

Nov. 28, 1961

G. E. LYVERS

3,010,443

ENGINE STARTING DEVICE

Filed March 19, 1959

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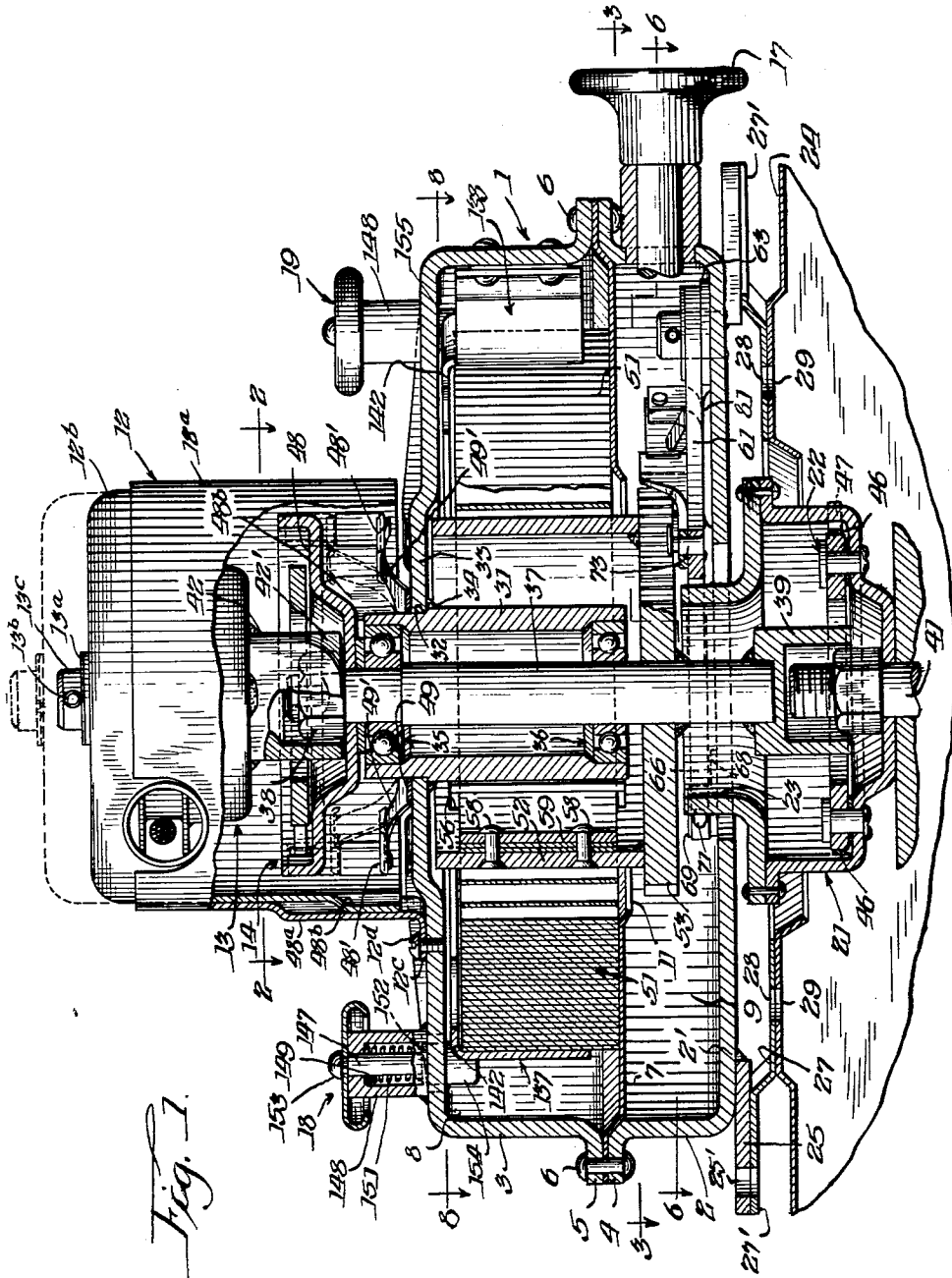


Fig. 1.

