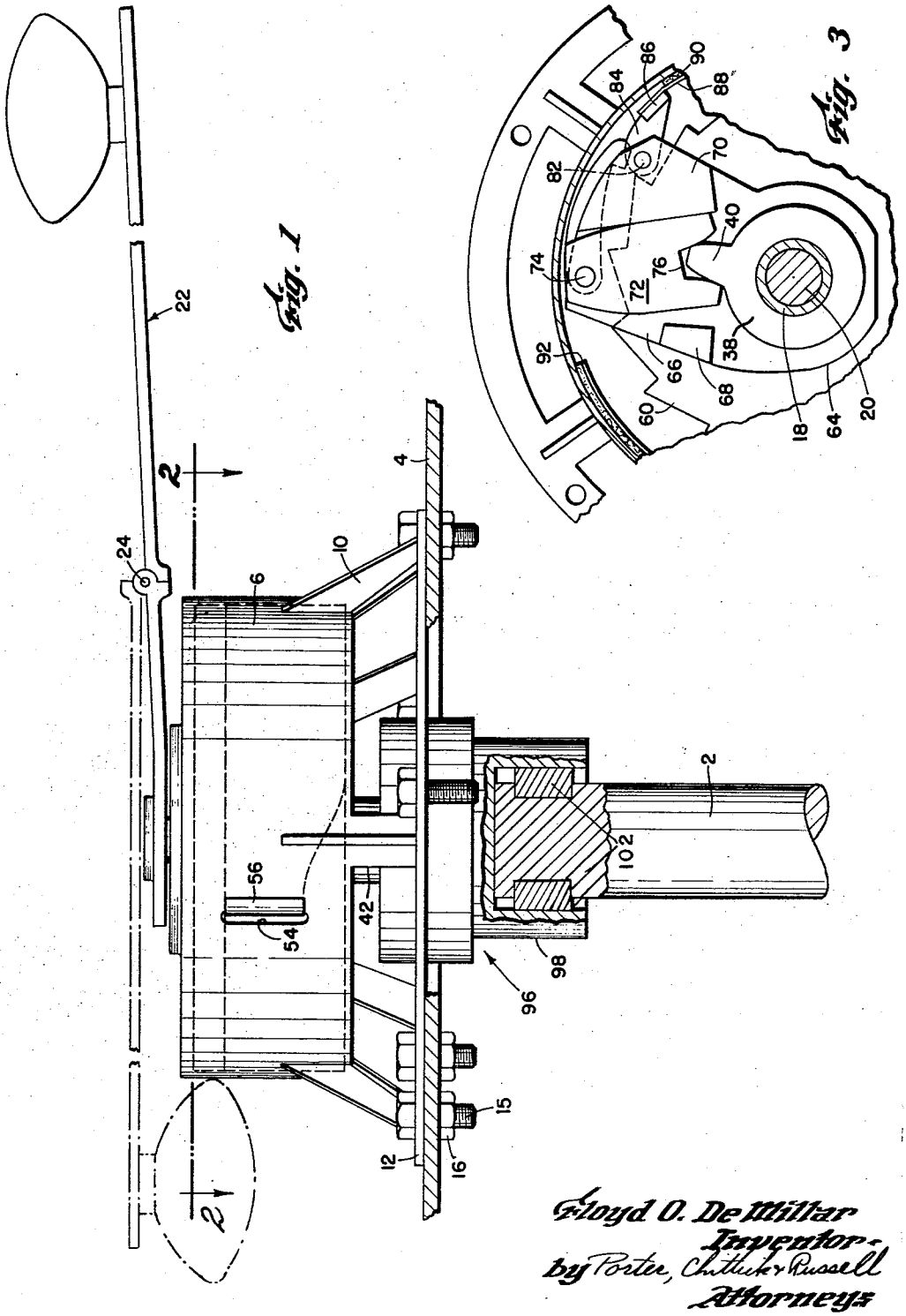
Aug. 30, 1960 F. O. DE MILLAR 2,950,780

STARTING MECHANISM FOR AN INTERNAL COMBUSTION ENGINE

Filed May 12, 1958 3 Sheets-Sheet 1



Floyd O. De Millar
Inventor:
by Porter, Chittick & Russell
