Aug. 28, 1934. M. P. WHITNEY 1,971,740

REBOUND CHECK FOR ENGINE STARTERS

Filed Jan. 30, 1932 3 Sheets-Sheet 1

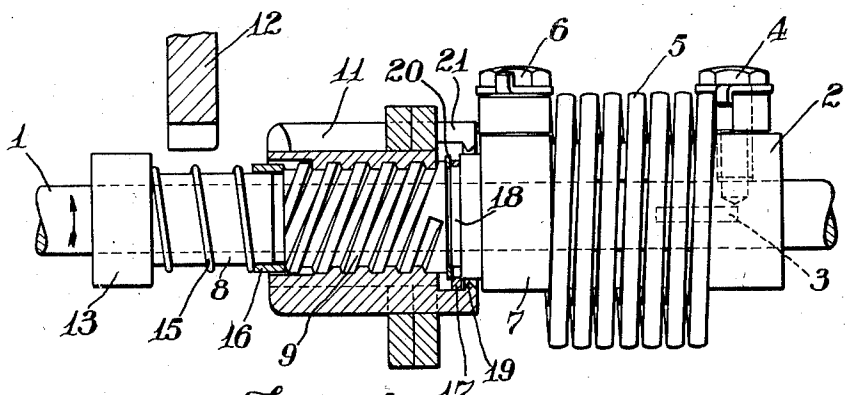


Fig. 1

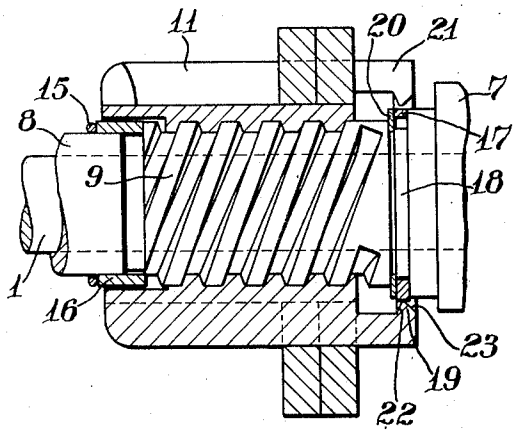


Fig. 2

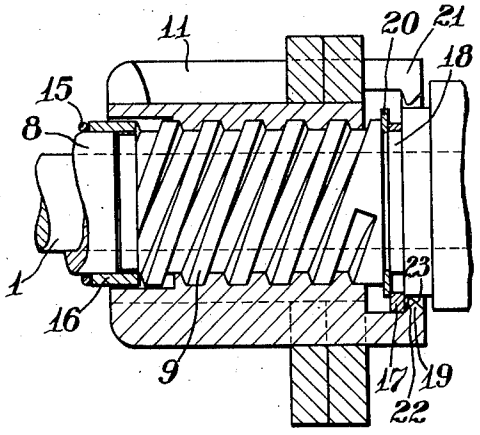


Fig. 3

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REBOUND CHECK FOR ENGINE STARTERS

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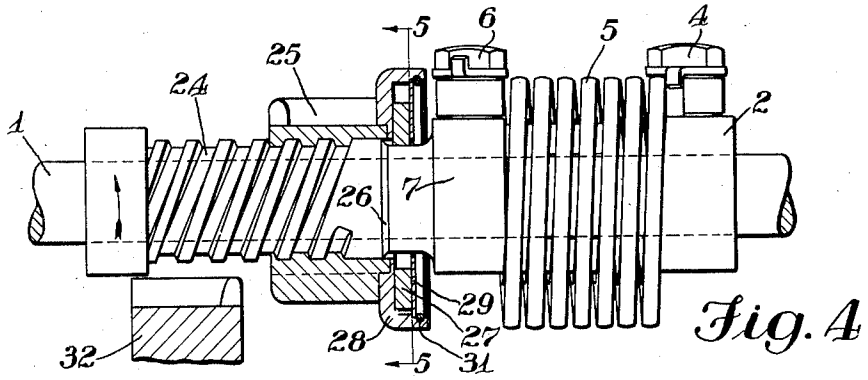


