April 6, 1965 E. ROSE 3,176,525

STARTER MECHANISM FOR REVERSIBLE ENGINE

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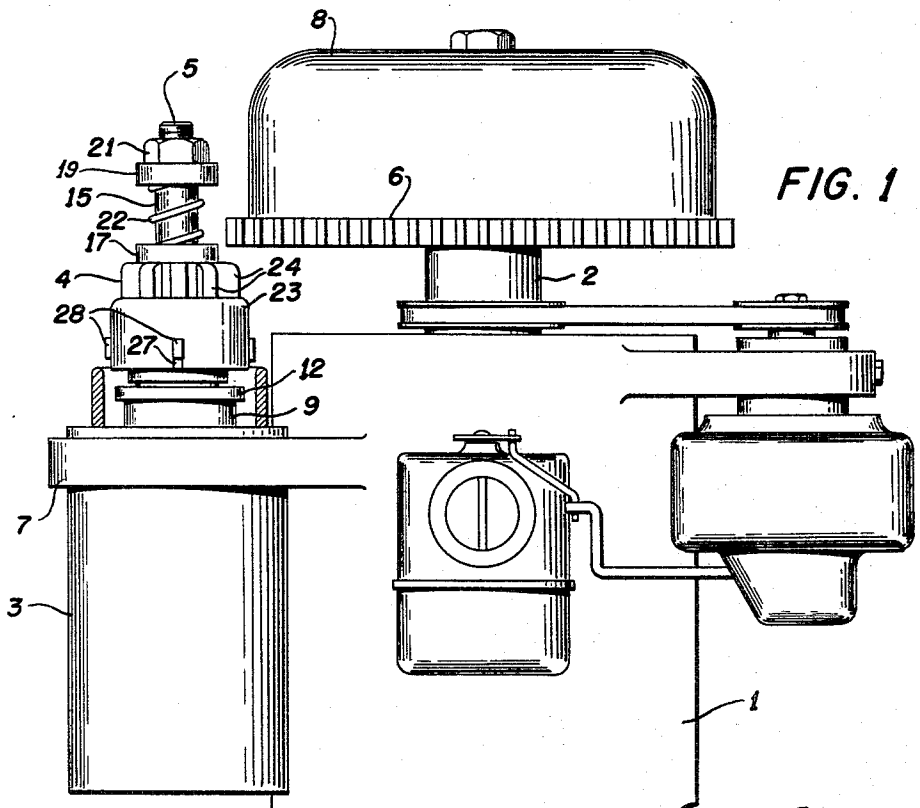