Attorneys

Aug. 30, 1960 F. O. DE MILLAR 2,950,780

STARTING MECHANISM FOR AN INTERNAL COMBUSTION ENGINE

Filed May 12, 1958 3 Sheets-Sheet 2

Fig. 2

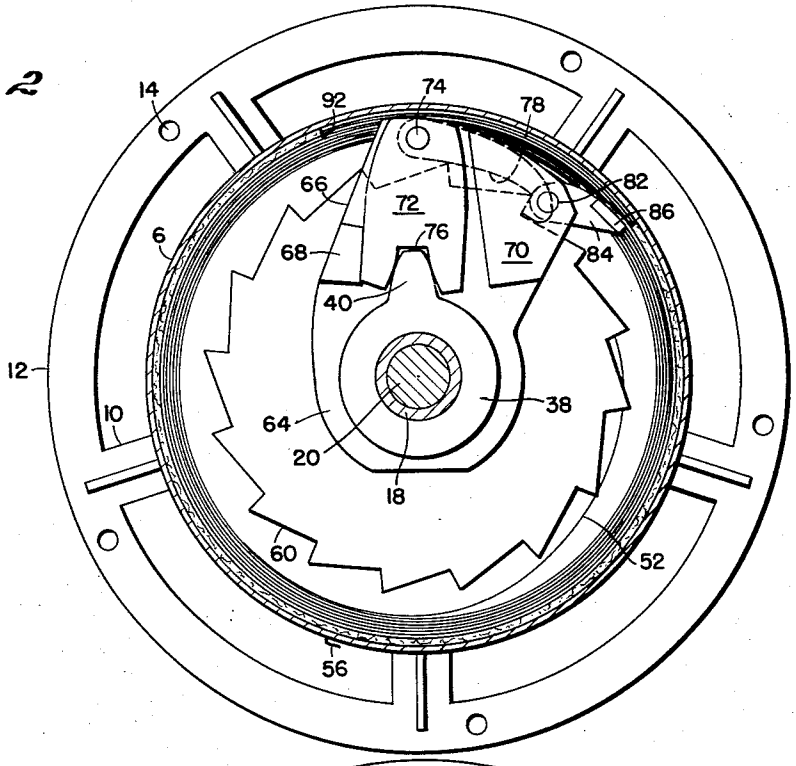
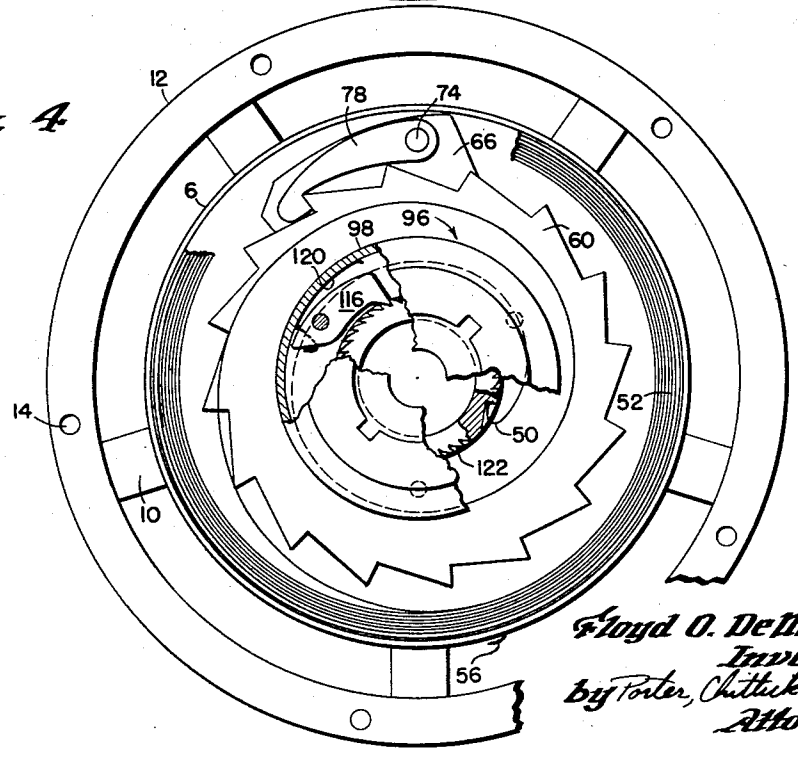


