Sept. 12, 1961 L. J. HAMMAN 2,999,490

SPRING STARTER

Filed April 27, 1959 3 Sheets-Sheet 1

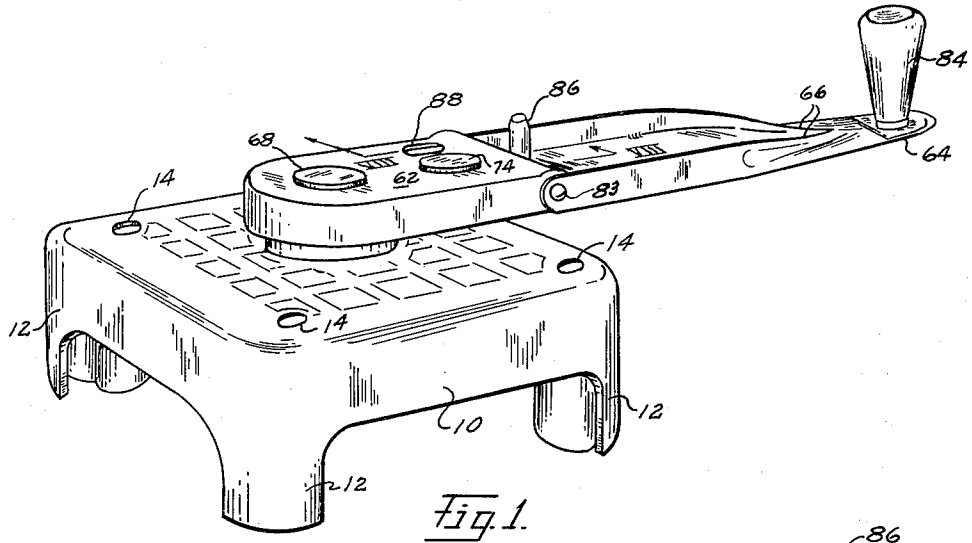


Fig. 1.

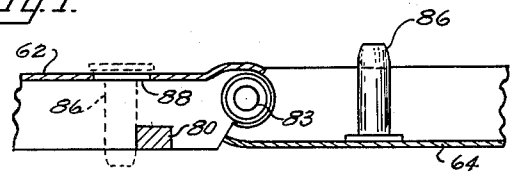


Fig. 8.

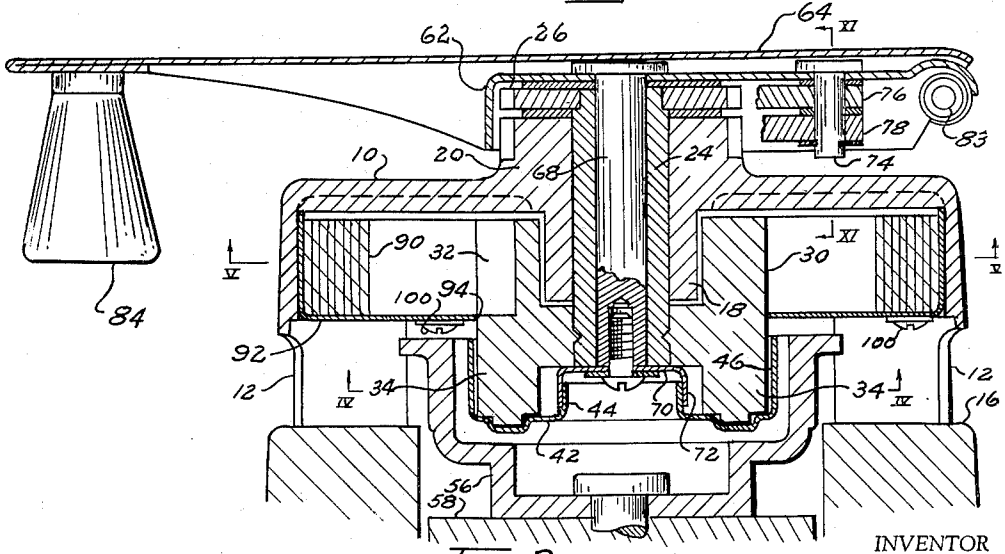


Fig. 2.

