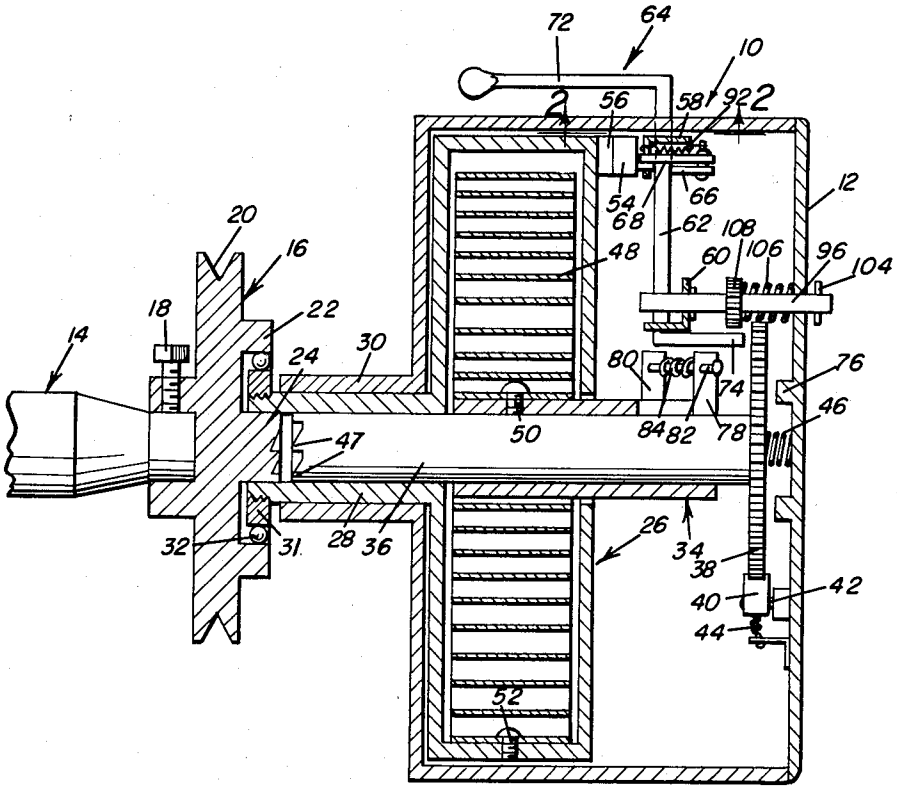
May 8, 1956 F. R. BLANKENBURG 2,744,586

ENGINE STARTER

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Fig. 1



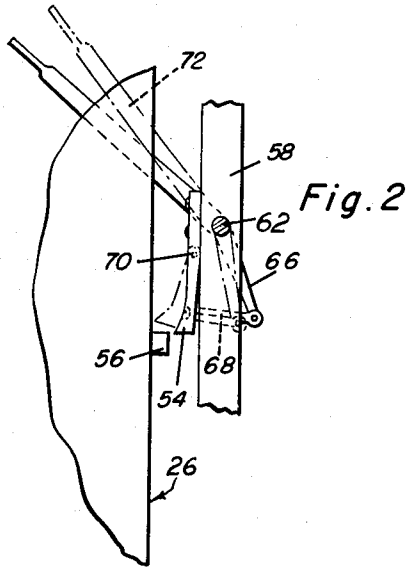


Fig. 2

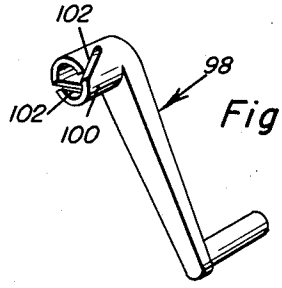


Fig. 6

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Fig. 3

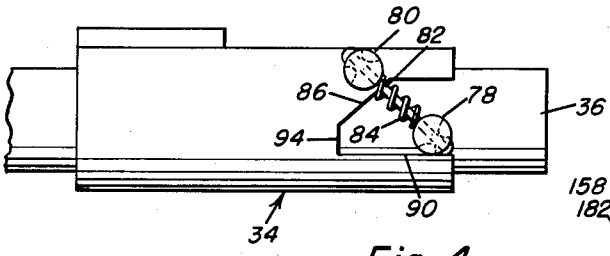
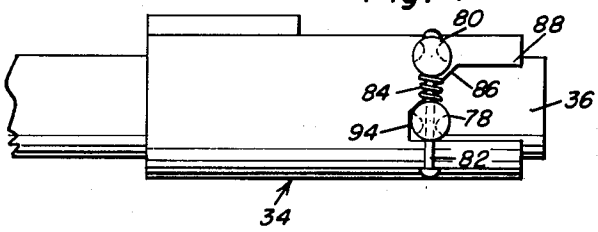


