

May 1, 1945.

W. L. KISSEL ET AL

2,374,685

STARTING DEVICE

Filed March 12, 1942

3 Sheets-Sheet 1

Fig. 1.

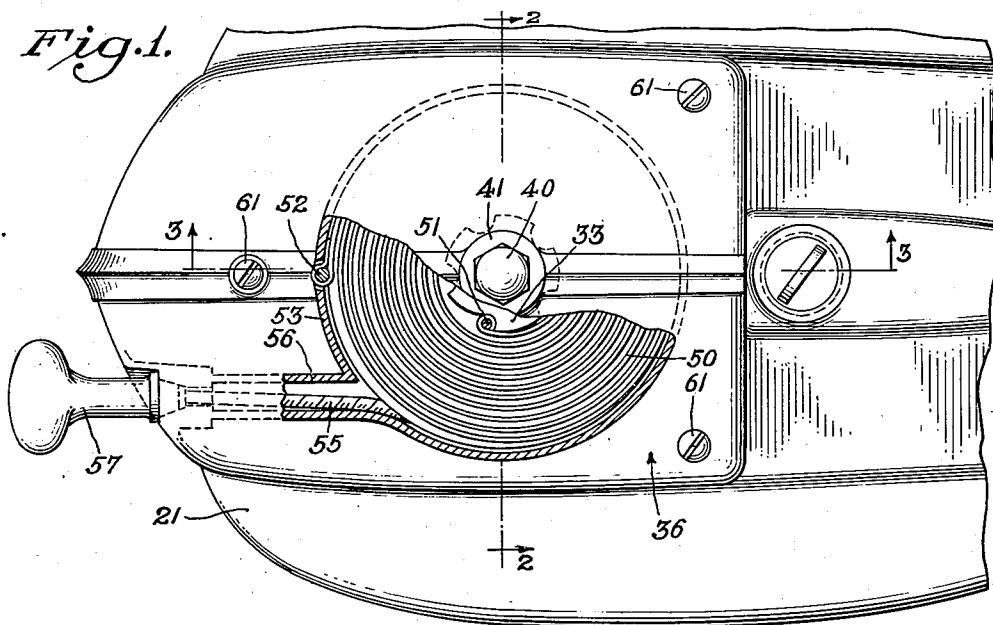
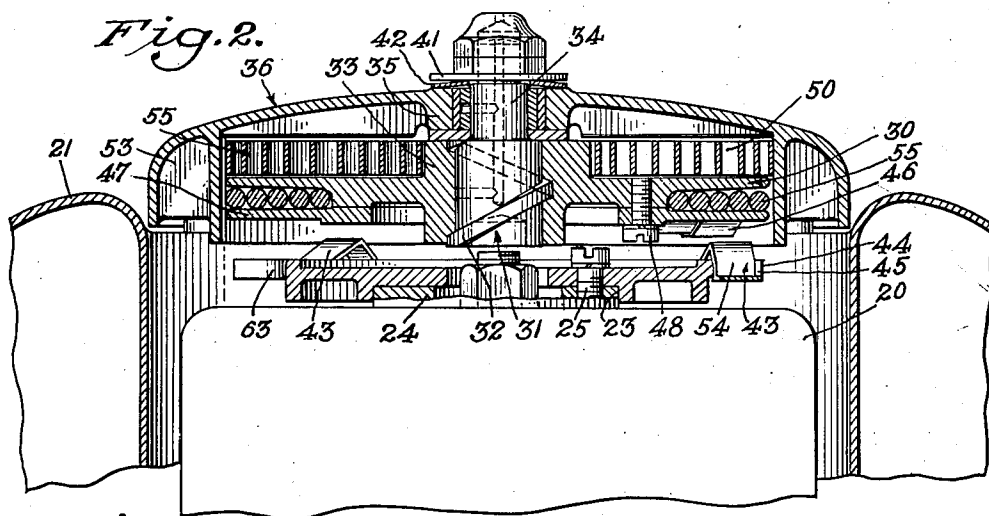


Fig. 2.



