June 27, 1950 C. S. J. MacNEIL ET AL 2,512,803

SPEED RESPONSIVE HYDRAULIC CONTROL MEANS

Filed Oct. 22, 1943 2 Sheets-Sheet 1

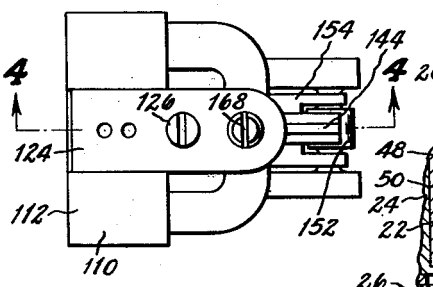

Fig. 3

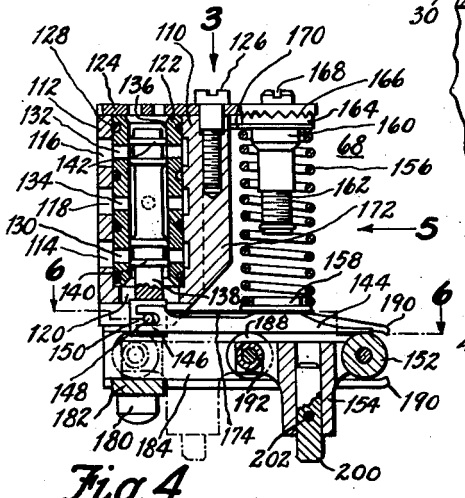

Fig. 4

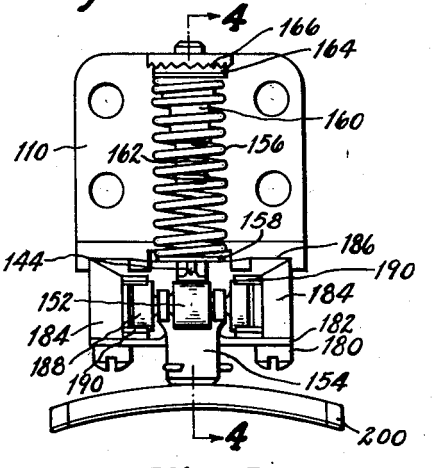

Fig. 5

