

July 16, 1957

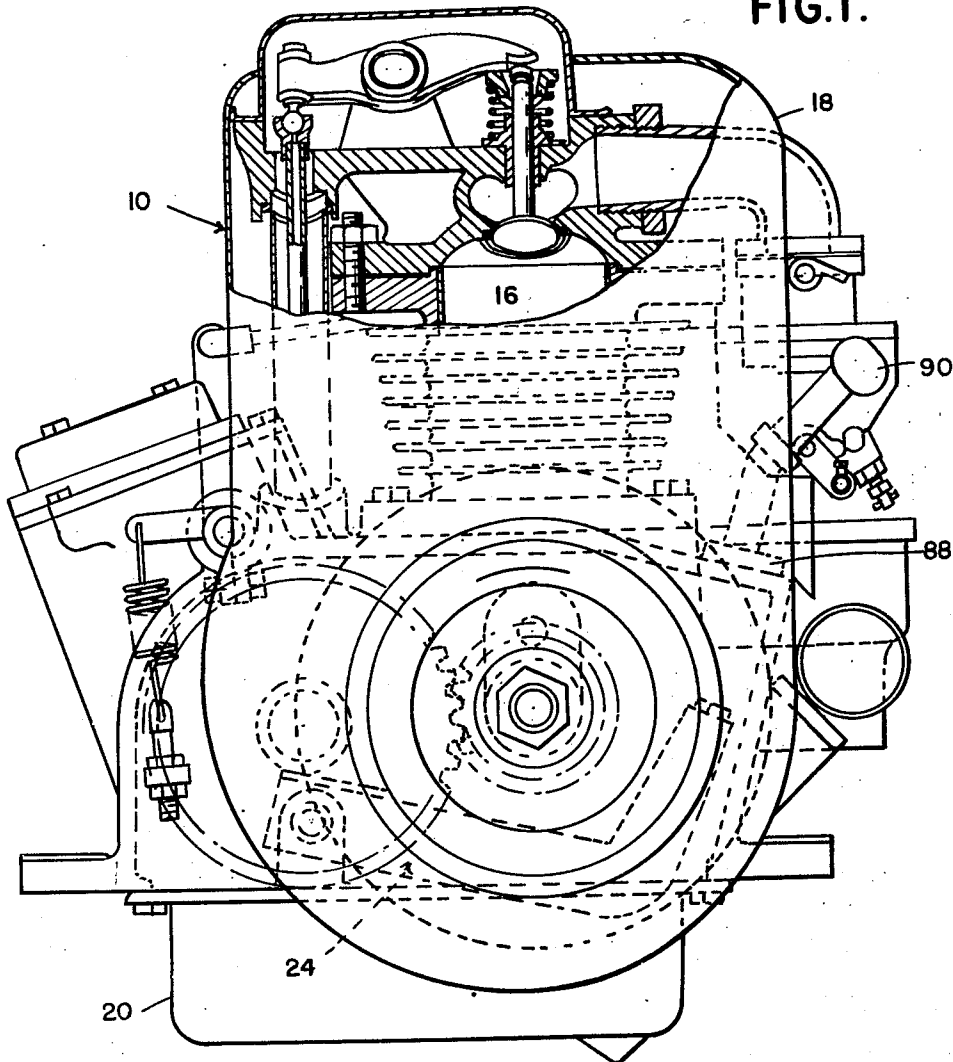
L. D. BAKKE ET AL
RECOIL STARTERS

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3 Sheets-Sheet 1

FIG. 1.



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FIG. 2.