Fig. 4

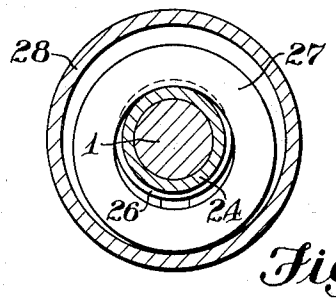


Fig. 5

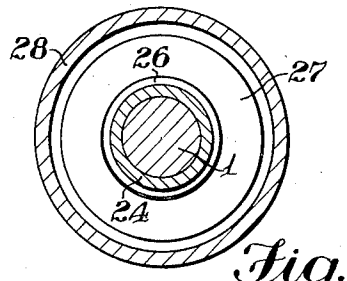


Fig. 6

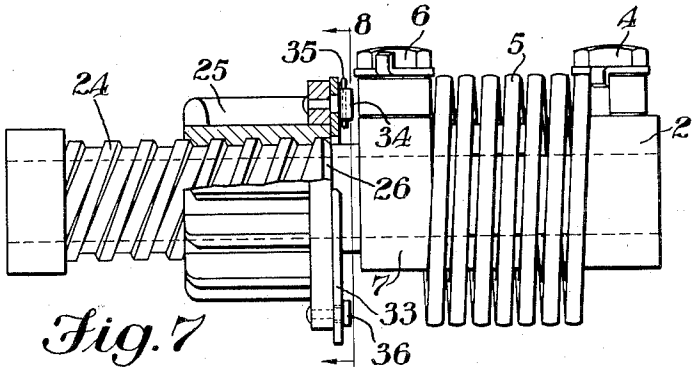


Fig. 7

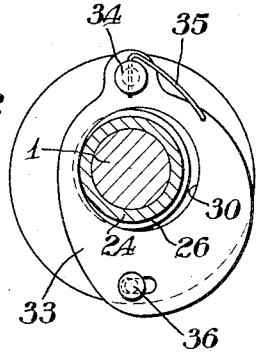


Fig. 9

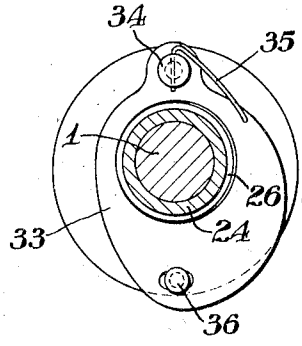


Fig. 8

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REBOUND CHECK FOR ENGINE STARTERS

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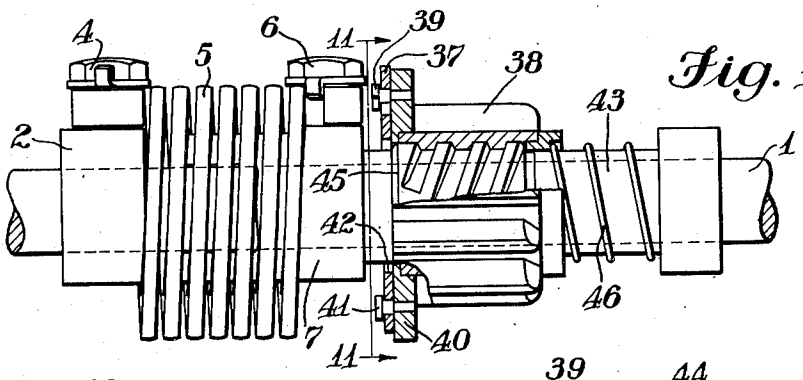


