

May 5, 1942.

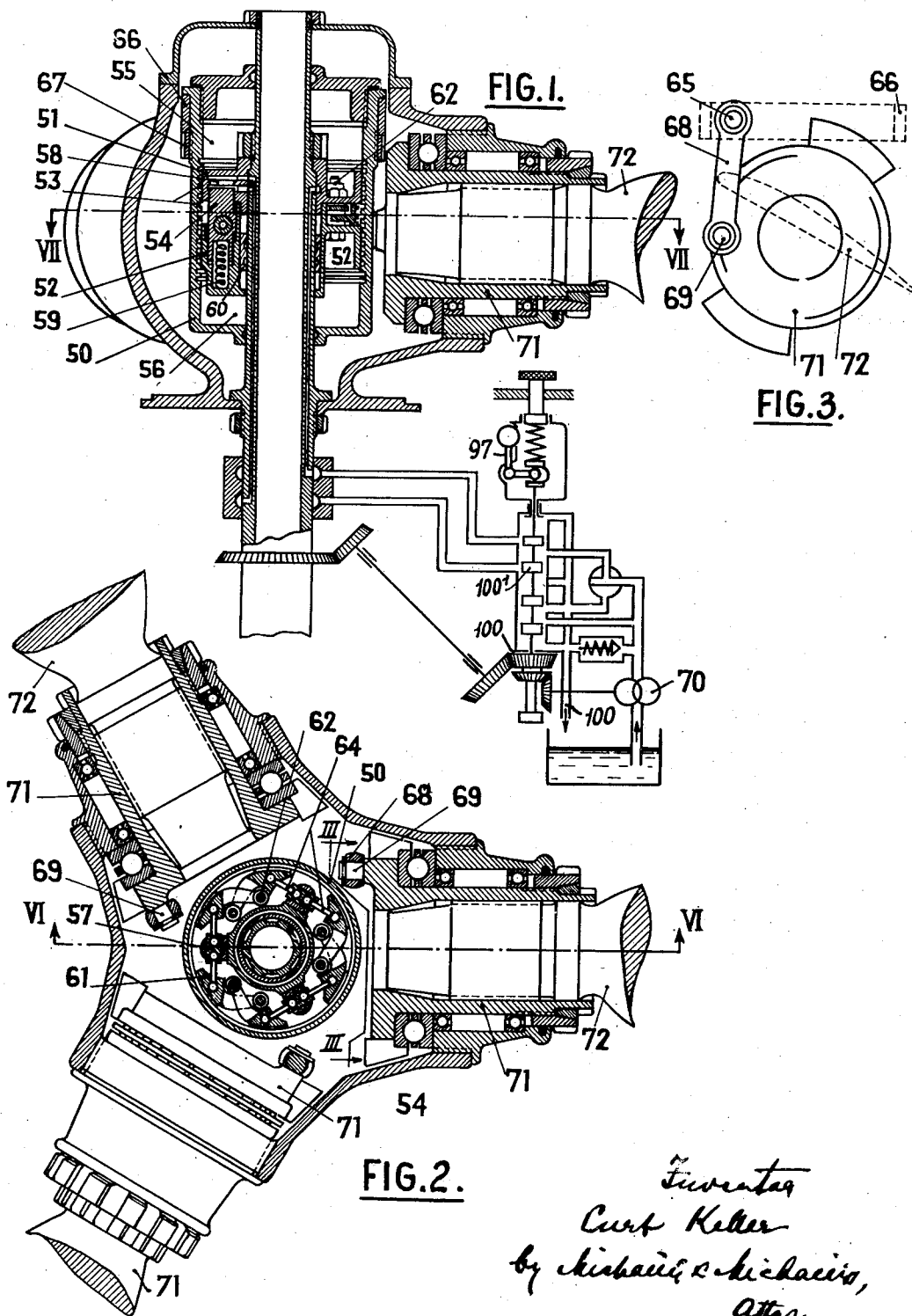
C. KELLER

2,282,297

CONTROLLABLE PITCH PROPELLER

Filed March 30, 1938

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FIG. 4.

