Sept. 29, 1953

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2,654,007

ENGINE STARTER CONTROL

Filed April 2, 1949

2 Sheets-Sheet 1

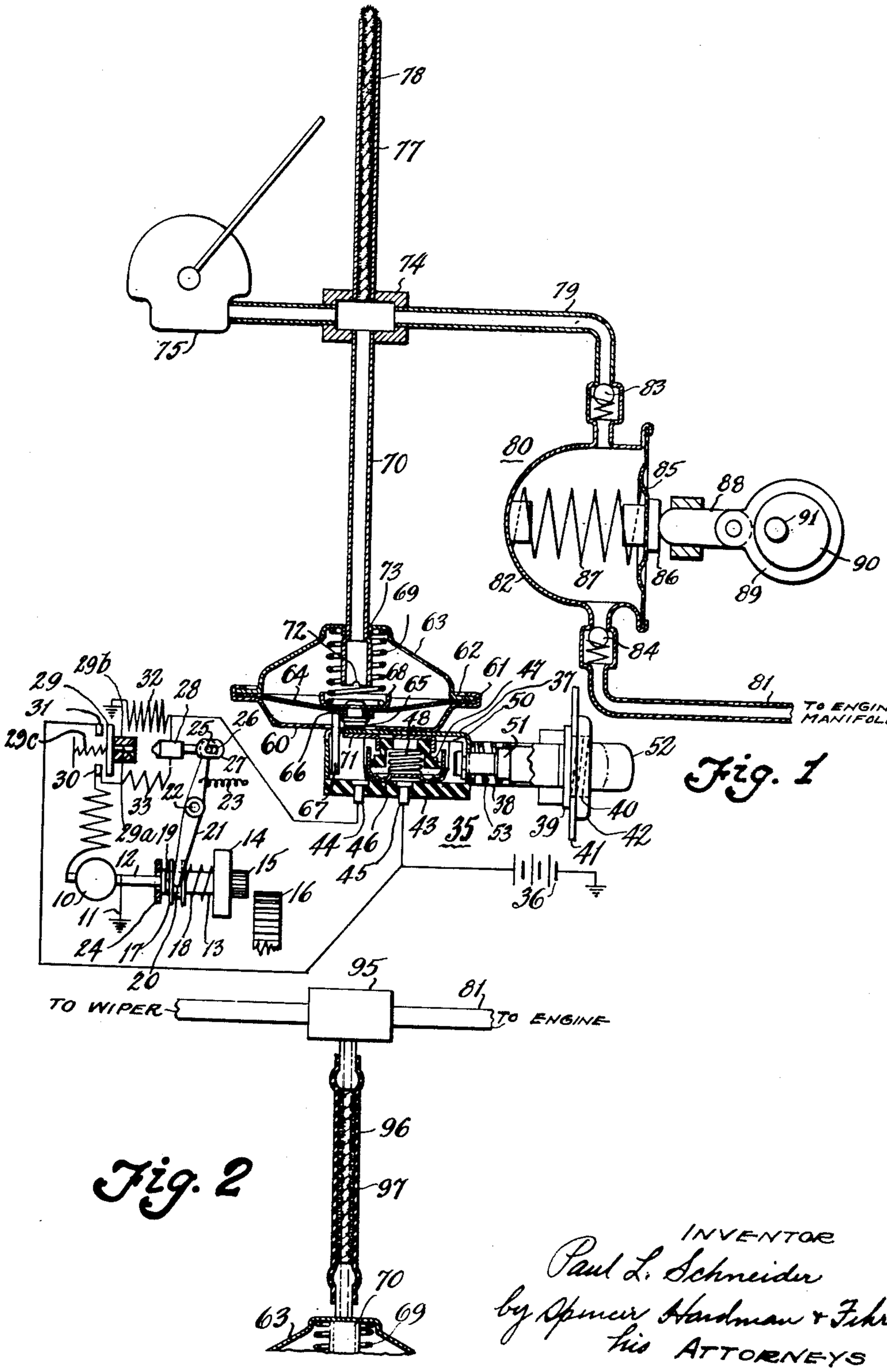

Fig. 1

Fig. 2

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2 Sheets-Sheet 2

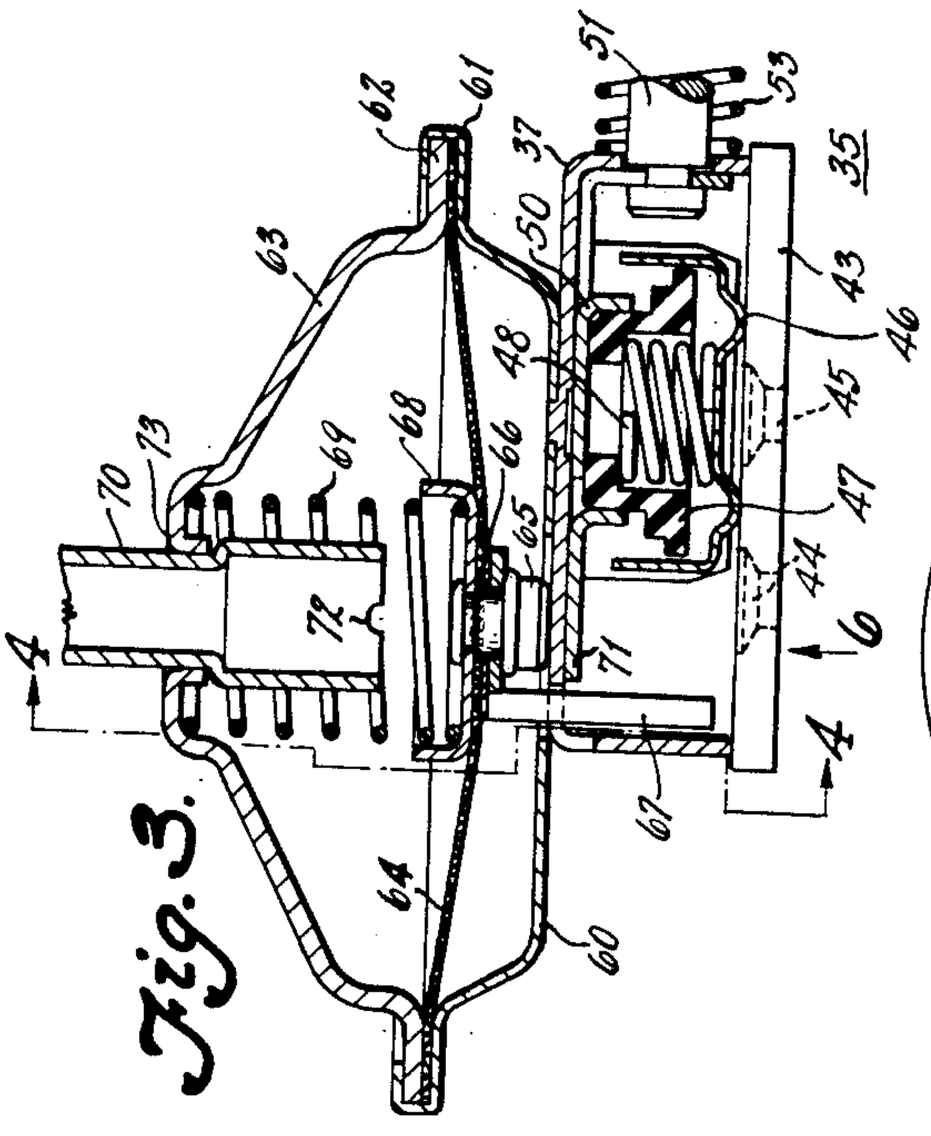

Fig. 3.

