Nov. 3, 1942. C. S. JANES 2,300,928

ENGINE STARTER GEARING

Filed June 20, 1941

Fig. 1

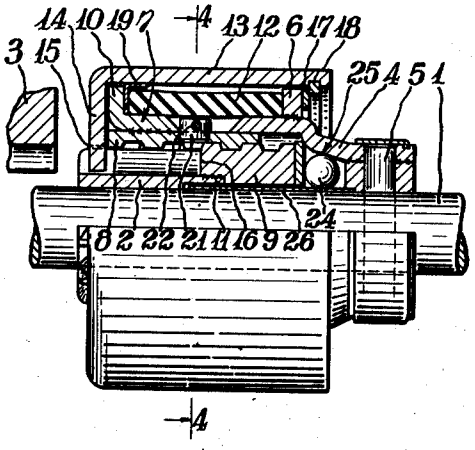


Fig. 2

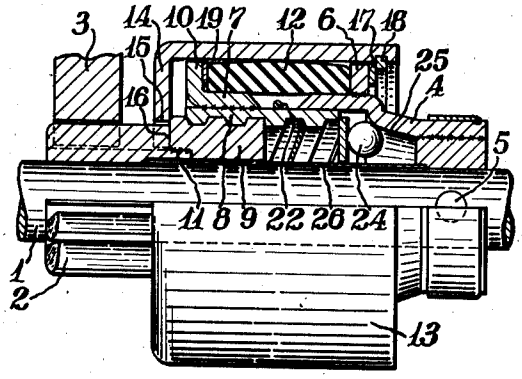


Fig. 3

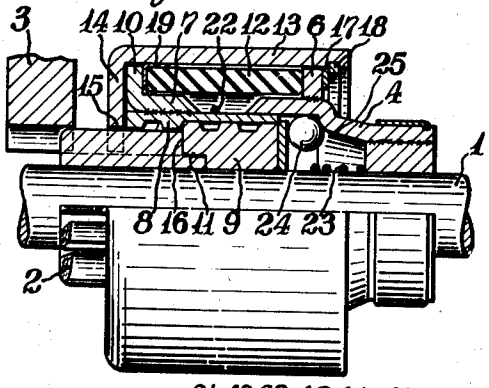
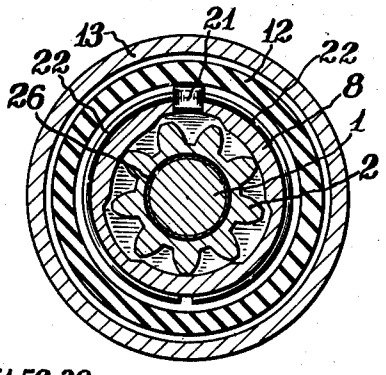


Fig. 4



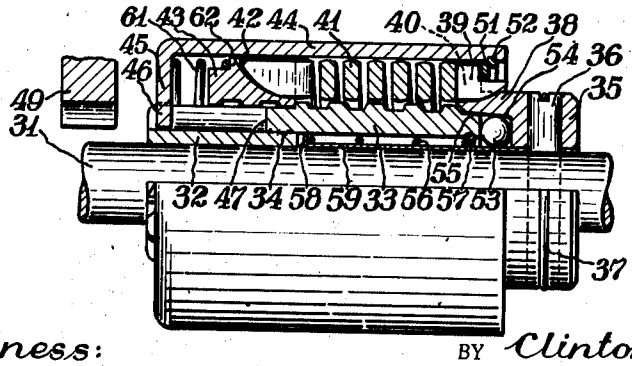


Fig. 5

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ENGINE STARTER GEARING

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9 Claims. (Cl. 74—7)

The present invention relates to engine starter gearing and more particularly to a drive of the automatically engaging type adapted to maintain operative connection until the engine is reliably self-operative.

In drives of this type various means have been employed to prevent disengagement of the gearing by the initial explosions of the engine, some depending on the speed of rotation of the drive and some on other factors which differentiate a false start from a true start.

It is an object of the present invention to provide a novel engine starter drive of the type set forth which is efficient and reliable in operation, simple and compact in construction and adapted for economical manufacture.

It is another object of the invention to provide such a device which is adapted to connect a starting motor to a member of an engine to be started upon actuation of the starting motor and to maintain such connection as long as the starting motor is energized.

