

[54] **ENGINE STARTER DRIVE ASSEMBLY**
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[52] U.S. Cl. **74/7 R**
[51] Int. Cl. **F02n 11/00**
[58] Field of Search..... **74/7 R, 7 B, 6, 7 A**

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[57] **ABSTRACT**
A drive assembly for a starter motor used in starting an internal combustion engine is provided including a rotatable shaft extending from the motor housing with a threaded portion. A tubular driving member is employed having an internal threaded portion meshing with the threaded portion of the shaft, the driving member having an external toothed portion to cooperate with part of the engine to be started. Shielding means is provided supported by one of the motor housing and driving member or both to shield a portion of the shaft extending from the motor housing to prevent foreign matter from contacting the portion of the shaft.

8 Claims, 10 Drawing Figures

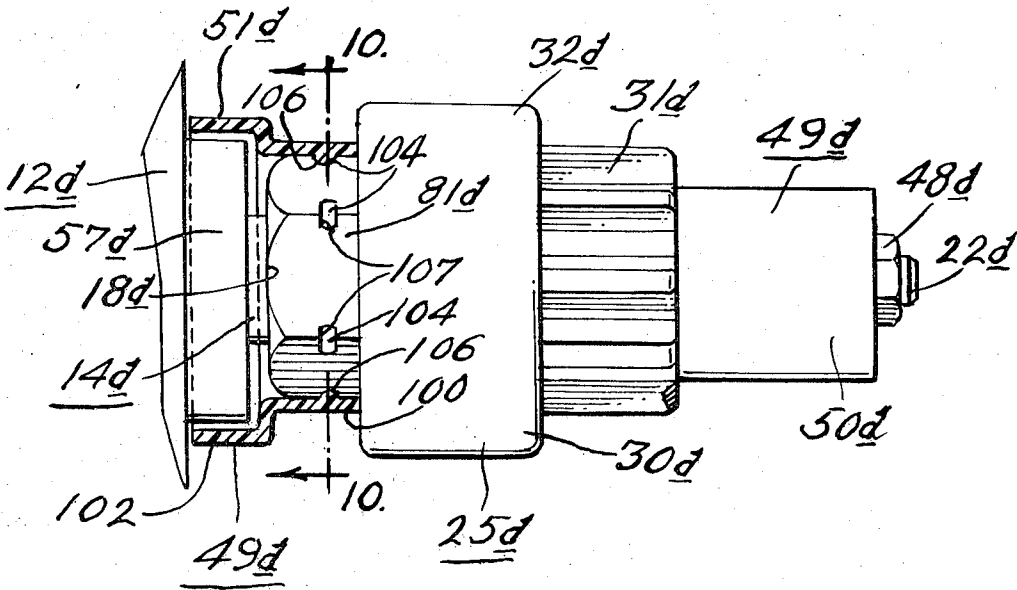


FIG. 1.

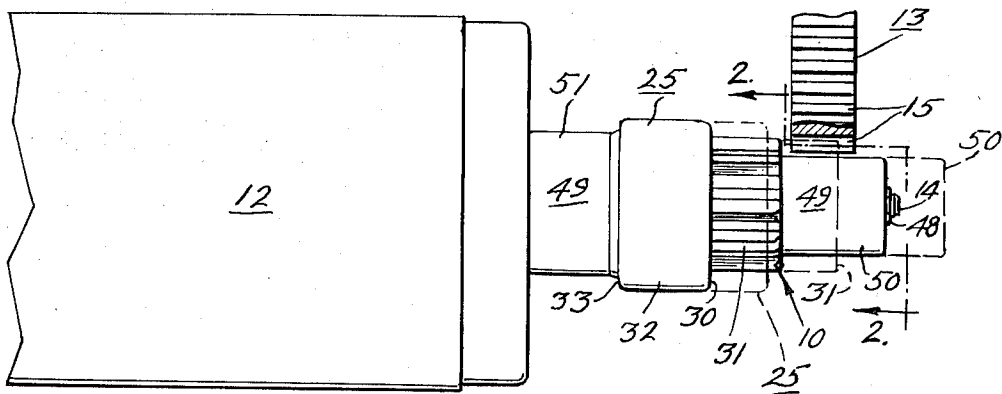


FIG. 2.

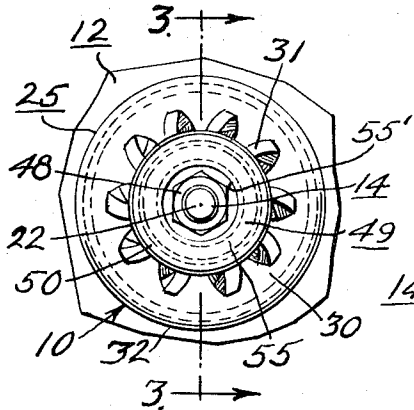


FIG. 3.