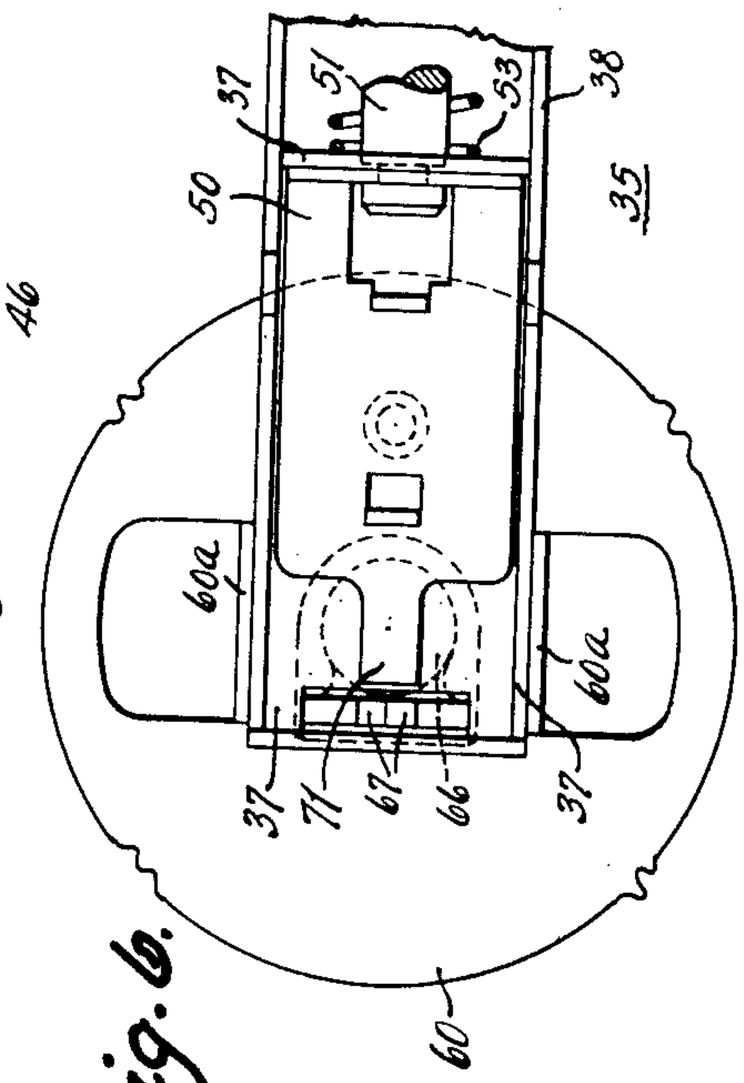

Fig. 6.