FIG. 1

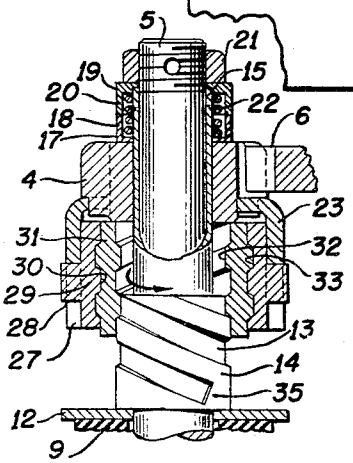


FIG. 3

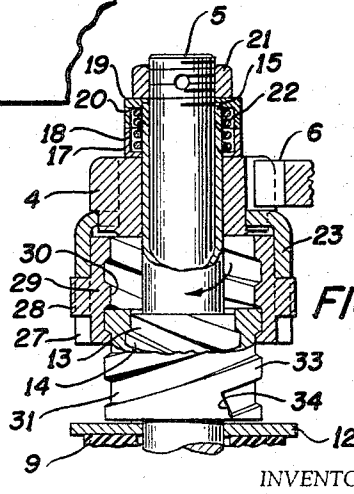


FIG. 4

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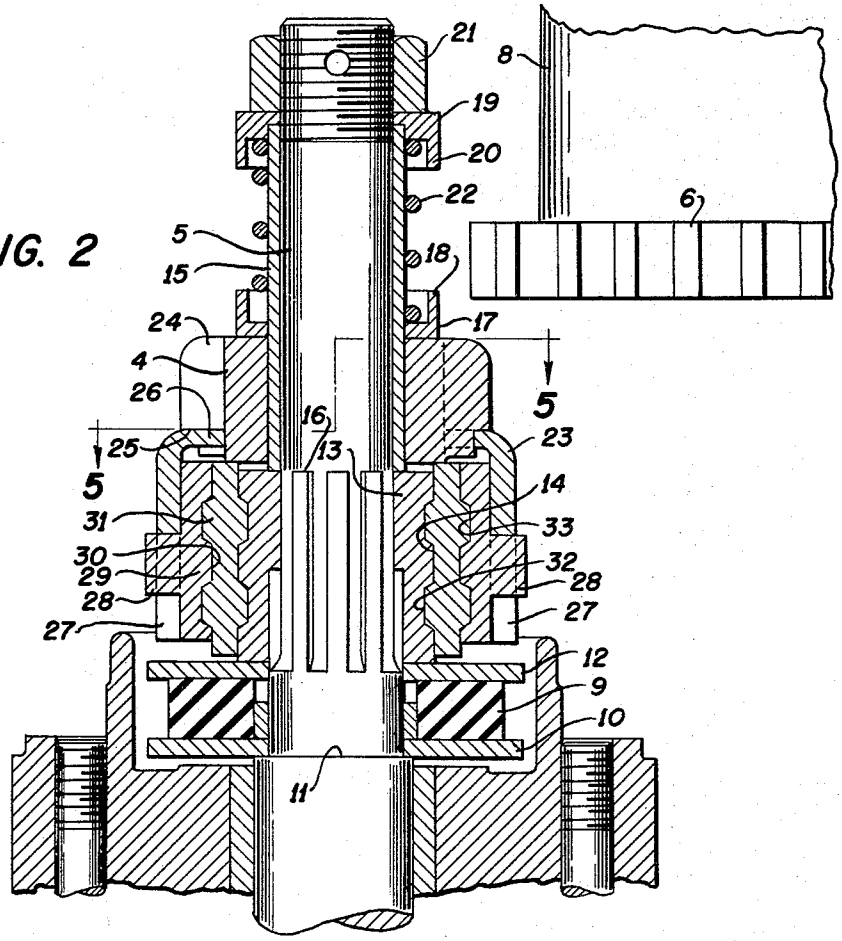
Attorneys

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FIG. 2



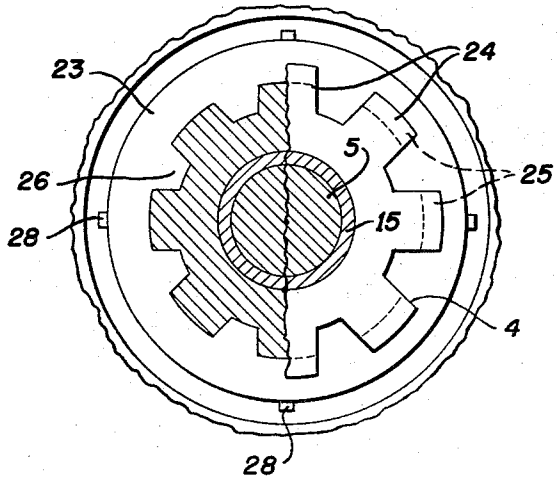


FIG. 5

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STARTER MECHANISM FOR REVERSIBLE ENGINE

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6 Claims. (Cl. 74—7)

This invention relates to a starter mechanism for a reversible internal-combustion engine.

Electric motors are commonly employed to crank internal-combustion engines for starting. For unidirectional engines, a pinion gear is mounted on a helix carried by the motor shaft. Upon starting the motor to crank the engine, the inertia of the pinion gear is relied upon to hold it against rotation and the gear moves axially along the helix into engagement with the engine gear and then proceeds to crank the engine. After the engine is started, the overrunning engine gear kicks the starter pinion gear out of engagement.

For reversible engines, reversible electric starter motors have been employed and the helix on the starter motor shaft commonly carries a pair of pinion gears. The respective pinion gears are spaced from each other and disposed on opposite sides from the engine gear. For starting the reversible engine in a given direction, the starter motor shaft is driven in a corresponding direction to move the corresponding pinion gear into engagement with the engine gear. For starting the engine in the opposite direction, the starter motor shaft is reversed to move the other of the pinion gears into engagement with the engine gear.

In still another type of starter mechanism for reversible engines, the helix on the starter motor shaft carries but a single pinion gear which is disposed between and adapted to engage selectively either of a pair of engine gears depending on the direction for starting.

According to the present invention, a single pinion gear is carried on the shaft of a reversible electric starting motor and is adapted to move into engagement with a single engine gear of a reversible internal-combustion engine and crank the same in either direction for starting as desired.

The embodiment of the invention illustrated in the drawings and described hereinafter provides that a reversible electric starter motor be supported relative to a reversible internal-combustion engine so that driving engagement may be effected between the starter pinion gear carried on the starter motor shaft and the engine starter gear. An intermediate sleeve is disposed between the starter motor shaft and the starter gear or its carrier. The sleeve is provided with an internal helix corresponding to the helix provided on the motor shaft. Externally the sleeve is provided with an opposed helix which corresponds to the helix on the pinion gear or its carrier. When the starter motor is energized to crank the engine in one direction for starting, the sleeve is locked relative to the shaft and the pinion gear moves on the external sleeve helix axially of the motor shaft into engagement with the engine gear. When the starter motor is energized to crank the engine in the opposite direction, the sleeve is locked relative to the pinion gear and the gear and sleeve together move axially on the shaft helix into engagement with the engine gear.