It is another object to provide such a device which permits the engine to overrun the starting motor quietly and without danger of jamming or dragging.

It is a further object to provide such a device which is dependent on the speed of rotation of the starting motor to keep the gearing engaged.

Further objects and advantages will be apparent from the following description taken in connection with the accompanying drawing in which:

Fig. 1 is a side elevation partly in section showing a preferred embodiment of the invention with the parts in idle position;

Fig. 2 is a similar view showing the parts in the positions assumed during the cranking operation;

Fig. 3 is a similar view of a slightly modified form of the invention, showing the parts in positions assumed when the engine starts and overruns the drive while the starting motor is still in operation;

Fig. 4 is a section taken substantially on a line 4—4 of Fig. 1; and

Fig. 5 is a view similar to Fig. 1 showing another embodiment of the invention.

In Fig. 1 of the drawing there is illustrated a power shaft 1 which may be the extended armature shaft of the starting motor not illustrated. A pinion member 2 is slidably journalled on the power shaft for longitudinal movement into and out of engagement with a gear 3 of an engine to be started. A driving member in the form of a sleeve 4 is fixed on the power shaft in any suitable manner as by means of a cross pin 5 and has formed thereon or fixed thereto as by welding a radial driving flange 6. A driven head 7 is arranged to surround the pinion 2 and has a radial flange 10 formed thereon and an internally threaded sleeve or nut member 8 rigidly fixed therein as by welding or brazing, and in sliding telescopic relation with the adjacent end of the driving sleeve. The threaded sleeve or nut 8 is adapted to cooperate with an externally threaded screw shaft 9 fixed rigidly to the pinion member 2 as indicated at 11 so as to form a part thereof.

A cylinder 12 of elastically deformable material such as rubber is arranged to surround and closely fit on adjacent cylindrical portions of the driving sleeve 4 and driven head 7, and in loosely abutting relation with the flanges 6 and 10. A barrel member 13 is arranged to surround the flanges 6 and 10, bearing rotatably thereon and loosely surrounding and enclosing the cylinder 12. Barrel 13 has an inturned flange 14 at one end having a dentate opening 15 adapted to form a splined connection with the toothed portion of the pinion member 2, and to abut against the end 16 of the screw shaft 9 to limit the travel of the pinion member. A thrust ring 17 is mounted in the open end of the barrel in position to bear against the rear of the driving flange 6, and is confined in the barrel by a split lock ring 18 so positioned as to properly limit the depth of mesh of the pinion with the engine gear. The cylinder 12 is so dimensioned that it is not under any initial compression between the flanges 6 and 10 when the parts are in idle position, but it frictionally engages the cylindrical portions of the drive sleeve 4 and the driven head 7. A thimble 19 is preferably provided in the barrel 13 adjacent the flange 10 to prevent the elastic member 12 from entering the space between the barrel and the flange and thereby becoming abraded.

Means are provided for normally maintaining the pinion in idle position as illustrated in Fig. 1, this means being here shown in the form of a detent member 21 slidably mounted in the driven head 8 and pressed inwardly so as to bear frictionally on the screw shaft portion 9 of the pinion member 2 by means of a spring ring 22. (Fig. 4.)

Inasmuch as the elastic member 12 is normally loosely mounted between the flanges 6 and 10, the driving connection between the drive sleeve 4 and driven head 7 is only established by the screw jack action of the threaded members 8 and 9 which compresses the member 12 between

flanges 6 and 10. The elastic member 12 therefore cooperates to form an overrunning connection between the driving sleeve 4 and driven head 7 which will permit the pinion to overrun the drive when the engine starts, such overrunning being facilitated by the action of centrifugal force on the elastic member which tends to release it from its frictional engagement with said members. It may, however, in some instances, be desired to provide an overrunning connection between the pinion member and the driven head 7, and this is readily accomplished as illustrated in Fig. 3 by terminating the threads of the nut member 8 adjacent the end of the screw shaft 9 when the parts are in idle position so as to permit the screw shaft to run off the ends of said threads. Proper re-engagement of the threads when rotation of the power shaft and its associated parts exceeds that of the pinion is secured by means of a re-entry spring 23 located between the end of the screw shaft 9 and the driving sleeve 4.