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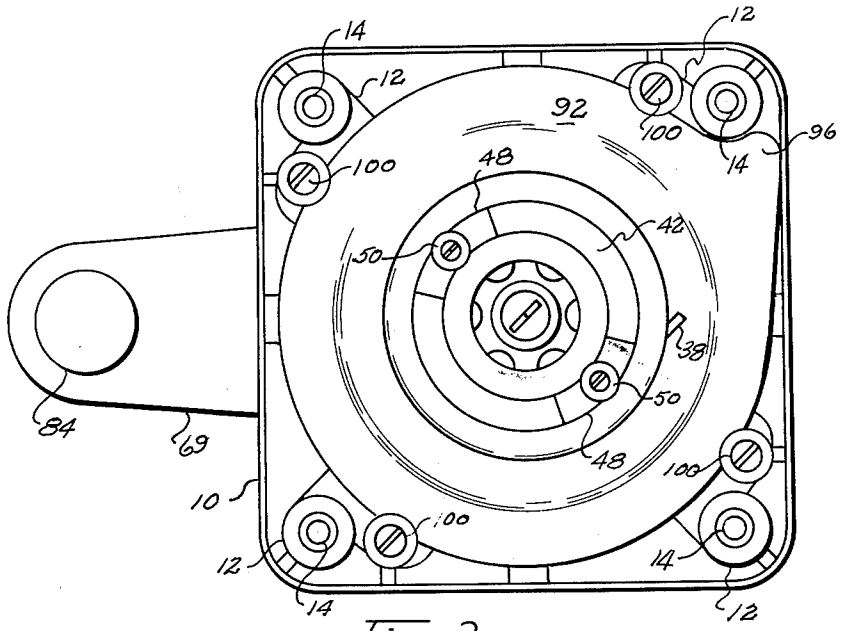


Fig. 3.

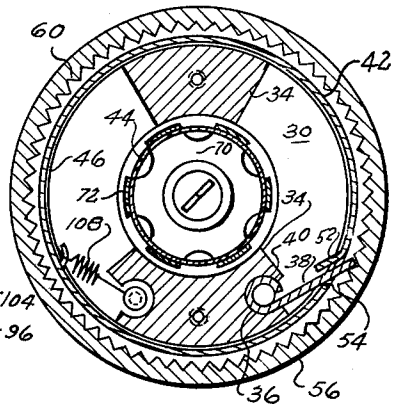


Fig. 4.

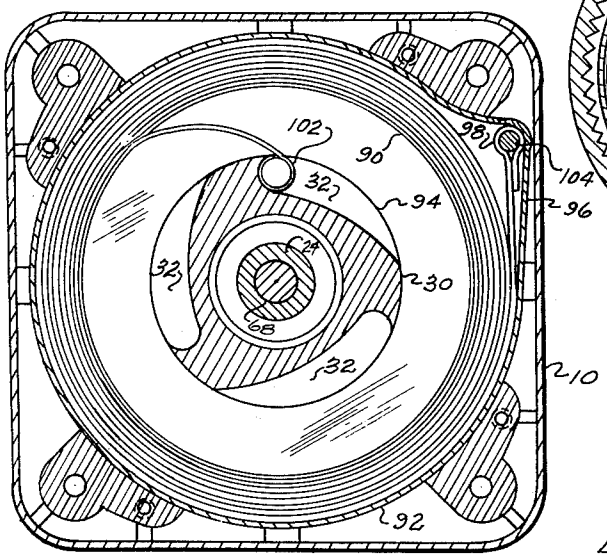


Fig. 5.

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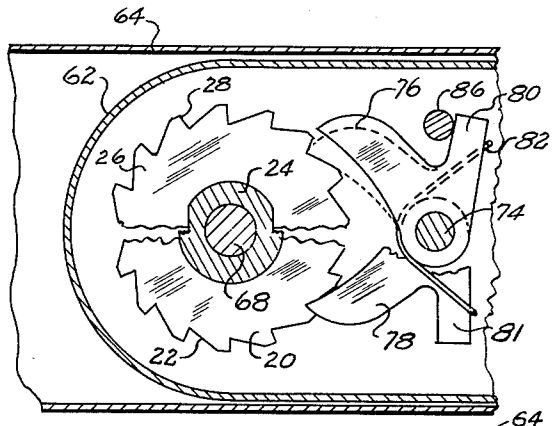


Fig. 6.

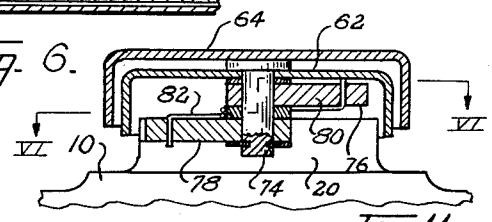


Fig. 11.

