

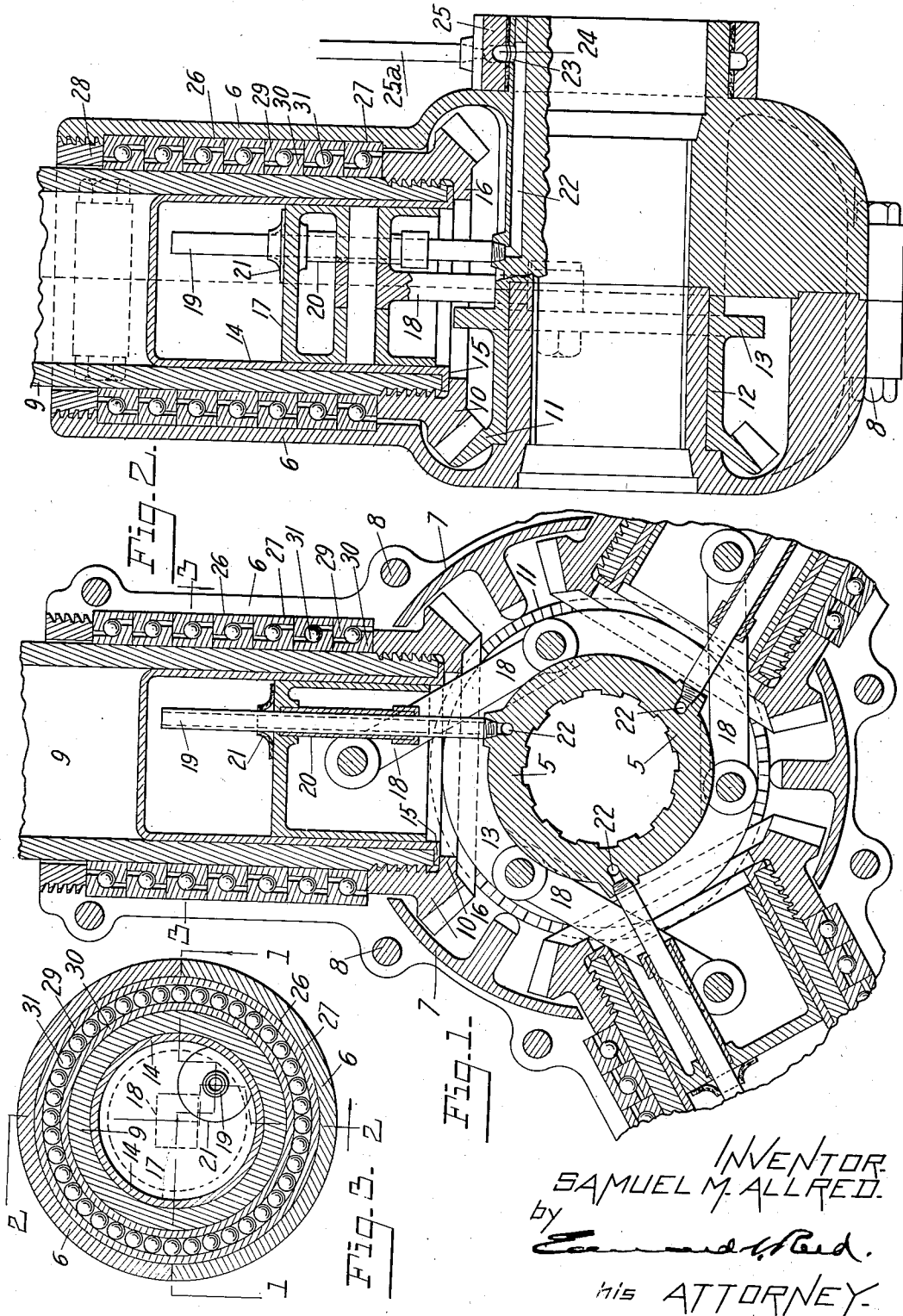
April 5, 1938.

