Sept. 2, 1952 A. H. LOCKHEED 2,609,056

CONTROLLABLE PITCH PROPELLER

Original Filed June 23, 1941 3 Sheets-Sheet 1

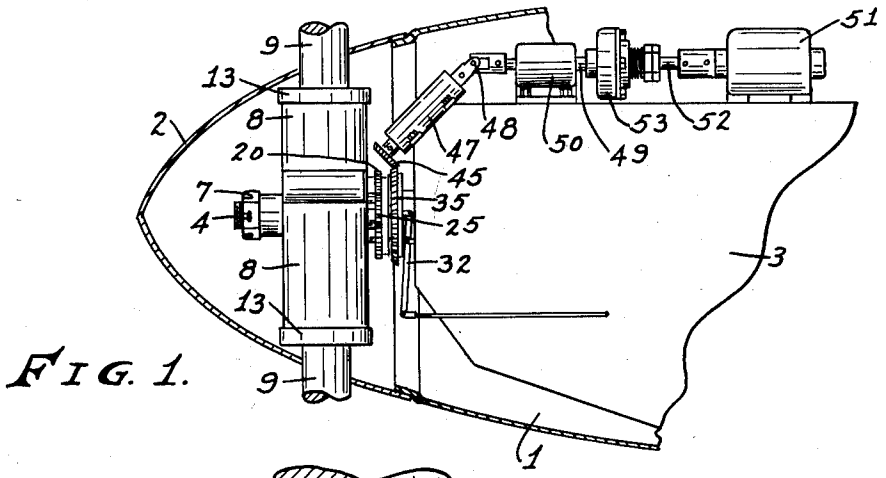


FIG. 1.

