J. A. WILLIAMS.

STARTER.

APPLICATION FILED APR. 30, 1914.

1,268,414.

Patented June 4, 1918.

2 SHEETS—SHEET 1.

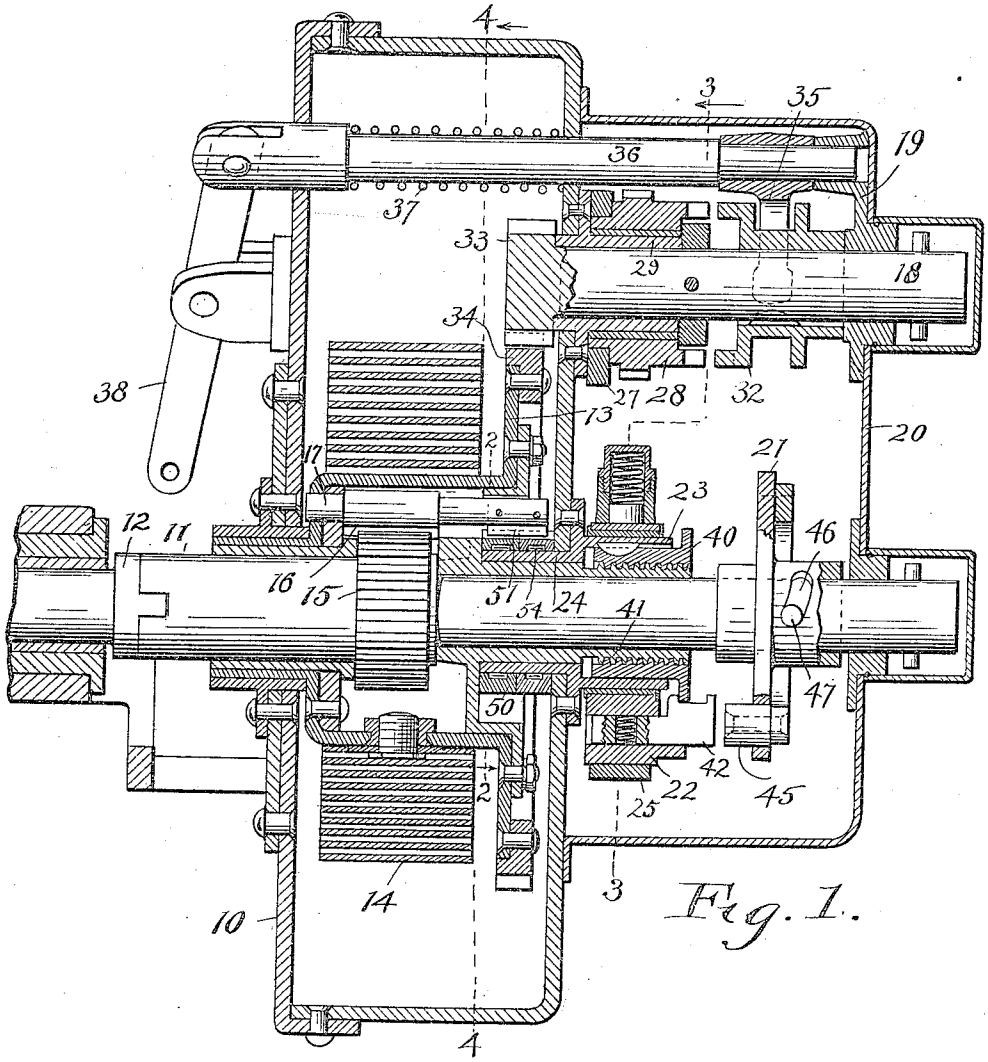
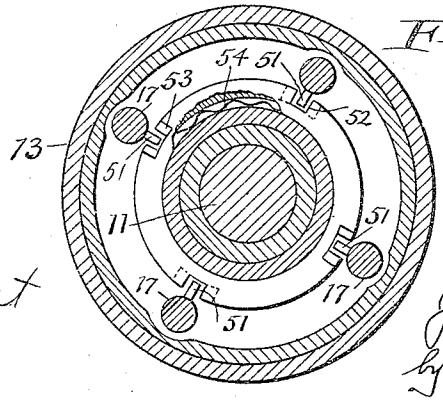


Fig. 1.

Fig. 2.



