April 7, 1942. R. J. HERRINGTON 2,278,547

STARTING DEVICE

Filed Jan. 11, 1941 2 Sheets-Sheet 1

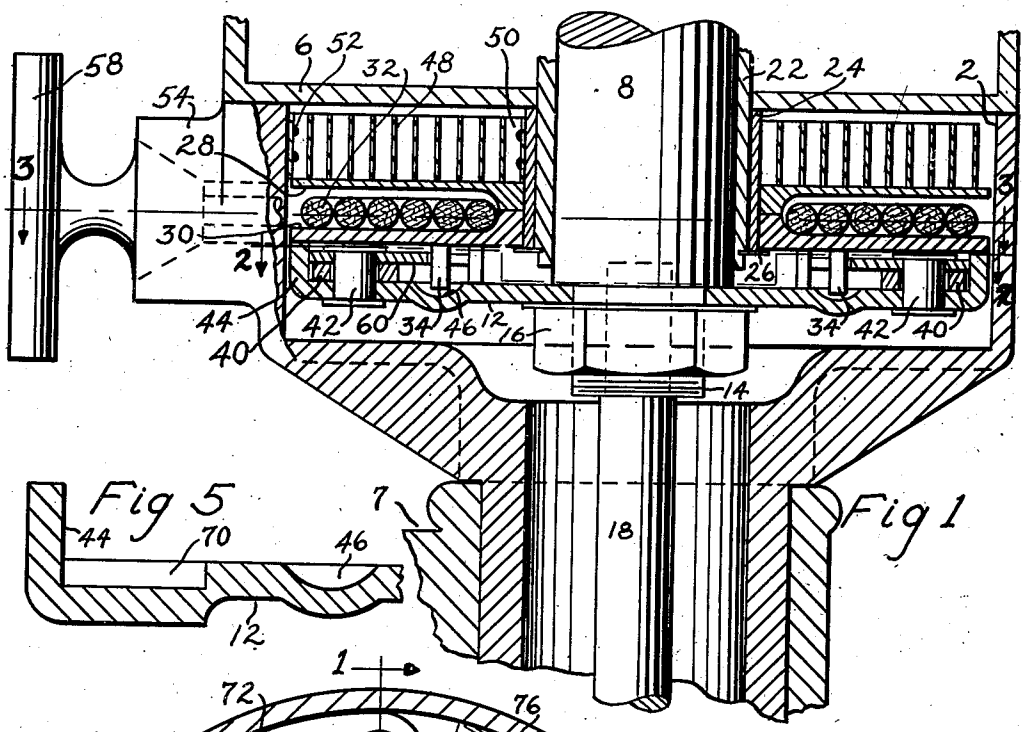

Fig 1

Fig 5

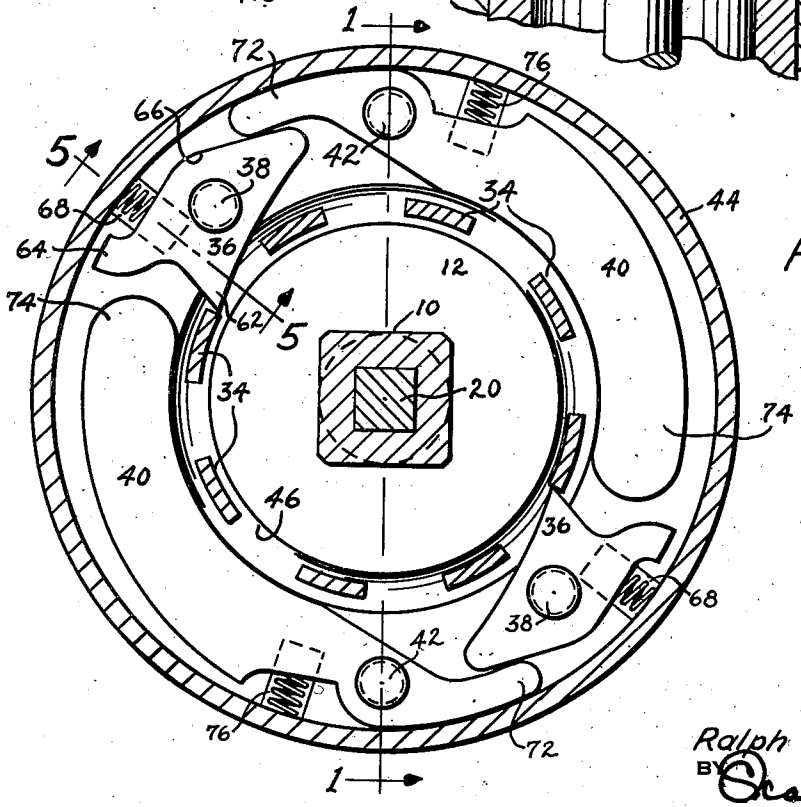

Fig 2

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April 7, 1942. R. J. HERRINGTON 2,278,547

