Dec. 23, 1941. R. J. HERRINGTON 2,266,865

STARTING DEVICE

Filed Jan. 11, 1941 2 Sheets-Sheet 1

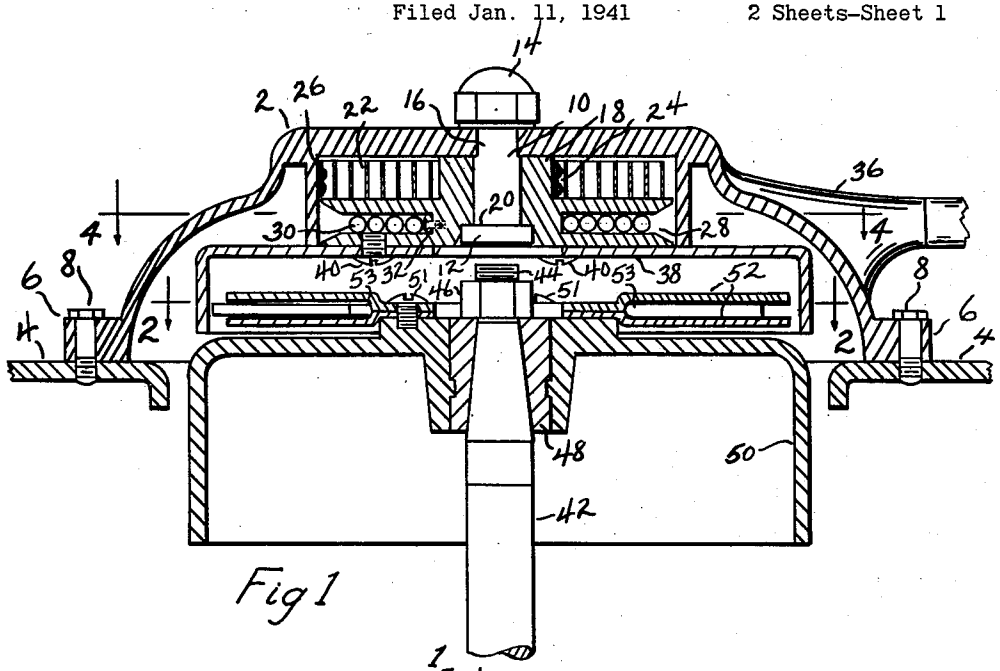

Fig 1

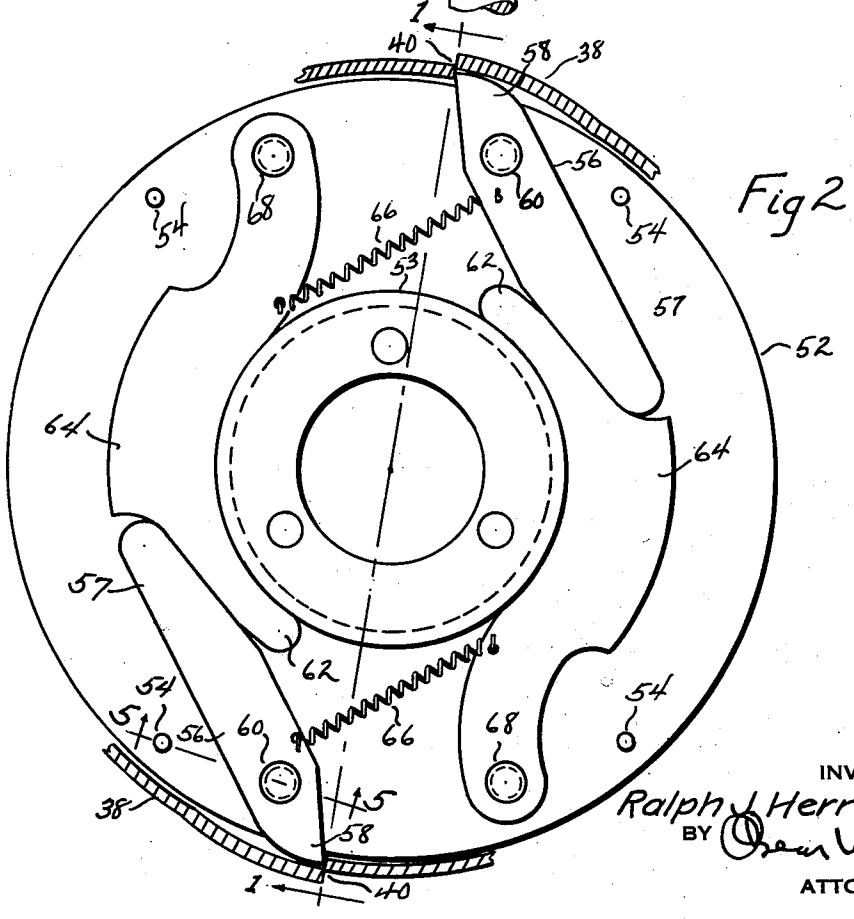

Fig 2

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STARTING DEVICE

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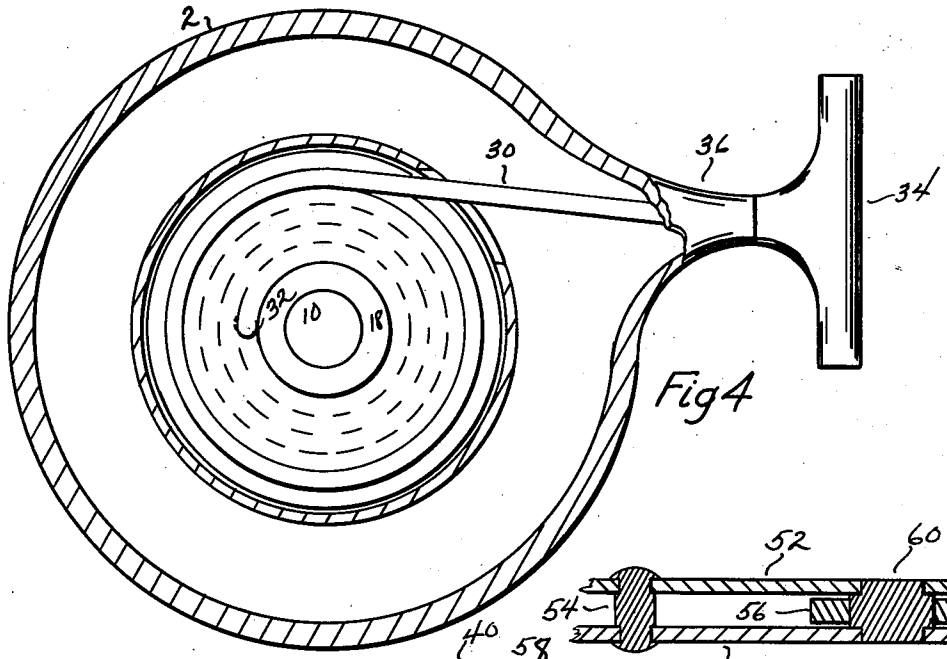

Fig 4

Fig 5