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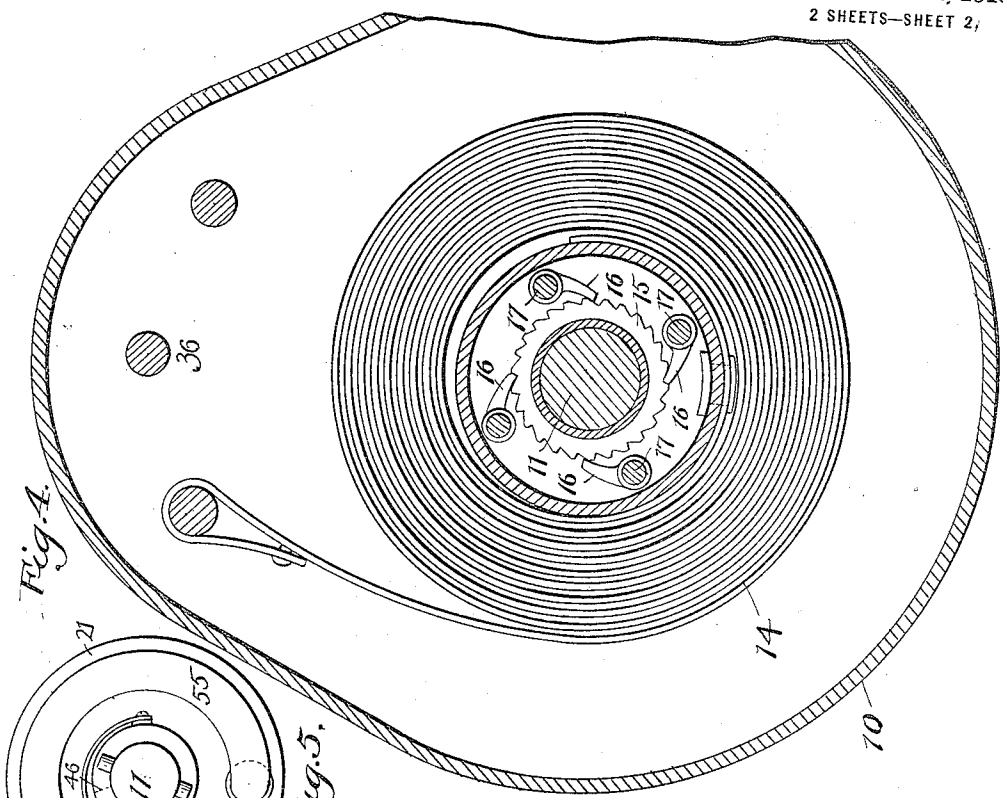
STARTER.

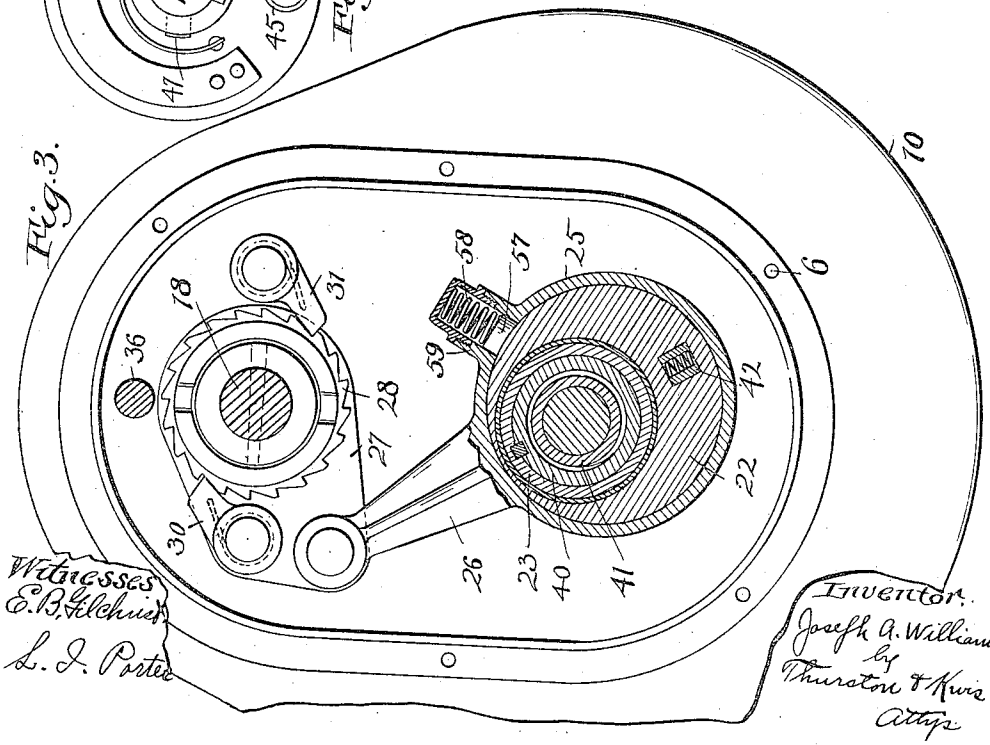
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2 SHEETS—SHEET 2.