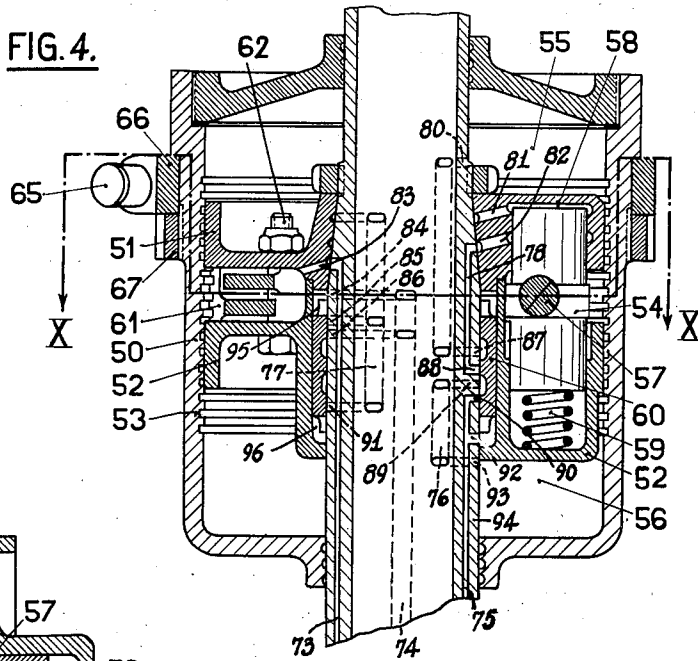


FIG. 6.

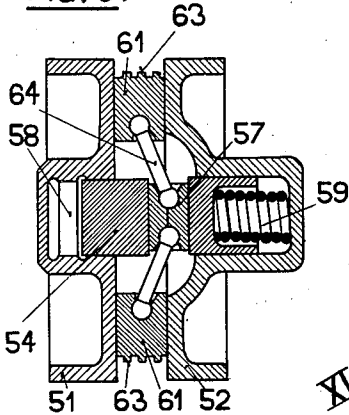
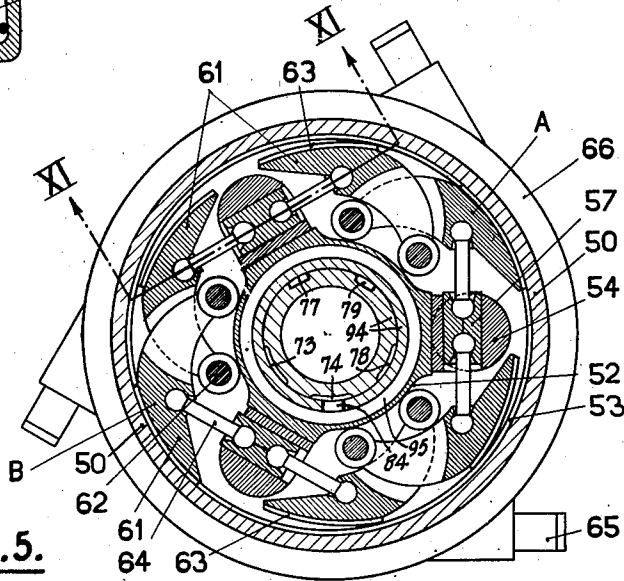


FIG. 5.



Inventor
Curt Keller
By Michaelis & Michaelis,
attys.

UNITED STATES PATENT OFFICE

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CONTROLLABLE PITCH PROPELLER

Curt Keller, Zurich, Switzerland, assignor to
Escher Wyss Maschinenfabriken Aktiengesell-
schaft, Zurich, Switzerland

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In Switzerland April 1, 1937

8 Claims. (Cl. 170-163)

My invention relates to controllable pitch propellers and more particularly to the hydraulic control of the propeller blades, especially of the kind formed with a central opening extending in the direction of the axis of rotation of the propeller.

It is one of the objects of my invention to provide blade controlling means which, whilst enabling the blades to be continuously adjusted within a large range of adjustment, automatically locks mechanically the blades whenever the fluid pressure required for adjustment should fail, whereupon the propeller can continue to work like one with fixed blades.

In order that this object be attained, controlling mechanism according to the present invention comprises, in addition to the blade adjusting means proper, auxiliary means held by the liquid, which operates the adjusting means, against the action of an auxiliary force in a position from which they move automatically into the position wherein they lock mechanically the adjusting means as soon as the pressure of the liquid falls below a fixed minimum value.

In the drawings affixed to this specification and forming part thereof an embodiment of my invention is illustrated diagrammatically by way of example.

In the drawings

Fig. 1 is a section on the line I—I in Fig. 2,

Fig. 2 being a section on the line II—II, and

Fig. 3 a section on the line III—III in Fig. 1, while Figs. 4 to 6 illustrate this embodiment on a larger scale.