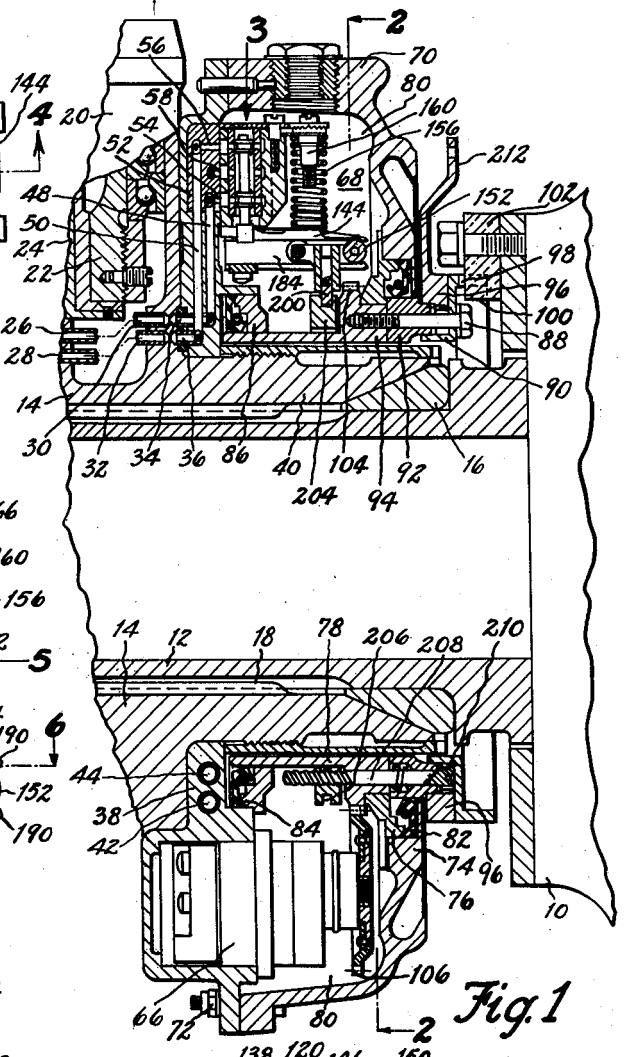

Fig. 1

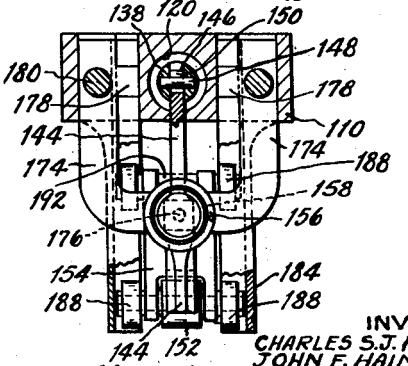

Fig. 6

INVENTORS
CHARLES S.J. MacNEIL
JOHN F. HAINES
HOWARD CARSON
RICHARD E. MOORE
FRANK MACK

Spencer, Hardman & Fehr
ATTORNEYS

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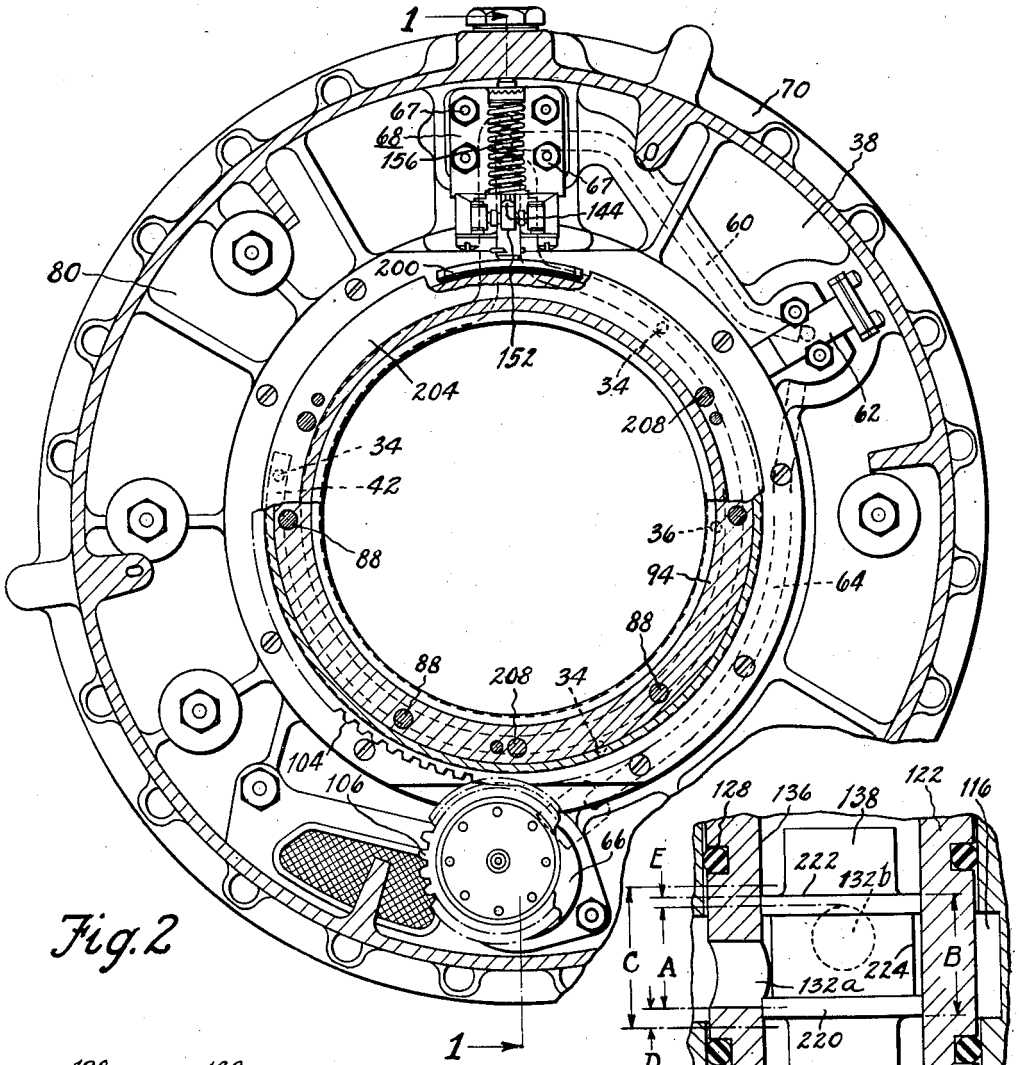