According to the present invention means are provided for resisting the return of the pinion member 2 to idle position while the power shaft 1 is being rotated by the starting motor. As here shown this means is in the form of one or more centrifugal weight members such as balls 24 located between the end of the screw shaft 9 and the driving sleeve 4, and adapted to cooperate with a flared surface 25 formed in the interior of said sleeve. The surface 25 is so tapered that centrifugal force causes the balls 24 to apply longitudinal pressure to the screw shaft 9 to assist in traversing the pinion into mesh with the engine gear and to resist the demeshing of the pinion as shown in Fig. 3.

The re-entry spring 23 serves to bridge the space between the end of the driving sleeve 4 and the end of the screw shaft 9 when the pinion is in idle position and prevent the weight members from being lost in shipment or while the drive is dismounted from the power shaft 1. In the form of the invention illustrated in Figs. 1 and 2 this function is accomplished by a bushing 26 fixed in the driving sleeve and arranged to telescope into the pinion member when the parts are in idle position.

In the embodiment of the invention illustrated in Fig. 5 a power shaft 31 has slidably journalled thereon a pinion member 32 having a hollow screw shaft 33 formed thereon or rigidly fixed thereto as by brazing or welding as indicated at 34. A driving sleeve 35 is fixed on the power shaft as by means of a cross pin 36 retained by a split lock ring 37. The driving sleeve 35 has an axially extending cylindrical portion 38 terminating in a radial flange 40 which is slotted for the reception of the outturned end 39 of a drive spring 41 so as to anchor the drive spring to the driving sleeve. The opposite end of the spring 41 is slidably seated in a slot 42 in a nut member 43 which is mounted on the pinion member 32 in position to cooperate with the threads of the hollow screw shaft 33.

Means for limiting the longitudinal movement of the pinion member 32 is provided in the form of a barrel member 44 having an inwardly extending flange 45 at one end with an opening therein surrounded by teeth 46 conforming to the tooth spaces of the pinion member 32. The teeth 46 of the barrel are arranged to engage the end 47 of the screw shaft 33 when the pinion member is in operative engagement with a gear 49 of the engine to be started. Longitudinal movement of the barrel member 44 is prevented by a thrust ring 51 which is mounted in the open end of the barrel member in position to engage the rear side of the radial flange 40 of the driving sleeve and is retained in the barrel by a split lock ring 52. The screw jack action of the screw shaft 33 and nut 43 thus causes the spring 41 to be compressed between flange 40 and the nut prior to the application of the cranking torque to the spring. In order to prevent the pinion member from moving out of mesh with the engine gear 49 as long as the power shaft is rotating above a pre-determined speed, one or more balls 53 are mounted in the recess 54 in the cylindrical portion of the driving sleeve 35. This recess has a radially and axially inclined surface 55 so arranged that centrifugal force causes the balls to move axially and assist in the traversal of the pinion member 32 into engagement with the engine gear, and resist return of the pinion member to idle position.

Means for normally maintaining the pinion member in idle position is provided in the form of an anti-drift spring 56 located within the screw shaft 33, bearing at one end against a split thrust ring 57 in the interior of the screw shaft and at its other end against a radial flange 58 on a sleeve 59 which is fixed in any suitable manner to the driving sleeve 35 whereby it is anchored to the power shaft 31. Sleeve 59 serves also to retain the balls 53 when the drive is dismounted. A re-entry spring 61 in the closed end of the barrel is arranged to bear against a shoulder 62 on the nut member 43 so as to insure that the nut member enters the threads of the screw shaft 33 upon rotation of the nut member by the power shaft.

In the operation of this embodiment of the invention rotation of the power shaft 31 by the starting motor is transmitted through the driving sleeve 35 and spring 41 to the nut member 43 which thereupon threads itself upon the screw shaft 33, causing the pinion member 32 to be advanced into mesh with the engine gear 49, the meshing movement being limited by engagement of the teeth 46 of the barrel 44 with the stop shoulder 47 at the end of the screw shaft. Further rotation of the power shaft is transmitted to the pinion member causing rotation thereof to crank the engine.

