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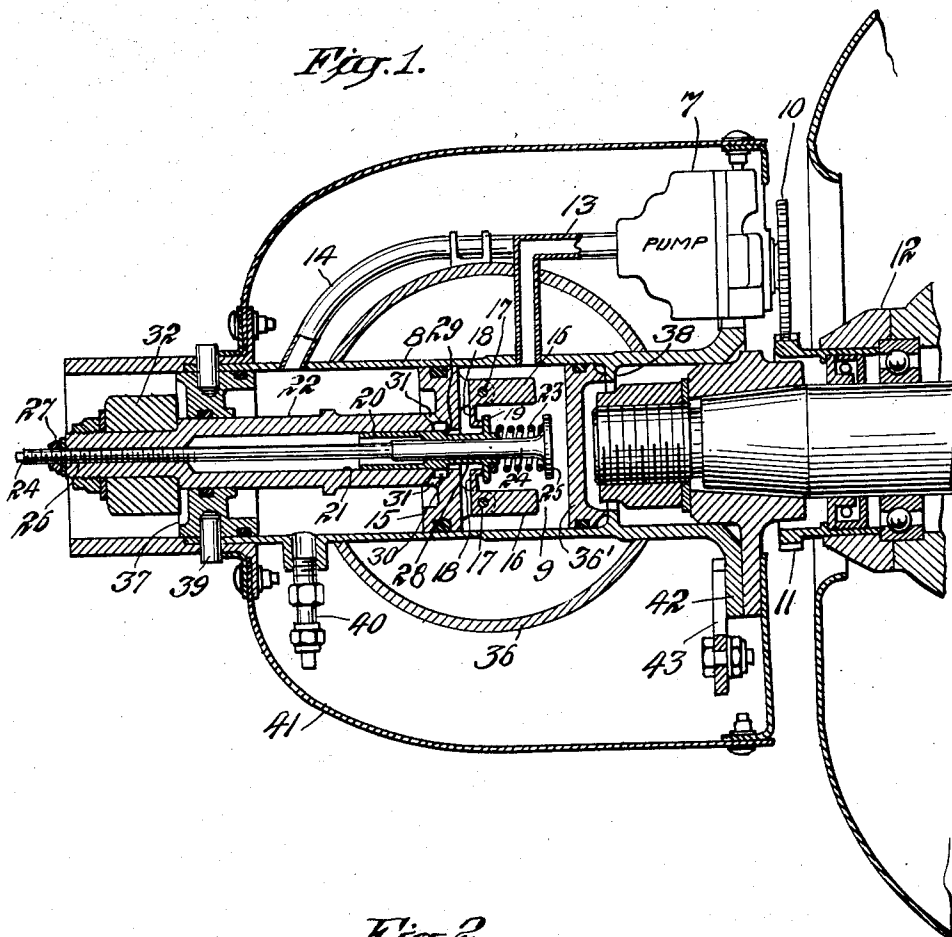
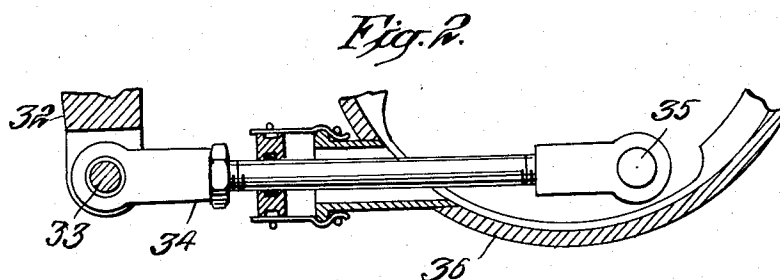
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CONSTANT SPEED PROPELLER WITH SELF-CONTAINED PUMP AND GOVERNOR

