

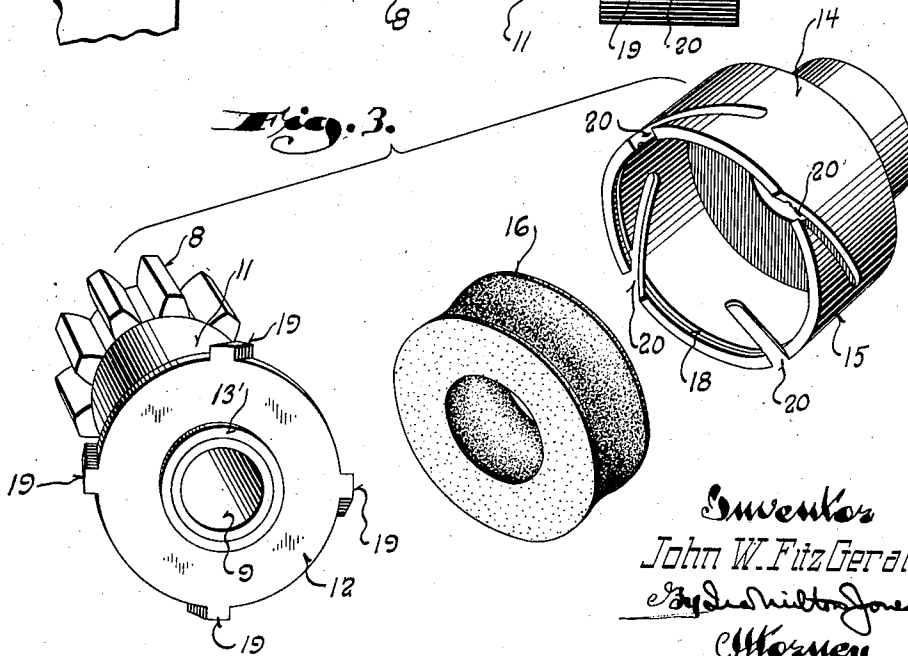
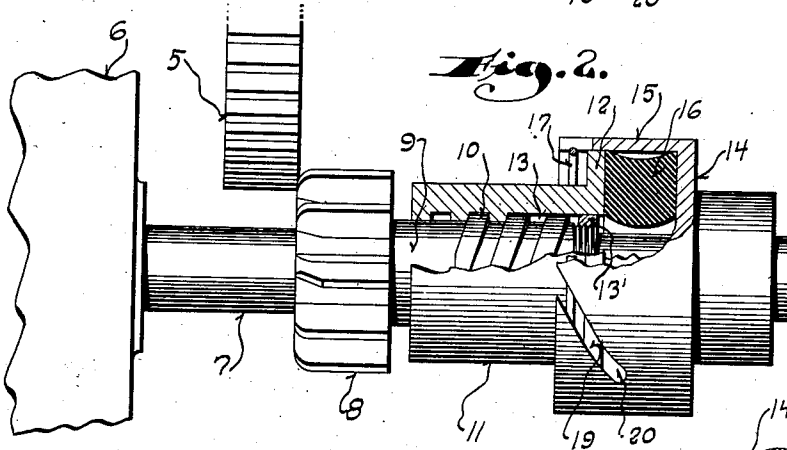
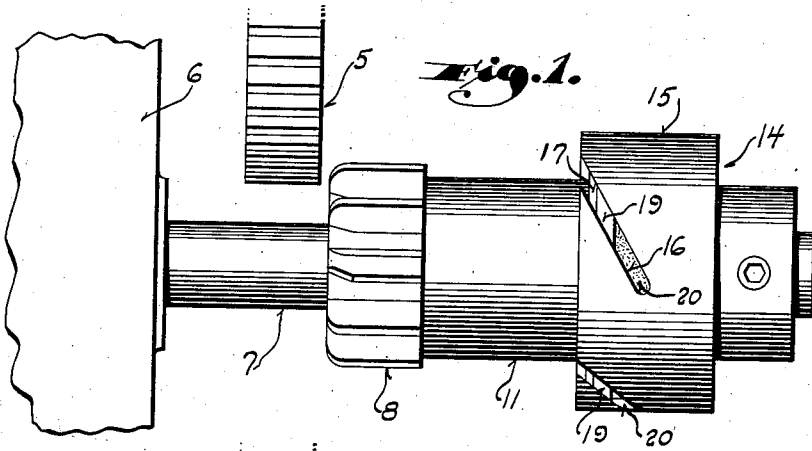
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J. W. FITZ GERALD