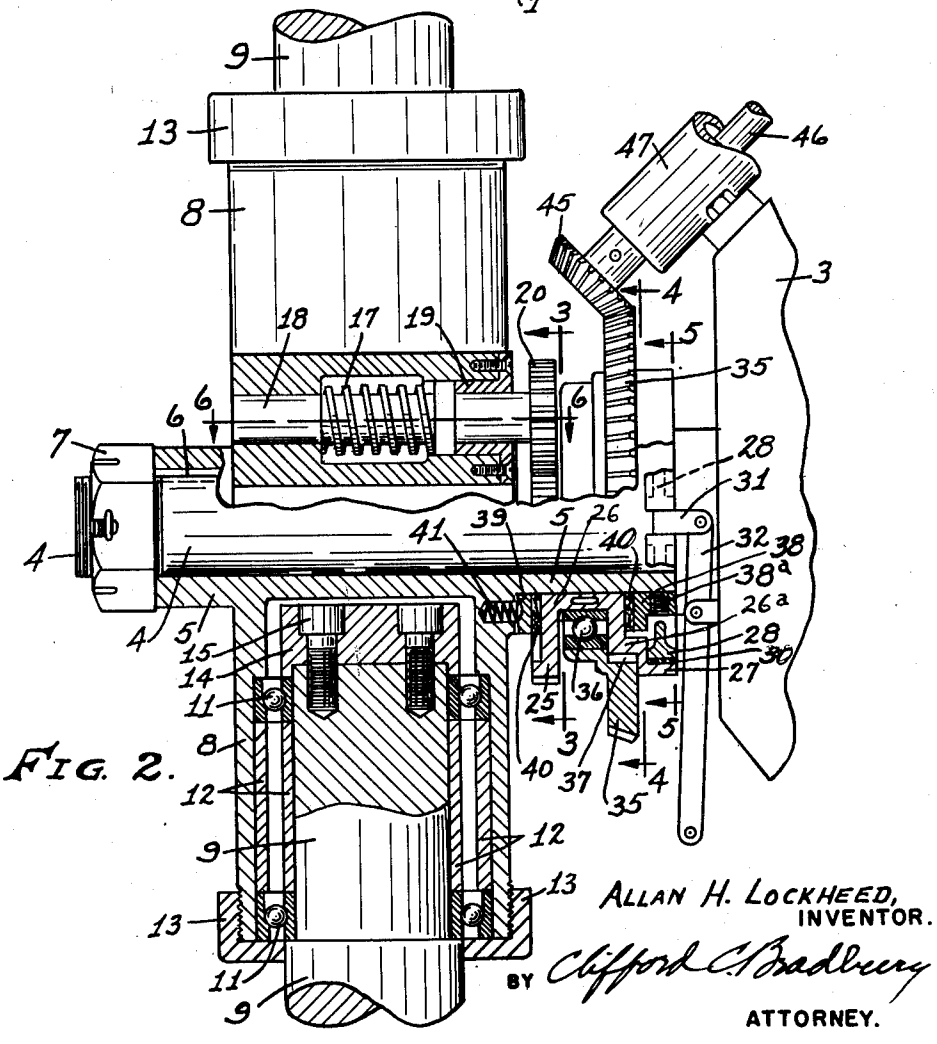


FIG. 2.

ALLAN H. LOCKHEED,
INVENTOR.

BY Clifford C. Bradbury

ATTORNEY.

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Original Filed June 23, 1941 3 Sheets-Sheet 2

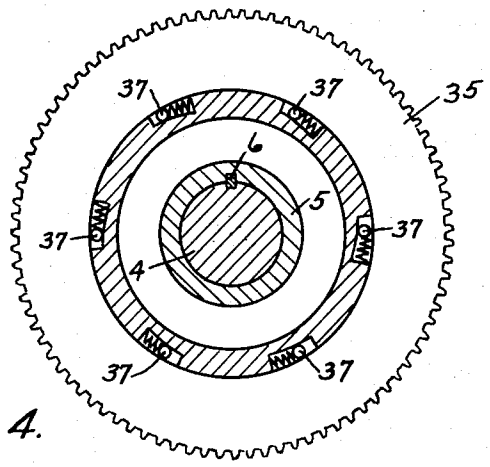


FIG. 4.

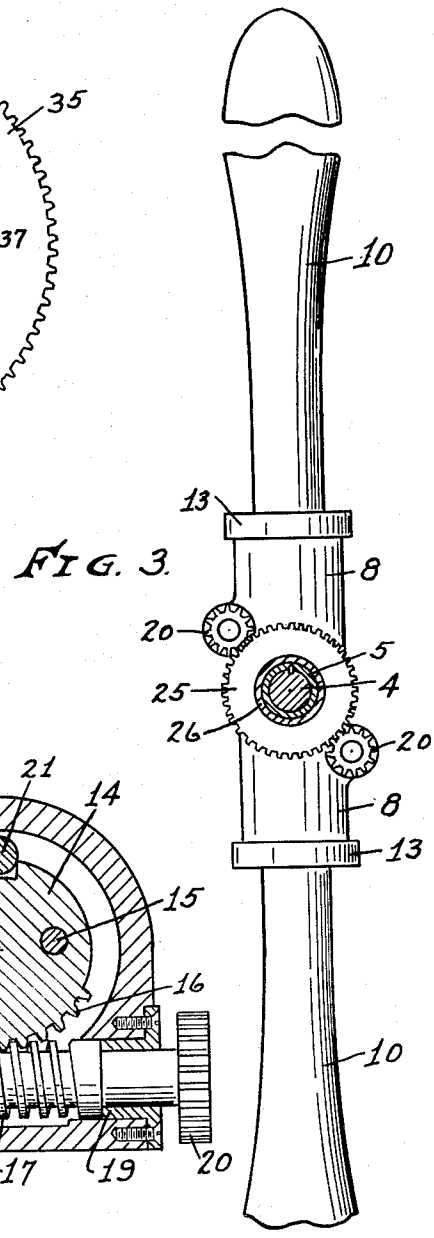


FIG. 3.

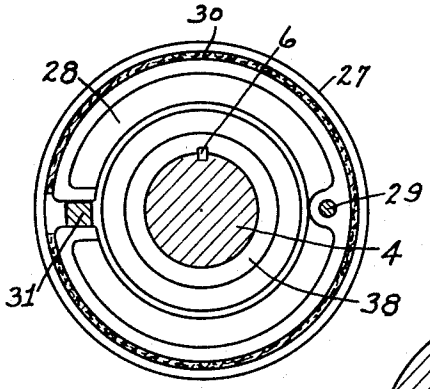


FIG. 5.