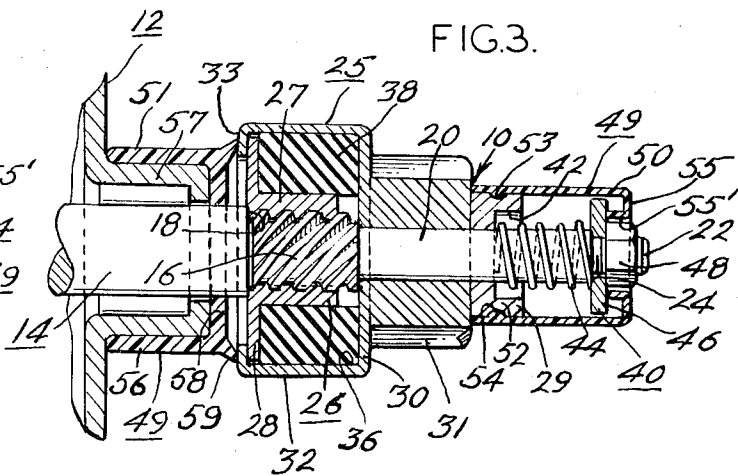


FIG. 4.

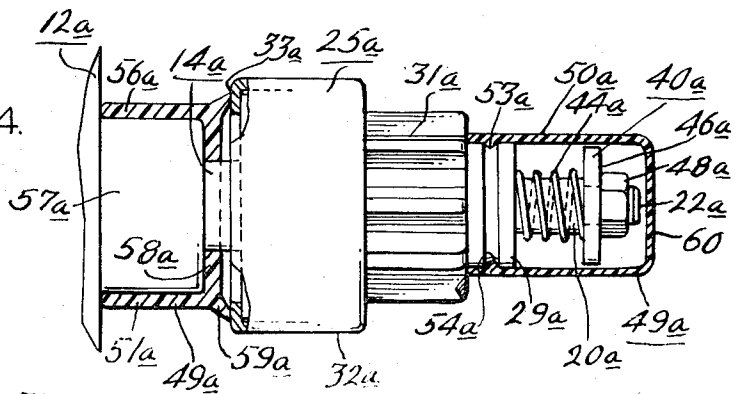
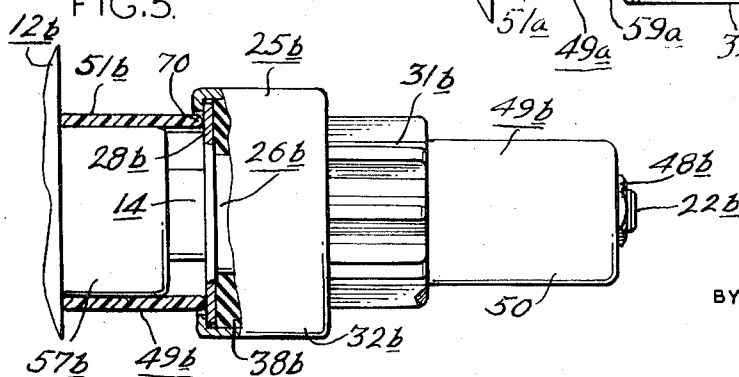
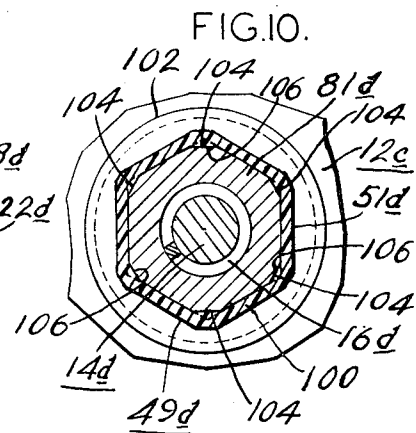
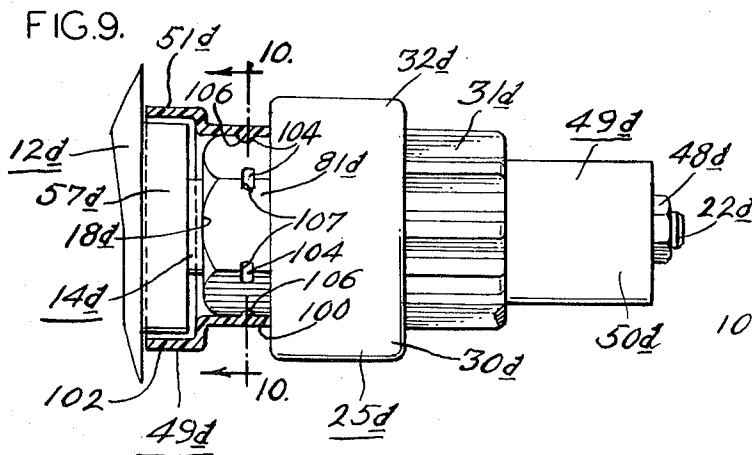
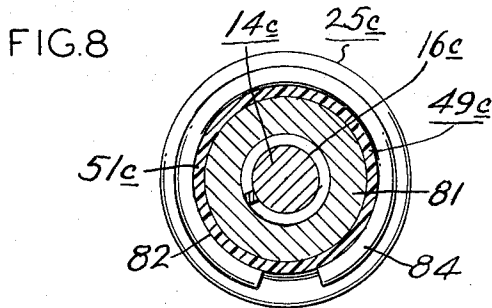
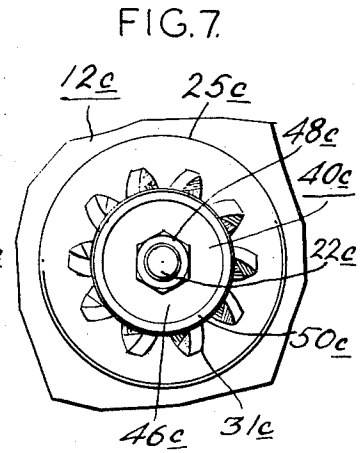
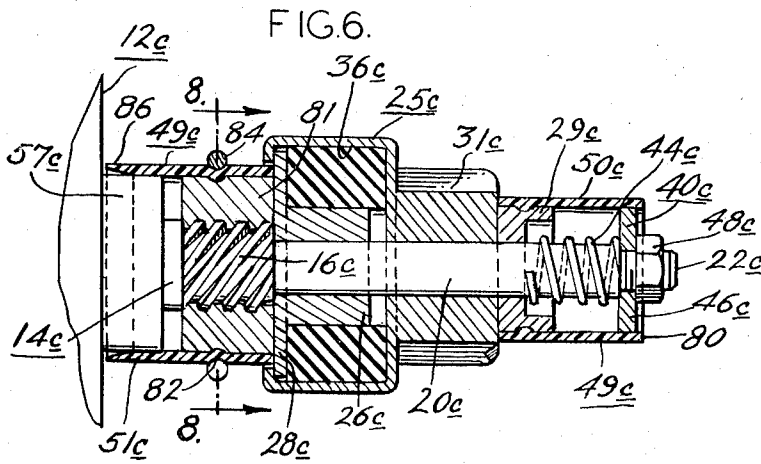