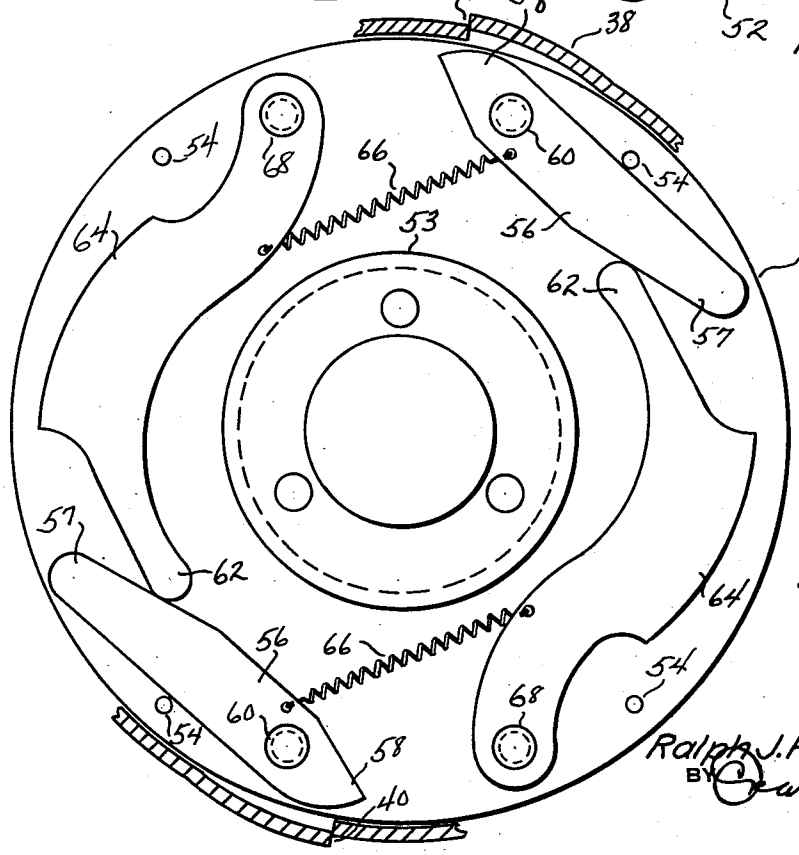

Fig 3

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STARTING DEVICE

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9 Claims. (Cl. 74—140)

This invention relates to a starting device particularly adapted for use on outboard motors and similar internal combustion engines which may be started by use of a pull rope.

