March 14, 1944. C. S. JANES 2,344,463

ENGINE STARTER GEARING

Filed Jan. 20, 1943

Fig. 1

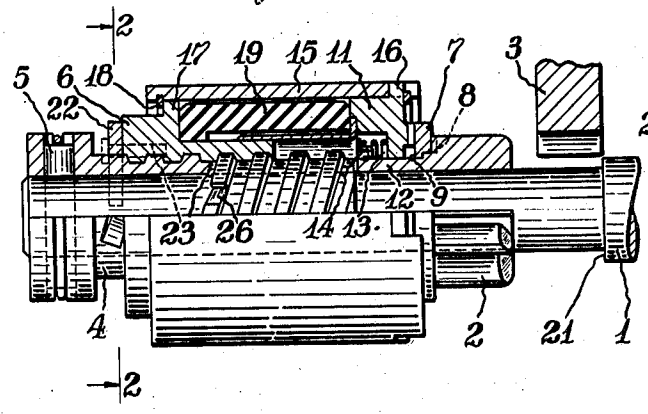
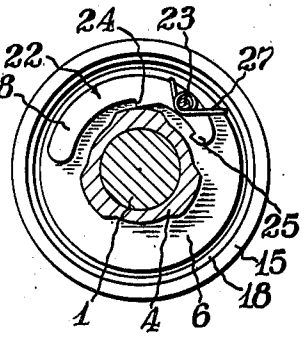


Fig. 2



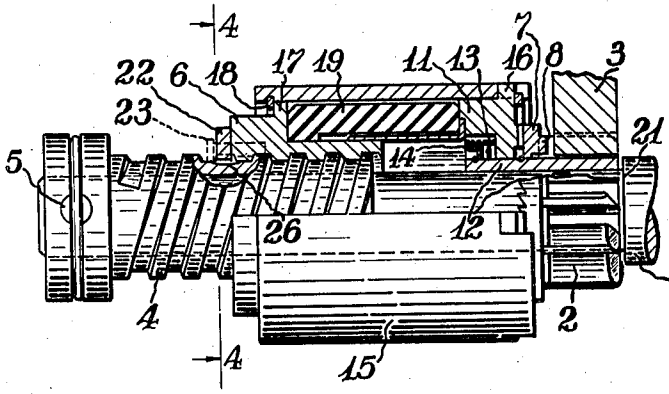


Fig. 3

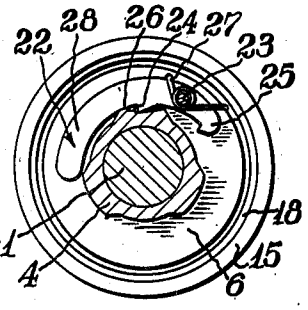


Fig. 4

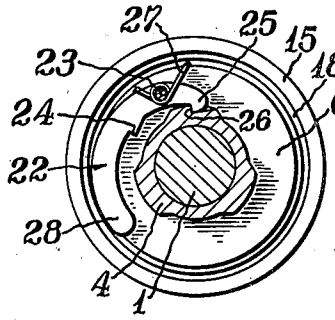


Fig. 5

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ENGINE STARTER GEARING

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7 Claims. (Cl. 74—7)

The present invention relates to engine starter gearing and more particularly to that type of starter drive which automatically engages an engine gear when the starting motor is operated, and maintains such engagement until the engine has become reliably self-operative.

Starter drives of this type have been developed which utilize centrifugal controlling means for holding a drive pinion in mesh with the engine gear, but some difficulty has been encountered in providing such a drive which is effective under all conditions of use. Thus, a latch such as illustrated in the patent to Whitney 2,004,643 which is set to throw out at a predetermined high speed of rotation may be disengaged by an initial powerful explosion of the engine before the engine is reliably self-operative. On the other hand, those latches which are arranged to engage by centrifugal force and release at low speed, such as shown for instance in the patent to Buxton, 2,287,669, do not always operate as desired under low temperature and/or weak battery conditions. Under such conditions cranking may be so slow that the latch is not rendered operative and the pinion can be demeshed by an initial abortive explosion of the engine.

It is an object of the present invention to provide a novel engine starter drive which is arranged to automatically engage an engine gear and maintain such engagement until the engine is reliably self-operative.