Fig. 10

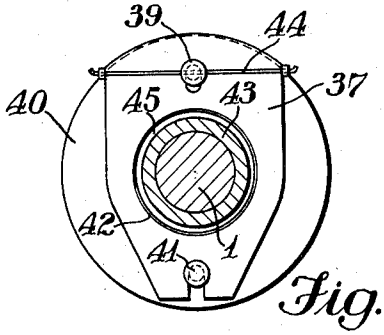


Fig. 11

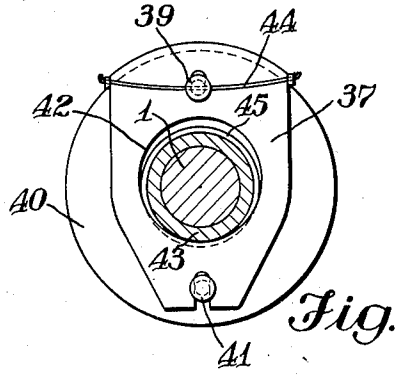


Fig. 12

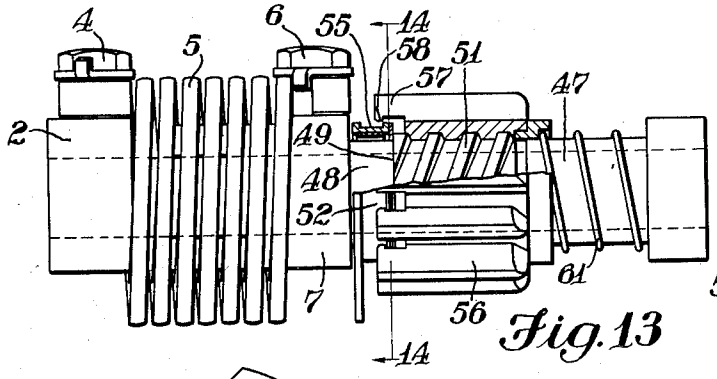


Fig. 13

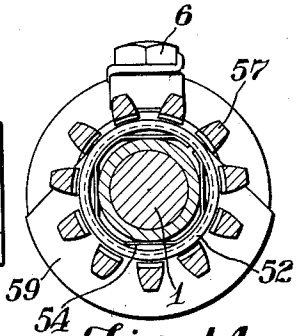


Fig. 14

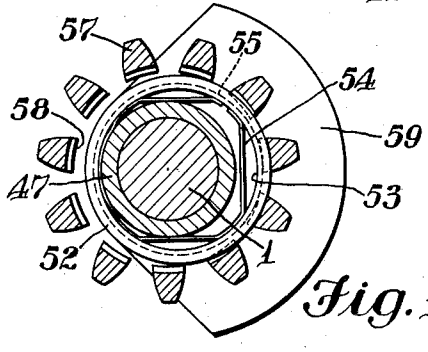


Fig. 15

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Patented Aug. 28, 1934 1,971,740

UNITED STATES PATENT OFFICE

1,971,740

REBOUND CHECK FOR ENGINE STARTERS

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Application January 30, 1932, Serial No. 589,895

8 Claims. (Cl. 74—7)

This invention relates to rebound checks for engine starters and more particularly to automatic starter pinion drives having provisions for preventing the pinion from bounding back toward the engine flywheel when it is thrown out of mesh therewith.

In engine starters of the type in which a motor driven pinion is moved into engagement with an engine gear to start the same, and is automatically thrown out of such engagement by the overrunning of the engine gear when the engine starts, there is a tendency for the pinion to bound back from its normal idle position and strike the engine gear, thus causing undesirable noise and wear of the parts.

It is an object of the present invention to provide a novel rebound check for a starter pinion which is effective and reliable in action while being simple and economical in construction.

It is another object to provide such a device which does not interfere with the automatic traversal of the pinion into mesh with the engine gear when the starting motor is energized.

It is a further object to provide such a device which is controlled by the speed of rotation of the pinion or of the motor shaft or of both whereby it is most effective at the time that its function becomes most necessary.

