March 29, 1932. E. SEPPELER 1,851,874

PROPELLER FOR FLYING MACHINES

Filed April 26, 1930

FIG. 3

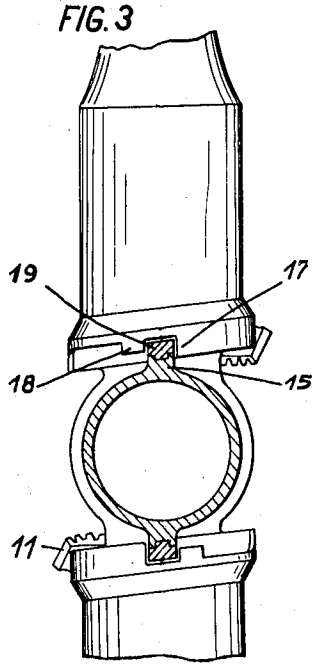

FIG. 1

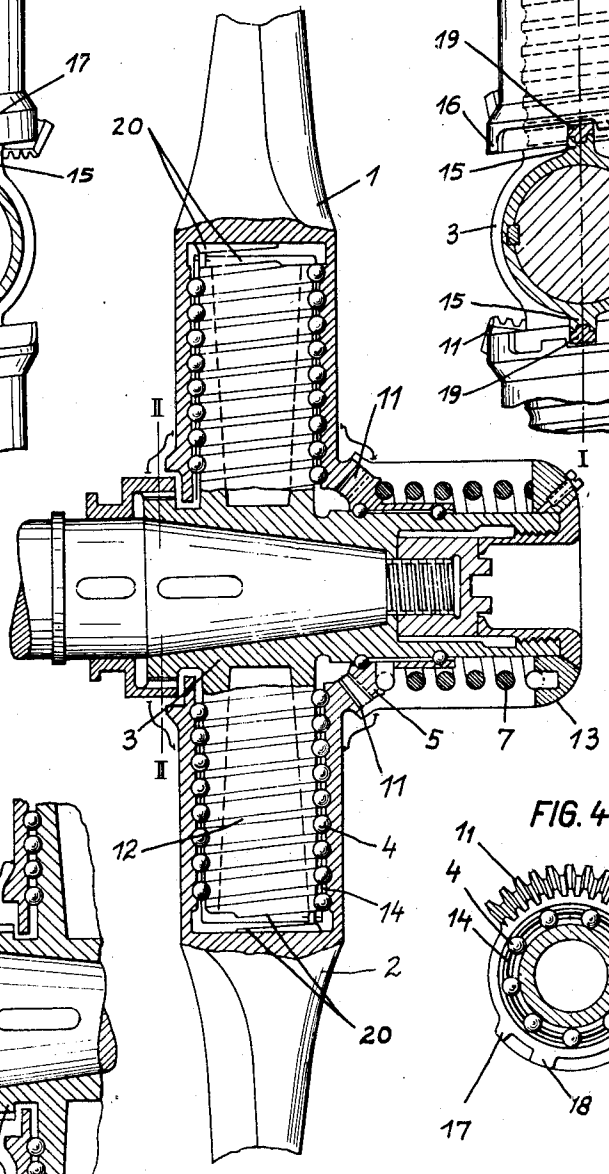

FIG. 2

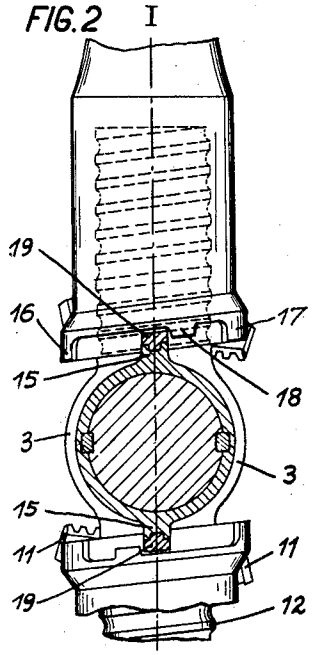

FIG. 5

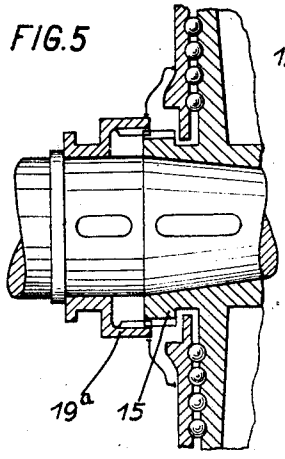

FIG. 4

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UNITED STATES PATENT OFFICE

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PROPELLER FOR FLYING MACHINES

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There are known propellers for flying machines in which the position of the blades can be varied relatively to the propeller shaft, that is to say, in which the pitch of the blades can be varied and is varied in proportion to the compensation between the turning moment of the rotating blades on the one hand and the action of a spring encompassing the axis of the propeller shaft or hub on the other hand. Also the present invention relates to a propeller of this type, and the progress of this improved propeller over the known ones resides therein that that compensation is effected on the shortest way imaginable.