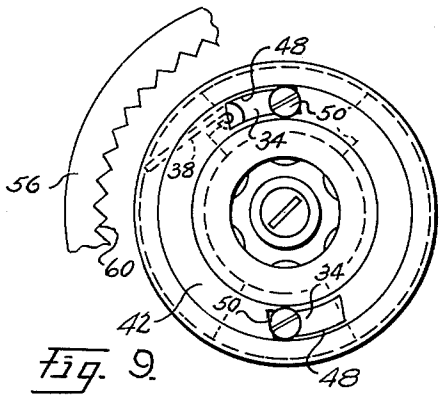


Fig. 9.

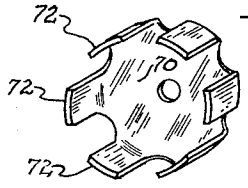


Fig. 7.

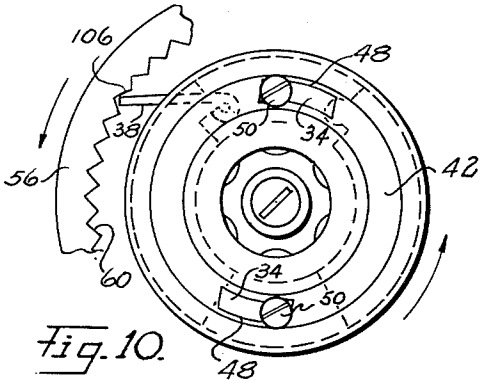


Fig. 10.

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United States Patent Office 2,999,490 Patented Sept. 12, 1961

2,999,490
SPRING STARTER

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Filed Apr. 27, 1959, Ser. No. 809,165
15 Claims. (Cl. 123—179)

The invention relates to starters for internal combustion engines and particularly relates to a spring impulse starter wherein the energy stored within a spring is employed to crank the engine.

Manual starting means are extensively used with small internal combustion engines of the type employed with lawn mowers, outboard marine motors, pumps, small tractors and the like. Conventional starting means commonly in use include a rope wound about a flywheel sheave, automatic rewind rope pull starters and foot operated kick starters. These types of engine cranking means will rotate the engine flywheel at a speed dependent on the force exerted by the operator, e.g. a weak pull on the rope slowly rotates the flywheel while considerable manual energy must be expended to spin the flywheel at a speed sufficient to start a cold or "balky" engine. The speed of the flywheel rotation during starting is important with small engines of the type using manual starting means as the ignition spark is usually produced by a magnet in the flywheel passing a relatively stationary coil and hence a strong spark can be created only by moving the magnet rapidly past the coil. For this reason many engines need to be rotated at a high speed to provide proper starting ignition and several very hard pulls on the starter rope are often necessary to start the engine, especially when the engine is cold and the fuel does not readily vaporize. For the above reasons, many people, especially women, find it difficult to start a lawn mower engine or the like because they are unable to produce the force necessary to rapidly spin the flywheel.

To overcome the above objections of conventional starting means it is proposed to utilize a spring motor to crank the flywheel at a high rate of speed which will quickly start an internal combustion engine even under severe weather conditions. While spring motor starters have been employed before in starting internal combustion engines it is an object of the invention to provide a spring starter of economical construction and of such small size as to be readily attachable to fractional horsepower engines. A spring motor, although manually wound, may develop several horsepower for a short period of time and in the practice of the invention a spring is employed which may be relatively easily wound yet is capable of rapidly cranking the engine.

It is thus an object of the invention to provide a spring starter for internal combustion engines which may be employed with small engines and is capable of cranking the engine at a high rate of speed.

A further object of the invention is to provide a spring starter adapted to crank an engine flywheel wherein automatic clutching means connect the starter to the flywheel during cranking and completely disconnect the starter after completion of the cranking sequence.

Another object of the invention is to provide a spring starter which may be manually wound, employs positive locking means to prevent "kick back" and automatically actuates the engine cranking action upon shifting the manual rewind lever to an inoperative position.

Yet a further object of the invention is to provide a spring starter employing a spiral torsion spring, which is of low overall height and wherein separate housing means are provided for the spring, per se, whereby spring installation and replacement is simplified.

Another object of the invention is to provide a spring starter which may be employed with an internal combustion engine that does not require exact concentric alignment with the engine flywheel.

