

May 1, 1962

D. B. FURLONG

3,032,024

SPRING-IMPULSE ENGINE STARTER

Filed Aug. 9, 1960

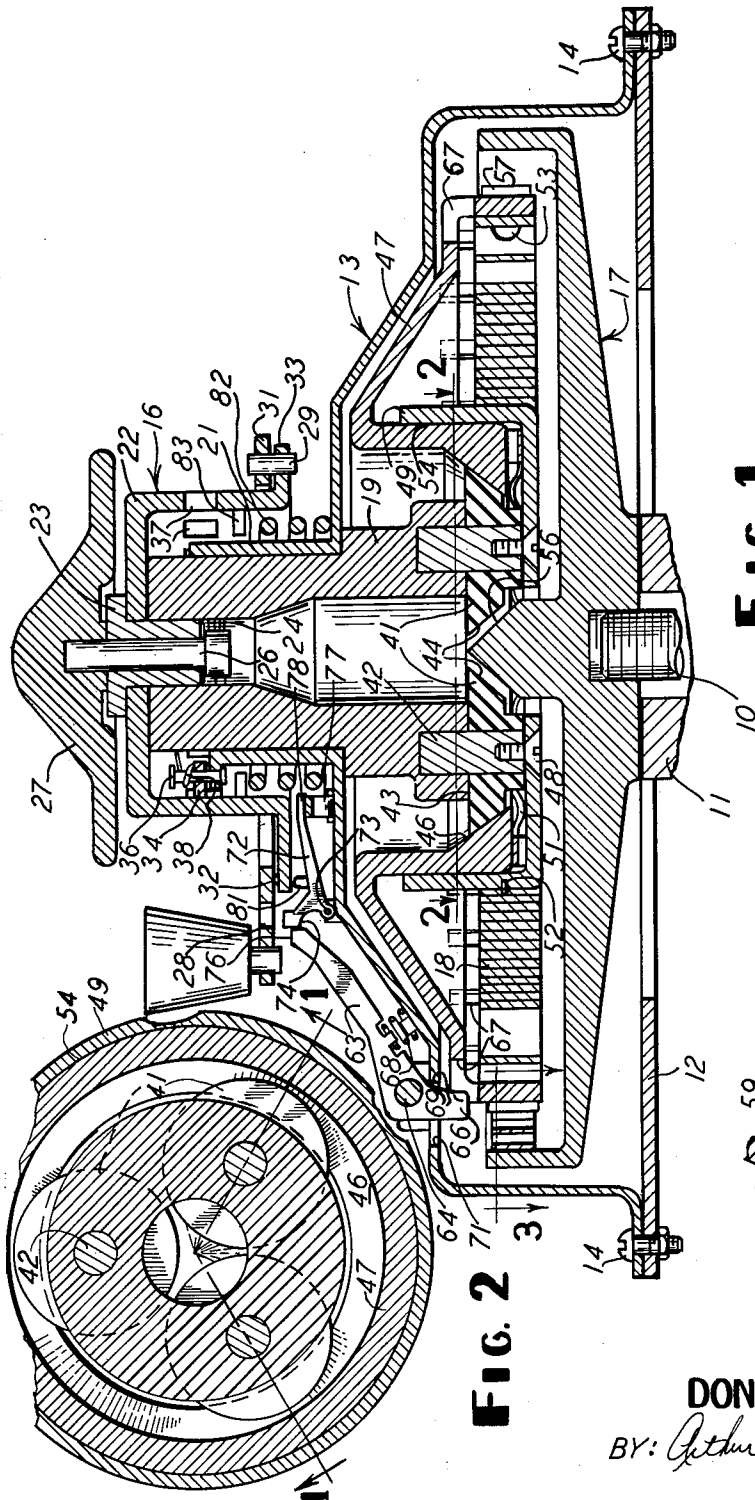


FIG. 1

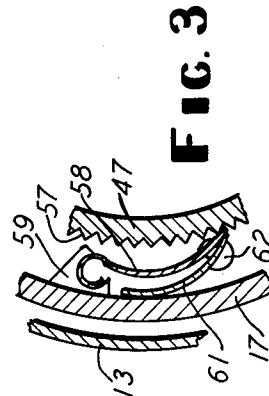


FIG. 3

INVENTOR:

DONN FURLONG

BY: *Arthur J. Donomann*
ATTORNEY

1

3,032,024

SPRING-IMPULSE ENGINE STARTER

Donn B. Furlong, Claremont, Calif., assignor to Acme Die Casting Corp., Racine, Wis., a corporation of Wisconsin

Filed Aug. 9, 1960, Ser. No. 48,524
17 Claims. (Cl. 123—179)

This invention relates to a spring-impulse type of engine starter, and more particularly, it relates to an engine starter which is rewound under the power of the engine when the latter is running.