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2,113,438

VARIABLE PITCH PROPELLER FOR AIRPLANES OR THE LIKE

Filed July 8, 1935



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2,113,438

VARIABLE PITCH PROPELLER FOR AIR-PLANES OR THE LIKE

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Application July 8, 1935, Serial No. 30,221

18 Claims. (Cl. 170-163)

This invention relates to a variable pitch propeller for airplanes or the like and more particularly to such a propeller in which the pitch angle of the blades is controlled by fluid operated mechanism. It has been proposed heretofore to provide hydraulically controlled blades in a propeller but in these propellers the hydraulic mechanism has, for the most part at least, been mounted exteriorly of the propeller hub and was of a more or less complicated character. As a result it offered an increased air resistance, interfered with the proper balancing of the propeller and was subject to injury by impact and vibration.

One object of the invention is to provide a propeller in which the pitch angle of the blades will be controlled by fluid operated mechanism located wholly within the propeller hub.

A further object of the invention is to provide such a propeller in which the fluid operated mechanism will be of such a character and so arranged that it will not interfere with the proper balancing of the propeller.

A further object of the invention is to provide such a propeller in which the pitch angle of the several blades will at all times be the same and in which the blades will be rotated to change the pitch angle simultaneously and to the same extent.

A further object of the invention is to provide such a propeller in which the blades may be adjusted through a relatively wide angle.

A further object of the invention is to provide such a propeller which will be simple in its construction and of a strong durable character.

A further object of the invention is to provide such a propeller with blade bearings of a character which will withstand the severe longitudinal and transverse strains to which they are subjected.

Other objects of the invention may appear as the structure is described in detail.

In the accompanying drawing Fig. 1 is a transverse section taken through the propeller hub on the line 1-1 of Fig. 3 and partially broken away; Fig. 2 is a longitudinal section taken through the propeller hub on the line 2-2 of Fig. 3, and partly broken away; and Fig. 3 is a transverse section taken on the line 3-3 of Fig. 1.

In the drawing I have illustrated one embodiment of my invention and have shown the same as applied to a three blade propeller but it will be understood that this particular embodiment has been chosen for the purposes of illustration only, that the mechanism may take various forms

and may be embodied in propellers of various kinds.

In the particular construction here illustrated the propeller comprises a hub having a tubular inner portion 5 adapted to receive the driving shaft, and a plurality, in the present instance three, blade sockets 6 which are carried by and project radially from a housing 7 arranged about the tubular member 5 of the hub and spaced from the intermediate portion thereof. The hub is preferably divided transversely to its axis, as shown in Fig. 2, to facilitate the assembly thereof and the two parts are rigidly connected one to the other, as by bolts 8. The propeller blades are mounted in the respective sockets 6 for rotatory movement therein, the shanks only of the blades being shown at 9.

The several blades are connected one to the other to cause the same to rotate in unison and to maintain the same at the same pitch angle and suitable fluid operated mechanism is mounted within the hub and connected with the blades to control the rotatory movement thereof, this fluid operating mechanism being preferably connected with the means which connects the blades one to the other.

As here shown, the shank of each blade has secured thereto a beveled pinion 10, the hub of which is, in the present instance, screw threaded onto the inner end of the shank. Each pinion 10 meshes with a beveled gear 11 rotatably mounted about a portion of the tubular member 5 of the hub and having an elongated bearing 12 provided near its inner end with a circumferential flange 13. The fluid operated mechanism may take various forms but preferably comprises a plurality of substantially radial cylinders projecting from the housing 7 of the hub. Preferably these cylinders correspond in number to the blade sockets and are arranged within the respective sockets. In the construction shown, the blade shanks 9 are tubular and cylinders 14 are fitted snugly within the respective tubular shanks, and rigidly secured therein, as by flanges 15 clamped between the inner ends of the blade shanks and shoulders 16 on the pinions 10. The outer end of each cylinder is closed and mounted in each cylinder is a piston 17 which is connected with one or more of the blades. Preferably each piston is connected with all the blades and this may conveniently be accomplished by connecting the same with the flange 13 of the gear 11 by means of connecting rods 18. The connections are of such a character that all the pistons will act upon the gear 11 and, through this gear and the pinions

