

[54] **STARTER PINION WITH MOLDED BASE
AND DRIVE**

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[51] Int. Cl. **F02n 11/00**

[58] Field of Search ... **310/254, 258, 259, 179, 180;
290/37, 38, 48; 123/179**

[56] **References Cited**

UNITED STATES PATENTS

2,944,427	7/1960	Antonidis et al.	290/38 X
3,177,368	4/1965	Seilly	290/38
2,811,658	10/1957	Brainard	310/258 X
3,062,966	11/1962	Merrian	290/38
3,084,561	4/1963	Mattson	290/38 X
2,818,735	1/1958	Sabatini	290/38 X

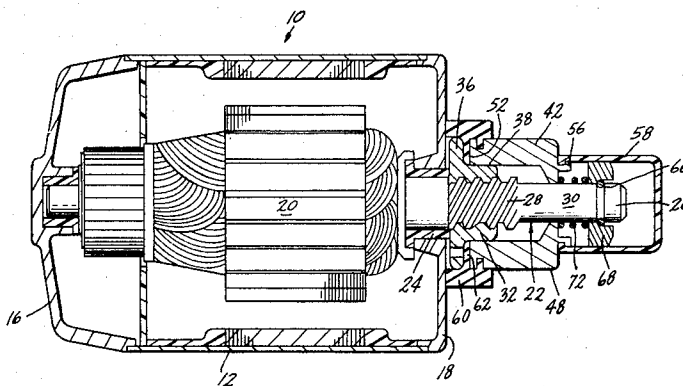
Primary Examiner—G. R. Simmons

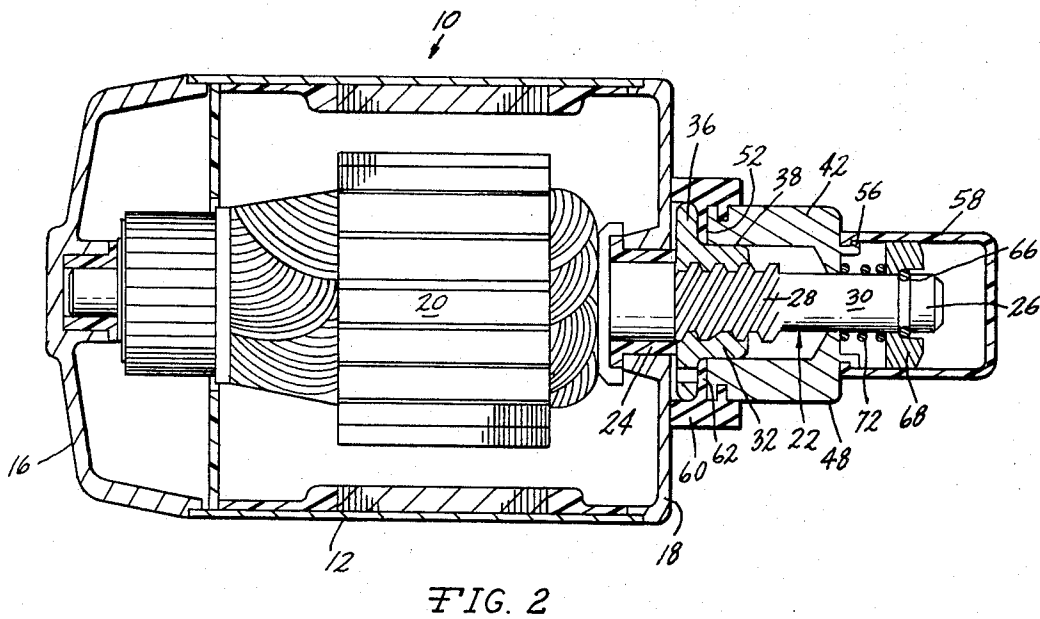
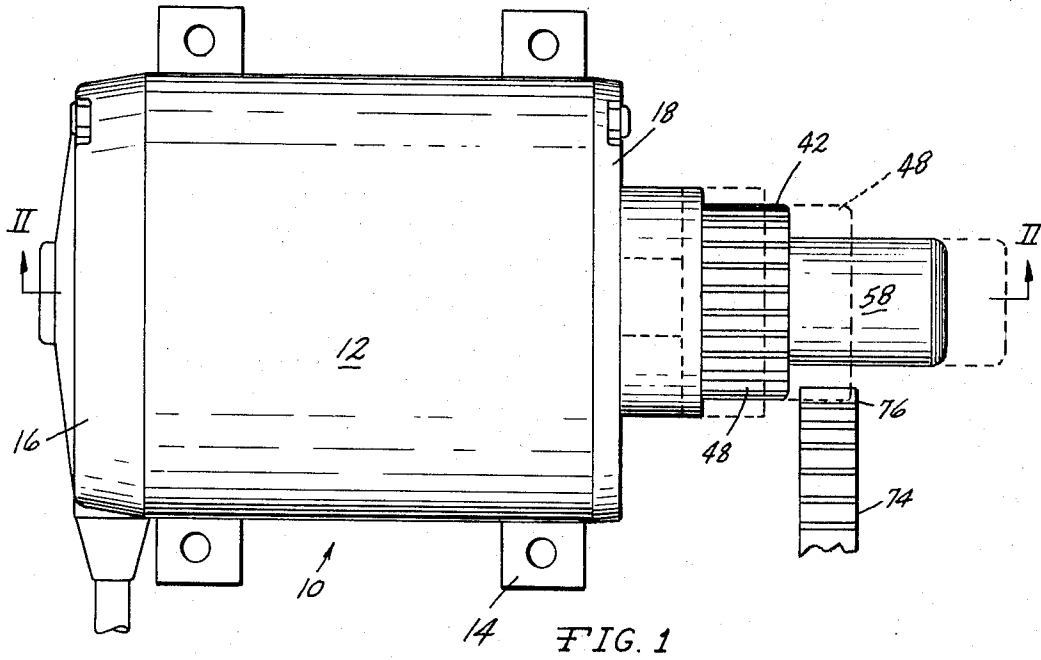
Attorney, Agent, or Firm—Beaman & Beaman

