Aug. 6, 1929. H. S. HELE-SHAW ET AL 1,723,617

FEATHERING SCREW PROPELLERS

Filed Nov. 2, 1925

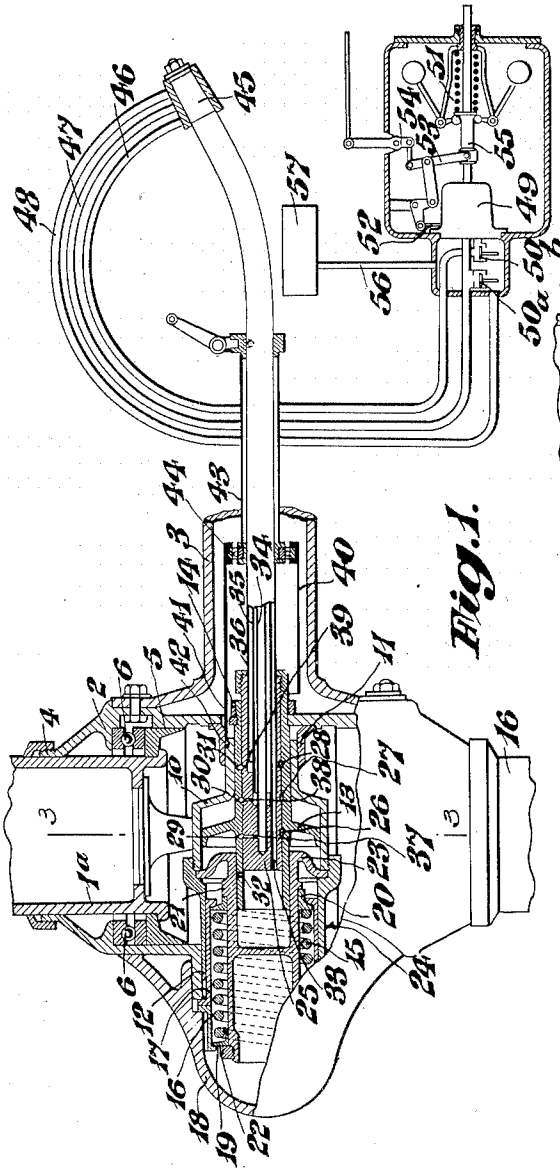


Fig. 1.

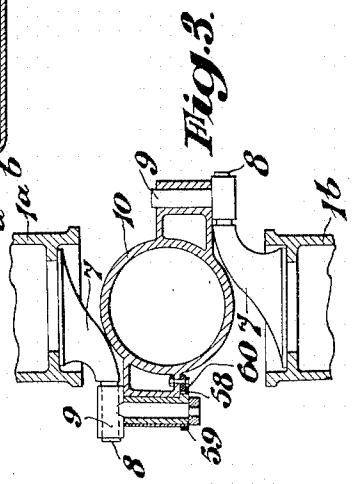


Fig. 3.

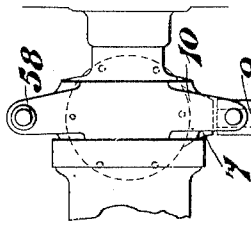


Fig. 2.

Inventors
Henry Selby Hele-Shaw
Thomas Edward Beacham
By Liverance & Van Antwerp
Attorneys

Patented Aug. 6, 1929. 1,723,617

UNITED STATES PATENT OFFICE.

HENRY SELBY HELE-SHAW AND THOMAS EDWARD BEACHAM, OF LONDON, ENGLAND.

FEATHERING SCREW PROPELLER.

Application filed November 2, 1925, Serial No. 66,151, and in Great Britain December 3, 1924.

This invention relates to feathering propellers particularly for use on aircraft.

As is well known an essential condition for the successful operation of an aeroplane is that the speed of the engine driving the propeller or air screw should be capable of control and this is effected according to present practice by the airman operating the throttle valve of the engine.

It is conceivable that there are various ways by which the present hand control could be replaced by an automatic control, such for example as a governor driven by the engine controlling the throttle, but there is in a propeller itself a potent means for ensuring a practically constant speed of the engine at its highest power and efficiency. This desideratum can be accomplished if means are available for varying the pitch of the propeller or airscrew and many attempts have been made to produce an airscrew or propeller of this kind.

The object of our invention is to provide such propeller or airscrew in combination with a control mechanism by means of which the pitch of the propeller or airscrew will, in normal running, be automatically varied, a further object of the invention being to provide in addition to the automatic control, a means whereby hand control can be effected in emergencies and a means whereby should the control mechanism fail for any reason the pitch of the propeller or airscrew will be adjusted or held in a normal or predetermined pitch leaving the pilot free to take over control by his engine throttle.