It is an object of this invention to provide an improved engine starter of the spring-impulse type which is rewound under the power of the running engine.

Another object of this invention is to accomplish the aforementioned object and to do so with an easily manufactured and relatively inexpensive starter which is also adaptable to the present day small gasoline engines for use in powering lawn mowers and like mobile tools and outboard motors and the like.

Still another object of this invention is to provide an engine starter of the spring-impulse type wherein the starter can both be cranked by hand and thereby place the spring under tension for starting the engine, and whereby the starter can also be reset under impulse spring tension by virtue of the engine power when the engine is running. In accomplishing this particular object it is also significant that the starter is so arranged so that the operator will know when the spring has again been wound under the power of the engine and thus the danger of overwinding the spring is eliminated.

Still a further object of this invention is to provide an engine starter wherein the energy of the starting spring is either positively retained by a stop on the starter, or it is positively released and the stop cannot be reset to engage a rotating part of the starter and thus possibly damage the starter. Thus this particular object provides for the starter which is positive in its action of either releasing or retaining the energy of the starting spring.

A significant object of this invention is to provide a spring-impulse type of engine starter which is automatically re-energized or set under the power of the operating engine and wherein the reset operation requires only a fraction or part of the torque required in winding the spring. In accomplishing this object, the starter is so arranged that a mechanical advantage is utilized in winding the spring under the power of the engine so that a substantially smaller torque or power is required to rewind the spring.

Another significant object of this invention is to provide a spring-impulse type of engine starter which is wound under the power of the engine and wherein the winding parts are subjected to only a minimum of wear, and the rewinding speeds are relatively low, and the operator can observe the starter to determine when the spring is fully rewound, and over-winding of the spring is not likely in view of certain inherent safety features of the rewinding parts.

Other objects and advantages will become apparent upon reading the following description in light of the accompanying drawings wherein:

FIG. 1 is a sectional view of a preferred embodiment of a starter constructed according to this invention, and with the section taken on the lines 1—1 of FIG. 2.

FIG. 2 is a sectional view taken along the lines 2—2 of FIG. 1.

FIG. 3 is a sectional view taken along the line 3 of FIG. 1.

The same reference numerals refer to the same parts throughout the several views.

2

The starter of this invention is shown mounted onto an engine which is shown to have the usual threaded crankshaft end 10, and engine boss 11, and housing or shroud 12. The starter housing 13 is attached to the engine housing by means of the bolts 14 as shown. The starter generally consists of the driving member 16 and a driven member 17, with the latter being shown as threadedly attached to the engine crankshaft 10 to thereby constantly rotate with the rotation of the crankshaft 10. Of course the driving member 16 and the driven member are thus shown to be rotatably mounted within the confines of the starter housing 13, and it will of course be understood that these parts are circular as shown in both FIGS. 1 and 2. A starter spring 18, of the usual spirally wound type commonly employed in spring-impulse starters, is operatively disposed between the driving member 16 and the driven member 17 to thus transfer the energy of the wound spring 18 from the driver 16 to the driven member 17, of course for the purpose of rotating the crankshaft 10 and thereby initially cranking the engine in the desired manner.

The driving member 16 is shown to consist of a central shaft or hub 19 which is rotatably mounted within the upper and circular flange 21 on the housing 13. The cap or connector 22 is disposed over the shaft 19 and is attached thereto by means of the threaded member or bolt 23 which threads into the threaded hole 24 in the upper end of the shaft 19. Thus the shaft 19 and the cap 22 are secured together, and at this time it might also be noted that a pin 26 extends through the bolt 23 and into a button or cover 27 which is preferably pressed onto the pin 26, and the latter is preferably rotatable within the bolt 23. With this arrangement, under slight holding force on the button 27, the bolt 23 and of course the cap 22 and shaft 19 will rotate with respect to the button 27 by virtue of the rotative relation between the pin 26 and the bolt 23. It will also be noted that a hand crank or handle 28 is attached to the cap 22 by means of a pin 29, and the attached end of the handle 28 is extended slightly at the part indicated 31 so that upon rotating the handle 28 about the pin 29 in clockwise direction as viewed from above, the handle portion 31 will abut the outer surface of the cap 22 to thereby engage the same and provide a cranking or rigid relation between the handle 28 and the cup 22 in the clockwise direction so that the handle 28 can be employed to rotate the cup 22 and the shaft 19. It will thus be obvious that the handle 28 is semi-circularly formed to nest around the circular cup 22 and be placed in the inoperative or non-cranking position shown in FIG. 1 to be a compact part of the starter, and a dimple or projection 32 on the cap lower flange 33 will cause the handle 28 to be releasably locked in the inoperative position shown in FIG. 1. Since this particular feature of the handle is of only passing concern in the description of this invention, no further showing of the described figuration and relation of the handle to the starter is deemed to be necessary for one skilled in the starter art.