Fig. 4



Floyd O. DeMillar
Inventor
by Porter, Chittick & Russell
Attorneys

Aug. 30, 1960 F. O. DE MILLAR 2,950,780

STARTING MECHANISM FOR AN INTERNAL COMBUSTION ENGINE

Filed May 12, 1958 3 Sheets-Sheet 3

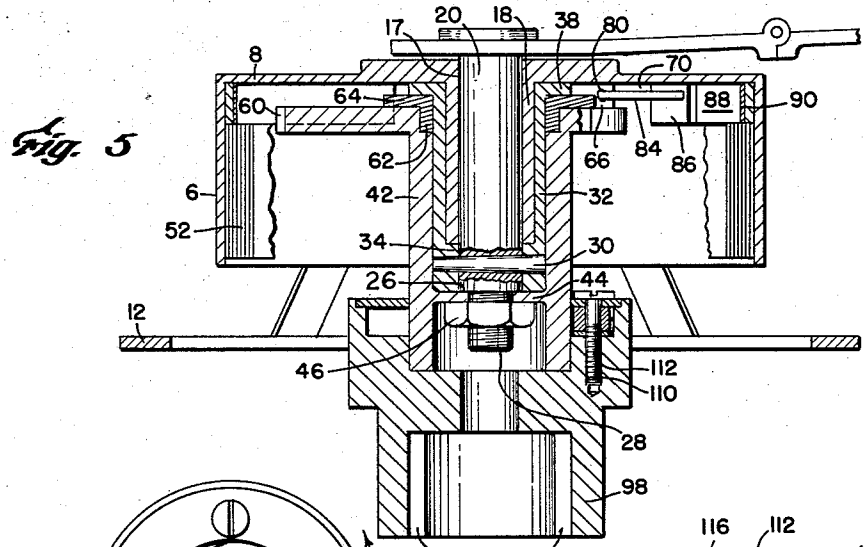


Fig. 5

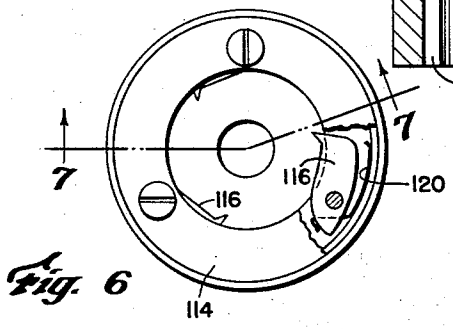


Fig. 6

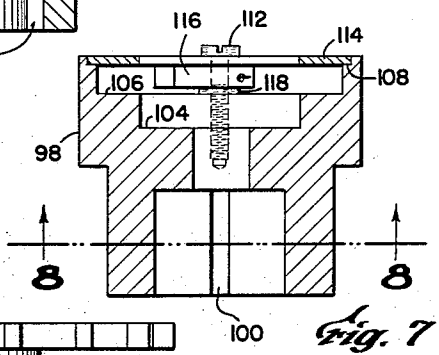


Fig. 7

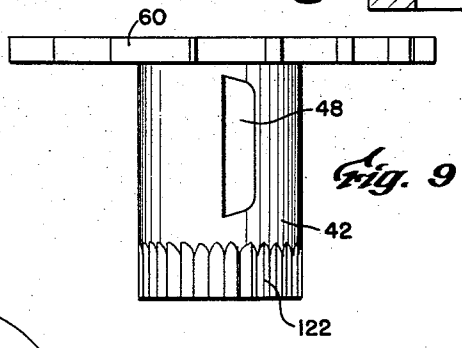


Fig. 9

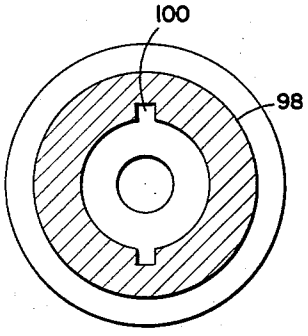


Fig. 8

Floyd O. DeMillar
Inventor
by Porter, Chittick & Russell
Attorneys

United States Patent Office 2,950,780 Patented Aug. 30, 1960

2,950,780

STARTING MECHANISM FOR AN INTERNAL COMBUSTION ENGINE

Floyd O. De Millar, Framingham, Mass., assignor to Radian Corporation, Framingham Center, Mass., a corporation of Massachusetts

Filed May 12, 1958, Ser. No. 734,473

8 Claims. (Cl. 185—41)

The present invention relates to a turning device for imparting a rapidly accelerating movement to a rotatable body and more particularly to improvements in manually operated spring starting mechanisms of the type disclosed and claimed in my United States Patent No. 2,804,173, issued August 27, 1957.

For a long time there has been a need for a small inexpensive manually operated starter to replace the conventional pull-rope starter on outboard engines and engines of the type employed on lawnmowers. The troubles attendant to the conventional rope starter are well known and require no elaboration here. Electric starters have been developed which are highly satisfactory from the standpoint of performance. However, for the most part, electric starters have supplanted rope starters only on outboard engines of 15 horsepower and higher. The cost of electric starters prohibits their use on engines of smaller horsepower, particularly those engines of less than 7.5 horsepower.

