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ENGINE STARTING MECHANISM

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Fig. 1

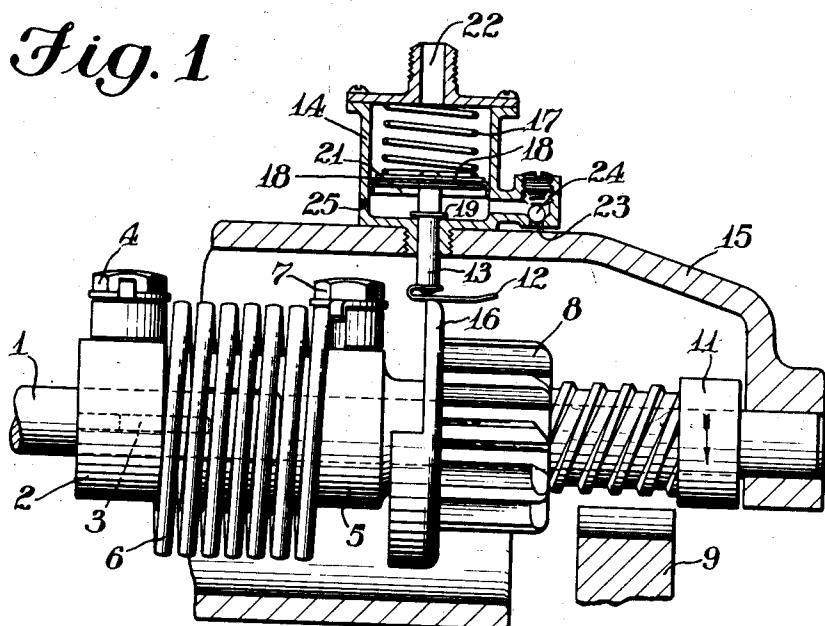
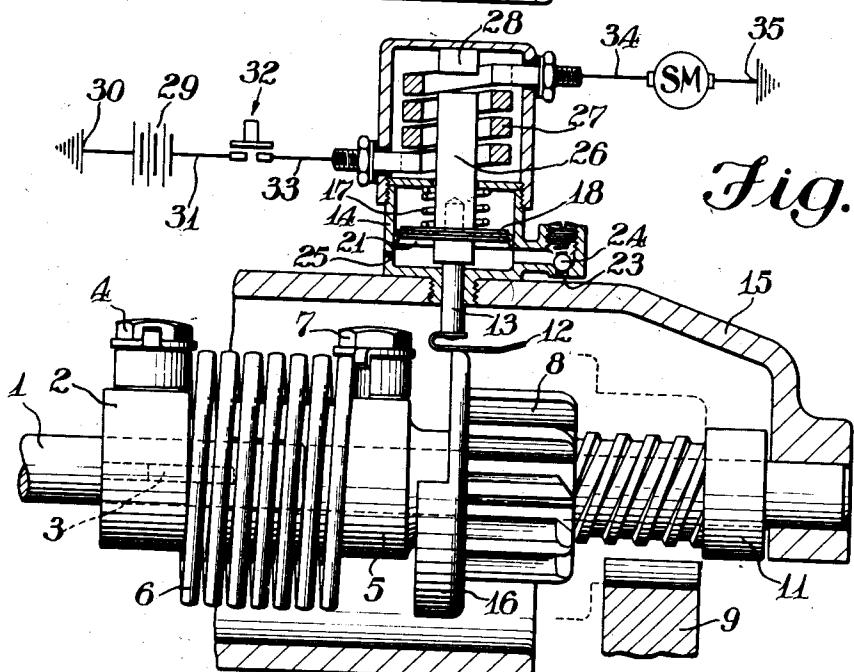


Fig. 2



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## ENGINE STARTING MECHANISM

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This invention relates to engine starting mechanism and more particularly to the type of starting mechanism in which a driving member is automatically traversed into and out of engagement with an engine member and rotated to crank the engine.

In some installations of this type, the driving member occasionally fails to traverse into mesh with the engine member due to an accumulation of dirt, rust, or grease or other causes. It is therefore an object of this invention to provide an engine starter of the above type, embodying novel means to automatically insure traversal of the driving member into driving relation with the engine member.

A further object of this invention is to provide such a device embodying an automatically controlled detent to cooperate with the driving member and assist traversal thereof upon actuation of the starter.

Another object of the invention is to provide such a device in which the detent controls the driving member during initial actuation of the starting mechanism and thereafter is rendered inoperative in order to prevent interference with the demeshing action thereof.

Another object of the invention is to provide such a device in which the detent controls the driving member during initial actuation of the starting mechanism and thereafter is rendered inoperative responsive to rotation of the engine in order to prevent interference with the demeshing action thereof.

Another object is to provide such a device embodying an electrically-controlled detent which normally cooperates with the driving member to keep it rotationally stationary while said member is being traversed toward the engine member upon closure of the starting circuit and thereafter is rendered inoperative until the starting circuit is again opened.