The problem on which the present invention is based is to utilize the centrifugal force arising when the propeller is rotating for turning the blades around their own axes. It would seem to suggest itself to screw the blades upon pivots extending radially forth from the hub and having a quick-pitch thread which is frictionless in such a degree that it does not lock by its own action, so that when a pressure or a pull is exerted in the direction of the thread axis the blades screw themselves upwardly or downwardly, as the case may be. But in view of the enormously great centrifugal force arising when the propeller is rotating that solution proves to be practically impossible. In the present actual, and practically at once possible, solution of the problem stated the blades are screwed upon the hub pivots with the insertion of anti-friction balls forming, as it were, a helical ball bearing within the blade. This construction renders it possible to reduce the friction in the threads very considerably and thereby to transform the centrifugal force into a turning motion of the wings.

The invention is illustrated diagrammatically and by way of example on the accompanying drawings on which Figure 1 is an axial section through a propeller designed according to this invention, the section being taken in the plane I—I of Fig. 2, Figure 2 is a transverse section in the plane II—II of Fig. 1, the lower part of Fig. 1 which is completely like the upper part being omitted in Fig. 2 from want of space; Figure 3 is a section like Fig. 2, but certain parts being in another position; Figure 4 is a transverse section through one of the blade bearings (blade socket and socket holding pivot), seen in the direction from the propeller shaft to the free blade end or tip; and Figure 5 is a view similar to the lefthand end of Fig. 1, showing a certain part in another position, all as fully described hereinafter.

The sockets of the blades 1 and 2 are screwed upon pivots 12 projecting forth from the hub 3 of the propeller. The external thread of said pivots and the internal thread of the bores of the blade sockets are so designed that a helical groove (Fig. 1) having a circular or elliptic or rectangular transverse section is formed between said threads. This groove is filled with anti-friction balls 4 so that the blades run, as it were, on ball bearings.

In front of the blade sockets a bevel-wheel 5 is supported on the hub 3 of the propeller, and is subjected to the pressure of a compression and torsion spring 7 encompassing the hub. The outer end of this spring bears upon, and is connected with a flange 13 of the hub, and the inner end bears upon, and is connected with, said bevel-wheel. This wheel meshes with two segmental bevel-wheels, or bevel-wheel segments 11 (Figs. 1 and 4) affixed to the blades so that these latter are, in this way, positively connected with one another and are also subjected to the action of the spring 7 which continuously tends to counter-act the turning of the blades upon the pivots 12.

The teeth of the bevel-wheel segments 11 rise in the direction from one end of the series of teeth to the other end thereof in correspondence with the pitch of the helical groove formed by and between the internal and the external thread mentioned so that the engagement between the sectors and the bevel-wheel 5 is maintained when the blade sockets turn on the pivots radially outwards.

As the spring 7 is not only a compression spring, but also a torsion spring, it counteracts elastically also any force tending to subject it to torsional stress, and the centrifugal force arising in the blades when the propeller

is rotating is, thus, transformed into a part-force which tends to screw the blades outwardly until that force has been compensated by the torsional stress to which the spring has been subjected.

The number of the blades may be as desired.

The positive connection of the blades with the spring, instead of being established by the toothed segments 11 and the bevel-wheel 5, may be established also by ropes or thrust rods or other equivalent members, and instead of using one only torsional spring as counteracting member for the two or more blades, a plurality of springs may be provided which, either, are attached directly to the individual blades or are coupled with one another by the toothed members 5 and 11 conjointly.

The balls 4 are held together preferably by means of a tubular cage 14. Opposite either the inner frontal edge of the cage (i. e. the edge opposite the hub of the propeller) or opposite the outer frontal edge of the cage (i. e. the edge opposite the blade proper) is a semicircular abutment and guide member 20, which is inclined in conformity with the pitch of the helical groove so that the cage is always in contact with that member and is retained by it in its proper position irrespective of the turning of the appertaining blade on its pivot. In the constructional form shown in Fig. 1 said member 20 is located opposite the outer end of said cage.