A main purpose of this invention is to provide a convenient means for starting an internal combustion engine by manual operation.

Another object is to provide return means for the starter so that no manual operation is required to reset the starting device for the next starting action.

Another object is to provide centrifugally controlled starting means adapted to immediately release engagement with the drive shaft upon an impulse from the motor on the drive shaft, whether it is a forwardly acting impulse or a backfiring impulse.

A further object is to provide a starter with centrifugal means for engaging a motor crankshaft, the centrifugal means having a high disengaging force in comparison to the weight of the centrifugal members.

A still further object is to provide means that will maintain the drive shaft entirely free from engagement with the starter mechanism while the engine is running at a speed even less than that of the original impulse required for release of the starter.

Heretofore pull rope starters have been devised in which the pull rope is permanently attached to a starting drum and is arranged to be returned after a manual starting stroke to its initial position. The usual arrangement is a spiral spring attached at one end to the housing and at the other end to the starting drum or shaft. When the pull rope is given its stroke the drive shaft is turned and at the same time the spiral spring is wound up. As the outward tension on the rope is diminished the spiral spring returns the starting drum to its initial position, winding the pull rope on the drum as the spring unwinds. However, such starters have not been generally adopted because of the lack of driving connections which could be depended upon to disengage upon firing of the engine.

Starters have also been proposed embodying the idea of latching the starter to the drive shaft during the starting period and subsequently releasing the starter when the drive shaft has gained sufficient speed under its own power to cause the disengagement of the starter through centrifugal force. A problem in connection with this type of starter, as well as other types of rope starters, is the difficulty encountered in adequately providing for a safety device in case the engine backfires. It has been proposed in a centrifugally controlled starter that the housing be frictionally mounted to take up the shock if the motor should backfire and rewind the starting rope under engine power. It is undesirable, however, to allow the starting mechanism to reverse itself to any appreciable extent because of undue strain on the mechanism and the probability of physical harm to the person operating the starter.

The present invention employs the conventional pull rope and spiral spring rewinding means as now is well known in the art. In addition, the present invention utilizes centrifugally controlled pawls so constructed and so arranged that they will immediately be disengaged from the starting ratchet the moment the motor starts or backfires. The release action is accomplished by the same means and in the same manner for either starting or backfiring. The engagement between the starting ratchet and the pawls never becomes binding in spite of the fact that it is frictional to some degree.

Other objects and features of the invention will appear as the invention is hereinafter more fully disclosed.

In the 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 centrifugal pawl arrangement taken on the line 2—2 of Fig. 1 and with the plate member immediately above this line removed;

Fig. 3 is a view similar to Fig. 2 but shows the position of the centrifugal members in the position they assume when the drive shaft is rotating under power;

Fig. 4 is a cross-sectional view of the starter housing taken on the line 4—4 of Fig. 1; and

Fig. 5 is a detailed cross-sectional view of a portion of Fig. 2 taken on the line 5—5.

Like numerals indicate like parts in the different views.

Referring now more particularly to the drawings, this invention comprises a housing 2 and starting mechanism contained therein. The starter housing 2, which may be cast of metal or other suitable material is secured to the gas tank housing 4 situated at the top of an outboard motor. The starter housing 2 carries several lugs 6 adapted to be secured to the gas tank housing 4 by means of bolts 8. When the motor is running all moving parts in the upper portion of the outboard motor are completely covered by the housing 2. Any danger to the person or clothing accruing from exposed moving parts in an outboard motor is thus eliminated.

Secured to housing 2 at its center is a spindle 10 having a head 12 at one end and threaded at the other end to cooperate with cap 12. The spindle 10 has a reduced portion 16 which extends through the housing 2 so that the shoulder formed rests against the upper inside surface of the housing 2 and prevents the spindle from being drawn up when cap 14 is tightened. The spindle 10 is rigid with respect to the housing 2

and the pull rope spool 18 rotates on it. The upper surface 20 of the head 12 is the bearing surface for the rotatable spool 18.