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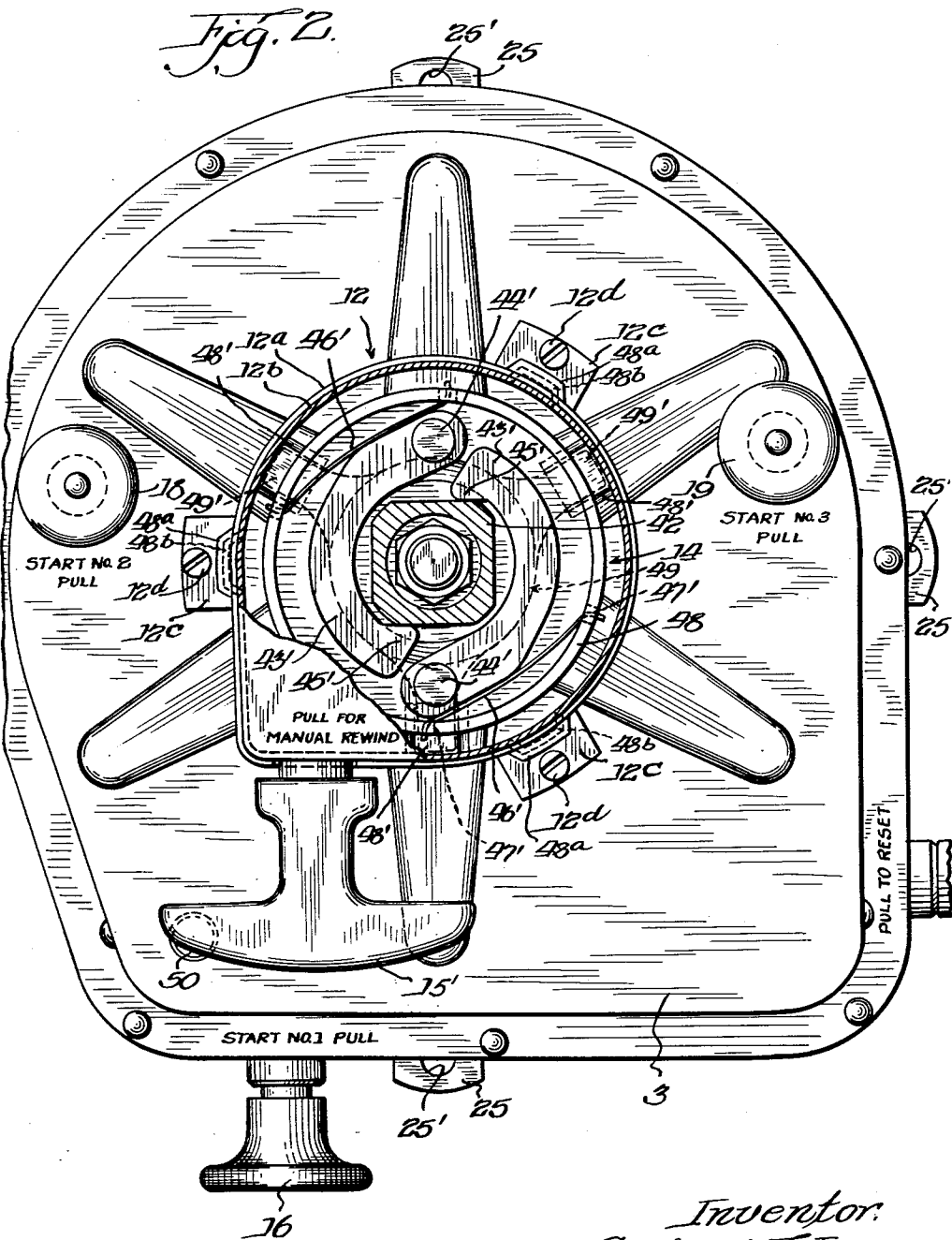
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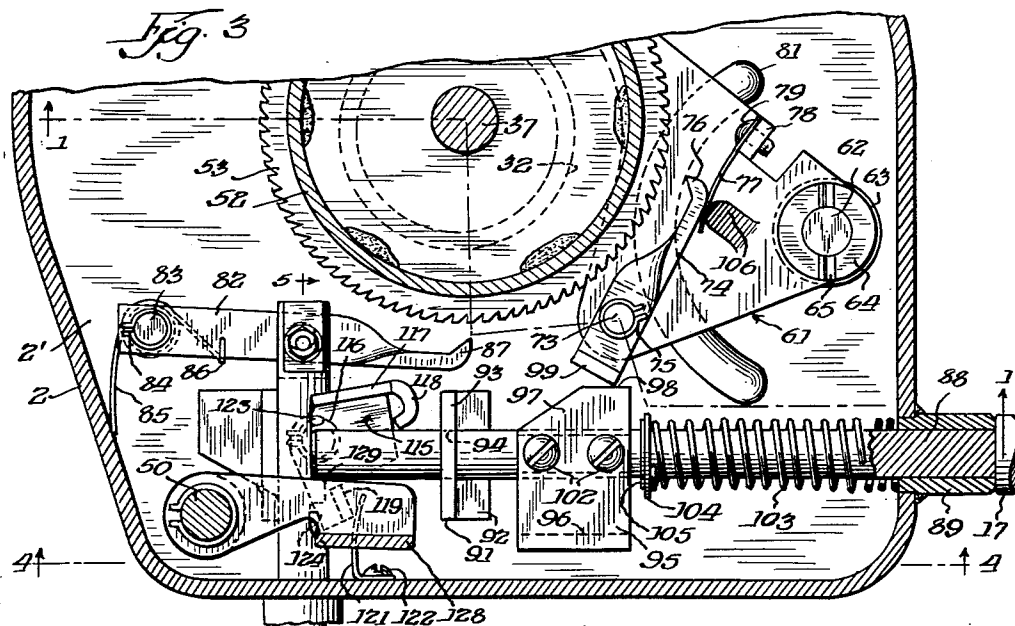
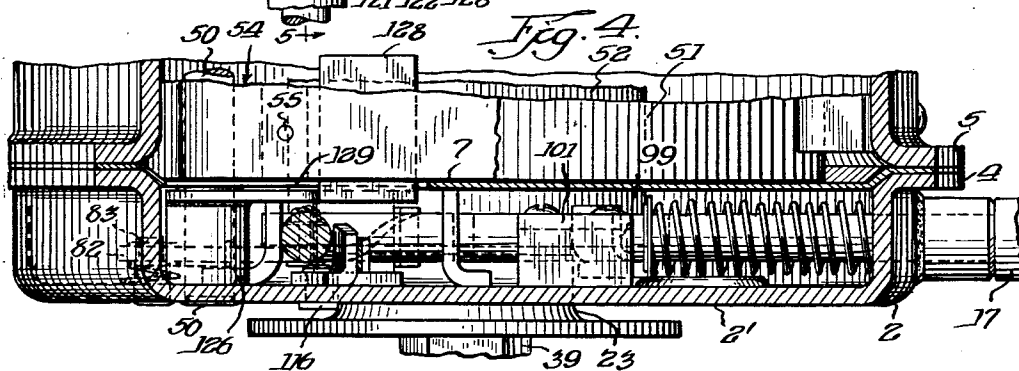
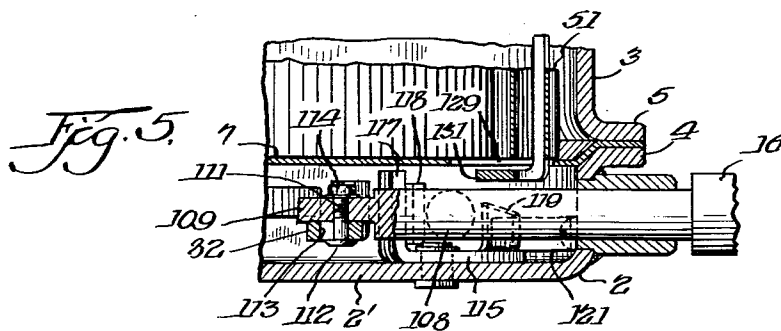
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ENGINE STARTING DEVICE

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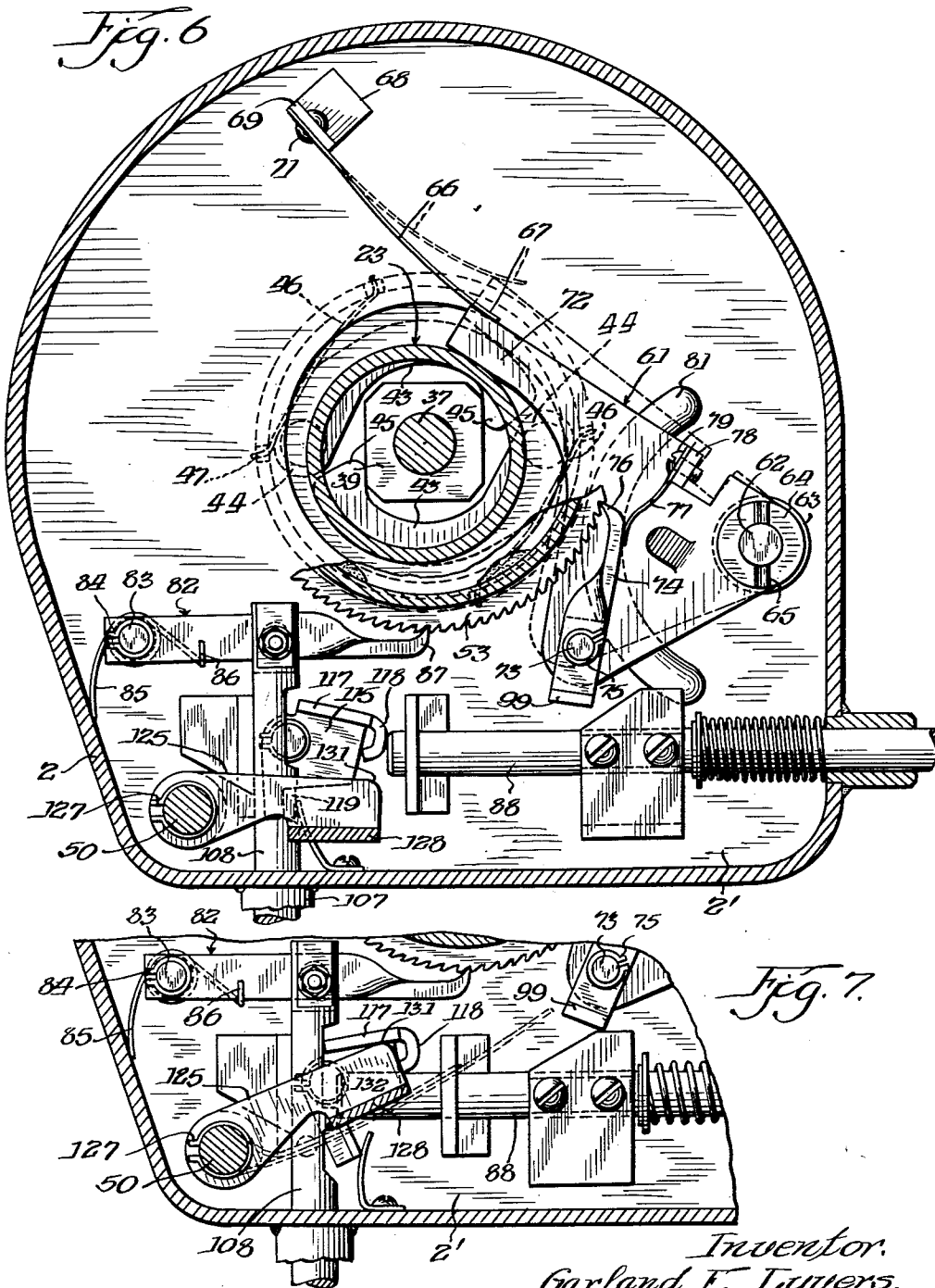
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ENGINE STARTING DEVICE

