March 19, 1946. J. E. BUXTON 2,396,986

STARTER FOR INTERNAL-COMBUSTION ENGINES

Filed Jan. 8, 1945 2 Sheets-Sheet 1

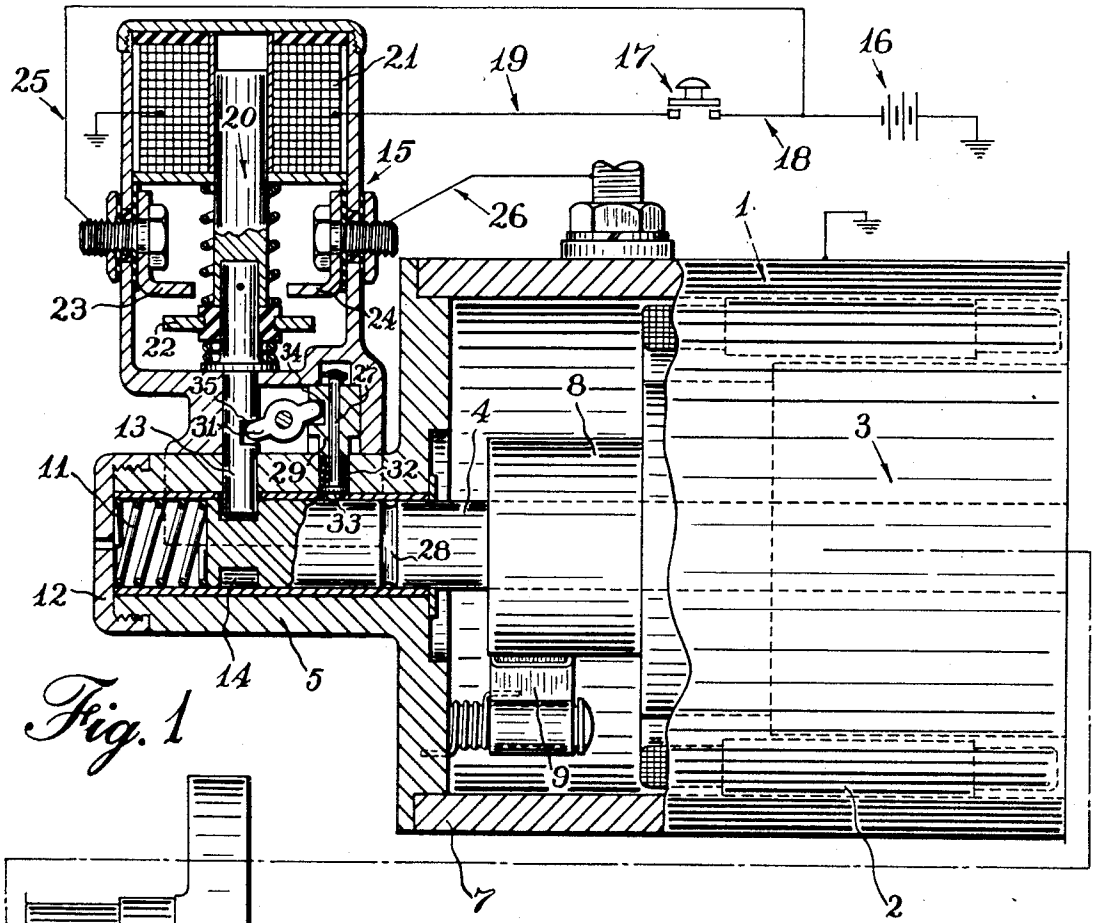
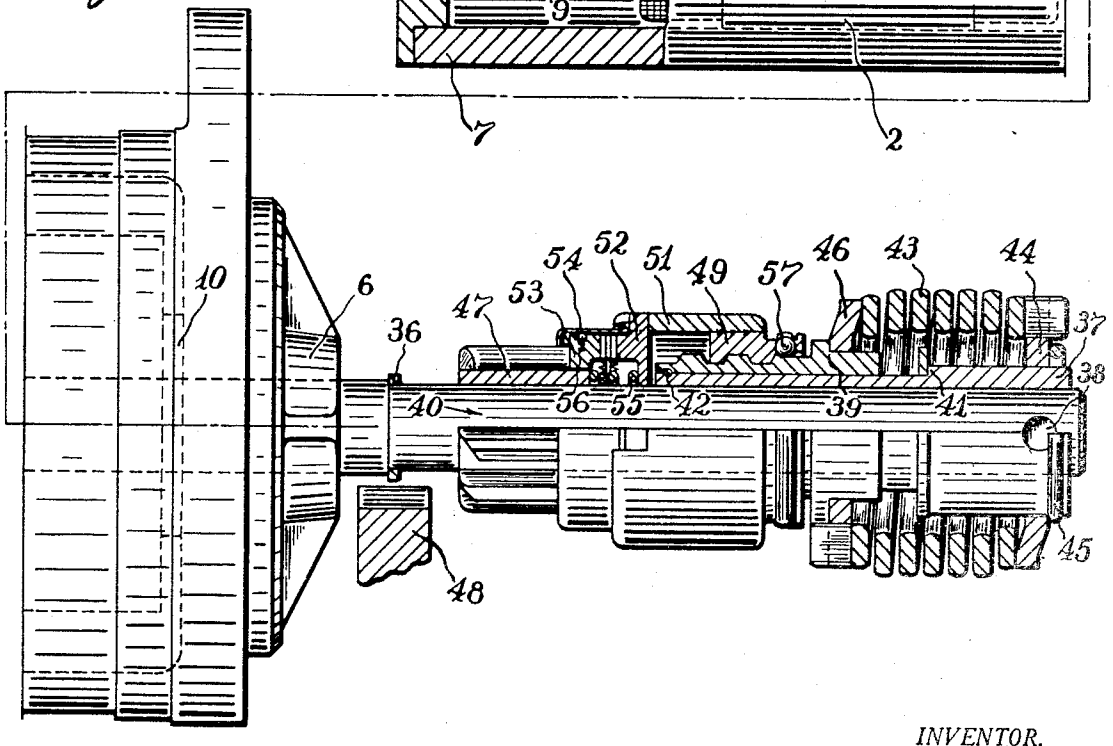