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ENGINE STARTER

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Inventor
John W. FitzGerald
By *Edwin H. Jones*
Attorney

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ENGINE STARTER

John W. Fitz Gerald, Milwaukee, Wis., assignor
to Briggs & Stratton Corporation, Milwaukee,
Wis., a corporation of Delaware

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This invention relates to engine starters and refers particularly to starters for automobile engines.

Starters of this type now generally comprise a motor driven shaft having a pinion mounted thereon for engagement with the ring gear of the engine and means to propel the pinion forwardly into mesh with the ring gear upon initial operation of the starting motor. Usually there is no interference with the proper engagement of the pinion and ring gear, but at times the pinion and ring gear will meet with their teeth abutting end to end. When this occurs, the mechanism which propels the pinion forwardly must yield and a slight rotation must be imparted to the pinion to permit its proper engagement with the ring gear.

Heretofore, various schemes have been proposed to take care of this contingency, but most of the devices heretofore used have lacked positiveness so that at times the starter would actually jam.

It is therefore one of the objects of this invention to provide an improved construction for engine starters of the character described which incorporates means for positively relieving the parts of the tension or stress which holds the pinion and ring gear improperly meshed to thus assure proper meshing at all times.

More specifically it is an object of this invention to provide a starter construction of the character described which is so designed that in the event of improper engagement between the pinion and ring gear, the pinion will be retracted slightly to disengage the same from the ring gear and permit its free rotation into proper position with respect to the teeth of the ring gear.

Another object of this invention is to provide a starter construction of the character described wherein relative rotation between two yieldingly coupled parts, which occurs the instant forward propulsion of the pinion is arrested, operates to retract the pinion slightly and permit it to be freely turned into proper relationship with the teeth of the ring gear.

The mechanism used to propel the pinion forwardly comprises essentially a screw and nut, and as only the inertia of one of these parts is depended upon to hold it against turning while the other is driven, it is essential that a free running fit be at all times maintained between these parts.

In starter constructions of the type to which this invention appertains, a yielding cushion is compressed whenever forward propulsion of the

pinion is arrested, and in the past the compression forces had to be carried by the screw threaded connection used to propel the pinion into and out of mesh with the ring gear. This resulted in undue wear on the screw and nut and interfered with their free relative motion.

To overcome this objection, the present invention contemplates the provision of means which becomes active the instant compression of the cushion is needed to take up shock, and which acts positively to perform this function independently of the screw to thus relieve the same of all strain.

With the above and other objects in view which will appear as the description proceeds, this invention resides in the novel construction, combination and arrangement of parts substantially as hereinafter described and more particularly defined in the appended claims, it being understood that such changes in the precise embodiment of the hereindisclosed invention may be made as come within the scope of the claims.

The accompanying drawing illustrates one complete example of the physical embodiment of the invention constructed in accordance with the best mode so far devised for the practical application of the principles thereof, and in which:

Figure 1 is a side view of an engine starter constructed in accordance with this invention and showing the parts in their normal inactive positions;

Figure 2 is a view similar to Figure 1, with parts broken away and in section, but with the pinion shown improperly engaging the ring gear; and

Figure 3 is a perspective view of all of the component parts of the starter, with the exception of the shaft, shown in their respective positions of assembly.

Referring now particularly to the accompanying drawing in which like numerals indicate like parts, the numeral 5 designates the ring gear of an engine with which the starter is associated.

The starter comprises an electric motor 6 having a shaft 7 projecting past the ring gear, as shown. Freely slidably and longitudinally movably mounted on the shaft is a pinion 8. The pinion is adapted to be propelled forwardly from its normal inactive position, shown in Figure 1, toward the ring gear 5 to mesh therewith upon initial operation of the starting motor, and, as is customary, to be retracted from engagement with the ring gear when the engine starts.

