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STARTING APPARATUS

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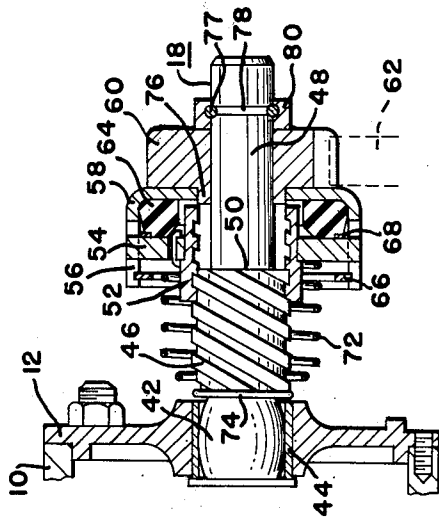


Fig. 2

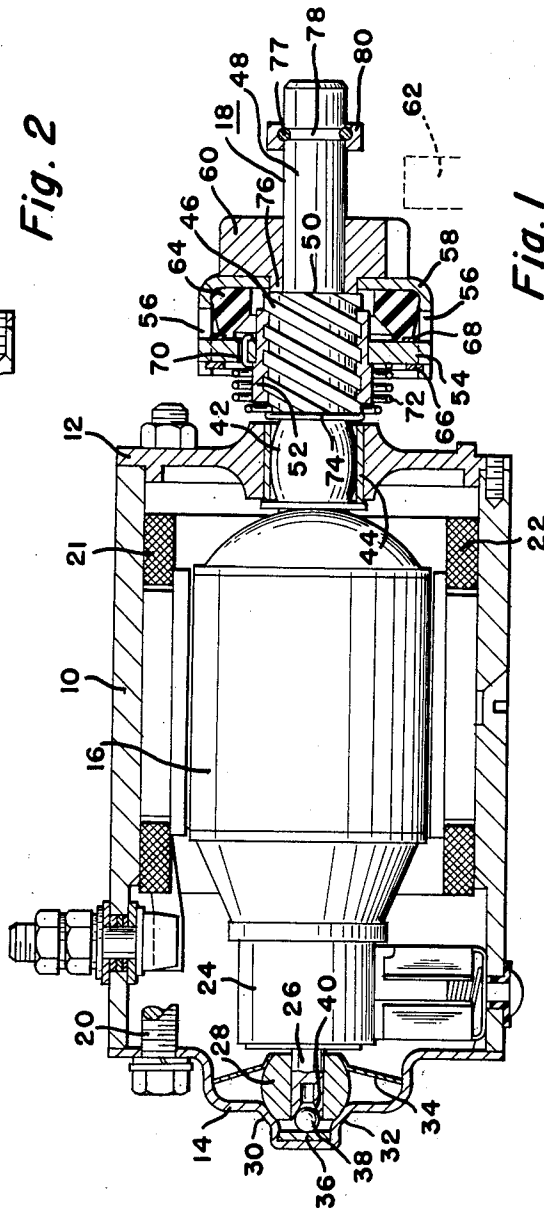


Fig. 1

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This invention relates to a starting apparatus for cranking an internal combustion engine.

One of the objects of this invention is to provide a starting apparatus for cranking an outboard engine or the like, which is economical to manufacture and durable in operation.

A further object of this invention is to provide a starter drive that includes a shaft having an integral threaded portion extending along a part of its length and a smooth reduced portion, the juncture of the threaded portion and smooth portion forming a stop shoulder for a pinion assembly that is threaded onto the threaded portion and which has a part slidably engaging the smooth portion of the shaft.

Still another object of this invention is to provide a starter apparatus including an electric motor having a shaft, one end of which is supported by a spherical bearing, the shaft carrying a pinion assembly which at times becomes meshed with the ring gear of an engine to be cranked.

Another object of this invention is to provide a starting apparatus including an electric motor having a shaft which is supported by spaced bearings that permit slight tilting movement of the shaft, the shaft carrying a pinion assembly at one end thereof.