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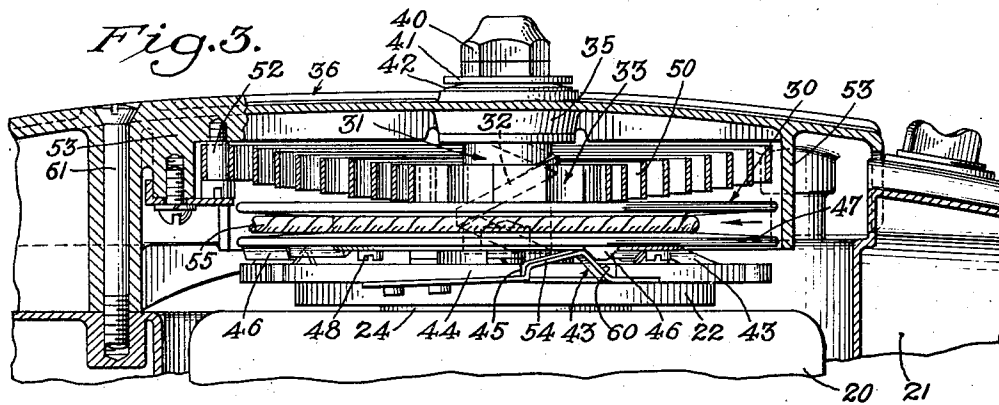
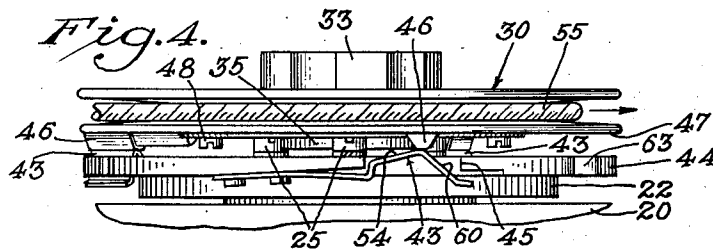
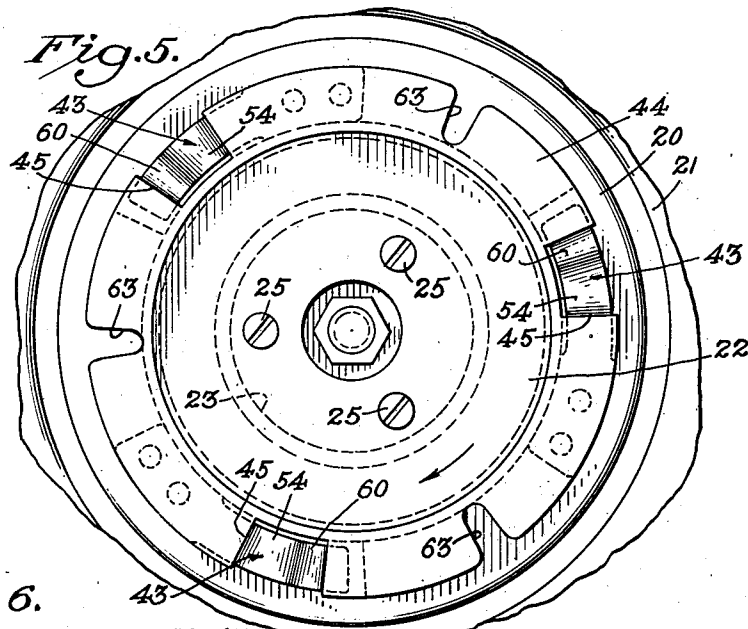
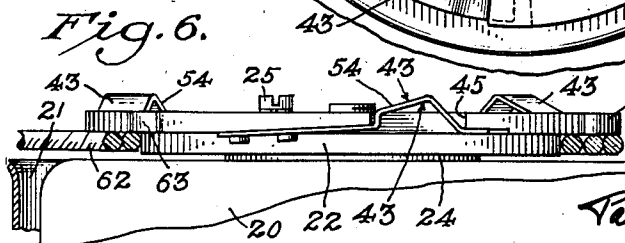
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3 Sheets-Sheet 2



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3 Sheets-Sheet 3

Fig. 7.

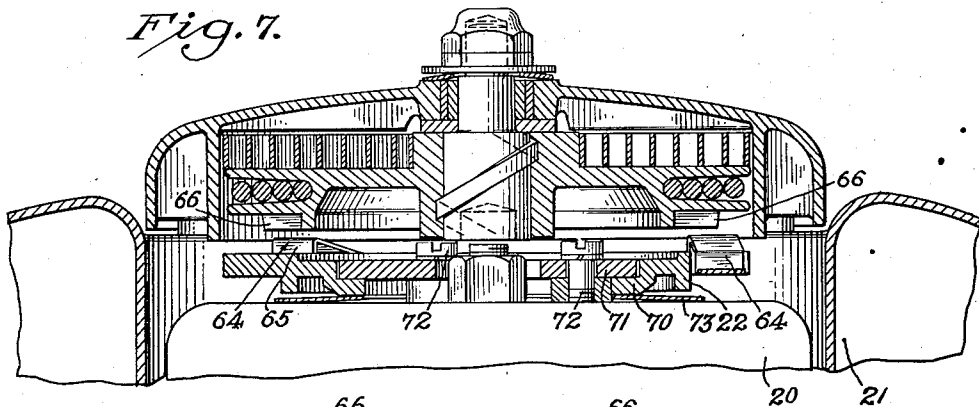


Fig. 8.

