March 25, 1941. A. RUPP 2,236,201

SCREW PROPELLER

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Fig. 1

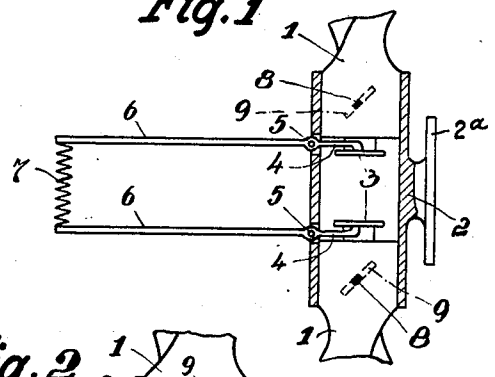


Fig. 2

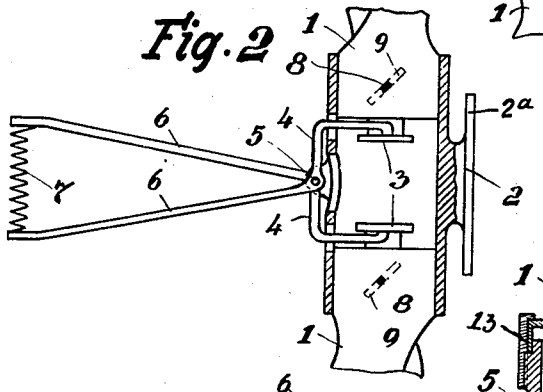
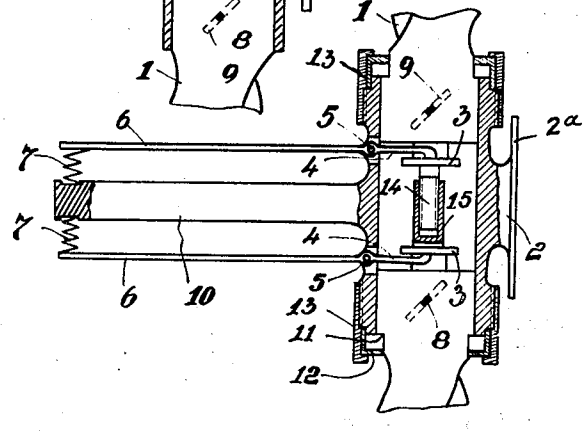


Fig. 3



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Fig. 4

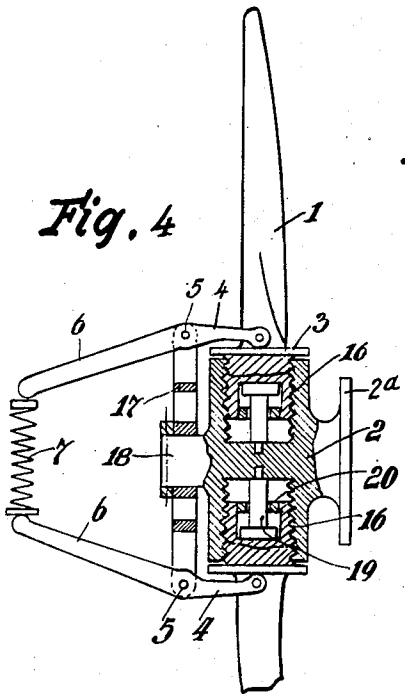


Fig. 5

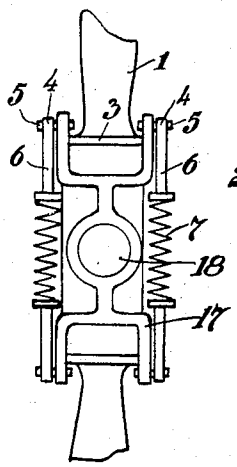


Fig. 6

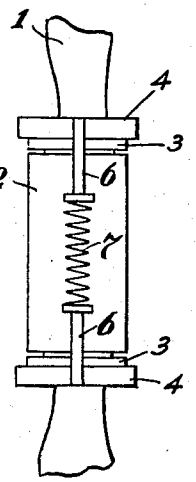


Fig. 8

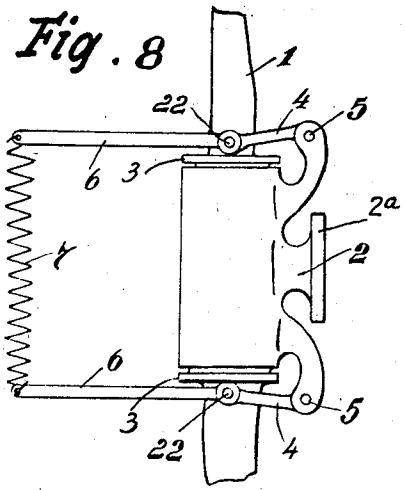
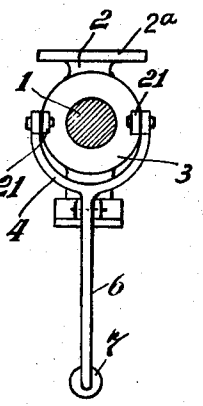