Also, the conventional pawl and ratchet type of mechanism is employed between the housing 13 and the rotatable cap 22 to permit the latter to rotate in one direction only and to restrain it from rotating in the opposite direction. Thus FIG. 1 shows a pawl 34 pivotally mounted on the cylindrical portion 21 of the housing 13 by means of the pin 36. The pawl 34 of course has its operating or engaging end (not shown) extending away from the section plane in FIG. 1 so that the end engages the opening 37 provided around the cap 22 to permit the described clockwise rotation of the cap 22 and to restrain the counterclockwise rotation thereof. Thus, also a usual biasing spring 38 is engaged around the pin 36 with one end of the spring 38 abutting the shaft 19 and the op-

posite end of the spring 38 engaging the usual pointed end of the pawl 34 to urge the pawl radially outwardly and into engagement with the hole 37 in the usual sequential manner. Of course the pawl and ratchet thus constitute a conventional type of stop commonly employed in spring-type starters to permit rotation in one direction and to restrain rotation in the opposite direction.

The lower end of the shaft 19 has three frusto-conical members or beveled wheels 41, preferably made of hard rubber, attached thereto by means of the rollers or pins 42 so that the wheels 41 of course can rotate about the axis of the pins 42 and the wheels 41 are shouldered at the lower surface 43 of the shaft 19 to be rigidly supported by the latter. It will also be noted that the wheels 41 have tapered circumferences 44 which are shown aligned with a tapered circular surface 46 on a spring carrier or cage 47 which is rotatably mounted in the housing 13. Screws 48 are employed to connect a circular member 49 below the wheels 41, and the screws 48 connect into the pins 42. Thus the wheels 41 are rotatably mounted with respect to the shaft 19 and are secured thereto by the screws 48, and it will also be noted that a wavy spring 51, which is a pressure-limit means, is disposed between the carrier 47 and the member 49 to urge the latter two apart and thereby retain the parts in the positions shown and induce a desired and resilient force between the wheel surfaces 44 and the tapered circular surface 46. Of course it will also be understood that the inner end of the spring 18 is secured to the member 49 by means of a pin 52, and a rivet or the like 53 secures the outer end of the spring 18 to the carrier 47. The member 49 and the carrier 47 overlap each other in the manner shown along the line 54 and they are rotatable with respect to each other on the surface indicated by the line 54 and this of course is the circular surface shown in FIG. 2, for instance.

It will also be noted that the driven member 17 has a conical surface 56 on the axis thereof and this surface is engaged by the tapered surfaces 44 of the wheels 41 in a manner described later. Also the outer circumference of the carrier 47 is provided with teeth 57 which are engaged by a pawl 58 which is rotatably mounted on a boss 59 on the driven member 17. A flat spring 61 is attached to the pawl 58 by the rivet 62 and the other end of the spring 61 engages the inside of the driven member 17 to urge the pawl 58 radially inwardly on the starter and into engagement with the teeth 57. Thus, a clockwise, driving relation is established between the carrier 47 and the driven member 17. It will also be understood that the pawl 58 is influenced by centrifugal force so that upon reaching a certain speed of revolution of the members 47 and 17, the pawl 58 will pivot radially outwardly against the influence of the spring 61 and thus disengage the drive relation with the teeth 57. These parts thus constitute a one-way drive connector.

It will also be noted that a stop or pawl 63 is pivotally mounted on the housing 13 by means of the pin 64 and the inner end 66 of the pawl 63 engages spaced openings 67 in the carrier 47 to retain the latter from rotating with respect to the housing 13. A compression coil spring 68 is employed to urge the pawl 63 into the position shown which is one limit of its pivotal relation and the end 66 abuts the edge 69 of the opening 71 in the housing 13 to retain the pawl 63 in the limit of pivotal movement shown so that it cannot pivot beyond this position. A latch 72 is also pivotally mounted on the housing 13 by means of a pin 73 and a surface 74 of the latch 72 engages a surface 76 of the pawl 63 when the latter is pivoted clockwise from the position shown so that the surface 76 is disposed beneath the latch surface 74. Then a flat spring 77 is disposed between the housing 13 and the latch end 78 to continuously urge the latch in a counter-clockwise direction about the pin 73 and thus it will retain the pawl 63 in the latched position described. It will be further understood that when the

pawl 63 is pivoted to a position of locked engagement with the latch 72, then the pawl end 66 is free of the opening 67 so that the carrier 47 is free to rotate. However, it will also be understood that the pawl 63 and the latch 72 are so arranged that upon depressing the pawl 63 to release it from the carrier 47, the pawl surface 76 will first pass below the latch surface 74 before the pawl end 66 is free of the opening 67. This provides for a positive latching of the pawl 63 before the pawl releases the cage 47 and thus accidental reengagement of the pawl ends 66 with the cage 47 is prohibited and thereby avoids damage to the latter when the latter is rotating. That is that the pawl 63 must be fully depressed to be released from the opening 67 and by this time the latch 72 will engage the pawl surface 76 to retain the pawl 63 in the released position and it cannot therefore be reengaged until a further and different action is accomplished. Spring 77 is stronger and more effective than spring 68.