[57] **ABSTRACT**

A starter pinion assembly for use with electric starters for internal combustion engines wherein a starter pinion gear is axially displaced upon a drive shaft during initial rotation of the shaft to engage the pinion gear with an engine flywheel in order to crank the flywheel. The starter pinion includes a hub portion upon which the pinion gear teeth are mounted, the pinion gear teeth being capable of rotation relative to the hub portion, and resilient frictional drive means are interposed between the hub and toothed gear portion through which torsional forces are transmitted. Axial forces imposed upon the hub maintain an effective frictional drive connection with the toothed gear portion, and impact and shock forces are absorbed. A stop mounted upon the drive shaft limits axial movement of the starter pinion assembly, and a compression spring maintains the starter assembly in the "retracted" position when the drive shaft is not being rotated. The resilient drive means prevents binding of the pinion assembly with the stop. A resilient bumper mounted upon the starter assembly, formed of the friction material, absorbs axial movement of the starter assembly toward the noncranking position, brakes the pinion assembly against rotation and also functions as a dust seal.

15 Claims, 4 Drawing Figures





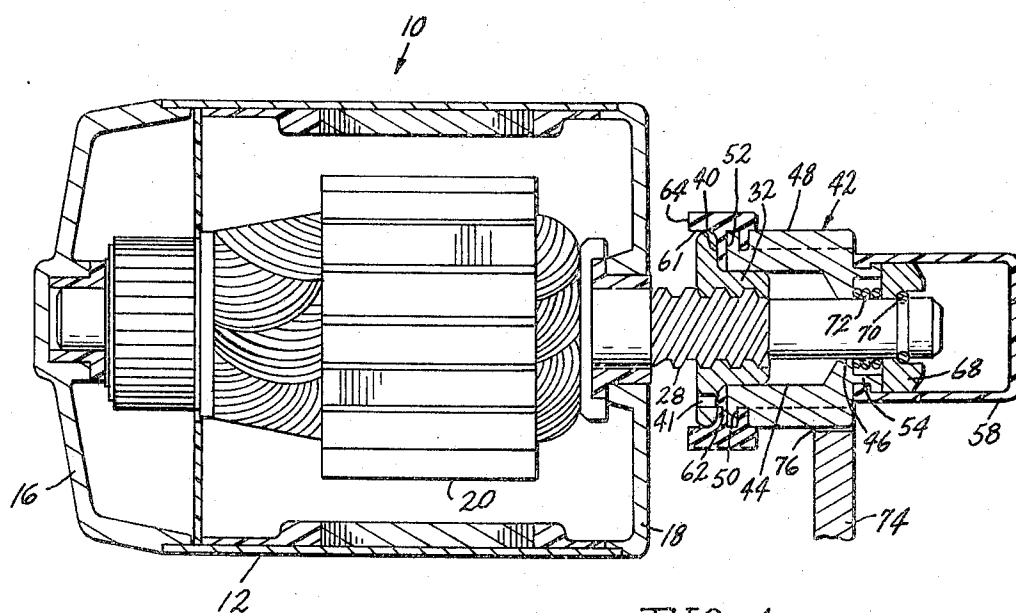
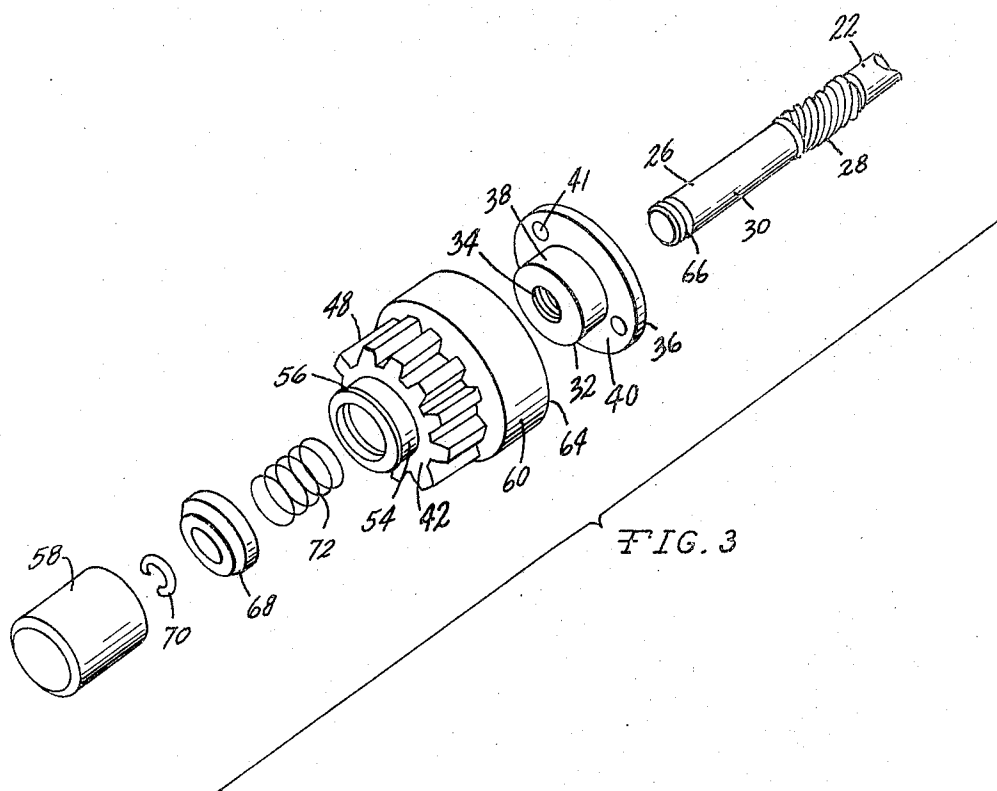


FIG. 4

STARTER PINION WITH MOLDED BASE AND DRIVE

REFERENCE TO RELATED APPLICATIONS

This application is directed to electric starter apparatus also disclosed in my copending U.S. application Ser. No. 283,559 filed Aug. 24, 1972.