The mechanism for propelling and retracting the pinion into and out of mesh with the ring gear comprises a sleeve 9 extending from the ring gear and externally threaded to provide a screw 10. Mounted on the screw is a nut member 11 provided with an annular flange 12 at its end remote from the pinion. The flanged end of the nut member has a counterbore 13 to provide space for a stop collar 13' screwed to the outer end of the sleeve 9. Engagement of the collar 13' with the bottom of the counterbore 13 limits relative outward movement of the pinion and nut member. The collar 13' thus takes the place of the usual stop fastened to the shaft 7 and makes the unit complete in itself.

Fixed to the outer end of the shaft 7 is a cup-shaped member 14, the forward cupped end 15 of which encircles the flange 12 of the nut member. Confined between the flange 12 and the bottom of the cup is a rubber ring 16 which yieldingly urges the flange 12 outwardly into engagement with a stop provided by a spring ring 17 snapped into an annular groove 18 in the inner periphery of the cup. Although the rubber ring 16 is not compressible in the strict sense, i. e., capable of reduction in volume, it is, of course, deformable, and, to the extent that its ends may be pressed toward each other it is capable of being compressed; and it is to be understood that where this specification and the claims refer to compression of the rubber ring, it is this deformation which is contemplated.

The stop 17 is so located that the rubber ring or collar is maintained under a slight degree of compression to provide a frictional driving connection from the cupped member to the nut member. Consequently, upon rotation of the shaft and the cupped member, rotation will be imparted to the nut member and through its threaded connection with the pinion, forward propulsion of the pinion will be effected.

If the pinion meshes with the ring gear properly, this forward propulsion of the pinion continues until the stop collar 13' engages the bottom of the counterbore 13, whereupon compression and torsional twisting of the rubber ring 16 takes place to cushion the application of the driving torque to the engine. This follows from the novel connection provided between the nut member and the cupped member, as now about to be described.

As best shown in Figure 3, the flange 12 has a plurality of radially projecting lugs 19 and the side wall of the cupped member has an equivalent number of cam slots 20 to receive these lugs. The sides of the lugs are disposed at an angle to the faces of the flange to have a smooth sliding engagement in the slots 20.

The direction of pitch of the cam slots 20 is opposite the pitch of the screw threaded connection between the pinion and nut member so that relative rotation between the cupped member and the nut member draws the nut member toward the cupped member. This action is of course opposed by the compressible rubber ring.

With this construction, the frictional driving connection which the rubber ring establishes between the two coupling members, viz., the nut member and the cupped member, is augmented and strengthened to preclude slipping. Inasmuch as the lugs 19 have frictional engagement with the walls of the cam slots 20, a supplementary or auxiliary frictional driving connection is established from the power shaft to the pinion.

The elements involved in this driving connection are the cup-shaped member 14 which is fixed to the shaft, the barrel formed by its cupped end 15, the walls of the slots 20, the lugs 19, and the nut member 11 which at this stage of the operation (when the pinion is fully engaged with the ring gear) is, in effect, rigid with the pinion by virtue of the fact that the collar 13' abuts the bottom of the counterbore 13 and thus prevents further outward motion of the pinion. Hence, it will be seen that the frictional drive transmission provided by the rubber ring is augmented by the friction between the lugs 19 and the sides of the slots 20.

The torsional twisting of the rubber ring and its endwise compression continues under these circumstances until the force built up in the rubber ring is equal to the load of the engine, whereupon this force is expended to aid the starting motor in overcoming the break-away load of the engine.

It is to be noted that during this compression of the rubber ring no stress or load is placed upon the screw threaded connection between the pinion and nut, thus greatly minimizing wear on these parts.

The cam connection formed by the lugs 19 riding in the slots 20 between the two coupling members also serves to correct for improper meshing of the pinion and ring gear which occurs when the pinion and ring gear meet with their teeth abutting end to end, as shown in Figure 2. During this contingency, the action of the cam connection between the nut member and cupped member retracts the pinion slightly and frees it from engagement with the ring gear to permit the same to be turned freely into proper position with respect to the ring gear.

