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MECHANICAL STARTER MOTOR ENERGIZED BY ENGINE OPERATION

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2 Sheets-Sheet 2

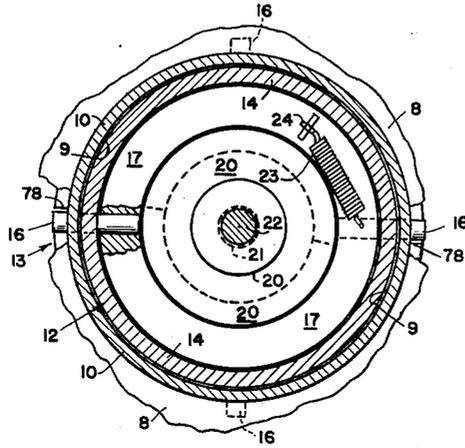


Fig. 6

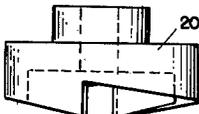


Fig. 10

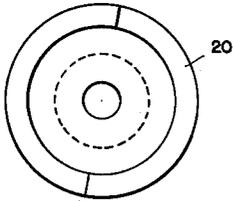


Fig. 11

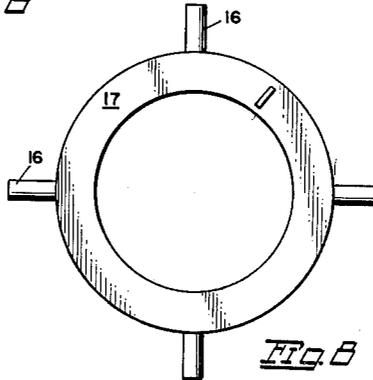


Fig. 8

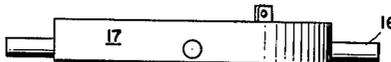


Fig. 9

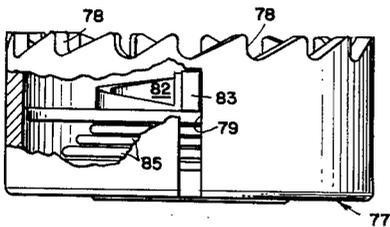


Fig. 7

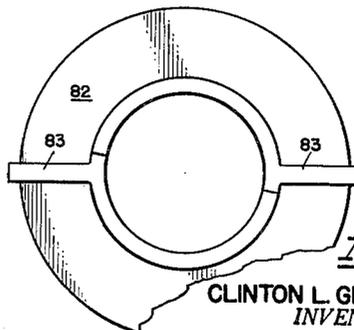


Fig. 12

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**MECHANICAL STARTER MOTOR ENERGIZED
 BY ENGINE OPERATION**

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This invention relates to starting devices for engines of the internal combustion type and has for its principal object to provide a starter of this character which derives and stores primal energy from manually operable means and wherein energy expended for starting the engine is automatically restored by sequential engine operation.

Another object of the invention is the provision of an engine starter which is entirely mechanical in structure and operation, not dependent upon starter ropes and the like, or upon battery current as in electric starters, and one which can only be activated to start the engine by means of a key-operated release mechanism thus rendering the device foolproof against accidental or unintentional operation.

A further object is the provision of an engine starter of this character which is of simple, efficient, durable, compact, light weight construction, readily adaptable for installation on any engine and coupled to the engine shaft thereof during construction of the engine or as an accessory to it at any time thereafter.

The foregoing and other objects and advantages which will become subsequently apparent reside in the details of construction and operation as more fully hereinafter described and claimed, reference being had to the accompanying drawings forming a part hereof and in which:

FIGURE 1 is a sectional side elevational view of an engine starter made in accordance with my invention.

FIGURE 2 is a top plan view of FIGURE 1 with fragments broken away to reveal internal parts.

FIGURE 3 is a sectional detail view taken along the line 3-3 of FIGURE 1.

FIGURE 4 is a fragmentary detail view taken approximately along the line 4-4 of FIGURE 1.

FIGURE 5 is a perspective view of a spring-winding and latch releasing tool.

FIGURE 6 is a sectional detail view taken approximately along the line 6-6 of FIGURE 1.

FIGURE 7 is a side elevational detail view of a clutching mechanism and some of its related parts.