In the operation of the starter, it will now be understood that the handle 28 is employed to be disposed in its cranking position and to rotate the shaft 19 through the cap 22 and to thereby rotate the member 49 and the inner end of the spring 18. Of course in this operation the pawl 63 is in the position shown to retain the carrier 47 so that the spring becomes wound as shown in FIG. 1. The handle 28 is then placed into position as shown in FIG. 1 and the starter is now ready to crank the engine. Thus, upon depressing the pawl 63, the cage 47 will be released and it will engage the driven member 17 through the pawl 58 and rotate the driven member to crank the engine and start the same. When the engine is then running, the operator can depress the button or control member 27 to displace the shaft 19 along with the cap 22 and cause the wheels 41 to engage the conical surface 56 of the driven member 17. It will now be seen that upon displacing the cap 22, its flange 23 will engage the latch 72 through the projection 81 on the latch 72 and the latter is thus rotated clockwise about the pin 73 to release the pawl 63 and permit it to return to the position shown in FIG. 1. By virtue of the arrangement of the parts just mentioned, the latch 72 releases the pawl 63 prior to the engagement of the wheels 41 with the surface 56 so that the shaft 19 is not yet rotated to cause rotation of the carrier 47. Thus the parts are not subjected to damage by virtue of having the pawl 63 engage the carrier 47 while the latter is rotating. Continued depression of the button 27 and the shaft 19, will have the wheels 41, which are the planet elements, engage the surface 56, which is the sun element, and the surface 46, which is the stationary ring element or surface, in a manner to have the mentioned elements constitute a planetary gear type of drive between the driven member 17 and the shaft 19. That is, since the carrier 47 is now held against rotation, the wheels 41 will roll over the surface 46 and thereby rotate the shaft 19 and the member 49 attached thereto as described. This rotation of course winds the spring 18 under the influence of the engine. Since a planetary drive is employed, only a part of the torque required to otherwise wind the spring is required as the action of winding is a relatively low speed movement and is therefore not at the high engine speed which would be undesirable and which would require full winding torque. The planetary arrangement is also a speed reducer. Of course in this operation, the cap 22 has been depressed against a compression coil spring 82 which is disposed between the housing 13 and projections 83 on the interior of the cap 22. Thus, the latter is urged upwardly by the spring 82. Here again the pawl 63 is released from the latch 72 to engage the opening 67 prior to the time that the member 47 commences rotation, and this is as desired.

In rewinding the spring 18, it will be noted that the cap 22 rotates during the rewinding operation so that the operator can readily detect that the spring 18 is being

5

wound and when the cap 22 stops rotation, the operator will then know that the spring is fully wound. Continued pressure on the button 27 will only serve to have the wheels 41 slip over the surface 46 and at this time it will be noted that the wavy spring 51 has determined the pressure between the wheels 41 and the surface 46 so that a maximum or upper limit in this pressure of force is built into the starter by virtue of the spring 51 and excessive damaging pressure cannot be exerted. The planetary wheels are a mechanical advantage engager since they serve to engage and disengage between the driving member 16 and the driven member 17, and to thereby selectively transmit rotation from the driven member 17 to the driving member 16. The driving member 16, along with the button 27, comprise an engager actuating means since they are depressed to effect the rotational engagement described.

While a specific embodiment of this invention has been shown and described, it should be obvious that certain changes could be made in the embodiment and the invention should therefore be limited only by the scope of the appended claims.

What is claimed is:

1. In a spring-impulse engine starter of the type including a driven member attachable to the crankshaft of an engine, a housing adapted to be mounted onto said engine, a driving member rotatably mounted in said housing, a spring connected at one end to said driving member, rotative means connected to said driving member for imparting manual rotation to the latter and winding said spring, the invention comprising a spring cage included in said driving member and being rotatable with respect thereto and being rotatably mounted in said housing and connected to the other end of said spring, a uni-directional drive member connected to said driven member for transmitting rotation from said spring cage to said crankshaft and in one direction only, a one-way-only stop means releasably connected to said housing and said driving member for selectively controlling rotation of the latter, a manually releasable stop mounted on said housing and engaged with said spring cage for restraining the latter from rotation and being movable in a releasing direction for releasing said spring cage, a latch mounted on said housing and engaged with said stop by means of engaged abutting surfaces on said stop and said latch with said surfaces being disposed to become engaged prior to release of said stop from said spring cage to thereby effect latching of said stop prior to rotation of said cage, and resilient means engaged with said latch for urging same in a direction to induce further movement of said stop in its said releasing direction and thereby release said cage and releasably retain said stop fully in said releasing direction.