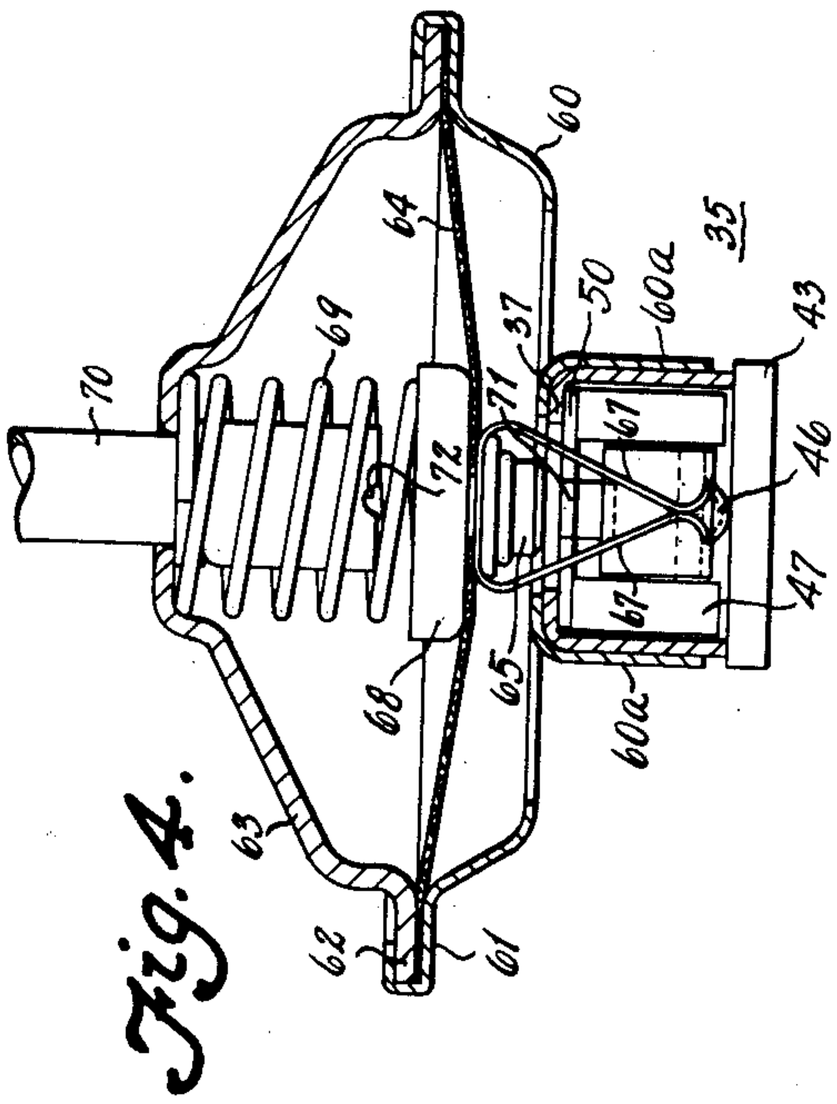

Fig. 4.