It is another object to provide such a device incorporating means for maintaining the engagement with the engine gear until the drive has accelerated above a predetermined speed, and then decelerated below a predetermined lower speed.

It is another object to provide such a device incorporating a latch having two alternatively operative holding positions.

It is another object to provide such a device in which the latch is spring-biased toward the first holding position and is centrifugally movable into the second holding position.

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 of a preferred embodiment of the invention shown partly broken away and in section, with the parts illustrated in idle position;

Fig. 2 is a section taken substantially on the line 2—2 of Fig. 1;

Fig. 3 is a view similar to Fig. 1 showing the drive pinion in mesh with the engine gear and held in position by the spring-pressed latch;

Fig. 4 is a section taken substantially on the line 4—4 of Fig. 3; and

Fig. 5 is a section similar to Fig. 4 showing the high speed locking position of the latch.

In Fig. 1 of the drawing there is illustrated a power shaft 1 having a pinion 2 slidably journalled thereon for movement into and out of engagement with a gear 3 of an engine to be started. Means for traversing and rotating the pinion is provided comprising a screw shaft 4 suitably fixed to the power shaft 1 as indicated at 5 and having a nut member 6 threaded thereon. The pinion 2 is provided with an overrunning clutch member 7 fixedly mounted thereon in any suitable manner as by means of lugs 8 engaging between the teeth of the pinion, maintained in engagement by a lock ring 9. A driving clutch member 11 is slidably journalled on an extended hub 12 of the pinion and is yieldably held in engagement with the driven clutch member 7 by means of a spring 13 retained by an abutment thimble 14.

A barrel member 15 is fixed at one end to the driving clutch member 11 as indicated at 16 and is journalled at its other end on a radial flange 17 of the nut 6, being retained thereon by a split lock ring 18. A yielding driving connection between the nut and the barrel and driving clutch member is provided in the form of a cylindrical block 19 of elastically deformable material such as rubber mounted within the barrel between the nut and the driving clutch member and adapted to be compressed therebetween when the longitudinal movement of the pinion 2 is arrested by its engagement with a shoulder 21 on the power shaft 1 which defines its cranking position.

According to the present invention means are provided for holding the pinion in engagement with the engine gear until the actuating mechanism of the drive is rotated above a predetermined speed, and also means for thereafter holding the pinion in mesh with the engine gear until said actuating means is decelerated below a predetermined lower speed. As here shown, these functions are accomplished by means of a latch member 22 pivotally mounted at 23 on the nut member 6 and having two inwardly extending projections 24 and 25 substantially equi-distant from the pivot 23 and arranged to engage alternatively in a notch 26 of the screw shaft 4 as shown in Figs. 4 and 5.

The notch in the screw shaft is so located, as shown in Figs. 1 and 3, that it is positioned for

engagement by the latch when the pinion is meshed with the engine gear.

A spring 27 normally urges the latch 22 in a counterclockwise direction so as to cause the projection 24 to engage the screw shaft. Means for disengaging the projection 24 of the latch and engaging the projection 25 with the screw shaft at a predetermined rotative speed of the drive is provided in the form of a weighted extension 28 of the latch which is caused by centrifugal force to rotate the latch in a clockwise direction about its pivot 23. The strength of the spring 27 and the weight of the arm 28 are so chosen that the disengagement of the projection 24 and the engagement of projection 25 with the screw shaft takes place at a speed of rotation somewhat higher than ordinary cranking speed. Inasmuch as the weight 28 of the latch moves outward by centrifugal force in this operation, it will obviously hold the latch in this position until the drive decelerates to a speed considerably lower than that necessary for the original shifting of the latch.

In operation, starting with the parts in the positions illustrated in Figs. 1 and 2, rotation of the power shaft by the starting motor not illustrated causes the nut 6 to shift along the screw shaft 4, moving the pinion 2 into mesh with the engine gear 3. Just before the pinion 2 engages the abutment 21, the projection 24 of latch 22 passes by the notch 26 in the screw shaft, whereby the pinion is prevented from retrograde movement by the engagement of said projection in the notch by the action of spring 27 as illustrated in Fig. 4. Further rotation of the power shaft causes the nut 6 to compress the rubber block 19 against the driving clutch member 11 and within the barrel 15, thus compressing the clutch members 11, 7, and applying torque to the pinion to crank the engine. When an initial explosion of the engine is secured, the acceleration of the engine gear 3 causes the pinion 2 to overrun the drive, the initial overrunning movement being transmitted to the driving clutch member 11 until it is moved back far enough to disengage its teeth from those of the driven clutch member 7. Further backward movement of the members of the drive is prevented, however, by the engagement of the projection 24 of the latch in the notch 26 of the screw shaft as shown in Fig. 4 so that if the engine does not continue to be self-operative, cranking will be resumed as soon as the speed of the drive catches up with the rotation of the engine gear.