10, on the several rotatable blades. Fluid under pressure, such as oil, may be supplied to the outer portions of the cylinders, beyond the pistons, in any suitable manner, and, in the present instance, conduits, such as rigid pipes 19, extend through the respective pistons into the outer portions of the cylinders and are connected at their inner ends with the tubular member 5 of the hub. Each piston is slidably mounted on its conduit 19 and means are provided for preventing the leakage of the fluid through the piston about the pipe, such as the sleeve 20 and packing 21. The tubular member 5 of the hub is provided with longitudinally extending passageways 22, each of which communicates with the inner end of one of the conduits 19. These passageways 22 extend beyond the rear side of the housing and are provided with ports 23 by means of which they communicate with an annular channel 24 in a stationary collar 25 mounted about the inner portion of the tubular member 5 of the hub. The collar 25 fits snugly about the end of the tubular member 5 so as to prevent the escape of fluid from the channel 24 and if it is desired suitable packing may be interposed between the stationary and movable parts. A supply pipe 25a leads from the annular channel 24 to a suitable source of fluid under pressure, preferably an oil pump, the operation of which is under the control of the pilot in any suitable or well known manner. Inasmuch as the pump constitutes no part of the present invention and the fluid may be delivered to the apparatus from any suitable source of supply the pump is not illustrated.

The blade sockets 6 are of an internal diameter somewhat greater than the external diameter of the blade shanks and a suitable bearing 26 is interposed between each shank and its socket. This bearing is subjected to very severe strains both longitudinally of the blade and transversely or radially thereto and in order that it may withstand these strains and provide a free running bearing for the blade I prefer to construct it of a series of separate ball bearing units 27 superposed one upon the other, the innermost unit being supported by the end of the hub of the pinion 10 and the outermost unit contacting with a suitable stop device, such as an internal collar 28, in the outer end of the blade socket. In this manner the bearing also serves to lock the blade in the socket. Each bearing unit comprises two separate parts each of which is provided with a ball race, as shown at 29 and 30, and these ball races are arranged in a line oblique to the axis of the blade. The ball races are so shaped as to provide opposed contact surfaces arranged in a line extending lengthwise of the blade and other opposed contact surfaces arranged in a line extending transversely to the blade, whereby the balls 31, mounted in the races, strongly resist either transverse or longitudinal thrusts of the blade. In the construction shown each ball race has a contact surface extending transversely to the race through an arc of approximately ninety degrees and on such a radius that the balls will contact with substantially the entire area of that surface, but, if desired, the intermediate circumferential portion of the surface may be cut away or relieved to reduce friction. By this arrangement of superposed bearing units the stresses are divided and each bearing unit receives only its proportional share of the total load imposed upon the bearing as a whole.

When the propeller is in operation centrifugal force will tend to move the pistons outwardly and

thus, through the connecting rods 18, gear 11 and pinions 10, rotate the blades in a direction to increase the pitch thereof. This outward movement of the pistons is, however, resisted by the fluid in the outer portion of the cylinder and the amount of this fluid and hence the amount of movement imparted to the pistons may be controlled by the pilot. When the pitch of the blades is to be decreased fluid under pressure is admitted to the cylinders to move the pistons inwardly and thereby rotate the blades about their axes in a direction to decrease the pitch thereof. In this manner the fluid operated device controls the movement of the blades in both directions. It will be obvious, however, that by reversing the connections the movement of the piston by centrifugal force could be caused to decrease the pitch of the blades and the fluid pressure utilized to increase the pitch of the blades. The character of the mechanism permits of a relatively long movement of the connecting rods which, in the present arrangement, is sufficient to move the gear 11 through an arc of approximately ninety degrees, thereby providing a wide range of adjustment for the blades.

While I have shown and described one embodiment of my invention I wish it to be understood that I do not desire to be limited to the details thereof as various modifications may occur to a person skilled in the art.

Having now fully described my invention, what I claim as new and desire to secure by Letters Patent, is:

1. In a variable pitch propeller comprising a hub having means for connecting the same with a shaft and having a plurality of blade sockets, and blades having shanks rotatably mounted in the respective sockets and held against radial movement therein, fluid operated mechanism mounted within said hub and comprising a radially movable member controlled in part by centrifugal force, means for operatively connecting said movable member with all of said blades to impart rotary movement thereto and for causing said blades to rotate in unison, and means for supplying fluid under pressure to said fluid operated mechanism to oppose the action of centrifugal force on said movable member.

