ENGINE STARTING DEVICE FOR AEROPLANES

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This invention relates to starting devices for aeroplane engines or motors, and has for its object the provision of an improved device of this character. More specifically, this invention relates to a starting device operable by the aviator from the cockpit. Herefore, when starting aeroplane motors, it has been customary for a second person outside of the aeroplane, to start the motor by rotating the propeller by hand. When aeroplanes are launched from suspended positions, this method is not possible. To meet motor starting conditions of this character, I have provided a starter, operable by merely pulling a handle accessible to the aviator from the cockpit.

My invention will be better understood from the following description taken in connection with the accompanying drawings and its scope will be pointed out in the appended claims.

In the drawings illustrating what I now consider to be a preferred form of my invention,

Fig. 1 is a sectional side elevation of a starting device embodying my invention.
Fig. 2 is a sectional view taken on the line 2—2 of Fig. 1.
Fig. 3 is an enlarged scale section taken on the line 3—3 of Fig. 1, and
Fig. 4 is a diagrammatic side elevation of an aeroplane embodying my invention.

Referring now to the drawings, wherein like reference characters indicate like parts throughout the several views, the structure of the present invention is adapted for use with any suitable type of engine or motor having a crank case 1 provided with a suitable bearing 2. Three brackets, 3, 3', 3'', in triangular relation, shown in Fig. 2, are secured at their outer ends to the crank case 1, in any suitable manner, such as by bolts 4, 4', 4''. At their respective opposite ends, the brackets 3, 3', 3'' are united and formed with a casing 5, in one wall of which is provided a suitable bearing 6, in axial alignment with the crank case bearing 2. A starter shaft 7, supported in the bearings 2, 6 and adapted for limited longitudinal movement relative thereto, is provided at one end with a ratchet 8. This latter member is arranged to coact with a similar ratchet 9 formed at one end of the engine or motor shaft 10 which is coaxial with the starter shaft 7. The motor shaft is operationally connected to an aeroplane propeller 11.

The casing 5 is formed with an inner wall 12, intermediate the bearings 2 and 6, having an opening into which is fitted a stationary flanged sleeve 13 concentrically positioned with respect to starter shaft 7, and a nut 14, for a purpose hereinafter to be described.

The nut 14, is engaged by a spiral gear 15 formed on the starter shaft 7 and having steep threads to give a relatively rapid movement.

The movement of said nut is controlled by a suitable clutch which is best illustrated in Fig. 3 and which comprises an inner clutch member 16, keyed or otherwise suitably secured to the nut 14, and having a convenient number of L-shaped notches 17, preferably three, in its periphery, in each of which are located balls 18. With this arrangement, when shaft 7 is rotated in a counter-clockwise direction as viewed in Fig. 3, the nut is free of the clutch, but when rotated in a clockwise direction, the nut is clutched.

A plate 19, is rigidly secured to the member 16, and is urged by a helical expansion spring 20, located within the casing 5, against a friction washer 21, interposed between said plate 19 and the stationary flanged sleeve member 13. The longitudinal movement of the starter shaft to the left, as viewed in Fig. 1, is limited by a stop 22 suitably secured to said shaft. From the foregoing, it will readily be understood that the nut or control member 14 is normally held in a fixed position by the friction washer 21 through the action of the expansion spring 20, and when the shaft 7 is rotated in a counter-clockwise direction, as viewed in Fig. 3, the same is caused to move forward, causing ratchet 8 to mesh with ratchet 9 on the motor shaft 10. If, however, the shaft 7 is now rotated in a clockwise direction, then, as above described, the ball clutch system is effective, to hold the nut against rotation and the clockwise rotation of the shaft 7, causes the shaft to return to its original position, disengaging said
ratchets. When the shaft 7 is rotating in a counter-clockwise direction with ratchets 8, 9 in mesh, and the speed of the motor shaft 10, rotating in the same direction, exceeds that of the starter shaft 7, ratchet 9 will ride over ratchet 8, pushing the shaft 7, nut 14 and inner member 16 back against the action of spring 20, and disengaging plate 19 from friction washer 21. The nut 14 and member 16, now being free, move forward on the spiral gear 15 by the action of spring 20 on plate 19, until the parts are restored to normal position, in which position the ratchet 8 is held free of ratchet 9.

The starter shaft is caused to rotate by a drum 23, mounted thereon, adjacent the bearings 6, as shown in Fig. 1. Preferably, the drum 23 is oval shaped, to obtain the largest leverage possible within the space available.