Fig. 1



WITNESS

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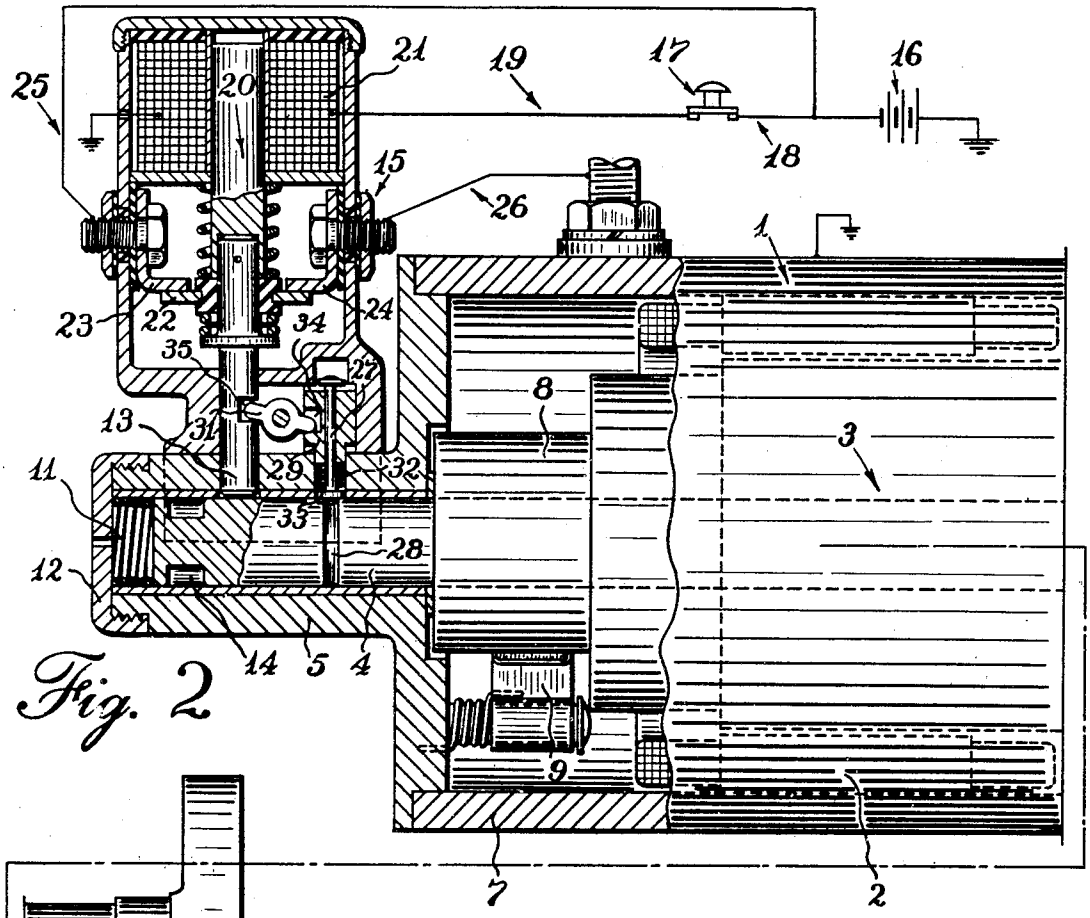
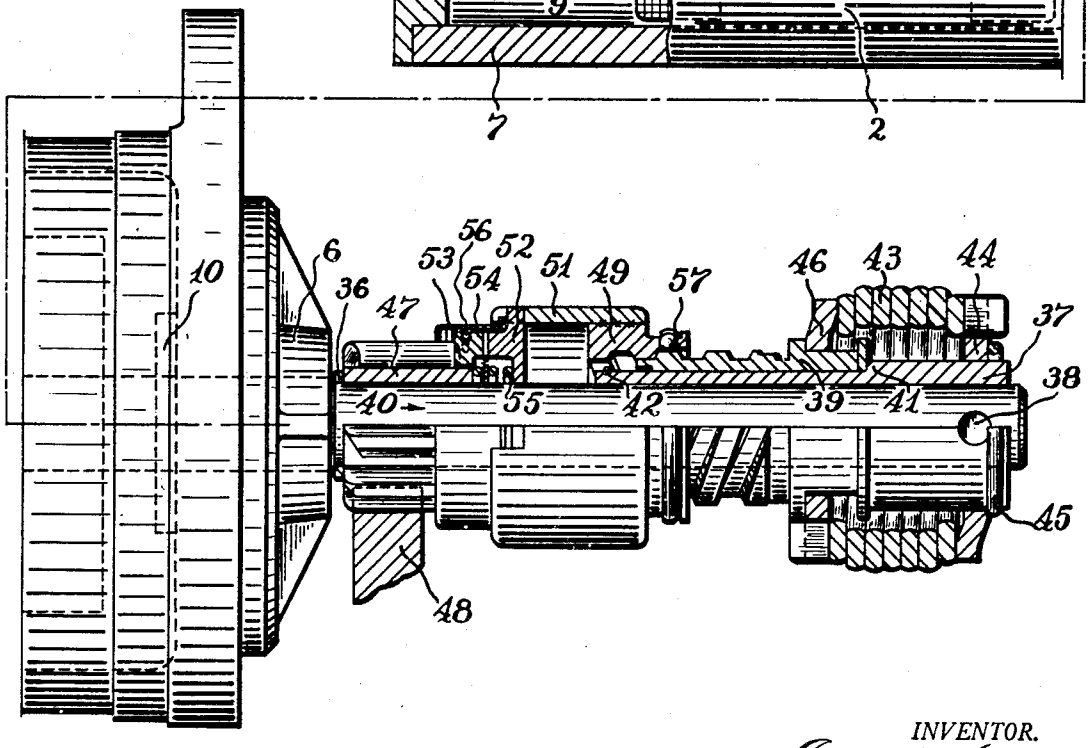


Fig. 2



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STARTER FOR INTERNAL-COMBUSTION ENGINES

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Application January 8, 1945, Serial No. 571,885

5 Claims. (Cl. 290—38)

The present invention relates to starters for internal combustion engines and more particularly to disconnectable gearing for rotating an engine member from a starting motor.

It is an object of the present invention to provide a novel engine starter in which a drive pinion is mounted on the armature shaft of the starting motor and is moved by longitudinal motion of said shaft into and out of mesh with a gear of an engine to be started.

It is another object to provide such a device incorporating means for preventing undesired engagement of the pinion with the engine gear.

It is another object to provide such a device incorporating means for holding the armature of the motor centered longitudinally with respect to the field poles thereof.

It is another object to provide such a device in which both said means are controlled by the means for actuating the starting motor switch.

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

Fig. 1 is a side elevation, partly broken away and in section showing a preferred embodiment of the invention with the parts in normal or idle position; and

Fig. 2 is a similar view showing the parts in cranking position.

