Nov. 6, 1934. J. A. CHARTER 1,979,869

ENGINE STARTER

Filed Oct. 31, 1932 2 Sheets-Sheet 1

FIG. 1.

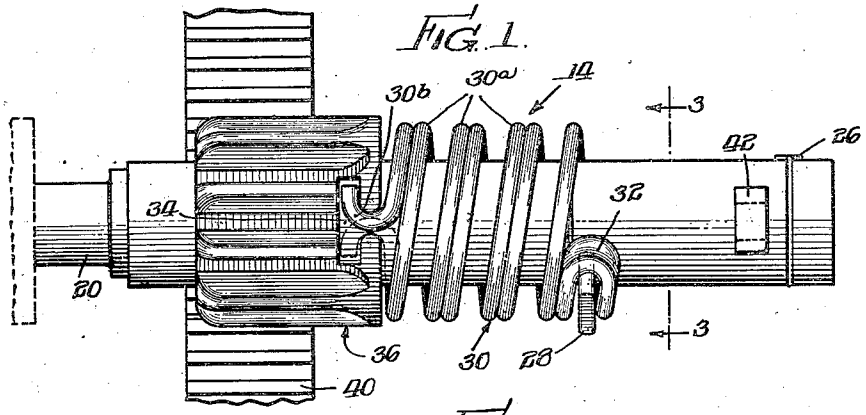

FIG. 2.

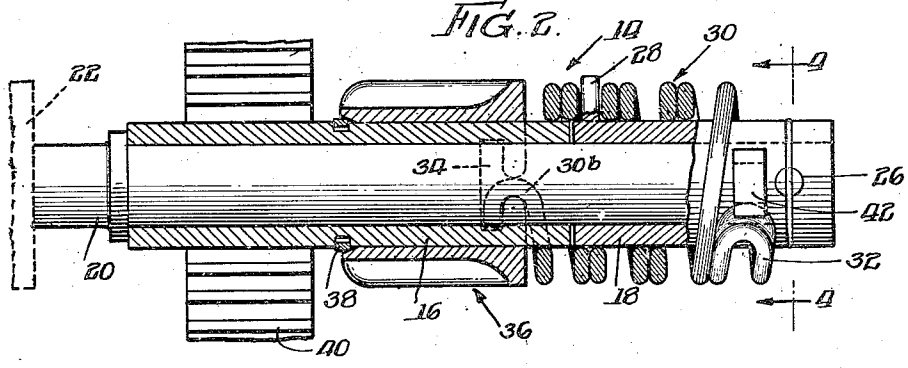

FIG. 3.

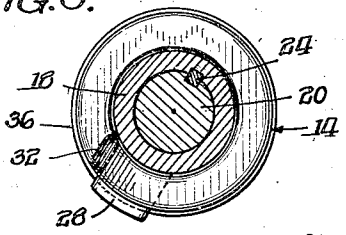

FIG. 4.

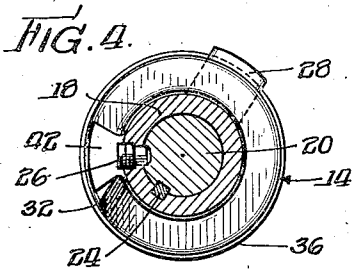

FIG. 5.

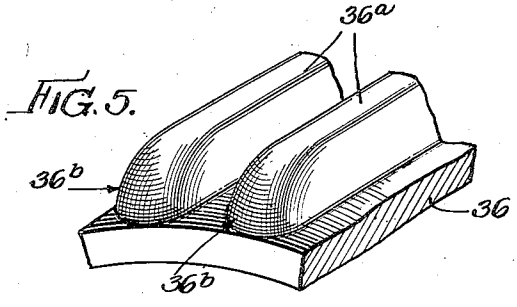

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FIG. 6.

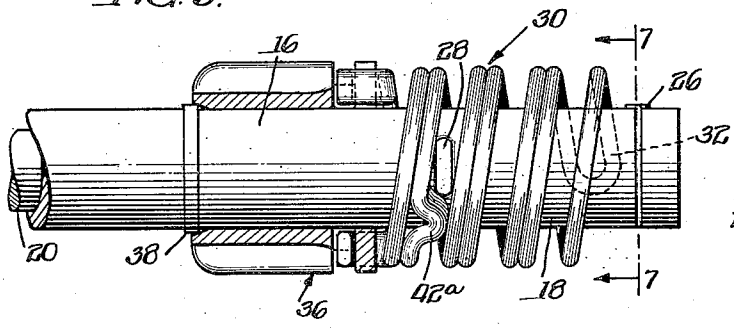


FIG. 7.