2. A spring-impulse type of engine starter, comprising a driven member attachable to the crankshaft of an engine, a housing adapted to be mounted onto said engine, a driving member rotatably mounted in said housing, stop means releasably connected between said housing and said driving member for selectively controlling rotation of the latter, a spring disposed in said housing and being operably connected between said driven member and said driving member, rotative means connected to said driving member for imparting manual rotation to the latter and winding said spring, a friction engager including two rotatively engageable parts and being of a planetary gearing type with the planet parts being on said driving member and with the sun part being on said driven member and with the ring part rotatably included in said driving member and with said parts being engageable to impart rotation of said driven member to said planet parts of said driving member when said engine is running and thereby rewind said spring under the power of said engine, a spring disposed between said planet parts and said ring part for establishing a predetermined maximum pressure therebetween, an engager actuating means

6

attached to said driving member for engagement and disengagement of said engager, and a stop mounted on said housing and engageable with said ring part for controlling rotation of the latter.

3. In a spring-impulse engine starter of the type including a driven member attachable to the crankshaft of an engine, a housing adapted to be mounted onto said engine, a driving member rotatably mounted in said housing, a spiraled spring connected at one end to said driving member, rotative means connected to said driving member, for imparting manual rotation to the latter and winding said spring, the invention comprising a spring cage included in said driving member and being rotatably mounted in said housing and connected to the other end of said spring, a uni-directional drive member operatively engaged between said driven member and said spring cage for transmitting rotation from said spring cage to said driven member only and in one direction only, stop means releasably connected to said housing and each said driving member and said spring cage for selectively controlling rotation of the latter two, a friction engager including two rotatively engageable parts with a respective one of said parts on each of said driven member and said driving member and with said parts being selectively engageable to impart rotation of said driven member to said driving member when said engine is running, an engager actuating means connected to said engager for engagement and disengagement of the latter, and a spring disposed between said driving means and said spring cage for limiting pressure therebetween and correspondingly limiting the pressure transmitted through said engager and to said spiraled spring.

4. In a spring-impulse engine starter of the type including a driven member attachable to the crankshaft of an engine, a housing adapted to be mounted onto said engine, a driving member rotatably mounted in said housing, a spring connected at one end to said driving member, rotative means connected to said driving member for imparting manual rotation to the latter and winding said spring, the invention comprising a spring cage included in said driving member and rotatably mounted in said housing and connected to the other end of said spring to be rotated thereby, a drive connector operatively engaged between said driven member and said spring cage for transmitting rotation therebetween, stop means releasably connected to said housing and each said driving member and said spring cage for selectively controlling rotation of the latter two and with said stop means on said driving member being a one-way-only stop means, a mechanical advantage engager including two rotatively engageable parts with a respective one of said parts on each of said driven member and said driving member and with said parts being engageable to impart rotation of said driven member to said driving member at an increased torque compared to the torque developed by said driven member to thereby wind said spring when said engine is running, and an engager actuating means connected to one of said parts for moving same into engagement with the other of said parts.

5. In a spring-impulse engine starter of the type including a driven member attachable to the crankshaft of an engine, a housing adapted to be mounted onto said engine, a driving member rotatably mounted in said housing, a spring connected at one end to said driving member, rotative means connected to said driving member for imparting manual rotation to the latter and winding said spring, the invention comprising a spring cage included in said driving member and rotatably mounted in said housing and connected to the other end of said spring to be rotated thereby, a one-way-only drive connector operatively engaged between said driven member and said spring cage for transmitting rotation therebetween, stop means releasably connected to said housing and each said driving member and said spring cage for selectively controlling rotation of the latter two but in only one direction on said driving member, an engager including two rotatively en-

gagable parts with a respective one of said parts on each of said driven member and said driving member and with said parts being engagable to impart rotation of said driven member to said driving member to thereby wind said spring when said engine is running, said engager including a speed reducer on one of said parts to transmit rotation between said driving member and said driven member at a speed less than the normal running speed of said engine, an engager actuating means attached to said engager for selective engagement of the latter, and resilient means connected intermediate said housing and said engager actuating means for constantly urging said engager toward a disengaged position.