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UNITED STATES PATENT OFFICE.

JOSEPH A. WILLIAMS, OF CLEVELAND, OHIO, ASSIGNOR TO THE K. W. IGNITION COMPANY, OF CLEVELAND, OHIO, A CORPORATION OF OHIO.

STARTER.

1,268,414. Specification of Letters Patent. Patented June 4, 1918.

Application filed April 30, 1914. Serial No. 835,358.

To all whom it may concern:

Be it known that I, JOSEPH A. WILLIAMS, a citizen of the United States, residing at Cleveland, in the county of Cuyahoga and State of Ohio, have invented a certain new and useful Improvement in Starters, of which the following is a full, clear, and exact description.

This invention relates to spring starters for internal combustion engines, and especially the engines of motor vehicles, and is an improvement over the starter forming the subject matter of my prior application Serial No. 789,041, filed Sept. 11th, 1913.

The chief object of the present invention is to improve the construction and operation of the starter such as shown in my prior application. More specifically considered, the present invention aims to improve the construction and operation, and avoid liability of breakage in the pawl and ratchet mechanism forming the power transmitting means between the arbor of the spring and the starter shaft. Another of the more specific objects is to improve the rewinding mechanism in such a manner as to avoid the liability of breakage in the timing mechanism which forms the operative connection between the parts of the rewinding mechanism, and in reducing the noise incident to the operation of the rewinding mechanism.

My invention may be briefly summarized as consisting in certain novel details of construction and combinations and arrangements of parts which will be described in the specification and set forth in the appended claims.

In the drawings, wherein I have shown the preferred embodiment of the different features of my invention, Figure 1 is a vertical sectional view through the starter. Fig. 2 is a sectional view substantially along the line 2—2 of Fig. 1, looking in the direction indicated by the arrow. Fig. 3 is a sectional view substantially along the irregular line 3—3 of Fig. 1, looking in the direction indicated by the arrow, with the sub-cover removed. Fig. 4 is a sectional view substantially along the line 4—4 of Fig. 1, looking in the direction indicated by the arrow. Fig. 5 is an end view of the starter shaft and of the driving member on the starter shaft forming a part of the rewinding mechanism.

The starter includes a main casing 10 formed of sheet metal parts secured together, and a shaft 11 which is journaled in the casing and extends transversely therethrough,—this starter shaft being designed to be connected by a suitable coupling 12 to the crank shaft of the engine to be started. The starter as a whole will be mounted at the front end of the motor vehicle, with the shaft 11 in axial alinement with the crank shaft. Within the casing 10 and surrounding the shaft 11 is a spring arbor 13 composed of two or more parts fastened together, this arbor being formed largely of sheet metal. The arbor is provided with bearing flanges which surround the shaft and which extend between the latter and bearing flanges on the front and rear walls of the casing, and it is provided also with an annular hub-like portion which is surrounded by a spiral spring 14, in which energy is adapted to be stored for starting purposes, this spring having its inner end secured to the arbor, and its outer end secured to the casing, as shown in Figs. 1 and 4.

The arbor is adapted to be connected to the starter shaft 11 for starting purposes by pawl and ratchet mechanism including a ratchet wheel 15 which is secured to the shaft within or between the two side members composing the arbor and by pawls 16 mounted upon pins 17 which are journaled in the said two side members of the arbor. The mechanism for controlling these pawls, that is for throwing them into engagement with the ratchet teeth to secure driving relationship between the arbor and the shaft 11, or to throw them out of engagement therewith, constitutes an important part of the present invention, and this mechanism will be described after the other main parts of the starter have been referred to in this general description of the starter as a whole.

Sufficient energy will be stored in the spring to start the engine under normal conditions, and as soon as the engine is started, the spring will be automatically rewound, by rewinding mechanism extending between the starter shaft and gearing on a rewinding shaft 18 journaled in one wall of the main casing 10, and in a bearing member 19 supported by a sub-cover or sub-casing 20. The rewinding mechanism includes a driving member 21 which is held by a pin to the shaft 11, so as to rotate therewith, and which is adapted to rotate an eccentric 22 when operatively connected thereto by timing mechanism to be referred to pres-

ently, and involving another important part of my invention.