BACKGROUND OF THE INVENTION

The invention pertains to electric starter apparatus for internal combustion engines utilizing pinion gears axially displaceable upon a drive shaft.

Many electric starters for internal combustion engines use Bendix type apparatus wherein a pinion gear is axially displaceable upon a drive shaft rotated by an electric motor. Initial rotation of the drive shaft axially moves the pinion gear upon the shaft for engagement with gear teeth formed on the engine flywheel, wherein the flywheel is rotated and the engine cranked for starting purposes. Such Bendix type starters have been constructed in a wide variety of mechanical variations, and the basic principles have proven acceptable for the function designed.

While Bendix type starters have been constructed utilizing shock absorbing features, those arrangements presently available are relatively expensive, and are not readily incorporable into concise apparatus which is adaptable for use with small electric starters and small internal combustion engines, such as used on lawn mowers and the like. Prior art electric starters using cushioning devices are shown in U.S. Pat. Nos. 1,876,642; 1,955,110; 2,271,216 and 2,876,644, and starters such as those shown in these patents do not meet the aforementioned prerequisites for electric starters for use with small engines.

In an economical electric starter construction the number of components must be minimized, and the interrelationship between operating components must be as simple and dependable as possible. Electric starters mounted upon small internal combustion engines are subjected to extensive vibration forces, and considerable wear will occur between the starter components due to such vibration, even when the starter itself is not energized. The relationship of components, and the multiplicity of components of electric starters of the prior art seriously affect the economics of manufacturing and dependability of operation of prior constructions.

BRIEF DESCRIPTION OF THE INVENTION

It is an object of the invention to provide a starter pinion assembly for electric starters, particularly electric starters used with small internal combustion engines such as used on lawn mowers, garden tractors, and the like. The starter assembly of the invention utilizes a minimum of components, components which are economically manufactured, dependable in operation, and the entire assembly is of a concise configuration occupying a minimum of space, and requires a minimum of clearance for association with engine components.

The starter assembly includes a hub member and a toothed pinion gear member mounted upon a thread formed on a drive shaft. The pinion member is rotatably mounted upon the hub member, and both members include radially extending opposed surfaces be-

tween which a friction, torque transmitting, resilient material is interposed.

The relationship of the radial flange defined upon the hub which is in opposed relation to a radially opposed surface on the pinion gear between which the friction and shock absorbing material is related is such that as the pinion gear is axially moved into alignment with the engine flywheel for engine cranking purposes, the resistance of rotation of the pinion gear during cranking and engagement of the gear with a stop causes a compression of the friction material. Thus, the higher the torque requirements during engine cranking, the greater the frictional engagement between the hub and pinion gear components insuring that the necessary torque be transmitted to the pinion gear. The resilient material produces a reverse torque which prevents binding of the gear and its stop and its ability to compress aids in aligning the pinion gear teeth with the flywheel teeth of the engine to be started.

The drive shaft upon which the starter pinion is mounted is of a cantilever form and includes a stop member located near the shaft end. A compression spring is interposed between the stop member and the pinion gear which biases the pinion gear assembly towards its normal or noncranking position. A stop sleeve is defined upon the pinion gear to enclose the spring, yet not interfere therewith, and a cover member encloses the spring, stop sleeve and stop member to protect these components.