6. A spring-impulse type of engine starter, comprising a driven member attachable to the crankshaft of an engine, a housing adapted to be mounted onto said engine, a driving member rotatably mounted in said housing, a one-way-only stop means releasably connected between said housing and said driving member for selectively controlling rotation of the latter but in only one direction, a spring disposed in said housing and operatively associated between said driven member and said driving member, rotative means connected to said driving member for imparting manual rotation to the latter and winding said spring, means operatively interconnecting said driving member and said driven member, a friction engager including two rotatively engagable parts with a respective one of said parts on each of said driven member and said driving member and said parts being engagable to impart rotation of said driven member to said driving member to thereby wind said spring when said engine is running, said engager including pressure-limit means therein for enabling only a limited maximum pressure to be applied through said engager, an engager actuating means including a button rotatably mounted therein and with the latter said means connected to said engager for engagement of said engager upon depressing said button, and resilient means disposed between said housing and said engager actuating means for urging said engager to a position of disengagement.

7. A spring-impulse type of engine starter, comprising a driven member attachable to the crankshaft of an engine, a housing adapted to be mounted onto said engine, a driving member rotatably mounted in said housing, a one-way-only stop means releasably connected between said housing and said driving member for selectively controlling rotation of the latter in one direction only, a spring disposed in said housing and operatively interconnected between said driven member and said driving member, rotative means connected to said driving member for imparting manual rotation to the latter and winding said spring, a planetary type of engager including two rotatively engagable sun and planet parts with a respective one of said parts on each of said driven member and said driving member and with said parts engagable to impart a reduced speed rotation of said driven member to said driving member to wind said spring when said engine is running, a reactionary ring on said driving member engagable with said planet parts for effecting orbital movement of the latter and being rotatable with respect to said driving member, a stop connected to said housing and being selectively engagable with said ring, and an engager actuating means attached to said engager for selective engagement and disengagement of the latter.

8. A spring-impulse type of engine starter, comprising a driven member attachable to the crankshaft of an engine, a housing adapted to be mounted onto said engine, a driving member rotatably mounted in said housing, stop means releasably connected between said housing and said driving member for selectively controlling rotation of the latter, a spring disposed in said housing and being operatively associated between said driven member and said driving member, rotative means connected to said driving member for imparting manual rotation to the latter and winding said spring, a planetary type of engager including

two rotatively engagable sun and planet parts with a respective one of said parts on each of said driven member and said driving member and with said parts being engagable to impart a reduced speed rotation of said driven member to said driving member to wind said spring when said engine is running, said planet parts of said engager including a plurality of beveled wheels rotatably mounted on said driving member and being displaceable into engagement with said sun part on said driven member, a beveled ring rotatable on said driving member and being engagable with said planet parts for effecting orbital movement of the latter and with said ring being attached to the outer end of said spring, a stop mounted on said housing and being engagable with said ring for controlling rotation of the latter, an engager actuating means attached to said engager for selective engagement and disengagement of the latter, and means operatively interconnecting said beveled ring and said driven member.

9. A spring-impulse type of engine starter, comprising a driven member attachable to the crankshaft of an engine, a housing adapted to be mounted onto said engine, a driving member rotatably mounted in said housing, stop means releasably connected between said housing and said driving member for selectively controlling rotation of the latter in one direction only, a spring disposed in said housing and operatively associated between said driven member and said driving member, rotative means connected to said driving member for imparting manual rotation to the latter and winding said spring, a planetary type of engager including two rotatively engagable sun and planet parts with a respective one of said parts on each of said driven member and said driving member and with said parts being engagable to impart a reduced speed rotation of said driven member to said driving member to wind said spring when said engine is running, said planet parts of said engager including a plurality of beveled wheels rotatably mounted on said driving member and being displaceable into engagement with said sun part on said driven member, a beveled ring rotatable on said driving member and being connected to the outer end of said spring and engagable with said planet, parts for effecting orbital movement of the latter, a stop mounted on said housing and being selectively engagable with said ring for controlling rotation of the latter, means operatively interconnecting said beveled ring and said driven member, and an engager actuating means non-rotatively connected to said driving member for displacing the latter into engagement with said driven member through said ring.