Accordingly, the object of this invention is to provide a starter for gasoline engines which is easier to operate than the conventional rope starter, is cheaper to manufacture than an electric starter, provides a high starting torque, is durable, will operate satisfactorily under all types of climatic conditions, and is adaptable with engines of various sizes.

Another object of this invention is to provide a spring starter which constitutes an improvement over the starter disclosed and claimed in said issued Patent No. 2,804,173. The most significant improvement effected by the present invention is the reduction in complexity of construction.

A more specific object of this invention is to provide a spring starter for imparting a rapidly accelerating rotative movement to a rotatable body comprising, a fixed housing provided with an end wall, a shaft rotatably mounted in said housing, one end of said shaft extending through said end wall, a crank arm outside of said housing, means securing said crank arm to said shaft, a pawl within said housing operatively coupled to said shaft for rotation therewith, a drum rotatably mounted on said shaft, said drum having a plurality of circumferentially arranged gear teeth positioned to be drivingly engaged by said pawl when said shaft is rotated by said crank arm in a first direction, said drum also having a notch cut in its surface in axial spaced relation with said gear teeth, a spiral spring within said housing, said spring having an outer end secured to said housing and an inner end provided with a hook normally engaging said drum in position to fall into and engage said notch as said drum is rotated in said first direction by said pawl, whereby to cause winding of said spring upon said drum as said drum rotates in said first direction, selectively operated means for disengaging said pawl from said gear teeth to release the energy stored in said spring, whereby to rotate said drum in a second opposite direction, and means for connecting said drum to said rotatable body whereby to drive said body when said drum is driven in said second direction by said spring.