FIG. 5.



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ENGINE STARTER DRIVE ASSEMBLY

The present invention relates to a drive assembly for a starter motor and, more specifically, to an improved drive assembly having shielding means associated therewith for preventing foreign matter from interfering with operation of the driving member along its supporting shaft.

In recent years there has been a great interest in employing electric powered starter motors for use in cranking small gasoline engines, such as outboard engines for boats, and gasoline engines employed to power small garden tractors, lawn mowers, snow blowers and the like. Until recently, many such engines were started by a rope or other manual means. There has been a variety of approaches taken in designing an effective, durable and economical drive for starter motors which would automatically engage and disengage a rotatable part, usually the flywheel, of the gasoline engine. These drives usually consist of an inertia type drive which is rotated to provide axial movement along a shaft of a starter motor as the starter motor armature shaft accelerates. The inertia type drive depends on the combination of inertia from the weight of the engaging or driving member, which has a pinion gear adapted to engage the flywheel, and the acceleration of the armature shaft of the starting motor. The driving member is threaded on an armature shaft, and the acceleration of the threaded shaft together with the weight of the driving member causes axial movement of the driving member to have the pinion gear engage teeth on the flywheel upon rotation of the armature shaft.

In the prior art the starter motors with which such drive assemblies are employed are often used on machinery that is exposed to weather conditions and foreign matter, such as dirt, dust, grass, ice, water and the like. The foreign matter may accumulate on the shaft supporting the driving member and accumulate between the shaft and the driving member, which loosely mates with the shaft. It has been found that the accumulation of such foreign matter may result in the driving member sticking or binding in either or both extremes of its movement. Also, it has been found that dirt and oil forming grime has accumulated between the mating threads of the shaft and driving member to prevent the driving member from freely moving into its engaged position with the flywheel. Thus, it is desirable to provide a drive assembly for a starter motor which would operate over long life without malfunction in rugged use and in varying environmental conditions.

In accordance with the present invention, a drive assembly for a starter motor having a housing is provided comprising a rotatable shaft extending from the motor housing and having a threaded portion and a tubular driving member having an internal threaded portion meshing with the threaded portion of the shaft. The driving member is rotatable with the shaft and axially movable thereon and has an external toothed portion to cooperate with part, which is preferably the flywheel, of the engine to be started. Stop means is supported by the shaft to limit axial movement of the driving member when rotated to engage the flywheel. Shielding means is preferably supported by one of the motor housing and the driving member and extends to encircle the shaft to provide a covering for a portion of the shaft extending from the motor housing. In this arrangement, the shielding means covers a portion of the

shaft to prevent foreign matter from accumulating on the portion of the shaft. The shielding means permits a compact drive assembly while preventing foreign matter from interfering with operation of the starter drive assembly and does not interfere with normal operation of the drive assembly.

Preferably, a first shielding member is provided between the drive member in its rest position and the stop means and a second shielding member is provided between the driving member in its rest position and the starter motor housing.