A further object of this invention is to provide a bearing for the shaft of an electric starting motor or the like that includes a porous metal bushing engaging a length of the motor shaft which is crown ground to have a central fixed diameter section that tapers off in opposite directions toward reduced diameter sections.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings wherein a preferred embodiment of the present invention is clearly shown.

In the drawings:

FIGURE 1 is a sectional view of a starting apparatus made in accordance with this invention.

FIGURE 2 is a view of a portion of FIGURE 1 showing the pinion of the starting apparatus of this invention in mesh with a ring gear to be cranked.

Referring now to the drawings and more particularly to FIGURE 1, the starting apparatus of this invention includes an electric motor having a housing 10 and end frames 12 and 14. The housing contains the usual armature 16 having an armature shaft designated in its entirety by reference numeral 18. One or more through bolts 20 are provided which hold the end frames 12 and 14 in fixed relationship with the main frame 10. The motor has field windings 21 and 22 positioned as shown in FIGURE 1. The armature 16 has the usual coil windings connected with a commutator 24 that is carried by the armature shaft.

The armature shaft 18 has a portion 26 located adjacent the commutator 24 that is fitted within a bearing member 28. The bearing member 28 has a spherical outer contour engaging arcuately extending portions 30 and 32 of the end frame 14. A plate member 34 extends between the end frame 14 and the bearing member 28 and has arcuate portions engaging the bearing member 28. A plate member 36 is positioned between the end frame 14 and a ball 38. It is seen that the ball is

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located between the plate member 36 and a groove formed in the shaft 26 which is spherical to accommodate the ball 38.

The shaft 18 also has a crown ground portion 42 which is of larger diameter at its center than it is at its opposite ends. The taper away from the center section is arcuate and has been greatly exaggerated in the drawings. In practice, the section 42 is ground slightly so that the shaft tapers toward reduced sections from a larger diameter central section. It is seen that the crown ground portion 42 of the shaft engages a porous metal bearing 44 which is located in the end frame 12.

The shaft 18 has an integral threaded portion 46 and a smooth reduced portion 48. It is seen that the junction of the threaded portion 46 and the smooth portion 48 form a shoulder 50 which operates as a stop for the pinion assembly in a manner to be more fully described hereinafter.

The pinion assembly of this invention includes a nut member 52 having an internal threaded portion which engages the integral threaded portion 46 of the shaft 18. The pinion assembly further includes a washer member 54 that is brazed or otherwise secured to the nut member 52 and which has portions positioned within longitudinally extending slots 56 formed in a shell member 58. The shell member 58 is brazed or otherwise secured to a pinion member 60 having teeth which are adapted to engage a ring gear 62 of an internal combustion engine to be cranked. An annular member 64 formed of rubber or other elastomeric material is positioned between the washer 54 and one wall of the shell member 58. A snap ring 66 holds the assembly together and a thin washer 68 is positioned between the annular rubber member 64 and the washer 54. The washer member 54 has one or more openings 70 which receive one end of a torsion spring 72. The spring may be passed through one of the openings and then bent to provide a positive connection between one end of the spring and the pinion assembly. The opposite end of the spring is fixed to the shaft 18 as at 74 so that the torsion spring tends to pull the pinion assembly to the position illustrated in FIGURE 1 wherein a portion of the pinion member 76 engages the wall 50 formed by the threaded portion 46 and the reduced portion 48 of the shaft.

The smooth portion of the armature shaft 18 carries a pinion stop which includes a snap ring 77 fitted within a groove 78 formed in the shaft. An annular member 80 has an internal groove which receives the snap ring 77 and this annular member serves as a stop for the pinion assembly when it is thrown into mesh with the ring gear 62.