Other objects and many of the attendant advantages of this invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings, wherein:

Fig. 1 is a side elevational view showing how a starting mechanism constructed according to the present invention is mounted on and operatively connected to an internal combustion engine;

Fig. 2 is a plan sectional view taken along line 2—2 of Fig. 1;

Fig. 3 is a fragmentary view similar to Fig. 2 showing how the starter is released by operation of the winding crank;

Fig. 4 is a bottom view partly in section of the same starter;

Fig. 5 is a vertical section taken through the center of the starter;

Fig. 6 is a plan view of the overrunning clutch which couples the starter to the shaft of the internal combustion engine;

Fig. 7 is a vertical section through the center of the overrunning clutch;

Fig. 8 is a sectional view of the same clutch taken along line 8—8 of Fig. 7; and,

Fig. 9 is a side elevational view of the winding drum of the starter.

Referring now to Figs. 1 and 5, numeral 2 designates the shaft member which is to be driven. For purpose of illustration shaft 2 may be considered to be the main driving shaft of an outboard motor. However, it is to be understood that shaft 2 may also be the driving shaft of a small internal combustion engine of the type employed on lawnmowers or small snow-throwers. The numeral 4 designates a portion of the top wall of the housing of the motor.

The spring starter comprises a cylindrical casing 6 having a top end wall 8. The bottom end of the casing is open. Welded to the casing is a plurality of legs 10 of T-shaped cross section. These legs extend downwardly and outwardly from the casing and are welded at their bottom ends to a flat ring 12 which is concentric with casing 6. Ring 12 has a plurality of spaced openings 14 to receive bolts 15 which together with nuts 16 are used to fixedly secure the casing to the top wall 4 of the engine housing. As most small internal combustion engines have secured to their drive shafts blades for promoting air circulation around their outer casings the supporting members 10 of my starter unit, as shown in Fig. 5, are designed to hold it an appropriate distance away from any such air cooling means.

Top wall 8 of casing 6 is provided with a central opening 17. Formed integral with top wall 8 and depending therefrom in axial relation with opening 17 is a bearing sleeve 18. It is to be noted that sleeve 18 can be formed independently of top wall 8 but secured thereto by suitable means, such as welding, instead of being formed integral with the top wall as shown.

Rotatably positioned within bearing sleeve 18 is a winding shaft 20. The top end of winding shaft 20 protrudes above the top wall 8 of casing 6 and affixed thereto is a collapsible handle 22. Handle 22 is formed in two parts with the two parts hinged together as at 24. Winding shaft 20 extends down beyond the bottom end of bearing sleeve 18 and terminates in an end section of reduced diameter that forms a shoulder 26 and is threaded as at 28. A short distance above shoulder 26 winding shaft 20 is provided with a diametrically extending opening adapted to receive a locking pin 30. Rotatably sur-

rounding sleeve 18 is a second sleeve 32. The latter has an internal flange 34 at its bottom end which engages winding shaft 20 and is locked thereto by locking pin 30. At its top end sleeve 32 has a peripheral flange 38 provided with a radial projection 40. The purpose of radial projection 40 is explained hereinafter in connection with the means for releasing the energy stored in the spring of the starter.

Mounted on sleeve 32 is a cylindrical winding drum 42. The latter has an internal annular flange 44 through which extends the threaded end of winding shaft 20. A nut 46 screwed into threads 28 keeps flange 44 in sliding engagement with shoulder 26 of winding shaft 20. Drum 42 is provided with a saw tooth notch 48 which is so located as to engage the hooked inner end 50 of a flat coiled power spring member 52 which is disposed within casing 6. The casing has a slot 54 in its side wall to accommodate the hooked outer end 56 of power spring member 52. When winding drum 42 is rotated counterclockwise (Fig. 2) it acts on the hooked spring end 50 to wind up the spring member 52. The energy stored in spring member 52 when it has been wound upon winding drum 42 is the energy that is used to drive shaft 2 to start the engine to which the starter is attached. The mechanism for rotating drum 42 to wind up the spring and the mechanism for holding the spring in wound condition and for selectively releasing the spring are described hereinafter. These mechanisms are all operated by the handle 22.