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Filed Jan. 11, 1941 2 Sheets-Sheet 2

Fig 3

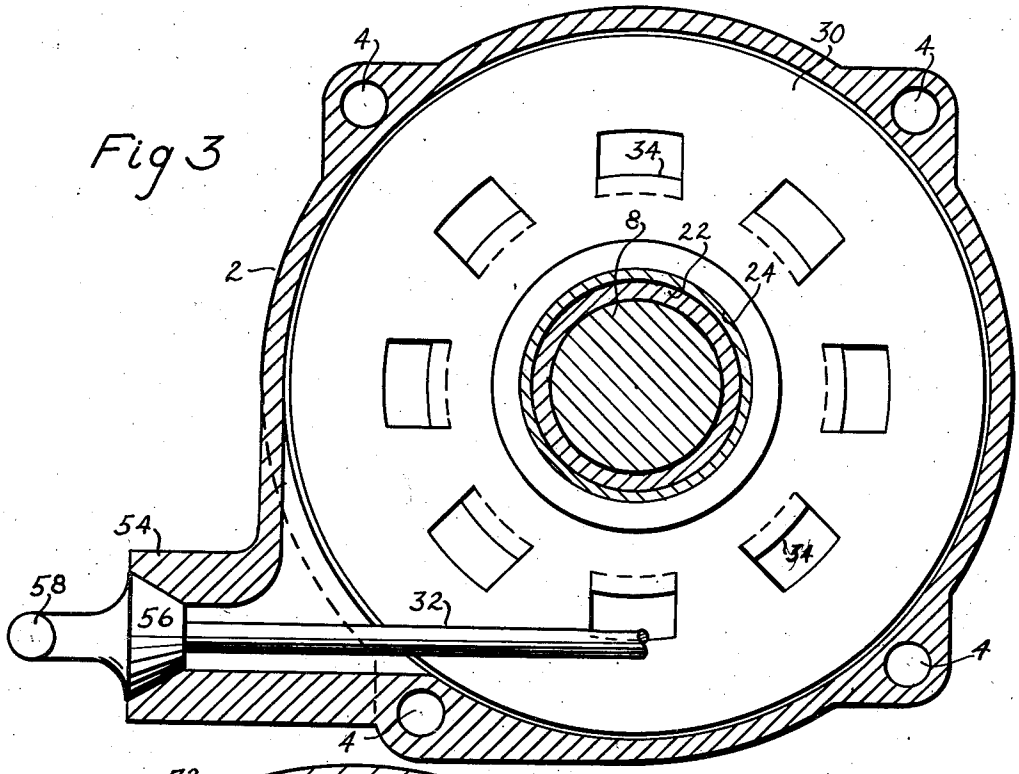
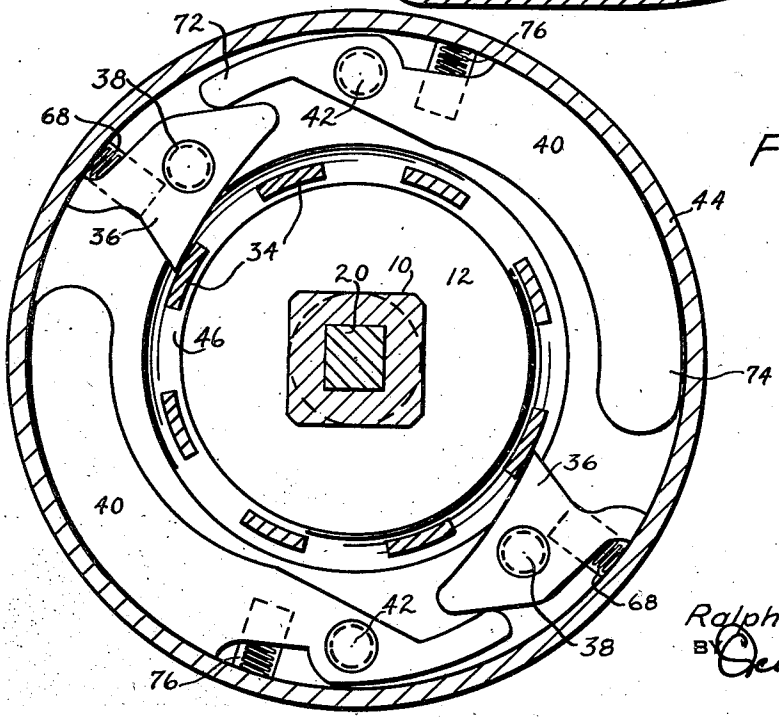