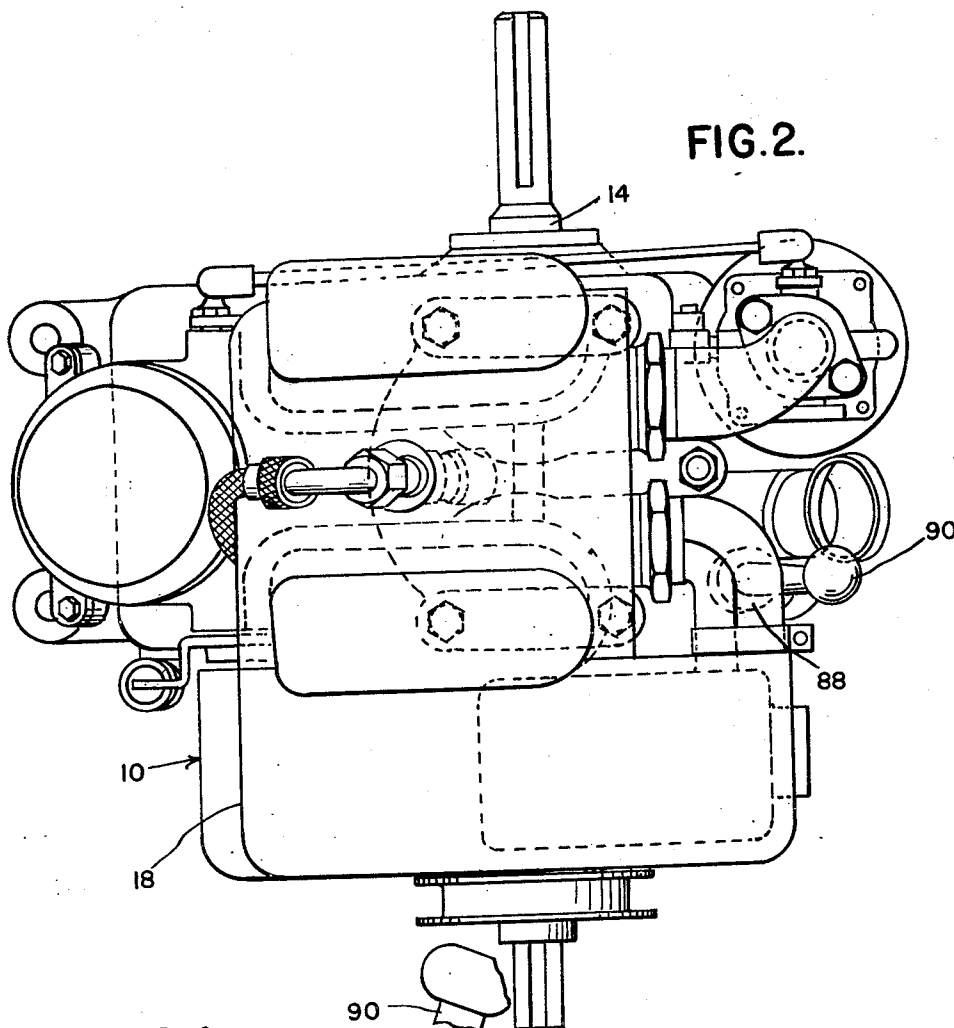
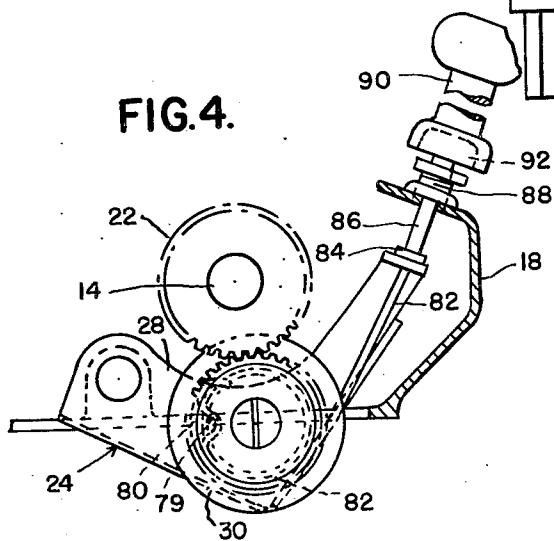


FIG. 4.



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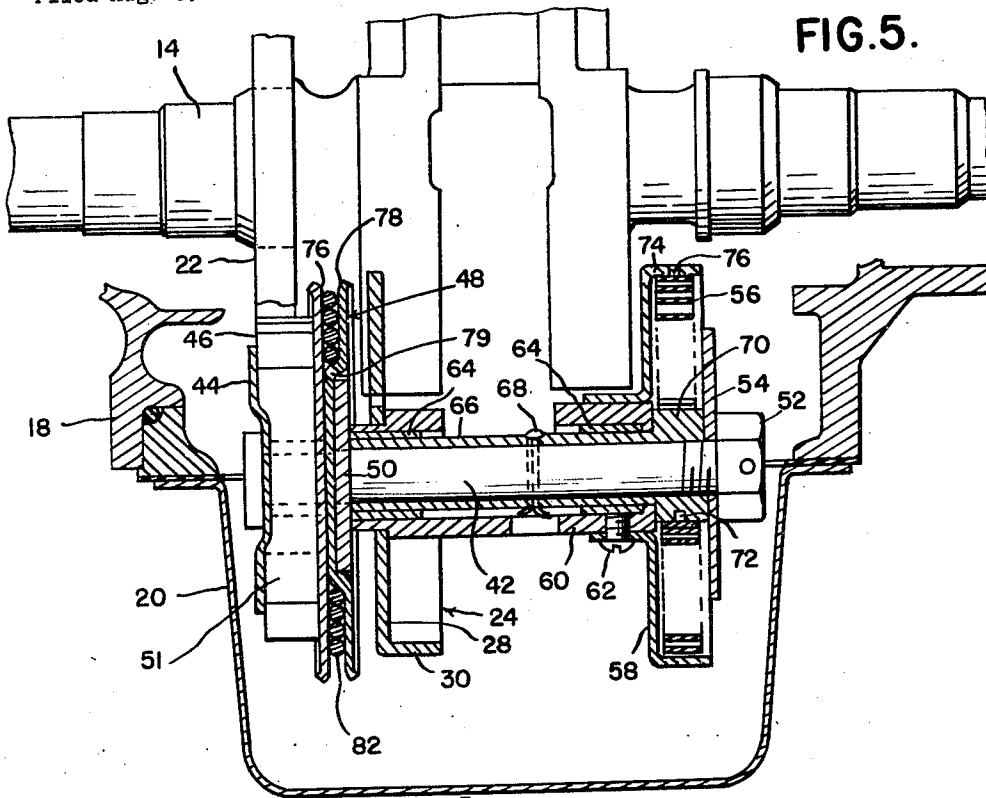