Looking now to Figs. 2, 4, 5 and 9 in particular, the winding drum 42 is provided at its upper end with a ratchet gear 60. Gear 60 may be formed integral with drum 42 as shown or may be a separate element that is secured to the drum by suitable means, e.g., by welding. Mounted on sleeve 32 is a collar 62 provided with a peripheral flange 64 having an enlarged generally radial projection 66. Flange 64 engages flange 38 of sleeve 32 and is in turn engaged by gear 60. The top surface of projection 66 is provided with two spaced ribs or stops 68 and 70. The space between ribs 68 and 70 is occupied by a flat locking member 72 which is pivotally secured to the end of projection 66 by means of a pivot pin 74. The opposite end of locking member 72 is notched as at 76 to accommodate radial projection 40 of sleeve 32. Projection 40 and notch 76 are so shaped as to permit them to pivot relative to each other. Secured to pivot pin 74 on the under side of projection 66 is a pawl 78. The connection between projection 40 and notch 76 permits pivoting of pawl 78 inwardly or outwardly, depending upon the direction in which radial projection 40 is rotated by handle 22 acting through shaft 20 and sleeve 32. When locking member 72 is pivoted by projection 40 into engagement with stop 68, pawl 78 is in engagement with the teeth of ratchet gear 60 (Fig. 2). This is accomplished when handle 22 is rotated in a counterclockwise direction as viewed in Fig. 2. When locking member 72 is pivoted into engagement with stop 70, pawl 78 is disengaged from gear 60. This is accomplished by moving handle 22 in a clockwise direction as viewed in Fig. 2. Thus winding drum 42 can be rotated by the handle 22 only in one direction, the direction in which the spring is wound upon drum 42. When the handle is turned in the opposite direction, the energy stored in spring 52 causes the drum to spin in a clockwise direction to release the energy and permit the spring to return to its original position. When the drum is connected to the shaft 2 of the engine to be started, the high torque applied to the drum by the spring when gear 60 is released from pawl 78 will cause the shaft 2 to turn at a high speed to start the engine.

The foregoing discussion assumes that means are provided for preventing the drum from rotating clockwise prematurely and for holding the spring in wound-up condition until it is desired to start the engine. The means for accomplishing this will now be described.

Referring to Figs. 2, 3 and 5, projection 66 has a slot 80 cut between its bottom surface and the top surface of stop 70. Pivotally secured in slot 80 by means of a pivot pin 82 is an arm 84. The outer extremity of arm 84 is provided with a flange 86. Attached to flange 86 is a flat strip 88 of spring steel which is provided on its outer surface with a brake lining 90. As viewed in Fig. 2, the spring steel strip 88 extends in a clockwise direction away from arm 84. The brake lining 90 bears against the inner wall of casing 6 which restrains spring strip 88 against unwinding. The free end 92 of the spring strip 88 terminates short of projection 66.

The brake consisting of strip 88 and lining 90 slides readily relative to housing 6 when the drum 42 is rotated counterclockwise (Fig. 2) by operation of handle 22. This is due to the fact that the brake is subjected to a pulling action by projection 66. However, when the handle 22 is no longer being rotated in a direction to wind up spring 52, the brake will not move in the opposite direction. The reason for this is that projection 66 tends to exert a pushing force on the brake and this pushing force, aided by the fact that arm 84 can pivot relative to projection 66, urges the brake into tighter engagement with the casing, causing it, and in turn the drum 42, to resist clockwise movement by spring 52.