FIG. 6.

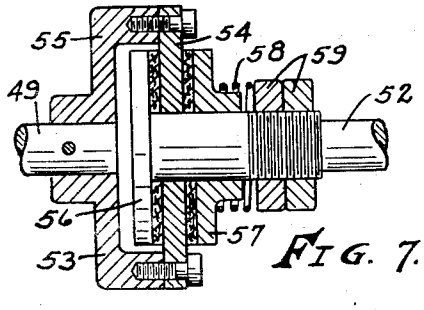


FIG. 7.

ALLAN H. LOCKHEED,
INVENTOR.

BY Clifford C. Bradbury

ATTORNEY.

Sept. 2, 1952 A. H. LOCKHEED 2,609,056

CONTROLLABLE PITCH PROPELLER

Original Filed June 23, 1941 3 Sheets-Sheet 3

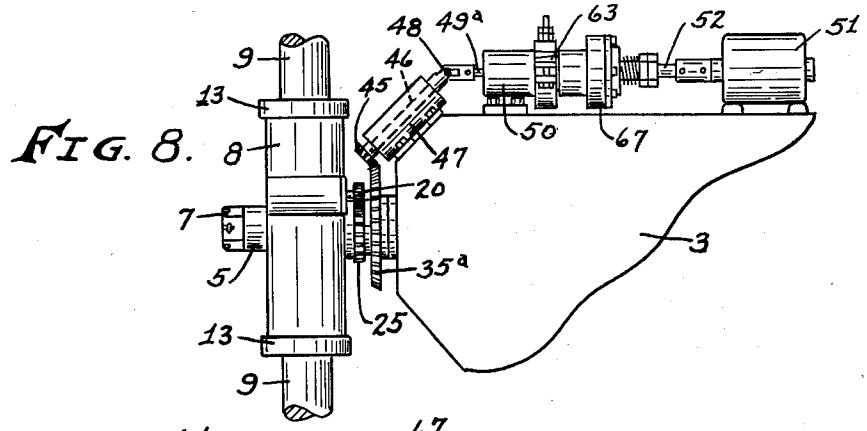


FIG. 8.

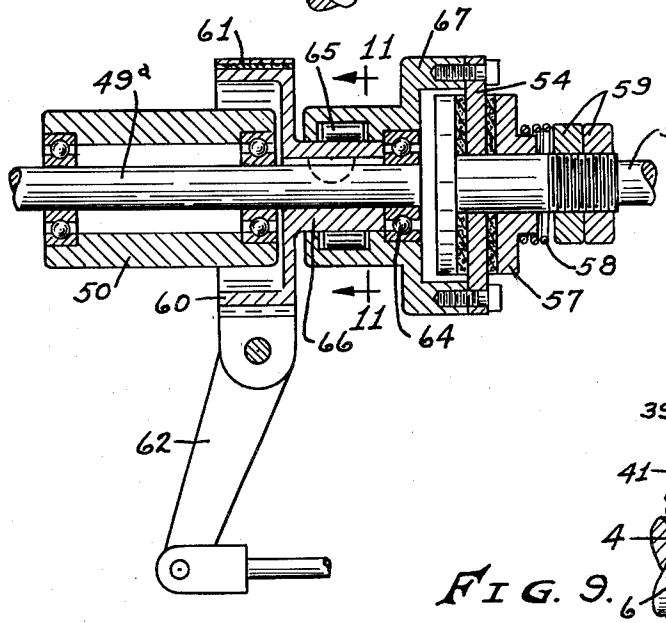


FIG. 10.

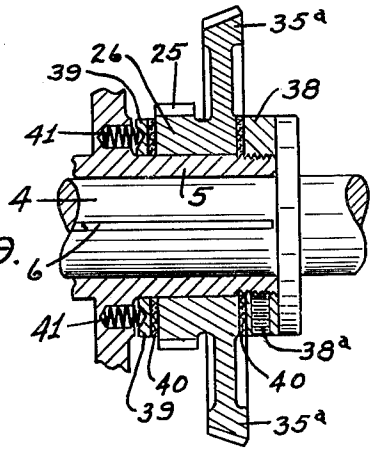


FIG. 9.

