June 24, 1947. E. E. HOOD ET AL 2,423,068

ENGINE STARTER

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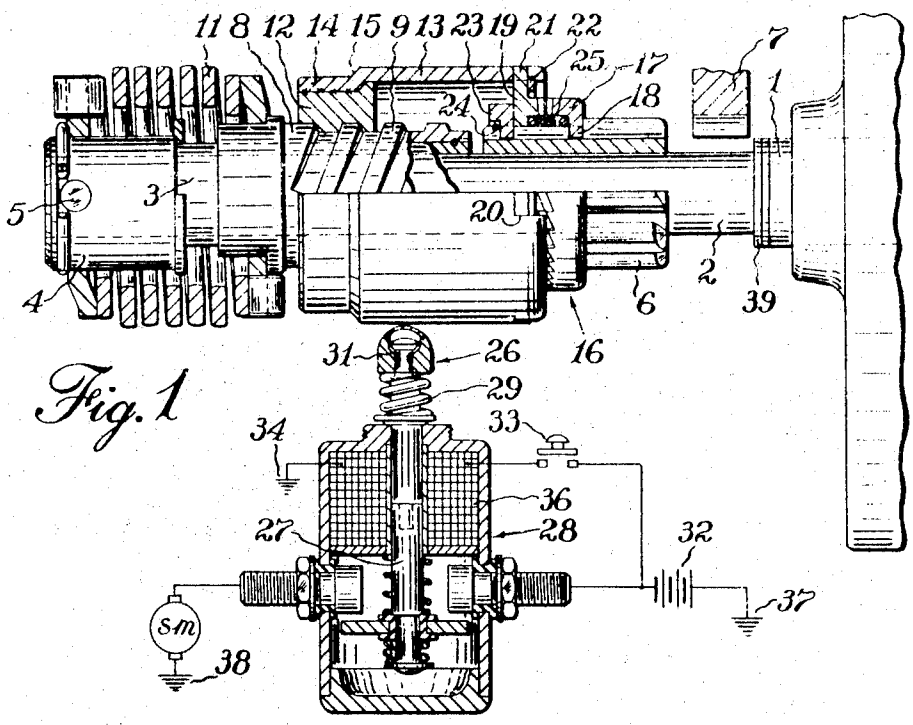