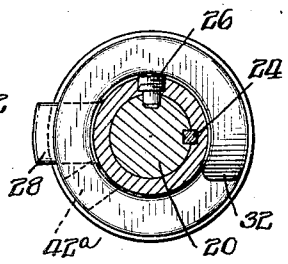


FIG. 8.

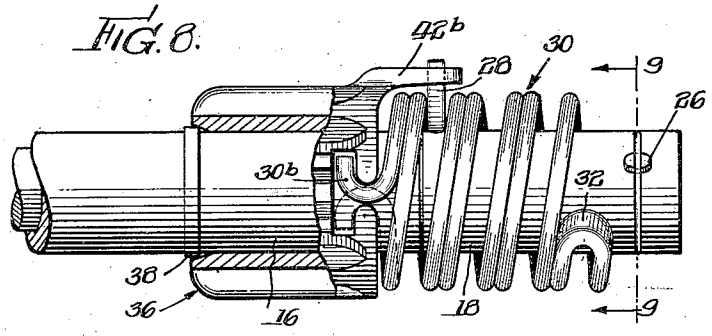


FIG. 9.

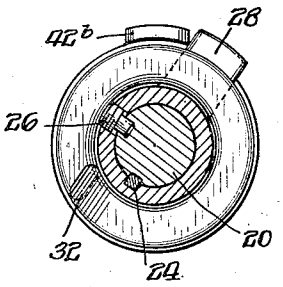


FIG. 10.

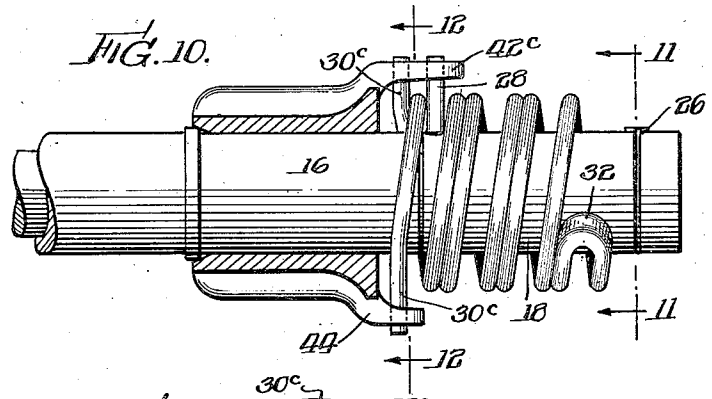


FIG. 11.

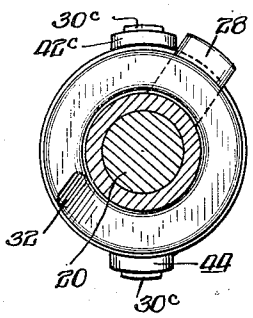
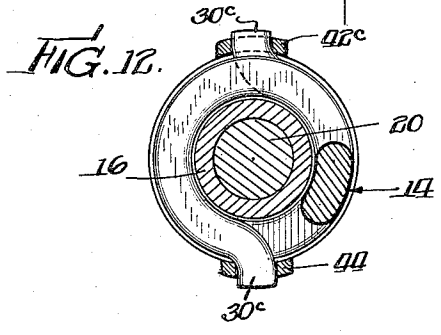


FIG. 12.



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UNITED STATES PATENT OFFICE

1,979,869

ENGINE STARTER

James A. Charter, Chicago, Ill., assignor to Charter Drive, Inc., Chicago, Ill., a corporation of Illinois

Application October 31, 1932, Serial No. 640,483

8 Claims. (Cl. 74—9)

My invention relates generally to engine starters and particularly to improvements in devices adapted to effect the automatic starting of internal combustion engines.

The subject matter of my present invention relates more specifically to the general type of engine starters wherein a coiled spring structure is coupled with a pinion adapted to move into and out of engagement with a driven gear of the engine or motor, and said spring structure cooperates with a member, sometimes referred to as a tracker, which is movable between the convolutions of the spring structure, and thus serves, in response to the activation of the starting motor, to automatically move the pinion into operative engagement or mesh with the gear on the motor. In starting devices of the type mentioned, the spring structure has a triple purpose—first, the helix thereof cooperates with the tracker to effect longitudinal movement of the pinion; second, it provides an endwise cushioning effect in the event that the teeth of the pinion and gear make end-to-end contact as the pinion is initially moved into association with said gear, thereby permitting a slight rotative movement between the pinion and gear to take place before meshing, and thus minimizing deleterious effects which might otherwise result from the endwise clashing of the teeth; and third, the spring structure yields to the rotative torque experienced thereby as the driving force is imparted from the pinion to the gear on the motor.