Fig. 4 being an axial longitudinal section through a portion of the propeller.

Fig. 5 is a section on the line X—X of Fig. 4, and

Fig. 6 is a section on the line XI—XI of Fig. 5.

Referring to the drawings 50 is a movable cylinder. The fixed piston, relatively to which the cylinder 50 can be displaced, consists of two parts 51, 52. The axial movement of the cylinder 50 is brought about by supplying a liquid under pressure from a source 70 to one or the other of two chambers 55, 56 formed by the cylinder 50 and the piston 51, 52. The cylinder 50 is formed on the inside with circular grooves 53. The means for locking the cylinder 50 comprise three auxiliary pistons 54 mounted displaceably within the piston 51, 52, each piston 54 defining, together with the piston part 51, a space 58 supplied with liquid under pressure from the source 70 to which can also be connected the two spaces 55, 56 above and below the piston 55

51, 52. When liquid under pressure is supplied to the space 58, the corresponding auxiliary piston 54 is moved against the action of a spring 59 into one of its two end positions. 60 (Fig. 5) is an auxiliary distributing valve controlling the supply and exhaust of liquid under pressure to the chambers 58.

On each side of each auxiliary piston 54 is arranged a pawl 61, which is displaceable between the piston parts 51, 52. The pawls 61 are formed with teeth 63 (Fig. 5) the cross-section of which corresponds to that of the circular grooves 53 of the cylinder 50. Each pawl 61 is pivoted to a pin 62 (Figs. 2, 4 and 5), the pins 62 being fixed inside the piston parts 51, 52, and is connected through a link 64 to a movable cross-head 57 adapted to be displaced transversely within the correlated auxiliary piston 54. The teeth 63 of the different pawls 61 are displaced, in respect to one another, in such a manner, in the direction of the axis of the cylinder 50, that only two diametrically opposite pawls 61 can engage at the same time in the grooves 53 of the cylinder 50.

The axial displacement of the cylinder 50 is transmitted by pins 65 (Figs. 4 and 5) mounted on a ring 66 to connecting rods 68 for adjusting the blades 72, each of which is mounted in a socket 71 bearing a pin 69 which is connected by means of the rod 68 with a pin 65 on ring 66. Ring 66 is fixed to cylinder 50 by means of a nut 67. Here also cylinder 50 is prevented, by means arranged on the hub (not shown), from rotating.

The device operates as follows: In Fig. 4 the auxiliary distributing valve 60 is shown in its middle position. If it be assumed that liquid under pressure shall be fed to the chamber 55 of the adjusting cylinder 50, in which case the control valve 100¹ (Fig. 1) of the control device 100 has been so adjusted by the centrifugal governor 97 that liquid can enter the conduit 74 (Figs. 4 and 5) of the hollow shaft 94, the liquid will flow through an aperture 84 in the hollow shaft 94 into the annular space 95 (Fig. 4) in front of the control valve 60 which is freely displaceable. The valve 60 is now shifted into its rear end position, in which the aperture is connected through the annular space 95 with another aperture 85 in the hollow shaft 94, which leads to a conduit 77 extending in the longitudinal direction of the shaft and communicating through a conduit 81 in the piston 51 with the space 58. The auxiliary pistons 54 are therefore shifted, counter to the action of the springs 59, to the rear, whereby the teeth 63 of all pawls 61 are disengaged from the notches 53 of the main cylinder 50. Each auxil-

lary cylinder 54 now uncovers a conduit 82 in the piston 51, which conduit communicates with a conduit 78, leading to an aperture 88 in the hollow shaft 94. In the rear end position of the control valve 60 the aperture 88 is connected through an annular groove in the valve 60 with an aperture 87 of the hollow shaft 94, which aperture is further connected through the longitudinal conduit 79 and an aperture 80 with the chamber 55 of the main adjusting cylinder 50. The liquid under pressure which enters the chamber 55, now shifts the cylinder 50 forwards and thereby causes the blades 72 of the propeller to be adjusted by means of the parts 69, 68, 65, 66. During this movement of the adjusting cylinder 50 the chamber 56 must be enabled to discharge liquid; this can be done through an aperture 93 in the hollow shaft 94, a conduit 76 and an aperture 89, which now communicates by way of an annular groove 89¹ of the control valve 60 and an aperture 90 with the conduit 75 extending longitudinally of the shaft 94. This conduit 75 is connected at this moment with the exhaust pipe 100² (Fig. 1) by the control valve 100¹ of the control device 100.