A further object is to provide such a device embodying a time delay in connection with the detent for preventing said detent from returning to a normal operative position for a predetermined time after the de-

tent controlling means has become ineffective.

It is another object to provide such a device which is readily adaptable to commercial types of starters, and may be positioned in various relations thereto without affecting its efficiency or reliability.

It is a further object of the invention to provide such a device which is reliable in operation, cheap in construction, and adjustable to the varying conditions of engine operation.

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

Fig. 1 is a side elevation partly in section of one preferred embodiment of the invention, the parts being shown in normal or idle position;

Fig. 2 is a view similar to Fig. 1 illustrating another embodiment of the invention.

Referring first to Fig. 1 of the drawing, there is illustrated a power member 1 which may be the extended armature shaft of an electric motor, now shown, and a drive head 2 suitably fixed thereon as by means of a key 3 and anchoring stud 4. An operating member in the form of a screw shaft 5 is slidably journaled on the power shaft 1 and has a yielding driving connection thereto in the form of a coiled driving spring 6 anchored to the drive head and to said screw shaft as by means of anchoring studs 4 and 7 respectively.

A driving member in the form of a pinion 8 is threaded on the screw shaft 5 whereby relative rotation therebetween causes automatic traversal of the pinion into or out of engagement with a member of an engine to be started such as a flywheel gear 9. Traversal of the pinion into mesh with the flywheel gear is limited by suitable stop means such as a stop nut 11 on the screw shaft in the path of said pinion whereby further rotation of the screw shaft in the meshing direction as indicated by the arrow is transmitted to the pinion to crank the engine.

According to the present invention means are provided for insuring the automatic

traversal of the pinion 8 into mesh with the engine gear 9 in the form of a detent for restraining rotation of the pinion upon initial actuation of the screw shaft, said detent 5 being so arranged and controlled as not to interfere with the free rotation of the pinion during cranking or with the demeshing action thereof. As shown in Fig. 1 this detent is in the form of an elastic friction shoe 10 12 carried by a rod 13 which is slidably mounted in the end of a cylinder 14, said cylinder being suitably mounted on a housing 15 for the starter drive in such a position that the rod 13 extends within said housing 15 with the shoe 12 in position to bear on a flange 16 of the pinion 8 when the latter is in idle position. Means are provided for normally yieldably pressing the shoe 12 against the flange 16 in the form of a spring 20 17 within the cylinder 14 bearing on a head 18 fixed on the rod, inward movement of the rod being suitably limited as by means of a flange 19 thereon.

In order to prevent the detent from bearing on the pinion during the cranking action, the shoe 12 is formed to engage the flange 16 only until the pinion has come into initial meshing engagement with the engine gear, the further meshing movement of the pinion causing disengagement from the detent. In order to prevent interference of the detent with the demeshing action of the pinion, means are provided for withdrawing the detent from operative position responsive to 30 rotation of the engine. For this purpose any engine operated source of power such as intake vacuum, exhaust pressure, or an engine driven pump or generator may be used. As here illustrated this means is provided by 35 suitable obturating means 21 mounted on the head 18 of rod 13 to form therewith a piston having a fluid-tight fit in the cylinder 14, said cylinder being provided with coupling means 22 for connection with a source 40 of vacuum such as the intake manifold of the engine or an engine driven air pump.

The return of the detent to operative position upon stoppage of the engine is preferably delayed for a predetermined time after 50 the dissipation of the intake vacuum. This is advantageous for instance in case of a false start to prevent the premature reengagement of the pinion. For this purpose the lower end of cylinder 14 is provided with an inlet 55 23 controlled by a check valve 24 for allowing rapid withdrawal of the piston 18, while a bleeder opening 25 is arranged to control the return movement of the piston to secure the desired time delay.

60 In the operation of this embodiment of the invention energization of the starting motor causes rotation of the screw shaft 5 in the direction of the arrow. Rotation of the pinion 8 therewith is resisted by the detent 12 as well as by its own inertia, whereby

the pinion is traversed into mesh with the fly-wheel gear. Meshing of the pinion is thus insured by contact of the detent on the pinion member until said pinion is well into mesh with the flywheel gear. Further rotation of the screw shaft 5 after the pinion has engaged the stop nut 11 causes the engine to be cranked in the usual way.

As soon as an appreciable vacuum is established by the turning over of the engine, the piston 18 is actuated to retract the detent from operative position, the check valve 24 opening to allow this action, and said detent is maintained in retracted position as long as the engine remains self-operative. When the engine stops, the air below the piston 18 is trapped by said check valve and forced to escape through the bleeder 25. The return of the detent to operative position is thus retarded as above set forth.