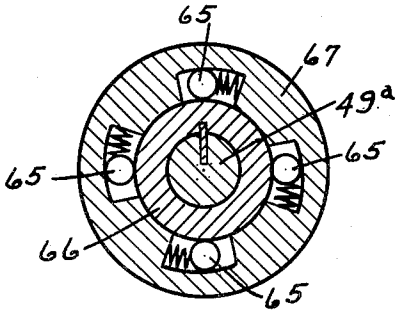


FIG. 11.

ALLAN H. LOCKHEED,
INVENTOR.

BY Clifford C. Bradbury
ATTORNEY.

Patented Sept. 2, 1952 2,609,056

UNITED STATES PATENT OFFICE

2,609,056

CONTROLLABLE PITCH PROPELLER

Allan H. Lockheed, Los Angeles, Calif.

Substituted for abandoned application Serial No. 399,273, June 23, 1941. This application January 4, 1945, Serial No. 571,229

4 Claims. (Cl. 170—160.29)

1

This application is a substitute for applicant's prior application, Serial No. 399,273, filed June 23, 1941, which became abandoned April 3, 1944.

This invention relates to controllable pitch propellers of the general class of screw propellers in which the inclination of the blades may be varied or adjusted.

Although this propeller is primarily designed for aviation use it may be adapted for marine propellers or for fans or for any of that general type of device.

The object and function of a controllable pitch propeller is well known in the art and does not need to be herein elaborated upon. It is sufficient to say that in aviation use it is desirable to have the propeller adjusted with low pitch for increased engine speed and power as for taking off and in climbing and to have the blades adjusted with high pitch for normal flying.

The object of this invention is to provide a simplified construction which will be strong and durable and particularly one which occupies a minimum of space and is simply operated. The device is provided with various novel features of construction and arrangement as hereinafter more fully described and particularly pointed out in the claims, reference being had to the accompanying drawings, in which

Fig. 1 is an elevation of the forward part of the fuselage of an airplane showing a part of the engine in outline, with the controllable pitch propeller mounted on the engine shaft and with a part of the pitch actuating mechanism mounted on the propeller hub.

Fig. 2 is an enlarged view of the hub of the propeller and a part of the actuating mechanism with parts broken away in different planes to illustrate details of construction.

Fig. 3 is a cross-section on the line 3—3 of Fig. 2 showing the propeller and its hub in elevation.

Fig. 4 is a cross-section on the line 4—4 of Fig. 2 illustrating details of construction and particularly a one-way roller clutch mechanism.

Fig. 5 is a cross-section on the line 5—5 of Fig. 2 illustrating the brake mechanism.

Fig. 6 is a section through the hub on the line 6—6 of Fig. 2 illustrating the worm and gear actuating mechanism.

Fig. 7 is a longitudinal section of the safety clutch illustrated in Fig. 1.

Fig. 8 is a fragmentary view of a second form of operating mechanism.

Fig. 9 is a fragmentary section illustrating that part of the second form of actuating mechanism which is located upon the propeller hub.

2

Fig. 10 is a longitudinal section of the driving shaft, safety clutch, one-way clutch and brake illustrated in Fig. 8.

Fig. 11 is a cross-section of the one-way clutch device on the line 11—11 of Fig. 10.

Describing first that form of structure illustrated in Figs. 1 and 2 and other partial views, the nose section 1 of the fuselage of an airplane has a conical shield or "spinner" 2 fixed to the propeller and rotating with it and carried by a conventional engine 3 shown in outline. The engine shaft 4 (Fig. 2) projects forwardly from the engine and has the propeller hub 5 fixed to it in a conventional way as by a key 6 and a nut 7.

The hub 5 has radially extending blade sockets 8 corresponding in number to the number of blades, two being shown. The inner ends 9 of the propeller blades 10 are received in the sockets 8 and are rotatably retained by suitable bearings such as ball bearings 11 spaced by sleeves 12 and retained by suitable structure such as a cap 13.