The invention consists therefore, in its broadest aspect, of a driving mechanism for aircraft and the like comprising a propeller having its blades capable of movement about axes to vary their pitch, an engine for driving said propeller, mechanism for altering the pitch of the propeller blades and a governor driven by the engine and operatively connected with the pitch altering mechanism for automatically controlling the pitch of the propeller blades in accordance with the engine speed.

The preferred form of the invention involves the employment of a hydraulic transmission mechanism comprising a pump controlled in accordance with the engine speed and a ram or rams in liquid circuit with the pump for effecting the desired movement of the propeller blades about their axes.

The invention further includes the provision of emergency means whereby the control of the pump can be effected by hand and means whereby in the event of failure of the hydraulic mechanism the blades will be caused to automatically adopt and be held in a predetermined position as regards pitch.

In order that the invention may be clearly understood one practical embodiment is illustrated in the accompanying drawings wherein Figure 1 is a more or less diagrammatic sectional view of a propeller constructed and controlled in accordance with the invention, Figure 2 is a plan view illustrating the method of swivelling the propeller blades and Figure 3 is a section on the line 3—3 of Figure 1 with parts removed for clearness of illustration.

Referring to these drawings throughout which like numerals of reference indicate corresponding parts the numerals 1^a and 1^b designate the two propeller blades which are mounted in the hub shell 2 so as to be capable of rotation about an axis perpendicular to the axis of the hollow driving shaft 3. Each blade is supported in the hub by means of two journal bearings 4 and 5 and a ball thrust 6 is fitted between each blade and the hub in order to sustain the centrifugal force on the blade and render it rotatable about its axis without undue friction. Each blade is provided with an arm 7, ending in a cylindrical shaft 8, on which slides a T piece 9 which is pivoted to the crosshead 10. In the case of one blade the T piece 9 is mounted in the crosshead 10 in an eccentric bush 58 which bush is prevented from rotating by means of castellations 59 engaging with similar castellations in a washer 60 bolted to the crosshead. The crosshead is slidably carried in the hub by means of two bearings 11 and 12 and is arranged so that the crosshead can slide to and fro along the axis of the shaft. The crosshead is bored internally to form a cylinder which slides on the piston 13, which is fixed to the hub 2 by means of nut 14. A spring 15 is compressed between two spring cases 16 and 17, which are clamped to the hub 2 by means of end cover 18. At the ends of the springs are fitted two loose washers 19, 20 which

engage respectively with the shoulder 21, and the nut 22 on the end cover 23 which is in turn clamped to the crosshead 10 by means of a screw thread on the end of the crosshead sleeve 24 engaging a screw thread on the crosshead 10. The interior of the piston 13 is bored to receive the cylindrical valve 25 this valve being fixed and the piston rotating round it. The cylindrical valve 25 is fitted with three annular ports 26, 27, 28 which cooperate with the passages 29, 30, 31 in the piston. A further passage 32 in the piston is in communication with the annular port 28 by means of the hole 33. Three concentric pipes 34, 35, 36, are connected to the valve 25, and the annular port 26 communicates with the pipe 34 by means of the passage 37; the annular port 27 communicates with the annular space between pipes 34, 35 by means of passage 38; and the annular port 28 communicates with the annular passage between pipes 35, 36 by means of passage 39. The tubular member 40 is provided with projections 41 which pass through holes in the hub 2, and are attached to the crosshead 10 by means of pins 42. The tubular member 40 is attached to the indicator sleeve 43 by means of the ball race 44. The three pipes 34, 35, 36 are attached by means of the unions 45 to three pipes 46, 47, 48 arranged so that the pipe 46 is in communication with pipe 34, 47 with the annular space between 34 and 35, and 48 with the annular space between 35 and 36. Pipes 46, 47 communicate with the flow and return outlets to the variable and reversible stroke pump 49 arranged to be driven by the engine and are each fitted with a non-return valve 50^a and 50^b respectively communicating with the interior space of the pump case. Pipe 49 communicates directly with the pump case. 51 is a governor driven by the engine which operates the stroke shifting spindle 52, of the pump through the floating lever 53, one end of which is attached to the control crank 54. 56 is a pipe which places an overhead liquid tank 57 in communication with the case of the variable stroke pump 49. This pump may conveniently be a Hele-Shaw pump of the type described in the specification of British Letters Patent No. 9402 of 1910 but any type of variable stroke reversible pump may be applied. In the operation of this mechanism the governor is so arranged that at a certain definite speed it sets the stroke control lever 52 to neutral and that if the engine speed rises the governor acts on the control spindle 52 of the variable stroke pump causing it to pump liquid—preferably oil—out of the pipe 46 into the pipe 47 creating pressure in the latter and causing the crosshead to move to the right. The crosshead carries with it the T pieces 9 attached to the shanks 8 which turn the two blades and so causes them to increase their pitch. On the other hand should the speed of the engine fall below the predetermined point the stroke control 52 is moved to the opposite direction, the pump pumps pressure liquid into the pipe 46 and moves the crosshead 10 in the opposite direction and so changes the pitch of the blades. Should, for any reason, the crosshead be driven by the oil pressure either one way or the other up to the limit of its stroke the ports 32 in one direction or 31 in the other will allow the pressure liquid to by-pass directly into the pipe 48 and back to the casing of the pump, and thus prevent any excessive pressure caused by the crosshead coming up to the end of its travel. The speed of the engine may be controlled by means of the crank 54 operating on the floating lever 53 and so altering the relationship between the movement of the governor sleeve 55 and the neutral position of the variable stroke pump. In the unlikely event of a pipe breakage or failure of the oil pressure system from any cause the spring 15 will operate so as to return the blades to a predetermined pitch. If the crosshead has moved to a position to the left of that shown in Figure 1 the spring would return it to the position shown in Figure 1 by pressing against the shoulder 21 while if the crosshead has moved to the right the spring would similarly return it by pressing against the nut 22.