If the propeller blades 72 shall be adjusted in the opposite direction, the valve 100¹ of the control device 100 is shifted by the centrifugal governor 97 into a position in which liquid under pressure may enter the conduit 75 in the hollow shaft 94. Through an aperture 92 in the shaft communicating with conduit 75 liquid now enters the annular space 56 (Fig. 4) to the rear of the valve 60, whereby this latter is now shifted into its forward end position. Liquid under pressure may now flow from the annular space 96 through the aperture 91 into the longitudinal conduit 77 of shaft 94 and from this conduit through conduit 81 of piston 51 into the space 58 between the auxiliary piston 54 and piston 51. In the meantime the valve 60 has covered the apertures 85 and 90. The piston 54 is now caused to move to the rear counter to the action of the springs 59, whereby the teeth 63 of the locking members 61 are disengaged from the notches 53 of cylinder 50. The conduit 82 in the piston 51 is now uncovered by the piston 54, so that liquid under pressure can also enter the chamber 56 through conduits 82 and 78, apertures 88, 89, conduit 76 and aperture 83. At the same time the chamber 55 is connected by way of the aperture 80, conduit 79, apertures 87, 86 and conduit 74 with the exhaust 100² of the control device 100. The adjusting cylinder 50 is now free to move towards the rear and to thereby adjust the propeller blades to the desired position.

In Fig. 5 the pawls A and B are shown in the position in which they engage in the grooves 53 whilst the other four pawls 61 are shown in the position in which they rest on the projecting parts of the grooves 53, without however engaging the latter. In this manner it is possible to lock the cylinder 50 in a position which very accurately corresponds to that required; consequently, it is also possible to accurately hold the blades of the propeller accurately in a predetermined position. Two diametrically opposed pawls 61 are caused to engage in the grooves 53 of the cylinder 50 as soon as the pressure exerted by the liquid supplied to the spaces 58 correlated to said pawls is lower than the pressure exerted by the spring 59 on the piston 54. The two pawls 61 caused to engage in the cylinder 50, then prevent any further axial displacement of

the latter, whereby the means (not shown) for displacing the propeller blades are locked also.

The adjusting mechanisms above described are particularly suited for aeroplane propellers with a central opening extending in the direction of the propeller axis. The blade adjusting means may be locked in any desired position within the whole range of adjustment of the blades.

I wish it to be understood that I do not desire to be limited to the exact details of construction shown and described for obvious modifications will occur to a person skilled in the art.

I claim:

1. Controllable pitch propeller comprising in combination, a hub, a plurality of blades arranged on said hub for adjustment about their longitudinal axes, means displaceable by the action of a hydraulic pressure medium and comprising a piston arranged coaxially to said hub and a cylinder axially displaceable relative to said piston for adjusting said blades, and means acted upon by the same hydraulic pressure medium and adapted to instantly lock mechanically said cylinder and through it also the blades in their actual positions, whenever and as long as the hydraulic pressure drops, and remains, below a predetermined value, said locking means controlling moreover the admission of the hydraulic pressure medium to one or the other of two chambers in the cylinder on opposite sides of said piston in such a way that a supply of pressure medium can only occur after said mechanical locking means have released the cylinder.

2. Controllable pitch propeller comprising in combination, a hub, a plurality of blades arranged on said hub for adjustment about their longitudinal axes, means displaceable by the action of a hydraulic pressure medium comprising a piston arranged coaxially to said hub and a cylinder axially displaceable relative to said piston for adjusting said blades, means acted upon by the same hydraulic pressure medium and adapted to instantly lock mechanically said cylinder and thereby also said blades in their actual positions, whenever, and as long as, the hydraulic pressure drops, and remains, below a predetermined value, and means for preventing angular movement of said axially displaceable cylinder relative to said hub, said locking means controlling moreover the admission of the hydraulic pressure medium to either one of two chambers in the cylinder on both sides of said piston in such a way that a supply of pressure medium can only occur after said mechanical locking means have released the cylinder.