The extreme and inner end of each blade is provided with a plate 14 rigidly fastened to it by screws 15 and provided on a portion of its periphery with gear teeth 16 (Fig. 6) meshing with worm gears 17. Each respective worm gear 17 is provided with a shaft 18 journaled in bearings provided in the hub socket 8 and they are retained in place by suitable structure such as a sleeve 19 held in place by screws. One end of each shaft 18 projects from the rear side of the propeller hub and is provided with a pinion gear 20.

Rotation of the gears 20, the shafts 18 and the worm gears 17 will cause rotation of the respective propeller blades on axes radial to the axis of the shaft 4, this blade rotation being limited in each direction by a stop pin 21 fixed to the base of the socket 8 and projecting into a notch or recess 22 in the periphery of the plate 14 so that the rotation of the blades on their axes is limited. The rotation of the blades on their axes changes the pitch of the propeller. The limit of movement is controlled by the said pin 21 in the notch 22, being set for extreme high pitch in one position and extreme low pitch in the other position.

The aforedescribed mechanism is identical in each of the two forms of operating mechanism disclosed herein.

A gear 25 meshing with both pinions 20 has a hub 26 rotatably mounted upon the propeller hub 5, this hub 26 having a continuation 26a fixed to it which is provided with a brake drum 27. A circular brake shoe 28 is split and expansible and anchored to a stationary part of the engine at 29 (Fig. 5) and provided with a brake lining 30 lo-

cated within the brake drum 27 and is expanded for braking action by suitable means such as a wedge 31 inserted at its split part and manually actuated by a lever 32 (Fig. 2) which may be controlled from a suitable location such as the pilot's cockpit.

A gear 35 (Fig. 2) surrounds the hub 26 of the gear 25 and is mounted for free rotation thereon by a ball bearing 36. Rollers 37 constituting a conventional one-way clutch are interposed between the gear 35 and the hub continuation 26a, which is fixed to and rotated with the hub 26 of the gear 25, so that free relative rotation may be had between the gears 25 and 35 in one direction but the gears will be clutched together by the rollers 37 in attempted relative rotation in the opposite direction and particularly in the present instance when the gear 35 is rotated faster than the gear 25 the clutch will act to positively drive the gear 25 with the gear 35.

Frictional resistance to movement of the gear 25 on the propeller hub 5 is obtained by a collar 38 (Fig. 2) fixed to the propeller hub 5 adjacent the gear hub continuation 26a and a spring pressed plate 39 adjacent the front face of gear 25, suitable friction disks 40 being interposed. The springs 41 act to squeeze the hub of the gear 25 against the fixed collar 38 locked by a set screw 38a and to frictionally resist its movement relative to the propeller hub 5.

The gear 35 meshes with a bevel gear 45 fixed to a shaft 46 journaled in a bearing 47 mounted on the engine 3, this shaft being connected by a flexible coupling or universal joint 48 to a shaft 49 journaled in a bearing 50 mounted on the engine. A small electric motor 51 is mounted on the engine and has its shaft 52 in alignment with the shaft 49 and connected thereto by a safety friction clutch 53 (Fig. 7) which comprises a disk 54 fixed to the housing 55 and a head 56 and collar 57, both on the shaft 52, and located upon opposite sides of the disk 54 and held into frictional engagement therewith by a spring 58 bearing against nuts 59. This safety clutch transmits power under normal conditions but will slip when overloaded.