In the preferred arrangement of the present invention, the driving member has an axially extending portion toward the stop means and the shielding means comprises a first shielding member supported by the axially extending portion of the driving member and extending to encircle the stop means such that when the driving member is rotated to the stop means, the first shielding member will rotate around the stop means. Furthermore, preferably, the starter motor housing has a portion extending around the shaft and the shielding means further includes a second shielding member supported by the portion of the starter motor housing and extending from the starter motor housing to adjacent the driving member, when the driving member is in its rest position. In another arrangement of the second shielding member, the driving member has a longitudinal portion extending toward the starter motor housing, and the second shielding member is supported by the longitudinal portion of the driving member to encircle the shaft, the second shielding member extending from the driving member to adjacent the motor housing when the driving member is in its rest position. In these arrangements, the shielding means covers or encloses the shaft between the driving member and the stop means by the first shielding member and between the motor housing and the driving member by the second shielding member to prevent foreign matter from contacting the shaft when the driving member is in its rest position.

For a better understanding of these and other features and advantages of the present invention, reference is made to the following description and accompanying drawings, in which:

FIG. 1 is a side elevational view of one form of the engine starter drive assembly of the present invention and showing the driving member in alternative positions of disengagement and engagement with the flywheel of the engine to be started;

FIG. 2 is a sectional view taken along line 2—2 of FIG. 1;

FIG. 3 is a sectional view taken along line 3—3 of FIG. 2;

FIG. 4 is a side elevational view, partially in section, and showing an alternative embodiment of the shielding member adjacent the end of the driving shaft;

FIG. 5 is a side elevational view, partially in section, of another alternative embodiment of the drive assembly and showing a different embodiment of the shielding member between the driving member and starter motor housing;

FIG. 6 is a side elevational view, partially in section, of still another form of the driving member and shielding members associated therewith in accordance with the present invention;

FIG. 7 is an end elevational view of the drive assembly of FIG. 6;

FIG. 8 is a sectional view taken along line 8—8 of FIG. 6;

FIG. 9 is a side elevational view, partially in section, of still another form of the shielding member between the driving member and starter motor housing; and

FIG. 10 is a sectional view taken along line 10—10 of FIG. 9.

Referring to FIG. 1, there is shown an engine starter drive assembly, generally designated 10, employed with a suitable electric drive motor, generally designated 12, which is preferably a direct-current motor and is the prime mover for the drive assembly used to provide the driving force for starting an internal combustion engine. The drive assembly 10 is adapted to mesh with a part 13 of the engine to be started and, preferably, the drive assembly meshes with gear teeth 15 of a flywheel of the engine (not shown).

As shown in FIGS. 1, 2 and 3, an armature shaft 14 extends from the motor housing 12. The shaft 14 has a first reduced diameter portion 16 extending from shoulder 18, a second further reduced diameter portion 20 extending from the first reduced diameter portion 16, and a third further reduced diameter portion 22 extending from the second reduced diameter portion at shoulder 24, as shown in FIG. 3. The first reduced diameter portion 16 of shaft 14 is threaded to provide a threaded portion for rotating the drive assembly. The drive assembly includes a driving member 25 which is mounted on the free end of shaft 14 beyond shoulder 18. Driving member 25 has an internally threaded portion which meshes with the threaded portion 16 of shaft 14.

More specifically, the driving member 25 comprises a drive hub 26 having a hub portion 27, which is internally threaded along the axial length to mesh with the threaded portion 16 of shaft 14, as shown in FIG. 3. The drive hub has an annular radially extending disc portion 28 at the axial end thereof nearest to the motor housing 12. The driving member 25 further includes an annular engaging member 30 having an external toothed portion 31 providing a pinion gear adapted to mesh with the gear teeth 15 of flywheel 13 for starting the engine. The bore of the toothed portion 31 of the engaging member loosely encircles shaft 14, the engaging member and shaft being made of ferrous material such as steel. The engaging member rides on the smooth surface of portion 20 of shaft 14 beyond the threaded portion. A bearing sleeve may be provided within the bore of toothed portion 31 to ride over portion 20 of shaft 14 but is not required for proper operation of the assembly. The driving member 25 further includes an annular axially extending portion 29 provided by a cup-shaped member of ferrous material having a central opening adapted to receive portion 20 of shaft 14. The rim of cup-shaped member 29 extends toward the free end of the shaft encircling and spaced a distance from the smooth surface of portion 20 of the shaft. The cup-shaped member 29 is preferably brazed or otherwise fixed to the end of the engaging member 30 as an integral part thereof toward the free end of the shaft but may merely rest against the engaging member as will be explained more fully hereinafter.

The annular engaging member 30 is provided with an integral increased diameter collar 32, which extends toward the motor housing and over the axial length of the drive hub 26 and surrounds the periphery of the annular radially extending disc portion 28 of the drive hub. The increased diameter collar portion 32 is swaged or rolled over at its end 33 to provide a flange extending toward the shaft to capture the drive hub 26 between the flange and pinion portion 31 of annular engaging member 30, as shown in FIG. 3.