FIG. 5.

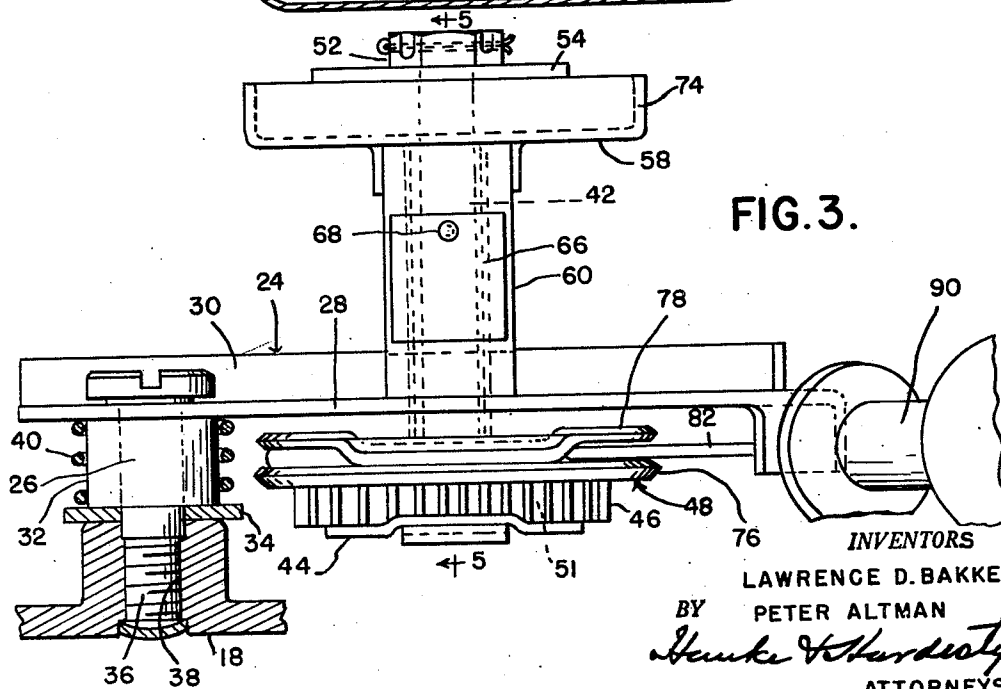


FIG. 3.

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RECOIL STARTERS

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2 Claims. (Cl. 123—185)

This invention relates to a recoil starting mechanism and more particularly to a recoil starter embodied within an engine, whereby the entire mechanism is compactly arranged as a unit.

Small engines which require an applied torque for starting are generally constructed with a separable cable wrapped about an outboard pulley on the crankshaft of the engine. The engine is started by drawing on the cable, thus rotating the crankshaft. The cable and pulley are on the outside of the engine housing. The cable is separable from the engine pulley.

In the instant invention the starting cable is fixed to the starting mechanism, which is enclosed by the engine housing. Only a manual operating handle connected to the cable is exteriorly arranged on the outer surface of the housing.

The compactness of the construction provides for a permanent cable affixed to the starting mechanism inside the engine housing, a crankshaft engageable and disengageable starting mechanism, an automatic cable rewinding mechanism, and a starting mechanism for an engine which is adapted to permit repeated pumping on the engine crankshaft without disengagement of the starter from the crank gearing.