When the engine starts, the acceleration of the pinion member 32 causes it to thread itself back out of the nut member 43, but since at this time the power shaft and driving sleeve 35 are rotating at high speed, the centrifugal balls 53 are moved by centrifugal force out of the recess 54 in the driving sleeve and engage the end of the screw shaft 33 and prevent the pinion member 32 from moving out of mesh with the engine gear 49. The nut member 43 therefore moves to the left, compressing the spring 61 until the nut member runs off the threads of the screw shaft whereby the pinion member is permitted to overrun the drive.

If the engine does not continue to be self-operative, as soon as the pinion slows down below the speed of the power shaft, the nut member will thread itself back on the screw shaft, moving the pinion into full mesh with the engine gear and cranking will be resumed. When the engine becomes reliably self-operative, deenergization of the starting motor by the operator causes the power shaft to come to rest, whereupon the centrifugal balls 53 permit the pinion member to be returned to idle position by the expansion of the springs 61 and 56.

Although but two embodiments of the invention have been described and shown in detail, it will be understood that other embodiments are possible and that variations in the design and arrangement of the parts may be employed without departing from the spirit of the invention as defined in the claims appended hereto.

What is claimed is:

1. In an engine starter a power member, an engine driving member, means responsive to acceleration of the power member for moving the engine driving member into engagement with a member of the engine to be started and thereafter rotating the same, said means including an overrunning connection, and means including a centrifugal member responsive to rotation of the power member for assisting in the traversal of the engine driving member into engagement with the engine member and resisting disengagement thereof.

2. An engine starter as set forth in claim 1 in which the overrunning connection is released by centrifugal force so as to overrun freely.

3. In an engine starter drive a power shaft, a pinion member slidably journalled thereon, means responsive to acceleration of the power shaft for moving the pinion into engagement with an engine gear, said means including an overrunning connection and means including a weight member bodily movable by centrifugal force to urge the pinion into initial engagement with the engine member and resist disengagement thereof.

4. In an engine starter drive, a power shaft, a pinion member slidably journalled thereon, for movement into engagement with a gear of the engine to be started, said pinion member including a screw shaft, a nut member thereon, a driving sleeve fixed to the power shaft, a yielding driving connection between the driving sleeve and nut member, said driving sleeve having a flared portion, and means including a weight member in said flared portion movable by centrifugal force to resist disengagement of the pinion from the engine gear.

5. In an engine starter drive a power shaft, a pinion member slidably journalled thereon for movement into engagement with a gear of the engine to be started, said pinion member including a screw shaft, a nut member thereon, a driving sleeve fixed to the power shaft, a yielding member connecting said sleeve and nut member for rotation in unison, means including said yielding member for limiting relative longitudinal movement of the screw shaft and nut, said screw shaft being arranged to overrun the nut when the engine starts, and means including a member rotated with the driving sleeve movable by centrifugal force to oppose demeshing movement of the pinion.

6. In an engine starter drive a power shaft, a driving member fixed thereon, a pinion member slidably journalled on the power shaft, means responsive to acceleration of the driving member for moving the pinion member into engagement with an engine gear, and means including a centrifugal member within the driving member rotatable therewith and movable by centrifugal force to hold the pinion in engagement with the engine member.

7. In an engine starter drive a power shaft, a driving member fixed thereon having a longitudinally flared inner surface, a pinion member slidably journalled on the power shaft for movement into engagement with an engine gear, means responsive to acceleration of the driving member for moving the pinion into engagement with the engine gear, and means within the driving member adapted to be moved outwardly by centrifugal force along the flared interior thereof to assist in the traversal of the pinion member into engagement with the engine gear.

8. In an engine starter drive, a power shaft, a pinion member including a screw shaft slidably journalled thereon, a nut member on the screw shaft, a driving sleeve fixed on the power shaft, a yielding overrunning clutch connection between the driving sleeve and nut member, and means including a centrifugal member rotatable with the power shaft for holding the pinion member spaced from the driving sleeve.

9. In an engine starter drive a power shaft, a pinion member including a screw shaft slidably journalled thereon for engagement with an engine gear, a nut member on the screw shaft, said screw shaft being arranged to run out of the threads of the nut and overrun the nut when the engine starts, a driving head on the power shaft, a yielding driving connection between the driving head and nut member, and means including a centrifugal member movable by rotation of the power shaft for maintaining the engagement of the pinion member with the engine gear.

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