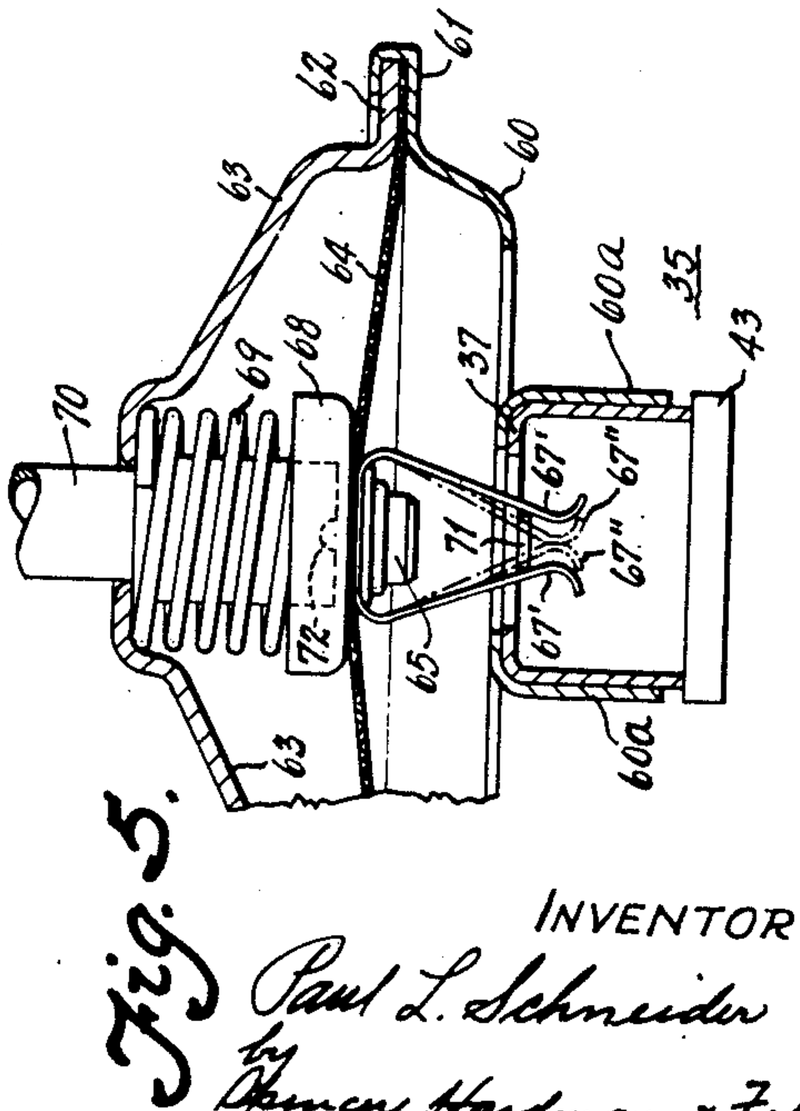

Fig. 5.

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UNITED STATES PATENT OFFICE

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ENGINE STARTER CONTROL

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3 Claims. (Cl. 200—83)

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This invention relates to engine starters of the type comprising an electric motor which drives a pinion movable axially into mesh with the flywheel gear of the engine to be started. In one form of such starter a solenoid is used to effect axial movement of the pinion and close the main switch connecting the storage battery with the electric motor. The energization of the solenoid is controlled by a push button switch. In case the self operation of the engine is only temporary, in other words, a false start, the inclination on the part of the driver is to operate the push button switch immediately to connect the battery with the solenoid without waiting for the starting motor and its pinion to coast to a stop and for the engine to come to a complete stop. Under these conditions, clash of gears would result before the starting operation is repeated. In case the engine is running and the driver operates the push button, the pinion will strike the flywheel gear while it is moving rapidly, resulting in damage to both the gear and pinion teeth.

Objects of the present invention are to prohibit the use of the engine starter in case of a false start for a time sufficient for the starter and engine to become stationary and to prohibit the use of the starter as long as the engine is running. In the disclosed embodiment thereof, the present invention provides means under control by engine suction for blocking movement of the push button switch while the engine is running and for delaying the return of the blocker to a non-blocking position when the engine stops. The blocker is attached to a diaphragm forming one side of a suction chamber connected with the engine intake so that movement of the diaphragm under engine suction will move the blocker to functioning position, said movement being opposed by a spring which, when the engine stops, moves the diaphragm and the blocker to a non-functioning position. The operation of the spring is retarded by a restriction in the vent of the diaphragm chamber. The vent restriction is provided by a length of smoking pipe cleaner placed in a portion of the diaphragm chamber vent duct. This form of restricted vent has two advantages, first, it is quiet in operation as compared with a vent restriction provided by a small hole through which air passes and makes a whistling sound during the venting action, and second, ease of adjustment of the time delay is provided by varying the length of the smoking pipe cleaner included in the vent duct.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawing wherein preferred embodiments of the present invention are clearly shown.

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In the drawing:

Fig. 1 is a diagram of an engine starter control system embodying the present invention.

Fig. 2 is a diagram of a modification thereof.

Fig. 3 is a sectional view of the starter control switch on a larger scale than in Fig. 1.

Fig. 4 is a sectional view on line 4—4 of Fig. 3.

Fig. 5 is a sectional view similar to Fig. 4 showing certain parts in other positions.

Fig. 6 is a view in the direction of arrow 6 of Fig. 3, certain parts being omitted.

Referring to Fig. 1 in which the engine starter is shown diagrammatically, the starting motor 10 has one terminal grounded at 11 and the other connected to a switch contact 30. The motor armature shaft 12 is splinedly connected with a sleeve 13 connected through a one-way or overrunning clutch 14 with a pinion 15 adapted to mesh with the flywheel gear 16 of the engine. A grooved collar 17 which is slidable on sleeve 13 is urged by a spring 18 against a split wire snap ring 19 received by a groove in sleeve 13. Pins 20 received by the groove of collar 17 are attached to a lever 21 which is bifurcated and which is pivoted at 22. A spring 23 urges lever 21 clockwise and sleeve 13 against a stop 24.