A spiral spring 22 of appreciable strength is disposed about the spool 18 and is secured at one end 24 to the spool and at the other end 26 to the housing 2. Within a notched portion 28 of the spool 18 the pull rope 30 is wound. The inner end of the pull rope is secured to the spool 18 at 32 and the rope terminates at the other end with a handle attachment 34, as seen in Fig. 4. The handle rests against a hollow abutment 36 which may be cast integrally with the housing 2. The pull rope 30 is wound upon the spool 18 in an opposite direction from that in which the spiral spring 22 is wound. Thus when the pull rope is pulled outwardly from the housing the spiral spring 22 winds up as the rope unwinds from the spool and vice versa. There is sufficient residual strength left in the spring at the end of its windup action to keep the pull rope tensioned, and consequently, the handle 34 positioned against the abutment 36. When the rope 30 is pulled outwardly from the housing the tension in spiral spring 22 increases so that the rate of outward pulling is rapidly decreased near the finish of the stroke and no sudden shock is produced at the end of the pull rope 32 fastened to the spool 18.

Secured to spool 18 and rotatable therewith is the ratchet cup 38 which is substantially circular in shape. At two points 40 in the periphery of the cup 38 and diametrically opposed, offset portions may be formed. These offset portions 40 constitute a form of ratchet arrangement. The ratchet cup 38 is secured to the spool 18 by screws as at 40 and constitutes the driving member of the starter.

The crank shaft 42 terminates at its upper end in a threaded reduced portion 44 which is engaged by a nut 46. The crank shaft 42 bears a collar 48 which is adapted to be wedged rigidly thereon when the nut 46 is tightened. A magneto flywheel dome 50 is in turn rigidly secured to the collar 48 and rotates together with the drive shaft 42. Pawl plates 52 are bolted to the magneto flywheel dome as at 51 and constitute the driven member of the starter. The pawl plates 52 are circular in shape as may be seen from Figs. 2 and 3. At about one-half of the radial length of the two pawl plates 52 the plates are offset somewhat at 53 to form spaced areas when they are placed face to face as in Fig. 1. The plates are rigidly secured together by pins 54 which are riveted in place as shown in detail in Fig. 5.

The pawls 56 are elongated members terminating at one end in tooth-like points 58 which are engageable with the offset ratchet portions 40 of the ratchet cup 38 to establish a driving connection between the ratchet cup and the pawl plates. At the other end the pawls 56 form weighted arms 57. Although each weighted arm 57 is shown integral with the pawl member, it is to be understood that any type of weight attachment or engagement with the weight may be employed at this end of the pawl. Short pivot pins 60 extend through the pawls 56 and are fixed thereto. The pivots 60 are journaled in opposing pairs of holes drilled in the pawl plates as shown in detail in Fig. 5. The pawls 56 are slightly narrower than the spaced opening between the pawl plates 52 to insure free movement of the pawls therebetween. The pawls 56 are rotatable within a fixed arc defined by one pair of the pins 54 and an extension 62 of the weight members 64. Springs 66 tensioned between the pawls 56 and the weight members 64 maintain the pawl teeth 58 normally in an extended or outward position to establish a driving connection with the ratchet portions 50 of the ratchet cup 38 as shown in Fig. 2. Each pawl 56 rests against the opposite weight member 64 from that to which it is spring-tensioned.

The weight members 64 have fixed thereto pivot pins 68 which are journaled between opposed holes drilled through the pawl plates 52 in the same manner as the pawls 56. The springs 66 normally maintain the weight members 64 in retracted position pressed against the circular offset portions 53 of the pawl plates 52 as shown in Fig. 2. The weight members 64 are rotatable about the pivot pins 68 for a limited arc defined by the offset portion 53 of the pawl plates 52 and by the pawls 56 in their extreme counter-clockwise position against stop pins 54.

There is a distinct advantage in having the pawls 56 and weight members 64 mounted on the crankshaft 42 and rotating within the ratchet cup 38. This advantage is the high leverage obtainable in such an arrangement with parts of comparatively light weight and compactly assembled. It will be observed that pawl 56 is pivoted quite close to the pawl tooth 58 and the opposite end acts centrifugally to exert a strong counter-clockwise force on the pawl. The weight member 64 pivoted at 68 also acts centrifugally and intensifies the counter-clockwise force applied at the engaging surface of pawl tooth 58. This force is likewise greater at the tooth end of the pawl than at the lever-arm end because of the above mentioned high leverage.