These and other objects of the invention will become apparent from the following description and accompanying drawings wherein:

FIG. 1 is a perspective view of the starter of the invention with the crank handle in the "winding" position,

FIG. 2 is an elevational, sectional view of the invention as installed on an engine,

FIG. 3 is a view of the underside of the starter,

FIG. 4 is a sectional view of the clutch mechanism and flywheel cup taken along line IV—IV of FIG. 2,

FIG. 5 is a sectional view of the spring, housing and inner spring anchor as taken along line V—V of FIG. 2,

FIG. 6 is a plan, sectional view of the release lock ratchet and dog and the anti-kick back ratchet and dog, taken along the line VI—VI of FIG. 11,

FIG. 7 is a perspective view of the frictional brake element employed to control the lost motion operation of the clutch,

FIG. 8 is a sectional, elevational view of a crank handle detail showing the release finger taken along line VIII—VIII of FIG. 1,

FIGS. 9 and 10 are underside views of the starter and flywheel cup in declutched and clutched positions, respectively, and

FIG. 11 is a sectional elevational view taken along line XI—XI of FIG. 2.

The starter of the invention may be incorporated in many variations of housings and may be constructed as an attachment to be affixed to any small internal combustion engine or may be incorporated directly into the flywheel shroud when installed as original equipment. To simplify illustration the starter embodiment is shown and described as attachable to a conventional engine and it will be appreciated that variations to the housing and interior components may be apparent without departing from the scope of the invention.

In the illustrated embodiment, the starter is incorporated within an inverted cup-like housing **10** of rectangular form having leg portions **12** extending downwardly at the corners and holes **14** extend through the legs whereby bolts may be employed to affix the housing to the motor structure, represented at **16** in FIG. 2. The housing **10** may be a die casting and is centrally provided with a downward projecting boss **18** and an exterior cylindrical boss **20** having ratchet teeth **22** defined thereon.

An axiall bore is formed in housing **10** concentric with bosses **18** and **20** and a tubular sleeve or shaft **24** is journaled therein. The upper end of sleeve **24** is provided with chordal flats which coact with a noncircular hole in a circular locking plate **26** having teeth **28** formed in the periphery thereof. The plate **26** is thus keyed to the sleeve **24**.

A driving block **30** is affixed to the lower end of sleeve **24** for rotation therewith and is recessed as to receive the boss **18**. A portion of the periphery of block **30** is provided with spiral recesses **32** having the deep end semi-cylindrically shaped to grip the inner end of the torsion spring as will be later apparent. A pair of diametrically opposed, axially extending, arcuate bosses **34**, FIG. 4, extend from the lower end of block **30** and a cylindrical recess **36** is defined in the forward edge of at least one of the ears to receive the drive dog **38**. The dog **38** is formed of a length of flat metal stock having one end bent back and formed into a semi-cylindrical portion **40** which permits the dog to be swiveled within the recess **36**.

The bosses **34** are enclosed by an annular dog actuator cup **42** having an inner flange **44** and an outer flange **46**. The cup **42** is affixed to block **30** for rotation therewith, however, a lost motion connection is interposed between the cup and block permitting limited relative rota-

tion. The lost motion connection may take the form of a pair of elongated arcuate slots 48, FIG. 3, defined in the cup and headed screws 50 extending through the slots 48 threaded into the bosses 34. The heads of the screws are larger than the width of the slots, however, the cup is formed such that tightening the screws does not compress, but merely overlap the cup, and hence limited rotation of the bosses 34 and cup 42 is possible.

A slot is formed in the outer flange 46 of the cup 42 to provide the means for controlling the radial position of the end of dog 38. The slot is defined by slitting and displacing inwardly a portion 52 of the outer flange which also forms an edge 54 and the dog 38 may pass through the outer flange between the portion 52 and edge 54.

The length of the slots 48 and the location of the portion 52 are related to the dog 38 such that when the cup 42 is rotated the maximum degree counterclockwise, see FIG. 9, with respect to block 30, the edge 54 is located the maximum distance from recess 36 and will push the end of dog 38 to its innermost position which aligns the dog end with the periphery of outer flange 46. Upon rotating cup 42 clockwise with respect to block 30 the portion 52 will move toward recess 36 swiveling dog 38 outwardly, note FIG. 10. A drive cup 56 is concentrically affixed to the engine flywheel 58 and encompasses the lower end of block 30 as shown in FIG. 2. Cup 56 is provided with interior teeth 60 whereby the free end of dog 38 may make driving engagement with the teeth 60 when in the position shown in FIG. 10. The above described clutch structure is similar to that of my copending application Serial No. 639,507, filed February 11, 1957, now Patent No. 2,926,648.