Fig. 2

Fig. 9

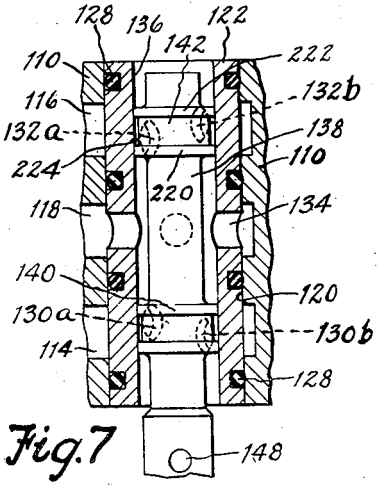

Fig. 7

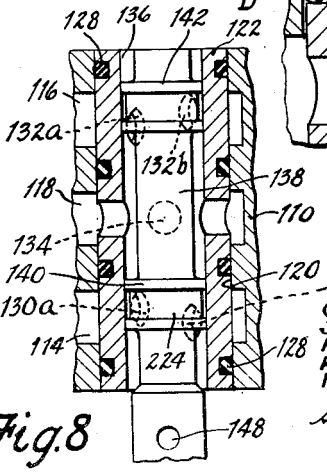

Fig. 8

INVENTORS
CHARLES S.J. MacNEIL
JOHN F. HAINES
HOWARD CARSON
RICHARD E. MOORE
FRANK MACK

Spencer, Hardman & Fehr
ATTORNEYS

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SPEED RESPONSIVE HYDRAULIC CONTROL MEANS

Charles S. J. MacNeil, John F. Haines, Richard E. Moore, Frank Mack, and Howard Carson, Dayton, Ohio, assignors to General Motors Corporation, Detroit, Mich., a corporation of Delaware

Application October 22, 1943, Serial No. 507,310

10 Claims. (Cl. 137—21)

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This invention relates to hydraulic control mechanism for aircraft propellers, and has for an object to refine centrifugally operated control valves, such that the pitch change effected by them will be consistent with small increments of initiating power, and also be corrective in response to small increments of speed change.

Another object of the invention is to simplify the design of a piston and cylinder in a control valve, yet retain features of stability and fidelity of operation.

A further object of the invention is to provide a control valve with an articulated actuating lever supported by a lever positioning spring or the like, whereby forces transmitted to the valve are restricted to lineally directed forces.

A further object is to provide a control valve with an articulated actuating lever and means for preventing binding of the valve in a casing, whereby the valve will not be inconsistent or erratic in its governing action.

Another object of the invention is to provide a control valve of the class described wherein a valve piston is isolated from an actuating lever except for strictly lineally applied forces.

A further object of the invention is to provide a control valve of the centrifugal type which is opposed by a helical coil spring and a lever locating spring thus rendering it sensitive to small changes in lineally applied forces.

Another object of the invention is to provide a control valve of the clamp on type which may be mounted without distortion of the porting cylinder.

A further object of the invention is to provide a control valve of the centrifugally responsive type whose movement is opposed by a spring actuated lever, and embraces stops marking the high and low speed limits of the valve movement.

A still further object of the invention is to provide means associated with a plunger type valve and porting sleeve for insuring the stability of the valve member within its casing.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings wherein a preferred embodiment of the present invention is clearly shown.

In the drawings:

Fig. 1 is a longitudinal sectional view illustrating a propeller control mechanism embracing the instant invention, it being a view substantially as indicated by the line and arrows 1—1 of Fig. 2.

Fig. 2 is a transverse view through the regulator mechanism therefor substantially as indicated by the line and arrows 2—2 of Fig. 1.

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Fig. 3 is a plan view of the governor valve assembly substantially as indicated by the arrow 3 of Figs. 1 and 4.

Fig. 4 is an enlarged sectional view thru the governor valve assembly as indicated by the line and arrows 4—4 of Figs. 3 and 5.

Fig. 5 is an elevational view substantially as indicated by the arrow 5 in Fig. 4.

Fig. 6 is a transverse sectional view thru the governor valve assembly substantially as indicated by the line and arrows 6—6 of Fig. 4.

Fig. 7 is a large detail view in section illustrating the relation of the porting sleeve and valve plunger in the neutral position.

Fig. 8 is a similar view, but with the valve plunger moved to a controlling position calling for an increase of pitch.

Fig. 9 is a fragmentary view on a much enlarged scale of one of the valve lands and its associated ports.

With particular reference to the drawings 10 indicates an engine nose or gear casing of an aircraft from which extends a rotatable propeller shaft 12 of hollow construction and to which is secured a propeller hub 14 seated against a rear cone 16 and to be driven by the splines 18. The hub 14 provides a plurality of sockets 20 within which are secured blade roots 22 enclosing torque units 24 for effecting the pitch change of the blades. The torque units 24 comprise a cylinder and piston well known to those experienced in the art and in which the piston is moved by the application of a fluid under pressure to one side or the other of the piston by means of the tubular passages 26 and 28 which are carried to points 30 and 32 of the hub where they align with and communicate with the transfer tubes 34 and 36 embodied in a regulator plate 38 mounted on a tubular extension 40 of the hub 14. The regulator plate embeds tubular passages 42 and 44 which communicate with all of the tubes 34 and 36 respectively leading to the several blades of the propeller mechanism, and from the tubes 42 and 44 extensions 48 and 50 run to a mounting pad 52 and there open outwardly to the face thereof as at 54 and 56 respectively. A third and intermediate opening 58 communicates with a pressure supply tube 60 also embedded in the regulator plate 38 and which leads to a pressure relief valve 62 and thence by a tube 64 to a pump mechanism 66.