Fig. 1

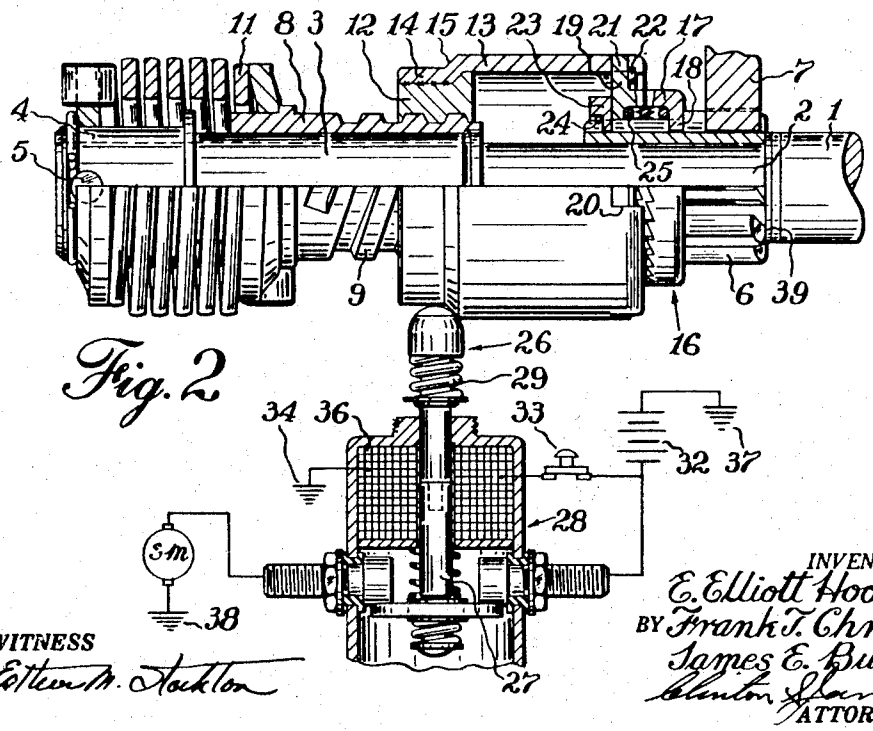


Fig. 2

WITNESS

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Fig. 3

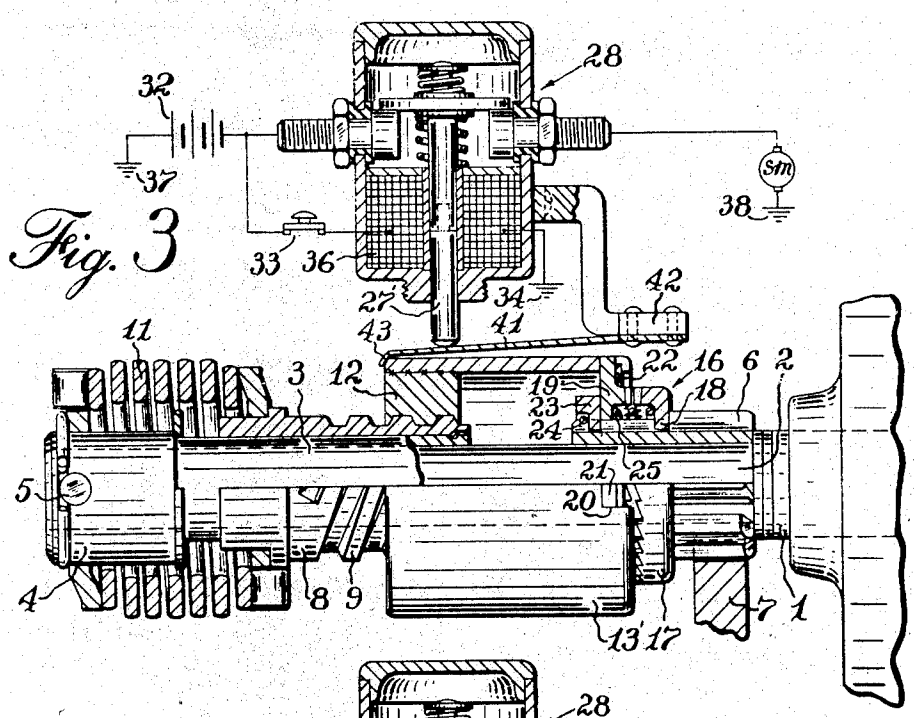
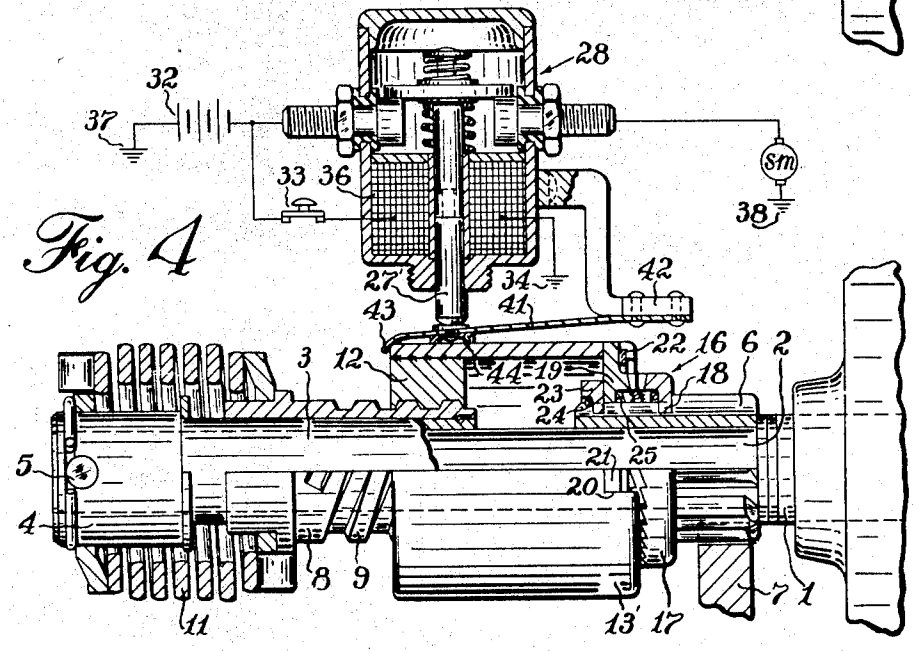


Fig. 4



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ENGINE STARTER

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6 Claims. (Cl. 74—7)

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The present invention relates to an engine starter drive and more particularly to that type of starter in which a pinion remains operatively connected to a gear on the engine to be started until the operator causes the starting mechanism to be deenergized. Starting drives of this type, such as exemplified in the patent to Buxton, 2,332,986, usually incorporate means such as a detent for holding the pinion in mesh with the engine gear, and a clutch between the pinion and the member from which it is driven to permit overrunning of the pinion when the engine starts.