The system is kept full of liquid by means of a pipe 56 communicating to a store of liquid in an overhead tank 57 and any leakage of oil which may take place is returned to the pipe system through one of the non-return valves 50^a and 50^b in accordance with known practice.

One blade may be rotated relatively to the other in order that the pitch of the two blades may be adjusted to be exactly equal by rotating the eccentric 58.

It will be understood that a suitably indicating device may be provided to inform the pilot at all times of the pitch adopted by the propeller blades.

It will thus be seen that we have by our invention provided a driving mechanism for aircraft in which during normal running the pitch of the propeller blades will be automatically adjusted from time to time in accordance with varying conditions while at the same time leaving it open to the pilot to directly control the pitch by hand should emergency demand it and moreover in the event of failure of the mechanism the propeller blades will adopt a predetermined pitch and the pilot can control by means of the engine throttle in the manner at present familiar.

What we claim and desire to secure by Letters Patent is:—

1. Driving mechanism for aircraft com-

prising, a propeller having blades adapted to swivel to vary their pitch, a motor to drive said propeller, hydraulic mechanism associated with the propeller for varying the pitch of its blades, a hydraulic pump communicating with said hydraulic mechanism, a governor being associated with the hydraulic pump whereby output of the compresser is controlled in direct relation to the engine speed, and manually adjustable means for varying the output of the pump relative to the governor.

2. Driving mechanism for aircraft comprising, a propeller having blades adapted to swivel to vary their pitch, a motor to drive said propeller, hydraulic mechanism associated with the propeller for varying the pitch of its blades, a hydraulic pump communicating with said dydraulic mechanism, a governor driven by the motor which drives the propeller, and means for controlling the output of said pump, said means being adapted to be actuated either manually or by said governor.

3. Driving mechanism for aircraft comprising, a propeller having blades adapted to swivel to vary their pitch, a motor to drive said propeller, hydraulic mechanism associated with the propeller for varying the pitch of its blades, a hydraulic pump communicating with said hydraulic mechanism, a governor actuated by the motor which drives the propeller, and means associated with the pump for governing its output, said means including a link which may be either manually actuated or actuated by said governor.

4. A variable pitch propeller having blades adapted to swivel to vary their pitch, spring means associated with the blades to yieldably retain or move them to normal position, and means for moving the blades in either direction from normal against tension of said spring.

5. A variable pitch propeller having blades adapted to swivel to vary their pitch, hydraulic means associated with the blades for swiveling them in either direction from normal, a source of hydraulic pressure, a return pipe adapted to return the fluid to the source of pressure, and means moved to communicate said hydraulic means with said return pipe by movement of the blades to either of its extreme positions.

6. Driving mechanism for aircraft and the like comprising a propeller having its blades capable of swivelling movement about axes to vary their pitch, an engine for driving said propeller, a hydraulic system of transmission to effect the movement of said blades about their axes, a governor mechanism driven by the engine and operating to control the hydraulic transmission mechanism and as a consequence the pitch of the blades in relation to the engine speed and means for restoring the pitch of the blades to a normal pitch on failure of the hydraulic mechanism.

7. Driving mechanism for aircraft comprising a propeller having its blades capable of swivelling movement about axes to vary their pitch, an engine for driving said propellers, a hydraulic ram connected to the blades to effect the movement of said blades about their axes, a variable stroke pump operating to deliver liquid to operate said rams and means for controlling the stroke of the pump and consequently the ram movements.

8. Driving mechanism for aircraft comprising a propeller having blades adapted to swivel to vary their pitch, spring means tending to hold said blades in normal position and compressible upon swivelling of the blades in either direction from normal position, and hydraulic means associated with said propeller and acting against the tension of said spring to vary the pitch of the blades in either direction from normal, said spring tending to turn and hold the blades in normal position upon failure of the hydraulic means.

In witness whereof we affix our signatures.

HENRY SELBY HELE-SHAW.
THOMAS EDWARD BEACHAM.