller having hydraulically-operated pitch-changing means, an hydraulic pump having two relatively movable portions comprising one portion rotatable with said propeller and relative to another portion for supplying fluid under pressure to said pitch-changing means during operation of said propeller, said other portion being rotatable relative to said propeller and said one portion for supplying fluid under pressure to said pitch-changing means while said propeller is stationary and means including an electric motor normally stationary while the propeller is rotating and energizable for rotating said other portion while said propeller is stationary.

18. A combined pump and governor comprising, a rotatable shaft, a rotary pump surrounding said shaft and having a rotor rotatable with said shaft and a stationary casing surrounding said rotor, passages in said shaft and rotor arranged to form fluid connections between said shaft and said pump, speed responsive means associated with said shaft operably connected with said pump for moving said casing and rotor relative to said shaft to change the relative relation of the passages in said shaft and rotor to control the

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output of said pump in accordance with the speed of said speed responsive device.

19. A combined pump and governor, comprising, a pump having a rotor and a casing, a member rotatable with said rotor, valve ports in said rotor connected with the intake and outlet of said pump, valve ports in said member positioned to cooperate with the rotor valve ports, speed responsive means associated with said pump and said member, means connecting said speed responsive means and said pump for moving said pump rotor relative to said member to control the output of said pump by controlling the relative position of said valve ports.

20. In a hydro-controllable propeller, a hub, a plurality of blades carried by said hub and mounted for pitch changing movements, a fluid motor operatively connected with said blades for changing the pitch thereof, a fluid pump carried by said hub for supplying pressure fluid to said

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motor, a cut-off valve between said pump and motor, a governor for operating said valve, a governor compensator for operating said valve independently of said governor and means for actuating said compensator in response to pitch changing movement of said propeller blade.

21. In a hydro-controllable propeller, a hub, a plurality of blades carried by said hub and mounted for pitch changing movements, a fluid motor operatively connected with said blades for changing the pitch thereof, a fluid pump carried by said hub for supplying pressure fluid to said motor, a cut-off valve between said pump and motor, a governor for operating said valve and a governor compensator including means operative in response to the velocity of pitch change movement of the blades for shifting the position of said valve.

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