It is an object of the present invention to provide a novel starter of the above type incorporating a detent of simple and economical construction in association with the starter drive for assisting the engagement of the pinion with the engine member and continuing such engagement until the operator interrupts the starting operation.

It is a further object to provide such a device having a detent under the control of the operator for cooperating with a pinion driving member to assist movement of the pinion into mesh with the engine gear and thereafter oppose demeshing until the operator releases the starting switch.

It is a further object to provide such a device having a detent so positioned with reference to the starting drive as to bear on a pinion driving sleeve while the pinion is traversing into mesh with the engine gear, but is free of the driving sleeve when full mesh of the pinion is secured.

It is another object to provide such a device in which the detent with its operating means is combined with the starting switch as an operative unit.

It is a further object to provide such a device in which the detent is flexible to permit the pinion to demesh if heavily stressed by unusual conditions such as by the fouling or sticking of the overrunning clutch.

It is a further object to provide such a device in which the flexible detent is further provided with a friction block for contacting a member attached to the pinion and preventing wear on the flexible detent.

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

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

Fig. 2 is a view similar to Fig. 1 with the parts thereof in the positions assumed when the engine

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starts and the pinion overruns the starting motor;

Fig. 3 is a view similar to Fig. 2 illustrating a second embodiment of the invention wherein the flexible detent is in operation during overrunning of the pinion; and

Fig. 4 is a view similar to Fig. 3 showing a third embodiment of the invention in which the flexible detent is provided with a friction block bearing on a member attached to the pinion during overrunning of the pinion.

In Fig. 1 of the drawing, there is shown a portion of a starting motor SM having an armature shaft 1 provided with a smooth reduced extension 2. A sleeve 3 having a portion 4 of enlarged diameter is secured on the outer end of the shaft 1 as by means of an anchor pin 5. A driving member in the form of a pinion 6 is journalled on the reduced portion 2 of the shaft 1 in position to be traversed into and out of engagement with an engine member in the form of a ring gear 7. Means for actuating the pinion 6 is provided, comprising an operating member in the form of a screw shaft 8, threaded at 9, slidably journalled on the sleeve 3 and yieldably driven therefrom as by means of a drive spring 11, anchored at its ends to said sleeve and shaft respectively. A control member for the pinion is provided in the form of a nut 12 threaded on the operating member 8. The control member has a pinion driving sleeve or barrel 13 attached thereto, as by welding or brazing, so as to form in effect an extension of said control member, the rear portion of which is of reduced diameter as indicated at 14, creating an inclined step or shoulder 15. Disconnectable driving means are provided between the nut 12 and pinion 6 in the form of an overrunning clutch, indicated generally by numeral 16. As here shown, this clutch is of the dental type, having one toothed plate 17 non-rotatably mounted on the hub of the pinion at 18, and a mating toothed plate 19 journalled on the pinion hub and keyed to the barrel 13 as by means of lugs 21 on the plate held within slots 20 of the barrel by a snap ring 22. Means are provided for normally holding the clutch parts 19 and 17 in spaced relation, in the form of a spring 25 interposed between the plates, the separation of the plates being limited by an abutment ring 23 locked in place on the end of the pinion hub by a snap ring 24.

According to the present invention, unitary means are provided to insure traversal of the pinion 6 on the shaft 1 into mesh with the engine gear when the motor is energized, and to oppose premature demesh of the pinion. To this

end, means for restraining initial rotation of the pinion is provided in the form of a detent 26 which is located close to the pinion driving barrel and is movable into frictional engagement therewith. The detent is preferably controlled by the operator as an incident to the energization of the starting system. As shown, this is accomplished by mounting the detent on an extension of the plunger 27 of starting switch 28, in position to engage said barrel when the switch is closed. A slight amount of lost motion is incorporated in the head of the detent 26 for taking care of errors in installation and manufacture, and a spring 29 is seated under the head of the detent so as to bias it against a stop shoulder 31. The switch 28 can be of any desired conventional construction and is energized from a battery 32 through a manual switch 33, the coil 36 of the switch being grounded at 34. Closure of the starting switch is arranged to connect the starting motor SM to the battery 32, the battery and starting motor being grounded at 37 and 38 respectively to complete the starting circuit.

