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ENGINE STARTER GEARING

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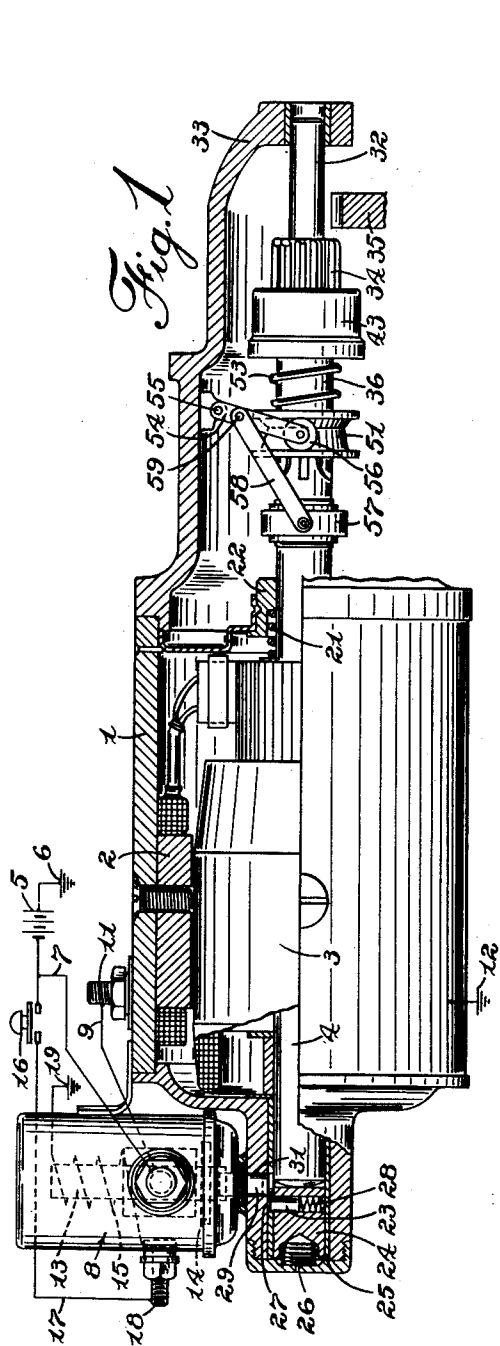


Fig. 1

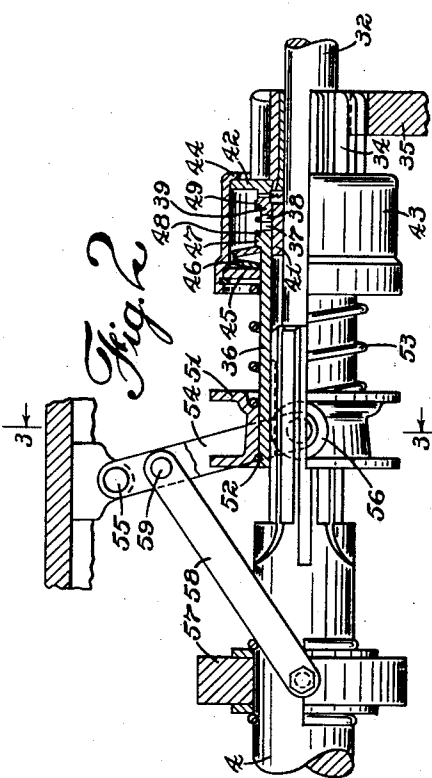


Fig. 2

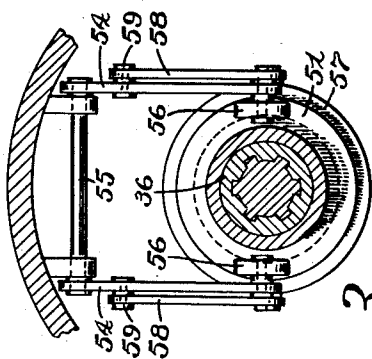


Fig. 3

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ENGINE STARTER GEARING

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The present invention relates to engine starter gearing and more particularly to an electro-magnetically operated gear shift.

It has heretofore been proposed to utilize the powerful centering force of the field of a starting motor on its armature to initiate engagement of a starting pinion, but due to mechanical considerations and space limitations, supplemental means such as screw threaded connections or the like have been required to complete the meshing movement. Since these supplemental means have ordinarily depended for their action on rotation of the armature, it has been necessary to so construct the gearing as to cushion and control the shock loads which might otherwise be harmful. These provisions tend to increase the size, complexity and cost of the installation to a point where the economy effected by this elimination of the conventional solenoid actuating mechanism is lost.

It is an object of the present invention to provide a novel engine starter gearing in which the movement of the pinion is controlled entirely by the movement of the motor armature.

It is another object to provide such a device including a travel-multiplying link and lever connection between the armature and the starter pinion.

It is another object of the invention to provide such a device including a latching arrangement for stabilizing the shifting action of the armature under the control of the starting switch.

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, partly broken away and in section, of a preferred embodiment of the invention, the electrical system being illustrated diagrammatically;

Fig. 2 is an enlarged detail of the starter gearing and the actuating means therefor, showing the parts in cranking position; and

Fig. 3 is a section taken substantially on the line 3—3 of Fig. 2.

In Fig. 1 of the drawing there is illustrated a starting system including a motor 1 having a stationary field 2 and a rotary armature 3 mounted on a shaft 4 in such a manner as to be shiftable longitudinally in the motor frame so as to move the armature into and out of centered relation with respect to the field.

Means for actuating the motor are provided in the form of a battery 5 grounded at 6 and connected through a lead 7 to an electro-magnetic starting switch 8 which latter is connected by a

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lead 9 to the terminal 11 of the motor, the frame of the motor being grounded as indicated at 12 to complete the cranking circuit.