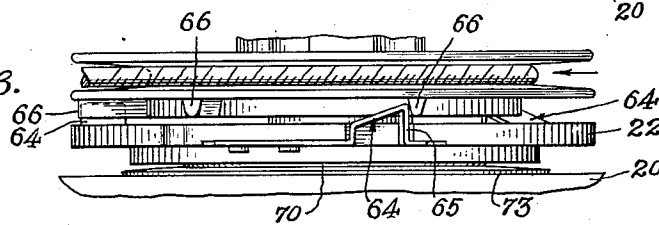


Fig. 9.

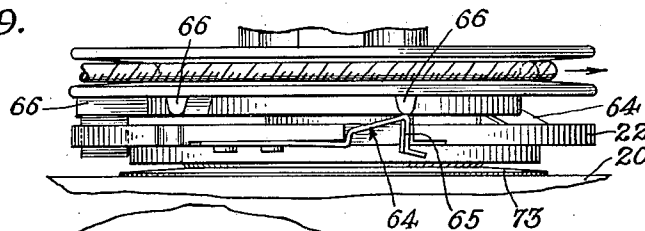
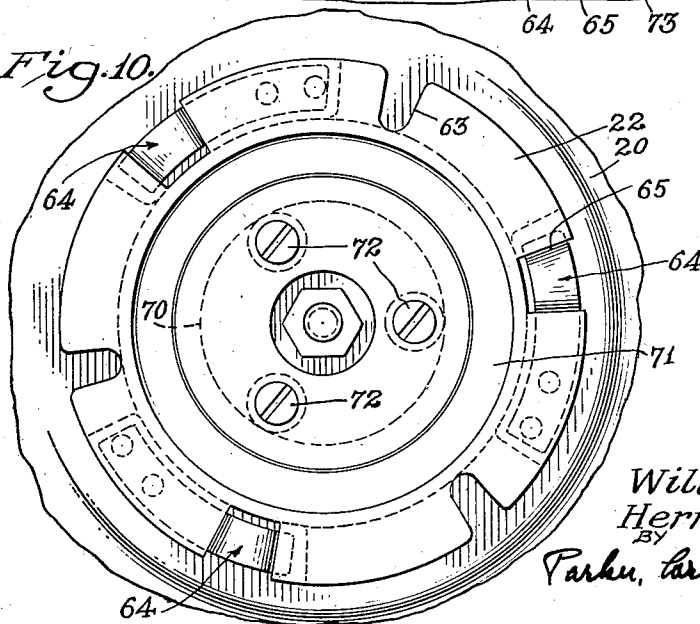


Fig. 10.



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UNITED STATES PATENT OFFICE

2,374,685

STARTING DEVICE

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Application March 12, 1942, Serial No. 434,330

16 Claims. (Cl. 123—185)

The invention relates generally to starting devices for internal combustion engines and more particularly to a starting device for an outboard marine motor.

The general object of the invention is to provide a novel starting device which is simple to operate and inexpensive to manufacture, and which sufficiently rotates the crank shaft of the motor to effect rapid starting.

It is also an object to provide a starting device which is so constructed as to be released from driving engagement with the motor in case of backfire of the latter so as to avoid damage to the starting device or injury to the operator.

Another object is to provide a starting device a major portion of which may be readily removed from the motor in case of damage to the device, leaving portions attached to the motor about which a rope may be wound to start the motor in the heretofore usual manner.

A further object is to provide a starting device having a manually rotated part movable axially of the motor by such rotation into driving engagement with a part rotating with the motor to effect starting, and automatically movable in the opposite direction after the motor is started so that it moves out of the way of the part rotating with the motor.

A still further object is to provide a starting device having a manually rotated part movable as aforesaid, with the part rotating with the motor having yielding means to provide the engagement between it and the manually rotated part, said yielding means being so arranged as to be moved out of the way of the manually rotated part until the latter has moved axially far enough to clear the yielding means.

Still another object is to provide a starting device having yielding means serving the above-mentioned function and also serving to provide a release between the manually rotated part and the part fixed to the motor in case of backfire.

Other objects and advantages will become apparent as the description proceeds, taken in connection with the accompanying drawings, in which:

Figure 1 is a plan view partially in section of a starting device embodying the features of the invention and showing a portion of an outboard motor to which it is attached.