The foregoing duties which the spring structure and pinion are called upon to perform, present problems in the field which the present invention proposes to overcome. One of the problems which the present invention has solved is that of producing a spring structure which is small enough in cross sectional area to permit of its being formed of a wire or strip into a helix without subjecting it to deleterious internal strains and stresses, and at the same time retaining in the spring structure sufficient strength to withstand the severest loads to which it is subjected in actual use.

To provide a spring structure of the type mentioned above, I propose to employ a double strand of spring wire, the convolutions of which are adjacently positioned, thereby enabling a smaller sized wire to be formed into a helix, and at the same time obtain increased strength to withstand the forces both compressive and rotative which act upon the spring when in use.

More specifically, it is an object of my invention to provide a double strand wire for engine starters as set forth above, which is provided with a loop at one extremity, which loop provides an effective means for limiting the longitudinal travel of the driving element or pinion.

Another object of the present invention is to render more effective the three-purpose functioning of the spring structure as mentioned above, by so forming the outer extremities or end surfaces of the teeth in the driving element or pinion as to greatly facilitate the meshing of the pinion with the driven gear without clashing. To this end, I propose to form the teeth with a rounded or ball-pointed end, which will serve with equal effectiveness to facilitate the meshing of teeth regardless of the direction of rotation of the driving element or pinion.

Still another object of my invention is to provide a spring structure as mentioned above, which may be formed with either a right or a left-hand helix, and to so arrange the driving element or pinion as to receive either a right or a left-hand helix.

A further object of my invention is to provide in combination with a starter of the type mentioned above, a novel arrangement for limiting the rearward travel of the pinion, and to this end I propose to extend the structure of the driving member into the path of the tracker which travels between the convolutions of the spring structure.

A still further and more specific object is to provide a novel spring construction of the type mentioned above, in which the spring itself provides a stop or abutment between the convolutions thereof, against which the tracker moves to limit the travel of the driving member or pinion away from the driven gear.

The foregoing and numerous other objects and advantages will be more apparent from the following detailed description when considered in connection with the accompanying drawings, wherein—

Figure 1 is an elevational view of a starter device embodying features of my invention, the driving member thereof being shown in operative engagement with the gear on the motor;

Figure 2 is a view similar to Figure 1 shown partly in section, disclosing the driving member or pinion in its retracted position;

Figure 3 is a transverse sectional view taken substantially along the line 3—3 of Figure 1;

Figure 4 is a similar transverse sectional view taken substantially along the line 4—4 of Figure 2;

Figure 5 is a fragmentary perspective view disclosing two of the teeth in the driving member or pinion to more clearly illustrate the rounded or ball-pointed extremities of the portion of the teeth which move into meshing engagement with the driven gear;

Figure 6 is an elevational view of a modified starter construction in which the spring provides an abutment or stop between the convolutions thereof;

Figure 7 is a transverse sectional view taken substantially along the line 7—7 of Figure 6;

Figure 8 is another modified starter device in which the driving member or pinion is provided with an extension adapted to be engaged by the tracker when the pinion occupies its retracted position;

Figure 9 is a transverse sectional view taken substantially along the line 9—9 of Figure 8;

Figure 10 discloses a modified construction in which the free extremities of the looped coil extend radially into apertures provided in extensions on the driving pinion;

Figure 11 is a transverse sectional view taken substantially along the line 11—11 of Figure 10; and

Figure 12 is a similar transverse sectional view taken substantially along the line 12—12 of Figure 10.

Referring now to the drawings more in detail wherein like numerals have been employed to designate similar parts throughout the various figures, it will be seen that in Figures 1 to 5 inclusive I have disclosed a preferred embodiment of the invention, and I have indicated generally the starter mechanism disclosed in these figures by the numeral 14. This starter device includes a pair of abutting sleeves 16 and 18 which are adapted to be mounted upon a drive shaft 20 of a starting motor 22, which is indicated by dotted lines in Figures 1 and 2. The sleeve 16 is freely rotatable upon the shaft 20, while the sleeve 18 is freely rotatable with said shaft through the agency of a key 24, Figures 3 and 4, and is secured against longitudinal displacement with respect to the shaft by a suitable set screw 26. A radial projection or tracker 28, preferably secured to or formed integral with the sleeve 18, is positioned between the convolutions of a spring structure designated generally by the numeral 30.