A ball clutch, similar to that described in connection with the nut 14, controls the rotation of said drum, but effective in a direction opposite to that controlling said nut; that is, when the drum is rotated in a counter-clockwise direction, when viewed from the left in Fig. 1, the clutch is effective, and the shaft 7 is rotated, but in the opposite direction, the rotation of said drum is independent of the starter shaft 7. The drum clutch mechanism is formed with a circular member 24, rigidly secured to the shaft 7, in any suitable manner, having on its periphery, L-shaped notches, and balls similar to slots 17 and balls 18, but oppositely arranged. The outer clutch race is formed by a flanged ring member 25, which is rigidly secured in any suitable manner to the drum, as shown in Fig. 1. The drum is rotated by means of a cable 27, suitably secured thereto, which cable is secured to a handle or lever 28, conveniently located to be operated by the aviator when sitting in the cockpit, as shown in Fig. 4. Suitable guide pulleys may be provided, as indicated at 29. Drum 23 is returned to its normal position in any suitable manner, such as by means of a rubber band 30 mounted on a circular flange 26 formed on said drum.

From the foregoing detailed description, the operation of my invention will be readily understood. To start the motor, the handle 28 is pulled in the direction of the arrow, which rotates the drum 23 in a counter-clockwise direction, looking to the right in Fig. 1. When so rotated, the drum clutch mechanism is effective, and the starter shaft 7 is also rotated in a counter-clockwise direction. When the starter shaft rotates in this direction, the ball clutch mechanism of nut or control member 14 is ineffective but said nut is yieldingly held against rotation by spring 20, member 16, plate 19 and washer 21. The rotation of the shaft 7, through the action of spiral gear 15 and said nut, causes the starter shaft 7 to move forward longitudinally, bringing ratchet 8 into mesh with ratchet 9, thereby rotating the motor shaft 10 is in the same direction to start the motor. After the motor starts, the speed of motor shaft 10 will exceed the speed of starter shaft 7, causing ratchet 9 to ride over ratchet 8, and push the starter shaft back, against the action of spring 20, thus moving the nut 14, member 16, and plate 19 free from the friction washer 21. The nut 14, now being free, is rotated forward to its original position by the spring 20. In the meantime, the release of handle 28 permits the drum to be rotated clockwise by the band 30, in which direction its clutch is free of the shaft 7, and the drum is set for a second operation.

If the motor should kick back, the shaft 7 will be rotated in a clockwise direction, in which case, the ball clutch mechanism of nut 14 is effective. To prevent rotation of said nut, and the clockwise rotation of the shaft moves ratchet 8 away from ratchet 9, the steep threads of the spiral gear 15 making this operation very rapid. The starter shaft 7 is thereby also again reset for operation.

It will therefore be seen that I have provided a very efficient and reliable device for starting aeroplane engines or motors, operable by the aviator from his seat in the aeroplane, making the services of an extra person to start the motor unnecessary, obviating the dangers accompanying the hand starting of propellers, and safeguarding the machine from damage by the backward kick of the motor.

While I have described my invention as embodied in concrete form in accordance with the provisions of the patent statutes, it should be understood that I do not limit my invention thereto, since various modifications thereof will suggest themselves to those skilled in the art, without departing from the spirit of my invention, the scope of which is set forth in the annexed claims.

Having herein described my invention, what I claim and desire to secure by Letters Patent is,

1. In an aeroplane, a device for starting the motor comprising a starter shaft, means for rotating said shaft from the aviator's seat, means for moving said shaft longitudinally when the latter is rotated, said last-named means being also movable longitudinally with said shaft, resilient means opposing the longitudinal movement of said last-named means, and means for preventing the rotation of said second means in one direction.

2. In an aeroplane, a device for starting the motor comprising a starter shaft, means for rotating said shaft from the aviator's seat, means for automatically moving said shaft longitudinally upon rotation thereof, said means being also capable of a longitudinal movement, means limiting the movement of said second means in one direction, resilient means opposing the movement of said second
means in the opposite direction, and means for preventing the rotation of said second named means in one direction.

5. In an aeroplane, a device for starting the motor comprising a starter shaft movable longitudinally, having a spiral gear, means for rotating the starter shaft from the aviator's seat, a rotatable nut having a ball clutch mechanism preventing its rotation in one direction cooperating with said gear, a friction element, and resilient means normally holding said nut against said friction element and opposing the longitudinal movement of said nut in one direction, when the shaft moves in that direction.