The operation of the parts during this time is as follows.

When the forward propulsion of the pinion is interrupted by improper engagement with the ring gear, the threaded connection between the pinion and the nut member because of the continued relative rotation between these parts will cause the nut member to back off the screw 10 against the resiliency of the rubber ring 16 and without the cam connection between the nut member and the cupped member, the endwise movement apart of the pinion and nut member would cause the pinion to jam itself tightly against the ring gear as the ring gear would carry all of the reaction force incidental to the compression of the rubber ring. Under these circumstances, it would be difficult to impart the necessary rotation to the pinion to free the same from improper engagement with the ring gear, and consequently, the starter would jam.

However, the cam connection provided by the lugs 19 and the slots 20 acting in opposition to the screw threaded connection between the pinion and nut member and having a steeper pitch, retracts both the nut member and the pinion away from the ring gear to actually disengage the pinion from the ring gear and thus free the same for rotation into proper position with respect to the ring gear.

From the foregoing description taken in connection with the accompanying drawing, it will be readily apparent to those skilled in the art that this invention provides novel means for positively precluding jamming of the starter, and that it provides an efficient and simple manner of providing both torsional and endwise yieldability without imposing strain upon the screw threaded

connection which propels and retracts the pinion.

What I claim as my invention is:

1. In an engine starter: a motor driven shaft; a pinion movable longitudinally and rotatably with respect thereto; a screw connected with the pinion; a nut member having a threaded engagement with the screw and free to move longitudinally and rotatably with respect thereto; a driving connection between the shaft and the nut member so that rotation of the shaft in one direction advances the pinion longitudinally with respect to the shaft; and means operable upon relative rotation between the shaft and the nut member in said direction for moving the nut member longitudinally in a direction to retract the pinion.

2. In an engine starter: a motor driven shaft; a pinion movable longitudinally and rotatably with respect thereto; a driving connection between the pinion and the shaft operable upon relative rotation between the shaft and pinion for advancing the pinion longitudinally with respect to the shaft, said driving connection including two yieldingly coupled parts; and cam means between said two parts operable to retract the pinion in the event of relative rotation of said parts in one direction.

3. In an engine starter: a power shaft; a pinion movable longitudinally and rotatably with respect thereto; a screw threaded part carried by the pinion; a driving connection between the power shaft and the pinion including two co-operating parts, one of which is fixed to the shaft and the other threaded to the screw threaded part of the pinion; a torsionally and endwise resilient driving connection between said parts; and means operable upon relative rotation of said parts in one direction for imparting longitudinal movement to the pinion in one direction.

4. In an engine starter: a power shaft; a pinion; a screw threaded sleeve carried by the pinion; a drive member threaded to said sleeve; an endwise and rotatably yielding driving connection between the shaft and said drive member operable to propel the pinion forwardly upon relative rotation of the shaft and drive member with respect to the pinion; and a cam connection between the drive member and a shaft carried part for retracting the drive member and pinion upon relative rotation of the shaft and drive member in one direction.

5. In combination with the ring gear of an engine: a pinion slidably mounted to move into and out of mesh with the ring gear and adapted to drive the ring gear; a power driven shaft slidably and rotatably mounting the pinion; means operable upon relative rotation between the shaft and pinion for advancing the pinion toward the ring gear, said means including a part yieldingly coupled to the shaft to allow relative rotation between said part and the shaft; and means operable upon relative rotation between said part and the shaft, as produced by the pinion striking the ring gear with the teeth thereof disposed end to end, for retracting the pinion away from the ring gear.

6. In an engine starter, the combination of: a power driven shaft; a pinion; means for moving the pinion longitudinally on the shaft including two parts having a screw threaded connection; a yieldable driving connection between the shaft and one of said screw threaded parts including, a cup-shaped driving member carried by the shaft and a resilient compressible member disposed within said cup-shaped member and

engageable with said designated screw threaded part; and means for retracting the pinion regardless of the functioning of said first named pinion moving means comprising a cam connection between said cup-shaped driving member and said designated screw threaded part.