Further objects and advantages will be apparent to those skilled in this art from the following description taken in connection with the accompanying drawings in which:

Fig. 1 is a side elevation partly in section of a preferred form of the invention;

Fig. 2 is an enlarged detail of the structure shown in Fig. 1 partly in longitudinal section and showing the positions of the parts at the initiation of the meshing movement;

Fig. 3 is a view similar to Fig. 2 showing the parts in the positions assumed when the starting pinion has been thrown back to its normal position by the starting of the engine;

Fig. 4 is a view similar to Fig. 1 of a second embodiment of the invention;

Fig. 5 is a section taken substantially on the line 5—5 of Fig. 4;

Fig. 6 is a section similar to Fig. 5 showing the parts in the positions assumed after the initiation of the meshing movement of the pinion;

Fig. 7 is a side elevation partly in section of a third embodiment of the invention;

Fig. 8 is a section taken substantially on the line 8—8 of Fig. 7 showing the parts in the positions assumed after the initiation of the meshing movement of the pinion;

Fig. 9 is a view similar to Fig. 8 showing the parts in the positions assumed when the pinion is thrown back to its normal position by the starting of the engine;

Fig. 10 is a side elevation partly in section of a fourth embodiment of the invention;

Fig. 11 is a section taken substantially on the line 11—11 of Fig. 10 showing the parts in the positions assumed when the pinion is stationary in its normal or idle position;

Fig. 12 is a view similar to Fig. 11, showing the parts in the positions assumed when the pinion is thrown back to its idle position by the starting of the engine;

Fig. 13 is a side elevation partly in section of a fifth embodiment of the invention;

Fig. 14 is a section taken substantially on the line 14—14 of Fig. 13 showing the parts in the positions assumed when the pinion is stationary in its normal or idle position; and

Fig. 15 is an enlarged sectional detail taken substantially on the line 14—14 of Fig. 13 showing the parts in the positions assumed when the pinion is thrown back to its normal position by the starting of the engine.

Referring first to Fig. 1 of the drawings, there is illustrated a power member in the form of a shaft 1 which may be the extended shaft of a starting motor, not shown. A driving head 2 is fixedly mounted on the shaft 1 in any suitable manner as by means of a key 3 and stud 4, which stud serves also to rigidly connect a drive spring 5 to said head. The opposite end of the spring 5 is rigidly connected as by means of a stud 6 to a driven head 7 which is formed as a part of a hollow shaft 8. Shaft 8 is threaded for a portion of its length as indicated at 9 for the reception of a driving member in the form of a threaded pinion 11 whereby relative rotation between the shaft and pinion causes the pinion to be traversed into and out of mesh with a driven member 12 such as the flywheel gear of the engine to be started.

A stop 13 is provided at the end of the smooth portion of shaft 8 in position to be engaged by the pinion 11 when the latter is meshed with the engine gear 12, whereby further rotation of the shaft with respect to the pinion is prevented and the pinion is forced to rotate therewith and therefore to rotate the engine gear 12.

Means are provided for yieldably retaining the pinion in its normal position as illustrated in Fig. 1, such means being shown in the form of a light compression spring 15 located between the stop

13 and a ring 16 fitting within a recess in the end of pinion 11.

According to the present invention, means are provided for preventing automatic traversal of the pinion 11 toward the engine gear 12 when the shaft 8 and pinion thereon are in rapid rotation. As here shown, this means comprises an eccentrically weighted detent ring 17 loosely mounted between radial shoulders defining a groove 18 in shaft 8, and retaining shoulders 19 formed on the interior of longitudinal extensions 21 of the pinion teeth. Means are provided to prevent longitudinal movement of the detent with respect to the power shaft while allowing limited radial movement thereof, in the form of a split ring 20 which confines said detent ring within this groove 18 on said shaft. The groove 18 and ring 17 are so located with respect to the shoulders 19 that when the pinion 11 is in its idle position, the ring 17 is located within the extensions 21 and adjacent the inner side of the shoulders 19.