Fig. 4



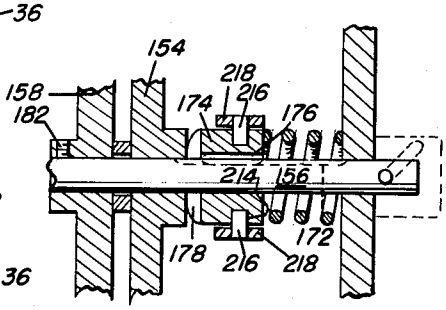
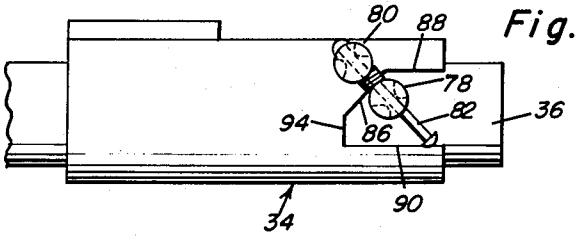


Fig. 10

Fig. 5



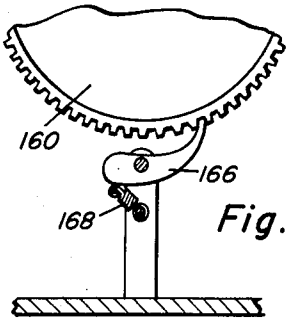


Fig. 11

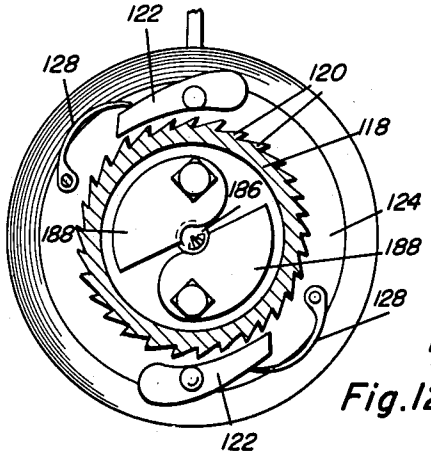


Fig. 12

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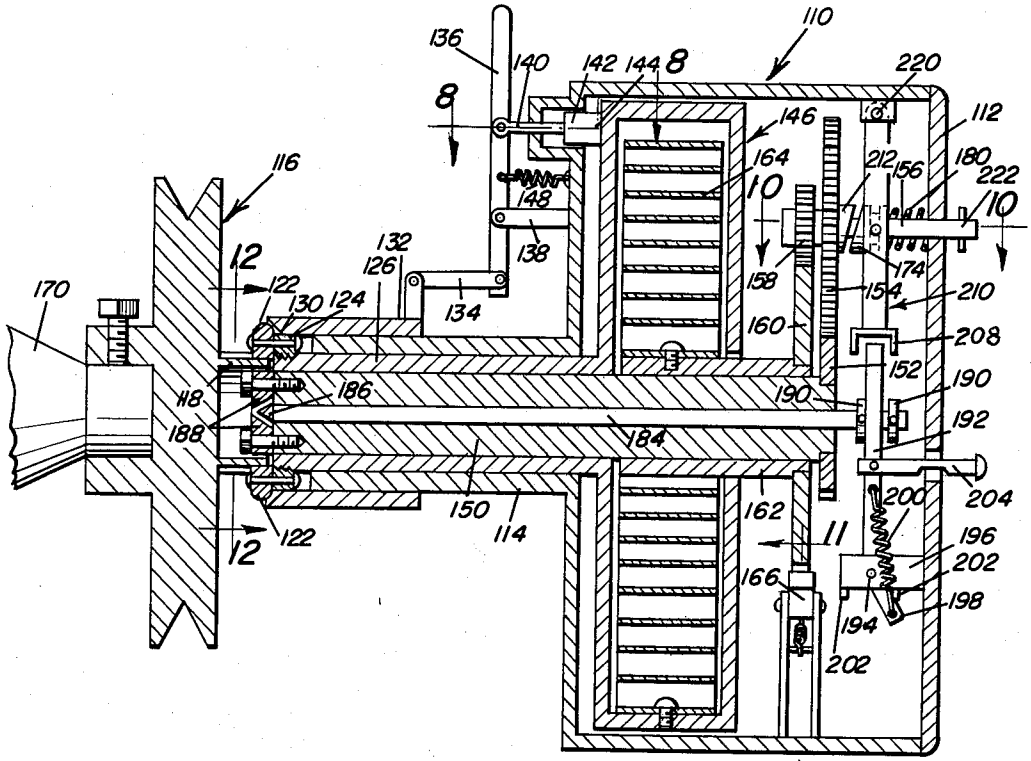
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Fig. 7