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2 Sheets-Sheet 1



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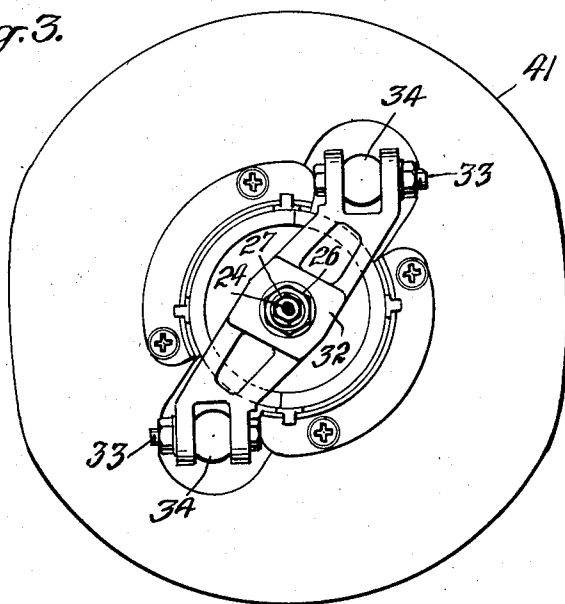
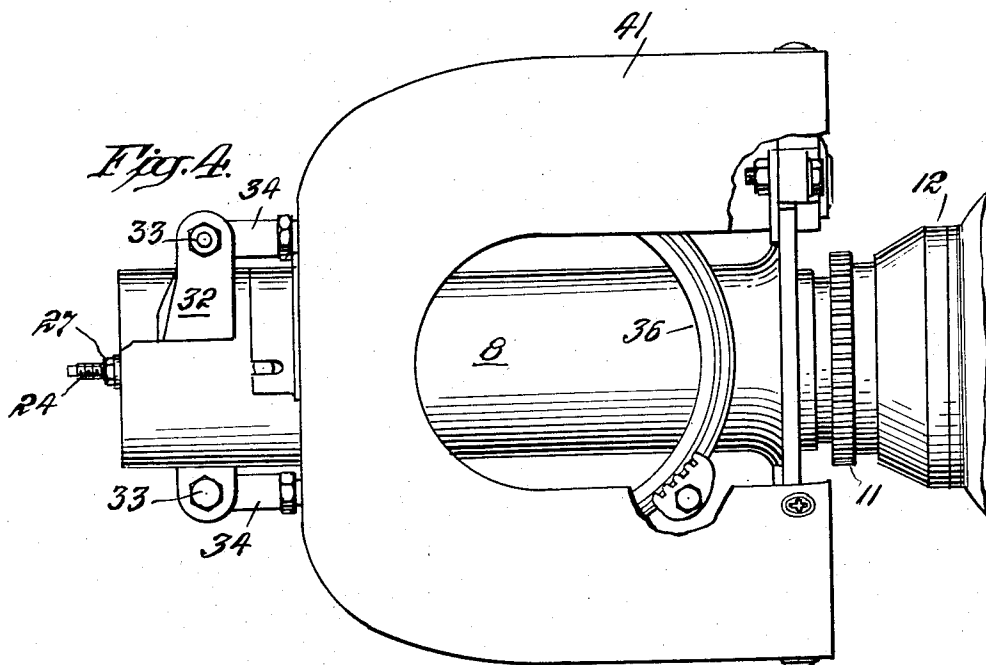
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Fig. 3.



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CONSTANT SPEED PROPELLER WITH SELF-CONTAINED PUMP AND GOVERNOR

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8 Claims. (Cl. 170—160.21)

The invention herewith disclosed relates to variable pitch constant speed propellers.

Objects of the invention have been to provide a propeller of this description which would be essentially complete and self-contained as regards all mechanism for effecting pitch control and maintaining constant speed. While particularly essential for pilotless aircraft such as target drones, the invention is of importance in other types of aircraft.

Speaking generally, the invention involves the building into the hub of the propeller both the pump for furnishing power to change and hold desired pitch angle and a governor for regulating the pump action to maintain the desired constancy of speed.

Further novel features and other desirable results attained by the invention are set forth and will appear in the course of the following specification.

The drawings accompanying and forming part of the specification illustrate a present practical embodiment of the invention, but it is to be understood that structure and arrangement may be modified and changed in various ways, all within the true intent and scope of the invention as hereinafter defined and claimed.

Figure 1 in the drawings is a broken longitudinal sectional view of one of the new unitary type propellers showing the pump mounted on the base flange of the propeller hub and the centrifugal governor built into the piston of the hydraulic cylinder effecting pitch control.

Figure 2 is a broken sectional detail illustrating linkage connection from the piston yoke back to the propeller blades.

Figure 3 is a front end view of the propeller hub showing particularly linkage from the yoke back to the blades.

Figure 4 is a broken plan view of the hub structure with blades omitted.

As shown more fully in Figure 1, the invention comprises the mounting of a pump 7 on the hub of the propeller, gear driven from a stationary part of the engine and connected to the hydraulic cylinder 8 of the pitch control mechanism through the medium of a governor 9 arranged to regulate the action of the pitch control mechanism.

The pump is indicated as of the gear type and as driven by pinion 10 in rolling mesh with a stationary gear 11 fixed on the engine housing 12.

Pressure and return connections 13, 14 are shown extending from opposite sides of the pump to cylinder 8 at opposite sides of the piston 15 operating therein.

The governor is shown as made up of fly weights 16 pivoted on the back of the piston at 17 and having angularly extending arms 18 engaging the flange 19 of pilot valve 20 slidably mounted in the bore 21 of the piston rod 22.