Fig. 2 is a vertical sectional view taken along the line 2—2 of Fig. 1 and showing the starting device when in its idle position.

Fig. 3 is a vertical sectional view taken on the

line 3—3 of Fig. 1 and showing the parts of the device when in position to start the motor.

Fig. 4 is a fragmentary view similar to Fig. 3 but showing the position of the parts just after the motor has been started and before the parts have returned to their idle position.

Fig. 5 is a top view showing parts of the device attached to the motor after a detachable portion has been removed.

Fig. 6 is a fragmentary view similar to Fig. 3 but showing parts that remain permanently attached to the motor after a detachable portion has been removed.

Fig. 7 is a vertical sectional view similar to Fig. 2 but showing a modified form of the device with the device in its idle position.

Fig. 8 is a fragmentary side elevational view of the modified form and showing the position of the parts during the starting of the motor.

Fig. 9 is a view similar to Fig. 8 but showing the position of the parts immediately after the motor has started.

Fig. 10 is a plan view of the portion of the modified form of starting device that remains permanently attached to the motor after the detachable portion thereof has been removed.

A starting device embodying the features of the invention is adapted for use in starting an internal combustion engine and in the form illustrated is primarily adapted for use on an outboard motor. In the present instance, the portion of the outboard motor shown in the drawings comprises a part rotatable with the motor, such as a magneto 20, and a fixed structure such as a gasoline tank 21 surrounding the magneto 20. The starting device is mounted on these parts of the outboard motor and is adapted to rotate the magneto 20 and thereby start the motor.

The starting device comprises generally a member rigidly secured to the magneto and a manually rotatable member movable longitudinally during the first part of its rotation into engagement with the first-mentioned member and thereafter causing rotation of said first-mentioned member. The manually rotatable member is in the form of a pulley around which is wrapped a rope, the latter being adapted to be pulled to cause rotation thereof. The pulley is so supported that it is caused to move longitudinally during the first part of its rotation so that it will move into engagement with the member fixed to the magneto. After such engagement is effected, continued rotation of the pulley rotates the first-mentioned member and the magneto sufficiently to start the motor, but

longitudinal movement of the pulley is prevented by such engagement.

To support the manually rotatable member or pulley for such movement, a stud is provided which is rotatably supported but is provided with friction means tending to prevent rotation of the stud. The stud and the pulley have a threaded engagement. Thus rotation of the pulley first causes it to move along the thread of the stud since the latter is held against rotation by the friction means. However, when the pulley engages the member attached to the magneto, the pulley can no longer move longitudinally and the pulley and stud rotate together, overcoming the resistance of the friction means.

In order to move the pulley longitudinally out of engagement with the member attached to the magneto after the motor is started, a torsion spring is provided which is wound up by the forward rotation of the pulley. When the pulley rope is released, the torsion spring causes reverse rotation of the pulley and the latter moves longitudinally out of engagement with the member attached to the magneto by virtue of the threaded engagement with the stud. At the same time the starting rope is wound upon the pulley but since the rotation necessary to effect complete winding is greater than is necessary to move the pulley out of engagement with the member attached to the magneto, the torsion spring is strong enough to overcome the frictional resistance to rotation of the stud so that the latter rotates with the pulley during the continued rotation thereof to complete the winding of the rope.

One of the prominent features of the invention lies in the fact that in case of breakage or damage to any part of the starting device the major portion thereof may be readily removed from the outboard motor, leaving structure about which a rope may be wrapped in the heretofore usual manner to start the motor. To this end the pulley with its torsion spring and the stud are carried by a cover which is removably secured to a fixed portion of the outboard motor such as the tank structure 21. When these parts are removed, the member attached to the magneto 20 remains and is accessible. This member is formed with a flange so positioned relative to the magneto 20 as to provide therewith a peripheral groove within which a rope may be wrapped to start the motor in the manner heretofore generally employed.

Driving engagement between the member secured to the magneto and the pulley is provided by means of a plurality of spring fingers carried by said member and adapted to be engaged by lugs on the pulley. Thus as the pulley moves longitudinally toward the member the lugs move downwardly into engagement with such fingers. When the motor is started, it rotates at such speed that there is not time for the pulley to move upwardly on its threaded connection with the stud so that the lugs and spring fingers will immediately clear. For this reason the spring fingers on their back faces are provided with cam surfaces which are engaged by the lugs to force the spring fingers out of the way and permit the pulley to remain stationary or be reversely rotated while the member is rotated forwardly by the engine. However, as soon as the pulley has rotated sufficiently to move it along the thread of the stud, the lugs

on the pulley no longer engage the spring fingers.