Switch 8 comprises a magnetic plunger 13 which actuates a movable contact member 14 to close the starting circuit upon energization of the solenoid coil 15. Coil 15 is energized from the battery 5 by means of a manual switch 16 connected by a lead 17 to the switch terminal 18, the opposite terminal of the coil being grounded at 19 to complete the starter control circuit.

A spring 21, mounted on the armature shaft bears at one end against a bearing bushing 22 fixedly mounted in the frame of the motor 1; and its other end applies pressure to the armature 3 to normally maintain it in decentered position with respect to the field 2, as illustrated in Fig. 1. Latching means under the control of the starting switch is provided for holding the armature in centered position. As here shown, this latch comprises a spring actuated plunger 23 mounted for radial sliding movement in a cylindrical bearing member 24 which is slidably mounted in a bearing bushing 25 fixed in the end of the motor housing. A light spring 26 presses the bearing member 24 against the adjacent end of the armature shaft. Bushing 25 is provided with a slotted opening 27 into which the end of the latch 23 is pressed by the spring 28. The plunger 13 of the starting switch is provided with an extension 29 traversing an opening 31 in the motor frame which is in registry with the slot 27 of the bushing 25, the end of the plunger extension 29 being flush with the exterior surface of the bushing 25 when the starting switch is open, but being withdrawn to the position shown in dotted lines when the switch is closed.

The armature shaft 4 is extended as indicated at 32 and is supported at its outer end in an out-board bearing 33 of the motor frame. A pinion 34 is slidably journaled on the armature shaft extension 32 for movement into and out of mesh with a gear 35 of the engine to be started. Means for actuating the pinion from the armature shaft is provided comprising a sleeve 36 (Fig. 2) splined on the armature shaft and having inclined teeth 37 engaging similar teeth 38 on a coupling member 39 journaled in a bushing 41 bearing on the armature shaft. Coupling member 39 has a dental overrunning clutch connection with a clutch member 42 fixedly mounted on the pinion 34 and the parts are held in assembled relation by a barrel member 43 having a terminal flange 44 embracing the driven clutch member 42 and having at its other end an annular disc 45 which acts as an abutment for one

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end of a heavy compression spring 46, which bears at its other end against a flange 47 on the sleeve 36. A light compression spring 48 is located between the flange 47 of the sleeve 36 and a flange 49 on the coupling member 39, normally maintaining the overrunning clutch teeth of the members 39 and 42 in engagement.

Means are provided for multiplying the longitudinal movement of the armature shaft and thereby shifting the pinion 34 into and out of mesh with the engine gear 35. For this purpose a shift collar 51 is slidably mounted on the sleeve 36, and pressed against a lock ring 52 by a mesh-enforcing spring 53. A shift fork 54 pivoted at 55 to the frame of the motor 1 is provided at its free end with rollers 56 engaging in the shift collar 51 to transmit to it the swinging movement of the fork. A collar 57 is swiveled on the armature shaft and connected by the links 58 to the shifting fork 54, the pivotal connections 59 of the links to the fork being adjacent the pivot 55 of the fork so that the longitudinal movement of the armature shaft is multiplied by the link and fork connection, and the pinion 34 is shifted into and out of mesh with the engine gear 35 by a correspondingly small longitudinal movement of the armature shaft.

In operation, starting with the parts as illustrated in Fig. 1, closure of the manual switch 16 energizes the coil 15 to close the starting switch 8 and withdraw the extension 29 of plunger 13. The consequent energization of the field and armature of the starting motor produces a magnetic flux therebetween which draws the armature to the right into centered relation with the field 2. The bearing member 24 follows the movement of the armature shaft 4 responsive to the pressure of the spring 26 thus bringing the latch 23 into registry with the opening 31 in the motor housing, whereupon the latch spring 28 expands and moves the latch into said opening thereby positively holding the bearing member 24 and consequently the armature shaft 4 in its centered position.

This longitudinal displacement of the armature shaft is multiplied and transmitted to the sleeve 36 through the links 58 and fork 54, thereby shifting the pinion 34 into mesh with the engine gear 35 as shown in Fig. 2. It will be understood that this shifting movement takes place instantaneously upon energization of the starting motor and prior to any substantial rotation thereof so that the parts are not subject to rotational shock loads. Cranking of the engine then takes place in the usual manner, the

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pinion being held in meshed relation with the engine gear by the latch 23 as long as the starting switch 8 remains closed, overrunning of the pinion when the engine fires being permitted by its clutch connection to the coupling member 39.

When a successful start has been secured, release of the manual switch 16 by the operator opens the starting switch, thus projecting the plunger extension 29 so as to release the latch 23 from the opening 31 and allow the spring 21 to return the parts to idle position.

Although but one embodiment of the invention has been shown and described in detail it will be understood that changes may be made in the design and arrangement of the parts without departing from the spirit of the invention.

I claim:

1. In a starter for internal combustion engines a motor having a fixed frame, a stationary magnetic field structure therein, and a rotatable armature, including a shaft slidably journaled in the frame; means including a spring urging the armature away from its centralized position with respect to the field, a pinion slidably journaled on the armature shaft for movement into and out of mesh with a gear of an engine to be started; a sleeve splined on the armature shaft, means connecting the sleeve to the pinion for rotation and longitudinal movement in unison, a forked lever hinged to the motor frame at one end and having a swivel connection with the sleeve at the other end, a collar swiveled on the armature shaft, and a rigid link connecting the collar to an intermediate point of said lever, the lever and link being so proportioned and arranged that the pinion is normally spaced from the engine gear by the action of said spring, and is moved into mesh with said gear when the armature is centralized with respect to the field.

2. An engine starter as set forth in claim 1 including further means for holding the armature in centralized position responsive to energization of the starting motor.

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