Fig. 7



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Fig. 9

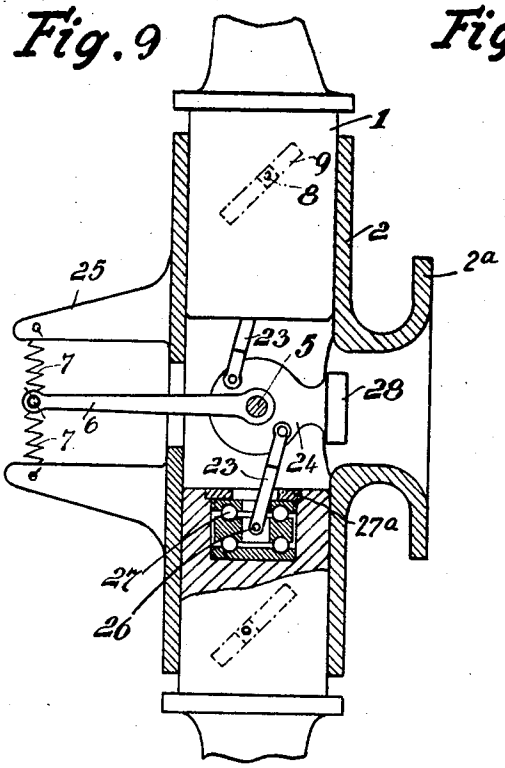


Fig. 10

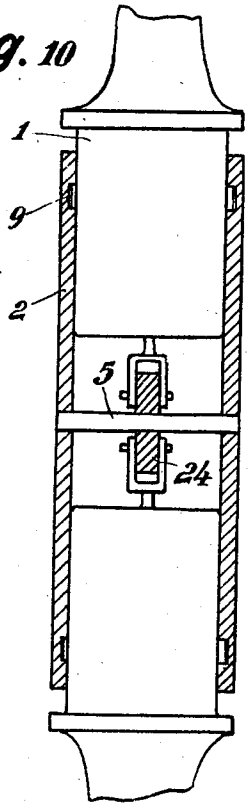


Fig. 11

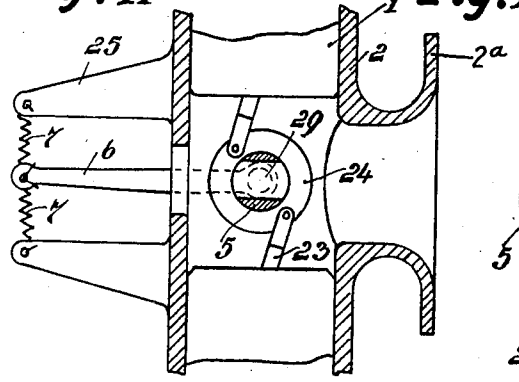
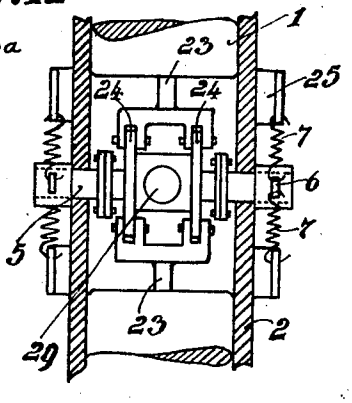


Fig. 12



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UNITED STATES PATENT OFFICE

2,236,201

SCREW PROPELLER

Albert Rupp, Berlin-Sudende, Germany

Application October 3, 1938, Serial No. 233,100
In Germany September 17, 1937

7 Claims. (Cl. 170—162)

The invention relates to screw propellers, intended especially for aircraft, in which the blades are mounted on the hub so as to be centrifugally adjustable in diameter and in which means is provided to automatically effect pitch adjustment of the blades when diametral adjustment is effected. By these adjustments an approximately constant rotational speed of the motor may be maintained at different flying heights of the aircraft.

It is an object of the present invention to ensure an accurate, positive and uniform adjustment of all blades.

Several examples of the invention are illustrated in the drawings:

Figs. 1 to 4 show sectional side elevations of four different embodiments, the section in each case being taken through the hub;

Figs. 5 and 6 show front elevations of two further embodiments;

Fig. 7 is a plan of Fig. 6, the blade being in section;

Fig. 8 is a lateral elevation of Fig. 7;

Figs. 9 and 10 show side and front sectional elevations respectively of a further embodiment;

Figs. 11 and 12 show views similar to Figs. 9 and 10 of a further embodiment.