This spring structure 30 comprises a strip or length of spring stock which is looped at 32, and is then formed helically so as to present a plurality of convolutions 30*a*, each comprising adjacently positioned sections of the spring stock. Each free extremity of the spring is bent to form a hook 30*b*, and these hooks are positioned at diametrically opposite positions with respect to the axis of the drive shaft unit, which includes the shaft 20 and the sleeves 16 and 18.

These hook sections 30*b* interlock with T-shaped peripheral recesses 34 provided within a driving member or pinion designated generally by the numeral 36. In the disclosed embodiment the portion of the pinion which receives the hooks 30*b* is formed integral with the remaining portion of the pinion, but my invention contemplates the provision of separate means in the form of a collar or the like, which may be secured in any suitable manner to a pinion proper. My invention contemplates the use of either right or left-hand springs, and it will be apparent that by having the T-shaped openings 34 in the driving element or pinion 36, a single pinion will accommodate either a right or a left-hand spring structure. A suitable resilient abutment, such as the split ring abutment 38 shown in Figure 2, prevents the pinion from creeping into engagement with a driven gear 40 shown fragmentarily in Figures 1 and 2. This driven gear is secured in any suitable manner to the part of the engine with which the starter mechanism may be used.

Assume that the pinion 36 occupies the retracted or starting position shown in Figure 2, and that the starting motor 22 is activated so as to suddenly rotate the shaft 20 in a clockwise direction, as viewed from the right of Figure 2. This causes the tracker 28 to move between the helical convolutions 30*a*, thereby causing the automatic advancement of the driving pinion 36 into operative engagement or mesh with the driven gear 40. When the pinion 36 reaches the advanced position shown in Figure 1, the tracker is engaged by the loop 32 of the spring structure 30, thereby preventing further advancement of the pinion. This closed loop 32 provides a very practical and effective abutment, and I prefer to curve the engaging surface of the tracker 28 so as to favor the companion curved surface of the loop 32. The closed loop also provides an abutment section in the spring which will not open up regardless of the force exerted thereagainst by the tracker. When the loop 32 thus engages the tracker 28, a driving connection is established between the starting motor 22 and the motor gear 40. Rotation of the starting motor is continued until the engine becomes self-activated and, when the speed of the gear 40 exceeds the rotative speed of the pinion 36, said pinion will automatically move from the position shown in Figure 1 to the position shown in Figure 2 in response to the coaction between the convolutions of the spring structure 30 and the tracker 28. As the pinion reaches the position shown in Figure 2, the outer surface of the loop 32 engages an abutment 42 which is carried by the sleeve 18. The shape of this abutment or lug 42 is best shown in Figures 2 and 4. Thus the engagement of the loop 32 with the lug 42 prevents further retraction of the driving pinion 36.

Particular attention is directed to the manner in which I have shaped the forward extremities of the teeth 36*a* in the pinion 36. This is best shown in the perspective view, Figure 5. It will be seen that the advancing ends, which I have designated by the numeral 36*b*, are rounded or what might be properly termed ball-pointed, so as to facilitate the meshing of the pinion teeth with the teeth of the gear 40. Thus, should the teeth in the pinion and gear abut each other as the pinion moves forwardly, these rounded or ball-pointed surfaces of the teeth cooperate with the endwise cushioning effect afforded by the spring structure in causing the pinion teeth to automatically seek their meshing relation with the teeth of the gear 40. In other words, the curved surfaces of the pinion teeth prevent clashing, and thus prevent tooth breakage when the pinion is suddenly urged into operative association with the gear 40. It will also be observed that the curvature on one side of each tooth corresponds with the curvature on the opposite side, thereby rendering the pinion equally adaptable for use with right or left-hand spring structures. In practice, some starting motor shafts are arranged in what is commonly termed "outboard" fash-

ion, while others are arranged in "inboard" fashion. That is to say, in some automobiles the pinion must move toward the starting motor and in others away from the starting motor when moving into mesh with the driven gear. Obviously such constructions call for different springs, namely, a right or a left-hand spring. Hence, by employing the improved ball pointed or curved tooth construction in the pinion, said pinion may be used with either a right or a left-hand spring structure.