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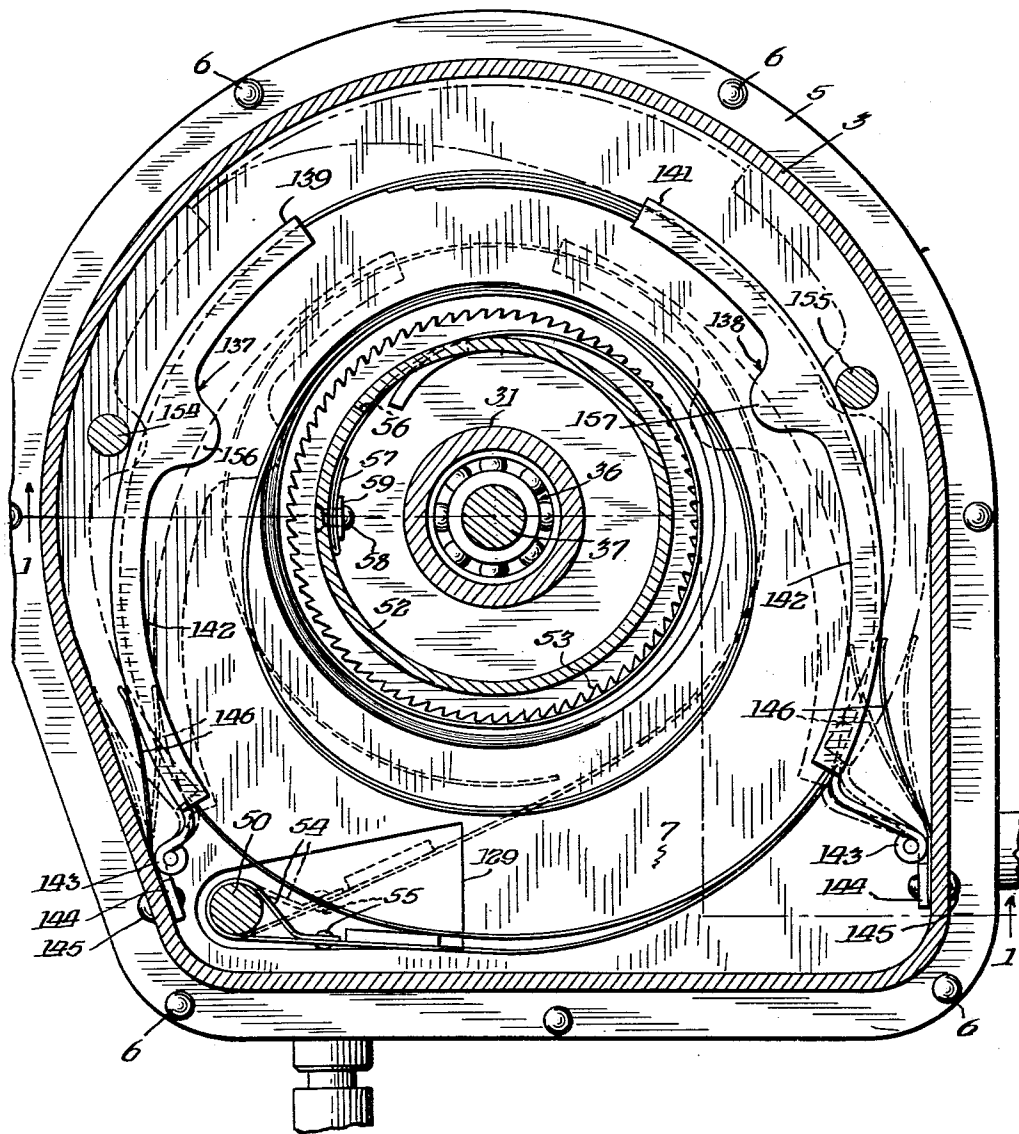
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Fig. 8.



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ENGINE STARTING DEVICE

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18 Claims. (Cl. 123-179)

The invention relates to starters for combustion engines and the like and more particularly to an engine starter for outboard boat motors and the like.

The invention has among its objects the production of an engine which may be spring-powered, and while small and compact in size, may supply power for one or more engine starts. In the particular embodiment of the invention illustrated, three engine starts may be obtained from one spring winding.

Another object of the invention is the production of such a starting device which is relatively simple in construction, comparatively inexpensive to manufacture and highly efficient for the purposes intended.

Another object of the invention is the production of such a starting device which is so constructed that it may be readily operated by inexperienced persons, only simple controls being employed, at the same time being substantially foolproof in operation, safety features being provided to eliminate any possibility of improper operation.

A further object of the invention is the production of such a starting device which may be provided with simple mounting means providing substantially universal application of the device to motors of different makes and sizes.

A further object of the invention is the production of such a starting device which may be provided with manual spring winding means under the control of a reset button or member and which is so designed that when the spring is wound by means of the engine it will automatically be disconnected from the latter when the spring has reached a predetermined tension.

Many other objects and advantages of the construction herein shown and described will be obvious to those skilled in the art from the disclosure herein given.

In the drawings, wherein like reference characters indicated like or corresponding parts:

FIG. 1 is a transverse vertical section through the device, the section through the upper portion of the housing being taken approximately on the line 1-1 of FIG. 8, and the section of the lower portion of the housing taken approximately on the line 1-1 of FIG. 3;

FIG. 2 is a sectional view taken approximately on the line 2-2 of FIG. 1;

FIG. 3 is a fragmentary sectional view taken approximately on the line 3-3 of FIG. 1, the mechanism being illustrated in the fully unwound position;

FIG. 4 is a sectional view taken approximately on the line 4-4 of FIG. 3;

FIG. 5 is a fragmentary sectional view taken approximately on the line 5-5 of FIG. 3;

FIG. 6 is a sectional view similar to FIG. 3 taken approximately on the line 6-6 of FIG. 1 and illustrated the parts in spring winding relation;

FIG. 7 is a fragmentary view similar to FIG. 6 but illustrating the corresponding parts in fully wound position; and

FIG. 8 is a sectional view taken approximately on the line 8-8, illustrating the actuating spring and associated parts in position following an initial starting operation, and illustrating in broken lines the positions of the elements when fully wound, and after the second and third starts.

The present invention contemplates a starting device in which the motive power comprises a spring which is adapted to be connected with the motor or engine to provide a starting torque thereto upon the release of a start

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or release knob or button. In the present embodiment of the invention, a second start button and a third start button are provided, each of which is operative to permit additional uncoiling of the spring and supply a second and a third starting torque to the engine. Following the starting of the engine, the spring may be rewound by actuating a reset or rewind knob or button which will then operatively connect the device to the engine to rewind the spring, and upon the latter becoming wound to the desired tension, the device will be automatically disconnected from the engine and ready for subsequent starting operations. As illustrated in the drawings, the device may also be provided with a manual rewind structure so that if for any reason the engine does not catch on the first three starts, the spring may be manually rewound for further starting operations. The device is constructed to be mounted on the top of an engine in axial alignment with the drive shaft thereof, whereby it may be operatively connected to the latter to apply a starting torque to the engine.

I am aware that various types of spring-actuated starters have hereto been designed, but these all have had various disadvantages. Some have been bulky and wholly impractical for use on small engines, others have employed control structures that were impractical for small engines, and all have been relatively costly, whereby they could not compete with electric starter devices and the like. Furthermore, none have been completely foolproof, whereby children and inexperienced persons could operate them without danger of improper operation, and damage thereto.