10. A spring-impulse type of engine starter, comprising a driven member attachable to the crankshaft of an engine, a housing adapted to be mounted onto said engine, a driving member rotatably and axially movably mounted in said housing, stop means releasably connected between said housing and said driving member for selectively controlling rotation of the latter in one direction only, a spring disposed in said housing and operatively interconnected between said driven member and said driving member and having one end connected to said driving member, rotative means connected to said driving member for imparting manual rotation to the latter and winding said spring, a spring cage rotatably mounted in said housing and being connected to the other end of said spring and being releasably rotatably engaged with said driving member, a stop mounted on said housing and being selectively engagable with said spring cage for controlling rotation of the latter, means operatively interconnecting said spring cage and said driven member, an engager including two rotatively engagable parts with a respective one of said parts on each of said driven member and said driving member and with said driving member and said one part thereon being axially movable for engagement with said driven member to impart rotation of said driven member to said driving member to wind said spring when said engine is running, and a latch movably

mounted on said housing and being engaged with said stop which is engaged with said spring cage and being disposed for movement in response to axial displacement of said driving member for releasing said stop from said latch and subsequently engaging said stop with said spring cage prior to winding said spring.

11. A spring-impulse type of engine starter, comprising a driven member attachable to the crankshaft of an engine, a housing adapted to be mounted onto said engine, a driving member rotatably and axially movably mounted in said housing, stop means releasably connected between said housing and said driving member for selectively controlling rotation of the latter in one direction only, a spring disposed in said housing and being operatively associated between said driven member and said driving member, rotative means connected to said driving member for imparting manual rotation to the latter and winding said spring, an engager including two rotatively engageable parts with a respective one of said parts on each of said driven member and said driving member and with the latter being spring biased away from said driven member to be disengaged therefrom and said driving member being axially movable for engagement with said driven member to impart rotation of said driven member to said driving member to wind said spring when said engine is running, a spring cage rotatable on said driving member and having an end of said spring connected thereto and being releasably rotatably engaged with said driving member, a pawl pivotally mounted on said housing and having one end engaged with said spring cage to selectively retain the latter against rotation, means operatively interconnecting said spring cage and said driven member, and a latch on said housing and engageable with the other end of said pawl for securing the latter out of retaining position with said spring cage whenever said pawl is pivoted to release said spring cage and with said latch being movable in response to axial movement of said driving member to release said pawl from said latch prior to engagement of said engager parts.

12. In a spring-impulse engine starter of the type including a driven member attachable to the crankshaft of an engine, a housing adapted to be mounted onto said engine, a driving member rotatably mounted in said housing, a spring connected at one end to said driving member, rotative means connected to said driving member for imparting manual rotation to the latter and winding said spring, the invention comprising a spring cage included in said driving member and being rotatable with respect to the remainder thereof and being rotatably mounted in said housing and connected to the other end of said spring, a uni-directional drive member operatively interconnected between said spring cage and said driven member for transmitting rotation from said spring cage to said crankshaft and in one direction only, stop means releasably connected to said housing and each said driving member and said spring cage for selectively controlling rotation of the latter two, an engager including two rotatively engageable parts with a respective one of said parts on each of said driven member and said driving member and with said parts being engageable to impart rotation of said driven member to said driving member when said engine is running, and an engager actuating means mounted on said driving member and including a button rotatably mounted therein for depressing said driving member to engage said engager.

13. In a spring-impulse engine starter of the type including a driven member attachable to the crankshaft of an engine, a housing adapted to be mounted onto said engine, a driving member rotatably mounted in said housing, a spring connected at one end to said driving member, rotative means connected to said driving member for imparting manual rotation to the latter and winding said spring, the invention comprising a spring cage included in said driving member and being rotatable with respect to the remainder thereof and being rotatably mounted in

said housing and connected to the other end of said spring, a uni-directional drive member operatively interconnected between said spring cage and said driven member for transmitting rotation from said spring cage to said crankshaft and in one direction only, a one-way-only stop means releasably connected to said housing and said driving member for selectively controlling rotation of the latter, a manually releasable stop mounted on said housing and engaged with said spring cage for restraining the latter from rotation, an engager disposed with respective parts on said driving member and said driven member for transmitting rotation therebetween and with said engager being rotatably engageable with said spring cage and with said driving member being axially movable for engagement and disengagement of said engager, latch means operatively associated with said stop for selectively securing the latter in engaged and disengaged relation with said spring cage, and an engager actuating means included in said driving member for axially displacing the latter and with said engager actuating means including a member for engaging said latch means upon axial displacement of said engager actuating means for actuating said latch means and securing said stop in the engaged position.

14. In a spring-impulse engine starter of the type including a driven member attachable to the crankshaft of an engine, a housing adapted to be mounted onto said engine, a driving member rotatably mounted in said housing, a spring connected at one end to said driving member, rotative means connected to said driving member for imparting manual rotation to the latter and winding said spring, the invention comprising a spring cage rotatably included in said driving member and being rotatably mounted in said housing and connected to the other end of said spring, a uni-directional drive member connected to said driven member for transmitting rotation from said spring cage to said crankshaft and in one direction only, stop means releasably connected to said housing and each said driving member and said spring cage for selectively controlling rotation of the latter two, a latch mounted on said housing and including a surface engageable with one of said stop means, said one of said stop means and said latch being arranged for engagement on said surface prior to release of said spring cage by said one of said stop means, and a spring engaged with said latch for urging the latter and said one of said stop means in a direction to release said one of said stop means from said spring cage after said engagement on said surface.