Referring now to Figs. 2 and 3 of the drawings, it will be noted that shoulder 19 is formed with a steeply inclined side 22 adjacent the ring 17 when the parts are in idle position, said inclination being such that considerable longitudinal pressure is necessary to raise the ring 17 to a concentric position as illustrated in Fig. 2 in order to initiate the meshing movement of the pinion. The opposite side 23 of the shoulder 19 is inclined at a lesser angle in order to facilitate passage of the shoulder 19 by the ring 17 when the pinion is returned to its idle position.

In the operation of this embodiment of the invention, energization of the starting motor causes rapid rotation of the shaft 1 in the direction of the arrow, which rotation is transmitted through the driving head 2 and spring 5 to the power shaft 8. The pinion 11, due to its inertia, does not at once take up the rotation of shaft 8 and is therefore traversed longitudinally into mesh with the engine gear 12 until it engages the stop 13. Further rotation of shaft 8 causes the pinion 11 to crank the engine in the usual manner. It will be noted that during the initiation of the meshing movement of the pinion, the pinion is stationary and the shaft is rotating at a comparatively slow rate of speed whereby the ring 17 is maintained in its eccentric position by gravity only. The longitudinal force tending to traverse the pinion 11 is therefore easily capable of raising the ring 17 by means of the inclined surface 22 of shoulder 19.

When the engine starts, the rapid acceleration of the engine gear 12 causes the pinion 11 to overrun the shaft 8 thus causing the pinion to be traversed back to its normal position. This rearward traversal of the pinion may take place with considerable violence which might cause the pinion to bound back and engage the rapidly moving engine gear. Since the shaft 8 and pinion 11 however are rotating at this time at high speed, the effect of centrifugal force on the ring 17 prevents the shoulder 19 from raising the ring to its concentric position, whereby the pinion is effectively locked in its idle position. It will be noted that the inclination of the outer side 23 of the shoulder 19 is sufficiently gradual to allow the shoulder to pass over the ring 17 in the demeshing direction in spite of the centrifugal force acting on said ring.

It will be noted that the static resistance offered by the ring 17 to traversal of the pinion when the parts are idle may be relied on to prevent the pinion from drifting into engagement with the engine gear while the engine is running. In such case the anti-drift spring 15 and spacing collar 16 may be omitted.

In the embodiment of the invention illustrated in Figs. 4, 5, and 6, the motor shaft 1, driving head 2, and spring 5 are similar to the corresponding elements of the first embodiment of the invention and function in a similar manner. As here shown, however, a power shaft 24 is arranged to be driven by the spring 5 which shaft is threaded for the reception of a pinion 25. Means for preventing undesired actuation of the pinion 25 away from its idle position is illustrated in the form of a centrifugally actuated detent ring 27 held against a shoulder formed by a bell-shaped flange 28 on the rear end of pinion 25, by means such as an annular disk 29 and snap ring 31. Ring 27 is free to slide radially within the flange 28 and rests upon the shaft 24. Means for cooperating with said centrifugal detent to prevent longitudinal movement of the pinion toward the engine gear is provided in the form of an inclined shoulder 26 on shaft 24, in position to be engaged by said detent when the pinion is in idle position.

In the operation of this embodiment of the invention, rotation of shaft 24 by the starting motor causes the pinion 25 to be traversed into mesh with an engine gear 32, the ring 27 riding up on the inclined shoulder 26 with only sufficient resistance from the weight of said ring to form an effective anti-drift. When the engine starts and throws the pinion back out of mesh, the rapid rotation of the pinion causes the ring 27 to drop down behind the shoulder 26 when the pinion reaches its idle position, centrifugal force holding the ring against the shaft with sufficient pressure to cooperate with shoulder 26 to form an effective latch for the pinion and prevent the rebounding of the pinion toward the engine gear.