Mounted over the pad 52 by means of screw devices 67 there is a governor valve assembly 68

that distributes fluid under pressure from the opening 58 to one or the other of the openings 54 or 56 and by way of those to either side of the piston in the torque unit 24 and in doing so effects control of the pitch of the propeller blades. Secured to the regulator plate 38 is a shell or cover 70 which is secured thereto by screw devices 72, and whose inward flange 74 of the cover supports a bearing 76 journalling an adaptor sleeve 78 which cooperates with the regulator plate 38 and the cover 70 to provide an annular ring like reservoir 80 enclosing the governor valve assembly, the relief valve, the pump mechanism, and linkage extending to the outside for controlling the operation of the governor valve assembly. The reservoir is charged with a quantity of hydraulic fluid, and with the intake of the pump, along with the embedded tubular passages and outlets of the governor mechanism, comprise a self-contained and sealed hydraulic system. The sealing of the system is effected by the centrifugally operated seals 82 and 84 carried by the cover and regulator plate respectively, that, under a condition of rest are spring urged inwardly to engage opposite ends of the adaptor sleeve 78, but when rotated at a predetermined speed lift away from the adaptor sleeve to reduce friction.

The adaptor sleeve 78 after engaging the bearing 76 extends across the inner bounds of the reservoir where it engages a bearing ring 86 supported by the regulator plate 38, and confines the bearing seal 84. The adapter sleeve is retained against rotation with the regulator by means of screw devices 88 passing thru an adaptor plate 90, a guide or spacer ring 92 and threading into a thickened shoulder 94 of the adapter sleeve, a ring gear 96 being journalled for rotation about the guide ring 92 and spaced between it and the adapter plate 90 as will presently appear. The adaptor plate 90 has its flange notched at 98 for reception of a lug 100 extending radially inward from a block 102 secured to the engine nosing, such that the adaptor assembly is restrained against rotation with respect to the engine nosing by the single lug and notch engagement 98, 100, but has a journal bearing within the bearing rings 76 and 86 of the regulator housing. The thickened portion 94 of the adapter sleeve provides a toothed flange 104 within the reservoir that meshes with a pinion 106 carried by the pump 66 and thereby effects driving of the pump, and a supply of fluid under pressure, whenever the regulator is rotated.

With particular reference to Figs. 3 to 6 inclusive, the governor valve assembly comprises a block or body 110 that has a mounting face 112 adapted for mounting upon the pad 52 in sealing relation, and which is apertured at 114 and 116, and at 118, to line up with the openings 54, 56 and 58 of the mounting pad 52. Lengthwise of the block there is a bore 120 receivable of a porting sleeve 122 and held in place by a stop plate 124 and screw device 126. The porting sleeve 122 has peripheral grooves within which are lodged synthetic rubber like seal rings 128, which must necessarily be compressed into the grooves somewhat when the porting sleeve is positioned within the bore 120, and are so disposed as to prevent fluid passage lineally of the sleeve from or between any one of the ports 114, 116, 118. Aside from sealing the porting sleeve and block against leakage, the sealing rings 128 also act as cushion members between the porting sleeve and block when the latter is clamped down on the pad 52, since any strains exerted by

the screw devices 67 tending to bind or warp the body 110 are taken up by the packing rings and not transmitted to the porting sleeve as might otherwise be done. The porting sleeve is appropriately fixed with cross passages to provide sets of control ports 130, 132 mating with the ports 114 and 116, and also with pressure ports 134 constantly exposed to the ports 118 of the body 110, the details of which ports will be treated in a later paragraph. The porting sleeve 122 has a lineal bore 136 that opens into all of the ports 130, 132 and 134 and is traversed by a valve plunger 138 having spaced lands 140 and 142 for alignment with and coverage of the ports 130 and 132, as will be later explained. To one end of the valve plunger there is coupled an actuating lever 144 by means of a bifurcation 146 straddling a cross pin 148 extending across a slot 150 in the plunger, the opposite end of the lever constantly engaging a fulcrum roller 152 mounted on a carriage 154 where it is held by means of a compression spring 156 engaging a pad 158 and supported from a spring seat 160 threaded on a stud 162 supported from the plate 124. For purposes of adjusting spring 156 the stud 162 after passing through the spring seat 160 provides a flange 164 with ratching provisions cooperating with the projecting end of the plate 124 as indicated at 166, and the stud 162 extends therethru in a plain bearing to provide a screw driver slot 168. The spring seat 160 has a lateral extension 170 adapted to straddle a rib 172 on the proximate portion of the body 110, which prevents the nut from turning relative thereto when the stud 162 is turned.