Fig 4



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UNITED STATES PATENT OFFICE

2,278,547

STARTING DEVICE

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11 Claims. (Cl. 123—179)

This invention relates to a starter for internal combustion engines and is particularly adapted for use with marine outboard motors.

An object of the invention is to provide a starter of the manually operated type in which a pull rope is attached to a pulley which is connected in driving relationship with the crank shaft of the engine when the engine is not running under its own power and which is automatically disconnected from the drive shaft when the engine fires and starts to run under its own power.

Another object of the invention is the provision of means for returning the pull rope to its initial position to automatically reset the device for the next starting action, in combination with a mechanism in which centrifugal force is employed to break the driving connection when the motor turns under its own power.

In devices heretofore designed to accomplish the above objects, where pawl and ratchet driving connections have been employed, one important disadvantage, which the present invention overcomes, is the objectionable impact of the centrifugally operated pawl members against the ratchet member as the latter is rotated to starting position after an unsuccessful effort to start the motor. The loud noise and undue wear on the parts is greatly reduced in the present construction.

A further object of the invention is to provide an outboard marine motor and starter assembly in which the force exerted by the operator in starting the motor will have substantially no tendency to rock the motor in a vertical plane about the point at which the motor is pivotally attached to the boat.

Referring to the accompanying drawings:

Fig. 1 is a vertical cross-sectional view of the starter assembly taken on the line 1—1 of Fig. 2;

Fig. 2 is a plan view of the starter assembly taken on the line 2—2 of Fig. 1 showing the pawls and the weight members which operate them in the position which they assume when the motor is at rest;

Fig. 3 is a plan view taken on the line 3—3 of Fig. 1, the coiled portion of the rope being removed for clarity;

Fig. 4 is a view similar to Fig. 2 but shows the pawls and the weight members in the position which they assume when the motor is operating under its own power; and

Fig. 5 is a detailed cross-sectional view, taken on the line 5—5 of Fig. 2 showing the construction of a portion of the pawl plate.

Like numerals designate like parts throughout the different views.

Referring now more particularly to the drawings, a housing 2 shown in Fig. 3 as having bolt holes 4 for the attachment of a suitable cover plate, serves to enclose and protect the starter mechanism. The cover plate 6 shown in Fig. 1 also constitutes the lower portion of the crank shaft housing. The motor and the fly wheel are, in this embodiment, disposed above the plate 6 and above the starter mechanism.

The starting mechanism is preferably located intermediate the motor and the propeller, adjacent the point of attachment of the motor to the boat. This attachment preferably includes a collar 7, which is pivotally secured to a conventional bracket adapted to be clamped to the stern of a boat. The entire motor and starter assembly may be rotated about the pivotal attachment in a vertical plane. The preferred construction, wherein the starting mechanism is located below the fly wheel and motor, reduces to a minimum the tendency of the motor to rock toward the operator, upon application of pulling force to the pull rope, since leverage about the pivotal attachment of the motor is thereby greatly reduced.

As shown in Figures 1 and 2, the crank shaft 8 of the motor is provided with a squared portion 10 which passes through a substantially square opening in the pawl plate 12, the latter constituting a driven member and being secured against rotation with respect to the crank shaft. The lower portion 14 of the crank shaft is round, as shown by the dotted line in Fig. 2, and is threaded to receive a nut 16 which rigidly secures the pawl plate 12 to the lower end of the crank shaft.