The annular collar portion 32 of annular engaging member 30 provides a casing to form an annular chamber between collar portion 32 and drive hub 26. An annular cushion member 38 of resilient material, such as rubber, is positioned within the collar portion 32 in the annular chamber 36 and surrounds the hub portion 27 of drive hub 26. The cushion member extends axially from abutment against the pinion portion 31 to abutment against the disc portion 28 of the drive hub and thereby urges disc portion 28 against flange 33 of engaging member 30, providing a space between the end of hub portion 27 and the pinion portion 31 of engaging member 30. The drive hub 26, cushion member 38 and engaging member 30 are held together by flange 33 of the collar 32 capturing the drive hub and cushion member within the collar 32 of engaging member 30. The engaging member 30 is caused to rotate with the drive hub 26 by the cushion member 38 frictionally engaging drive hub 26 and engaging member 30. The cushion member 38 also acts to absorb or cushion the impact forces created when the drive hub and engaging member, respectively, abut stops positioned along shaft 14.

The drive hub 26 of driving member 25 is adapted to engage shoulder 18 between the main portion of armature shaft 14 and the threaded portion 16, the shoulder 18 providing an abutment or stop means for limiting axial movement of the driving member toward motor housing 12. When the drive hub 26 of the driving member is abutted against shoulder 18, the driving member 10 is in its rest position along shaft 14. The driving member 25 is rotatable with shaft 14 and is axially movable along the shaft by being advanced toward the free end of the shaft through relative rotation of the shaft by motor 12. In the present embodiment of the driving member 25, the driving member may be moved axially along the shaft until its axially extending portion 29 abuts stop means 40 supported by the free end of the shaft to limit axial movement of the driving member in one direction, that is, toward the free end of the shaft when the driving member is rotated. When the axially extending portion 29 of the driving member abuts stop means 40, the driving member is in its engaged position with the flywheel.

The annular axially extending portion 29 of driving member 25 encircles the shaft and its bore 42 within its rim is adapted to receive one end of a coil spring 44 encircling the shaft within the bore. The coil spring 44 extends between the driving member and stop means. The stop means 40 is provided by an annular retaining member 46, which may be a washer, having a central opening adapted to receive threaded end portion 22 of shaft 14. The retaining member 46 abuts against the shoulder 24 and is fixed to the shaft by nut 48 received on threaded end portion 22 of the shaft.

More specifically, the coil spring 44 encircles portion 20 of shaft 14 between the driving member 25 and the retaining member 46 of stop means 40. Coil spring 44 is seated on one end against annular member 29 within the bore 42 and at its other end against the retaining member 46 of stop means 40. Spring 44 serves to retard axial movement of the driving member 10 toward the retaining member and urges the driving member toward the shoulder 18 of the shaft, thereby preventing movement of the driving member due to vibrations in the system when the starter motor is not operating. By having coil spring 44 received within the bore 42 of axially extending member 29, when the driving member is rotated axially along shaft 14 to abut against the retaining member, the spring is received within the bore of member 29 preventing damage to the coils of the spring. As previously stated the cup-shaped member 29 is preferably fixed to pinion portion 31 of engaging member 30 but may be loose against the engaging member. In the latter instance, spring 44 would force the cup-shaped member against engaging member 30 and the cup-shaped member 29 would move with the engaging member as the driving member 25 is rotated to its engaged position with the flywheel. Thus, the member 29 would move with the engaging member as a part of the driving member.

In operation of the driving member 25, when electric starter motor 12 is operated, armature shaft 14 will be rotated and the driving member will be rotated and moved axially toward stop means 40 due to the screw action between the mating threads of the drive hub and the shaft. When the driving member moves toward stop means 40, the toothed portion 31 of engaging member 30 will mesh with the gear teeth 15 of flywheel 13 of the engine to be started. When the axially extending portion 29 of the driving member abuts against retaining member 46 of stop means 40, the driving member is in its engaged position with the flywheel and will rotate with the armature shaft and the flywheel will be rotated. When the engine is started and is operating, the starter motor 12 is deenergized. Upon deenergization of the starter motor, the driving member will automatically be returned to its rest position shown in FIG. 1 because of the rotation of the flywheel rotating the driving member on the threaded portion of the shaft and the urging of coil spring 44 between the driving member and stop means 40.

In the environment in which the starter motor is employed, such as on outboard engines, garden tractors, lawn mowers, snow blowers and the like, the starter motor drive assembly may be contacted by foreign matter, such as dirt, dust, grass, ice, vegetation, and the like. In use of such machinery, it has been found that the foreign matter accumulates on the shaft 14 and between the driving member 25 and the shaft, which loosely receives the driving member, preventing proper operation of the driving member. For example, any dirt which accumulates on or contacts the shaft may contact oil on the shaft forming grime, which may cause binding of the drive hub on the threaded portion of the shaft, thereby preventing the driving member from moving into its engaged position with the flywheel. Furthermore, foreign matter which accumulates or collects between the coils of spring 44 may prevent the spring from allowing the driving member to move into

its engaged position with flywheel 13. In the present arrangement, in order to overcome these problems while maintaining a compact assembly, there is provided shielding means, generally designated 49, supported by one of the motor housing and driving member, or both, and extending to encircle the shaft 14 to provide a covering for a portion of the shaft extending from the motor housing, as shown in FIG. 3.