The drum 42 is connected to the shaft 2 of the engine by means of an overrunning clutch designated generally by the number 96. Clutch 96 comprises a cylindrical clutch member 98 provided at its bottom end with a pair of internal keyways 100. These keyways are provided to receive keys 102 affixed to the upper end of engine shaft 2. At its upper end clutch member 92 has three internal annular shoulders 104, 106, and 108. The clutch member 98 fits over the bottom end of drum 42 which is spaced from shoulder 104 by an approximate clearance to permit free rotation. Shoulder 106 is provided with three equiangularly located tapped openings 110 which receive screws 112. Shoulder 108 supports an annular ring 114 whose inner edge slidably engages drum 42. Screws 112 extend through suitable openings in ring 114 and each screw carries a pawl 116 and a washer 118. Small springs 120 urge pawls 116 inwardly of the clutch member 98. The ends of these pawls engage ratchet teeth 122 formed in the bottom end of drum 42. The teeth 122 are oriented so that they act through pawls 116 to rotate clutch member 98 when the drum is rotated clockwise by spring 52 as viewed in Figs 2 and 3. Since clutch member 98 is keyed to engage shaft 2, it drives the shaft when the energy stored in spring 52 is released to drive drum 42. However, because of the shape of the ends of pawls 116 and centrifugal force, once the engine is started the clutch member 98 overruns the drum 42, thereby preventing injury to the spring 52 or the other elements of the starter. Looking from the top toward the bottom of the starter, operation of the starter is as follows: Handle 22 is swung to extended position and then turned in a counterclockwise direction. Initial rotation of the handle cams pawl 78 from the position of Fig. 3 to the position of Fig. 2. Continued rotation of the handle causes pawl 78 to turn ratchet gear 60 and drum 42 in a counterclockwise direction to wind up spring 52. Because of the orientation of ratchet teeth 122, drum 42 will rotate relative to clutch member 98. The brake consisting of steel strip 88 and lining 90 prevents drum 42, handle 22 and the elements connecting them from rotating clockwise. When spring 52 has been wound upon drum 42 sufficiently, handle 22 is rotated in the opposite (clockwise direction). This cams pawl 78 back to the position of Fig. 3, releasing ratchet gear 60 and drum 42. As soon as this occus the energy stored in spring 52 causes drum 42 to rotate clockwise. This in turn causes clutch 96 to drive shaft 2 to start the engine.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. Therefore, it is to be understood that the in-

vention is not limited in its application to the details of construction and arrangement of parts specifically described or illustrated, and that within the scope of the appended claims it may be practised otherwise than as specifically described or illustrated.

I claim:

1. In combination with an internal combustion engine provided with a rotatable shaft by means of which said engine may be started, a manually operable spring starter, said starter comprising a fixed casing, a flat spring coiled upon itself within said casing, the outer end of said spring attached to said casing, a winding drum for said spring rotatably supported within said casing, means on said winding drum for acting on the inner end of said spring to wind said spring upon said drum as said drum is rotated in a first direction, a handle, releasable means connecting said handle and said winding drum operative when said handle is rotated in said first direction to rotate said drum to wind said spring thereon and operative when said handle is turned in a second opposite direction to disconnect said drum from said handle whereby the energy stored in said spring will cause said drum to spin in a said second direction to unwind said spring, means for preventing rotation of said drum in said second direction so long as said connecting means remains in unreleased position, and means connected between said shaft and said drum for rotating said shaft in said second direction under the influence of said energy stored in said spring when said connecting means is released by movement of said handle in said second direction.

2. Apparatus for imparting a rapidly accelerating rotative movement to a shaft comprising, a fixed casing, a flat coiled spring positioned within said casing with the outer end of said spring attached to said casing and the inner end of said spring having a hook, a winding drum rotatably supported within said casing, said winding drum having means for engaging said hook and for winding said spring upon said drum as said drum is rotated in a first direction, a handle rotatably supported by said casing, releasable means connecting said handle and said winding drum operative when said handle is rotated in said first direction to rotate said drum in said same direction to effect winding of said spring on said drum and operative when said handle is rotated in the opposite direction to disconnect said drum from said handle whereby the energy stored in the spring wound upon said drum will cause said drum to spin in said second direction to unwind said spring, means for preventing spinning of said drum in said second direction so long as said connecting means remains in unreleased condition, and means carried by said drum for driving said shaft when said drum rotates in said second direction.