Crank handle means are provided for winding the spring of the starter and this crank consists of a first portion 62 to which is hinged the portion 64. The handle is preferably formed of stamped metal and portion 62 is provided with a downward extending flange while portion 64, as viewed in FIG. 1, has a flange portion which is folded over on itself at 66 to give excellent strength characteristics.

Referring to the handle portion 62, a shaft 68 is affixed to this portion and extends through the bore of sleeve 24 and is rotatably journaled therein as to not interfere with the rotation of the sleeve. A brake 70 is affixed to the lower end of shaft 68 by a screw and the brake is provided with a plurality of friction fingers 72 which frictionally engage the inside of inner flange, FIG. 2. The purpose of the fingers 72 is to frictionally "brake" the relative rotation of cup 42 and block 30 to cause the cup to actuate the dog as described above, insuring that rotation of the block 30 in the cranking direction will move the dog to the operative position. The brake 70 is preferably formed of spring steel and the dimensions of the cylinder defined by fingers 72 is slightly less than the diameter of inner flange 44 whereby constant engagement of fingers and flange are produced.

A pivot pin 74 is also fixed to handle portion 62, projecting downward, and pivotally supports the release lever 76 and ratchet lever 78. These levers are best illustrated in FIG. 6 and consist of a tooth engaging portion and a spring anchor portion 80 formed on lever 76 and anchor portion 81 on lever 78. A spring 82 circumscribes pin 74 and engages portions 80 and 81 of both levers to bias the release lever 76 into engagement with the teeth 28 of locking plate 26 and the ratchet lever 78 into engagement with the ratchet teeth 22 of boss 20. Thus, in the normal relation, both levers will be engaging the teeth of their respective cooperating members.

The handle portion 64 is hinged at 83 to portion 62 for pivotal movement in a diametrical plane with respect to boss 20, the operative or cranking position being shown in FIG. 1 wherein the crank knob 84 is accessible to the operator and the inoperative or non-cranking position being illustrated in FIG. 2. A release finger 86, having a rounded free end, is affixed to handle portion 64 and an opening 88 is defined in handle portion 62 to receive finger 86 when the portion 64 is in the inoperative position. The spring anchor portion 80 of release lever 76 is positioned below opening 88 whereby pivoting handle portion to the inoperative position of FIG. 2 will engage finger 86 with the release lever anchor 80 and pivot lever 76 out of engagement with teeth 28. This relationship is illustrated in the solid lines of FIG. 6. It will be thus appreciated that merely pivoting handle portion 64 from the position of FIG. 1 to that of FIG. 2 will disengage the lever 76 from the teeth of the locking plate 26.

Referring to FIGS. 2, 3 and 4 the spiral torsion spring structure will now be described. Preferably the torsion spring 90 is housed within a cup-like keeper 92 of generally cylindrical shape having a large central opening 94. The cylindrical configuration of keeper 92 is broken by an ear-like portion 96 which receives the fixed end 98 of the spring which is formed with a closed cylindrical loop. The keeper 92 is positioned in the housing 10 such that the spring itself is confined between the bottom of the keeper and the underside of the housing, FIG. 2, and screws 100 threaded into a section of the legs 12 maintain the keeper in position. The inner end of spring 90 is folded back in a cylindrical roll 102 and is of a size to be received within the cylindrical deep end of recesses 36 of the driving block 30. An anchor pin 104 is affixed to housing 10 and upon inserting the spring and keeper into the housing the spring end 98 is aligned to slide over pin 104 to anchor one end of the spring to the housing.

As will be observed in FIG. 2 the driving block 30 is received within the keeper opening 94 and the inner end of spring 90 is formed as to constantly bias the roll 102 into engagement with block 30, thus by removing screws 100 the spring and keeper may be readily installed and removed as a unit and will not require troublesome and dangerous recoiling if a new spring need be installed.