Particularly, shielding means 49 in the embodiment shown in FIGS. 1-3 comprises a first shielding member 50 supported by axially extending portion 29 of the driving member and a second shielding member 51 supported by an axially extending portion of starter motor housing 12, which encircles shaft 14 and through which shaft 14 extends. More specifically, the first shielding member 50 is generally tubular or annular in form and adapted to fit snugly on the periphery of axially extending portion 29 of driving member 25 and extends from the driving member to encircle retaining member 46 of stop means 40. Although the shielding member 50 is received snugly on the peripheral surface of the axially extending portion 29, in order to assure that the shielding member does not slip off the axially extending portion of the driving member, the axially extending portion 29 is provided with an annular retaining shoulder 52 positioned along the surface of axially extending portion 29, the shoulder 52 being formed by an annular groove 53 in the peripheral surface of the axially extending portion 29. The first shielding member is provided with an internal retaining portion 54, preferably an internal annular rib around the inner surface of the shielding member adapted to mate with the shoulder 52 by fitting into groove 53 to securely hold the first shielding member on axially extending portion 29 of the driving member, as shown in FIG. 3.

The free end of the first shielding member circles the stop means 40 and extends a distance past the retaining member 46. The free end of the shielding member 50 is formed with an inwardly extending rim 55 toward the shaft and nut 48, and an internally axially extending flange 55' from the rim 55, the rim and flange providing the shielding member with an end that is bent back on itself in a generally U-shaped configuration in cross-section, as shown in FIG. 3. The internal axially extending flange 55' is adapted to lightly engage or abut against the opposite side of the retaining member from the side contacted by axially extending portion 29 of the driving member. In this arrangement, the first shielding member provides a closure for the shaft between the driving member, when in its rest position, and stop means 40, which limits movement of the driving member toward the free end of the shaft.

The second shielding member 51 comprises a tubular or annular portion 56 which encircles and snugly engages the peripheral surface of an axially extending portion or boss 57 of motor housing 12 and an inwardly extending portion or rim 58, which extends between boss 57 and driving member 25 and closely circles armature shaft 14 without retarding rotation of the shaft. Second shielding member 51 also has an outwardly extending annular flange or lip 59 at the bend between annular portion 56 and rim 58, the flange 59 being adapted to lightly engage or abut flange 33 of driving member, when the driving member is in its rest position

against stop means or shoulder 18, as shown in FIG. 3. It should be noted that the flange or lip 59 of second shielding member 51 could also be adapted to lightly engage or abut the disc portion 28 of drive hub 26, when the driving member is in its rest position.

The second shielding member 51 is frictionally held to the boss 57 of the motor housing, whereas the first shielding member 50 is carried by the driving member so that the first shielding member travels axially with the driving member when it is moved to its engaged position with the gear teeth of flywheel 13. The first and second shielding members can be made of nylon, rubber, plastic or metal. Preferably, the shielding members are made of a moderately flexible or resilient material so as to more readily conform and grip to the parts which support them and to conform to the surfaces of the stop means 40 and driving member 25 which the first and second shielding members, respectively, abut to provide a seal therebetween. More specifically, the inwardly turned axial flange 55' of the first shielding member 50 is preferably flexible enough to provide a seal around the retaining washer 46 to prevent foreign matter from passing between the retaining washer and first shielding member. Similarly, the lip 59 of second shielding member 51 is preferably flexible enough to provide a seal around the flange 33 of the driving member, when the driving member is in its rest position, in order to prevent foreign matter from passing between the second shielding member and driving member.

In this arrangement, the first shielding member provides a closure for the free end of the shaft between the driving member in its rest position and the stop means 40, and the second shielding member provides a closure around the shaft between the motor housing and driving member when the driving member is in its rest position.

It should be noted that the boss 57 of motor housing 12 could be provided with a retaining shoulder formed by a groove in the peripheral surface thereof, in a manner similar to groove 53 in axially extending portion 29 of the driving member and the second shielding member provided with an inwardly extending annular rib to mate therewith for more securely holding the second shielding member in position on boss 57 of the motor housing 12.

It should be appreciated that the first and second shielding members may be embodied in a large variety of forms in order to prevent foreign matter from accumulating on the armature shaft 14, spring 44 and driving member. In FIG. 4, one alternate embodiment of the first shielding member, which is carried by the driving member, is shown. In this modification of the first shielding member, parts similar to those in the structure of FIGS. 1-3 are identified by the same number designator with the addition of the letter "a" thereto. The primary differences in the arrangement of FIG. 4 and that in FIGS. 1-3 lies in the use of a modified first shielding member 50a supported by the driving member to provide a closure for the shaft between the driving member in its rest position and stop means 40a.

In the embodiment of FIG. 4, first shielding member 50a encircles stop means 40a and has a closed end wall 60 past the free end of the shaft 14a. In this arrangement, the first shielding member 50a provides a

complete closure for the free end of the shaft from the driving member in its rest position. In this manner, it is assured that all foreign matter is prevented from contacting spring 44a, stop means 40a and shaft 14a from the driving member in its rest position to the end of the shaft. The operation of the driving member in FIG. 4 is the same as described in regard to FIGS. 1-3 and first shielding member 50a moves with driving member 25a when the driving member moves from its rest position to its engaged position.