In the embodiment shown in Fig. 1, the blades 1 are mounted in the hub 2 so as to be radially movable and at the same time turnable about their own axes. The propeller hub 2 has substantially the form of a simple radial tube which is or may be connected by a flange 2a to the engine shaft (not shown). The roots 3 of the blades are provided with recesses in which engage arms 4 of two-armed levers 4. These levers are fulcrumed each at a fixed location on the hub 2, being provided with pivots at the parts 5. By virtue of these levers, co-operation of all parts of the device is obtained and accurate and positive operation ensured. The two-armed levers 4 are also connected at the ends of their longer arms 6 by a spring 7. On rotation of the propeller the blades tend, under the action of centrifugal force to move radially out of the hub 2. However, by means of the levers, which are engaged by the spring 7 through the intermediary of their arms 6, the blades 1 are urged in a diameter-reducing direction and can only be moved radially outwards by a force the magnitude of which is dependent upon the magnitude of the diameter-reducing force exerted by the spring 7. To give pitch adjustment of the blades simultaneously with the diametral adjustment, a pitch-varying connection is provided between the blades and the hub, the connection being constituted as keys 8 fixed on the hub 2 and of screw grooves 9 on the blades 1.

Fig. 2 shows a construction similar to Fig. 1, having the blades 1, hub 2, flange 2a, blade roots 3, lever arms 4, spring 7, lever arms 6, keys 8 and grooves 9. In this embodiment however the levers are scissor-shaped so that there is only a single fulcrum 5 for the levers. The mode of operation of this construction is the same as in the construction according to Fig. 1 except only that the spring is tensioned whereas in the construction according to Fig. 1 it is compressed.

Fig. 3 shows a modification which also corresponds in its essentials with Fig. 1. The lever arms 6 however are not in this case connected together by a spring, but a number of springs 7 are employed according to the number of blades in the propeller. These springs are anchored to a central abutment 10 on the hub 2. In this modification, also, the hub 2 and the blades 1 display features which prevent the blades from falling out if a spring breaks. These safety features consist in this case of a shoulder 11 on each blade which co-operates with a flange 12, engaging therewith on moving outwardly, the flange 12 being secured to the hub 2 by a screw cap 13. As a further safeguard against unequal adjustment of the blades on breaking of a spring, one blade is provided with an extension 14 which is constructed as a bolt and the opposite blade has an extension 15 which is constructed as a nut or socket to fit the bolt 14.

Fig. 4 shows a construction in which the pitch-adjustment movement of the blades is obtained by centrifugal force through the intermediary of screw threads 16. The fulcrums 5 of the levers with their arms 4 and 6 in this case are not provided directly on the hub 2, but on a bracket 17 which is detachably mounted on a nose 18 on the hub 2, being held thereon by a fastener element as shown. The roots of the blades 1 lie outside of the hub 2 and the shorter lever arms 4 press on the outer surfaces of the roots 2. A pressure spring 7 is also inserted between the longer lever arms 6.

Fig. 5 illustrates a construction corresponding essentially to Fig. 4 in which the levers with their arms 4 and 6 are not centrally disposed but two levers and two springs are provided for each blade and the bracket 17 has an appropriate forked construction.

Figs. 6 and 7 show a further construction corresponding to Fig. 4 in which the levers with their arms 4 and 6 have a central disposition on the

hub. Fig. 7 shows the levers to have a yoke shape, each yoke embracing the respective blade 1. As this yoke must slide upon the upper side of the root 3 on movement of the blade, rollers 21 are provided at the end of the yoke to lessen friction.

In the constructions according to Figs. 4 to 6 the blades are held from falling out, on breaking of the springs 7, by bolts 19 which are secured in the transverse part of the hub 2 and by a plate 20 which is provided on each blade 1.

Fig. 8 shows a construction in which the fulcrums 5 for the levers with their arms 4 and 6 are arranged on a bracket on the driven side of the hub 2, this side being distinguished by a coupling element or flange 2a for connecting the propeller to the driving motor. The levers bear through the intermediary of rollers 22 on the roots 3 of the blades 1.