Centrifugal action of the governor weights is opposed

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by a spring 23 surrounding the stem 24 and in abutment with the flange 25 at the inner end of said stem.

The outer end of the spring abutment stem or stud is shown as screwthreaded at 26 in the outer end of the piston rod where it may be secured after adjustment of the spring tension, by lock nuts 27.

The pilot valve is shown as tubular in form for passage of the stud therethrough, sufficient clearance being provided between these two for free flow of liquid, to maintain the same pressure at both sides of the pilot valve.

The pilot valve is shown as having a portion 28 of reduced diameter where it enters the head of the piston, providing an annular shoulder 29 to operate as a cut-off in the annular valve groove 30 in the piston, surrounding the pilot valve.

The valve or orifice groove 30 is shown as connected by ports 31 with the forward side of the piston. Longitudinal movement of pilot valve 20, therefore, will control orifice size and therefore pressures at opposite sides of the piston.

Operating connections from the piston back to the blades are provided in the present disclosure by a yoke 32 on the forward end of the piston rod carrying pivots 33 for links 34 connected at their inner ends with pivot pins 35 on the root ends of the propeller blades.

A special feature of the embodiment illustrated is that the center tube, heretofore designated as cylinder 8, extending through the hub body 36 and constituting in effect the base of the hub and providing the drive and mounting means for the hub, is used to serve as a hydraulic cylinder and is sized to constitute a reservoir for the hydraulic actuating fluid of the pitch control mechanism. This is accomplished by finishing the interior of the central drive tube 8 as a hydraulic cylinder for piston 15 and by closing opposite ends of the finished cylinder by inner and outer cylinder heads 36', 37 placed to accommodate a sufficient supply of the oil or other actuating medium used. The inner cylinder head is shown sealed in the inner end of the cylinder in engagement with an annular abutment shoulder 38 and the outer cylinder head is shown fixedly secured in the outer end portion of the cylinder by pins 39, the relation being such as to hold contained a volume of the liquid sufficient for circulation by the pump under all pitch angle controlling conditions.

The cylinder is shown provided with a valved fitting 40 for filling and drainage purposes.

A spinner or protective cowling 41 may be mounted over the hub body to cover the pump and connections to and from the power cylinder.

The invention is adapted to both flange and spline or shaft mounted propellers. In both instances it is practical to provide the center drive sleeve or cylinder 8, with an annular flange at the back, as illustrated at 42, Fig. 1, and to mount the pump on this flange with suitable counterbalancing means at the opposite side of the shaft center, as indicated at 43.

From the preceding description the operation will be clear, it being evident that with increase of shaft rotation the fly weights 16 will operate to reduce orifice size and increase pressure in back of the piston 15, causing piston to move forward to increase propeller pitch. In reverse effect, an under speed condition will cause the governor to increase the control orifice, thus to permit retractive movement of the piston to decrease pitch angle of the blades.

Operation of the centrifugal governor may be varied by adjustment of the spring tensioning stud 24.

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Necessary parts are relatively few and can be compactly arranged in symmetrically balanced relation. All mechanism is self-contained in the propeller and no electrical, hydraulic or mechanical connections are required other than the engagement of the pump pinion on the hub with stationary gear on the engine or other adjacent support. By combining and arranging all the hydraulic pitch control mechanism in the propeller, the parts of such mechanism are closely related and connected, reducing weight, simplifying construction and assuring sensitive, instant pitch control action.

The control action is particularly sensitive and prompt because of the fact that the "On Speed" position of the blades is governed by variation of pressure in a constant volume rather than by varying volume as in conventional constant speed control systems. In this new pressure method of control, volume remains constant but pressure on opposite sides of the blade setting piston is varied by the governor located at the axial center of the hub and therefore sensitive immediately to any change in propeller speed. The volume of liquid in the short, closed hydraulic circuit is constantly susceptible to any slight variation in orifice size caused by the governor so regulation is prompt and effective.

What is claimed is:

1. Self-contained constant speed propeller comprising the combination of a propeller hub having variable pitch propeller blades and provided with a central drive tube finished as a hydraulic cylinder and having cylinder heads at opposite ends, a piston operating in said cylinder, operating connections extending from said piston to said blades for effecting pitch angle adjustments of the blades, a hydraulic pump mounted on the hub, gearing for effecting operation of said pump in rotational operation of the propeller including a gear on the pump in mesh with a driving gear, hydraulic connections extending from said pump to the hydraulic cylinder at opposite sides of the piston therein, a centrifugal governor mounted on said piston and a pilot valve actuated by said centrifugal governor and arranged to effect pressure control in the cylinder between opposite sides of said piston.