In Fig. 1 of the drawings there is illustrated a starting motor 1 comprising field coils 2 and an armature 3 mounted on a shaft 4 which is journalled in bearings 5 and 6 in the frame 7 of the motor. A commutator 8 is fixed on the armature shaft 4, and brushes 9 are arranged to cooperate therewith in the usual manner. The armature shaft 4 is longitudinally slidable in the bearings 5 and 6, and is normally maintained in the position shown in Fig. 1 with the armature 3 decentered with respect to the field coils 2, by means of a spring 11 bearing on the end of the armature shaft 4 and retained within the bearing 5 by a perforated cap member 12.

The longitudinal movement of the armature to the right in Fig. 1 under the action of said spring is limited by a thrust bearing 10 which thus defines the idle position of the armature.

Means for positively holding the armature in idle position is provided in the form of a latch 13 arranged to enter a circumferential groove 14 in the armature shaft 4 which registers with the latch when the armature is in idle position. The latch is formed as an extension of the plunger 20 of a magnetic switch 15 which controls the energization of the starting motor from a battery 16. Manually controlled means for energizing the starting switch is provided in the form of a push button 17 connected by a lead 18 to the battery 16 and by a lead 19 to the coil 21 of the starting switch. The plunger 13—20 of the starting switch carries a movable contact 22 arranged to bridge a pair of fixed contacts 23 and 24, the former being connected by a lead 25 to the battery 16 and the latter by a lead 26 to the starting motor.

Means for yieldingly holding the armature in its centered position is provided in the form of a detent 27 slidably mounted in the bearing 5 in position to register with a groove 28 in the armature shaft when the armature is in centered position with respect to the field coils 2. Means for applying yielding pressuring to the detent during the starting operation is provided in the form of a sliding thrust member 29 actuated by a lever 31 to compress a spring 32 which bears on a flange 33 fixed to the detent. Lever 31 engages at its ends in notches 34, 35, formed in the thrust member 29 and the latch member 13, respectively, whereby withdrawal of the latch causes the thrust member to be projected downwardly so as to compress the spring 32.

The armature shaft 4 is arranged to extend beyond the bearing 6 of the motor as indicated at 40, and is reduced in diameter so as to form a stop shoulder 36. A sleeve 37 is fixed on the smooth reduced extension 40 of the shaft in any suitable manner as by means of a cross pin 38, and has journalled thereon a screw shaft 39 having freedom for longitudinal movement limited in one direction by a shoulder 41 on the sleeve and in the other direction by a thrust ring 42 mounted in a groove in the end of the sleeve.

Yielding means for actuating the screw shaft 39 from the sleeve 37 is provided in the form of a spring 43 which is anchored at one end to the sleeve 37 by means of an anchor plate 44 retained by a thrust ring 45, and at its other end by an anchor plate 46 non-rotatably mounted on the end of the screw shaft.

A pinion 47 is slidably journalled on the reduced extension 40 of the armature shaft for longitudinal movement into and out of engagement with a gear 48 of an engine to be started. Means for actuating the pinion from the screw shaft 39 are provided in the form of a nut 49 threaded on the screw shaft and rigidly connected by a barrel member 51 to a dental clutch plate 52. The pinion 47 has a cooperating dental clutch member 53 fixed thereon in any suitable

manner, and a thimble 54 is anchored at one end to the barrel 51 and has a swiveled connection to the pinion clutch member 53 so as to limit separation of the clutch members. Means normally maintaining the clutch members out of engagement is provided in the form of a light compression spring 55 located therebetween. Detent means for frictionally connecting the pinion 47 to the barrel 51 is provided in the form of a spring ring 56 anchored in the pinion clutch member 53 and bearing frictionally against the interior of the thimble 54. An anti-drift member in the form of a spring pressed ball 57 is mounted in the nut member 49 to bear on the screw shaft 39 so as to normally maintain the nut in retracted position.