A propeller shaft 18 constitutes a continuation of the crank shaft 8, the upper end 20 of the propeller shaft being squared and fitting within a square recess in the lower end of the crank shaft, as shown in dotted lines in Figure 1. The crank shaft 8 rotates within a stationary housing 22 and a sleeve 24 is rotatably mounted on the housing 22 and is secured against axial movement thereon by a washer 26. The rotatable sleeve 24 has rigidly secured thereto a ratchet means including two spaced complementary plates 28 and 30 joined together to form a spool upon which the pull rope 32 may be wound. A series of tangs 34 are punched out of the lower plate 30 and extend downwardly at right angles thereto, the tangs being arranged in a circle about the center of rotation and forming ratchet elements engageable by pawls, generally designated 36.

Pawls 36 act as the driving connection between the driving member and the driven member as will be explained hereinafter, and they are pivotally secured to the pawl plate 12 by pins 38 about which they are free to rotate. Although only two pawl members are shown, it will be understood that more than two may be used if desired.

Weight members, generally designated 40, are also pivotally secured to the pawl plate 12 by pins 42 and the number of weight members corresponds to the number of pawl members. The pawl plate 12 is turned up at its periphery thus forming an annular upstanding skirt portion 44 which serves to limit the outward movement of the pawls 36 and the weight members 40. The pawl plate 12 is also preferably provided with a circular depression 46 into which the circular series of ratchet elements 34 extend. It will be noted that the upstanding annular portion 44 of the pawl plate 12 encloses the ratchet elements 34 with which the pawls 36 are adapted to engage.

A spiral spring 48 is disposed about the drive shaft 8, one end of the spring being attached to the rotatable sleeve 24 at 50 and the other end of the spring being attached to the inner side of the housing 2 at 52. In the illustrative embodiment shown in the drawings the spring 48 is disposed on top of the plate 28 and is wound in a counter-clockwise direction and the pull rope 32 is wound in a clockwise direction on the spool formed by the plates 28 and 30. Accordingly, when the pull rope is pulled outwardly from the housing the spiral spring 48 winds up and the rope unwinds from the spool and vice versa.

The housing 2 is provided with a tubular extension 54 through which the pull rope passes and the opening at the end of the extension 54 is substantially conical in shape to conform with the substantially frusto-conical base 56 of the handle 58.

The spring is of sufficient strength not only to return the pull rope to its initial position but also to keep it tensioned so that the handle 58 is positioned in the opening of the extension 54.

The pawl members 36 and weight members 40 lie in approximately the same plane, resting on the pawl plate 12, and a ring shaped plate 60, in which the upper ends of the pivot pins 38 and 42 are fixed, is disposed immediately above the pawl and weight members.

Each pawl member is preferably provided on one side of its pivot pin 38 with a projection 62 adapted to engage the ratchet elements 34 and an abutment 64 adapted to engage the annular skirt 44, and on the other side of the pivot pin it is provided with a cam surface 66 against which the weight member 40 acts to move the pawl. The shape of the pawl is not important provided that it has parts or surfaces adapted for these purposes. In the preferred embodiment of the invention, however, it is important for reasons which will be pointed out hereinafter, that the weight of the pawl member be distributed approximately equally as between the part forming the cam surface 66 and the parts forming the projection 62 and abutment 64. In other words, the pawl is approximately balanced with respect to the centrifugal force resulting from rotation of the pawl plate 12 about the drive shaft 8 and this centrifugal force will have substantially no tendency to move the pawl about its pivot pin.

Springs 68 resting in concavities 70 in the pawl plate are compressed between the upstanding annular portion 44 and the pawls 36 and act on the sides of the respective pawls which carry the abutments 64 and projections 62 so that the latter are urged inwardly into engagement with the ratchet members 34.

As will be seen from the drawings, each weight member 40 is elongated and pivoted intermediate its ends on a pivot pin 42. The portion 72 of the weight member, on the side of the pivot nearest the pawl 36, is preferably considerably shorter than the portion 74 which is on the side of the pivot remote from the pawl. The relative length of the portions 72 and 74 is not critical but it is essential that the portion 74 be considerably heavier than the portion 72 so that centrifugal force resulting from rotation of the pawl plate by the engine will throw the portion 74 out against the annular portion 44 of the pawl plate, as the weight member is thus rotated about its pivot pin 42 the portion 72 will move inwardly and since the latter bears against the cam surface 66 of the pawl, the latter will be rotated in the opposite direction and will thereby be disengaged from the ratched elements 34.