The drawings furnished herewith illustrate the best mode of carrying out the invention as presently contemplated and set forth hereinafter.

In the drawings:

FIG. 1 is an elevational view of a reversible internal-combustion engine and shows the starting mechanism of this invention;

FIG. 2 is an enlarged sectional view with parts broken away showing the starter mechanism of this invention in the inoperative position;

FIG. 3 is an elevational view partially in section and with parts broken away and sectioned and shows the starter pinion gear in position for cranking the engine in one direction for starting;

FIG. 4 is a view similar to that of FIG. 3 and shows the starter pinion gear in position for cranking the engine in the opposite direction for starting; and

FIG. 5 is a view taken on line 5—5 of FIG. 2.

Referring to the drawings, the internal-combustion engine 1 is of the reversible type wherein the crankshaft 2 may be driven in either a clockwise or counterclockwise direction.

A starter mechanism is provided for the engine 1 and includes a reversible electric starter motor 3 which is supported relative to the engine so that driving engagement may be effected between the starter pinion gear 4 carried on the starter motor shaft 5 and the engine starter gear 6. In the embodiment shown in the drawings, the starter motor 3 is supported by a bracket member 7 formed integrally with the engine and which is adapted to place the starter motor shaft 5 in adjacent relation to the engine starter gear 6 carried by the flywheel 8 mounted on the engine crankshaft 2.

According to this invention, the pinion gear 4 carried by the reversible starter motor shaft 5 is adapted to drivingly engage the engine gear 6 to crank the reversible engine 1 in either a clockwise or counterclockwise direction for starting as desired.

As illustrated in the embodiment shown in the drawings, the reversible starter motor shaft 5 carries an annular cushioning pad 9 sandwiched between the washer member 10 which rests on shoulder 11 of shaft 5 and the axially movable washer member 12. The annular member 13 provided with a spiral or helix 14 outwardly thereof is splined or otherwise secured on the shaft 5 for rotation therewith and is slidable axially of the shaft. Disposed in engagement with washer member 12, axial movement of member 13 in the direction of shoulder 11 is yieldingly resisted by cushioning pad 9 and is limited in the opposed direction by the lower end of the bearing sleeve 15.

The bearing sleeve 15 rests on shoulder 16 of shaft 5 and slidably and rotatably mounts the pinion gear 4. Axial movement of pinion gear 4 into engagement with the engine gear 6 is resisted by yielding means including the cup washer 17 having an upwardly extending flange 18 disposed on sleeve 15 in engagement with the pinion gear. A second cup washer 19 having a downwardly extending stop flange 20 is spaced above cup washer 17 and is fixedly secured to the shaft 5 between the upper end of sleeve 15 and the nut 21. The compression spring 22 seated between the spaced cup washers 17 and 19 serves to bias the pinion gear 4 out of engagement with the engine starter gear 6.

The pinion gear 4 is supported and carried by a carrier assembly including the annular carrier member 23 which is generally spaced outwardly and concentrically of annular member 13. The several teeth 24 of pinion gear 4 are each provided with an outwardly disposed lower stepped portion defining a radially extending downwardly facing shoulder 25. The respective shoulders 25 on pinion gear 4 rest on an inwardly extending flange 26 provided on the upper end of carrier member 23. The flange 26 further extends inwardly into the root cavities between the several teeth 24 of the pinion gear to rotationally lock the gear and carrier together. Thus, the mounting of the pinion gear 4 relative to its carrier 23 provides that as the carrier moves upwardly axially of the shaft 5 the pinion gear will move correspondingly on the bearing

sleeve 15, and rotation of the carrier will effect corresponding rotation of the gear.

The carrier member 23 for the pinion gear 4 is provided with a plurality of circumferentially spaced axially extending slots 27 at the lower end thereof for receiving the corresponding radial projections 28 of the annular member 29 upon which the carrier member is mounted. The interengagement between the slots 27 and projections 28 serve to rotationally interlock the members 23 and 29 and further provide that the members will move axially upwardly together as a unit to move the pinion gear 4 into engagement with the engine starter gear 6.

The annular member 29 interlocked with the carrier member 23 is spaced radially outwardly from the annular member 13 splined on the starter motor shaft 5 and is provided internally thereof with a helix 30 which is of opposite hand to the helix 14 on member 13.