These and other features of the construction will become more apparent as the description of the invention unfolds below. For a visual understanding of the invention, reference may be had to the accompanying drawings in which like parts are referred to by like reference numerals throughout the several views illustrating a preferred embodiment of the invention, in which

Fig. 1 is a vertical side elevational view, partly in section, of the engine embodying the inventive recoil starting mechanism.

Fig. 2 is a plan view of the engine of Fig. 1.

Fig. 3 is a plan view of the recoil starting mechanism.

Fig. 4 is a vertical side elevational view of the mechanism of Fig. 3.

Fig. 5 is a vertical sectional view of the line 5—5 of Fig. 3.

As shown in Figs. 1 and 2, the engine 10, in which the novel and inventive recoil starting mechanism is embodied, comprises a single cylinder internal combustion engine having a crankshaft 14 rotatably driven by a rod connected piston 16. The engine is contained in a housing 18 having a bottom pan 20 attached thereto below it. Crankshaft 14 has a driven gear 22 fixedly mounted thereon, adapted to be engaged by the recoil starting mechanism 12 for rotating the crankshaft and starting the engine.

The recoil starting mechanism 12, Figs. 3, 4 and 5, comprises a hanger 24 pivotally mounted on engine housing 18 and adapted to pivot in a vertical plane about pivot pin 26. Hanger 24 has a vertically arranged portion 28 through which pivot pin 26 is passed. A stiffening flange 30 is formed in the hanger 24 along its bottom edge. Exteriorly of hanger portion 28 and pivot pin 26 is a spacing tube 32 and a washer 34 holding hanger 24 in

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spaced relation to housing 18. Pivot pin 26 has a threaded end 36 adapted to thread into housing 18 at opening 38. About spacing tube 32 is a coil spring 40 having its ends arranged in such a way with and connected to hanger 24 and housing 18 as to urge hanger 24 constantly in a downward direction. The purpose of this action will be described in more detail below, in connection with the operation of the recoil starting mechanism 12.

Mounted on hanger 24 is a shaft 42, arranged in a direction opposite to that of pivot pin 26, whose axis it parallels. As seen more clearly in Figs. 3 and 5, shaft 42 carries a dished washer 44, a clutch connected driving gear 46, a shaft affixed driving sheave 48, and a thrust washer 50. A one-way overrunning driving gear slip clutch 51 is located within the bore of driving gear 46 between washer 44 and sheave 48. These elements are located to the left of hanger 24 in Fig. 5. At the extreme right end of shaft 42 (Fig. 5) is a locking nut 52 threadedly mounted thereon and holding retainer 54 against recoil spring 56 in recoil spring housing 58. Housing 58 is mounted on cross tube 60 and held fixedly in place thereon by screw 62. Cross tube 60 extends from hanger portion 28, to which it is affixed, to recoil spring 56, and is adapted to rotate upon bearings 64 arranged on the spacer tube 66. This latter spacer tube is fixedly connected to shaft 42 by a split rivet 68. A hub 70 fixed on shaft 42 adjacent recoil spring retainer 54 is used to anchor the inner end 72 of recoil spring 56, and the flange 74 of housing 58 is used to anchor the outer end 76 of recoil spring 56, which is in the shape generally of a watch spring.

Returning now to driving sheave 48, it will be noted that it comprises two formed discs, 76 and 78 respectively. Through an opening 79 in disc 78, one end 80 of a cable 82 is passed so that the cable end 80 is firmly held between sheave disc 78 and washer 50. The cable end 80 is substantially compressed and flattened out. Cable 82 is shown wound around sheave 48 in several turns and leading through hanger fitting 84, cable housing 86, and engine housing fitting 88 to cable handle 90 where it is securely anchored. A recess 92 at the bottom of handle 90 is adapted to seat over engine housing fitting 88, when the handle 90 is at rest on the engine housing 18.

Inside driving gear 46, between washer 44 and sheave 48, is the slip clutch mechanism 51—which is not claimed as a part of the inventive recoil starting mechanism—that permits slip of driving gear 46 when the engine has been started, if driving gear 46 is still engaged with crankshaft mounted driven gear 22. The one-way overrunning slip clutch mechanism 51 is of standard and conventional construction, and details thereof are therefore not included.