General assembly

Referring to the drawings and more particularly to FIGS. 1 through 5, the reference numeral 1 indicates generally a housing structure having a lower base portion 2 and an upper cover portion 3 which are provided along their meeting edges with complementary flanges 4 and 5 secured together by suitable means, as for example, rivets 6. Disposed between the flanges 4 and 5 and secured therewith by the rivets 6 is a separator plate or sheet 7 which divides the housing into an upper chamber 8 and a lower chamber 9, the separator 7 having a central circular opening 11 therein.

In general, the chamber 8 houses the actuating spring and associated elements for the second and third starts, while the lower chamber 9 houses the mechanism for rewinding the spring and controlling the first start.

Supported by the housing 1 is a generally cylindrical cap or cover structure, indicated generally by the reference numeral 12, which supports and encloses the manual winding mechanism 13 and a suitable one-way clutch mechanism indicated generally by the numeral 14 by means of which the manual winding mechanism may be operatively connected to the device. The specific manual rewinding mechanism 13 is of a type which is commercially procurable and the specific details thereof form no part of the present invention. However, the construction is such that a pull rope 15 has its free end operatively connected to a handle 15', and applying pressure to the top of the cap and pulling the rope by means of the handle, the manual winding mechanism may be actuated, a spring actuated arrangement returning the cap and pull rope to their original positions.

As illustrated in FIGS. 1 and 2, the device may be provided with a pair of knobs 16 and 17 extending laterally from the lower housing portion 2 and a second pair of knobs 18 and 19 extending upwardly from the upper housing portion 3, the knobs 16, 18 and 19 comprising the actuating elements for initiating the first, second and third starts, while the knob 17 is operative upon actuation to initiate the spring rewinding operation after the motor has started.

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The device is operatively connected to the motor on which it is installed by means of a hollow cup-like member indicated generally by the numeral 21 which houses a one-way clutch indicated generally by the numeral 22 and provided at its upper end with a cylindrical cam 23.

The housing 1 may be mounted by any suitable means on the top 24 of a motor by any suitable means, that illustrated comprising a plurality of laterally extending bracket members or lugs 25 which are suitably secured by welding or other means to the bottom portion 2 of the housing, and adapted to receive mounting means engageable with a portion of the motor structure to rigidly mount the housing thereon. In most cases it may be necessary to drill holes in the adjacent portion of the motor structure to receive the mounting means and if desired, suitable adapter collars may also be employed to properly position the structure on the motor. FIGURE 1 illustrates the use of such an adapter structure, the embodiment illustrated comprising an adapter ring or collar 27 which is generally annular in shape and provided with four tabs or ears 27' corresponding to the lugs 25. The adapter ring may be provided with a plurality of circumferentially spaced holes 28 therein for receiving mounting means such as bolts or the like. Thus the top 24 of the motor may be suitably drilled to provide a hole 29 therein for each hole 28.

In practice, the top member 24 may be removed, drilled and adapter ring bolted thereto, following which the top is replaced and the housing 2 then secured to the adapter ring by means of bolts or the like passing through the holes 25' therein and the corresponding holes in the ears 27'. The holes 25' preferably, are of a configuration and size that a slight degree of adjustment between the housing and the adapter plate 27 and thus the motor shaft 41 may be achieved to permit accurate alignment of the shafts 37 and 41.

Obviously, the adapter rings may be variously shaped to meet the requirements of the particular motor involved.

The spring power train and manual rewind mechanism

Concentrically positioned in and supported by the upper housing section 3 is a tubular bearing housing 31 which is illustrated as being formed with a shoulder 32 bearing on the inner face of the top 33 of the housing section 3 and secured thereto by suitable means such as welding 34 or the like. Supported by the housing 31 through a pair of ball bearing assemblies 35 and 36 is a main shaft 37 which rigidly carries at its upper end the one-way clutch 14, the latter being secured to the shaft by a nut 38. The lower end of the shaft 37 terminates in a hub portion 39 which is square in external configuration as illustrated in FIG. 6, and forms a part of the one-way clutch 22, by means of which the shaft 37 may be operatively connected to the drive or crank shaft 41 of the motor to which the device is applied.

The clutches 14 and 22 are generally identical in construction with the exception that the direction of drive, and thus the arrangement of the parts are reversed in the respective clutches, and manually actuated means is associated with the clutch 14 to effect a complete disconnection thereof. Thus referring to FIGS. 2 and 6, the hub 39 constitutes the driving member in the clutch 22, while a generally similar shaped hub 42 comprises the driving member in the clutch 14.

Pivotaly supported in the hub member 21 are a pair of clutch pawls 43, the latter being pivotaly mounted on pins 44 and terminating at their opposite free ends in hook-like portions 45, each of which is adapted to engage one face of the hub 42 as illustrated in FIG. 6. In operation, when the driving hub of the clutch 22 is rotated in the proper direction, it will rotate the associated pawls 43 therewith which are urged into engaging relation by the springs 46, thus carrying the driven member 21 with the hub. However, if the driven member starts to rotate at a greater speed than the driving mem-

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ber, as for example, when the motor starts, no interlocking relation exists between the pawls and the hub member, and as the driven member picks up speed, centrifugal force will urge the pawls outward to completely disengage the same from the hub member.

The clutch 14, in the embodiment illustrated in FIGS. 1 and 2, is generally similar to the clutch 22, utilizing similar pawls 43', supported by pins 44' in a cup shaped member 48 forming a part of the clutch and secured to the shaft 37 by means of the nut 38. Likewise, the pawls 43' are provided with hook-like portions 45' adapted to engage oppositely disposed faces of the hub 42. Each of the pawls 43' is urged toward the hub 42 by leaf springs 46', having their free ends positioned in apertures 47' in the member 48.

However, in the clutch 14, means is provided for effecting a manual engagement thereof when the spring is to be manually rewound. Referring to FIGS. 1 and 2, the cap structure 12 is made in two sections, a rigid section 12a and a vertically movable section 12b, the section 12a being secured to the housing 1 by suitable means such as screws 12d passing through lugs 12c formed on the section 12a and threaded into the housing.

The sections 12a and 12b are provided with a plurality of complementary guide beads 48a and 48b respectively formed therein and functioning to restrict outward movement of the section 12b with respect to the section 12a, the beads also providing additional means for restricting relative rotation therebetween. The section 12b is also provided with a plurality of inwardly directed ears 48' which are struck out of the side wall thereof and adapted to engage respective arms 49' of a generally cross or X-shaped spring 49, having a central annular shaped portion adapted to encircle the upper end of the sleeve 31, and which is operative to urge, and normally maintain the section 12b in its upward or outward position, as viewed in FIG. 1.

The rewind mechanism 13 may be secured to the section 12a by any suitable means, as for example by a washer 13a and spring pin 13b passing through the supporting shaft 13c of the mechanism, the specific details of which form no part of the present invention.

The operation of the rewind mechanism illustrated is as follows: Normally, the section 12b will be in its upward position with the hub 42 elevated above and out of engagement with the pawls 43', as illustrated in FIG. 1. In the event the spring becomes fully unwound without starting the motor, the operator, after drawing out the reset knob 17, merely applies downward pressure on the section 12b to move the same to the position illustrated in solid lines in FIG. 1.

It will be noted that, to facilitate engagement of the hub with the pawls, the trailing edges of the hub may be relieved as indicated at 42' operative to cam the structure into operative engagement. The handle 16 is then pulled to rotate the mechanism 13 and hub 42, resulting in rotation of the shaft 37 in spring-winding direction, return movement of the shaft being prevented by the stop pawl 82. Upon release of the section 12a, it will return to the position illustrated in dotted lines in FIG. 1.

In some cases, it may be desired to eliminate the manual winding mechanism, in which case the clutch 14 may be eliminated and a circular washer substituted therefore, upon which the nut 38 may be drawn down. Likewise, the mechanism 13 would then be eliminated and the cover structure 12 replaced by a small cover or cap large enough to cover the end of the structure remaining.