FIGURES 8 and 9 are top plan and side elevational views respectively of a clutch actuating member.

FIGURES 10 and 11 are similar views of one clutch member, and

FIGURE 12 is a top plan view of a companion clutch member.

With continuing reference to the drawings wherein like references of character designate like parts, reference numeral 1 indicates generally a downwardly opening cylindrical base housing provided with leg members 2, adapted for securement to an engine shroud indicated by broken lines, and recessed as at 3 for the passage of cooling air therethrough.

Superimposed upon and secured as at 5 to the top of the housing 1 is a second downwardly opening housing 6. Secured as at 7 within the open bottom end of the housing 1 is what will be hereinafter referred to as an annular

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engagement guide plate 8 provided with a central concentric opening 9 defined by an upwardly extending annular flange 10. Rotatably mounted within the opening 9 is an inverted cup-shaped member 12 of a drive assembly indicated generally at 13 (see also FIG. 7). The annular flange 14 of the member 12 is provided with downwardly opening diagonal slots 15 for the reception of pins 16 radiating from an annulus 17 surrounding a first clutch member 20 secured as at 21 to the bottom end of a shaft 22. The annulus is normally held in the position shown by a tension spring 23 whose one end is secured as at 24 to the annulus 17 with its opposite end secured as at 25 to the interior of the cup-shaped member 12.

It is to be noted that the support of member 17 in the assembly, is maintained by the upward or lifting bias of the spring 23 and by engagement of the pins 16 on wall surfaces of the cup slots 15. In addition to its lifting bias (which may be observed in FIG. 1), the spring 23 exerts a turning moment on member 17 in the direction (FIG. 6) to urge the pins 16 toward and to the inner ends of the cup slots 15, such as to effect the inactive position of member 17 as shown in FIG. 1.

The shaft 22 is slidably and rotatably mounted within a hollow shaft 30 threadedly attached as at 31 to a hub 32 integrated concentrically with the top wall 33 of a drum 34 for a coil spring 35. The terminal end of the outermost coil of the spring is attached as at 40 to the inside wall of the drum 34 and the terminal end of the innermost coil is turned back on itself as at 41 and thus secured within a truncated opening 42 in a hub 43 of a guide plate for the spring in the form of a disc 44 provided with downwardly extending detent elements 45. The disc 44 by means of its hub 43 is secured as at 46 to the top wall of the cup-shaped member 12.

The lower portion of the hollow shaft 30 is slidably splined or keyed as at 47 to the hub 43 of disc 44. The upper end of hollow shaft 30 is bored inwardly as at 50 to accommodate an enlarged diameter 51 of shaft 22 and a subjacent compression spring 52. The top end of shaft 22 is reduced in diameter as at 55 and flattened as at 56 for engagement with a correspondingly shaped sleeve 57 integrated with a driving gear 58 at its bottom end. Gear 58 is at all times slidably enmeshed with a driven gear 60 integrated with a reduction gear 61 and both carried by a shaft 59. Gear 61 is enmeshed with a second driven gear 62 secured as at 63 (see FIG. 2) to the hub 32 of the drum 34.

A pawl 65 is pivotally attached by means of the fastening screw 5 to the top wall 67 of the base housing 6 and urged into engagement with the gear 62 by a spiral spring 68 attached at its bottom end to the pawl and at its top end to the top wall 67 of housing 6.

Secured as at 75 to the end of and for rotation with the engine crankshaft 76 and in axial alignment with the shaft 22 is an upwardly opening cup-shaped member 77 having ratchet teeth 78 formed about its top rim and having diametrically opposed slots 79 down its side walls. Disposed within and rotatable with member 77 is a second clutch member 82 provided with outwardly extending diametrically opposed lugs 83 slidably engaged within the slots 79 to thereby permit of upward and downward movement of the second clutch member relative to the first clutch member 20. A conical spring 85 disposed within the member 77 normally maintains the second

clutch member in the uppermost position shown, against the top end of the slots 79.