3. Controllable pitch propeller comprising in combination, a hub, a plurality of blades arranged on said hub for adjustment about their longitudinal axes, means displaceable by the action of a hydraulic pressure medium comprising a piston arranged coaxially to said hub and a cylinder axially displaceable relative to said piston for adjusting said blades, other displaceable means adapted to be acted upon by the same hydraulic pressure medium, locking members operatively connected to said other displaceable means and located within said displaceable cylinder, and means on said cylinder enabling said locking members to instantly lock mechanically said cylinder in its actual position whenever, and as long as, the hydraulic pressure drops and remains below a predetermined value, said other displaceable means controlling the admission of the hydraulic pressure medium to one or the

other of two chambers in the cylinder on both sides of said piston in such a way that a supply of pressure medium can only occur after said mechanical locking members have released the cylinder.

4. Controllable pitch propeller comprising in combination, a hub, a plurality of blades arranged on said hub for adjustment about their longitudinal axes, means displaceable by the action of a hydraulic pressure medium comprising a piston arranged coaxially to said hub and a cylinder axially displaceable relative to said piston for adjusting said blades, auxiliary pistons displaceable within said cylinder and adapted to be acted upon by the same hydraulic pressure as the cylinder, locking members operatively connected to said auxiliary pistons and located within said displaceable cylinder, and means on said cylinder enabling said locking members to instantly lock mechanically said cylinder in its actual position whenever, and as long as, the hydraulic pressure drops, and remains, below a predetermined value, said auxiliary pistons controlling the admission of the hydraulic pressure medium to one or the other of two chambers in the cylinder on both sides of said piston in such a way that a supply of pressure medium can only occur after said mechanical locking members have released the cylinder.

5. Controllable pitch propeller comprising in combination, a hub, a plurality of blades arranged on said hub for adjustment about their longitudinal axes, means displaceable by the action of a hydraulic pressure medium and comprising a piston arranged coaxially to said hub and a cylinder axially displaceable relative to said piston for adjusting said blades, other displaceable means adapted to be acted upon by the same hydraulic pressure medium, and toothed pawls operatively connected to said other displaceable means and located within said displaceable cylinder, which cylinder is formed with grooves on its inner circumference serving to cooperate with said toothed pawls to instantly lock said cylinder in its actual position whenever the hydraulic pressure drops below a predetermined value.

6. Controllable pitch propeller comprising in combination, a hub, a plurality of blades arranged on said hub for adjustment about their longitudinal axes, means displaceable by the action of a hydraulic pressure medium and comprising a piston arranged coaxially to said hub and a cylinder axially displaceable relative to said piston for adjusting said blades, other displaceable means adapted to be acted upon by the same hydraulic pressure medium, and toothed pawls operatively connected to said other displaceable means, said

pawls being located within said displaceable cylinder, which cylinder is formed with grooves on its inner circumference, the teeth on one of said pawls being so staggered relative to the teeth on another pawl in the direction of the axis of said cylinder that only the teeth on diametrically opposite pawls can engage in the grooves of the cylinder to instantly lock said cylinder in its actual position whenever the hydraulic pressure drops below a predetermined value.

7. Controllable pitch propeller comprising in combination, a hub, a plurality of blades arranged on said hub for adjustment about their longitudinal axes, means displaceable by the action of a hydraulic pressure medium and comprising a piston arranged coaxially to said hub and a cylinder axially displaceable relative to said piston for adjusting said blades, auxiliary pistons movably arranged within said displaceable cylinder and adapted to be acted upon by the same hydraulic pressure medium, springs acting on the auxiliary pistons in a direction opposite to that of the hydraulic pressure medium, a cross-head in connection with each auxiliary piston and movable transversely therein, locking members operatively connected to said cross-heads and located within said displaceable cylinder, and means on said cylinder enabling said locking members to instantly lock said cylinder in its actual position whenever the spring pressure acting on the auxiliary pistons is greater than the prevailing hydraulic pressure, said auxiliary pistons controlling the admission of the hydraulic pressure medium to the one or the other of two chambers in the displaceable cylinder on both sides of said piston in such a way that a supply of medium can only occur after that said locking members have released the cylinder.

8. Controllable pitch propeller comprising in combination, a hub, a plurality of blades arranged on said hub for adjustment about their longitudinal axes, means displaceable by the action of a hydraulic pressure medium and comprising a piston arranged coaxially to said hub and a cylinder axially displaceable relative to said piston for adjusting said blades, a number of auxiliary means adapted to be acted upon in succession by the same hydraulic pressure medium, locking members located within said displaceable cylinder and operatively connected to said auxiliary means by which they can be successively disengaged and means on said cylinder enabling said locking members to instantly lock said cylinder in its actual position whenever the hydraulic pressure drops below a predetermined value.

CURT KELLER.