2. Self-contained constant speed propeller comprising the combination of a propeller hub having variable pitch propeller blades and provided with a central drive tube finished as a hydraulic cylinder and having cylinder heads at opposite ends, a piston operating in said cylinder, operating connections extending from said piston to said blades for effecting pitch angle adjustments of the blades, a hydraulic pump mounted on the hub, gearing for effecting operation of said pump in rotational operation of the propeller including a gear on the pump in mesh with a driving gear, hydraulic connections extending from said pump to the hydraulic cylinder at opposite sides of the piston therein, a centrifugal governor mounted on said piston and a pilot valve actuated by said centrifugal governor and arranged to effect pressure control in the cylinder between opposite sides of said piston and orifice means actuated by said pilot valve.

3. Self-governing and self-contained constant speed propeller comprising a propeller hub, propeller blades having variable pitch mounting in said hub, a central drive sleeve extending through said hub and finished interiorly as a hydraulic cylinder, cylinder heads at the forward and rearward ends of said cylinder, a piston operating in said cylinder and having a forwardly extended piston rod, pitch angle adjusting connections extending from the forward end of said piston rod back to said blades, a pump mounted on the hub and rotatable therewith, said pump having an operating gear, a stationary gear engaged by said pump gear for effecting operation of the pump in the rotation of the propeller, connections extending from the pump to the cylinder at opposite sides of the piston therein, said piston having an orifice passage therethrough in communication with the cylinder at opposite sides of the piston, an orifice controlling valve slidable longitudinally

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in the piston and a centrifugal governor on the piston connected to control said orifice valve.

4. Self-governing and self-contained constant speed propeller comprising a propeller hub, propeller blades having variable pitch mounting in said hub, a central drive sleeve extending through said hub and finished interiorly as a hydraulic cylinder, cylinder heads at the forward and rearward ends of said cylinder, a piston operating in said cylinder and having a forwardly extended piston rod, pitch angle adjusting connections extending from the forward end of said piston rod back to said blades, a pump mounted on the hub and rotatable therewith, said pump having an operating gear, a stationary gear engaged by said pump gear for effecting operation of the pump in the rotation of the propeller, connections extending from the pump to the cylinder at opposite sides of the piston therein, said piston having an orifice passage therethrough in communication with the cylinder at opposite sides of the piston, an orifice controlling valve slidable longitudinally in the piston and a centrifugal governor on the piston connected to control said orifice valve, said valve being of tubular construction and having a flange engaged by the centrifugal governor, a stud extending through the tubular valve and having a head at the inner end, a spring surrounding said stud and interposed between said head and the flanged end of the valve and means for securing said stud in spring tensioning adjustment.

5. Variable pitch constant speed propeller comprising a propeller hub having an axially extending central drive tube finished interiorly as a hydraulic cylinder, cylinder heads at the forward and rearward ends of said cylinder, a piston operable in said cylinder, inner and outer heads at the rearward and forward ends of said cylinder providing hydraulic reservoir capacity for said cylinder, a piston operating in said cylinder between said cylinder heads and having a tubular piston rod projecting through the outer forward cylinder head, propeller blades rotatably mounted in the hub, pitch changing connections extending from the forward end of the piston rod back to said propeller blades, said piston having a valve passage extending therethrough to cylinder space at opposite sides of the piston, a valve operating in the bore of the tubular piston rod to control said valve passage, centrifugal governor means rotatable with the hub and arranged to shift said valve, a pump mounted on the hub and rotatable therewith, means for driving said pump, and pressure supply and return connections from said pump to the cylinder at opposite sides of the piston therein.

6. The invention according to claim 5 with said governor means mounted on the piston and means extending through the piston rod to said governor means for effecting adjustment of the governor means.

7. Constant volume, variable pressure system of pitch control comprising the combination of propeller hub, propeller blades mounted for variable pitch adjustment in said hub, companion hydraulic cylinder and piston elements in cooperative relation mounted in said hub and connected with said propeller blades to effect pitch adjustment of said propeller blades and a short, closed circuit hydraulic system for said hydraulic cylinder and piston elements comprising a pump, means for driving said pump in the rotation of said propeller, hydraulic connections extending from the opposite sides of said pump to said cylinder at opposite sides of the piston therein and constituting with said cylinder a short, constant volume closed hydraulic circuit, a centrifugal governor located in synchronism with said propeller, a valve located in said closed hydraulic circuit controlling pressure in the cylinder on opposite sides of the piston therein and operating connections from said centrifugal governor to said valve whereby to vary pressure in the closed hydraulic circuit with change in propeller speed, without varying the volume in the circuit.

8. The invention according to claim 7 in which said cylinder element is provided by a centrally located, axially extending drive tube with said piston centrally located therein and said governor is carried by said piston and said control valve is mounted in said piston and controls passage of hydraulic fluid through from one side to the other side of said piston.

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