Referring to FIGS. 2, 3, 4 and 8, rigidly secured to the bottom wall 2' of the bottom housing section 2 is a stud 50 which extends through the top 33 of the upper housing section 3 as indicated in FIG. 2.

Positioned in the upper chamber 8 of the housing 1 is a coiled leaf spring formed of flat strip stock 51, having its outer end suitably connected to the stud 50 and its inner end operatively connected to the shaft 37. This is

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accomplished by means of a tubular hub member 52 which is rigidly carried by a ratchet gear 53, the latter being rigidly connected to the shaft 37. The hub 52 is connected to the gear 53 and the latter to the shaft 37 by welding or the like. Referring to FIG. 8, the outer end terminates in a loop 54 formed by bringing the free end of the spring back upon itself and anchoring the same with a pair of rivets 55. As illustrated in FIGS. 1 and 8, the inner end of the spring passes through a slot 56 in the hub, the free end doubled back upon itself as indicated at 57 and secured to the hub by rivets 58, the latter passing through a reinforcing strip 59 positioned at the adjacent face of the spring end and passing through the hub 52.

It will be apparent from an examination of FIG. 8, that the arrangement of the spring 51 and its connections are such that when the spring is fully wound, indicated in dotted lines in FIG. 8, the spring will tend to drive the shaft 37 in a clockwise direction as viewed in FIG. 8, and at the same time drive the shaft 41 through the clutch 22. Similarly, when the shaft 37 is rotated in a counterclockwise direction, as for example, by the manual winding mechanism and clutch 14, the spring may be rewound.

Main start and rewinding controls

The mechanism for controlling rewinding and starting operations of the device may be broken down into the categories; first, the rewind and main start controls which are interrelated, and second, the additional or second and third start controls which are associated with the spring structure itself while the first start mechanism is associated with the reset mechanism.

The rewind and main start mechanism is illustrated in FIGS. 1 and 3 through 7, FIGS. 3, 4 and 5 illustrating the mechanism in a fully unwound position following the third start, while FIG. 6 illustrates the mechanism in a spring winding relation, and FIG. 7 when the spring has been fully wound.

The spring 51 is adapted to be wound mechanically by the shaft 41 through a cam driven ratchet mechanism. Thus, referring particularly to FIGS. 1 and 6, carried by the bottom 48 of the section 2 of the housing is a drive lever indicated generally by the numeral 61, pivotally mounted on a stud 62 rigidly connected by welding or other means to the bottom 48 of the housing, the lever 61 being illustrated as supported on a washer 63 and maintained in operative position by a washer 64 and spring pin 65 extending through the stud 62. The lever 61 is urged in a counterclockwise direction as viewed in FIG. 6 by a leaf spring 66, one end 67 of which bears on the side face of the lever 61, while the opposite end is held stationary by an anchor bracket 68 which is welded or otherwise rigidly secured to the bottom 48, the spring 66 being secured to the up-standing portion 69 thereof by a rivet 71.

As clearly illustrated in FIG. 6, the elongated portion 72 of the lever 61 is adapted to engage the outer peripheral surface 32 of the cam eccentric 23 so that upon rotation of the latter, the lever 61 will be oscillated from the position illustrated in solid lines in FIG. 6, to the position illustrated in dotted lines. Pivotally mounted on a stud 73 rigidly carried by the lever 61 is a drive pawl 74, the latter being retained on the stud 73 by suitable means such as a spring locking washer on ring 75. The free end of the pawl 74 is provided with a ratchet engaging tooth 76 which is normally urged into ratchet engaging position by a leaf spring 77, one end of which bears on the pawl 74, and the other end is rigidly mounted to a vertical lug 78 on the lever 61 by suitable means such as a screw 79. Thus when the lever 61 is oscillated by means of the cam 23, the pawl 74 will rotate the ratchet gear 73 in a counterclockwise direction, to wind the spring 51. The lever 61 may be further supported in its oscillatory movement by an arcuate-shaped boss 81 formed in the bottom 2' of the housing.

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The ratchet gear 53 is adapted to be held in a stationary position during return movement of the drive pawl 74 as the lever 61 moves in a counterclockwise direction, as viewed in FIG. 6, by a stop pawl 82 which is pivotally supported on a shouldered stud 83 and retained thereon by a suitable spring washer or clip 84, the pawl normally being urged in a counterclockwise direction, as viewed in FIG. 6, by a torsion spring 85 which encircles the stud 83, one end of the spring bearing on the adjacent side wall of the housing and the opposite end being formed with a hook portion 86 engaged with the pawl 82.

Thus, each time the lever 61 is oscillated in a clockwise direction, the drive pawl 74 will carry with it the ratchet gear 53, the single tooth 87 of the stop pawl 82 being cammed out of operative engagement with the ratchet gear 53, but upon return movement of the lever 61, the tooth 87 will engage the ratchet gear 53, preventing clockwise rotation thereof, while the tooth 76 of drive pawl 74 is cammed out of operative engagement with the teeth on the ratchet gear 53. Positive rewinding of the spring will therefore take place.

It will be apparent that when the spring is released to apply a torque to the shaft 37, both of the pawls 74 and 82 must be operatively disconnected from the ratchet gear 53 and at the same time the lever 61 operatively disengaged from the cam 32.

Such a condition is illustrated in FIGS. 3, 4 and 5 wherein all of the parts are illustrated in a position immediately following unwinding of the spring before the mechanism is reset to rewind the latter.

Positioned in the lower chamber 9 is an axially slidable reset or rewind control shaft or member 88 which is supported in a bushing or sleeve 89 secured to and extending outwardly from the side wall of the section 2 of the housing, the sleeve 89 being illustrated as welded or otherwise secured to the housing. An angular shaped bracket 91 having a generally horizontal portion 92 is secured, by welding or other suitable means, to the bottom 2' and is provided with an upright portion 93 having a bore 94 therein through which the inner end of the shaft 88 extends.

Mounted on the reset shaft 88 is a release bracket or cam 95 which is generally L-shaped, having a leg portion 96 extending down to the bottom 2' and a horizontally extending portion 97 having an end edge 98 adapted to engage an upstanding lug portion 99 on the free end, adjacent the stud 73, of the pawl 74, the member 95 being secured to a flat 101 formed on the reset shaft 88 by suitable means such as a pair of screws 102.

The reset shaft 88 is adapted to be urged inwardly or toward the left as viewed in FIG. 3 by a compression spring 103 having one end bearing against the inner face of the housing and the opposite end bearing on a washer 104 which is secured in operative position by a suitable spring or split ring 105 engaged in an annular groove in the shaft 88.

As illustrated in FIG. 3, the cam member 95 is so proportioned that the edge 98 will rock the drive pawl 74 in a clockwise direction, which movement is restricted by a shoulder or stop 106 formed on the drive lever 61, the stop being so positioned with respect to the drive pawl that as soon as the latter has been disengaged from the ratchet wheel by such clockwise movement, the pawl 74 will engage the stop 106, further movement of the cam member 95 and reset rod 88 inwardly, acting to rotate the entire drive lever assembly in a clockwise direction and rotate the cam engaging arm 72 of the drive lever out of operative engagement with the cam 23. Consequently, when the drive lever and associated parts are in the position illustrated in FIG. 3, the drive lever is completely disengaged from the cam 23 and the pawl disengaged from the ratchet wheel 53.

Axially slidable in a sleeve or bushing 107, secured by welding or other suitable means to the side wall of the housing section 2, is a release or main start control shaft

or member 108 having the release knob 16 attached to the outer end thereof, the inner end of the shaft being operatively connected to the stop pawl 82.