Cooperating with the ratchet elements 45 on the disc 44 is a detent 88 secured to the inner end of an actuating shaft 89 journalled as at 90 in the outer flange 91 of the guide plate 8 and enlarged at its outer end as shown to allow for the provision of a socket 92 matching the shape of the interior of the sleeve 57. A key 95, made to fit within the socket or within the sleeve, is adapted to perform respectively either the spring (35) winding operation or the tripping of the detent 88. The detent is normally maintained in engagement with the ratchet elements 45 by the top end of a compression spring 96 whose bottom end is seated within a socket 97 in the guide plate 8.

The operation of the invention is as follows:

With the parts in the positions shown in FIGURE 1 the spring 35 is shown as having been fully wound by rotation of the sleeve 57 and its related gear train by means of the winding and detent-releasing key 95. The spring is held so energized by the engagement of the detent 88 with one of the ratchets 45 on disk 44. Spring-winding rotation of the sleeve 57 is in a clockwise direction as is also the winding action of spring 35. Also held against rotation by such detent engagement is the inverted cup-shaped member 12, because of its securement as at 46 to the hub 43 of detent-held disk 44. Hollow shaft 30 is also held against rotation because of its splined attachment (47) to the hub 43.

Further with regard to the parts in the spring wound-up condition wherein the spring motor hub 43 is held by the then engaged detents 45-88, it will be observed that reverse or counterclockwise rotation of the drum 34 is prevented by the pawl 65 engaging the gear 62. In initial mounting of the starter to an engine (or when the engine fails to start upon starter drive thereof), the actuating member 30 will be in its lowermost position, as partly unthreaded from hub 32. In such lowermost position the actuating member 30 through engagement of its bottom end with the clutch member 20, disposes the latter in full clutching engagement with clutch member 82. Now upon inserting the key 95 in sleeve 57 and turning it clockwise, the drive comprising the elements 58, 60, 61, and 32 (the gear 62 then turns clockwise as permitted by pawl 65) rotates the drum 34. At such time the spring motor hub 43 is held stationary (against spring unwinding) by the engaged detents 45-88, so that the spring 35 will be wound-up. Also, the hub 32 in clockwise rotation on spring wind-up, will thread the actuating member 30 upwardly into the hub, this movement of 30 being axial only, as permitted by the spline connection 47 between the actuating member 30 and the spring motor hub 43. The spline 47 then prevents rotation of the actuating member 30, as the hub 43 is held stationary through the engaged detents 45-88.

In engine starting, upon release of the engaged detents 45-88 through operation of key 95 in socket 92, the spring 35 will rotate hub 43, cup-shaped member 12 and shaft 30 in the clockwise direction. Since at such time the drum hub 32 is held stationary by pawl 65 on gear 62, the resulting rotation of actuating member 30 by spline 47 will cause downward movement of the actuating member, in the unthreading direction relative to hub 32, to displace the clutch member 20 into engagement with clutch member 82. Rotation of cup member 12 and the resultant cam action of the diagonal slots 15 in the annular wall 14 thereof will pull the pins 16 carried by ring 17 downwardly into engagement with the ratchet teeth 78 in the top rim of the upwardly opening engine-cranking cup-shaped member 77 to start engine operation. At the same time the clockwise rotation imparted to hollow shaft 30 by hubs 43 and spline 47 will, because of the right hand threads on shaft 30, cause the shaft to move downwardly to engage the first clutch member 20 with the second clutch member 82

which, because of engagement at 83 with 79, is now being driven in a clockwise direction of rotation by the engine and the upwardly opening cup member 77. Such rotation of member 77 will, by means of the ratchet teeth 78 about its top rim, cam the pins 16 upwardly out of engagement with itself and such disengagement will be assisted by the tension spring 23 in urging the ring 17 in a clockwise direction of rotation as the pins move upwardly within the diagonal slots 15.

Further with regard to the action of the pins 16, on spring release the hub 43 and attached cup member 12 begin rotation quickly, undergoing in effect a snap-start. At that instant and by reason of the inertia of the member 17 and pins 16 (being stationary prior to spring release), the cup member 12 tends momentarily to rotate ahead of the pins 16. Consequently, the pins 16 bearing in the inclined cup slots 15 will be thereby urged or cammed downwardly (outwardly of the slots) into drive engagement with the vertical sides of the ratchet teeth 78 on clutch member 77. Now on engine starting and as the engine rotation of clutch member 77 exceeds the speed of spring drive rotation of the pins 16, inclined surfaces of the ratchet teeth 78 (see FIG. 7) bear against the pins 16 and thus cam the pins upwardly away from the ratchet teeth. This result is assisted by the elevating bias of spring 23 on member 17.