2. In a variable pitch propeller comprising a hub having means for connecting the same with a shaft and having a plurality of blade sockets, and blades having shanks rotatably mounted in the respective sockets and held against radial movement therein, a device connecting said blades one with the other to cause them to rotate in unison, a separate fluid operated device associated with each socket and mounted in said hub, each fluid operated device having a radially movable member controlled in part by centrifugal force and operatively connected with said blade connecting device to cause the latter to impart simultaneous rotary movement to said blades, and means for supplying fluid under pressure to said fluid operated devices.

3. In a variable pitch propeller comprising a hub having means for connecting the same with a shaft and having a plurality of blade sockets, and blades having shanks rotatably mounted in the respective sockets and held against radial movement therein, means for rotating said blades including a device connected with all of said blades to cause them to rotate in unison, a plurality of substantially radial cylinders carried by said hub, pistons mounted for reciprocatory movement in said cylinders, means for operatively

connecting each of said pistons with said blade connecting device, and means for supplying fluid under pressure to said cylinders.

4. In a variable pitch propeller comprising a hub having means for connecting the same with a shaft and having a plurality of blade sockets, and blades having shanks rotatably mounted in the respective sockets and held against radial movement therein, means for rotating said blades including a piston mounted in one of said sockets for movement lengthwise thereof, a device connected with all of said blades to cause them to rotate in unison, means for operatively connecting said piston with said blade connecting device to control the rotation of said blades, and means for supplying fluid under pressure to the outer side of said piston.

5. In a variable pitch propeller comprising a hub having means for connecting the same with a shaft and having a plurality of blade sockets, and blades having shanks mounted in the respective sockets for rotatory movement therein, fluid operated means for rotating said blades including pistons mounted in the respective sockets for movement lengthwise thereof, a device rotatably mounted in said hub and connected with all of said blades to cause them to rotate in unison, means for operatively connecting each of said pistons with said rotatable device, and means for supplying fluid under pressure to the outer sides of said pistons.

6. In a variable pitch propeller comprising a hub having means for connecting the same with a shaft and having a plurality of blade sockets, and blades having shanks mounted in the respective sockets for rotatory movement therein, fluid operated means for rotating said blades including a cylinder in one of said sockets, a piston mounted in said cylinder for movement lengthwise thereof, a device connected with all of said blades to rotate the same in unison, means for connecting said piston with said device to actuate the same, a conduit extending through said piston to the outer side thereof, and means for connecting said conduit with a source of supply for fluid under pressure.

7. In a variable pitch propeller comprising a hub having means for connecting the same with a shaft and having a plurality of blade sockets, and blades having shanks mounted in the respective sockets for rotatory movement therein, fluid operated means for rotating said blades including a cylinder in one of said sockets, a piston mounted in said cylinder for movement lengthwise thereof, a device connected with all of said blades to rotate the same in unison, means for connecting said piston with said device to actuate the same, a conduit rigidly mounted in said hub and extending through said piston to the outer side thereof, said piston being slidable on said conduit, and means for connecting said conduit with a source of supply for fluid under pressure.

8. In a variable pitch propeller comprising a hub having means for connecting the same with a shaft and having a plurality of blade sockets, and blades having shanks mounted in the respective sockets for rotatory movement therein, fluid operated means for rotating said blades including cylinders in the respective sockets, pistons mounted in the respective cylinders for movement lengthwise of said sockets, a device rotatably mounted in said hub and connected with all of said blades to cause them to rotate in unison, means for connecting each of said pistons with said rotatable device, a conduit extending

through each piston to the outer portion of its cylinder, said piston being slidably mounted on said conduit and said hub having passageways connected with the respective conduits, and means for connecting said passageways with a source of supply for fluid under pressure.

9. In a variable pitch propeller comprising a hub having means for connecting the same with a shaft and having a plurality of blade sockets, and blades having shanks mounted in the respective sockets for rotatory movement therein, at least one of said shanks having a cylinder within the same, a piston mounted in said cylinder for movement lengthwise of said shank, means for connecting said piston with at least one of said blades to control the rotatory movement of the latter, and means for supplying fluid under pressure to said cylinder on the outer side of said piston.