The operation of the first form of structure is as follows: In normal operation of the propeller the blades are set to either extreme high pitch or extreme low pitch within the limits controlled by the stop pin 21 in the notches 22. In these positions the inherent irreversible character of the intermeshing worm 17 and gear teeth 16 tends to lock the blades in their adjusted positions and to prevent inadvertent movement. A further lock is provided by the frictional resistance to rotation of the gear 25 on the propeller hub 5 by the spring pressed plate 39 squeezing its hub against the fixed collar 38, the gear 25 meshing with the pinions 20 on worm gear shafts 18. With the propeller rotating, when it is desired to move the blades 10 to change their pitch in one direction the lever 32 (Fig. 1) is operated to apply braking resistance to the brake drum 27 which is connected to the hub of the gear 25 and when this braking resistance is greater than the frictional resistance caused by the spring pressed plate 39 the gear 25 will be slowed in its rotation relative to the propeller hub 5 and caused to rotate upon the propeller hub 5 at a speed less than the speed of rotation of the hub and this relative movement will be transmitted to the pinion gears 20 which will rotate the worm gears 17 causing the blades 10 to change their pitch and inasmuch as there is no mechanism provided to indicate the extent of this movement it is presumed that this change of pitch will continue until the stop pin 21 prevents further movement of the blades which will cause the brake shoe 28 to slip on the brake drum 27.

The opposite adjustment of the blades is accomplished by actuation of the motor 51 and may be done either when the propeller is at rest or while it is rotating. To accomplish this adjustment the motor is energized and through its various heretofore described connections it will rotate the gear 35 in the same direction as, though momentarily just a little faster than, the normal rotation of the propeller hub and in this direction of rotation the rollers 37 will act to clutch the gear 35 to the gear 25 causing it to rotate in the same direction as the propeller thus rotating the pinion gears 20 and the worm gear 17 to move the blades 10.

The motor 51 must mave sufficient speed so that it can drive the gear 35 faster than the rotation of the shaft 4 and the propeller hub 5 and it must have sufficient power to overcome the frictional resistance to rotation of the gear 25 caused by the spring pressed plate 39. It also must turn in the proper direction to drive the gear 35 in the same direction as the rotation of the shaft 4.

The safety clutch 53 is to permit slippage when the blades have reached the limit of their adjustment and the motor 51 continues to rotate. This safety clutch also acts to prevent damage to the motor 51 in case of a "kick-back" of the engine which sometimes occurs.

In the form of structure illustrated in Figs. 8, 9, 10 and 11 the gears 25 and 35a are integrally formed or rigidly connected together and mounted for rotation on the propeller hub 5 and the gear 25 meshes with the pinions 20 and actuates them to adjust the blades as previously described. The hub 26 of these gears is squeezed between the collar 38 fixed to the propeller hub and the spring pressed plate 39 as and for the purpose previously described.

In this form of structure (Fig. 9) the bevel gear 45 is constantly driven by the gear 35a all of the time that the propeller is rotated. The gear 45 is mounted on a shaft 46 journaled in the bearing 47 and is connected by a universal joint 48 with a shaft 49a journaled in the bearing 50.

A brake drum 60 (Fig. 10) is fixed to the shaft 49a adjacent the bearing 50 and is surrounded by a brake band 61 which is operated to exert braking effort on the drum 60 by a lever 62 which is connected to some suitable device as a cam 63 (Fig. 8) which will contract the brake band 61 upon operation of the lever 62.

A combined safety clutch and one-way clutch is located in a housing 67 (Fig. 10) which surrounds the shaft 49a and is mounted for rotation thereon on a bearing 64. Rollers 65 are interposed between the housing 67 and the hub 66 of the brake drum 60 and act to clutch the housing 67 to the drum 60 upon relative rotation of the two parts in one direction but permits free relative rotation thereof in the opposite direction.

The safety clutch portion of this device corresponds to that shown in Fig. 7 and previously described and serves to connect the clutch housing 67 with the shaft 52 of the electric motor 51.

In the operation of this form of structure the shafts 46 and 49a (Fig. 8) and the brake drum are constantly rotated during rotation of the shaft 4. However, the one-way clutch rollers 65 are released during normal shaft rotation and

the rotation of the shaft 49a is not transmitted to the clutch housing 67 and the motor shaft 52 which normally remain idle. When it is desired to change the pitch of the propeller blade in one direction the brake band 61 is clamped upon the drum 60 which retards rotation of the shaft 49a and transmits this retarding effort to the gears 35a and 25 causing them to rotate on the propeller hub 5 in a direction opposite to the propeller shaft rotation, this rotating movement being transmitted through the pinions 20, the worm gears 17 and the gear teeth 16 to the respective propeller blades.