The upper end of lever 21 carries a pin 25 received by a slot 26 in a member 27 attached to a solenoid armature 28 engageable with a rod 29*a* connected with a movable switch contact 29 for connecting contacts 30 and 31. A spring 29*c* urges contact 29 away from contacts 30 and 31 and into engagement with a rod bearing 29*b* which provides a magnetizable pole piece toward which the armature 28 is attracted when solenoid windings 32 and 33 are energized by closing a motor control switch 35 which connects these windings with a battery 36.

The switch 35 comprises a case 37 which a yoke 38 attaches to a mounting plate 39 having a threaded portion 40 which extends through a hole in an instrument panel 41 and receives a nut 42, the tightening of which secures the plate 39 to the panel 41. Case 37 is closed by a nonconducting cover 43 supporting contacts 44 and 45 engageable by a sliding contact 46 mechanically connected to a nonconducting carrier 47 enclosing a spring 48 which urges the contact 46 toward the cover 43. Carrier 47 is mechanically connected to a carrier slide 50 connected to a rod 51 extending through the plate 39 and attached to a push button 52. A spring 53 urges

the rod 51 toward the right and slide 50 against the right wall of case 37.

Case 37 supports a shell 60 having its flange 61 crimped around the flange 62 of a shell 63. Shell 60 has ears 60a (Fig. 5) punched out and bent down and attached by welding to case 37. The peripheral portion of a diaphragm 64 is pinched between shells 60 and 63 and its central portion is connected by a rivet 65 with a plate 66 integral with two spring fingers 67 (Figs. 3–6) and with a cupped washer 68 which receives one end of a spring 69 which surrounds a tube 70 attached to a flange 73 (Fig. 3) of the shell 63. The spring 69 urges the diaphragm 64 down until the rivet 65 touches the case 37. The fingers 67 are then disposed as shown in Fig. 4 to receive between them a part 71 of the carrier slide 50. Upward movement of the diaphragm 64 is stopped by engagement of washer 68 with the tube 70 which is notched at 72 so that suction on the diaphragm 64 continues after said engagement.

Tube 70 is connected with a junction block 74 connected with a suction operated windshield wiper 75. Block 74 is connected with a tube 77 containing a smoking pipe cleaner 78 and with a tube 79 with a vacuum booster pump 80 connected by tube 81 with the engine intake. Pump 80 comprises a chamber 82 connected with tubes 79 and 81 by check valves 83 and 84 respectively, and is closed on one side by a diaphragm 85 carrying a stud 86 which a spring 87 urges against a bar 88 attached to an eccentric strap 89 surrounding an eccentric 90 driven by the cam shaft 91 of the engine.

To start the engine, the button 52 is pushed left to cause the contact 46 to connect contacts 44 and 45 and current flows from the battery 36 through solenoid coils 32 and 33. Armature 28 moves left to cause lever 21 to move counterclockwise to move the collar 17 right and through the spring 18 to move the sleeve 13, clutch 14 and pinion 15. If no tooth abutment occurs, pinion 15 meshes with gear 16 and then the contact 29 engages contacts 30 and 31 and the battery 36 is directly connected with the motor 10 and the engine gear 16 is rotated. Though coil 33 is shorted, coil 32 remains effective to hold the armature 28 in fully attracted position. If tooth abutment occurs, left movement of armature 28 continues to close the contacts 29, 30 and 31 while spring 18 is compressed. The motor 10 operates to turn the pinion 15 to relieve the abutment, whereupon spring 18 is released to move the pinion 15 quickly into mesh with the gear.

When the engine starts, pinion 15 overruns the motor shaft by virtue of the one-way clutch 14. The button 52 is released to permit spring 53 to open the contacts 44, 45 and 46. Coil 32 is deenergized and the armature 28 moves right and the pinion 15 moves left under the action of spring 23. Spring 29c separates contact 29 from contacts 30 and 31. In case of a back fire and the pinion 15 remains in mesh with gear 16, the button 52 is released to permit spring 29c to separate contact 29 from contacts 30 and 31, said movement being possible by virtue of the pin-and-slot lost motion connection between the armature 28 and the lever 21.