In Figs. 7, 8 and 9 of the drawings there is illustrated a third embodiment of the invention similar to that illustrated in Figs. 4, 5 and 6 except that the detent member is pivotally connected to the pinion instead of being mounted thereon for sliding movement in all radial directions. As here shown, a detent member in the form of an eccentric ring 33 is pivoted to the pinion as indicated at 34 said pivotal movement being limited as by a pin 36, and a shaft 24 is provided with an inclined shoulder 26, behind which shoulder the detent ring 33 is adapted to engage when the pinion is in idle position.

Means for yieldably urging said detent into latching position is provided in the form of a spring 35 which tends to move the ring 33 eccentrically until stopped by the engagement of the edge of the opening 30 therein on the shaft 24, whereby the detent cooperates with the shoulder 26 on shaft 24 to form an anti-drift device.

Detent 33 also functions as a rebound check by reason of its eccentricity with respect to both shaft 24 and pivot 34. The eccentricity of the detent with respect to shaft 24 causes the force of spring 35 to be supplemented by centrifugal force when the pinion is thrown out of mesh, thus causing the detent to be pressed firmly down on the shaft; and the eccentricity with respect to pivot 34 causes the detent to be forced against the shaft by its rotary momentum when the rotation of the pinion is arrested after it is thrown out of mesh. Both these forces combine to latch said detent firmly behind the shoulder 26 and prevent rebounding of the pinion.

In the operation of this embodiment of the

invention, the initiation of the meshing movement of the pinion 25 causes the detent 33 to ride up the shoulder 26 as indicated in Fig. 8 against the resistance of the spring 35. When the pinion 25 is demeshed by the starting of the engine, the centrifugal force and momentum of the detent ring 33 causes the latter to be held down on the shaft 24 back of the shoulder 26 with sufficient force to prevent rebounding of the pinion as above set forth.

In Figs. 10, 11 and 12 of the drawings, a rebound check is illustrated comprising a detent member 37 slidably mounted on a shoulder formed by a radial flange 40 on the rear end of pinion 38 as by means of guides 39 and 41, and normally maintained with its opening 42 concentric with a power shaft 43 on which the pinion is mounted, by suitable yielding means such as a spring 44. Detent member 37 is eccentrically weighted, and shaft 43 is provided with an inclined shoulder 45 adapted to engage the inner edge of the opening 42 in said detent when the detent is moved eccentrically by centrifugal force. Pinion 38 is normally maintained in its idle position by suitable means such as an anti-drift spring 46.

In the operation of this embodiment of the invention, rotation of the power shaft 43 causes traversal of the pinion 38 into its driving position against the force of the spring 46 in the well-known manner, the detent 37 offering no resistance to such movement since it is maintained out of contact with the shaft 43 by means of the spring 44. When the pinion is thrown back to its normal position by the starting of the engine, however, centrifugal force acting on the detent 37 causes the edge of the opening 42 to engage back of the shoulder 45 on shaft 43 with sufficient force to prevent the pinion from rebounding.

In Figs. 13, 14 and 15, a power shaft 47 is illustrated which is provided with a smooth portion 48 defined by a square shoulder 49 formed by the ends of the threads 51. The smooth portion 48 is arranged to form a seat for an annular detent member 52 which is loosely journaled thereon. Detent 52 is provided with an opening 53 for receiving the shaft 47 which is of considerably larger diameter than said shaft, and a spring 54 is provided for normally centering the detent on said shaft as illustrated in Fig. 14.

The detent 52 is provided with a peripheral channel 55, and a pinion 56 mounted on the threaded portion 51 of shaft 47 is provided with teeth having rearward extensions 57 with inwardly extending lugs 58 in position to engage within the channel 55 when the pinion is in its normal position.

Detent 52 is provided with an eccentric flange 59 whereby centrifugal force moves said detent radially as shown in Fig. 15, causing the lugs 58 to become seated in the channel 55 thereby latching the pinion 56 against longitudinal movement.