For adjusting the blades to the other position the motor 51 is energized and when the speed of rotation of the shaft 52, which is connected to the clutch housing 67 by the safety clutch heretofore described, becomes greater than the rotation of the shaft 49a the clutch roller 65 will grip the hub 66 of the drum 60 and cause the shaft 49a to rotate faster than it had previously been driven by rotation of the propeller shaft. This increased rotation will be transmitted through the various connecting parts to the gears 35a and causing them to rotate upon the hub 5 in the direction of rotation of the hub and rotating the pinions 20 and their connected parts to move the propeller blades to the opposite angle.

I claim:

1. A controllable pitch propeller comprising a hub mounted on a shaft, propeller blades mounted for rotation on axes radial to the axis of said hub, means for rotating said blades on their respective axes including pinions spaced from and rotating on axes substantially parallel to the axis of said hub, a gear rotatably surrounding said hub and meshing with said pinions, a brake to retard rotation of said gear during rotation of the hub, a second gear rotatably surrounding the axis of said hub, a one-way clutch acting to clutch said second gear to said first gear, and means for rotating said second gear faster than the rotation of the shaft.

2. A controllable pitch propeller comprising a hub mounted on a shaft, propeller blades mounted for rotation on axes radial to the axis of said hub, means for rotating said blades on their respective axes including pinions spaced from and rotating on axes substantially parallel to the axis of said hub, a gear rotatably surrounding said hub and meshing with said pinions, constantly acting friction means to resist rotation of said gear relative to said hub, a brake to retard rotation of said gear during rotation of the hub, a second gear rotatably surrounding the axis of said hub, a one-way clutch acting to clutch said second gear to said first gear, and means for rotating said second gear faster than the rotation of the shaft.

3. A controllable pitch propeller comprising a hub mounted on a shaft, propeller blades mounted for rotation on axes radial to the axis of said hub, means for rotating said blades on their respective axes including pinions spaced from and rotating on axes substantially parallel to the axis of said hub, a gear rotatably surrounding said hub and meshing with said pinions, a brake to retard rotation of said gear during rotation of the hub, a second gear rotatably surrounding the axis of said hub, a one-way clutch acting to clutch said second gear to said first gear, and means for rotating said second gear faster than the rotation of the shaft comprising a motor rotatably connected to the second gear.

4. A controllable pitch propeller comprising a hub mounted on a shaft, propeller blades mounted for rotation on axes radial to the axis of said hub, means for rotating said blades on their respective axes including pinions spaced from and rotating on axes substantially parallel to the axis of said hub, a gear rotatably surrounding said hub and meshing with said pinions, a brake to retard rotation of said gear during rotation of the hub, a second gear rotatably surrounding the axis of said hub, a one-way clutch acting to clutch said second gear to said first gear, and means for rotating said second gear faster than the rotation of the shaft comprising a motor rotatably connected to the second gear and a friction clutch interposed between the motor and the second gear.

ALLAN H. LOCKHEED.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,378,401	Davies	May 17, 1921
1,427,178	Turnbull	Aug. 29, 1922
1,719,953	Wiegand	July 9, 1929
1,776,650	Carter	Sept. 23, 1930
1,793,654	Turnbull	Feb. 24, 1931
1,799,828	McCauley	Apr. 7, 1931
1,857,392	Nixon	May 10, 1932
1,875,598	Heath	Sept. 6, 1932
2,000,049	Taylor	May 7, 1935
2,007,417	Aivaz	July 9, 1935
2,033,342	Lansing et al.	Mar. 10, 1936
2,127,687	Heath	Aug. 23, 1938
2,138,339	Chauviere	Nov. 29, 1938
2,144,927	Lavasseur	Jan. 24, 1939
2,181,985	Waseige	Dec. 5, 1939
2,306,135	Mercier	Dec. 22, 1942
2,314,025	Waseige	Mar. 16, 1943
2,327,217	Reiber et al.	Aug. 17, 1943
2,362,914	McLeod	Nov. 14, 1944
2,372,667	Forsyth et al.	Apr. 3, 1945

FOREIGN PATENTS

Number	Country	Date
445,652	Great Britain	Apr. 16, 1936