Another prominent feature of the invention lies in the provision made for backfire of the motor. To permit the starter to be released in case of such backfire, frictional engagement of certain parts of the device is provided such that the friction thereof is strong enough to resist any slippage when the pulley is rotated by means of its rope. However, when a backfire occurs, the forces exerted are sudden and slippage may occur so that the pulley will not be driven in a reverse direction by the motor. In the preferred form of the device, the spring fingers are provided with sloping surfaces, engaged by the lugs, which are sufficiently steep to normally effect driving engagement by the lugs on the pulley when the pulley is rotated by means of its rope. However, with the force of a backfire, the steeply sloping surfaces of the spring fingers cause a camming action against the lugs of the pulley and the springs are forced out of the way. In the modified form of the device shown in Figs. 7, 8, 9, and 10, the member attached to the magneto has a frictional engagement therewith and the backfire overcomes such frictional engagement to release the pulley from the member.

As shown in the drawings, the preferred form of the device is illustrated in Figs. 1 to 6, inclusive. This form comprises a member in the form of a plate 22 arranged to rotate with the magneto 20. To this end the plate 22 is provided with a socket 23 in its lower face fitting over a central boss 24 on the magneto, and the plate 22 is held in place by means of a plurality of screws 25 threaded into the boss 24.

Mounted over the plate 22 is a pulley, indicated generally at 30, arranged so that it may be manually rotated and, by such rotation, caused first to move longitudinally into engagement with the plate 22 and then effect rotation of the plate along with the motor to start the latter. To provide for such movement of the pulley it is mounted on a stud, indicated generally at 31. The stud is provided with a steep pitch thread 32 within a hub portion 33 of the pulley, and friction means are provided tending to hold the stud 31 against rotation. Thus when the pulley 30 is rotated it first moves longitudinally or axially by virtue of the thread 32 until it engages the plate 22. Thereafter such engagement prevents further longitudinal movement of the pulley 30 and further rotation thereof overcomes the resistance of the friction means so that the stud may rotate with the pulley in starting the motor.

The stud 31 preferably has a reduced upper end portion 34 extending through a hub 35 of a cover, indicated generally at 36, suitable anti-friction bushings being interposed therebetween. The upper end of the reduced portion 34 is threaded to receive a pair of lock nuts 40. The friction means comprises preferably a flat washer 41, interposed between the nuts 40 and the hub 35 of the cover, and a slightly dished spring washer 42 thereunder. The spring washer 42 bears against the hub 35 of the cover and against the flat washer 41 and thereby sets up frictional resistance to rotation of the stud shaft 31. Thus, when the pulley is rotated in a forward direction, the spring washer 42 holds the stud shaft 31 against rotation and causes the pulley 30 to move down along the thread 32 until the pulley engages the plate 22. When such engagement occurs, longitudinal movement of the pulley 30 is

prevented so that further rotation thereof causes the stub shaft 31 to rotate by overcoming the frictional resistance of the spring washer 42.

Driving engagement between the pulley 30 and the plate 22 is effected by means of a plurality of spring fingers 43 carried by the plate 22. Preferably such spring fingers are secured to a flange 44 formed on the plate 22 and having a plurality of notches 45 through which bent portions of the spring fingers 43 project upwardly. The bent portions of the spring fingers are adapted to be engaged by lugs 46 formed on the bottom of the pulley. Since the lugs 46 will be subjected to considerable wear it is desirable to make them of such material as bronze. However, it is not necessary to make the entire pulley of bronze and preferably the main portion of the pulley is made of aluminum. Therefore the upper flange of the pulley and the hub 33 thereof are made of aluminum while the lower flange, indicated at 47, together with the lugs 36 integrally cast thereon are made of bronze, the lower flange 47 being secured to the upper flange as by screws 48.

The pulley 30, as mentioned above, is adapted to be rotated by a rope and after each time the pulley is forwardly rotated by pulling on the rope, the rope must be rewound. To this end a torsion spring 50 is mounted on the upper surface of the pulley 30 and has its inner end attached to the hub 33 of the pulley as by being bent around a pin 51 and its outer end fixed as by being secured to a pin 52 mounted in an internal flange 53 of the cover 36. The spring is so arranged that as the pulley is rotated forwardly by the rope, the spring is tensioned or wound up. When the rope is released after pulling it out to its full length, the spring 50 causes reverse rotation of the pulley.