The major portion of the rewinding mechanism and of the timing mechanism referred to is on the outside of the main casing 10 and are inclosed within the subcover or casing 20, as shown in Fig. 1. The eccentric 22 is between the driving member 21 and the adjacent wall of the main casing 10 and is mounted upon a cylindrical flange 23 projecting laterally outward from a member 24 constituting in effect a bearing hub secured to the adjacent wall of the casing 10, concentric with respect to the axis of the shaft 11. The eccentric is engaged by an eccentric strap 25 having an upwardly projecting arm 26 which is oscillated or reciprocated by the eccentric in a well known manner, the upper end of the arm being pivoted to a plate 27, which loosely engages and has a bearing on the hub or cylindrical flange of a ratchet wheel 28, which is mounted loosely on the cylindrical bearing flange 29 in which the rewinding shaft 18 is journaled. This plate 27 carries a spring pressed pawl 30 which engages the teeth of ratchet wheel 28, so that by the rotation of the eccentric 22, the said ratchet wheel will be stepped along or turned intermittently. A spring pressed holding pawl 31 prevents the ratchet wheel from turning in the reverse direction.

The ratchet wheel 28 is loose on its bearing shaft, as before stated, and driving connection is established between this ratchet wheel and the shaft 18 by a clutch member 32, which is connected by a key or feather to the shaft 18 so as to be slidable therealong, but rotatable therewith. This clutch member and the adjacent face of the hub or body of the ratchet wheel 28 have cooperating clutch jaws which are adapted to engage when the clutch member 32 is shifted toward the ratchet wheel 28. When these jaws are in engagement, the ratchet wheel 28 may turn the rewinding shaft 18, and when the clutch member 32 is thrown out of engagement with the ratchet wheel 28, as when it is desired to start the engine, the shaft 18 is free to turn, or the shaft 18 is released so that the spring may rotate the arbor. The rewinding shaft 18 is provided at its inner end just within the front wall of the casing 10 with a pinion 33 which engages a gear 34, in the form of a peripherally toothed ring which is secured to the outer part of the spring arbor alongside of the spring 14.

The clutch member 32 is adapted to be shifted along the rewinding shaft 18 by a clutch yoke 35 secured to a releasing rod 36 which is mounted for endwise movement in bearings of the casing 10 and said subcasing 20 and at its rear end, that is at its end toward the engine, will be connected to some suitable shifting mechanism which will extend rearwardly to a point within convenient reach of the operator occupying the front seat of the vehicle. In this case, a spring 37 shifts the rod 36 to the left as the same is viewed in Fig. 1, and serves to hold the clutch member in locking engagement with the ratchet wheel 28, and a pivoted lever 38 which is connected to the rear end of the rod 36 is adapted to shift said rod in the reverse direction to release shaft 18.

The timing mechanism or the mechanism which times the establishment of driving relationship between the disk or driving member 21 and the eccentric for the purpose of starting the rewinding of the spring, includes a traveling nut 40, which is located within and is connected by a key or feather to the flange 23 supporting the eccentric, and which engages the threaded end of a flange 41 projecting forwardly from the arbor through the forward wall of the casing 10. This nut is moved forwardly toward the driving disk 21 when the spring is unwinding and moves rearwardly or away from said member, when the arbor is being turned to rewind the spring. After a predetermined movement of the nut 40 in either direction, the nut engages a projection on a driving finger 42, and thence moves said finger in the same direction that the nut is traveling. After a predetermined outward movement of the finger 42, the end of the finger comes into the path of movement of a pin 45 extending laterally inward toward the finger from the disk or driving member 21. This driving member 21 includes a hub having spiral slots 46, into which project the ends of a pin 47 which connects the member 21 to the shaft 11. The arrangement is such that when the end of the finger 42 engages the end of finger 45, the member 21 is retarded, and this causes the member 21 to move inward on the shaft 12 a distance equivalent to the inclination of the slots 46. By this endwise movement of the member 21, the finger and pin 45 will overlap to such an extent that good driving connection is established between the finger and pin so as to enable the member 21 to effectively rotate the eccentric to rewind the spring. After a predetermined movement of the nut 40 in the opposite direction to that which it had previously moved, the finger moves out of engagement with the pin 45, whereupon the member 21 again moves endwise slightly in the reverse direction, breaking the driving engagement between the pin and finger.