The turning of each blade on its pivot, that is to say, the degree or extent of its angular motion, is limited by means of a lug 15 (Figs. 2 and 3) projecting radially forth from the hub of the propeller and co-operating with lugs 16 and 17 projecting forth radially inwards from the hub ends of the blades, one or the other of these latter lugs contacting with the lug 15 of the hub in the respective end-position. In Fig. 3 this is the case as regards the lug 17. The lugs 15, 16, and 17 form, thus, abutment members, and besides these three abutment members there is a fourth, 18, which is located between the members 16 and 17, and co-operates with a fifth abutment member 19 that is located, and shiftable, upon the member 15 and can be connected with it in its adjusted position. In Fig. 2 the abutment member 19 is in contact with the lefthand side of the abutment member 18, and in Fig. 3 it engages the space between the abutment members 17 and 18. As there are at least two of each of the abutment members 15, 16, 17 and 18, there are also a corresponding number of the abutment members 19, and these members form parts of a sleeve 19^a (Fig. 5) which is coupled with the propeller shaft by feather and groove and can, thus, be shifted on it, but rotates with it. The sleeve 19^a may be actuated by any suitable means. In Fig. 5 the sleeve with its abutment members 19 is shown withdrawn from the abutment members 18, so that the members 19 co-operate solely with the members 16 and 17. The abutment member 18 is of lesser height than the members 16 and 17. When the additional abutment member 19 is withdrawn, the intermediate abutment member 18 does not come in contact with it, but when it is in its operative position, it depends upon the position of the blade whether the amount of the turning movement of the blade is limited by the abutment members 18 and 16 or 18 and 17. In the first of these cases the blades drive rearwardly with negative pitch, and in the other case they drive forwardly with positive pitch.

I claim:

1. A propeller for flying machines, having blades, the pitch of which can be adjusted or readjusted automatically by the centrifugal force arising while the propeller rotates, comprising, in combination with said blades and with internally threaded bores in their hub-ends, pivots projecting radially outwards from the hub of the propeller and engaging said bores in the blades and being externally threaded, said internal and external thread forming a helical groove within the blade; anti-friction balls in said groove; abutment members projecting radially outwards from the hub, and abutment members projecting radially inwards from the hub ends of the said blades, the arrangement of said abutment members relatively to one another being such that the amount of turning of the blades around their axes is limited; a torsion spring arranged co-axially with the propeller axis, and coupling means between this spring and the blades and adapted to transmit the torsional force of said spring to the blades in such a manner that this force counteracts the turning of the blades around their axes.

2. A propeller for flying machines, having blades, the pitch of which can be adjusted or readjusted automatically by the centrifugal force arising while the propeller rotates, comprising, in combination with said blades and with internally threaded bores in the hub ends of the blades, pivots projecting forth from the hub of the propeller end engaging said bores and being externally threaded in such a manner that this thread together with that of the blade bore forms a helical groove; anti-friction balls in this groove; a torsion spring arranged co-axially with the propeller shaft; coupling members connecting the blades with said spring in such a manner that said force counteracts the turning of the blades around their axes; abutment members projecting radially outwards from the hub; abutment members projecting radially inwards from the hub ends of the blades, the arrangement of said abutment members relatively to one another being such that the amount of turning of the blades

around their axes is limited; abutment members located upon the first-mentioned abutment members and adapted to be adjusted thereon; and abutment members located between those of the blades, and being lower than them and so arranged with respect to the adjustable abutment members as to be adapted to cooperate with them, substantially as set forth.

3. A propeller for flying machines, having blades, the pitch of which can be adjusted or readjusted automatically by the centrifugal force arising while the propeller rotates, comprising, in combination with said blades, pivots extending radially from the hub of the propeller and having the blades attached to them and having each a helical groove in its circumferential surface, a corresponding groove being provided in the opposite surface of the appertaining blade bore enclosing the appertaining pivot; balls in the hollow screw-thread formed by the oppositely located grooves, a torsion-spring surrounding the hub and being at one end connected therewith, a bevel-wheel supported upon the hub and being connected with the other end of said spring; and segment-forming sets of bevel-teeth provided at the hub-ends of the blades and meshing with said bevel-wheel so as to transmit the rotational force produced by the action of the centrifugal force upon the blades to the said spring, the strength of this latter being such that it is just able to counterbalance said forces, the combination and arrangement of the parts being, for the rest, such that the driving power is transmitted from the propeller shaft to the said pivots with their blades directly, without any co-action of the said spring.