Referring now to Fig. 2 of the drawing, the parts of the starter drive and detent therefor are similar in arrangement to Fig. 1 and are correspondingly numbered. In this embodiment of the invention, however, electro-magnetic means energized from the starting circuit are used to control the detent 12. As here shown, this controlling means comprises a magnetic plunger 26 suitably fixed to the detent rod 13 and a coil 27 surrounding said plunger and adapted when energized to attract said plunger toward a fixed pole piece 28. The coil 27 is placed in series in the starting circuit comprising a battery 29 grounded at 30 and connected by a lead 31, starting switch 32 and the lead 33 to one terminal of said coil. The opposite terminal is connected by a lead 34 to a starting motor SM which is grounded at 35 to complete the starting circuit.

The coil 27 and spring 17 are suitably designed so that a proper balance of forces is established, permitting withdrawal of the plunger when the starting motor cranking current is near its maximum flux. Spring 17, is, however, made of sufficient stiffness to prevent retraction of the plunger until the starting motor circuit is near its maximum cranking flux, at which time magnetic plunger 26 moves into contact with stationary pole piece 28 thus completing the magnetic circuit. Since the holding effect on magnetic plunger 26 is increased by the closure of the magnetic circuit, the current in the starting circuit is sufficient to hold the detent retracted under all conditions until the starting switch 32 is opened.

In the operation of this embodiment of the invention and starting with the parts in the positions illustrated, closure of the starting switch 32 causes energization of the starting motor SM to cause the pinion 8 to engage and crank the engine as above set forth. Upon initial closure of the starting switch, the coil 27 is energized to some extent, but

the current passing through said coil during traversal of the pinion is not of sufficient strength and duration to retract the plunger 26 to inoperative position against the force of spring 17. When the starting motor picks up the load of cranking the engine, however, the cranking current renders the coil 27 effective to overcome spring 17 and move plunger 26 into contact with stationary pole piece 28. When the magnetic circuit has thus been closed, the reluctance thereof is reduced whereby the coil 27 is enabled to hold the detent retracted even when the current is diminished by the release of the load on the starting motor as the engine starts. It will thus be seen that the detent is effective during traversal of the pinion into mesh with the engine member but is rendered inoperative during cranking of the engine and remains inoperative as long as the starting circuit is closed.

When the starting switch 32 is opened by the operator, the time delay means including the check valve 24 and bleeder opening 25 functions to prevent the premature return of the detent to operative position as above described.

Although but two embodiments of the invention have been shown and described in detail, it will be understood that these embodiments are not exclusive and other embodiments are possible and various changes may be made in the arrangement and construction 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, an operating member, a driving member, said members having connecting means whereby relative rotation causes translation of the driving member into or out of engagement with a member of an engine to be started, means for opposing rotary movement of the driving member to insure its traversal into engagement with the engine member, means for rendering said opposing means inoperative to oppose traversal of the driving member out of driving position when the engine starts, and means for delaying the restoration of the opposing means for a predetermined time.

2. In an engine starter, an operating member, a driving member, said members having connecting means whereby relative rotation causes translation of the driving member into or out of engagement with a member of an engine to be started, a yielding detent for opposing rotary movement of the driving member to insure its traversal into engagement with the engine member, means for withdrawing said detent when the engine starts, and means for delaying the return movement of the detent to operative position.

3. In an engine starter, an operating mem-

ber, a driving member, said members having connecting means whereby relative rotation causes translation of the driving member into or out of engagement with a member of an engine to be started, a yielding detent for opposing rotary movement of the driving member to insure its traversal into engagement with the engine member, a piston connected to said detent, means for moving said piston to retract the detent when the engine starts, and means cooperating with said piston to form a dash-pot to delay movement of said detent to operative position.

4. In an engine starter, a screw shaft, a pinion threaded thereon for movement into and out of engagement with an engine gear, a detent normally opposing rotation of the pinion, means responsive to rotation of the engine for retracting said detent and means for maintaining said detent retracted until after the starting motor shall have come to rest.

5. In an engine starter, a screw shaft, a pinion threaded thereon for movement into and out of engagement with an engine gear, a detent normally opposing rotation of the pinion, pressure producing means operated by the engine, means operated by said pressure producing means for retracting said detent, and means for maintaining said detent retracted until after the engine comes completely to rest.

6. In an engine starter, a screw shaft, a pinion threaded thereon for movement into and out of engagement with an engine gear, a detent normally opposing rotation of the pinion, means energized by cranking current for withdrawing said detent and holding it retracted as long as the starting motor is energized.

7. A starting mechanism for internal combustion engines having a rotatable shaft and a driving member mounted thereon for longitudinal movement thereof and rotary movement therewith and adapted to engage a member of the engine to be started, a detent normally cooperating with a portion of the driving member to insure traversal of said driving member into driving relation with said engine member, power-operated means for disengaging said detent when said engine becomes self-operative, and time delay means preventing reengagement of the detent and drive member until a predetermined time after said power-operating means ceases to be effective.

In testimony whereof, I have hereunto signed my name.

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