I have now described as briefly as possible and consistent with clearness, the construction of the starter as a whole, omitting, however, detailed reference to the principal features in which the present invention di-

rectly resides. These will now be taken up in logical order.

As previously stated, a part of my invention resides in the controlling or shifting means for the pawls 16, forming part of the ratchet mechanism between the arbor and starter shaft. In my prior construction, as disclosed in my application above referred to, the spring arbor has two pawls which simultaneously engage two oppositely disposed teeth of the ratchet wheel. This construction, while generally effective, occasionally results in breakage of the pawl and ratchet mechanism, because of the fact that the pawls may not engage the teeth fully or deeply, but may, on the other hand, engage simply the tips or outer ends of the teeth. If this occurs, the pawls are liable to slip from the teeth and either jump to the next adjacent teeth, or they may fly outward to the periphery of the chamber of the arbor, and thence be thrown inward but before they reëngage the ratchet, the arbor may be rotating at such a speed, that when the reëngagement takes place, the pawls or the teeth of the ratchet wheel are liable to be broken. To avoid this occurrence, I provide two sets of pawls 16, preferably four in number, mounted on four of the pins 17, and I provide for the purpose of throwing the pawls inward or outward, two separate friction rings 50 having notches into which project from the pins, tongues 51. One of these friction rings controls two oppositely disposed pawls, and the other ring controls the other two oppositely disposed pawls. Each of the rings has four notches in which the tongues 51 extend, but one ring has two narrow notches 52, which are oppositely disposed, and receive the tongues corresponding to the two pawls which that particular ring controls, and it also has two wider notches 53 which are simply clearance notches, and receive the tongues corresponding to the pawls which the other ring controls. I further provide means whereby when two of the pawls have full engagement with the teeth of the ratchet, the other two pawls are not quite in engagement with the ends of the ratchet teeth, as shown in Fig. 4, so that two of the pawls only are effective for driving, but in the event that the two pawls which do the driving, simply engage near the outer ends of the teeth, and in the event that they slip from the teeth, the other two pawls will at once engage two of the teeth before there is any material relative movement between the pawls and the ratchet wheel. The arrangement by which when two of the pawls engage two of the teeth, the other two pawls do not quite engage the ends of the teeth, may be accomplished in two different ways: first, by providing a number of teeth on the ratchet wheel which is not a multiple of four, or displacing two of the pawls slightly from a position midway between the other two pawls. In the present case, the four pawls are equally spaced, and the number of teeth is not a multiple of four.

It will be seen that the two friction rings 50 are arranged side by side just outside of the arbor of the spring, and between one of the side members of the arbor, and the adjacent side member of the casing. Slight friction is placed on the movement of these rings preferably by providing between the rings and the hub member 24 corrugated leaf springs 54 as shown in Fig. 2.

Another feature of my invention resides in the timing mechanism which controls the engagement between the parts of the rewinding mechanism. It has been found that if the pin or other projecting part corresponding to the pin 45 of the driving member 21 is rigid with the driving member, and if when the pin 42 is moved outwardly by the traveling nut, the two parts 42 and 45 happen to be in direct alinement at just the time when the finger 42 is supposed to be moved past the end of the pin 45, the two parts will engage end to end, and either the finger carried by the eccentric or the pin or equivalent device carried by the driving member 21 is liable to be broken. To avoid this danger, I yieldingly mount either the pin 42 or finger 45 and preferably the latter, as shown in this case. In this instance, the pin 45 is secured to the end of a spiral spring 55 which lies along the outer side or face of the driving disk 21 and has one end fixed thereto as shown in Fig. 4. The pin 45 extends loosely through an opening in the disk 21 so that in the event that the end of the finger 42 engages the end of the pin 45, the latter may yield until the pin 45 passes beyond the end of the finger 42.