As soon as the engine fires, the release of the cranking load permits the starting motor to rapidly accelerate the drive. When the rotation of the drive has thus substantially exceeded the normal cranking speed, the centrifugal weight 28 rotates the latch 22 to disengage projection 24 and engage projection 25 with the screw shaft. The pinion is accordingly still held in engagement with the engine gear, and if the engine should die, cranking will again be resumed until a reliable start is secured. When the engine has become reliably self-operative, the projection 25 of the latch being in engagement with the screw shaft due to the free spinning condition of the starting motor, the operator opens the starting circuit whereupon the deceleration of the drive permits the spring 27 to return the latch to its normal position. The consequent withdrawal of the projection 25 from the notch 26 in the screw shaft permits the nut and its associated parts to be returned to idle position by the deceleration of the screw shaft and the rotative drag of the pinion which is transmitted to the nut 6 through the overrunning clutch 7, 11 as controlled by the spring 13.

It will thus be seen that disengagement of the pinion from the engine gear by an explosion in the engine during slow cranking is prevented by the engagement of projection 24 in the notch 26 of the screw shaft, while disengagement in response to continuous self-operation of the engine is prevented by the projection 25 of the latch until after the operator judges that the engine is successfully started and opens the cranking circuit.

Although but one embodiment of the invention has been shown and described in detail, it will be understood that other embodiments are possible and that various changes may be made in the design 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. In an engine starter drive a pinion, means for moving the pinion into and out of engagement with a gear of an engine to be started and for rotating the pinion to crank the engine, means for holding the pinion in engagement with the engine gear until the moving means is rotated above a predetermined speed, and means for thereafter holding the pinion in mesh until the moving means is decelerated below a predetermined lower speed.

2. In an engine starter drive a power shaft, a pinion slidably journalled thereon, means including an overrunning clutch for moving the pinion into and out of engagement with a gear of an engine to be started, and for rotating the pinion to crank the engine, means for holding the pinion in mesh with the engine gear until the moving means is rotated above a predetermined speed, and means rendered operative by the release of the holding means for arresting the demeshing movement of the pinion until the moving means has decelerated below a predetermined lower speed.

3. In an engine starter drive, a power shaft, a pinion slidably journalled thereon for movement into and out of mesh with a gear of an engine to be started, means for traversing and rotating the pinion including an overrunning clutch, latch means for holding the pinion in engagement with the engine gear, said latch means including a member having two alternatively operative latch projections, spring means for biasing the member into position to render operative one of said projections, and centrifugal means for moving the member into position to render operative the other said projection.

4. An engine starter drive as set forth in claim 3 in which the pinion is arranged to move away from fully meshed position as the latch carrying member moves from its first mentioned position to its second mentioned position.

5. An engine starter drive as set forth in claim 3 in which the latch carrying member is mounted on the traversing means for the pinion, and the overrunning clutch is located between the traversing means and the pinion.

6. In an engine starter drive a power shaft, a screw shaft mounted thereon and connected to rotate therewith, a nut on the screw shaft, a pinion slidably journalled on the power shaft and adapted to rotate a gear on an engine to be started, means including an overrunning clutch connecting the nut and pinion, means in-

cluding a member movably mounted on the nut having two alternatively operative latch projections adapted to engage the screw shaft to hold the pinion in mesh with the engine gear, spring means for moving the latch carrying member into position to engine one of said latch projections with the screw shaft, and said latch carrying member having centrifugal means for moving it to disengage said one projection and engage the other projection with the screw shaft.

7. An engine starter drive as set forth in claim 6 in which said screw shaft has an abutment cooperating with the latch projections alternatively in said two positions of the latch carrying member to arrest demeshing movement of the pinion.

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