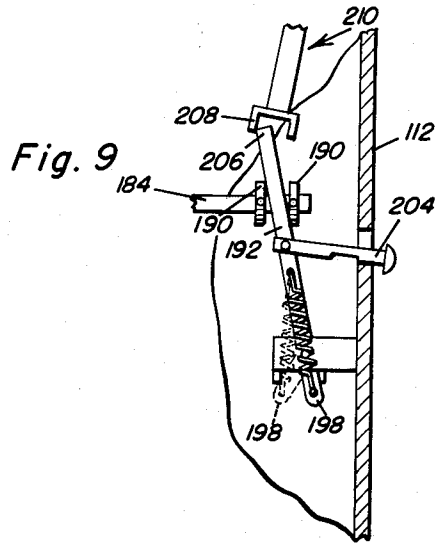


Fig. 9

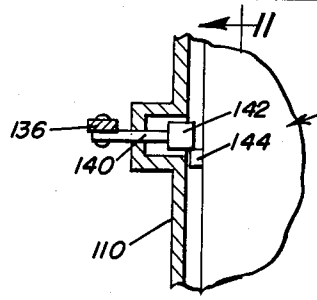


Fig. 8

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ENGINE STARTER

Frederick R. Blankenburg, Granby, Conn.

Application June 22, 1953, Serial No. 363,090

8 Claims. (Cl. 185—41)

This invention relates generally to attachments for effecting the starting of internal combustion engines, turbines, machines or mechanisms and pertains more particularly to a device for storing energy derived from the engine crankshaft during power operation of the engine, turbine, machine or mechanism which may be selectively released for starting the engine, turbine, machine or mechanism when the same is stopped.

A primary object of this invention is to provide an energy reservoir deriving its potential from the power of an internal combustion engine, turbine, machine or mechanism, means being associated with the reservoir for converting the potential energy stored therein to physical motion of the crankshaft of the internal combustion engine, turbine, machine or mechanism for starting the same.

Another object of this invention is to provide a self-energizing engine starter incorporating a spirally wound spring means operating through an overrunning clutch mechanism for imparting starting motion to an internal combustion engine crankshaft.

Another object of this invention is to provide an engine starter in conformity with the foregoing objects which incorporates manual means for storing energy in the spirally wound spring as well as means for winding the spring in response to rotation of the engine crankshaft.

These together with other objects and advantages which will become subsequently apparent reside in the details of construction and operation as more fully hereinafter described and claimed, reference being had to the accompanying drawings forming a part hereof, wherein like numerals refer to like parts throughout, and in which:

Figure 1 is a vertical section taken through one form of the novel engine starter showing a portion of an internal combustion engine crankshaft to which the assembly is drivingly attached;

Figure 2 is a horizontal section taken substantially along the plane of section line 2—2 of Figure 1 showing details of the spring release mechanism;

Figures 3–5 are enlarged plan views of the cam actuating mechanism of the assembly showing the same in several positions during operation of the starter;

Figure 6 is a perspective view of the hand crank utilized in manually rewinding the spring;

Figure 7 is a vertical section taken through a modified form of starter assembly;

Figure 8 is a horizontal section taken substantially along the plane of section line 8—8 of Figure 7 showing details of the spring release mechanism;

Figure 9 is a vertical section of a portion of the starter assembly shown in Figure 7 showing the rewind clutch actuating assembly in the rewind position;

Figure 10 is a horizontal section taken along the plane of section line 10—10 of Figure 7 showing details of the rewind mechanism on enlarged scale;

Figure 11 is a vertical section taken substantially along the plane of section line 11—11 showing the rewind pawl release mechanism; and

Figure 12 is a vertical transverse section taken substantially along the plane of section line 12—12 of Figure 7 showing details of the overrunning clutch and the rewind clutch.