The means for traversing the pinion gear 4 into engagement with the engine gear 6 for either direction of rotation of starter motor shaft 5 further includes the annular intermediate sleeve 31 disposed between the inner and outer annular members 13 and 29. The sleeve 31 is provided with internal and external helices 32 and 33 adapted for threaded engagement with helix 14 of member 13 and helix 30 of member 29, respectively.

To limit the movement of member 29 relative to sleeve 31 in the direction of cushioning pad 9, the external helix 33 of sleeve 31 terminates in a shoulder 34 which is engageable by an opposing shoulder, not shown, of helix 30. Movement of sleeve 31 relative to member 13 in the direction of cushioning pad 9 is similarly limited by the shoulder 35 of helix 14.

In operation and to crank the engine shaft 2 for operation in a clockwise direction, the starter motor 3 is energized to drive the motor shaft 5 in a counterclockwise direction as shown in FIG. 3. Rotation of the shaft 5 is transmitted to the annular member 13 through the splined connection therewith and the inertia of sleeve 31 and the parts carried thereby causes the sleeve to move upwardly on helix 14 carrying the pinion 4 and pinion carrier assembly upwardly therewith because of the engagement with shoulder 34 against the pressure of spring 22. Upward movement of the pinion 4 is arrested when the flange 18 of washer 17 engages the stop flange 20 of the fixed washer 19 placing the pinion in meshing engagement with the engine gear 6. Thereafter, rotation of the pinion gear 4 by the motor shaft 5 cranks the engine. Upon starting of the engine, the acceleration of the engine gear 6 overruns the pinion gear 4 causing the latter to return to its normal or inoperative position out of engagement with the engine gear.

To crank the engine in the opposed direction, the starter motor is energized to drive shaft 5 in the clockwise direction, as shown in FIG. 4. In this instance, the rotation of shaft 5 is transmitted through the annular member 13 to the sleeve 31 which is prevented from moving axially relative to member 13 by engagement with shoulder 35 and the inertia of the pinion 4 and carrier assembly causes the assembly to move upwardly on helix 33 of sleeve 31 to carry the pinion 4 into meshing engagement with the engine gear 6. Upon engagement of the cup washers 17 and 19, further rotation of shaft 5 causes the pinion gear 4 to crank the engine. The acceleration of the engine gear 6 after starting of the engine, will again overrun the pinion gear 4 causing its return to its inoperative position.

Various modes of carrying out the invention are contemplated as being within the scope of the following claims particularly pointing out and distinctly claiming the subject matter which is regarded as the invention:

I claim:

1. In a reversible engine starter drive a power shaft, a hollow screw shaft splined thereon, an internally and externally threaded sleeve threaded on the screw shaft, a pinion-control nut threaded on the sleeve for movement of the pinion into and out of mesh with a gear of an engine to be started, the internal and external threads of said sleeve being of opposite hand; means positively limiting the movement of the pinion-control nut and sleeve in the meshing direction, and yielding means resisting movement of the screw shaft in the opposite direction.

2. An engine starter drive as set forth in claim 1, including further yielding means urging the sleeve and pinion-control nut in the direction to demesh the pinion from the engine gear.

3. An engine starter drive as set forth in claim 2 including further means on the screw-shaft to limit the travel of the threaded sleeve thereon in the demeshing direction.

4. An engine starter drive as set forth in claim 3 including further means on the threaded sleeve for limiting the travel of the pinion-control nut thereon in the demeshing direction.

5. Starting means for a reversing internal-combustion engine having a starting gear, comprising a reversible starter motor having a shaft disposed adjacent the starting gear, a pinion mounted on the starter motor shaft and being movable axially of the shaft into and out of engagement with the engine starting gear, an annular carrier for said pinion and having an internal helix, a helix means nonrotatably secured on the starter motor shaft of opposite hand from the carrier helix, and an intermediate member disposed between the shaft and the pinion carrier and having internal and external helics meshing respectively with the corresponding helices of the helix means and carrier to provide a pair of opposite hand helical mountings for the pinion carrier, said shaft being selectively rotatable in a clockwise or counterclockwise direction to intertially move the carrier and pinion into engagement with the starting gear on one of said helical mountings to crank the engine in a given direction.

6. In a reversible engine starter drive; a power shaft; a pinion carried on said shaft and being movable axially thereon into and out of engagement with a gear of an engine to be started; an externally threaded annular member splined on said shaft; an internally and externally threaded sleeve in threaded engagement on said externally threaded member; an internally threaded annular carrier for said pinion in threaded engagement on said sleeve; the internal and external threads of said sleeve being of opposite hand; means positively limiting the movement of the pinion, the pinion carrier, and sleeve in the meshing direction; and yielding means resisting movement of the externally threaded annular member in the opposite direction.

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