Jan. 18, 1944. D. P. KEARNEY 2,339,486

ENGINE STARTER GEARING

Filed Oct. 7, 1942

Fig. 1

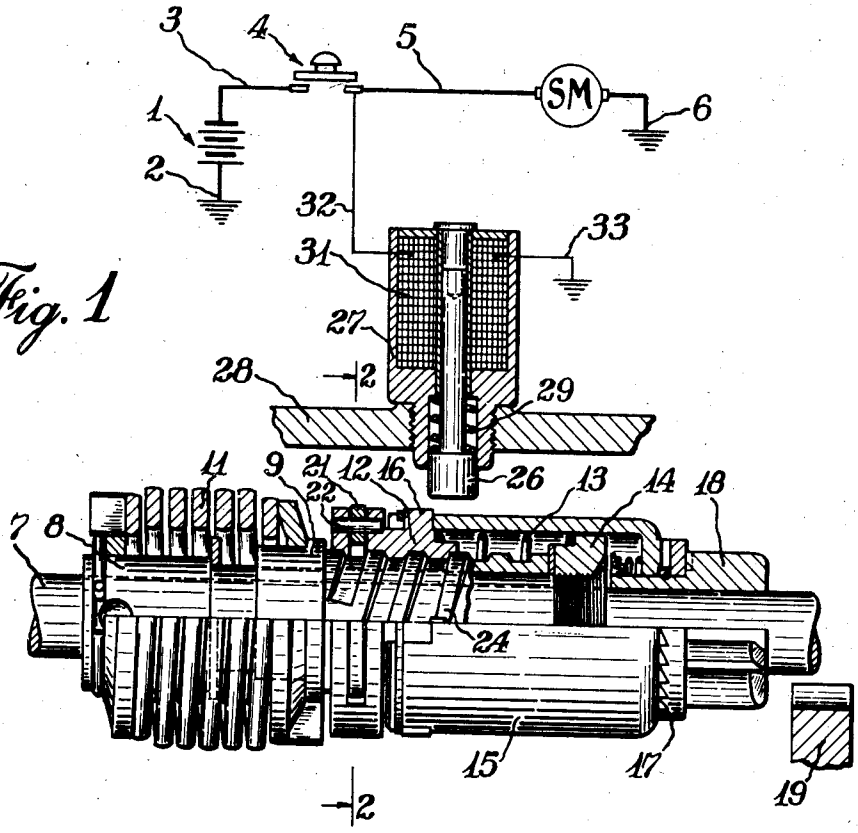


Fig. 2

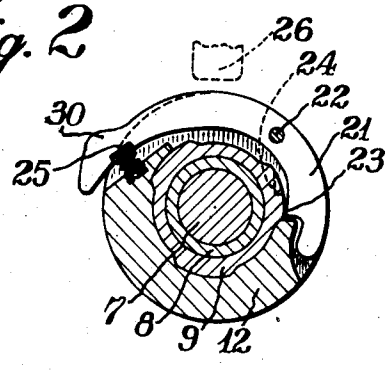
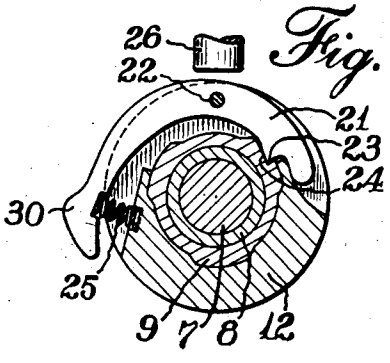


Fig. 3



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ENGINE STARTER GEARING

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5 Claims. (Cl. 290—38)

The present invention relates to engine starter gearing and more particularly to a drive of the type which automatically engages when the starting motor is energized and disengages when the engine starts.

When drives of this type are used to crank engines which are subject to false starting, it is desirable to provide some means for maintaining the gear connection until the engine is reliably self-operative. Thus, many engines, particularly when very cold, will fire in one or more cylinders enough to disengage the ordinary starter drive, and then fail to continue in operation. This necessitates a repetition of the entire cranking cycle of operation in order to re-engage the drive and resume cranking.

Various forms of drive have been developed for preventing de-mesh until a true start is secured, such for instance as disclosed in the patents to Whitney, 2,004,643; Kearney, 2,218,972 and FitzGerald, 2,221,085. In each such true starter drive some function of the engine or the starting motor is utilized to indicate a successful start and permit de-mesh of the drive. However, due to variations in operating characteristics of engines and starting motors under the widely divergent conditions of use, the optimum applicability of these devices is more or less specialized and no one type has been found best for all applications.

It is an object of the present invention to provide a novel engine starter drive in which the engagement of the gearing is completely under the control of the operator.

It is another object to provide such a device in which the gearing is engaged by energization of the starting circuit, and is held in mesh as long as the starting circuit is energized.

It is another object to provide such a device in which, when the starting circuit is de-energized, disconnection of the drive is brought about by the overrunning action of the engine.

It is another object to provide such a device incorporating clutch means permitting the engine to overrun the drive while the drive gear is maintained in mesh.

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

Fig. 1 is a semi-diagrammatic illustration of a starting system forming a preferred embodiment of the invention, the drive gearing and controlling means therefor being shown partly in side elevation and partly in vertical section;

Fig. 2 is a cross section of the starter drive taken substantially on the line 2—2 of Fig. 1; and

Fig. 3 is a view similar to Fig. 2 showing the parts in the positions assumed during the cranking operation.