Pinion 56 is normally maintained in its idle position by suitable means such as an anti-drift spring 61, but is arranged to be moved out into driving position by rotation of the power shaft 47 in the usual manner, this motion being unopposed by the detent 52 since at this time the spring 54 maintains said detent in its concentric position. When the engine starts and throws the pinion 56 back to its idle position, the rapid rotation of the detent 52 causes it to move radially so as to interlock with the lugs 58 on the pinion and prevent the pinion from rebounding. The lugs 58 and the side of the detent 52 are preferably bevelled on their outer edges in order to facilitate the passage of the pinion back to its idle position.

Although certain forms of the invention have been shown and described in detail, it will be understood that other embodiments are possible and various changes may be made in the construction and arrangement of the parts without departing from the spirit of the invention as defined in the claims appended hereto.

What is claimed is:—

1. An engine starter drive including a rotary power shaft, a driving pinion mounted for rotation thereon and therewith, and for longitudinal movement into and out of mesh with a gear of the engine to be started, a centrifugal element mounted on said pinion, said shaft having means adjacent the idle position of the centrifugal element arranged to cooperate therewith under the influence of centrifugal force to prevent longitudinal movement of the pinion toward said engine gear.

2. An engine starter drive including a power shaft, a driving pinion mounted thereon for longitudinal movement into and out of mesh with a gear of the engine to be started, a centrifugal detent mounted on said pinion, said power shaft having a shoulder arranged to cooperate with said centrifugal detent when the pinion is rotating rapidly in its idle position to prevent longitudinal movement of the pinion toward said engine gear.

3. An engine starter drive including a power shaft, a driving pinion mounted thereon for longitudinal movement into and out of mesh with a gear of the engine to be started, a detent member arranged to loosely surround the power shaft and movable by centrifugal force into a position eccentric thereto and means whereby said detent when so eccentrically positioned prevents longitudinal motion of said driving pinion away from its idle position.

4. An engine starter drive including a power shaft, a driving pinion mounted thereon for longitudinal movement into and out of mesh with a gear of the engine to be started, a detent member arranged to loosely surround the power shaft and movable by centrifugal force into a position eccentric thereto, said power shaft and pinion having shoulders arranged to cooperate with said detent when so eccentrically positioned to prevent longitudinal motion of said pinion away from its idle position.

5. An engine starter drive including a power shaft, a driving pinion mounted thereon for longitudinal movement into and out of mesh with a gear of the engine to be started, a detent member having an opening adapted to loosely receive the power shaft and being laterally slidable with respect thereto under the influence of centrifugal force, means normally retaining said detent with its opening concentric with said power shaft, and means on said power shaft and driving member arranged to cooperate with said detent when it is moved into eccentric position by centrifugal force to prevent longitudinal motion of said pinion away from its idle position.

6. An engine starter drive including a power shaft, a driving pinion mounted thereon for longitudinal movement into and out of mesh with a gear of the engine to be started, a detent member having an opening adapted to loosely receive the power shaft and being mounted on said

pinion for rotation therewith and for limited radial movement with respect thereto, said power shaft having a shoulder adapted to be engaged by the edge of the opening in said detent to retain said pinion in its idle position.

7. An engine starter drive including a power shaft, a driving pinion mounted thereon for longitudinal movement into and out of mesh with a gear of the engine to be started, a detent member having an opening adapted to loosely receive the power shaft, means preventing longitudinal movement of said detent with respect to said power shaft but allowing limited radial movement thereof, and means on said pinion adapted to be engaged by lateral movement of said detent to prevent longitudinal movement of the pinion from its idle position.

8. An engine starter drive including a power shaft, a pinion mounted thereon for rotation thereof and therewith and for longitudinal movement into and out of engagement with a member of an engine to be started, an annular detent member loosely surrounding said power shaft, and movable radially to latch the pinion in its idle position on the power shaft, means for yieldably urging said detent into latching position and centrifugal means for holding said detent in latching position.

MAURICE P. WHITNEY.