In accord with the concept of the invention the friction and shock absorbing material is bonded to the pinion gear, and is of a resilient material, such as rubber, or the like, and includes an axially extending portion which serves as a bumper and a brake for engaging the motor housing when the starter pinion assembly is moved to its extreme position toward the motor housing. Thus, upon the engine starting, and rotating the pinion gear in a direction which disengages the pinion gear from the flywheel gear teeth, this rapid axial movement of the pinion gear assembly toward the engine housing is absorbed by the flexible material "bumper" and the pinion gear rotation is frictionally braked.

BRIEF DESCRIPTION OF THE DRAWINGS

The aforementioned objects and advantages of the invention will be appreciated from the following description and accompanying drawings wherein:

FIG. 1 is an elevational view of a pinion gear starter assembly, and electric starter motor, as related to an engine flywheel, the cranking position of the pinion gear assembly being shown in dotted lines,

FIG. 2 is a sectional view of FIG. 1 as taken along Section II—II thereof,

FIG. 3 is an exploded, perspective, detail view of starter assembly, and

FIG. 4 is a view similar to FIG. 2 illustrating the starter components in cranking relationship.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The starter pinion assembly structure of the invention is used with an electric starter motor, such as of the 12 volt DC or 110 volt AC type. While the illustrated starter structure was specifically designed for using with starting systems used with lawn mower size engines, it will be appreciated by those skilled in the art

that the concepts may be employed with starters for all sizes of internal combustion engines. However, the concepts of the invention are particularly used to advantage with starter systems for small engines.

In the drawings the electric motor is indicated at 10, and the motor includes a housing 12 which may be mounted to the engine by mounting bracket 14 affixed to the housing. The housing 12 includes end caps 16 and 18 having bearing structure for rotatably supporting the armature, generally indicated at 20.

The armature 20 includes a drive shaft extension 22, FIG. 2, which is of a cantilever type, having a cylindrical portion received within end cap bearing 24, and the end of the shaft extension is indicated at 26.

The drive shaft 22 is provided with a threaded portion 28 wherein the threads are of a heavy duty multiple pitch type, and the shaft is of a reduced diameter cylindrical configuration at 30, between the thread 28 and the outer end 26.

A hub member 32 includes a threaded bore 34 which mates with the threads 28, and the hub includes a radial flange 36, and an axially extending cylindrical portion 38. The flange 36 is of a circular configuration, and includes a radial surface or face 40 facing the shaft end 26 and holes 41 extend through the flange in an axial direction.

The pinion gear 42 is rotatably mounted upon the hub portion 38, as the cylindrical bore 44 of the pinion is slightly larger than the hub portion 38. As will be noted in FIGS. 2 and 4, the diameter of the pinion bore is reduced at 46 whereby a close, but rotatable fit exists between the right end of the pinion, FIG. 2, and the shaft portion 30. The pinion gear 42 is provided with gear teeth 48, and is formed with an annular recessed groove 50 to aid in the attachment of the flexible material thereto, as will be later described. The inner end of the pinion gear includes a radially extending face or surface 52 in opposed relation to the flange surface 40. The right end of the pinion 42 is provided with an annular abutment sleeve 54 having a lip 56 whereby the protective cover 58, later described, may be attached to the pinion gear.

A frictional shock absorbing member 60 of rubber, or similar synthetic resilient material, is molded upon the pinion 42, and is received within the groove 50, whereby the resilient material is firmly bonded to the pinion. The member 60 includes a recess 61 defining an annular inner extending lip 62 received between the surfaces 40 and 52 and this lip is subjected to compressive forces during cranking of the engine, as will be described. The hub flange 36 snaps into recess 61 to maintain the assembly of the hub and pinion gear. The member 60 is of an enlarged thickness at its peripheral region, and is of such axial length extending to the left, FIG. 2, that the leftmost edge 64 of the member is left of the flange 36 whereby the edge 64 engages the housing end cap 18, FIG. 2, when the starter pinion assembly is at the noncranking or normal position illustrated in FIG. 2 for braking and dust seal purposes.