For positioning the lever 144, so that the bifurcated portion 146 will not push against the cross pin 148 or otherwise transmit a lateral force to the plunger 138, a lever locating spring 174 connects with the lever 144 beneath the spring pad 158 where it is secured by a pin 176. The lever locating spring 174 as shown in Fig. 6 is of U-formation and is formed of thin spring steel with its legs having inward laterally extending arms 178 disposable in notches on the underside of the block 110, and apertured to receive screw devices 180 by which it is secured thereto. The screw devices 180 and cleat 182 thereby clamping the ends of the U-shaped lever locating spring 174 between the ends of the ways and the body 110. The ways 184 are of channel form and set on edge so that their rear or clamped ends seat within notches 186 of the body 110 and provide a pair of parallel extending grooves bounded by the respective flanges of the channel members along which the rollers 188 of the carriage 154 are capable of rolling. The unattached ends of the ways 184 have their respective flanges pinched inwardly or toward each other as at 190 to restrain escape of the rollers therefrom when the carriage 154 is moved to the extreme right as viewed in Figs. 1 and 4.

The carriage is provided with four rollers 188, two on each side thereof being disposed in the channel of one of the ways, and it is between the front pair of rollers or those near the free ends of the ways 184 that the fulcrum roller 152 is disposed. Similarly, between the rear pair of rollers, or those nearest the plunger valve, a second roller 192 is disposed so as to be positioned beneath the attached end of the lever 144 to act as a stop whenever the valve plunger is in the underspeed position or when the regulator is at rest, with the carriage in the full line position shown in Fig. 4. When the carriage is

in the dotted line position the roller 192 will not engage the lever because the fulcrum 152 will be located between the spring 156 and valve plunger 138, so that the plunger and lever will be urged radially outward against the stop plate 124. For moving the carriage as desired, it is provided with a shoe member 200 which has a pin 202 rotatably carried by the carriage 154, and the shoe 200 is so disposed as to follow a groove of a control ring 204 as illustrated in Fig. 1. The control ring has its groove 206 of non-uniform circular extent about the periphery of the ring such as to provide a slight reciprocatory motion of the carriage as governor valve is rotated about the adapter assembly without movement of the control ring. For the want of a more apt term, that reciprocatory motion of the carriage is termed jittering and is incorporated for the purpose of keeping the valve plunger of the governor valve unit in a constant state of agitation while the propeller is in operation, so that the static friction to movement of the plunger will be very much reduced if not eliminated. That is brought about by the fact that though the control ring is in a fixed position along the length of the adapter sleeve, yet the groove being either of wave form or having its containing plane out of the perpendicular to the axis of rotation will have circumferentially spaced points at different distances axially away from the regulator plate 38 supporting the governor valve unit. Hence, as the regulator rotates about the adaptor assembly the wobbly groove 206 effects a fore and aft movement of the carriage 154 which effects a slight reciprocatory motion of the fulcrum 152. During normal propeller operation the reciprocatory motion of the fulcrum changes the moment arms through which the force of the spring 156 and the centrifugal force act upon the valve plunger and its linkage. Since the valve plunger under the normal propeller operating conditions is in the balanced position with respect to the control ports, then the slight change of moment arms effects a slight domination of the regulating forces exerted on the valve plunger, first the spring force dominates and then centrifugal force dominates, with continued and frequent repetition throughout the propeller operation, with the result that there are spurts of fluid pressure alternately to one control port and then to the other, as will be presently explained in connection with positive overlap of the plunger lands.

During a condition of under-speed operation of the propeller, or in those instances when the propeller is running at low speed, such as when it is being started or built up to rotation, the valve plunger and lever will then rest against the roller stop 192 as well as rest on the roller fulcrum 152. In this case the jittering movement of the carriage will tend to move the lever along with the valve plunger as a whole toward and away from the adaptor sleeve 78 without any substantial pivoting over the fulcrum roller or at the cross pin 148, articulating the lever with the valve plunger, and will transmit to the valve plunger a slight reciprocation within the porting sleeve. In either instance the surface tension of the fluid medium between the plunger and sleeve that might tend to bind the parts against free movement is broken. The valve plunger being kept in a state of infinite motion relative to the porting sleeve, it then offers little resistance to further movement by slightly greater forces exerted on the leverage or plunger by domination of either centrifugal force or spring force. Hence, the valve plunger is very sensitive to control forces of small magnitude and readily responds to a slight change in speed of propeller operation giving a governed control close to a selected speed level.

The particular speed level is selected by manipulation of the ring gear 96 from the lever 212, by which the control ring 204 is moved to a desired position along the available length of the adaptor sleeve 78 by means of a plurality of threaded control shafts 208 journalled in the adaptor assembly. The shafts 208 each have a pinion 210 meshing with the control ring gear 96, the oscillation of which, by linkage attached to the arm 212, effects rotation of the shafts 208 and causes the control ring 204 to move axially of the adaptor sleeve 78, that in turn causes the carriage 154 to move along the length of the ways 184. For every different position of the fulcrum along the length of the ways 184 there is a different speed setting at which the regulator will control, since for each position there is a different relation of moment arms through which the opposing forces act upon the valve linkage. With the fulcrum roller in the position illustrated in Fig. 4 the setting is for relative high speed, since the spring offers the greatest resistance or opposition to outward movement of the valve plunger. If the fulcrum be moved inward to a point between the position shown in Fig. 4 and the axis of the spring 156, then the spring has less opposing force to movement of the valve by centrifugal force, resulting in the equilibrium position of the valve plunger within the porting sleeve being reached at a lower speed of propeller rotation. That fact holds so long as the fulcrum is kept on the right hand side of the spring as shown in Fig. 4. Provision is also made for moving the fulcrum to the other side of the spring or to the other extreme end of the ways such as shown in dot-dash line Fig. 4. In that position the leverage is so changed that the spring force and centrifugal force are now in aiding relation because the fulcrum will be brought to a position between the spring and the mounting face of the governor valve assembly, which causes the valve plunger to be thrust radially outward for opening of the pitch increase port 132. In fact the spring force alone is sufficient to hold the valve in that position, such that there is unrestricted flow from the pressure port 134 through the control port 132 and the connections with the torque unit to effect an extreme shift to the feathered position of the blades.