Referring now more particularly to Figure 1, reference numeral 10 indicates generally a cylindrical housing member which may be secured in any suitable manner (not shown) to the block portion of an internal combustion engine and which is provided with a removable end cover 12. Reference numeral 14 indicates generally an internal combustion engine crankshaft while reference numeral 16 indicates generally a fan belt pulley assembly which is secured as by the setscrew 18 to the crankshaft and includes the pulley sheave portion 20 and the overrunning clutch race portion 22 as well as the centrally disposed rewind clutch dog portion 24. A spring housing 26 is provided with the projecting hub portion 28 which is journaled within a corresponding hub portion 30 forming a portion of the housing 10 and the free end of this hub is provided with external threads for the reception of an inner race member 31. The ball bearings 32 are disposed between this inner ring and the previously mentioned outer race 22 and it will be appreciated that these races are constructed as to provide an overrunning clutch mechanism the particular construction of which is not shown inasmuch as such mechanisms are conventional and well known in the automotive art. Sleeve 34 is freely received on a portion of the shaft 36 which is concentrically received within the hub portion 28 and journaled therein.

An outer end portion of the shaft 36 is provided with the gear 38 which is engaged by a pawl 40 pivotally received on the pin 42 and urged by spring 44 to normally engage with the teeth of the gear 38 and prevent its rotation in one direction while allowing its rotation in the other direction. A compression spring 46 is disposed between the end cover 12 and the outer end of the shaft 36 to normally urge this shaft to the left in Figure 1 so that its inner end portion formed with the dog clutch teeth 47 engages with corresponding teeth in the clutch portion 24 of the pulley assembly 16.

A flexible band 48 is wound in a coiled fashion about the sleeve member 34 and its inner end is secured thereto as by the fastener 50 whereas the outer end of this spring member is secured by the fastener 52 to the housing 26, the housing being normally prevented from rotating when this spring is wound tight by engagement of the latch member 54 with a projection 56 on the spring housing. In this regard, it will be noted that the shaft 36, and consequently the sleeve 34 in a manner hereinafter set forth, are prevented from rotation under action of the spring member 48 by reason of the engagement of the pawl 40 with the gear 38 to which the shaft 36 is rigidly secured.

Referring now more particularly to Figure 2 as well as Figure 1, it will be seen that the housing member 10 is provided with a rigid angle bracket 58 and a similar bracket 60, the two being vertically spaced as shown, and it will further be seen that the intermediate vertical portion 62 of the crank assembly 64 is pivotally received in these two brackets as will be readily apparent. An arm 66 is rigidly secured adjacent the upper end of the intermediate portion 62 and is pivotally secured to one end of a drag link 68 whose other end is pivotally secured to the latch member 54, the latching member being in turn oscillatably secured by the pin 70 to the bracket 58. The upper end of the crank 64 is provided with the laterally offset horizontal portion 72 by means of which the crank assembly is manually rotated. The crank assembly 64 also includes a lower horizontal end portion 74 terminating in a free end swingable into and out of engagement with the gear 38 to urge this gear and the shaft 36 in a direction toward the end cover 12 and

into engagement with the stop ring **76** on this cover against the action of the compression spring **46**, the purpose of this construction being presently apparent.

A radially projecting pin **78** is provided on the shaft **36** and a similarly disposed pin **80** is secured to the outer surface of the sleeve **34** and these pins are interconnected by a rod **82** which is enlarged or headed at its opposite end to prevent its displacement from the pin and which receives a compression spring **84** concentrically thereof for a purpose presently to appear.