The end of the shaft 22 is provided with a snap ring receiving groove 66, and an annular stop member 68 is mounted upon the shaft end, and is retained in this position by the snap ring 70 cooperating with the groove 66, and the bore of the stop member.

A compression spring 72 is interposed between the stop member 68, and the right end of the pinion 42, FIGS. 2 and 4. The compression spring 72 imposes a

biasing force on the pinion toward the left, and the spring normally maintains the edge 64 of member 60 in engagement with the housing end cap 18. The radial dimension of the stop member 68 is substantially equal to the radial dimension of the stop sleeve lip 56, as will be appreciated from the drawing.

An annular cover 58, of synthetic material, is attached to the pinion 42 by snapping the cover over the stop sleeve lip 56, and the cover 58 encloses the shaft portion 30, the stop member 68, the stop sleeve and the spring 72.

In operation, the components will initially be related as shown in solid lines in FIGS. 1 and 2. The pinion gear assembly will be at its innermost, at rest position due to the biasing force exerted by the spring 72, and in this position the pinion gear is out of alignment with the engine flywheel 74 to be cranked, and the edge 64 is engaging end cap 18 keeping foreign matter out of the hub and shaft 22.

Upon energizing the motor 10 the rapid acceleration of the drive shaft 22 will produce a relative rotation between the thread 28 and the hub 32 causing axial movement of the hub, pinion gear 42 and member 60 to the right to produce a meshing of the pinion gear teeth 48 with the flywheel teeth 76, as represented by dotted lines in FIG. 1, and as shown in full lines in FIG. 4. This movement of the pinion gear assembly to the right causes the right edge of the stop sleeve 54 to rapidly engage the stop member 68 as shown in FIG. 4, and in this position the pinion gear teeth are in full mesh with the flywheel teeth.

As the motor armature rotates, the hub 32 will be rotated in a direction tending to move the pinion gear 42 to the right. Of course, the engagement of the stop sleeve, with the stop 68, and the torque imposed upon the pinion gear causes the flange 36 to be forced against the friction member lip 62 compressing this material and establishing an effective frictional driving relationship between the flange and the pinion gear. This driving connection is enhanced by the holes 41, into which the lip material tends to extrude. Thus, the pinion gear 42 is rotatably driven through the lip 62, and the lip is highly compressed between the surfaces 40 and 52.

Upon the engine starting, the pinion 42 will be rotated faster by the flywheel 74, than the rate of rotation of the shaft 22 under the influence of the electric motor, and such condition rotates the pinion gear, and hub 32 in the direction on the thread 28 moving the pinion gear assembly to the left toward the housing end cap 18. This axial movement of the hub member and pinion gear continues until the edge 64 engages the end cap 18 as shown in FIG. 2. At this time the pinion gear 42 will be out of engagement with the flywheel teeth 76, and the starter motor 10 is deenergized. The spring 72 will insure that the pinion gear does not engage the flywheel until the starter motor is again energized.

The resilient and flexible nature of the material of member 60 serves several functions. First, the torque imposed on the lip 62 by the flange 36 produces a torsional spring effect that prevents the pinion gear 42 from "locking" or binding due to its engagement with stop member 68. The resilience of the material of lip 62 produces a reverse torsion on the gear 42 after the gear engages the stop member which "backs off" the hub 32 on the thread 28 slightly to prevent the gear from locking to the stop. Secondly, the material of lip 62 func-

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tions as a shock absorber and is able to slightly compress if the leading edge of gear teeth 48 engage the edge of flywheel teeth 76 as the teeth seek alignment. This ability of the lip to compress permits the gear teeth to align and mesh and the lip absorbs the shock of engagement of the misaligned teeth. Of course, the leading edge of teeth 48 are rounded and beveled to aid meshing. The fact that the lip and flange may be dimensioned so as to radially lie within the desired diametrical dimension of the pinion gear teeth 48, lends to the concise configuration of the starter pinion assembly, and the construction minimizes the likelihood of foreign matter affecting the frictional relationship between the starter components.