Such reverse rotation of the pulley also serves to move it out of engagement with the plate 22. Thus during the first part of the reverse rotation the friction washer 42 holds the stud 31 against rotation and the pulley moves upwardly along the thread 32. Since such longitudinal movement only requires a small portion of the total rotation of the pulley necessary to rewind the rope, the spring 50 is strong enough thereafter to cause the pulley and stud shaft 31 to rotate together, overcoming the resistance of the friction washer 42.

When the motor is started, the rotation thereof is such that the lugs 46 do not have time to move upwardly out of a position where they are engaged by the spring fingers 43. Therefore the bent portions of the spring fingers 43 are provided on their back faces with slightly slanting surfaces 54 which when they strike the lugs cause the spring fingers to be cammed downwardly, as shown in Fig. 4, so that they may pass the lugs 46. To facilitate such camming action, the lugs 46 are triangular in cross section. However, the reverse rotation of the pulley quickly moves the pulley sufficiently far from the plate 22 so that the lugs 46 no longer will contact the spring fingers 43.

The rope for rotating the pulley, indicated at 55, is long enough to provide for several turns around the pulley, as is clearly shown in Fig. 2. The inner end of the rope is anchored to the pulley, while the outer end extends tangentially therefrom through a guide portion 56 formed in the cover 36 so as to extend to an outside accessible position. On the outer end of the rope 55 a handle 57 is secured so that the rope may

be readily pulled. After the rope is pulled out to its full length to cause the pulley to rotate in a forward direction, the rope is released and the torsion spring 50 thereupon causes it to rewind on the pulley, drawing the handle 57 into a seated position in the guide portion 56.

One of the important features of the invention lies in the provision of a structure whereby the pulley is released from the engine in case of backfire so that the pulley will not be reversely rotated by the engine. Such reverse rotation might cause damage to the starter or break the rope 55, or even cause injury to the operator. To effect such release upon backfire of the motor, in the preferred form the spring fingers 43 are provided on their forward faces with steeply slanting surfaces 60. The angle of such faces when cooperating with the lugs 47 offer sufficient frictional resistance, when the pulley is turned by pulling the rope, to avoid any camming action on the spring fingers. However, under the sharp powerful impulse caused by a backfire, a camming action takes place therebetween and the spring fingers are forced downwardly so that the lugs 46 may pass thereover. Thus the pulley is released from the plate 22 so that it will not be reversely rotated under such conditions. As a consequence no damage to the starting device will occur as a result of backfire.

Another prominent feature of the invention lies in the fact that, should the starting device be disabled for any reason, the major portion thereof may be readily removed from the motor and the motor may then be started in a manner heretofore usual for such motors. To provide for such feature, the cover 36 is detachably secured to a fixed portion of the motor, such as the gas tank structure 21, as by screws 61. When the cover is removed, the pulley 30 and a stub shaft 31 are removed with it as a unit, leaving exposed the plate 22 attached to the magneto 20. The plate 22 is so constructed as to provide a peripheral groove between the flange 44 and the end face of the magneto within which a rope 62 may be wrapped. To secure such rope to the plate 22, notches 63 may be provided in the flange 44, in which the knotted end of the rope may be secured. Thus the plate 22, together with the magneto, may be rotated in a forward direction when a rope so wrapped under the flange 44 is pulled.

In the modified form of construction shown in Figs. 7, 8, 9, and 10, the spring fingers, here indicated at 64, have transversely extending faces 65 adapted to engage the lugs 66 on the pulley. However, such transversely extending surfaces do not provide for release in case of backfire. Such release, however, is attained by frictionally securing the plate 22 to the magneto 20. Thus the plate 22 instead of being rigidly secured to the magneto by screws, is provided with an inwardly turned flange 70 held under a securing plate 71 rigidly secured to the magneto as by screws 72. Interposed between the flange 70 and the upper face of the magneto is a dished spring plate 73 offering sufficient frictional resistance normally to prevent relative rotation between the plate 22 and the magneto 20. However, the sharp impulse of a backfire will overcome the frictional resistance offered by the spring plate 73 so that the magneto 20 can rotate in a reverse direction without carrying with it the plate 22 and the other rotating parts of the starter.

From the foregoing description, it will be apparent that we have provided a novel starting de-

vice which will turn the motor in a forward direction to effect starting, but which will be released in case of backfire so that the device will not be damaged in any way. Thus in the preferred form, the spring fingers 43 with their steeply slanting surface 60 normally provide a driving engagement, between the pulley 30 and the plate 22 but permit a release therebetween in case of backfire, the spring fingers being cammed out of the way so that the lugs 46 may pass thereover.