There is shown in FIG. 5 another modified embodiment of the shielding means from that shown in FIGS. 1-3. In the modification of FIG. 5, parts similar to those in the structure in FIGS. 1-3 are identified by the same number designator with the addition of the letter "b" thereto. The primary difference in the embodiment shown in FIG. 5 from that shown in FIGS. 1-3 lies in the use of a modified second shielding member 51b. The second shielding member in FIG. 5 is tubular or annular in form and is snugly received on portion 57b of motor housing 12b to hold the second shielding member fixed on the motor housing.

In the embodiment of FIG. 5, second shielding member 51b extends from the motor housing and has its annular end 70 completely open to lightly engage or abut against disc portion 28b of drive hub 26b. The end 70 of second shielding member 51b is preferably adapted to resiliently engage disc portion 28b of the driving member when the driving member is in its rest position. In this arrangement end 70 provides a seal with disc portion 28b to prevent foreign matter from passing between the second shielding member and the driving member to contact the shaft, when the driving member is in its rest position. It should be appreciated that the shielding member 51b preferably resiliently engages the driving member but may just extend to adjacent the driving member and prevent most foreign matter from contacting the shaft.

Referring to FIGS. 6, 7 and 8, further modified embodiments of the first and second shielding members are shown and the driving member has been somewhat modified from the driving member shown in FIG. 3. In the modification of FIGS. 6-8, parts similar to those in the structure in FIGS. 1-3 are identified by the same number designators with the addition of the letter "c" thereto. The primary difference in the arrangement of FIG. 6 and that of FIG. 3 lies in the change in shape of the free end of the first shielding member, the location of the threaded portion of the driving member and the shape and location of the second shielding member.

As shown in FIG. 6, the first shielding member 50c is generally annular in form over its entire axial length and is held to the axially extending portion 29c of driving member 25c in the same manner as shown in FIG. 3. In this embodiment, the free end 80 of first shielding member 50c closely encircles stop means 40c, and particularly closely encircles enlarged retaining member 46c. The free end 80 of first shielding member 50c is completely open and extends beyond the retaining member 46c on the opposite side of the retaining member from the location of the driving member, when the driving member is in its rest position. The first shielding member and the outer periphery of the retaining member 45c are sufficiently close and adjacent one another, while preferably out of direct contact, to

prevent dust and other foreign matter from passing between first shielding member 50c and retaining member 45c. The first shielding member rides with the driving member in a manner similar to the arrangement in FIG. 3.

The driving member in FIG. 6 has been modified to show one arrangement for having the driving member support second shielding member 51c. Driving member 25c further includes an annular drive collar 81, which is internally threaded to mesh with the threaded portion 16c of shaft 14c, which has portion 20c shown slightly extended in this embodiment; however, the parts of the driving member could be foreshortened or modified as desired. The drive collar 81 is preferably braised or otherwise fixed to the radially extending disc portion 28c of drive hub 26c to be an integral part thereof. In this arrangement, the drive hub 26c has a smooth inner surface to ride on the smooth surface of portion 20c of shaft 14c beyond the threaded portion. The driving member 25c in FIG. 6 operated in a manner similar to the driving member of FIG. 3 to engage the flywheel of the engine to be started.

The second shielding member 51c is tubular or annular in form and adapted to fit snugly on the peripheral cylindrical surface of the drive collar 81. In order to assure that the shielding member 51c is securely fixed to the drive collar, the drive collar is provided with an annular peripheral groove 82 and a split retaining ring 84 is positioned around shielding member 51c and drive collar 81 over groove 82 to force the shielding member into groove 82.

In the arrangement in FIG. 6, the second shielding member 51c extends from drive collar 81 of driving member 25c to encircle and loosely engage the peripheral surface of boss 57c of motor housing 12c. Shielding member 51c rotates and moves axially with the driving member and, when the driving member returns to its rest position, the shielding member rides onto the peripheral surface of boss 57c of motor housing 12c. To facilitate the end 86 of shielding member 51c easily riding onto boss 57c, end 86 of the shielding member is undercut or internally tapered to provide an increased inner diameter at end 86 so that boss 57c of the motor housing will easily fit within end 86 of the shielding member. In this manner, foreign matter is prevented from contacting shaft 14c between the motor housing and the driving member by shielding member 51c, when the driving member is in its rest position, which is its position except when starting the engine.

FIGS. 9 and 10 illustrate another embodiment of the driving collar and second shielding member of FIGS. 6-8. In this modification, parts similar to those in the structure of FIGS. 6-8 (and FIGS. 1-3) are identified by the same number designator with the addition of the letter "d" thereto. The primary difference between the structure in FIGS. 9 and 10 and in FIGS. 6-8 lies in the peripheral shape of the drive collar and the configuration of the second shielding member supported thereby. More specifically, drive collar 81d is the same as in FIG. 6, except that the peripheral surface is hexagonal in form and resembles a hexagonal shaped nut. The hexagonal surface of drive collar 81d, which is fixed to the drive hub as in FIG. 6, provides opposed surfaces to permit holding of the driving member by a

tool, such as a wrench, to prevent rotation of shaft 14d when nut 48d is threaded on the free end of shaft 14d. Shaft 14d must be presented from rotation in order to permit tightening of nut 48d after the driving member is positioned on the shaft. Of course, other means for permitting holding of the driving member by a tool, besides the configuration of the drive collar, could be employed, for example, providing the portion 32d of engaging member 30d with opposed surfaces.