Springs 76 resting in concavities 70 in the pawl plate are compressed between the upstanding annular portion 44 and the portions 74 of the weight members and consequently tend to move the latter about the pivot pins 42, this movement being limited by the abutment of the shorter arm 72 against the upstanding annular portion 44 of the pawl plate.

It will be noted that in the preferred embodiment shown in the drawings, the weight members 40 are curved so that the contour of their outermost sides conforms generally with the curvature of the annular portion 44 of the pawl plate and the innermost side conforms generally with the curvature of the circular series of ratchet elements 34. This shape is not essential but it results in a more compact and economical construction. It will also be noted that the shorter arm 72 of the weight member is substantially narrower than the heavier arm 74 and that the difference between the direction of curvature of the outer sides of the arms 72 and 74 determines the amount of movement of the weight member about its pivot. This particular design is not essential but it is advantageous from the point of view of compactness, economy of manufacture and efficiency of operation.

As will be apparent from the drawings and the foregoing description, the starting device operates in the following manner.

When the motor is at rest the parts assume the position illustrated in Figures 1 and 2, the pawls 36 engaging the ratchet elements 34 and the short arms 72 of the weight members 40 resting against the inner wall of the annular portion 44 of the pawl plate. The parts assume their positions as the result of the action of the springs 68 and 76. These springs are preferably designed to apply a force which is relatively small and only slightly in excess of that required to move the parts, allowing of course for the friction which will be encountered during prolonged use of the device. This is particularly desirable in the case of the springs 68, which may be lighter than the springs 76.

To start the engine the operator grasps the handle 58 and pulls the rope 32 so as to unwind it and turn the ratchet means in a clockwise direction. At the same time the coiled spring 48 will be wound up so that when the pull rope is released the rope and the ratchet means will be

returned to their initial position by the tension of the spring.

During the movement of the ratchet means in a clockwise direction, the parts are in the starting position shown in Figures 1 and 2, and accordingly there is a driving connection between the driving member (including the pulley and ratchet means) and the driven member (including the pawl plate 12 and the drive shaft 8 of the engine). The resulting rotation of the drive shaft 8 will usually cause the engine to fire and start whereupon the drive shaft and pawl plate are rotated by the engine independently of the rotation of the ratchet means.

This independent rotation of the drive shaft and pawl plate results in immediate outward movement of the heavy portions 74 of the weight member 40 as the result of centrifugal force. The weight member rotates about its pivot and the arm 72 moves inwardly against the cam surface 66 of the pawl 40 thus rotating the pawl and moving it out of engagement with the ratchet elements. The centrifugal force tending to so move the parts is much greater than the force applied by the springs 68 and 76 and the parts will remain in the positions illustrated in Fig. 4 as long as the engine continues to run under its own power.

Furthermore if the engine should backfire and cause rotation of the pawl plate in a direction opposite to its normal direction of rotation, centrifugal force will also move the parts and disengage the driving connection, in the manner described above, so that injury to the parts or to the operator is avoided.

Frequently the engine does not fire upon the first few attempts to start it and, as explained above, the pull rope and starting device will automatically return to its initial starting position when tension on the rope is relieved. During the return rotation of the ratchet means the pawls slide gently over the ratchet elements 34 and the relatively silent return operation contrasts with the loud noise and forceful impact which characterizes the return movement of a starting device employing pawls which are weighted at one side of the pivot. This advantage is due principally to the fact that there is no great variance between the weight of the parts of the pawl on each side of the pivot. It is also desirable to employ springs which do not exert a force greatly in excess of that required to move the pawl into its engaging position.

The use of a weight member which is separate from the pawl not only permits of the use of balanced pawls as described above but it is also desirable for other reasons. For example, the use of a separate weight member enables a distribution of the weight in such a manner as to result in a more positive and dependable action of the device. Furthermore the provision of an arm on the weight member which acts against a cam surface on one side of the pawl has an additional advantage in that the amount of leverage applied increases as the arm moves along the cam surface and away from the pawl pivot and consequently there is a tendency for the pawl to be snapped quickly out of engaging position. Furthermore because of the increased leverage, less centrifugal force is required to hold the pawl in disengaged position than is required to initiate the disengagement, thus insuring that the pawls will not move back and contact the ratchet when the engine is idling.

It is to be understood that various changes may be made in the details of construction within the scope of the claims, without departing from the spirit of the invention.