Engine-driven rotation of clutch member 20 by clutch member 82 will put gear 58 in clockwise rotation, driven gear 60 and reduction gear 61 in counter clockwise rotation which will drive the second driven gear 62, spring drum 33 and its hub 32 in clockwise rotation to rewind the spring in a clockwise direction. Clockwise rotation of the threaded hub 32 about the right hand threads 31 on hollow shaft 30 will pull the hollow shaft upwardly to thereby disengage the clutch members 20 and 82 upon completion of the spring winding operation and such disengagement will be assisted by the expansive forces of compression spring 52 acting upwardly against the collar 51 on shaft 42 to whose bottom end clutch member 20 is secured.

While I have shown a particular form of embodiment of my invention, I am aware that many minor changes therein will readily suggest themselves to others skilled in the art without departing from the spirit and scope of the invention. Having thus described my invention what I claim as new and desire to protect by Letters Patent is:

1. In a starting device for an internal combustion engine having a crankshaft, an engine cranking clutch member connected to said crankshaft, a spring motor including a tension spring, a rotatable and axially displaceable shaft, drive means connecting said shaft to said spring motor and operable by said shaft in rotation for tensioning said spring, clutch means on said spring motor and operable thereby for clutching engagement with said cranking clutch member to rotate the crankshaft and start the engine, said cranking clutch member being effective upon engine starting to cause disengagement of said clutch means therefrom, a first clutch element fixed on said rotatable shaft, a second clutch element rotatable with said cranking clutch member, an actuating member for effecting axial displacement of said shaft and corresponding displacement of said first clutch element, said actuating member being in threaded connection to said drive means and movable longitudinally of said shaft in the opposite threading and unthreading directions relative to the drive means, operating means between the actuating member and the spring motor adapted and arranged for permitting movement of the actuating member axially relative to the spring motor and for effecting rotation of the actuating member in engine cranking operation of the spring motor, such rotation of the actuating member thereby causing through said threaded connection movement of said actuating member in one of said directions to effect axial displacement of said shaft with corresponding displacement of said first clutch ele-

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ment to clutching engagement with said second clutch element, said clutch elements in engagement rotating said shaft and thereby operating said drive means to tension said spring and coincidentally therewith effect movement of said actuating member in the other of said directions, and yieldable means in operative relation between said shaft and actuating member effective upon the last said movement of the actuating member, to cause axial displacement of said shaft and disengagement of said first clutch element from said second clutch element.

2. In a starting device for an internal combustion engine having a crankshaft, a pair of connected clutch members one thereof connected to said crankshaft, a spring motor providing a tension spring, clutch means on said spring motor and operable thereby for engagement with one of said clutch members to rotate the crankshaft for cranking and starting the engine, a rotatable and axially movable shaft, drive means between said shaft and spring motor operable by the shaft in rotation for tensioning the spring, a clutch element on said shaft and engageable with the other of said clutch members upon axial movement of the shaft in one direction, an actuating member for said shaft, said actuating member being in threaded connection to said drive means and movable in threading and unthreading directions relative thereto, operating means between said spring motor and actuating member adapted and arranged for permitting movement of the actuating member axially relative to the spring motor and for effecting rotation of the actuating member in engine cranking operation of the spring motor, such rotation of the actuating member causing through said threaded connection movement of the actuating member in the unthreading direction and thereby movement of the shaft in said one direction to engage said clutch element with said other of the clutch members, whereby to effect engine drive of said shaft to operate said drive means for tensioning said spring, said drive means in operation to tension said spring causing movement of said actuating member in the threading direction, and yieldable means in operative relation between said shaft and actuating member responsive to movement of the actuating member in the threading direction to effect axial shaft movement in the opposite direction, to disengage said clutch element from said other of said clutch members.