In order to perform its second function of holding the pinion in mesh with the engine gear until a true start is secured, the detent 26 is so located that the final meshing movement of the pinion causes the detent to run off the shoulder 15; and the portion 14 of barrel 13 is sufficiently reduced in diameter to clear the detent and thereby permit rotation of the barrel without retardation by the detent as illustrated in Fig. 2. Under these circumstances, any attempt of the barrel to demesh the pinion, while the starting switch is closed, will be opposed by engagement of the detent against the shoulder 15. In order that the pinion may overrun freely when the engine starts, the detent is so located with respect to the shoulder 15 as to permit the barrel to move back sufficiently to allow disengagement of the overrunning clutch 16 before the detent engages said shoulder.

Fig. 2 of the drawing shows the starting drive in overrunning position with the detent 26 contacting against the stop shoulder 15 to prevent disengagement of the pinion 6 from the engine gear 7 and with the clutch parts 17 and 19 separated.

In operation, the operator presses the push button 33, thus completing a circuit through the battery 32, through push button 33, solenoid coil 36, and ground connection 34 to energize the main starting switch 28. Upon closure of the starting switch, another circuit is established from the battery 32 through the starting switch to the starting motor SM and ground connection 38 to energize the starting motor and rotate the motor shaft 1. At the moment that the motor shaft starts to rotate, the detent 26 has already contacted the barrel 13 due to the energization of solenoid 36, so as to frictionally prevent rotation of the nut member 12, and since the screw shaft 8 is rotating, the nut member and barrel will be traversed toward the starting motor. The consequent thrust transmitted from the barrel through the clutch members 19, 25 and 17 traverses the pinion 6 toward the shoulder 39 formed by the reduction in diameter of shaft 1. When the sliding motion of the pinion is arrested by the shoulder 39 incident to full mesh of the pinion 6 with the engine gear 7, the clutch parts 19 and 17 come into firm engagement so as to transmit torque from the motor shaft 1 to the pinion 6. When the engine is successfully started, the operator releases the control switch 33, thus causing the starting switch 28 to open and deenergize the starting motor, and at the same time moving the detent 26 out of engagement with the barrel 13. The rotation of the engine gear 7 causes the pinion to rotate faster than the starting motor, and the pinion is accordingly traversed backward into demeshed position by virtue of the torque transmitted from the pinion to the control nut by the frictional driving contact of the ends of spring 25 within the clutch 16.

Should the initial explosions of the engine be weak, the operator will keep the manual switch 33 closed, thus maintaining the detent 26 in operative position to oppose demesh of the pinion 6 by contact of the shoulder 15 on the detent. Since the main driving force tending to demesh the pinion while the clutch plates 19 and 17 are separated is transmitted frictionally through the spring 25 within the clutch 16, only a light pressure of the detent 26 is necessary to effectively overcome the demeshing effort. When the force of the explosions is expended therefore, the cranking operation is immediately resumed and continued until a successful start has been secured.

In the embodiment of the invention illustrated in Fig. 3, the parts of the drive are in general similar to those in the first embodiment, and are similarly numbered. In this embodiment however, a detent 41 for controlling the pinion is provided which is constructed as a flat spring or finger, anchored at one end as shown at 42 and provided with an inwardly extending hook 43 at its free end.

In idle position, the hook 43 of the detent 41 is positioned so as to clear the barrel 13' but upon actuation of the starting solenoid 28 by means of the manual switch 33, the plunger 27' presses against the detent 41 to flex it into frictional contact with the barrel. Simultaneously the motor shaft 1 is rotated and the pinion 6 is thereby traversed into mesh with the engine gear to crank the engine, the detent meanwhile restraining rotation of the barrel 13' to assist such traversal. In a normal starting operation, the manual switch 33 is opened as soon as the engine becomes self-operative and the consequent deenergization of the solenoid 36 releases the detent 41 and thereby permits the pinion and its associated parts to move back to idle position. If an abnormally great demeshing force is encountered due to excessive drag of the overrunning clutch 16 or otherwise, the barrel 13' will flex the spring detent hook 43 upward so as to allow the barrel and pinion to traverse back to idle position.