The operation of the starter is as follows: The handle portion 64 will normally be folded over portion 62, as in FIG. 2, when the engine was last stopped and hence the operator will first open the handle portion 64 to the winding position of FIG. 1. By gripping the knob 84 the operator may turn portions 62 and 64 in a counterclockwise direction which will rotate the lock plate 26 as the release lever 76 will be in engagement with the teeth 28. Rotation of plate 26 also turns shaft 24 and driving block 30 and one of the recesses 32 of the driving block will "pick up" the spring roll end 102 and wind the spring 90. During winding the ratchet lever 78 will ratchet over teeth 22 preventing the handle portions from rotating in the opposite direction due to the reaction force of the torsion spring.

After spring 90 is sufficiently wound, the handle portion 64 is hinged over on portion 62 as in FIG. 2 wherein the release finger 86 will extend through opening 88, engage portion 80 of the release lever 76 and disengage the lever from teeth 28. Once lever 76 is released there is no deterrent to prevent uncoiling of spring 90 and the block 30 will be rapidly rotated. Initial rotation of block 30 will rotate the bosses 34 with respect to cup 42 due to the frictional drag produced by fixed brake 70 on the cup and the screws 50 will be located in slots 48 as shown in FIG. 10 and the drive dog 38 will be pivoted outwardly engaging the teeth 60 of drive cup 56 thereby rotating the cup 56 and the engine flywheel at a speed sufficient to start the engine.

Once the engine starts, the cup 56 will continue rotating and the portion 106 of teeth 60 will push on the dog 38 swiveling the dog inwardly. This motion rotates cup 42 such that slot edge 54 will continue pushing the dog inwardly due to the inertia of cup 42 and completely retract the dog from the drive cup teeth 60. A spring 108 may be interposed between one of the block bosses 34 and the cup 42 to bias the cup in a direction retracting dog 38 to prevent vibration from rotating the dog actuator cup 42 and accidentally engaging the dog with the driving

cup teeth. It will be appreciated that spring **108** is relatively weak and will not interfere with the described operation of the cup **42** and dog **38**.

It will thus be apparent that a rugged, inexpensive, low profile spring starter is produced by the invention. Features such as the automatic operation of the release lever and use of a spring keeper simplify operation and assembly of the device and the use of recesses **32** and spring end **102** is very effective in establishing a connection between block **30** and spring **90** capable of withstanding the instantaneous shocks and forces produced during the uncoiling of the spring and starting of the engine.

Usually only a few revolutions of the crank handle are necessary to wind spring **90** sufficiently to start an engine and the ability of the spring to rapidly crank the engine permits operators to start an engine that they could not start by conventional starter means. By employing a single driving dog it is not necessary that exact concentricity of the axes of the starter and flywheel be achieved, however, if desired, a dog may be mounted in each of the bosses **34**.

It will be understood that various modifications to the described embodiment may be apparent to those skilled in the art without departing from the spirit of the invention and it is intended that the invention be defined only by the scope of the appended claims.

I claim:

1. A starter for an internal combustion engine having a clutch element in driving relation to the engine crankshaft comprising a spring fixed at one end with respect to the engine, a drive member affixed to the other end of said spring, means affixed to said drive member to rotate said member and wind said spring, said means comprising a crank handle movable between a cranking position and a non-cranking position, releasable means maintaining said spring in wound condition, release actuating means affixed to said crank handle releasing said releasable means upon moving said handle to the non-cranking position and clutch means mounted on said drive member establishing driving relation with the engine clutch element upon release of said spring and rotation of said drive member thereby to crank the engine.

2. A starter for an internal combustion engine having a clutch element in driving relation to the engine crankshaft comprising a spring fixed at one end with respect to the engine, means for winding said spring, releasable means maintaining said spring in wound condition, a drive member affixed to said spring adapted to be rotated by said spring upon the release thereof, a clutch dog mounted on said drive member for selective driving engagement with the engine clutch element, a dog actuator mounted on said drive member for rotation therewith operably positioning said dog and a lost motion connection interposed between said actuator and drive means responsive to the rotation of said actuator whereby rotation of said drive member by said spring causes said actuator to move said dog in engagement with said clutch element.

3. In a starter as in claim 2 wherein a fixed brake element frictionally engages said actuator to retard rotation of said actuator and actuate said lost motion connection.

4. A starter for an internal combustion engine comprising, in combination, a housing, a spring within said housing and affixed at one end thereto, a shaft rotatably mounted in said housing, a drive member affixed to said shaft means attaching the other end of said spring to said drive member, a crank handle rotatably mounted on said housing in rotatable driving engagement with said shaft, releasable means mounted on said handle maintaining said spring in a wound condition, manual actuated means for releasing said releasable means and clutch means mounted on said drive memebr.