At this point it should be noted that, by using the double strand of spring wire with a closed loop as previously described, I am able to employ a wire of smaller cross section than the wire which I have previously used in starter devices equipped with a single strand, and at the same time I obtain greater strength. The practical significance of this feature of the invention will be more apparent when it is understood that the spring wire, as it is coiled to form the helical spring structure shown in the drawings, obviously is subjected to certain internal and external strains and stresses. The smaller the wire the less these stresses and strains manifest themselves in the resulting structure. Thus, by employing the double strand construction, I am able to use a smaller gauge wire. By using the smaller gauge wire, I do not lose, but rather increase the strength of the coil structure. In this manner I provide a coil construction which possesses all the necessary resilient properties to insure the cushionlike action as the pinion engages the driven gear and a spring structure which is capable of withstanding all of the torsional stresses and strains to which it is subjected in actual use in the field. Furthermore, the looped construction enables me to employ the closed loop 32, and this will not open nor sever when used as an abutment for the tracker 28 under the severest loads.

In Figure 6 I have disclosed a modified construction wherein the spring structure is of the double strand construction described in connection with Figures 1 to 4, inclusive, the only difference being that a section of the spring wire is bent axially to provide an abutment 42*a*. This abutment 42*a* is adapted to engage the tracker 28 when the driving unit including the pinion 36 reaches its retracted position as shown in Figure 6. The provision of the abutment 42*a* eliminates the necessity of employing the stop or lug 42 shown in Figures 1 to 4, inclusive.

In Figure 8 another modified construction is shown which is similar to the structures previously described, but differs therefrom in the provision of a lug or abutment 42*b* extending axially from the periphery of the pinion 36. This abutment or lug 42*b* functions similarly to the abutment 42*a* shown in Figures 6 and 7, and the lug 42 shown in Figures 1 to 4, inclusive, in limiting the rearward or retracting movement of the pinion 36. As the pinion 36 of Figure 8 is moved to the right, the lug 42*b* eventually moves into engagement with the tracker 28, thereby preventing further longitudinal travel of the pinion.

In Figures 10 to 12, inclusive, a still further modified construction is employed. In these figures a projection 42*c* is shown, which functions similarly to the projection or lug 42*b* in Figure 8, in limiting the retracting movement of the pinion. The only structural difference, shown in Figures 10 to 12, inclusive, over that disclosed in Figure 8, is the arrangement whereby the free extremities of the spring structure, which I have designated by the numeral 30*c*, extend radially in diametrically opposite directions and pass through apertures, one of which is provided in the projection 42*c* and another in a similar projection 44. By the use of the spring construction shown in Figures 10 to 12 inclusive, I eliminate the necessity of forming the free extremities thereof into hooks of the type shown in the other figures.

Attention is directed to the fact that the double strand spring structure disclosed herein travels longitudinally and rotatably as a unit with a pinion, and is subjected to strains, vibrations, and torsional loads when it operatively functions in the line of power transmission. It will also be noted that by having the free extremities of the spring structure 14, namely the hook portions 30*b* connected with the driving member or pinion 36 at diametrically opposite positions with respect to the axis of said spring structure and drive shaft unit, a very desirable balanced rotation of the pinion and spring is obtained. In other words, no centrifugal forces having a tendency to unbalance the pinion and spring are introduced. Such a construction makes for smooth, balanced operating conditions and hence contributes toward the expeditious or efficient functioning of the starter under the most severe and heavy duty operating conditions.

From the foregoing it will be apparent that my invention contemplates the provision of improvements in starter devices, which are of a very practical nature and which materially increase the efficient functioning of the device. The parts comprising the unit are relatively few in number and may be manufactured by employing conventional machine shop practice. Obviously changes in the specific arrangement of the pinion structure, spring structure, and the drive shaft unit associated therewith may be made without departing from the spirit and scope of my present invention, and said invention should be limited only by the scope of the appended claims.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:

1. In an engine starting device, a drive shaft unit, an engine driving member on said unit for both longitudinal and rotary movement, said member being adapted in one shifted position to operatively engage an engine part to be driven, a coiled spring structure on said unit connected at one extremity with the engine driving member, said spring structure including a double strand of spring wire forming a helical way and movable as a unit with said driving member, the extremities of each strand at one end of the spring structure being coupled with the engine driving member, and means rotatable with the drive shaft unit and positioned between the double strand convolutions of said spring structure for controlling the longitudinal shifting of said spring structure and engine driving member and adapted to engage the other extremity of the spring structure and thereby effect a torsional driving connection between said engine driving member and drive shaft unit.