With particular reference to Figs. 7, 8, and 9, of the drawings, the specific relation of the control ports in the porting sleeve and the lands of the valve plunger are shown. The set of decrease pitch control ports 130, and the set of increase pitch control ports 132 are each divided into two pairs of ports or orifices 130*a*, 130*b* and 132*a*, 132*b*, respectively, the orifices of each pair being diametrically disposed and having the same axial location relative to the sleeve. Of these pairs, the orifices indicated by the subscript *a* are the pressure applying orifices and are circumferentially spaced 90° from the drain orifices indicated by the subscript *b* of the same set, while the pressure applying orifices and the drain orifices of each set are in substantial axial overlap as indicated, yet all are in unrestricted communication with the respective body apertures 114 and 116,

It is also to be noted that the pressure applying ports or orifices of one set are in axial alignment with the pressure applying ports of the other set, as also obtains for the drain ports of each set, and that in each instance the pressure applying ports, due to the stated overlap with the drain ports, are each nearer to the pump pressure port 134 than are the corresponding drain ports.

The characteristics of the valve plunger 136 are such that the center lines of each of the lands 140, 142 are coincident with the center lines for each set of associated ports, but each land has an axial extent, indicated by arrows B that slightly exceed the axial dimension of each set of ports indicated by arrows A, so that there will be a substantial positive overlap of the lands with respect to the respective set of ports as represented by arrows E. The distance between the center lines for the sets of control ports is equal to the distance between the center lines for the lands of the plunger, so that when the valve is in the equilibrium position the lands will overlap all ports equally. Each land and set of ports bears the relation set out in enlarged detail in Fig. 9 for the set of increase pitch ports, and where the land 142 comprises a pair of parallel peripheral ribs, 220, 222 bounding the axial limits, arrows B, of the land and are separated by a shallow peripheral groove 224. The axial limits of the ribs 220 and 222 are such as to exceed the axial dimensions of the set of ports 132*a*, 132*b*, preferably by .001 to .005 inch, thus providing the desired overlap between the lands and ports. The location of the ports and the dimension of the lands with their spacings are such that, when the valve plunger is centered with the porting sleeve, there will be the same amount of overlap arrows E, for each and every port, which makes for consistency and sensitivity of control by the valve plunger in all positions. The groove 224 on the land does not enter into the porting of the governor mechanism but does reduce the metal to metal contact between the valve plunger and porting sleeve thus making it easier to move on application of a small initiating force. That coupled with the aforesaid jittering motion of valve plunger, and the positive overlap of valve plunger on all ports results in a very stable and balanced proportionalizing control valve. The amount that the valve is jittering in the porting sleeve is not critical but should be greater than the positive overlap of the valve ports. In Fig. 9 the bounds of the lineal movement due to jittering is indicated by the arrows C, while the amount of jitter is represented by the arrows D. The value of the jitter in a four-way valve with positive overlap is to give the valve the proportionalizing characteristics of a negative overlap four-way valve without introducing the disadvantages that allow the bleeding of high pressure oil through the governor in the neutral governing position and resulting in forces acting on the piston tending to cause unbalance, which would cause erratic speed control, instability and valve chattering. The reason that the valve proportionalizes is that the jitter allows pressure pulsations to each side of the system for all positions of the piston about the neutral position. These pressure pulsations control the pressure in each side of the system with a minimum of flow through the valve unit. The flow being greatly reduced results in the forces due to high velocity flow being reduced and the valve more nearly in hydraulic balance.

In operation of a propeller regulator fitted with a governor valve embodying the stated features, controls the pitch of the blades to the selected speed level with great fidelity, and accomplishes it with promptness so that there is no substantial delay in effecting correction to the speed level that might otherwise occur due to variations encountered in air density, altitude and unevenness of air conditions. To accomplish that fidelity of control the valve plunger hovers around the neutral, balanced, or equilibrium position with respect to the porting sleeve.