3. A manually operable spring starter for imparting a rapidly accelerating rotative movement to a shaft comprising, a casing, a flat spring coiled within said casing, the outer end of said spring being attached to said casing and the inner end of said spring having a hook, a winding drum rotatably supported in said casing, said drum having means engageable with said hook to wind said spring upon said drum when said drum is rotated in a first direction, a ratchet gear carried by said drum, a shaft rotatably supported within said casing in coaxial relation with said drum, a handle secured to said shaft outside of said casing, a collar rotatably mounted on said shaft, said collar having a first radial projection, a pawl pivotally mounted on said radial projection, movable means carried by said radial projection and attached to said pawl operative in a first position to hold said pawl in operative engagement with said ratchet gear and in a second position to hold said pawl out of engagement with said ratchet gear, means carried by said shaft for turning said radial projection with said shaft, said last-mentioned means being operative when said handle is rotated in said first direction to move said movable means to said first position

and operative when said handle is moved in a second opposite direction to move said movable means to said second position, and means carried by said projection preventing rotation of said projection only in said second direction, said spring acting to spin said drum in said second direction to unwind the spring therefrom when said handle is rotated in said second direction to disengage said pawl from said ratchet gear.

4. A manually operable spring starter as defined by claim 3, further including an overrunning clutch attached to said drum for coupling said drum to the shaft to be rotated, said clutch comprising a clutch member drivable by said drum only in said second direction and adapted to overrun said drum when the speed of the shaft to which it is connected exceeds the speed of rotation of said drum.

5. Apparatus for imparting a rapidly accelerating rotative movement to a shaft comprising, a stationary casing, a spring coiled within said casing with the outer end of said spring attached to the wall of said casing, a first shaft extending into said casing through one end thereof, bearing means rotatably supporting said first shaft, a crank arm secured to the outer end of said first shaft for rotating said first shaft, a second shaft rotatably surrounding said first shaft, means on said second shaft for acting on the inner end of said spring to wind said spring upon said second shaft when said second shaft is rotated in a predetermined direction, means for turning said second shaft in said predetermined direction when said first shaft is rotated by said crank arm in a first direction, and means for rendering said last mentioned means inoperative when said first shaft is rotated by said crank arm in a second direction, whereby the spring wound upon said second shaft will rotate said second shaft in a direction opposite to said predetermined direction to restore said spring to its normal position.

6. A starter for an internal combustion engine having a drive shaft with an exposed end, said starter comprising a housing mounted on said engine over and in alignment with said shaft end; a coil spring in said housing and connected thereto; coupling means connected to said spring and mounted in said housing for rotation in response to energy stored in said spring; means connected to said housing for locking said coupling means against rotation; means including a handle mounted on said housing and communicating therethrough to said spring for storing energy in said spring when said locking means is engaged; means for releasing said locking means when energy is stored in said spring to impart rotation to said coupling means; and clutch means on said shaft end for engaging said shaft and said coupling means in driving relation only when said locking means is released and said engine is not running.

7. The starter defined in claim 6 further characterized by said coupling and clutch means constructed and arranged to provide a short path of free travel for said coupling means after said locking means is released and before said coupling means and clutch means actually become engaged in driving relation whereby said coupling means gains an increment of kinetic energy prior to final driving engagement with said shaft.

8. A starter for an internal combustion engine having an exposed rotating shaft and air cooling means associated with said shaft for drawing air through said engine around said shaft, said starter comprising; a housing, means for mounting said housing on said engine over said shaft end and spaced from said engine to permit free entrance of air around said shaft; spring means in said housing; ratchet and pawl mechanism operatively associated with said shaft and connected thereto for coupling said spring means and said shaft end when said engine is not running, said ratchet and pawl mechanism being held in disengagement by centrifugal force when said engine is running; means mounted on said housing

for storing energy in said spring; and means mounted on said housing for releasing said stored energy in said spring, whereby the release of energy stored in said spring is imparted to said shaft only when said engine is not running.

References Cited in the file of this patent

UNITED STATES PATENTS

2,568,136	Weimer	Sept. 18, 1951
2,804,173	De Millar	Aug. 27, 1957