10. In a variable pitch propeller comprising a hub having means for connecting the same with a shaft and having a plurality of blade sockets, and blades having shanks mounted in the respective sockets for rotatory movement therein, each of said shanks having a longitudinal cylinder within the same, pistons mounted for reciprocary movement in the respective cylinders, means for connecting said pistons with said blades to control the rotatory movement of the latter, and means for supplying fluid under pressure to said cylinders on the outer sides of said pistons.

11. In a variable pitch propeller comprising a hub having means for connecting the same with a shaft and having a plurality of blade sockets, and blades having shanks mounted in the respective sockets for rotatory movement therein, each of said shanks having a longitudinal cylinder within the same, pistons mounted for reciprocary movement in the respective cylinders, a device connected with all of said shanks to cause said blades to rotate in unison, means for connecting each piston with said device to control the rotation of said blades, and means for supplying fluid under pressure to said cylinders on the outer sides of said pistons.

12. In a variable pitch propeller, a hub having means for connecting it with a shaft and having a plurality of blade sockets, blades having tubular shanks mounted in the respective blade sockets for rotatory movement therein, a pinion secured to each blade shank, a gear rotatably mounted in said hub and meshing with each of said pinions, a cylinder in each tubular shank, a piston mounted for reciprocary movement in each cylinder, connecting rods operatively connecting the respective pistons with said gear, and means for supplying fluid under pressure to said cylinders.

13. In a variable pitch propeller, a hub having means for connecting it with a shaft and having a plurality of blade sockets, blades having tubular shanks mounted in the respective blade sockets for rotatory movement therein, a cylinder mounted in the shank of each blade, pistons mounted in said cylinders for movement lengthwise of the respective shanks, a device connected with said blades to cause them to rotate in unison, means for connecting each piston with said device to control the rotation of said blades, conduits carried by said hub and extending through said pistons to the outer portions of the respective cylinders, said hub having passageways connected with the respective conduits and extending to the exterior of said hub, and means for connecting said passage-

ways with a source of supply for fluid under pressure.

14. In a controllable pitch propeller, the combination of a hub, a propeller-blade rotatably mounted in the hub for pitch-variation, a cylinder in the blade, a weight and piston mounted in the cylinder for radial movement by centrifugal force, and connected to rotate the blade for pitch-variation, and means for shifting the piston to shift the weight against centrifugal force.

15. In a controllable pitch propeller, the combination of a hub, a propeller blade rotatably mounted in the hub for pitch-variation, a cylinder in the shank of the blade, a combined weight and piston movable in the cylinder, movable by centrifugal force, and connected to rotate the blade for pitch-variation, and means for delivering fluid under pressure into the cylinder to shift the piston and weight against the action of centrifugal force.

16. In a controllable pitch propeller, the combination of a hub, a propeller blade rotatably mounted in the hub for pitch variation and against radial movement, a weight movably mounted in the blade and movable by centrifugal force, means operable by the weight for rotating the blade to change its pitch in one direction, and fluid-pressure means for shifting the

weight against centrifugal force and for rotating the blade in the opposite direction.

17. In a controllable pitch propeller, the combination of a hub, a propeller blade rotatably mounted in the hub for pitch variation and against radial movement, a weight movably mounted in the blade and movable by centrifugal force, means operable by the weight for rotating the blade to change its pitch in one direction, and fluid-pressure means for shifting the weight against centrifugal force and for rotating the blade in the opposite direction, comprising a duct for fluid which extends through the weight.

18. In a controllable pitch propeller, the combination of a hub, a propeller blade rotatably mounted in the hub for pitch variation and provided in its shank with a radial cylinder, a weight movably mounted in the cylinder and movable by centrifugal force, means operable by the weight for rotating the blade to change its pitch in one direction, a piston fitted in the cylinder for shifting the weight against centrifugal force, and means for delivering fluid under pressure into the cylinder, for shifting the piston and weight against centrifugal force and rotating the blade to change its pitch in the other direction.

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