4. A propeller for flying machines, having blades, the pitch of which can be adjusted or readjusted automatically by the centrifugal force arising while the propeller rotates, comprising, in combination with said blades, pivots extending radially from the hub of the propeller and having the blades attached to them and having each a helical groove in its circumferential surface, a corresponding groove being provided in the opposite surface of the appertaining blade bore enclosing the appertaining pivot, balls in the hollow screw-thread formed by the oppositely located grooves; cages, each of which is located between one of said pivots and the corresponding blade portion and holding the appertaining balls in their proper position with respect to one another; a torsion spring surrounding the hub and being at one end connected therewith; a bevel-wheel supported upon the hub and being connected with the other end of said spring; and segment-forming sets of bevel-teeth provided at the hub-ends of the blades and meshing with said bevel-wheel so as to transmit the rotational force produced by the action of the centrifugal force upon the blades to the said spring, the strength of this latter being such that it is just able to counterbalance said forces, the combination and arrangement of the parts being, for the rest, such that the driving power is transmitted from the propeller shaft to the said pivots with their blades directly, without any co-action of the said spring.

5. A propeller for flying machines, having blades, the pitch of which can be adjusted or readjusted automatically by the centrifugal force arising while the propeller rotates, comprising, in combination with said blades, pivots extending radially from the hub of the propeller and having the blades attached to them and having each a helical groove in its circumferential surface, a corresponding groove being provided in the opposite surface of the appertaining blade bore enclosing the appertaining pivot, balls in the hollow screw-thread formed by the oppositely located grooves, cages, each of which is located between one of said pivots and the corresponding blade portion and holding the appertaining balls in their proper position with respect to one another, and guide members, each having a guide surface inclined in correspondence with the pitch of said screw-thread and being so arranged relatively to one of the edges of the appertaining cage as to remain in contact therewith at any angular position of the appertaining blade; a torsion-spring surrounding the hub and being at one end connected therewith; a bevel-wheel supported upon the hub and being connected with the other end of said spring; and segment-forming sets of bevel-teeth provided at the hub-ends of the blades and meshing with said bevel-wheel so as to transmit the rotational force produced by the action of the centrifugal force upon the blades to the said spring, the strength of this latter being such that it is just able to counterbalance said forces, the combination and arrangement of the parts being for the rest, such that the driving power is transmitted from the propeller shaft to the said pivots with their blades directly, without any co-action of the said spring.

6. A propeller for flying machines, having blades, the pitch of which can be adjusted or readjusted automatically by the centrifugal force arising while the propeller rotates, comprising, in combination with said blades, pivots extending radially from the hub of the propeller and having the blades attached to them and having each a helical groove in its circumferential surface, a corresponding groove being provided in the opposite surface of the appertaining blade bore enclosing the appertaining pivot, balls in the hollow screw-thread formed by the oppositely located grooves, cages, each of which is located

between one of said pivots and the corresponding blade portion and holding the appertaining balls in their proper position with respect to one another; two guide members for each of said cages, each of said guide members having a guide surface inclined in correspondence with the pitch of the screw-thread pertaining to the appertaining blade and its pivot and being so arranged relatively to the edges of the appertaining cage as to remain in contact therewith at any angular position of the blade; a torsion-spring surrounding the hub and being at one end connected therewith; a bevel-wheel supported upon the hub and being connected with the other end of said spring; and segment-forming sets of bevel-teeth provided at the hub-ends of the blades and meshing with said bevel-wheel so as to transmit the rotational force produced by the action of the centrifugal force upon the blades to the said spring, the strength of this latter being such that it is just able to counterbalance said forces, the combination and arrangement of the parts being, for the rest, such that the driving power is transmitted from the propeller shaft to the said pivots with their blades directly, without any co-action of the said spring.

7. A propeller for flying machines, having blades, the pitch of which can be adjusted or readjusted automatically by the centrifugal force arising while the propeller rotates, comprising, in combination with said blades, pivots extending radially from the hub of the propeller and having the blades attached to them and having each a helical groove in its circumferential surface, a corresponding groove being provided in the opposite surface of the appertaining blade bore enclosing the appertaining pivot; balls in the hollow screw-thread formed by the oppositely located grooves, a torsion-spring surrounding the hub and being at one end connected therewith; a bevel-wheel supported upon the hub and being connected with the other end of said spring; and segment-forming sets of bevel-teeth provided at the hub-ends of the blades and meshing with said bevel-wheel so as to transmit the rotational force produced by the action of the centrifugal force upon the blades to the said spring, the strength of this latter being such that it is just able to counterbalance said forces, the combination and arrangement of the parts being, for the rest, such that the driving power is transmitted from the propeller shaft to the said pivots with their blades directly, without any co-action of the said spring and the teeth of said bevel-wheel segments rising in the direction from one end of the series of teeth to the other end thereof in correspondence with the pitch of the helical groove formed by and between the internal and the external tween the sectors and the bevel-wheel 5 is maintained when the blade sockets turn on the pivots radially outwards.

In testimony whereof I affix my signature.

EDUARD SEPPELER.