When the valve plunger is in the equilibrium position as it is shown in Fig. 7, all of the control ports will be completely covered and the waist of the plunger between the lands will be subject to the pressure of the port 134 which will be delivered in small spurts to the control ports 130, 132, thus keeping both sides of the torque units full of fluid. But let there be a slight change in the speed of rotation of the propeller, which alters the centrifugal force acting on the valve plunger and lever to maintain the valve plunger in its equilibrium position, then the plunger will move along the porting sleeve 122 to uncover one of the control ports somewhat as shown in Fig. 8. That movement, whether it be in response to an increase or a decrease of speed, will open the pressure applying ports of one set to pressure from the port 134 and will open the drain ports of the other set to drain back to the reservoir. In Fig. 8, the valve ports have been shown moved in response to an increase of speed with the pressure applying port 132*a* and the drain port 130*b* both open, which conditions the torque unit 24 to increase the blade pitch. As the fluid under pressure flows to one side of the torque unit through the port 132*a* the other side drains back to the reservoir through the drain port 130*b*. The blade shift effected changes the load on the motor driving the propeller which changes the resultant speed with a consequent correction by the valve in returning to the equilibrium position.

While the embodiment of the present invention as herein disclosed, constitutes a preferred form, it is to be understood that other forms might be adopted, all coming within the scope of the claims which follow.

What is claimed is as follows:

1. A control valve assembly, comprising in combination, a housing having a bore therethrough, a valve plunger slidable along the bore, a pair of channeled ways extending from the housing normal to the bore of the cylinder and plunger, a carriage movable along the channels of the ways and having a pair of rollers, a lever articulated with the valve plunger and adapted to rest on one of the carriage rollers as a fulcrum, spring means supported by the housing and engaging the lever intermediate the roller fulcrum and valve plunger, and leaf spring means for locating the lever with respect to the housing so that the articulation of the lever and plunger is deprived of lateral movement due to endwise movement of the lever.

2. A governor valve unit, comprising in combination, a valve body providing pressure supply and distributing ports, a valve plunger cooperating with the ports to control fluid flow through the body, a lever having a crotched pivotal connection with one end of the plunger, a carriage providing spaced rollers one of which supports the other end of said lever, channeled ways secured to one end of the valve body for supporting and guiding the carriage, a hinge spring interposed between the ways and valve body and se-

cured to a mid point of the lever for defining the crotched pivot between the lever and plunger, and a yielding means supported from the valve body for maintaining the lever in engagement with said one roller and for yieldably urging the lever toward the other of said rollers.

3. The combination set forth in claim 2 wherein the hinge spring permits free oscillation of the lever about the fulcrum roller and prevents lateral movement of the plunger due to endwise movement of the lever.

4. In a controllable pitch propeller assembly, a hydraulic regulator, comprising in combination, means providing a reservoir mounted about a central axis, means for rotating the reservoir on the central axis, a governor valve unit mounted in the reservoir, said unit including a porting cylinder and valve piston arranged radially of the axis of reservoir rotation, a spring urged cantilever hinged at one end to the piston and arranged to oscillate in a plane including the axis of reservoir rotation, a carriage providing a fulcrum for the other end of the lever, a roller stop engageable by the lever in the radially inward position of said piston, and means for positioning the lever relative to the piston so that oscillation of the lever will transmit only radial forces to the piston, whereby forces tending to bind the piston in the cylinder are eliminated.

5. In a governor valve unit subject to rotation about an axis outside of the unit, the combination comprising, plate means arranged for revolution about said axis, means for rotating the plate means, a valve cylinder supported on said plate means having its bore radially disposed with respect to the axis of rotation, a valve piston arranged for movement along the bore of the cylinder in response to centrifugal force of rotation, said piston having a pair of lands and an intervening annular groove, said cylinder having a pressure supply port opening to the intervening groove of the piston, and sets of control ports opening from said cylinder on either side of the pressure supply port, each of said set of control ports comprising a circumferential row of openings arranged in a staggered relation about the cylinder and providing pressure applying orifices adapted to be connected to the pressure supply port by the intervening groove of the piston, and drain orifices more remote from the said pressure supply port but overlapping with the pressure applying orifices, so that each set of control ports is adapted to be completely covered by one of the lands of said piston, movement of the piston from a position covering both sets of control ports operating to connect the pressure applying orifice of one set with the pressure supply port while opening the drain orifice of the other set to discharge, said lands having a positive overlap on the respective sets of control ports of from .001 to .005 inch, a lever articulated to the piston, a movable fulcrum supporting the opposite end of the lever, spring means urging the lever against the fulcrum to oppose centrifugal force acting on said valve piston due to rotation of the cylinder about said axis, and means effective upon revolution of the cylinder and piston for reciprocating the fulcrum along the lever, whereby jittering of the piston is maintained throughout revolution of the cylinder, said jittering motion of the piston exceeding the total overlap between piston land and associated set of ports.