As illustrated in FIG. 5, the free inner end of the shaft 108 is provided with a flattened portion 109, having a threaded bore 111 in which is threaded a screw 112 which extends through an enlarged aperture or opening 113 in the stop pawl 82, the screw being locked in place by a suitable lock nut 114 or the like. The size of the aperture 113 is such that adequate lost motion between the stop pawl 82 and the screw 112 may be obtained to permit proper operation of the pawl 82 when the device is in spring winding relation, but at the same time permitting outward movement of the shaft 108 to withdraw the pawl 82 out of engagement with the ratchet wheel 53 when desired.

Pivotally mounted on the bottom 2' of the housing is a latch or stop member indicated generally by the numeral 115, the latter being carried on a pin 116 extending through the bottom 2' and secured in place by suitable means such as a spring ring 116. As illustrated in FIGS. 4 and 5, the latch member 115 is provided with an upwardly extending projection 117 having a laterally extending portion 118, and a second upright portion 119. The member 115 is urged in a clockwise direction by a small leaf spring 121 which extends from the adjacent side wall of the housing 2, the spring being secured thereto by suitable means such as a screw 112 or the like, the free end of the spring engaging the upright portion 119 of the member 115, tending to urge the same toward the left as viewed in FIG. 3.

Referring to FIG. 3, it will be noted that the release or start shaft 108 is provided with two notches 123 and 124, the former being of a size to receive the inner end of the reset shaft 88, while the notch 124 is of a size to receive the upright portion 119 of the latch member 115. The arrangement is such that when the release shaft 108 is in its innermost position as illustrated in FIG. 6, and the reset shaft in its outermost position, the spring 121 will rotate the latch member 115 clockwise to bring the projection 119 into the notch 124 and the portion 118 in the path of the reset shaft 88, thus retaining the latter in an outward position as illustrated in FIG. 6. Consequently, in such position, the release shaft cannot be moved outwardly nor can the reset shaft be moved inwardly.

In this position the mechanism is set for spring re-winding and the control of the mechanism is effected through the spring 51 by means of a lever 125 which, in the embodiment illustrated, is pivoted on the stud 50, the lever having rigidly associated therewith a sleeve or collar 126, welded or otherwise secured thereto, which encircles the stud 50, the lever being retained in operative position by a spring clip or washer 127 engaged in an annular groove in the stud 50. As illustrated in FIGS. 3 through 8, and in particular FIGS. 4, 5 and 8, the lever 125 is provided with an upwardly extending projection 128, the latter extending through an opening 129 in the separator sheet 7 and adapted to be positioned at the inner face of the outermost turn of the spring 51 adjacent the loop 54 therein. The arrangement is such that when the spring is fully wound, the outermost coil of the spring will engage the projection 128 and rotate it and the arm 125 to the position illustrated in FIGS. 7 and 8, whereas when the spring is partially or fully unwound the second convolution of the spring will engage the projection 128 on the opposite face thereof and pivot the lever 125 into the position illustrated in FIGS. 3 through 6.

Winding and starting operations

Assuming that the spring is in a fully unwound position following a starting operation, the various parts

of the mechanisms will be in the relative positions illustrated in FIG. 3.

In such case, the reset shaft 88 will be in its innermost position, resulting in the member 95 camming the drive pawl 74 and lever 61 out of operative engagement with the ratchet gear 53 and cam 23, respectively. At the same time, the release shaft 108 is in its outermost position, the shaft being held in such position against the action of the spring 86, acting upon the stop pawl 82 through screw 112, by the extreme end of the reset shaft which is positioned in the notch 123, resulting in engagement of the shoulder 129 on the shaft 108 engaging the peripheral edge of the shaft 88. In such position, the latch or stop member 115 is inoperative, the projection 119 thereon being positioned out of the notch 124 and the portion 118 being positioned along the side of the reset shaft 88. As the spring 51 is partially or fully unwound, the outermost coils will assume the positions illustrated in FIG. 8 to move the lever 125 to a position such as illustrated in FIG. 3.

Assuming that the motor to which the device is applied is running, the operator merely pulls out the reset or rewind control shaft 88 to the position illustrated in FIG. 6. This will result in the following operation of the parts:

(1) The block 95 is disengaged from the drive pawl 74, permitting the spring 66 to move the lever 61 in a counterclockwise direction, bringing the portion 72 thereof into engagement with the face 32 of the cam 23, and the tooth 76 of the pawl 74 into engagement with the ratchet gear 53.

(2) Simultaneously therewith, as the extreme inner end of the shaft 88 is withdrawn from the notch 123 in the release shaft 108, the spring 86 will rotate the stop pawl 82 in a counterclockwise direction, drawing the shaft 108 inwardly to its innermost position as illustrated in FIG. 6.

(3) As soon as the free end of the reset shaft 88 clears the projection 118 on the latch member 115, the latter, under the action of the spring 121 will be rotated in a clockwise direction to the position illustrated in FIG. 8, the projection 119 entering the notch 124 in the release shaft 108, thereby preventing the latter from being moved outwardly, and positioning the projection 118 in the path of the free end of the reset shaft 88, thereby preventing the latter from moving inwardly and returning to its original position.

Consequently with the parts in such positions the cam 23 will oscillate the lever 61, each oscillation resulting in the pawl 74 rotating the ratchet gear 53 and with it the inner end of the spring 51 in a counterclockwise direction to wind the spring, the stop pawl 82 preventing rotation of the ratchet gear 53 in a clockwise direction during the return movements of the lever 61. Such action will continue until the spring approaches its fully wound position, at which time the extreme outer end thereof will start to move from the position illustrated in FIG. 7 and in dotted lines in FIG. 8.

Referring to FIG. 7, as the lever 125 rotates in a counterclockwise direction, the edge portion 131 thereof will ultimately engage the upper portion of the projection 117, eventually camming the latch member 115 to the position illustrated in FIG. 7. Upon disengagement of the portion 118 of the latch member with the end of the reset shaft 88, the latter will move inwardly under the action of spring 103 to the position illustrated in FIG. 7, wherein the extreme inner end of the reset shaft is engaged on the portion 132 of the shaft 108, which portion is disposed between and defined by the notches 123 and 124. Such inward movement of the shaft 88 will also result in the member 95 engaging the upstanding projection 99 of the drive pawl 74 to rotate the latter out of engagement with the ratchet gear 53

and the lever 61 out of engagement with the cam 23, these elements assuming the positions illustrated in FIG. 3. The counterclockwise movement of the latch member 115 under the action of the lever 125 will also pivot the upstanding projection 119 out of the notch 124 in the release shaft 108, thereby permitting the latter to be manually moved outwardly when it is desired to start the motor.

Assuming that the parts are in the positions illustrated in FIG. 7, and the spring fully wound, when it is desired to utilize the device to start the motor on which it is mounted, the release or main start shaft 108 may be moved outwardly, thereby withdrawing the tooth 87, of the stop pawl 82, out of engagement with the ratchet gear 53, such outward movement of the shaft permitting the free end of the reset shaft to drop into the notch 123 and thereby prevent the return of the pawl 82 into engagement with the ratchet gear 53 upon manual release of the knob 16.

As soon as the tooth 87 of the stop pawl 82 is disengaged from the ratchet gear 53, the latter is free to rotate in a clockwise direction under the action of the spring 51 until the spring reaches the limit of its unwinding movement. The parts may then be in the position illustrated in FIG. 3, following which the cycle just described may be repeated.

As soon as the motor picks up speed whereby the shaft 41 is rotating at a higher speed than the shaft 37, the hub 39 will be disconnected from the pawls 43, the latter ultimately being thrown outwardly, under the action of centrifugal force, completely out of engagement with the hub.

In the event the motor failed to start and it is desired to rewind the spring 51, this may be accomplished by actuation of the manual winding mechanism 13 through the handle 16 and rope 15.