For purposes of clarity, the operation of the starter assembly will now be described. Assuming that the spring member **48** is tightly wound about the sleeve **34** and that the latch member **54** is in engagement with the projection **56** on the spring housing **26** so as to prevent unwinding of the spring, it will be seen that such unwinding is positively prevented by the previous engagement between the members **54** and **56** and by the engagement of the pawl **40** with the gear **38** to maintain the shaft **36** fixed. The spring **46** will be acting to urge the shaft **36** to the left in Figure 1 so that the dog clutch elements of the shaft and the pulley **16** are in mutual interengagement but this interengagement is prevented by the camming action between the sleeve **34** and shaft **36**. This camming engagement is a result of the disposition between the pin members **78** and **80** on the shaft and sleeve respectively, the pin **78** being forced to assume the position shown in Figure 5 due to the engagement of this pin with the cam surface **86** formed between the opposed side edges **88** and **90** of a cam notch cut longitudinally into one end portion of the sleeve as will be readily apparent. Due to the fact that the spring member **48** has rotated the sleeve **34** with respect to the shaft **36** until the pin **78** is disposed against the cam notch edge **88** as shown, the shaft **36** will be urged to the right in Figure 1 a sufficient amount, as shown, to effect disengagement between the dog clutch elements on the shaft and pulley respectively. Assuming now that it is desired to impart a rotation to the crankshaft of the engine to start the same, the lever portion **72** of the crank assembly is rotated to disengage the latching element **54** from the projection **56** which will allow the spring **48** to rotate the housing **26** and thus impart rotation to the crankshaft **14** through the overrunning clutch elements **22**, **31** and **32**. At the same time, the lower arm **74** of the crank assembly **64** urges the shaft **36** with the gear **38** to the right until the gear has engaged against the stop ring **76**, interengagement between the dog clutch elements being thereby prevented. When the engine has started and the crankshaft is rotating, the spring member **48** will have completely unwound itself, further unwinding being prevented by disengagement of the drive between the crankshaft and hub due to the overrunning clutch mechanism, so that the assembly is no longer effective to impart a starting rotation to the crankshaft. However, when the lever **72** of the crank assembly is released the crank assembly will assume the position shown in Figure 1 under action of the spring **92** associated with the latching mechanism whereby the spring housing **26** is once again latched against rotation and the gear **38** is not urged against the stop ring **76**. Just prior to the release of lever portion **72** or at any time when the spring member **48** is unwound and the lever **72** is manually moved in a direction to urge the shaft **36** to the fully extended right hand position shown in Figure 1, the cam assembly operatively connecting the shaft **36** and the sleeve **34** will be in the position shown in Figure 3 wherein the compression spring **84** disposed on the rod **82** will have rotated the sleeve **34** with respect to the shaft **36** until the pin **78** engages against the cam notch edge **90** as shown.

When the lever **72** is released from manual actuation, the shaft **36** will be forced to the left in Figure 1 under the action of the compression spring **46** until such time as the cam elements have assumed the position shown in

Figure 4 wherein the pin **78** is in engagement with the bottom edge **94** of the cam notch. The dog clutch elements of the shaft **36** are now in engagement with the corresponding elements on the portion **24** of the pulley **16** so that the internal combustion engine, being under power and rotating its crankshaft **14**, will impart a rotation to the shaft **36**. The pawl **40** will, of course, allow rotation of the shaft in this direction. Due to the fact that the spring housing **26** is prevented from rotating by engagement between the elements **54** and **56**, the shaft will impart rotation to the sleeve **34** and consequent winding of the spring **48** by virtue of the engagement of pin **78** against the cam surface **86** of the cam notch in the sleeve. As the spring is rewound and its tension becomes greater with respect to the sleeve, the pin **78** will gradually work its way along the cam surface **86** until it has reached the point in engagement with the notch edge **38** at which point the spring will have been completely rewound and the dog tooth clutch elements will have simultaneously been disengaged due to the shifting of the shaft **36** to the right in Figure 1 under the action of the cam engagement between the pin **78** and the surface **86**. The starter assembly is now in position to restart the engine.

It will be noted that the above described relative movement between the pin elements **78** and **80** would necessarily require some pivotal motion of the rod **82** with respect to these pins. In this respect, attention is called particularly to Figures 3—5 wherein it will be clear that the recesses or bores through the pins are of generally hourglass configuration in cross-section so as to allow this pivotal movement, this construction of the recesses being clearly shown in dotted lines in these figures.