In the normal starting operation, the pulley first moves downwardly by virtue of the thread 32, the stub shaft 31 being held by the friction spring washer 42. The pulley then causes rotation of the plate 22 along with the motor. After the motor has started, the thread 32 causes the reverse rotation of the pulley to move it upwardly to an idle position. However, in the meantime, the cam surfaces 54 on the spring fingers permit the latter to be pushed out of the way of the lugs 46 as the motor rotates relative to the pulley. The device is particularly convenient in use since if it becomes disabled in anyway it may be readily removed merely by taking off the cover 36 together with the major portion of the starting device. The plate 22 then has provision for wrapping a rope therearound in the way heretofore employed in starting a motor.

The device is simple to operate, and as will be apparent, is inexpensive to manufacture. It eliminates the necessity of winding a rope around a pulley each time it is desired to rotate the motor, and is capable of sufficiently turning the motor to effect rapid starting thereof.

We claim as our invention:

1. A starting device of the character described comprising, in combination, a member rotatable with the motor, a threaded stud rotatable independently of the motor, means for rotatably supporting said stud but tending to restrain the stud from rotation, and a manually operable rotatable member having threaded engagement with said stud and being adapted on rotation to move longitudinally of said stud into engagement with the first-mentioned member and then to rotate said first-mentioned member.

2. A starting device of the character described comprising, in combination, a member rotatable with the motor, a rotatably mounted stud independent of said motor, means for rotatably supporting said stud, and a manually rotated member having threaded engagement with said stud, said stud being frictionally held by said means against rotation until said last-mentioned member has moved longitudinally thereof by virtue of the threaded connection to effect engagement of said members and thereafter rotating with said members.

3. A starting device of the character described comprising, in combination, a pair of members one being connected to the engine and the other being manually rotatable, supporting means for said manually rotatable member arranged on initial rotation of said member to coact with said manually rotatable member to move the latter longitudinally until engaged with the other member and thereafter permitting said members to move in unison.

4. A starting device of the character described comprising, in combination, a member secured to a rotating part of the engine, a frame structure, a stud rotatably but frictionally mounted in said frame structure coaxial with the engine, a member mounted on said stud and normally

spaced from the first-mentioned member, said last-mentioned member and said stud having a threaded engagement whereby rotation of the last-mentioned member will cause it to move into engagement with the first-mentioned member, and whereby thereafter said last-mentioned member and said stud rotate together to start the motor.

5. A starting device of the character described comprising, in combination, a member secured to a rotatable part of the motor, a fixed element, a stud frictionally but rotatably supported by said fixed element, a manually rotatable member threaded on said stud, said members having abutment means movable into and out of engagement by relative longitudinal movement of the two members, said manually rotatable member first moving longitudinally into abutment with the other member by virtue of its threaded connection with the stud and then rotating the first-mentioned member to start the motor, and spring means tensioned by the rotation of said manually rotatable member to cause reverse rotation of the latter, such reverse rotation first causing the manually rotatable member to move longitudinally out of engagement with the other member by virtue of the threaded engagement with the stud.

6. A starting device of the character described comprising, in combination, a member secured to a rotatable part of the motor, a frame structure, a stud frictionally but rotatably carried by said frame structure, a pulley having threaded engagement with said stud, said pulley and said member being adapted to be engaged by longitudinal movement of said pulley along said stud, rotation of said pulley first effecting such longitudinal movement by virtue of the threaded engagement and thereafter causing rotation of said stud when said pulley and said member are in driving engagement, and a torsion spring having one end connected to said frame structure and the other end connected to said pulley and adapted to be tensioned when said pulley is rotated to start the motor, said torsion spring upon release of said pulley causing reverse rotation thereof to move the pulley longitudinally out of engagement with said member by virtue of the threaded engagement thereof with the stud.

7. A starting device of the character described comprising, in combination, a member fixed to a rotatable part of the engine, a cover structure, a stud frictionally but rotatably carried by said cover structure, a pulley adapted to be manually rotated by a rope wound thereon, said pulley being threaded on said stud and adapted to move longitudinally thereof into driving engagement with said member when rotated by said rope, and a torsion spring having its outer end secured to said cover structure and its inner end secured to said pulley and adapted to be wound when the pulley is rotated by the rope, said torsion spring causing reverse rotation of said pulley upon release of the rope and thereby causing the pulley to move longitudinally away from said member by virtue of the threaded engagement between the pulley and the stud.

8. A starting device of the character described comprising, in combination, a member secured to a rotatable part of the motor, a cover structure having a centrally located hub, a stud rotatably mounted in said hub, friction means interposed between said stud and said hub tending to resist rotation of said stud, a pulley having threaded engagement with said stud and adapted to move

longitudinally into engagement with said member by virtue of the threaded engagement, the engagement of said pulley and said member preventing further longitudinal movement of the pulley and thereby overcoming the frictional resistance of said friction means to permit the stud to rotate with the pulley.