The second shielding member 51d includes a hexagonal shaped portion 100 conforming to the shape of drive collar 81d and adapted to fit snugly on the peripheral surface of drive collar 81d. Shielding member 51d also includes an increased dimension annular portion 102 adapted to encircle boss portion 57d of motor housing 12d.

The drive collar is provided with six grooves 104 at the vertices of the hexagonal periphery and the hexagonal shaped portion 100 of shielding member 51d has six internally extending ribs 106 across the vertices thereof to mate with the grooves 104. The surfaces 107 of the grooves 104 provide shoulders or abutments for the ribs 106 to securely hold shielding member 51d on the drive collar of the driving member.

The operation of driving member 25d in FIG. 9 is the same as for the driving members of FIGS. 3 and 6. When the driving member is moved toward its engaged position with the flywheel by rotation of the shaft, the first shielding member 50d and the second shielding member 51d move axially with the driving member. When the driving member returns to its rest position, drive collar 81d abutting shoulder 18d, the annular portion 102 of second shielding member 51d will loosely encircle boss 57d of motor housing 12d.

It should be appreciated by those skilled in the art that other variations and modifications of the first and second shielding members and the means of supporting them can be made. For example, the first shielding member could be supported on the free end of the shaft and encircle an extension of the driving member so as not to interfere with movement of the driving member and its engagement of the flywheel. Furthermore, the first shielding member could be supported by the free end of the shaft and be accordion in form along its axial length between the stop means and driving member, so that, when the driving member is rotated, the first shielding member will resiliently fold to permit movement of the driving member. In this latter arrangement of the first shielding member, the spring between the driving member and stop means may be omitted.

It should be also appreciated that the shielding means in accordance with the present invention provides a compact and economical structure employed in the assembly. The shielding means prevents foreign matter from contacting and accumulating on the shaft and between the shaft and driving member to assure proper operation of the driving member in rugged outdoor use and varying environmental condition.

While the present invention has been described with particular reference to specific embodiments thereof in the interest of complete definiteness, it will be understood that it may be embodied in a large variety of forms diverse from the ones specifically shown and described without departing from the scope and spirit of the invention as defined by the appended claims.

I CLAIM:

1. An engine starter assembly comprising:
a starter motor having a housing;
a rotatable shaft extending from the motor housing
and having a threaded portion;
a tubular driving member having an internal
threaded portion meshing with the threaded portion
of the shaft to be rotatable with the shaft and
axially movable thereon and having an external
toothed portion to cooperate with part of an engine
to be started, the driving member having a longitudinal
portion including means for permitting holding of the driving member by a tool to
prevent rotation of the shaft;
stop means supported by the shaft to limit axial
movement of the driving member when rotated;
a spring member supported between the driving
member and stop means to retard axial movement
of the driving member toward the stop means; and
shielding means for providing a covering for at least a
portion of the shaft, the shielding means including
a shielding member supported by the driving
member and extending to encircle the shaft to provide
a closure between the driving member and
stop means, when the driving member is in its rest
position.
2. The engine starter assembly of claim 1 in which
the means for permitting holding of the driving member
comprises opposed surfaces on the peripheral surface
of the longitudinal portion of the driving member.
3. The engine starter assembly of claim 1 in which
the driving member has a portion with a peripheral surface
extending toward a stop means and having a
retaining shoulder positioned along the peripheral surface,
the shielding member being tubular in form and
made of resilient material, the shielding member being
supported by the portion extending toward the stop
means and having an internal retaining portion mating

with the shoulder to securely hold the shielding member to the driving member.

4. The engine starter assembly of claim 3 in which the retaining shoulder is provided by an annular groove in the peripheral surface, and the internal retaining portion is provided by an internal annular rib around the inner surface of the shielding member.

5. The engine starter assembly of claim 1 in which the tubular shielding member extends to encircle the stop means and free end of the shaft and has a closed end wall past the free end of the shaft to provide a complete closure around the spring, stop means and free end of the shaft.

6. The engine starter assembly of claim 1 in which the shielding means further includes another shielding member supported by one of the motor housing and driving member and extending to encircle the shaft to provide a closure between the driving member and motor housing, when the driving member is in its rest position.

7. The engine starter drive assembly of claim 6 in which the longitudinal portion of the driving member extends toward the motor housing and has a peripheral surface, the longitudinal portion having a retaining shoulder positioned along the peripheral surface; and said another shielding member is tubular in form and made of a resilient material, said another shielding member being supported by the longitudinal portion and including an internal retaining portion mating with the shoulder of the longitudinal portion to securely hold said another shielding member supported in position.

8. The engine starter assembly of claim 1 in which the longitudinal portion of the driving member extends toward the motor housing and includes the internal threaded portion of the driving member.

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