6. In a governor valve unit subject to movement about an axis of rotation, the combination comprising, plate means arranged for revolution about the axis, means for rotating the plate, a valve cylinder supported on said plate means having its bore radially disposed with respect to the axis of rotation, and having pressure delivering ports intervening lineally spaced pressure applying ports, a spool valve arranged for movement along the bore of the cylinder in response to changes in speed of rotation, and having lands lineally spaced to cover the pressure applying ports of the cylinder with a positive overlap, each land having a limit of axial extent greater than the pressure delivering ports, a lever and spring coupled to the spool valve for opposing movement of the valve in response to change in speed of rotation, and means for positioning the lever, so that lateral movement of the spool valve relative to the cylinder, due to lateral biasing movement by the lever is eliminated, and means for jittering the spool valve in the cylinder whereby static friction to movement of the valve within the cylinder is reduced.

7. In a governor valve unit, the combination comprising, plate means arranged for revolution about an axis of rotation, means for rotating the plate means, a valve cylinder supported on said plate means having its bore radially disposed with respect to the axis of rotation, a valve piston arranged for movement radially inward and outward along the bore of the cylinder in response to change in centrifugal force of rotation, said valve cylinder having a pressure supply port and two control ports, one spaced on either side of the supply port, said valve piston having a pair of lands spaced to cover both of the control ports but adapted upon movement of the piston along the bore of the cylinder to connect one of the control ports with the pressure supply port and connect the other control port with drain, a lever having an articulated connection with the piston and extending at right angles therefrom and parallel with said axis, a carriage having a fulcrum supporting the remote end of the lever, and movable toward and away from the lever and piston articulation, a stop provided by the carriage for limiting the radial inward movement of the piston, spring means resisting movement of the piston along the bore of the cylinder in response to centrifugal force, movement of the carriage altering the ratio of centrifugal force and resisting force applied to the valve, and a hinge spring secured to said cylinder for supporting the lever whereby movement of the carriage and oscillation of the lever will be free from transmitting movement to the piston laterally relative to the cylinder.

8. A governor valve assembly, comprising in combination, a supporting member, means for rotating the member about an axis, a valve cylinder having a pressure supply port and two sets of pressure distributing ports, each set of distributing ports being lineally spaced on opposite sides of the pressure supply port, a spool valve freely movable along the bore of the cylinder and having a pair of lands lineally spaced to cover all of said distributing ports with a positive overlap, means for mounting the cylinder and spool valve on the supporting member so that the bore of the cylinder and spool valve extend along a radius of the rotary axis, spring means for moving the spool valve along the bore of the cylinder in opposition to centrifugal force acting on said spool valve due to rotation of the support, a lever articulated with the spool valve and extending normal thereto, said spring means acting on the lever in a direction parallel to the movement of

the spool valve, means preventing the lever from transmitting any lateral forces to the spool valve due to endwise movement of the lever, including a leaf spring secured to the valve cylinder and lever, and the lands of said spool valve having wide annular grooves for reducing the metal to metal contact of the spool valve within the cylinder, whereby the static friction to movement of the spool valve along the cylinder is substantially reduced.

9. A control valve assembly, comprising in combination, a support having pressure and distributing passages, a valve housing on the support having a bore therethrough intersecting said pressure and distributing passages, a porting sleeve carried by the bore of the housing and having sets of distributing ports and pressure ports, each set of ports opening into a separate passage of the support, said sleeve having peripheral grooves situated on each side of a line of pressure ports, and on each side of a line of lineally spaced distributing ports; means exerting a clamping force normal to the bore for clamping the housing to said support, said sleeve having substantial clearance with the bore of the housing; and yieldable packing rings disposed in the grooves of the sleeve and compressed between the sleeve and housing to seal against fluid leakage between the ports, and to relieve clamping strain on the housing from being transmitted to the porting sleeve, a valve plunger movable along the porting sleeve and having lands adapted to stop flow through the distributing ports, but susceptible to movement for opening a distributing port to the pressure ports without binding between the sleeve and plunger due to distortion of the housing pursuant to mounting on the support.

10. In a controllable pitch propeller assembly, a hydraulic regulator, comprising in combination, means providing a reservoir, control apparatus mounted in the reservoir and including a governor valve unit, means for rotating said reservoir, said unit including a porting cylinder and piston arranged radially of the axis of rotation, a spring urged cantilever hinged to the piston and arranged to oscillate in a plane including the axis of rotation, with the piston moving radially inward and outward along the cylinder, a carriage providing a fulcrum for one end of the lever, a roller stop engageable by the lever in the radially inward position of said piston, centrifugal force tending to move said piston and lever outward and away from said stop, and a spring yieldably resisting said outward movement, means for selectively positioning the fulcrum along the length of the lever, and means effecting jitter of the fulcrum while the regulator is rotating regardless of the position of the fulcrum along the lever, as well as during underspeed when the lever may engage the roller stop.

CHARLES S. J. MACNEIL.
JOHN F. HAINES.
RICHARD E. MOORE.
FRANK MACK.
HOWARD CARSON.

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