9. A starting device of the character described comprising, in combination, a member secured to a rotatable part of the engine and provided with abutments, a manually rotatable member movable longitudinally and provided with abutments for driving engagement with the abutments on said first-mentioned member, a stud having threaded engagement with said manually rotatable member to provide for longitudinal movement of the latter upon rotation thereof, whereby the abutments on the respective members may be moved into and out of engagement with each other, one of said sets of abutments being yieldable to permit them to pass the other set after the motor is started in case the manually rotatable member has not moved longitudinally sufficiently for the abutments to clear.

10. A starting device of the character described comprising, in combination, a plate secured to a rotatable part of the motor and provided with a plurality of upwardly bent spring fingers, a manually rotatable member provided with a plurality of lugs adapted to engage said spring fingers, means for supporting said member arranged to cause the member to move longitudinally toward said plate when the member is rotated in one direction and to move longitudinally away from said plate when rotated in the other direction whereby said lugs are moved into and out of engagement with said spring fingers, said spring fingers being yieldable to permit them to pass said lugs when the engine is started in case the member has not moved far enough longitudinally to permit clearance between the lugs and fingers.

11. A starting device of the character described comprising, in combination, a plate secured to a rotatable part of the engine and provided with a plurality of spring fingers each bent upwardly to provide an abutting face and a camming face on opposite sides of the bend, a manually rotatable member provided with a plurality of lugs for engaging said spring fingers, and means for supporting said member and arranged to cause said member to move toward said plate with said lugs engaging said abutting faces when the member is rotated in one direction and to cause said member to move longitudinally out of engagement when the member is rotated in the opposite direction, said cam surfaces causing the fingers to yield and pass said lugs when the motor has started until said member has moved longitudinally far enough for said lugs to clear said fingers.

12. A starting device of the character described comprising, in combination, a plate secured to a rotatable part of the engine and provided with a plurality of spring fingers, a manually rotatable pulley mounted for rotation and longitudinal movement toward and from said plate, the flange of said pulley adjacent said plate being provided with lugs adapted to engage said spring fingers, said flange and lugs

being a separate part from the pulley proper but secured thereto and being made of relatively hard metal to provide for the wear on said lugs.

13. A starting device for an outboard motor having a rotatable part surrounded by a fixed structure, said starting device comprising a plate secured to said rotatable part, a cover detachably secured to said fixed structure, and a manually rotatable member mounted within said cover and adapted on rotation to engage said plate for starting the motor, said cover and said manually rotatable member being removable as a unit in case the starting device is disabled, and said plate being so mounted on the rotatable part of the motor as to provide space for a rope to be wrapped between said plate and said rotatable part for starting the motor.

14. A starting device of the character described comprising, in combination, a plate secured to a rotatable part of the engine and provided with a plurality of upwardly bent spring fingers, the upward bend of each finger having a steeply inclined face and a slightly inclined face, a manually rotatable member provided with a plurality of lugs adapted to engage against the steeply inclined faces of said spring fingers to start the motor, the steep inclination of said face normally providing sufficient resistance to avoid flexing the fingers during the starting of the motor but providing a camming action to bend the fingers out of the way of the lugs in case of backfire of the motor, the slightly inclined faces causing the spring fingers to flex and pass the lugs after the motor is started.

15. A starting device of the character described comprising, in combination, a plate secured to a rotatable part of the engine and provided with a plurality of yieldable abutments, a manually rotatable member adapted to be moved longitudinally toward the first-mentioned member and provided with lugs engageable by such longitudinal movement with said yieldable abutments, each of said yieldable abutments having a face of sufficient angularity normally to effect driving engagement with a lug to cause rotation of the engine but adapted to cause the abutment to yield and pass the lug upon backfire of the motor.

16. A starting device of the character described comprising a plate having a frictional connection with a rotatable part of the engine, a plurality of spring fingers secured to said plate and having upwardly bent portions, a manually rotatable member adapted to move longitudinally toward said plate and provided with a plurality of lugs adapted to engage the bent portions of said spring fingers, said spring fingers having substantially transverse faces on the bent portions engaged by said lugs when the manually rotatable member is rotated in a forward direction to start the motor and having slanting faces on the other sides of said bent portions adapted to be engaged by said lugs to cam the fingers out of the way after the motor has started, the friction of said connection between said plate and the rotatable part of said engine being overcome in case of backfire to prevent positive reverse rotation of the manually rotatable member.

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