2. In an engine starting device, a drive shaft unit, an engine driving member on said unit for both longitudinal and rotary movement, said member being adapted in one shifted position to operatively engage an engine part to be

driven, a coiled spring structure on said unit connected at one extremity with the engine driving member, said spring including a strand of spring wire doubled upon itself to provide a closed loop at one extremity thereof and movable as a unit with said driving member, the extremities of each strand of one end of the spring structure being coupled with the engine driving member, and means rotatable with the drive shaft unit and positioned between the convolutions of said spring structure for controlling the longitudinal shifting of said spring structure and engine driving member and adapted to engage the other extremity of the spring structure and thereby effect a torsional driving connection between said engine driving member and drive shaft unit.

3. In an engine starting device, a drive shaft unit, an engine driving member on said unit for both longitudinal and rotary movement, said member being adapted in one shifted position to operatively engage an engine part to be driven, a coiled spring structure on said unit connected at one extremity with the engine driving member, said spring structure including a double strand of spring wire forming a helical way and movable as a unit with said driving member, the extremities of each strand at one end of the spring structure being coupled with the engine driving member, means rotatable with the drive shaft unit and positioned between the double strand convolutions of said spring structure for controlling the longitudinal shifting of said spring structure and engine driving member and adapted to engage the other extremity of the spring structure and thereby effect a torsional driving connection between said engine driving member and drive shaft unit, and abutment means movable with the drive shaft unit for limiting longitudinal travel of the engine driving member.

4. In an engine starting device, a drive shaft unit including a pair of sleeves, an engine driving member on said unit for both longitudinal and rotary movement, said member being adapted in one shifted position to operatively engage an engine part to be driven, a coiled spring structure on said unit connected at one extremity with the engine driving member, said spring structure including a double strand of spring wire forming a helical way and movable as a unit with said driving member, the extremities of each strand at one end of the spring structure being coupled with the engine driving member, means rotatable with the drive shaft unit and positioned between the double strand convolutions of said spring structure for controlling the longitudinal shifting of said spring structure and engine driving member, and abutment means on one of said sleeves and adapted to be engaged by the free extremity of said spring structure for limiting longitudinal travel of the pinion.

5. In an engine starting device, a drive shaft unit, an engine driving member on said unit for both longitudinal and rotary movement, said member being adapted in one shifted position to operatively engage an engine part to be driven, a coiled spring structure on said unit connected at one extremity with the engine driving member, said spring structure including a double strand of spring wire forming a helical way, and means rotatable with the unit and positioned between the double strand convolutions of said spring structure for controlling the longitudinal shifting of said spring structure and engine driving member, the free extremities of the strands of said spring structure connected with the engine driving member at diametrically opposite positions with respect to the axis of said spring structure.

6. In an engine starting device, a drive shaft unit, an engine driving member on said unit for both longitudinal and rotary movement, said member being adapted in one shifted position to operatively engage an engine part to be driven, a coiled spring structure on said unit connected at one extremity with the engine driving member, said spring structure including a double strand of spring wire forming a helical way and movable as a unit with said driving member, and means rotatable with the drive shaft unit and positioned between the double strand convolutions of said spring structure for controlling the longitudinal shifting of said spring structure and engine driving member, the free extremities of the strands forming said spring structure terminating in hooks adapted to be coupled with said engine driving member.

7. In an engine starting device, a drive shaft unit including a pair of sleeves adapted to be mounted on a drive shaft, an engine driving member on said unit for both longitudinal and rotary movement, said member being adapted in one shifted position to operatively engage an engine part to be driven, a unitary coiled spring structure on said unit, said spring structure including a double strand spring wire forming a helical way, the extremities of each strand at one end of the spring structure being connected with the engine driving member and movable as a unit with said driving member, and a tracker secured as a unit to one of said sleeves and adapted to move within the convolutions of said double strand spring structure for controlling the shifting of said spring structure and engine driving member.

8. In an engine starting device, a drive shaft unit, an engine driving member on said unit for both longitudinal and rotary movement, said member being adapted in one shifted position to operatively engage an engine part to be driven, a coiled spring structure on said unit connected at one extremity with the engine driving member, said spring structure including a double strand of spring wire forming a helical way, and means rotatable with the unit and positioned between the double strand convolutions of said spring structure for controlling the longitudinal shifting of said spring structure and engine driving member, the extremities of the individual strands of said spring structure being secured to the driving member at diametrically opposite positions with respect to the axis of said drive shaft unit, the opposite extremity of the spring structure providing a loop against which the means which is positioned between the spring convolutions may drivingly bear.

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