It is to be noted that the pawl plates 52, the pawls 56, weight members 64 and springs 66 are all constructed and arranged in identical pairs so that a minimum number of dies are essential in the manufacture of these parts. The pawl plates 52 are symmetrically designed so that when two of them are placed face to face the design is not altered. Opposed bearings and openings may be brought into position even though the plates are diametrically opposed.

In the operation of the starter, the user grasps the handle 34 and pulls the starter rope 30 towards him in the same manner as that employed with the usual manually wound starter rope. The rope 30 is coiled about the spool 18 in such a manner that the pull will give the spool 18 and associated ratchet cup 38 a clockwise rotation as viewed in Figs. 2 and 4. The spiral spring 22 which is attached to the spool 18 at 24 and to the housing 2 at 26 is wound up by the clockwise rotation of the spool 18. As the rope 30 unwinds from the spool 18 and approaches the end connection 32, which secures the rope 30 to the spool 18, the tension in spring 32 increases to the point where the outward pull of the rope is checked and the connection 32 is thus saved from shock which would tend to tear the pull rope from the motor.

The pawl arms 57 are in their normally extended position during the outward pull of the rope 30 and in this position the pawl teeth 58 engage the offset portions 40 of the ratchet cup 38. Thus the clockwise rotation of the driving member (including the ratchet cup 38) causes rotation of the driven member (including the pawls 56 and the crank shaft 42). When the motor gives an impulse to the drive shaft 42, the pawls 56 and the weight members 64 are all thrown outwardly by centrifugal force which now

exceeds the strength of the springs 66 and other opposing forces. The tooth portions 58 are disengaged by the counter-clockwise motion of the pawls 56, and the motor, now running under its own power, maintains the centrifugal force which keeps the toothed portion 58 in a retracted position inside of the periphery of the ratchet cup 38 as shown in Fig. 3.

The rotation imparted to the crank shaft when the starter rope is pulled is not in itself sufficient to release the weight members 64 from the ratchet cup 38 since the tension of the springs 66, together with frictional forces, is greater than the opposing centrifugal force merely produced by the manually caused rotation of the drive shaft. However, an impulse transmitted from the motor to the pawl mechanism, being more in the nature of a shock, will result in an immediate outward clockwise rotation of weight members 64, and a corresponding counter-clockwise rotation of pawls 56 till they engage the stop pin 54. As long as the motor continues running the pawls will be held by centrifugal force against the stop pins 54. It will be noted that an increasingly greater leverage is secured by the weight members 64 as their extensions 62 slide along the edges of pawls 56. Thus with the motor running and the pawls and weight members in their outermost position much less centrifugal force is needed to keep them in their outermost position than was necessary to initiate the outward movement. Because the springs 66 are comparatively light and stretch very little the increased tension in the springs when the weight members and pawls are in their outermost positions has little effect in offsetting this leverage advantage. The motor may idle at speeds of the order of those used in starting the motor though in the latter case positive engagement is insured and in the former case positive disengagement is insured.

Rotation of the pawl plates 52 in either direction under motor power will cause the pawls 56 to be disengaged from the ratchet cup 38, and the release is immediate upon the first impulse whether it is a forward or backward impulse. Thus on a forward or running movement of the shaft 42 the pawl teeth 58 will immediately be withdrawn from engagement with the ratchet cup and there will be no need to gain speed to throw the pawls out of engagement nor any unpleasant clicking sound nor unnecessary wear caused by rubbing of the rounded back portion of the pawl teeth 58 over the ratchet cup offsets 40. Likewise if the motor should backfire and crankshaft 42 should be given an impulse in the opposite direction the pawls and weight members are equally affected by the reverse impulse of the drive shaft 42 and there will be an immediate and definite disengagement of the ratchet cup 38 and the pawl teeth 58. In this latter case the ratchet teeth 40 are bearing on the pawl teeth 58 and it is necessary that disengagement be effected while they are so engaged. There is not a binding action between the pawl teeth 58 and the ratchet member 40 because the bearing surface is relatively small and the mechanical advantage of the pawl and weight member arrangement gives a comparatively large disengaging force considering the weight of the centrifugal members. When the motor has not started at the first stroke of the pull rope 30 the operator allows the spring 22 to rewind the pull rope on spool 18. During this period the pawls 56 and the ratchet cup 38 behave in the characteristic pawl and ratchet manner, the rounded portions of the pawls 56 slipping over the ratchet teeth 40 as the ratchet cup 38 makes its counter-clockwise return trip.