Since the starter assembly may at sometime fail to start the engine by the time the spring **48** has become completely unwound, provision is made for manually rewinding such spring. A winding shaft **96** is journaled in the bracket **60** and the end cover **12** and projects beyond the latter for the reception of the hand crank **98** shown in Figure 6. The recessed hub portion **100** of this crank is provided with the helically extending notches **102** which are engageable with the cross pin **104** on the outer end of the winding shaft **96** so that the shaft will be urged to the right in Figure 1 against the action of the spring **106** to provide engagement between the pinion **108** and the gear **38**. When the winding shaft **96** is rotated through the crank assembly **98**, the shaft **36** will be rotated in a direction so that its dog tooth elements **47** will kick this shaft to the right in Figure 1 away from engagement with the crankshaft pulley **16**, this kicking being augmented by the immediate positioning of the sleeve and shaft to the position shown in Figure 5. Continued rotation of the winding shaft **96** will, of course, effect rewinding of the spring **48**.

Referring now more particularly to Figure 7, reference numeral **110** indicates generally the housing for the starter assembly whereas numeral **112** indicates the end cover for the same, reference numeral **114** indicating its hub portion projecting toward the crankshaft pulley **116**. Collar portion **118** of the crankshaft pulley is provided with the angularly disposed ratchet teeth **120**, see Figure 12, and pawl elements **122** carried by the nut **124** secured to hub **126** are engageable with the teeth. Arcuate spring fingers **128** are pivotally secured at one of their ends to the nut **124** and these fingers are arched in a direction to extend radially outwardly of the circumferential surface of the nut **124** so that they are engageable by the tapered end surface **130** of the clutch collar **132** when the latter is urged to the left into engagement with these fingers. This clutch collar is urged to the pawl engaging position by the link **134** secured to the lower end of the manual lever **136** pivotally secured at its intermediate portion to the bracket ear **138** on the housing **110**. The upper end of this lever is provided with a link **140** carrying the latching element **142** for engagement with the pro-

jection 144 on the spring housing 146, the spring 148 normally urging the lever to the position shown. A shaft 150 is rotatably received within the hub 126 and is provided with a gear 152 at its outer end portion which mates with the gear 154 on the winding shaft 156 and through the gears 158 and 160 on the winding shaft and sleeve 162 respectively, the cooperation between the sleeve 162, the spring member 164 and the spring housing 146 being identical to the cooperation between the same elements as previously described in conjunction with Figure 1.

Gear 160, see Figure 11, is provided with the pawl mechanism 166 urged by the spring 168 into engagement with the teeth of gear 160 to prevent rotation of this gear and its associated sleeve against the action of the coil spring member 164. When the release lever 136 is manually actuated to release the spring housing 146, the clutch collar 132 is also moved in a direction to engage the spring fingers 128 to urge the pawl elements 122 into engagement with the crankshaft pulley teeth 120 to transmit the rotation of the spring housing 146 to the crankshaft 170 of the internal combustion engine. When the engine has started and the spring 164 has spent itself, the spring fingers 128 will allow the pawl members 122 to be overrun by the crankshaft pulley teeth 120 in a manner readily apparent. When the actuating lever 136 is then released the clutch sleeve 132 will return to its normal position shown in Figure 7 and the spring 164 will remain in unwound relation until the hereinafter described rewinding mechanism is actuated.

Referring now more particularly to Figure 10, it will be seen that the rewind shaft 156 is provided with an elongated keyway 172 so that the cam element 174 is longitudinally slidable on this shaft although rotatably secured thereto through the key 176. The end cam surface 178 of this element mates with a corresponding surface on the gear 154 and, under the action of the spring 180 is frictionally engaged therewith. Since the gear 154 is freely journaled on the shaft 156, rotation of this gear will impart rotation to the shaft so long as resistance to rotation of the shaft is overcome by the spring 180, as will be readily apparent. The previously mentioned gear 158 is rigidly secured to the shaft 156 by the setscrew 182. The purpose of these gear and shaft assemblies is to impart a rewinding motion to the sleeve 162 in a manner presently apparent.