In operation of the starter drive, when the motor is energized to cause a rotation of the shaft 18, the pinion assembly moves rightwardly in FIGURE 1 to the position of FIGURE 2 where it becomes meshed with the ring gear 62. The pinion assembly moves rightwardly due to the fact that the shaft initially rotates much faster than the pinion assembly so that it is moved along the shaft by the engagement of the threaded portion 46 with the internal threads of nut member 52. The nut member, of course, drives the washer 54 which, in turn, drives the shell member 58 and the pinion member 60. It is seen that the pinion member 60 slides on the smooth portion 48 during the time that it is moving to a meshed position and during the time that it is returning from its meshed position. Once the engine starts, the pinion assembly is driven faster than the shaft 48 is rotating and it therefore moves leftwardly along the threaded portion 46 of the shaft to the FIGURE 1 position. The pinion assembly is at all times biased towards its FIGURE 1 position by the torsion spring 72 which is connected between the pinion assembly and the shaft. The shoulder

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50 engaging portion 76 of the pinion provides a stop for the pinion during its leftward movement.

The provision of the crown ground portion 42 of the shaft assures that the porous metal bearing 44 will not be scored or otherwise injured during operation of the starting apparatus. This is true because the shaft may tilt to some minor extent without causing a scoring or roughening of the porous metal bearing 44. The bearing assembly which includes the bearing member 28 also permits the armature shaft 18 to tilt to some extent during the operation of the starting apparatus. Thus, the bearing member 23 has universal movement with respect to the end frame 14 and the ball 38 takes up the end thrust applied to the shaft 18 during meshing of the pinion 60 with the ring gear 62. It is to be pointed out that when end tooth abutment occurs between the pinion 60 and the ring gear 62, the member 64 is compressed and thrust to the left in FIGURE 1 is set up. The ball 38 absorbs the thrust and allows the abutment to be cleared by providing low frictional drag to the rotation of shaft 26 as compared to other types of bearings. It has been found that the bearing apparatus of this invention provides for good meshing and unmeshing performance and also provides for long life of the parts of the starting apparatus.

While the embodiment of the present invention as herein disclosed constitutes a preferred form, it is to be understood that other forms might be adopted.

What is claimed is as follows:

1. Engine cranking apparatus comprising, an electric motor having first and second end frames, a shaft carrying the armature of said electric motor and journaled in first and second bearings supported respectively in said first and second end frames, said shaft having a first portion extending beyond said first end frame, said first bearing being a plain metal bearing having an inner annular surface of uniform diameter, said shaft having a crown ground portion fitting in said first bearing and directly engaging the inner annular surface of said first bearing, said first portion of said shaft that extends beyond said

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first end frame having a threaded section formed with integral threads and a small diameter section of uniform diameter, said smaller diameter section and said threaded section having a junction which forms an annular stop shoulder, a unitary pinion member having a central bore slidably engaging the smaller diameter section of said shaft and having an annular section which is directly engageable with said stop shoulder in one position of said pinion member, a generally cup-shaped shell member secured to said pinion member, and nut means engageable with said threaded section of said shaft for driving said shell member, said nut means, shell member and pinion member being shifted to a cranking position solely by rotation of said shaft when said motor is energized.

2. Engine cranking apparatus according to claim 1 wherein an annular member formed of elastomeric material is positioned between said shell member and nut means.

3. Engine cranking apparatus according to claim 1 wherein a torsion spring is connected between the shaft and the nut means to urge the annular section of the pinion member toward the stop shoulder.

4. Engine cranking apparatus according to claim 1 wherein the second bearing includes a spherical thrust bearing.

References Cited in the file of this patent

UNITED STATES PATENTS

1,390,077	Bijur	Sept. 6, 1921
2,228,394	Marvin et al.	Jan. 14, 1941
2,423,063	Buxton	June 24, 1947
2,813,762	Bridenbough	Nov. 19, 1957
2,838,701	Kuhagen	June 10, 1958
2,944,427	Antonidis et al.	July 12, 1960
2,944,428	Antonidis et al.	July 12, 1960

FOREIGN PATENTS

837,530	Great Britain	June 15, 1960
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