In Figs. 9 and 10 the blades 1 are again attached to the hub 2 so as to be turnably and radially movable. By centrifugal force the blades move outwardly and by means 8 and 9 which have already been described are caused to turn about the longitudinal axis of the blades. Unrestricted movement of the blades is prevented by means of compression and tension springs. These springs are conventional. They have a certain length when in a state of rest, and when they are compressed, they generate a counter pressure. When they are drawn upon or pulled, they generate a traction force. A connecting rod 23 is linked at one end to the blade 1 and at its other end to a crank disc 24. The crank disc 24 is turnably mounted on a pivot 5 which is fixed in the hub 2. An arm 6 is connected to the crank disc 24 so as to be turnable with it. At the outer end of the arm 6 springs 7 or other similar means are provided, the springs in turn being connected to brackets 25 on the hub. The link 23 is turnable about a pivot 26 in the blade 1 secured to the middle running ring of a ball bearing 27. The ball bearing 27 is secured by a disc 27a in a hollow of the base of the wing 1. The crank disc 24 has a counterweight 28. On outward movement of the blade 1 due to centrifugal force the crank disc 24 is turned and as the arm 6 is secured to the crank disc this arm is also pivoted about the axis 5. By means of the springs 7 at the end of the lever, which springs may be compression and tension springs or only compression or only tension springs and which provide a counter force to the centrifugal force on the propeller blades, the propeller blades are held in the most favorable position according to the speed of rotation.

In Figs. 11 and 12 a construction similar to that of Figs. 9 and 10 is illustrated. The wings are here again designated by 1, the propeller hub by 2, and the flange for connecting the hub with the engine shaft by 2a. The pivot pin 5 is enlarged so that a bore 29 may be provided parallel to the hub's axis. The crank disc member 24 is double-sided and forked extensions of the links 23 embrace the crank discs, as shown. In this construction two arms 6 are provided on projecting ends of the pivot pin 5, the arms being connected out with the hub 2 to brackets 25 on the hub by means of spring 7. The links are attached in the bases of the wings as shown in Fig. 9.

In the constructions according to Figs. 9 and 11 the crank disc in each case is disposed within a cavity in the hub.

All the examples according to Figs. 1 to 12 show that the hub 2 is a simple tubular member which extends radially, and that a tube opening is provided for each propeller wing 1. Inasmuch as, according to the invention, the long lever arm 6 with the springs 7 are outside of this tube, the latter is not weakened by the lever arm 6 and the springs 7, and the tube can be small, light and strong, so that it can transmit the rotary movement from the engine shaft to the propeller wings reliably and efficiently. On the other hand, the lever arms 6 may be made of any desired length, whereby the springs may be light.

I claim:

1. In a screw propeller comprising a hub with a driven side, and a plurality of blades radiating from the hub and in which, to give automatic adjustment of the diameter of the blades by centrifugal force with simultaneous adjustment of the pitch of the blades, each blade is supported in the hub so as to be radially movable and turnable about the blade's axis and a pitch-varying connection is provided between the blades and the hub; flanges on the blade roots, two lever devices non-rotatable with respect to the hub, pivots on the hub for the lever devices, resilient means loading the lever devices, each lever having an arm with a movement transmitting part pressing radially inwards on the flange of the respective blade and an arm engaged by the resilient means, said latter arm being disposed to the side remote from the driven side of the hub.

2. In a screw propeller comprising a hub with a driven side, and a plurality of blades radiating from the hub and in which, to give automatic adjustment of the diameter of the blades by centrifugal force with simultaneous adjustment of the pitch of the blades, each blade is supported in the hub so as to be radially movable and turnable about the blade's axis and a pitch-varying connection is provided between the blades and the hub; a lever device comprising levers, one for each blade, pivots at fixed locations on the hub at the driven side thereof for the respective levers, and resilient means loading the levers, each of the levers having an arm pressing radially inwards on the respective propeller blade and an arm engaged by the resilient means both of which arms are on the side of the pivot remote from the driven side of the hub.

3. In a screw propeller comprising a hub formed with a central cavity and a plurality of blades radiating from the hub so as to be centrifugally adjustable in diameter, means being provided to automatically effect pitch adjustment of the blades when diametral adjustment thereof is effected: in combination with a lever device comprising two arms, a pivot for the lever at a fixed location in the hub, the pivot being disposed in the cavity transversely of the hub's axis, an operative connection between the lever device and each of the respective blades, said connection being adapted to transmit diameter-reducing force to the blades, and resilient means urging the lever device to hold the blade in a limited position of diametral adjustment, the arm of said lever, which is loaded by said resilient means, projecting from said pivot to the side of the hub remote from the driven side of such hub.

4. A construction as defined in claim 1, wherein the arm projecting from said pivot is longer than the arm pressing on the blade.

5. A construction as defined in claim 1, wherein the hub is substantially a radially extending

tube having a flange for connecting the tube to the engine shaft.

6. A construction as defined in claim 1, wherein the flange on the blade root is provided on the inner wall of a hollow on the underside of the root and the lever arm pressing radially inwards on said flange is connected to the flange by means of a link.

7. A construction as defined in claim 1, wherein the pivot of the lever device is disposed in the hub cavity transversely of the hub's axis and is formed with a bore in alignment with the hub's axis.

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