7. In an engine starter: a power driven shaft; a pinion freely slidable and rotatable thereon; means for advancing the pinion longitudinally along the shaft including two members having a screw threaded connection, one of which is fixed with respect to the pinion; a rotatably yieldable driving connection between said other member and the shaft; and a cam connection between said other member and the shaft opposed to the pitch of the screw threaded connection and operable upon relative rotation between said other member and the shaft in one direction for moving said other member endwise in a direction to nullify the effect of the screw threaded connection.

8. In an engine starter including: a power driven shaft and a pinion freely rotatable and slidable thereon into mesh with an engine carried gear; a driving connection between the shaft and the pinion including two yieldingly coupled parts for moving the pinion forwardly to an operative position and retracting the same upon starting of the engine; and a cam connection between said parts operable upon relative rotation therebetween for effecting relative endwise motion as between said parts for retracting the pinion upon improper meshing.

9. In an engine starter including: a power driven shaft and a pinion freely rotatable and slidable thereon; a driving connection between the shaft and the pinion including two yieldingly coupled parts; a cam connection between said parts operable upon relative rotation therebetween for effecting relative endwise motion as between said parts, one of said parts being fixed to the shaft; and a screw connection between the other of said parts and the pinion operable upon relative rotation in one direction to propel the pinion forwardly.

10. In an engine starter of the character described: a power driven shaft; a pinion; a driving connection between the pinion and shaft including two yieldingly coupled parts, one of which is fixed to the shaft and the other having a screw connection with the pinion; a rubber cushion interposed between said parts to yieldingly oppose endwise movement thereof toward each other and by frictional engagement with said parts to yieldingly oppose relative rotation therebetween; and a positive cam connection between said parts operable upon relative rotation thereof to effect relative endwise motion of said parts.

11. In an engine starter of the character described: a power driven shaft; a pinion loose on the shaft; a cupped member fixed to the shaft; a member having a threaded connection with the pinion and having a part received in the open end of the cup; a rubber cushion confined between said part and the bottom of the cup to yieldingly oppose relative endwise motion of said part and cupped member toward each other and through frictional contact with said part and the bottom of the cup provide a yielding driving connection; and a cam connection between said part and the walls of the cup for drawing said part into the cup upon relative rotation of the cup and said part in one direction.

12. As an article of manufacture, an engine starter unit adapted to be bodily mounted upon

- the shaft of a starter motor, comprising: a pinion bored for the reception of the shaft; a screw carried by the pinion; a nut threaded on the screw; a driving member having a bore to fit the shaft; means carried by the driving member for securing it to the shaft; a resilient coupling between said driving member and the nut including a compressible rubber element interposed between said parts; a cam connection between the driving member and nut operable upon relative rotation between said parts in one direction to compress said element; and cooperating stop means carried by the pinion and nut for limiting their movement apart.
13. An engine starter for engines having a ring gear, comprising: a power driven shaft; a pinion slidable and rotatable thereon; means operable upon initial rotation of the shaft to propel the pinion forwardly toward the ring gear, said means including two yieldingly coupled members; and a connection between said two members operable upon improper engagement of the pinion with the ring gear for retracting the pinion away from the ring gear.
14. In an engine starter drive, a power shaft, a pinion slidably mounted thereon for movement into and out of engagement with a member of an

engine to be started, means including a cylinder of rubber-like material surrounding the power shaft and resiliently actuating the pinion therefrom, and means including a barrel member surrounding the cylinder, forming an auxiliary frictional driving connection between the power shaft and pinion established after engagement of the pinion with the engine member.

15. In an engine starter: a power shaft; a pinion movable longitudinally and rotatably with respect thereto; an end member fixed to the shaft; a resilient driving connection between said end member and the pinion comprising cooperating members having a screw threaded connection, one of said cooperating members being fixed to the pinion; an annular resilient rubber-like torque transmitting element drivingly connecting the other of said cooperating members with the end member; a barrel-like shell fixed to said end member and encircling the rubber-like torque transmitting element; and cooperating surfaces on the barrel-like shell and one of the two screw connected members providing a frictional driving connection to supply an auxiliary driving connection at the time the starter picks up the load of the engine.

JOHN W. FITZ GERALD.