In operation, to start engine 10, the cable handle 90 is grasped by hand and cable 82 is drawn forth from within engine housing 18. When cable 82 is first drawn upon, it will lift hanger 24 upward, causing driving gear 46 to engage with crankshaft mounted driven gear 22. Further draw on cable 82 will cause sheave 48 to rotate, causing driving gear 46 to rotate which in turn rotates driven gear 22. At the same time, recoil spring 56 is being wound up on shaft hub 70. Because recoil spring housing 58 does not rotate, being connected to non-rotating hanger 24 through cross tube 60, it is seen that after cable 82 has run off the sheave 48 to the affixed end 80, the recoil spring 56 will urge sheave 48 to rotate in the reverse direction and wind up cable 82 again thereon, drawing cable handle 90 back toward engine housing fitting 88. Hanger 24 will remain in uplifted position, i. e. with driving gear 46 engaged with driven gear 22, due to the tension on the cable 82 from the wound-up recoil spring 56, until cable handle 90 seats fitting 88 in handle recess 92, at which time the recoil spring 56 will be fully unwound, and hanger

24 then pivot downwardly, being urged in that direction by coil spring 40 as well as by the force of gravity. The principal function of spring 40 is to hold hanger 24 against accidental upward swing when engine 10 is in operation, thus preventing damage to gears 46 and 22.

So long as the cable handle 90 is not seated on fitting 83, the cable 82 will be under tension from the recoil spring 56, retaining the hanger 24 upwardly and the gears in mesh, and the cable 82 may be repeatedly drawn out or recoiled without disengagement of gears 46 and 22. This particular feature is provided for by the one-way over-running slip clutch 51 permitting the sheave to recoil without actuating the gears in the other direction.

All of this time, recoil spring 56 is winding and unwinding on shaft 42, as cable 82 unwinds and rewinds on sheave 48. The entire recoil starting mechanism 12, with the exception of cable handle 90, is completely encased within engine housing 18, where it is compactly arranged with crankshaft 14 to effectively start engine 10. The cable 82, preferably made of wire rope, is fixed in sheave 48, and does not require any manual winding, such as occurs in outboard motors and the like.

It will be apparent to those skilled in the art to which this invention pertains that various modifications and changes may be made without departing from the spirit of the invention or from the scope of the appended claims.

I claim:

1. In an internal combustion engine having a crankcase, a crankshaft rotatably supported in said crankcase, and a starter driven gear secured to said crankshaft, a recoil starter mechanism housed in said crankcase and comprising a hanger member pivotally supported by said crankcase and disposed below said crankshaft, said hanger member movable in a plane normal to the crankshaft axis, means resiliently urging said hanger member downwardly, a lay shaft supported by said hanger member and disposed parallel to and substantially directly below said crankshaft axis, a driving gear rotatably supported on said lay shaft and operable to engage said crankshaft driven gear when said hanger member is actuated upwardly, a cable sheave rotatably supported on said lay shaft and operably connected to said driving gear to rotate same in one direction only, a cable affixed to and wound on said sheave, said cable operable on being pulled to initially pivot said hanger member upwardly to engage said driving and driven gears, and on being further pulled to rotate said sheave while unwinding from same, said sheave thereby

rotating said driving gear, and a recoil spring mechanism connecting said sheave and said hanger member and operable to wind up as said cable is unwound from said sheave, and to rewind said cable when said cable is released, said hanger member being held in raised position by the tension of said cable against said recoil spring mechanism until said recoil spring mechanism is unwound.

2. In an internal combustion engine having a crankcase, a crankshaft rotatably supported in said crankcase, and a starter driven gear secured to said crankshaft, a recoil starter mechanism housed in said crankcase and comprising a hanger member pivotally supported by said crankcase and disposed below said crankshaft, said hanger member movable in a plane normal to the crankshaft axis, means resiliently urging said hanger member downwardly, a lay shaft supported by said hanger member and disposed parallel to and substantially directly below said crankshaft axis, a driving gear rotatably supported on said lay shaft and operable to engage said crankshaft driven gear when said hanger member is actuated upwardly, a cable sheave rotatably supported on said lay shaft and operably connected to said driving gear to rotate same in one direction only, a cable affixed to and wound on said sheave, said cable operable on being pulled to initially pivot said hanger member upwardly to engage said driving and driven gears, and on being further pulled to rotate said sheave while unwinding from same, said sheave thereby rotating said driving gear, and a recoil spring mechanism connecting said sheave and said hanger member and operable to wind up as said cable is unwound from said sheave, and to rewind said cable when said cable is released, said hanger member being held in raised position by the tension of said cable against said recoil spring mechanism until said recoil spring mechanism is unwound, said sheave and said driving gear mounted on one end of said lay shaft and said recoil spring mechanism mounted on the other end of said lay shaft and spaced from said sheave and driving gear, and parts of said rotating crankshaft operating in the space between said recoil spring mechanism and said sheave and driving gear.

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