Second and third starting mechanisms

While the structure thus far described will function very efficiently for single start operations, the present invention readily adapts itself for a plurality of starts rather than just a single start, thereby eliminating the necessity of rewinding the spring in the event the motor does not catch on the first start.

Thus, means may be provided for effecting a second and third start on one spring winding in the event such action becomes necessary. This may be accomplished by restricting the outward unwinding movement of the spring so that only a portion of the energy stored in the spring will be expended on any one start.

This operation is effected by a pair of stop members acting through suitable mechanism on the spring to limit the uncoiling thereof, the arrangement being such that when the main starting knob 16 is pulled outwardly and the spring released for starting action, it is unable to completely uncoil, only approximately one-third of the effective power in the spring being utilized, at which time further uncoiling of the spring is prevented. When the second start knob is actuated, a second third of the energy stored in the spring is permitted to be expended, at which time further uncoiling of the spring is prevented until the third button is actuated to permit the spring to become fully unwound.

Referring to FIGS. 1, 2 and 8, carried by the upper housing section 3, are a pair of spring retainers 137 and 138, which are generally similar in construction, although generally reverse in configuration, and each comprises a generally arcuate shaped body portion 139 and 141 having inwardly directed peripheral flanges 142 adapted to overlie the top edges of the outer convolutions of the spring 51.

The lower ends of each member 137 and 138, as viewed in FIG. 8, are formed with a hinge portion 143 cooperable with a stationary hinge portion 144 which is

secured to the side wall of the housing section 3 by rivets 145 or other suitable means. The retainers are urged in an inward direction toward the spring hub 52 by leaf springs 146 which, as illustrated in FIG. 8, may be secured to the housing side wall by interposing the adjacent end of the spring between the side wall and the hinge portion 144, whereby both the spring and the hinge may be secured to the housing by the rivets 145.

As shown in solid lines, the springs 146 will urge the retainers 137 and 138 inwardly against the convolutions of the fully wound spring as indicated in dotted lines in FIG. 8.

The start button 18 is operatively associated with the retainer member 137 while the third start button 19 is operatively associated with the retainer member 138. Referring to FIG. 1, it will be noted that the button 18 is secured to a stem 147 which is axially movable in a sleeve 148 suitably secured by welding or other means to the top 33 of the casing, the sleeve 148 having a shoulder 149 adjacent its outer end, forming a seat for the outer end of a spring 151, the inner end of which is seated on the shoulder 152 formed on the stem 147, the latter being secured to the button 18 by suitable means such as swedging the upper end of the stem as indicated at 153. Thus when the button is in the position illustrated in FIG. 1, the lower portion 154 thereof will be in the path of the retainer member 137 and thereby limit the outward movement thereof as well as the uncoiling of the spring 51. The third start button 19 is constructed in a similar manner and the lower portion 155 thereof is adapted to engage and limit outward movement of the retainer member 138. The operation of the structures illustrated in FIG. 8 wherein the retainer members 137 and 138 are shown in their operative positions at the end of the first starting operation initiated by the first start button 16. However, pulling upwardly on the buttons will result in disengagement of the lower portions thereof with their associated retainer members, thereby permitting the spring to further uncoil. Upon release of a button and outward movement of the retainer member associated therewith, return of the associated button to its original position is prevented by the extension 156 on the retainer member 137 and the portion 157 on the retainer member 138, thereby eliminating any possible interlock between the buttons and their associated retainer members after they have been once released.

Operation of the second and third start buttons

Assuming that the spring is fully wound, and the associated parts are in the positions heretofore described in connection with a fully wound spring condition as illustrated in FIG. 7, upon actuation of the release shaft 108 the spring 51 will begin to uncoil, and the release and reset shafts will assume the positions illustrated in FIG. 3. Uncoiling of the spring 51 will continue until the spring has expanded into the space defined by the retainer members 137 and 138 when the latter engage their associated pins 154 and 155 as illustrated in FIG. 8. It will be noted that at this time the lever 125 has been rotated from its original fully wound position as illustrated in FIG. 7 to the position illustrated in FIGS. 3 and 6.

In the event the engine did not start on the first starting action, the second start button 18 may then be pulled upwardly to withdraw the pin 154 from engagement with the retainer 137, permitting the latter to move to the position indicated in broken lines in FIG. 8, the portion 156 underlying the pin 154 and preventing its return to the position illustrated in FIG. 1.

In the event the engine failed to start on the second starting action, the third start button 19 may be pulled outwardly to disengage the pin 155 from the retainer 138 and permit the spring to expand to its fully unwound position as indicated in the broken lines.

To facilitate a visual understanding of the various positions attention is directed to FIGURE 8 wherein the fully wound position of the spring and associated parts is indicated in dotted lines, the solid lines indicating the positions of the parts after the first start, the retainer member 137 being illustrated in the broken lines at the end of the second and third starts, while the retainer member 138 is indicated in broken lines at the end of the third start.

Under normal operating conditions no difficulty should be experienced in starting an average engine in three starts if the engine has been reasonably well serviced.

It will be noted from the above description that I have provided a very efficient starting mechanism utilizing a spring for the motive power thereof, which mechanism is completely foolproof, having safeguards that will prevent improper operation of the device and at the same time retaining a relatively simple construction which may be readily and inexpensively manufactured to provide a relatively inexpensive starting device for outboard motors and the like.

Likewise I have provided a device which may be readily mounted on motors of varying design and construction so that the device is substantially universal in use.

Having thus described my invention, it will be obvious to those skilled in the art from the disclosure herein given that various immaterial modifications may be made in the same without departing from the spirit of my invention; hence I do not wish to be understood as limiting myself to the exact form, construction, arrangement and combination of parts herein shown and described or uses mentioned.

What I claim as new and desire to secure by Letters Patent is:

1. In a starter mechanism, the combination of a housing divided into an upper chamber and lower chamber, a rotatable drive shaft extending transversely through said chambers, a coiled spring positioned in said upper chamber, having its inner end operatively connected to said shaft, and its outer end fixed to said housing, a one-way clutch positioned below said lower chamber, having a driving member operatively connected to said drive shaft and a drive member constructed for operative connection to the motor to be started, a ratchet gear positioned in said lower chamber and rigidly mounted on said shaft, a drive pawl releasably engageable with said ratchet gear, cam means carried by said driven member, means associated with said pawl engageable with said cam means, whereby the latter is operative to reciprocate said pawl, to rotate said ratchet gear in a spring winding direction, a stop pawl carried by said housing engageable with said ratchet gear to prevent reverse rotation thereof upon return movement of said driving pawl, a rewind control member having means operatively associated with said driving pawl and actuating means therefor, for rendering the same inoperative in one position of said control member and operative in another position, means operated by winding of said spring for controlling movement of said control member and the said driving pawl and actuating means from their winding positions to their inoperative positions, a starting control member operatively connected to said stop pawl, operative in one position to release the latter from said ratchet gear, and a stop member operatively associated with said control members, operative when the spring is winding to prevent actuation of said start control member and movement of said rewind control member to a drive pawl disengaging position, interlocking means on said control members for preventing engagement of said stop pawl with said ratchet gear, following actuation of said start control member, until rewinding of said spring and a pivoted member engageable with said stop member to disengage the latter from said control members, said pivoted member having a portion engageable with a coil of said spring whereby the latter is operative when in fully wound position to

pivot said member into operative engagement with said stop member.

2. In a starter mechanism as defined in claim 1, a releasable stop member having a spring-engaging portion operative to restrict unwinding of said spring, release of said start member being operative to permit further unwinding of said spring, providing an additional starting action in the event the motor fails to start following actuation of said starting control member.

3. In a starter mechanism as defined in claim 2, wherein said spring is provided with a spring restricting members pivotally supported by said housing for pivotal movement about an axis extending parallel to the axis of said shaft, said releasable stop member being engageable with said spring restricting member to restrict expanding movement of the spring, and means on said spring restricting member for retaining said stop member in released position following manual release thereof until the spring winding operation is initiated.