5. In a starter as in claim 4 wherein said manual actuated means is mounted on said crank handle and said handle is shiftable to a spring releasable position.

6. A starter for an internal combustion engine comprising, in combination, a housing, a spring within said housing and affixed at one end thereto, a shaft rotatably mounted in said housing, a driving member affixed to one end of said shaft, a toothed plate affixed to the other end of said shaft, means attaching the other end of said spring to said drive member, a crank handle rotatably mounted on said housing, releasable means mounted on said handle selectively engaging the teeth of said plate to rotate said plate and wind said spring, a unidirectional drive interposed between said housing and crank handle rendering rotation of said handle unidirectional, clutch means mounted on said drive member and actuating means for releasing said releasable means to permit said spring to rotate said drive member.

7. In a starter as in claim 6 wherein said crank handle comprises a first portion rotatable on said housing and a second portion pivotally affixed to said first portion and said actuating means is mounted on said second portion whereby pivoting said second portion to a non-cranking position adjacent said first portion operatively engages said actuating means with said releasable means.

8. In a starter as in claim 7 wherein said first and second handle portions rotate in a common plane during winding of said spring and said second portion pivots in a plane of movement substantially perpendicular to said common plane in shifting from the cranking to non-cranking position.

9. A starter for internal combustion engines comprising, in combination, a spring within said housing and affixed at one end thereto, a tubular shaft rotatably journaled in said housing, a drive member affixed to one end of said shaft, means attaching the other end of said spring to said drive member, a toothed locking plate affixed to the other end of said shaft, a second shaft journaled within said tubular shaft, a first cranking handle portion affixed to said second shaft adjacent said locking plate, a toothed ratchet fixed to said housing concentric to the axis of said shaft, a release lever pivotally affixed to said first handle portion engageable with the teeth of said locking plate for rotating said plate, a ratchet lever affixed to said first handle portion engaging the teeth of said ratchet permitting rotation of said handle portion only in the direction to wind said spring, a second handle portion pivotally affixed to said first handle portion and selectively pivotal between cranking and spring release positions, a release lever actuator mounted on said second handle portion operably engageable with said release lever upon pivoting said second handle portion to the spring release position to disengage the release lever from the teeth of the locking plate, and a clutch mounted on said drive member engageable with an engine clutch element upon rotation of said drive member by said spring.

10. In a starter as in claim 9 wherein said clutch mounted on said drive member includes a dog pivotally mounted on said member, a dog actuator mounted on said drive member for rotation therewith, a lost motion connection interposed between said dog actuator and drive member permitting limited relative rotation therebetween, brake means affixed to said second shaft frictionally engaging said dog actuator and means interconnecting said dog and dog actuator whereby relative rotation of said dog actuator and drive member radially positions said dog with respect to the axis of rotation of said drive member.

11. In a starter as in claim 9 wherein the means attaching the spring to the drive member includes an overrunning connection between said drive member and spring wherein inertia forces within said driving member are not transferred to said spring upon unwinding of said spring.

12. In a starter as in claim 11 wherein said overrunning connection includes a cylindrical portion defined on the end of said spring and a recess defined in said driving

member receiving said cylindrical spring portion, said recess being of such configuration that the working tension of said spring maintains said cylindrical portion within said recess.

13. A starter for an internal combustion engine comprising in combination, a housing, a spring within said housing and affixed at one end thereto, a shaft rotatably mounted in said housing, a drive member affixed to said shaft, means attaching the other end of said spring to said drive member, a crank handle rotatably mounted on said housing, first unidirectional drive means operatively interconnecting said handle and said shaft, second unidirectional drive means operatively interconnecting said handle and said housing, said first unidirectional drive means drivingly engaging said handle and shaft to wind said spring, said second unidirectional drive means preventing rotation of said handle in a direction to unwind said spring, means selectively releasing said first unidirectional drive means and means mounted on said drive member for establishing a driving connection with an internal combustion engine.

14. In a starter as in claim 13 wherein said first unidirectional drive means includes a ratchet member affixed to said shaft and a pawl pivotably mounted on said handle and said second unidirectional drive means includes a ratchet member affixed to said housing and a pawl pivotably mounted on said handle.

15. In a starter as in claim 14 wherein said pawls are mounted upon a common pivot.

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