In Fig. 1 of the drawing there is illustrated a starting circuit including a battery 1 grounded at 2 and connected by a lead 3 to a manually operable starting switch 4. Switch 4 is connected by a lead 5 to the starting motor SM which is grounded at 6 to complete the starting circuit. The starting motor SM is arranged to actuate a shaft 7 which may be the extended shaft of the motor armature and has fixed thereon in any suitable way a tubular shaft 8. A screw shaft 9 is slidably journalled on the tubular shaft 8 and is yieldably connected to rotate therewith by means of a torsion spring connection 11. A nut 12 is threaded on the screw shaft and is normally maintained in its idle position as illustrated by an anti-drift spring 13 which bears against a stop nut 14 fixed on the tubular shaft 8.

A barrel member 15 is rigidly attached at one end to the nut 12 in any suitable manner as indicated at 16 and is provided at its other end with an overrunning clutch connection 17 with a pinion 18 slidably journalled on the drive shaft 7 for movement into and out of engagement with a gear 19 of an engine to be started.

Means for holding the pinion 18 in mesh with the engine gear 19 is provided in the form of a latch member 21 pivoted at 22 on the nut member 12 and having a shoulder 23 adapted to enter a notch 24 in the screw shaft under the action of a spring 25 when the nut has travelled on the screw shaft sufficiently to mesh the pinion with the engine gear.

Means under the control of the operator for releasing the latch are provided in the form of a trip plunger 26 slidably mounted in a holder 27 threaded in the starting motor casing 28. The free end 30 of the latch 21 extends radially beyond the body of the latch, and the plunger 26 is normally maintained by a spring 29 in position to engage said free end of the latch when the parts of the drive are rotating in cranking position.

Means are provided for retracting the trip plunger 26 from the path of the latch 21 during energization of the starting circuit. As here shown this is accomplished by means of a solenoid 31 mounted in the holder 27, connected by a lead 32 to the starting motor lead 5, and grounded at 33 so as to be energized from the

battery 1 as long as the starting switch 4 is closed.

In operation, starting with the parts in the positions illustrated in Fig. 1, closure of the starting switch 4 by the operator actuates the starting motor SM and at the same time energizes the solenoid 31 which thereupon retracts the plunger 26, compressing the spring 29. Rotation of the armature shaft 7 by the starting motor is transmitted through the yielding connection 11 to the screw shaft 9, whereby the nut 12 with its associated barrel 15 and pinion 18 are traversed longitudinally until the nut 12 engages the stop nut 14 at which time the pinion 18 is meshed with the engine gear 19. At or near the time that the control nut 12 engages the stop nut 14, the shoulder 23 of the latch 21 carried by the control nut enters the notch 24 on the screw shaft under the action of the spring 25 as shown in Fig. 3. This engagement effectively prevents retrograde motion of the control nut on the screw shaft so as to positively hold the pinion in mesh with the engine gear.

When the longitudinal movement of the control nut is arrested by the stop nut 14, the torque of the starting motor is transmitted to the pinion to crank the engine in the usual manner. When the engine fires, the consequent acceleration of the engine gear 19 causes the pinion 18 to overrun the drive, such overrunning action being permitted by the clutch 17. De-meshing of the pinion, however, is prevented by the latch 21. If the engine should fail to remain self-operative, as soon as it slows down to a speed corresponding to that of the starting motor the clutch 17 will re-engage and cranking will be resumed. When the engine becomes reliably self-operative, the operator opens the starting switch 4, thus de-energizing both the starting motor and the solenoid 31. Plunger 26 is then moved by the spring 29 into the path of the free end 30 of latch 21, thus tripping the latch and thereby permitting the pinion to be de-meshed by the control nut 12 overrunning the screw shaft 9 responsive jointly to the rotational effect transmitted from the pinion 18 to the control nut, the deceleration of the screw shaft by the stoppage of the starting motor, and the longitudinal pressure of the anti-drift spring 13. It will be readily appreciated that this arrangement provides means for positively holding the pinion in mesh irrespective of operating characteristics of the engine and starting motor as long as the starting switch is closed and for immediately causing de-meshing of the drive when the starting switch is opened. This puts the traversal of the pinion in complete control of the operator although the traversal is actually accomplished in the ordinary manner by the threaded connection of the drive.

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 a starting circuit including a motor, a starter drive operated thereby including a pinion and means actuated by the motor to traverse the pinion into and out of engagement with a member of an engine to be started, an overrunning clutch connection between the nut and pinion, means for positively holding the pinion in engagement with the engine member irrespective of the rotative speed of the pinion, and means responsive to de-energization of the starting circuit for releasing the holding means.

2. In an engine starting system a starting circuit including a motor, a pinion movable thereby to engage and rotate a member of an engine to be started, means including a latch for positively holding the pinion in engagement with the engine member irrespective of the rotative speed of the pinion, means for tripping the latch and means responsive to energization of the starting circuit for holding the tripping means out of engagement with the latch.

3. In an engine starting system a starting circuit including a motor, a pinion movable thereby to engage and rotate a member of an engine to be started, an overrunning clutch connection between the motor and pinion, means including a spring-pressed latch for holding the pinion in engagement with the engine member, means for engaging and tripping the latch, and electromagnetic means energized from the starting circuit for holding the tripping means in inoperative position.

4. In an engine starting system a starting circuit including a starting motor, a pinion, means actuated by the starting motor for moving the pinion into engagement with an engine gear and rotating the pinion to crank the engine, said means being operative to de-mesh the pinion responsive to overrunning of the engine gear, means for positively holding the pinion in mesh with the engine gear, means for releasing the holding means, and means responsive to energization of the starting circuit for preventing the operation of the releasing means.

5. An engine starting system as set forth in claim 4 including further, an overrunning connection between the starting motor and pinion.

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