I claim as my invention:

1. In a starter for a motor, a driven member connected to the crank shaft of the motor, a ratchet driving member encompassed by the driven member, means for rotating the ratchet member in a first direction, means for rotating the ratchet member in the opposite direction, a driving connection between the ratchet member and the driven member including a pawl member pivoted on the driven member and adapted to engage the ratchet member during the rotation of the ratchet member in the first direction, a weight member pivoted on the driven member and engaging the pawl member, both members being movable from a first position in which the pawl member engages the ratchet member to a second position in which the pawl member does not engage the ratchet member, the movement of the weight member resulting from centrifugal force acting on the weight member upon independent rotation of the driven member, and the movement of the pawl member resulting solely from the movement of the weight member.

2. In a starter for a motor, a circular driven member connected to the crank shaft of the motor, said driven member having an upstanding annular skirt portion, a ratchet driving member including ratchet elements consisting of metal tangs punched out of a metal disk, said disk extending over the top of said skirt portion to form a cover for the driving member, means for rotating the ratchet member in a first direction, means for rotating the ratchet member in the opposite direction, a driving connection between the ratchet member and the driven member including a pawl member pivoted on the driven member and adapted to engage the ratchet elements during the rotation of the ratchet member in the first direction, a weight member pivoted on the driven member and engaging the pawl member, both members being movable from a first position in which the pawl member engages the ratchet elements to a second position in which the pawl member does not engage the ratchet elements, the movement of the weight member resulting from centrifugal force acting on the weight member upon independent rotation of the driven member, and the movement of the pawl member resulting solely from the movement of the weight member.

3. In a starter for a motor, a driven member connected to the crank shaft of the motor, a ratchet driving member, means for rotating the ratchet member in a first direction, means for rotating the ratchet member in the opposite direction, a driving connection between the ratchet member and the driven member including a pawl member pivoted on said driven member and adapted to engage the ratchet member, during the rotation of the ratchet member in the first direction, the weight of the portion of the pawl member on one side of its pivot being approximately equal to the weight of the portion on the other side of the pivot, a weight member pivoted on said driven member and engaging the portion of the pawl member opposite the portion which engages the ratchet member, both members being movable from a first position in which the pawl member engages the ratchet member to a second position in which the pawl member does

not engage the ratchet member, the movement of the weight member resulting from centrifugal force acting thereon upon independent rotation of the driven member, and the movement of the pawl member resulting solely from the movement of the weight member.

4. In a starter for a motor, a driven member connected to the crank shaft of the motor, a ratchet driving member, means for rotating the ratchet member in a first direction, means for rotating the ratchet member in the opposite direction, a driving connection between the ratchet member and the driven member including a pawl member pivoted on the driven member and adapted to engage said ratchet member during the rotation of the ratchet member in the first direction, the weight of the portion of the pawl member on one side of its pivot being approximately equal to the weight of the portion on the other side of the pivot, a weight member pivoted on the driven member and engaging the portion of the pawl member opposite the portion which engages the ratchet member, spring means urging the pawl and weight members to a first position in which the pawl member engages the ratchet member, both members being movable from the first position to a second position in which the pawl member does not engage the ratchet member, the movement of the weight member resulting from centrifugal force acting on the weight member upon independent rotation of the driven member, and the movement of the pawl member resulting at least in part from the movement of the weight member.

5. In a starter for a motor, a driven member connected to the crank shaft of the motor, a ratchet driving member, means for rotating the ratchet member in a first direction, means for rotating the ratchet member in the opposite direction, a driving connection between the ratchet member and the driven member including a pawl member pivoted on the driven member and adapted to engage the ratchet member during the rotation of the ratchet member in the first direction, the weight of the portion of the pawl member on one side of its pivot being approximately equal to the weight of the portion on the other side of the pivot, a weight member pivoted on the driven member and having a relatively heavy arm on one side of its pivot and a relatively light arm engaging the portion of the pawl member opposite the portion which engages the ratchet member, both members being movable from a first position in which the pawl member engages the ratchet member to a second position in which the pawl member does not engage the ratchet member, the movement of the weight member resulting from centrifugal force acting on said relatively heavy arm upon independent rotation of the driven member, and the movement of the pawl member resulting solely from the movement of the relatively light arm.