3. In a starting device for an internal combustion engine having a crankshaft, an engine cranking clutch member connected to said crankshaft, a spring motor including a coiled tension spring and a disc member underlying said spring and having one end of the spring attached thereto, a rotatable and axially displaceable shaft, drive means connecting said shaft to said spring motor and operable by said shaft in rotation for tensioning said spring, said drive means including a hollow shaft of non-circular section, a first detent means carried by said disc member, a second detent means normally engaged with said first detent means and provided with an operating shaft having an axial non-circular opening therein matching that of said hollow shaft, a key having an end section matching the non-circular section of said hollow shaft and of said detent operating shaft insertable selectively in the non-circular section of the hollow shaft for turning the hollow shaft to effect spring tensioning, and in the non-circular opening of the second detent operating shaft for turning the latter to release the second detent means for engagement with the first detent means, clutch means on said spring motor and operable thereby for clutching engagement with said cranking clutch member to rotate the crankshaft and start the engine, said cranking clutch member being effective upon engine starting to cause disengagement of said clutch means therefrom, a first clutch element fixed on said rotatable shaft, a second clutch element rotatable with said cranking clutch member, an actuating member for effecting axial displacement of said shaft and corresponding displacement of said first clutch element, said actuating member being in threaded connec-

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tion to said drive means and movable longitudinally of said shaft in the opposite threading and unthreading directions relative to the drive means, operating means between the actuating member and the spring motor disc member adapted and arranged for permitting movement of the actuating member axially relative to the said disc member and for effecting rotation of the actuating member in engine cranking operation of the spring motor, such rotation of the actuating member thereby causing through said threaded connection movement of said actuating member in one of said directions to effect axial displacement of said shaft with corresponding displacement of said first clutch element to clutching engagement with said second clutch element, said clutch elements in engagement rotating said shaft and thereby operating said drive means to tension said spring, the drive means in spring tensioning operation effecting through said threaded connection with the actuating member, movement of said actuating member in the other of said directions, and yieldable means in operative relation between said shaft and actuating member effective upon the last said movement of the actuating member, to cause axial displacement of said shaft and disengagement of said first clutch element from said second clutch element.

4. In a starting device for an internal combustion engine having a crankshaft,

a spring motor including a drum having a drum hub, a disc having a disc hub, and a coiled, wind-up tension spring connected between said drum and said disc hub, the drum and disc being relatively rotatable, a rotatable and axially displaceable shaft coaxial with said drum and disc hubs,

a gear drive connection between said shaft and said drum hub including interconnected gear elements, pawl means engaging one of said gear elements and effective therethrough for constraining drum rotation to the spring wind-up direction only,

releasable means normally constraining said disc and disc hub against spring-driven rotation,

one-way clutch means including a clutch member on the engine crankshaft and a clutch member connected to said disc hub, operable upon spring drive of the disc hub following release of said releasable means, to rotate the crankshaft and start the engine, a first clutch element fixed on said shaft,

a second clutch element carried by said clutch member on the engine crankshaft and rotatable therewith,

an actuating member for effecting axial displacements of said shaft and corresponding displacements of said first clutch element,

said actuating member having threaded connection to said drum hub and movable longitudinally of said shaft in the opposite threading and unthreading directions relative to the drum hub,

an operating connection between said actuating member and said disc hub adapted and arranged for permitting movement of the actuating member axially relative to the disc hub and for effecting rotation of the actuating member during spring drive of the disc hub in engine starting, such rotation of the actuating member thereby causing through said threaded connection axial displacement of the actuating member in one of said directions to effect axial displacement of said shaft with corresponding displacement of said first clutch element into clutching engagement with said second clutch element,

said clutch elements in engagement rotating said shaft and thereby operating said drive connection to rotate said drum for wind-up of said tension spring and to effect through said threaded connection, displacement of said actuating member in the other of said directions, and

yieldable means in operative relation between said shaft and actuating member effective in the last said displacement of the actuating member, for causing

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axial displacement of said shaft in the direction to disengage said first clutch element from said second clutch element.

5 5. In a starting device according to claim 4 wherein the said second clutch element is capable of limited displacement axially relative to the said clutch member on the engine crankshaft, and
10 wherein yieldable means is provided between the said clutch member on the engine crankshaft and the said second clutch element, biasing the latter toward the said first clutch element.

6. In a starting device according to claim 4 wherein the said actuating member is a hollow shaft sleeved on

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the said rotatable and axially displaceable shaft, and normally in abutment with the said first clutch element.

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