15. A spring-impulse type of engine starter, comprising a driven member attachable to the crankshaft of an engine, a housing adapted to be mounted onto said engine, a driving member rotatably mounted in said housing and having a portion thereof disposed outside of said housing, a one-way-only stop means releasably connected between said housing and said driving member for selectively controlling rotation of the latter but in only one direction, a spring disposed in said housing and operatively interconnected between said driven member and said driving member, rotative means connected to said driving member for imparting manual rotation to the latter and winding said spring, a friction type engager including at least two rotatively engageable parts with a respective one of said parts on each of said driven member and said driving member and with the latter being movable into engagement with the other to impart rotation of said driven member to said driving member to thereby wind said spring when said engine is running, said engager including pressure-limit means therein for enabling only a limited maximum pressure to be applied through said engager, said parts of said engager on said driving member being attached to said portion of said driving member disposed outside of said housing for visual observation of whether or not said portion is rotating and to thereby determine if said maximum pressure has been applied

through said engager and said spring is wound, an engager actuating means including a rotatable button and being connected to said driving member for engagement of said engager upon depressing said button, and resilient means disposed between said housing and said engager actuating means for urging said engager to a position of disengagement.

16. A spring-impulse type of engine starter, comprising a driven member attachable to the crankshaft of an engine, a housing adapted to be mounted onto said engine, a driving member rotatably mounted in said housing, stop means releasably connected between said housing and said driving member for selectively controlling rotation of the latter, a spring disposed in said housing and being operatively interconnected between said driven member and said driving member, rotative means connected to said driving member for imparting manual rotation to the latter and winding said spring, a planetary type of gearing including two rotatively engageable sun and planet parts with a respective one of said parts on each of said driven member and said driving member and with one of the latter two being movable into engagement with the other to impart a reduced speed rotation of said driven member to said driving member to wind said spring when said engine is running, said planet parts of said gearing including a plurality of beveled wheels rotatably mounted on said driving member, a beveled ring rotatable on said driving member and being engageable with and disposed to one side of said beveled wheels for effecting orbital movement of the latter and being attached to the outer end of said spring, a stop mounted on said housing and being engageable with said ring for controlling rotation of the latter, actuating means attached to said gearing for selective engagement and disengagement of the latter, a connecting member attached to said beveled wheels and being attached to the inner end of said spring and extending spaced past said ring on the side thereof opposite said beveled wheels, and resilient means disposed in the space between said ring and said connecting member and exerting an outward pressure therebetween for establishing a maximum pressure between said beveled wheels and said ring.

17. A spring-impulse type of engine starter, comprising a driven member attachable to the crankshaft of an engine, a housing adapted to be mounted onto said engine, a driving member rotatably mounted in said housing, stop

means releasably connected between said housing and said driving member for selectively controlling rotation of the latter in one direction only, a spiraled spring disposed in said housing and being operatively interconnected between said driven member and said driving member, rotative means connected to said driving member for imparting manual rotation to the latter and winding said spring, an engager including at least two rotatively engageable parts with a respective one of said parts on each of said driven member and said driving member and with the latter being spring biased away from said driven member to be disengaged therefrom and said driving member being axially movable for engagement with said driven member to impart rotation of said driven member to said driving member to wind said spring when said engine is running, a spring cage rotatable on said driving member and being in rotational engagement with said one part on said driving member and having an end of said spring connected to said cage, a pawl pivotally mounted on said housing and having one end engaged with said spring cage to selectively retain the latter against rotation, means operatively interconnected between said spring cage and said driven member for inducing rotation in the latter, a latch pivotally mounted on said housing and having one end of said latch engageable with the other end of said pawl for securing the latter out of retaining position with said spring cage, a spring disposed between said latch and said housing in a position to urge said latch into the engaged position with said pawl, said latch having the other end thereof disposed in the path of said driving member when the latter is only partially axially displaced and said latch being displaced thereby prior to engagement of said engager, said axial displacement and said pawl and said latch all being arranged to have said pawl engage said spring cage upon additional axial displacement of said driving member and prior to engagement of said engager.

References Cited in the file of this patent

UNITED STATES PATENTS

1,097,899	Volkmar	May 26, 1914
2,042,841	Harmon	June 2, 1936
2,744,586	Blankenburg	May 8, 1956
2,974,658	Russell	Mar. 14, 1961
2,987,057	Kopp	June 6, 1961