A still further important feature of my invention resides in the means for silencing the action of the rewinding mechanism. It has been found that when the rewinding mechanism includes a rotating eccentric, as illustrated in this case, which is loose on the member which supports it, and which is adapted to be driven by two overlapping parts, such as the pin 45 on the driving member and the finger 42 on the eccentric, that when the center of mass of the eccentric reaches its uppermost position and starts downward, the eccentric, by reason of its unbalanced weight and momentum, has a tendency once each revolution to move faster than the driving pin, with the result that when the center of mass of the eccentric is just beyond its uppermost position, the finger 42 gets a little in advance of the driving pin 45, and thence when the pin 45 catches up with the finger, it causes a slight knock or hammer blow. This results in a disagreeable rattling noise, which my invention ob-

viates. I avoid this disadvantage in a very simple manner by providing a slight friction or retarding action on the eccentric. I utilize for this purpose a friction device in the form of a disk or plug 57 which is carried by the eccentric strap, and which is held yieldingly onto the periphery of the eccentric by a spring 58, both the disk 57 and the spring 58 being contained within a tubular or cylindrical inclosure 59, including a removable cap by which the parts can be assembled or removed.

Having thus described my invention, what I claim is:

1. In a spring starter, a starter shaft, a spring for rotating the shaft, means for establishing driving connection between the spring and shaft comprising ratchet mechanism including a ratchet wheel and a plurality of sets of pawls, and means for operating each set of pawls by which when one of said sets of pawls is in driving engagement with the teeth of the ratchet, the other is ineffective for driving, but becomes effective if the first set of pawls becomes ineffective.

2. In a spring starter, a starter shaft, a spring for rotating the shaft, ratchet mechanism for effecting driving relationship between the spring and shaft comprising a ratchet wheel, and a plurality of sets of pawls, and means for independently controlling the movement of the sets of pawls so that when one of the sets of pawls is moved into driving engagement with the teeth of the ratchet a second set of pawls is ineffective for driving, and if the first becomes disengaged from the teeth the second set of pawls is moved into driving engagement with the teeth.

3. In a spring starter, a starter shaft, a spring for rotating the shaft, ratchet mechanism for effecting driving relationship between the spring and shaft comprising a ratchet wheel and a plurality of sets of pawls, and means for independently moving the sets of pawls into engagement with the teeth of the ratchet, the spacing of the pawls of each set and teeth being such that when one set of pawls engages the end of a tooth, the other set of pawls is out of engagement with the end of a tooth.

4. In a spring starter, a starter shaft, a spring for rotating the shaft, ratchet mechanism for effecting driving relationship between the spring and shaft comprising a ratchet wheel on the shaft, a plurality of sets of pawls adapted to be rotated by the spring, and separate means for positively moving each of the sets of pawls into and out of engagement with the teeth of the ratchet.

5. In a spring starter, a starter shaft, a spring for rotating the shaft, ratchet mechanism for effecting driving relationship between the spring and shaft comprising a ratchet wheel and a plurality of sets of pawls, separate means for positively moving each set of pawls into and out of engagement with the teeth of the ratchet, the spacing of the pawls of each set and of the teeth being such that while one set of pawls is in engagement with the end of a tooth, the other set of pawls is out of engagement therewith.

6. In a spring starter, a starter shaft, a spring adapted to rotate the shaft, an arbor surrounding the shaft and connected to the spring, ratchet mechanism for establishing driving relationship between the arbor and the shaft comprising a ratchet wheel on the shaft, two sets of pawls carried by the arbor, and separate means for positively moving the two sets of pawls into and out of engagement with the teeth of the ratchet.

7. In a spring starter, a starter shaft, a spring adapted to rotate the shaft, an arbor surrounding the shaft and connected to the spring, ratchet mechanism for establishing driving relationship between the arbor and the shaft comprising a ratchet wheel on the shaft, two sets of pawls carried by the arbor, and separate means for positively moving the two sets of pawls into and out of engagement with the teeth of the ratchet, the spacing of the pawls and teeth being such that when one set of pawls is in driving engagement with the teeth of the ratchet, the other set of pawls are out of driving engagement with the teeth of the ratchet.

8. In a spring starter, a starter shaft, a spring for rotating the same, mechanism for winding the spring from the shaft when the latter is rotated by external means, said mechanism including a driving element on the shaft, an eccentric adapted to be rotated by said driving element, said eccentric having a part adapted to be engaged by a part on the driving member, and means by which said parts are retained in driving relationship during the winding operation.

9. In a spring starter, a starter shaft, a spring adapted to rotate the shaft, mechanism for winding the spring comprising an eccentric, a part rotated by the eccentric, means for rotating said eccentric, means operatively connecting the eccentric to the spring for winding purposes, and a friction device engaging said eccentric to cause the same to remain in driving engagement with the means which rotates it.

In testimony whereof, I hereunto affix my signature in the presence of two witnesses.

JOSEPH A. WILLIAMS.

Witnesses:
E. B. GILCHRIST,
L. I. PORTER.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."