It is appreciated that various modifications to the inventive concept may be apparent to those skilled in the art without departing from the scope of the invention.

I claim:

1. An electric starter for starting an internal combustion engine comprising, in combination, an electric motor having a housing and a rotatable output shaft extending from said housing having an axis, said shaft having an outer end and an inner portion disposed adjacent said housing, a hub rotatably mounted on said shaft, intermeshing cam means formed on said shaft and said hub rotating said hub and producing axial movement of said hub upon said shaft during relative rotation between said hub and said shaft, a pinion gear concentrically mounted on said shaft for rotational and axial movement thereon, stop means mounted on said shaft limiting axial movement of said gear toward said outer end, radially extending axially spaced opposed surfaces defined on said hub and said gear, and resilient friction means interposed between said hub and gear surfaces transmitting torque from said hub to said gear to rotate said gear, said hub surface facing in the direction of axial movement of said gear to engage said gear with engine starter structure whereby said resilient means is compressed between said surfaces during engine cranking.

2. In an electric starter as in claim 1 wherein said stop means is mounted on said shaft adjacent said outer end, and a compression spring interposed between said stop means and said gear biasing said gear toward said motor housing.

3. In an electric starter as in claim 1, a resilient shock absorber mounted on said gear engagable with said motor housing limiting axial movement of said gear on said shaft toward said housing and braking rotation of said gear with respect to said housing.

4. In an electric starter as in claim 1 wherein said resilient means is molded upon said gear.

5. In an electric starter as in claim 4 wherein said resilient means and said shock absorber are defined by a homogeneous resilient element mounted upon said gear.

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6. In an electric starter as in claim 1 wherein said hub includes a radially extending flange and an axially extending cylindrical portion, said gear having a cylindrical bore engaging said axially extending portion wherein said hub concentrically supports said gear on said shaft.

7. In an electric starter as in claim 6 wherein said radially extending hub surface is defined on said flange.

8. In an electric starter as in claim 1 wherein said cam means comprises a screw thread defined on said shaft inner portion and a mating screw thread defined on said hub.

9. A pinion gear assembly for an electric starter for internal combustion engines comprising, in combination, an annular hub having an axis, a bore and a first radially extending surface, a gear mounted upon said hub for relative rotational and axial movement thereon, a second radially extending surface defined upon said gear in opposed relation to said first surface, and resilient material interposed between said surfaces for transmitting torque forces between said hub and said gear.

10. In a pinion gear assembly as in claim 9 wherein said resilient material is bonded to said gear.

11. In a pinion gear assembly as in claim 9, a screw thread defined in said hub bore.

12. In an electric starter assembly, in combination, a rotatable drive shaft having an axis and first and second axially spaced portions, a hub rotatably mounted on said shaft first portion, engaging threads formed on said shaft first portion and said hub for rotating said hub and producing axial movement of said hub upon said shaft during relative rotation between said hub and said shaft, a pinion gear rotatably mounted upon said hub and axially movable thereon, stop means mounted on said shaft second portion limiting axial movement of said hub and gear on said shaft, radially extending, axially spaced opposed surfaces defined on said hub and said gear, and resilient friction material interposed between said hub and gear surfaces for transmitting torque from said hub to said gear, said hub surface facing in the axial direction of movement of said hub and gear to operatively engage said gear with engine starter structure.

13. In an electric starter assembly as in claim 12 wherein said resilient material is bonded to said gear.

14. In an electric starter assembly as in claim 12, a compression spring mounted on said shaft interposed between said stops means and said gear biasing said gear toward said hub surface and said first shaft portion.

15. In an electric starter assembly as in claim 14, an annular cover mounted on said gear encompassing said stop means and said spring.

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