4. In an aeroplane, a device for starting the motor comprising in combination a longitudinally movable starting element, means for rotating said starting element from the aviator's seat, a motor shaft, means for moving said element into engagement with said shaft when rotated, thereby rotating said shaft, means for moving said element back out of engagement with said element when the speed of the latter exceeds that of the former, means cooperating with said first named means and movable longitudinally with said element, and resilient means opposing the backward movement of said cooperating means for restoring said element and shaft to their original positions when the shaft is moved backwards.

5. In an aeroplane, a device for starting the motor comprising in combination a motor shaft, a starting shaft movable longitudinally, means for rotating the starting shaft from the aviator's seat, a spiral gear on said starting shaft, a nut cooperating with said gear to move the starting shaft forward into engagement with the motor shaft when the former is rotated, said nut being longitudinally movable with the starting shaft in a backward direction, ratchets on the starting and motor shafts arranged to push the starting shaft back when the speed of the motor shaft exceeds its speed, and resilient means opposing the backward movement of said nut, arranged to move the nut forward when the starting shaft is pushed back, thereby restoring the starting and motor shafts to their original positions.

6. In an aeroplane, a device for starting the motor comprising in combination, a starter shaft, a motor shaft, and means for moving said starter shaft to effective position into engagement with said motor shaft, said means including a nut, said starter shaft having a threaded portion engaging in said nut, means for holding said nut fixed while said starter shaft moves therethrough to effective position, and means whereby said nut is released when the speed of the motor shaft exceeds the speed of the starter shaft.

7. In an aeroplane, a device for starting the motor comprising in combination, a starter shaft, a motor shaft, and means for moving said starter shaft to effective position into engagement with said motor shaft, said means including a nut, said starter shaft having a threaded portion engaging in said nut, means whereby said starter shaft is moved through said nut to effective position, means whereby said shaft is moved to ineffective position when the speed of the motor shaft exceeds the speed of the starter shaft, and means whereby said nut is moved relative to said starter shaft, when the latter is moved into ineffective position, to maintain said starter shaft in ineffective position.

8. In a device for starting a motor, a starter shaft having a threaded portion thereon, a nut threaded on said shaft, means for rotating said shaft in one direction only for starting, means for yieldingly resisting rotation of said nut in said direction, and means for preventing rotation of said nut in the opposite direction.

9. In a device for starting a motor, a motor shaft, a starter shaft normally disengaged from but adapted to be moved into cranking engagement with said motor shaft, said starter shaft having a threaded portion thereon, a nut threaded on said shaft, means for rotating said shaft, means for yieldingly resisting rotation of said nut with said shaft in one direction so as to effect cranking engagement between said shafts, and means for positively preventing rotation of said nut in the opposite direction so as to effect disengagement of the shafts when the motor backfires.

10. In a motor starting device, the combination of a ratchet member secured to a rotatable member of the motor to be started, a starting shaft having a threaded portion thereon, a ratchet member adapted for rotation with said shaft and for cranking engagement with the motor ratchet member, a nut threaded on said starting shaft, means for causing longitudinal movement of said shaft relative to said nut so as to effect cranking engagement of the ratchet member, and means including said nut for returning said shaft to its original position when the motor starts under its own power.

11. In a motor starting device, the combination of a starting shaft normally out of engagement with but adapted to be moved into engagement with and to crank a member of the motor to be started, means for...
moving said shaft into cranking engagement
with the motor member, and means for rotat-
ing said starting shaft including a drum
mounted on said shaft, means for manually
rotating said drum in one direction, resilient
means carried by said drum for rotating the
latter in the opposite direction, and means
comprising an over-running clutch drivably
connecting said drum to said shaft for rota-
tion together in one direction only.

13. In starting mechanism for a motor hav-
ing a rotatable shaft, a member adapted to
engage and rotate said shaft, said member
having a threaded portion, a control mem-
ber operatively engaging the threaded por-
tion of the shaft and adapted for longitudi-
nal movement relative to the first named
member and shaft, means for holding said
control member against rotation in one di-
rection, means for yieldingly holding the con-
trol member against rotation in the other di-
rection, and means for rotating the first
named member.

14. In apparatus of the class described, a
driven member, a driving member adapted
to be moved into engagement with the driven
member and having a threaded portion, con-
trol means engaging said threaded portion,
means for yieldingly holding said control
means against movement during movement
of the driving member into engaging posi-
tion, means for positively holding the con-
trol means against rotation in one direction,
and means for rotating the driving member.

35 In testimony whereof I have affixed my
signature.

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