A rod 184 extends longitudinally through the shaft 150 and is provided with a conically tapered end portion 186 engageable with the pivoted brake shoes 188 so as to urge the same into frictional engagement with the inner surface of the pulley portion 118 when the rod is longitudinally shifted to the left in Figure 7. To effect this shifting of the rod, see Figures 7 and 9, the same is provided with the spaced stop collars 190 engaging on opposite sides of the shifting lever 192 whose lower end portion is pivoted as at 194 to the bracket 196. A trip lever 198 is pivotally secured at its upper end by the pin 194 and a tension spring 200 is stretched between its free end and an intermediate portion of the shifting lever 192. Limit stops 202 constrain the pivotal motion of the trip lever 198 so that when the shifting lever 192 is rotated to the position shown in Figure 9 by means of the push rod 204, the trip lever will engage over its center with respect to the shift lever so that it is snapped into the dotted line position shown in Figure 9 tending to maintain the shifting lever in the position shown wherein its upper end portion 206 is just engaging one of the spaced legs 208 of the yoke assembly 210 in the manner shown. With the engine crankshaft rotating and the rod 184 urging the brake shoes 188 into engagement with the portion 118 of the crankshaft pulley by reasoning of the positioning of the assembly as shown in Figure 9, the shaft 150, carrying the brake shoes, will be rotated which will effect corresponding rotation to the gears 154, 158, 160 and the sleeve 162 to thereby rewind the spring 164. When the spring 164 has been rewound a sufficient amount to resist rotation of the shaft 156 so as to cam the elements 174 away from the corresponding portion 212 of the gear 154, the cam element will be shifted along the shaft 156 to the right in Figure 7 and will, through the yoke assembly 210, return the shift lever 192 to the position shown in Figure 7 carrying the rod 184 therewith and to thus disengage the brake shoes 188 from frictional engagement with the crankshaft pulley. In this respect, it will be noted that the cam element 174 is provided with the circumferential groove 214 within which the pins 216 carried by the yoke legs 218 project. The upper end of this yoke is, of coures, pivotally secured as at 220 to the housing 110.

In order to manually rewind the spring 164, it is merely necessary to engage a suitable crank on the free end portion 222 of the rewind shaft 156, as will be readily apparent.

From the foregoing, the construction and operation of the device will be readily understood and further explanation is believed to be unnecessary. However, since numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction shown and described, and accordingly all suitable modifications and equivalents may be resorted to, falling within the scope of the appended claims.

What is claimed as new is as follows:

1. A starter assembly for driving an engine crankshaft and storing energy from an engine, said assembly comprising a starter housing including a hub portion, a spring housing in the starter housing including a spring housing hub extending out of the hub of said housing, overrunning clutch means operatively carried on an extending end portion of said spring housing hub for engagement with the engine crankshaft, a shaft reciprocably journalled in said spring housing hub and including means at one end portion for rotatable engagement with a member rotated by the engine crankshaft, a sleeve journalled on said shaft and extending within said spring housing, a coil spring concentrically disposed on said sleeve within the spring housing including an inner end secured to said sleeve and outer end secured to said spring housing, control means engageable with said spring housing permitting rotation thereof for rotating the engine crankshaft, gear means carried on an end portion of said shaft extending out of said sleeve, stop means engageable with said gear means permitting rotation of said shaft in one direction, and clutch engageable drive means engageable with said gear means for rotating said crankshaft and winding said spring.

2. A starter assembly as set forth in claim 1 wherein said starter housing includes means extending therefrom for manually rewinding said spring.

3. A starter assembly as set forth in claim 1 including resilient means engaging said gear means and starter housing for normally urging said shaft toward a position for engagement with said crankshaft to effect engagement of said clutch means to rewind said spring means, and cam means connecting said sleeve and said shaft for urging said shaft away from said crankshaft when said spring means is re-wound.

4. A starter assembly as set forth in claim 3 wherein said cam means includes a spring element engageable between pin elements extending upwardly from said sleeve and said shaft, said pin on said shaft being engageable on plural cam surfaces of a cam groove on said sleeve.

5. The combination of claim 1 wherein said overrunning clutch means includes pawls engageable with a toothed portion of said crankshaft, a collar slidably carried by said hub for engaging said pawls with said toothed portion of the crankshaft.

6. The combination of claim 5 wherein said means for releasably preventing rotation of said hub includes

a manually operable lever, a link connected to said collar and said lever.

7. The combination of claim 1 wherein said last clutch engageable drive means includes members carried by said shaft frictionally engageable with said crankshaft, and means for establishing said frictional engagement.

8. The combination of claim 7 wherein said last means includes a rod slidably carried by said shaft and having an end portion urging said members into engagement with said crankshaft in one position of its sliding movement.

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