The thrust bearing 10 for the armature shaft is arranged to define the idle position thereof so as to maintain proper de-meshed clearance between the pinion 47 and the engine gear 48 as illustrated in Fig. 1, when the parts are in idle position. When the armature is centered by the flux of the starting motor upon energization thereof as shown in Fig. 2, the pinion 47 is caused to enter into partial mesh with the engine gear. The rotation of the armature shaft, and consequently of the screw shaft 39 causes the nut 49 to move along the screw shaft and consequently to traverse the pinion 47 until its movement is stopped by the shoulder 36. The pinion is then fully meshed with the engine gear, and the clutch members 52 and 53 are pressed into engagement by the screw-jack action of the screw shaft and nut, the reaction causing compression of the drive spring 43 as illustrated in Fig. 2.

In operation, starting with the parts in the positions illustrated in Fig. 1, closure of the push button 17 by the operator completes a circuit from the battery through the coil 21 of the starting switch which is thereby energized to attract the plunger 20 closing the starting switch contacts 23, 22, 24, and withdrawing the latch 13 from engagement with the armature shaft 4. Energization of the starting motor by the closure of the starting switch causes the armature 3 to center itself with respect to the field coils 2, thereby moving the armature shaft longitudinally until the groove 28 therein registers with the detent 27 which is then pressed into said groove by the spring 32 which is placed under compression by the lever 31 as actuated by the latch member 13. This longitudinal movement of the armature shaft 4 brings the pinion 47 into initial mesh with the engine gear. Rotation of the armature shaft is transmitted through sleeve 37 and spring 43 to the screw shaft 39, whereby the nut 49 is caused to advance and move the pinion 47 fully into mesh with the engine gear 48, after which clutch members 52 and 53 are engaged, and the pinion connected to rotate with the armature shaft through the yielding connection provided by the spring 43.

When the engine fires, the acceleration of the engine gear causes the pinion 47 to overrun the armature shaft whereby the nut 49 is traversed back to its idle position, releasing the clutch members 52, 53 and permitting the pinion 47 to overrun freely. The pinion is maintained in mesh with the engine gear 47, however, since the armature shaft is maintained in its centered position as long as the starting switch is closed. Should the engine fail to continue self-operative, retardation of the pinion 47 below the speed of the armature shaft causes a drag to be applied to the nut 49 through the frictional ring 56 whereby the nut is again advanced to close the clutch 52, 53 and cranking is resumed. When the engine is reliably self-operative the operator releases the push button 17 thereby opening the starting switch 15, deenergizing the starting motor and permitting the armature to return to decentered position under the action of the spring 11, in which position it is positively locked by the entry of the latch 13 into the groove 14 in the armature shaft. Thereafter, accelerational forces applied to the vehicle cannot cause undesired engagement of the starting pinion with the engine gear by virtue of action of said latch.

Although but one embodiment of the invention has been shown and described in detail, it will be understood that other embodiments are possible and various changes may be made in the form and arrangements 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 a motor having a field and an armature which is shiftable longitudinally out of centered position with respect to the field, an armature shaft, a pinion slidably journalled thereon for movement into and out of mesh with a gear of an engine to be started, an overrunning driving connection from the shaft to the pinion, means for holding the armature shaft in decentered position, a detent for retaining the shaft in centered position, and manually controlled means for releasing the holding means and actuating said detent.

2. An engine starter as set forth in claim 1 in which the driving connection to the pinion includes means for traversing the pinion along the shaft toward and from its fully meshed position.

3. An engine starter as set forth in claim 1 in which the driving connection to the pinion includes means for traversing the pinion along the shaft toward and from its fully meshed position, said shaft having an abutment for arresting the meshing movement of the pinion, and said overrunning connection including clutch members which are closed by said traversing means when the longitudinal movement of the pinion is arrested by said abutment.

4. In an engine starter, a motor having a longitudinally displaceable armature shaft, a pinion slidably journalled thereon for movement into and out of mesh with a gear of an engine to be started, a connection between the shaft and pinion including a clutch, means for holding the shaft so displaced as to keep the pinion out of mesh with the engine gear, means for releasing the holding means and causing the shaft to so move as to bring the pinion into mesh with the engine gear, and means for retaining the armature shaft in position to keep the pinion meshed with the engine gear as long as the starting motor is energized.

5. In an engine starter, a motor having a longitudinally displaceable armature shaft, a pinion slidably journalled thereon for movement into and out of mesh with a gear of an engine to be started, a connection between the shaft and pinion including a clutch, means for holding the shaft so displaced as to keep the pinion out of mesh with the engine gear, a detent for retaining the armature shaft in position to keep the pinion meshed with the engine gear, and unitary means for releasing the holding means, actuating the detent, and energizing the starting motor.

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