In the embodiment of the invention illustrated in Fig. 4, the parts of the starting mechanism are the same as those found in Fig. 3 and are similarly numbered. In addition, means are provided for preventing wear on the spring detent 41 in the form of a block 44 of non-metallic material such as Bakelite fixed to the detent.

At the moment the starting solenoid switch 28 is closed, the solenoid plunger 27' presses the block 44 into firm contact with the barrel 13' thus affording sufficient frictional drag to overcome the tendency of the pinion to demesh. However, if the demeshing force becomes unusually great due to a fouled clutch or otherwise, the detent hook 43 will be flexed outward by the barrel 13' permitting the pinion to demesh the same as in the previous embodiment of the invention.

It will be seen that there is here provided a starting system incorporating a drive pinion which is moved automatically into engagement

with a member of an engine to be started, and a manually controlled detent formed as a part of a magnetic starting switch unit, for assisting the meshing of the pinion and for holding the pinion in mesh during false starts and until released by the operator.

Although certain embodiments of the invention have been shown and described in detail, it will be understood that other embodiments are possible, and the form and arrangement of the parts may be changed without departing from the spirit of the invention.

What is claimed is:

1. In an engine starter, a motor shaft, a pinion journalled thereon for traversal into and out of mesh with a gear on the engine to be started, means including an operating member driven from the motor shaft for actuating said pinion, said means further including a control member and a barrel forming an extension thereof having a circumferentially arranged shoulder, means including a clutch for connecting said control and pinion members, and means including a detent under the control of the operator cooperating with said shoulder for opposing demeshing of the pinion.

2. In an engine starter drive, a motor shaft, a screw shaft mounted on the motor shaft and connected to rotate therewith, a pinion journalled on the motor shaft for movement into and out of engagement with a gear of the engine to be started, a control nut having an extended sleeve threaded on the screw shaft, means including a clutch for connecting the control nut to the pinion and means for insuring meshing and preventing demeshing of the pinion including a detent movable into and out of frictional engagement with said sleeve, means under the control of the operator for moving the detent into contact with the sleeve and simultaneously energizing the starter.

3. In an engine starter, a motor shaft, a pinion slidably journalled on said shaft for traversal into mesh with a gear on the engine to be started, means for actuating said pinion including a screw shaft fixed to said motor shaft, a control nut threaded on the screw shaft, a sleeve attached to said nut, and a clutch between the sleeve and pinion closed by the final movement of the control nut; and means for insuring meshing and preventing demeshing of the pinion including a flat spring, having an inclined tip, and a solenoid plunger for moving said spring into frictional engagement with the sleeve.

4. In an engine starting mechanism, a starting circuit, a motor and a manual switch in said starting circuit, a starting drive actuated by said motor including a pinion slidably journalled on said shaft for traversal into mesh with a gear on the engine to be started, means for actuating said pinion including a screw shaft fixed to said motor shaft, a barrel, a control nut therein threaded on the screw shaft, and an overrunning clutch connecting the barrel to the pinion closed by the final movement of the control nut, and means under the control of said manual switch for insuring meshing and opposing demeshing of the pinion, including an elongated spring provided with a contact block for frictionally engaging said barrel and with a hooked end arranged to yieldably limit the demeshing movement of the barrel.

5. In an engine starter, a motor shaft, a pinion slidably journalled on said shaft for traversal into mesh with a gear on the engine to be started, a screw shaft drivingly connected to the motor shaft, means for actuating the pinion from the screw shaft, including a control nut threaded on the screw shaft, a sleeve attached to the control nut, and a clutch between said sleeve and pinion closed by the final movement of the control nut; and a starting switch comprising a movable plunger extending from the switch toward the periphery of the sleeve, and a detent carried by the plunger adjacent the sleeve, movable by closure of the starting switch into frictional engagement with the sleeve.

6. In an engine starter, a motor shaft, a screw shaft drivingly connected thereto; a pinion having an extended hub slidably journalled on the motor shaft for movement into mesh with a gear on the engine to be started, a control nut threaded on the screw shaft for controlling movements of the pinion, having an elongated sleeve fixed thereto, comprising cylindrical portions of different outer diameters merging at a shoulder, a clutch mounted on the hub of said pinion connecting the control nut and pinion; and means under the control of the operator including a yieldable detent for cooperation with said shoulder to prevent premature demesh of the pinion.

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