6. In a starter for an outboard marine motor, a driven member connected to the crank shaft of the motor, a ratchet driving member, means including a pulley and a pull rope permanently attached thereto for rotating the ratchet member in a first direction, spring means for rotating the ratchet member in the opposite direction, a driving connection between the ratchet member and the driven member including a pawl member pivoted on the driven member and adapted to engage the ratchet member during the rotation of the ratchet member in the first direction, the weight of the portion of the pawl member on one side of its pivot being approximately equal to the weight of the portion on the other side of the pivot, a weight member pivoted on the driven member and having a relatively heavy arm on one side of its pivot and a relatively light arm engaging the portion of the pawl member opposite the portion which engages the ratchet member, both members being movable from a first position in which the pawl member engages the ratchet member to a second position in which the pawl member does not engage the ratchet member, the movement of the weight member resulting from centrifugal force acting on said relatively heavy arm upon independent rotation of the driven member, and the movement of the pawl member resulting solely from the movement of the relatively light arm.

7. In a starter for a motor, a driven member connected to the crank shaft of the motor, a driving member, means for rotating the driving member in a first direction, means for rotating the driving member in the opposite direction, a driving connection between the driving member and the driven member including a pawl member pivoted on the driven member, the weight of the portion of the pawl member on one side of its pivot being approximately equal to the weight of the portion on the other side of the pivot, a weight member also pivoted on the driven member and engaging the portion of the pawl member opposite the portion which engages the driving member, means for holding the pawl and weight members in extended position for establishing the driving connection, both members being movable to a retracted position in which the pawl member does not engage the driving member, the movement of the weight member resulting from centrifugal force acting on the weight member upon independent rotation of the driven member and the movement of the pawl member resulting solely from the movement of the weight member, the weight member exerting greater leverage on the pawl member while in the retracted position than in the extended position.

8. In a starter for a motor, a driven member connected to the crank shaft of the motor, a ratchet driving member encompassed by the driven member, means for rotating the ratchet member in a first direction, means for rotating the ratchet member in the opposite direction, a driving connection between the ratchet member and the driven member including a pawl member pivoted on the driven member and adapted to engage the ratchet member during the rotation of the ratchet member in the first direction, a weight member pivoted on the driven member and engaging the pawl member, both members being movable from a position in which the pawl member engages the ratchet member to a second position in which the pawl member does not engage the ratchet member, the movement of the weight member resulting from centrifugal force acting on the weight member upon independent rotation of the driven member, the movement of the pawl member resulting solely from the movement of the weight member, and the movement of both members to the second position being limited by an annular skirt portion extending at right angles from the periphery of the driven member.

9. A marine outboard motor comprising an internal combustion engine, a starting device associated with the engine, means for operatively connecting the starting device to the engine in driving relationship, an attachment for securing

the engine and starting device to a boat, said attachment permitting the engine and associated starting device to be rocked toward the boat, said starting device being operated by force applied thereto in a direction tending to move the engine toward the boat, and the starting device being located between the engine and the said attachment and adjacent the latter, whereby the force applied to the starting device does not cause the engine and starting device to rock toward the boat.

10. In combination with a marine outboard motor, a starting device, an attachment for securing the motor and starting device to a boat, said attachment permitting the motor and starting device to be rocked toward the boat, said starting device comprising a driven member connected to the lower end of the crank shaft of the motor, a driving member below the crank case of the motor and including a pulley and a pull rope permanently attached thereto, means for establishing a driving connection between the driving member and the driven member upon rotation of the driving member in a first direction, means for disconnecting the driving member from the driven member upon independent rotation of the latter and means for rotating the driving member in a second direction.

11. In combination with a marine outboard motor, a starting device, an attachment for securing the motor and starting device to a boat, said attachment permitting the motor and starting device to be rocked toward the boat, said starting device comprising a driven member connected to the lower end of the crank shaft of the motor, a driving member below the crank case of the motor, means for rotating the driving member, a driving connection between said driving member and driven member including a first member pivoted on the driven member and adapted to engage the driving member, a second member pivoted on the driven member and engaging the first pivoted member, both members being movable from a first position in which the first pivoted member engages the driving member to a second position in which the first pivoted member does not engage the driving member, the movement of the second pivoted member resulting from centrifugal force acting on the second pivoted member upon independent rotation of the driven member, and the movement of the first pivoted member resulting at least in part from the movement of the second pivoted member.

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