4. In a starter mechanism as defined in claim 3, wherein a pair of releasable stop members and cooperable spring restricting members are provided, the latter being disposed at opposite sides of said spring on parallel axes, operative to provide three starts from a single winding of said spring.

5. In a starter mechanism as defined in claim 1, comprising a manual spring winding mechanism positioned above said shaft and releasable clutch means operative to transmit movement of said winding mechanism to said shaft in a spring winding direction.

6. In a starter mechanism for a combustion engine, the combination of a housing, a rotatable drive shaft positioned in said housing, a coiled spring having its inner end operatively connected to said shaft, and its outer end fixed to said housing, a one-way clutch, having a driving member operatively connected to said drive shaft and a driven member constructed for operatively fixed connection to such an engine, means for releasably connecting said driven member and said shaft operative to wind said spring, releasable means for retaining said spring in wound relation, a manually actuatable rewind control member having means operatively associated with the elements operative to effect rewinding of the spring for rendering such elements inoperative in one position of said control member and operative in another position, means operated by winding of said spring for controlling movement of said control member from its winding to its inoperative position, a manually actuatable starting control member operatively connected to said spring retaining means, operative in one position to release the latter and permit said spring to unwind, and a stop member operatively associated with said control members, operative when the spring is winding to prevent actuation of said start control member and movement of said rewind control member to a disengaging position, and interlocking means on said control members for rendering said spring retaining means inoperative, following actuation of said start control member, until said spring is unwound.

7. In a starter mechanism for a combustion engine, the combination of a housing, a rotatable drive shaft positioned in said housing, a coiled spring positioned in said housing, having its inner end operatively connected to said shaft, and its outer end fixed to said housing, a one-way clutch having a driving member operatively connected to said drive shaft and a driven member constructed for operatively fixed connection to such an engine, a ratchet gear positioned in said housing and rigidly mounted on said shaft, a drive pawl releasably engageable with said ratchet gear, cam means carried by said driven member, means operatively connected with said pawl engageable with said cam means, whereby the latter is operative to reciprocate said pawl, to rotate said ratchet gear in spring winding direction, a stop pawl carried by said housing engageable with said ratchet gear to

prevent reverse rotation thereof upon return movement of said driving pawl, a manually actuatable rewind control member having means operatively associated with said drive pawl and actuating means therefor, for rendering the same inoperative in one position of said control member and operative in another position, means operated by winding of said spring for controlling movement of said control member from its winding to its inoperative position, and a manually actuatable starting control member operatively connected to said stop pawl, operative in one position to release the latter from said ratchet gear.

8. In a starter mechanism for a combustion engine, combination of a housing divided into an upper chamber and lower chamber, a rotatable drive shaft extending transversely through said chambers, a coiled spring positioned in said upper chamber, having its inner end operatively connected to said shaft, and its outer end fixed to said housing, a one-way clutch having a driving member operatively connected to said drive shaft and a driven member constructed for operatively fixed connection to such an engine, a ratchet gear positioned in said lower chamber and rigidly mounted on said shaft, a drive pawl releasably engageable with said ratchet gear, cam means carried by said driven member, means operatively connected with said pawl engageable with said cam means, whereby the latter is operative to reciprocate said pawl, to rotate said ratchet gear in spring winding direction, a stop pawl carried by said housing engageable with said ratchet gear to prevent reverse rotation thereof upon return movement of said drive pawl, a manually actuatable rewind control member having means operatively associated with said drive pawl and actuating means therefor for rendering the same inoperative in one position of said control member and operative in another position, means operated by winding of said spring for controlling movement of said control member from its winding to its inoperative position, a manually actuatable starting control member operatively connected to said stop pawl, operative in one position to release the latter from said ratchet gear, and interlocking means on said control members for preventing engagement of said stop pawl with said ratchet gear, following actuation of said start control member, until rewinding of said spring.

9. In a starter mechanism for a combustion engine, the combination of a housing divided into an upper chamber and lower chamber, a rotatable drive shaft extending transversely through said chamber, a coiled spring positioned in said upper chamber, having its inner end operatively connected to said shaft, and its outer end fixed to said housing, a one-way clutch positioned below said lower chamber, having a driving member operatively connected to said drive shaft and a driven member constructed for operatively fixed connection to such an engine, a ratchet gear positioned in said lower chamber and rigidly mounted on said shaft, a drive pawl releasably engageable with said ratchet gear, cam means carried by said driven member, means associated with said pawl engageable with said cam means, whereby the latter is operative to reciprocate said pawl, to rotate said ratchet gear in spring winding direction, a stop pawl carried by said housing engageable with said ratchet gear to prevent reverse rotation thereof upon return movement of said drive pawl, manually actuatable control means operatively associated with said drive pawl and actuating means therefor for rendering the same inoperative in one position of said control means and operative in another position, means for controlling movement of said control member from its winding to its inoperative position, manually actuatable starting control means operative in one position to release said stop pawl from said ratchet gear, means operatively associated with the respective control means operative when the spring is winding to prevent actuation of said start con-

trol means and movement of said first control means to a drive pawl disengaging position, and means for preventing engagement of said stop pawl with said ratchet gear, following actuation of said start control means, until rewinding of said spring.

10. In a starting mechanism for an engine, the combination of an actuating spring, means for operatively connecting the spring when wound to such an engine, means for initiating release of said spring to impart a starting torque to such an engine, and releasable means positioned in the uncoiling path of the spring operative to restrict further unwinding thereof, and upon release of the latter means impart a second starting torque to such an engine.

11. In a starting mechanism for an engine, the combination of an actuating spring, means for rewinding said spring by operation of such an engine, a manually actuatable rewind control member operative to control the operation of said means, releasable means for operatively connecting said spring to such an engine for imparting a starting torque thereto, and a manually actuatable starting control member operative to control the operative release of said spring, and means operatively connecting said control member for preventing manual actuation of said starting control member to release said spring during actuation of said rewinding means.

12. An engine starting device as defined in claim 11 comprising means for preventing manual actuation of said rewind control member to an inoperative position until said spring is fully wound.

13. An engine starting device as defined in claim 11 comprising means for preventing actuation of said starting control member to spring retaining position, following releasing of said spring, until said rewind control member is manually actuated to operate said rewinding means.

14. An engine starting device as defined in claim 13, wherein said last-mentioned means comprises interlocking elements on said starting and rewinding control members.

15. An engine starting device as defined in claim 11 comprising a stop member having portions engageable during spring winding operation with said starting and rewind control members operative to prevent actuation of said starting control member to spring releasing position and said rewinding control member to a non-winding position, and means actuatable when the spring is in a fully wound position to disengage said stop member from said control members to discontinue the spring winding operation and ready the starting control member for spring release.

16. An engine starting device as defined in claim 15, wherein the means for disengaging said stop member comprises a lever pivotally related to said stop member and constructed for engagement with a coil of said spring and movable thereby when the spring is fully wound to engage and actuate said stop member.

17. In an engine starting mechanism, the combination of an actuating spring, means for rewinding said spring by operation of such an engine, a manually actuatable rewind control member operative to control the operation of said means, releasable means for operatively connecting said spring to such an engine for imparting a starting torque thereto, and a manually actuatable starting control member operative to control the operative release of said spring, means operatively connecting said control members for preventing manual actuation of said starting control member to release said spring during actuation of said rewinding means, and releasable means for restricting unwinding movement of said spring operative upon release to supply a second starting torque to such an engine.

18. In an engine starting mechanism, the combination of an actuating spring, means for rewinding said

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spring by operation of such an engine, a rewind control member operative to control the operation of said means, releasable means for operatively connecting said spring to such an engine for imparting a starting torque thereto, and a starting control member operative to control the operative release of said spring, and releasable means for restricting unwinding movement of said spring operative upon release to supply a second starting torque to such an engine.

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