In outboard motors employing manually wound pull ropes it is customary, if not imperative, that the starter spool be placed at the top of the motor where the operator's view will be unobstructed as he rewinds the pull rope. In the present invention the starter spool may be placed at any other convenient point above the drive shaft, a position beneath the magneto flywheel having the advantage of adding stability to the motor during the starting stroke and thus lessening the tendency of the motor to kick up from the rear of the boat to which it is attached when the pull rope is pulled vigorously.

While a preferred embodiment of the invention has been herein shown and described, it is to be understood that various changes and arrangements may be made in the details of construction, within the scope of the claims, without departing from the spirit of the invention.

What is claimed is:

1. 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 having a tooth portion on one side of the pivot adapted to engage the ratchet member during the rotation of the ratchet member in the first direction and having an operating arm 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 adapted to engage one side only of the operating arm of 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 said relatively heavy arm upon independent rotation of the driven member, and the movement of the pawl member resulting at least in part from the movement of the relatively light arm.

2. In a manual starter for an outboard marine motor, a driven member connected to the crank shaft of the motor, a ratchet driving member, pull rope means 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 driven member including a pawl member pivoted on the driven member said pawl member having a tooth portion on one side of the pivot adapted to engage the ratchet member and having a relatively heavy arm on the other side of the pivot, a weight member pivoted on the driven member and engaging the heavy arm of the pawl member, both members being movable by centrifugal force 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 in part from the movement of the weight member and

in part from the centrifugal force acting on the heavy arm of the pawl 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 the driven member said pawl member having a tooth portion on one side of the pivot adapted to engage said ratchet member during the rotation of the ratchet member in the first direction and having an operating arm on the other side of the pivot, a weight member pivoted on the driven member and adapted to engage the operating arm of the pawl 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 by centrifugal force 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.

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 the ratchet member during the rotation of the ratchet member in the first direction, the pawl member having an integral weighted portion on the side of its pivotal point opposite the portion which engages the ratchet member, a weight member pivoted on the driven member and having a relatively heavy arm on one side of its pivot engaging one side only of the weighted portion of the pawl member, both members being movable by centrifugal force 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 in part from the movement of the weight member and in part from the centrifugal force acting on the weighted portion of the pawl.

5. 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 first member pivoted on said driven member, a second member also pivoted on said driven member and engaging said first member, the second pivoted member being movable centrifugally from a first position of lesser leverage against the first pivoted member to a second position of great leverage against the first pivoted member.

6. 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 said driven member, a weight member also pivoted on said driven member and engaging said first member, the pivoted weight member being movable centrifugally from a first position of lesser leverage against the pivoted pawl member to a second position of greater leverage against the pivoted pawl member.

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 first member pivoted on the driven member, a second member also pivoted on the driven member and engaging the first pivoted member, means for holding the second pivoted member in retracted position and means for holding the first pivoted member in an extended position for establishing the driving connection, means for limiting centrifugal movement of the second pivoted member in an extended position, the second pivoted member exerting greater leverage on the first pivoted member while in the retracted position than while in the extended position.

8. In a manual starter for an outboard marine motor, a driven member connected to the crank shaft of the motor, a ratchet driving member, pull rope means 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, a weight member also pivoted on the driven member, the weight member having a relatively heavy arm on one side of its pivot engaging one side of the pawl member, spring means for holding the pawl member in an extended position for establishing the driving connection, means for limiting centrifugal movement of the pawl and weight members, the pivoted weight member exerting greater leverage on the pawl member while in the retracted position than while in the extended position.

9. In a manual starter for an outboard marine motor, a ratchet cup driving member, pull rope means for rotating said ratchet cup member in a first direction, spring return means for rotating said ratchet cup member in the opposite direction, a driven member connected to the crank shaft of the motor and disposed within said ratchet cup member, a driving connection between said ratchet cup member and said driven member including a pawl member pivoted on said driven member, a first weight member integral with said pawl member and mounted on a side of the pivotal point opposite said driving connection, a second weight member pivoted on said driven member, spring means for holding said pawl member in an extended position for establishing said driving connection, stop pin means for limiting centrifugal movement of said pawl member at a retracted position, said second weight member exerting greater leverage on said pawl member while in the retracted position than while in the extended position.

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