When the engine becomes self operative, engine suction applied to the upper side of diaphragm 64 causes it and the fingers 67 to rise so that the lower ends are in the path of movement of part 71 of the carrier slide 50. If the button 52 had not been released when the engine became self-operative, the part 71 of the carrier

slide 50 would remain between the fingers 67 and upward movement of the diaphragm 64 would cause the fingers 67 to engage part 71 and be spread apart to the positions 67′ in Fig. 5. When the button 52 is released spring 53 is still able to move the contact 46 to switch opening position because the frictional resistance between the fingers 67 and the part 71 is slight. When the part 71 has been retracted by spring 53, the fingers 67 move into position 67″ (Fig. 5) to block movement of the contact 46 into switch closing position while the engine is running. Therefore, the engine starter cannot be operated while the engine is running.

In case of a false start, the tendency on the part of the driver is to push the button 52 immediately without waiting for the pinion 15 to stop rotating after having been retracted from the gear 16. Immediate operation of the starter would cause gear clashing before the pinion 15 could remesh with the gear 16. To prevent this, the present invention provides a time delay in the lowering of the vacuum above the diaphragm 64. When the engine stops, the vacuum booster 80 stops with its valves 83 and 84 closed. Air is permitted to enter slowly into the pipe 77 by virtue of the smoking pipe cleaner 78 whose length included with pipe 77 is such that the lapse of a few seconds is required before the diaphragm 64 returns to down position to cause the fingers 67 to be located out of the path of movement of part 71 of the carrier slide 50. The cleaner 78 is adjusted longitudinally to effect that time delay required for the pinion 15 to coast to a stop after the false start.

If the equipment does not include a vacuum booster pipe 81 is connected with a junction block 95 connected with the windshield wiper and with the tube 70 by a removable hose 96 containing a piece of smoking pipe cleaner 97 of the length required to effect the desired retardation of return of the diaphragm 64 to down position.

In addition to facilitating adjustment of retardation of the return of fingers 67 to nonblocking position, the vent restriction provided by a length of smoking pipe cleaner is quiet in operation as compared with a conventional restriction provided by a small hole through which the passage of air causes a whistling sound.

The present invention is applicable also to the type of engine starter which comprises a starting motor driving a screw shaft on which the starter pinion is threaded, the operation of the motor under control by a push button switch causing the pinion to move axially into mesh with the engine flywheel gear and then to rotate it.

While the embodiments of the present invention as herein disclosed, constitute preferred forms, it is to be understood that other forms might be adopted.

What is claimed is as follows:

1. Control apparatus for an electrically operated engine starter comprising a manually operated, normally open switch the closing of which causes the engine starter to operate, said switch including a movable switch closing member, means operated by engine suction for blocking movement of the contacting closing member when the engine is self-operative and comprising a suction chamber member connected with the engine intake, a diaphragm closing one side of the chamber member, a spring opposing movement of the diaphragm by engine suction and returning the diaphragm to normal position when the engine stops, and a blocker attached to the

diaphragm and located in non-blocking position when the diaphragm is in normal position, and means for retarding movement of the diaphragm to normal position when the engine stops for a time sufficient for the engine starter to become stationary, said means including a valve operable to prevent communication between the suction chamber and the intake manifold upon a predetermined decrease in manifold suction and a passage connecting said suction chamber directly with the atmosphere having a piece of porous fibrous material positioned therein to restrict the passage of air therethrough, whereby movement of the diaphragm toward its normal position is retarded upon a reduction in manifold suction.

2. Control apparatus for an electrically operated engine starter comprising a manually operated, normally open switch the closing of which causes the engine to operate, said switch having a movable switch closing member, a spring biasing said member into switch-open position, a part movable with said member, means operated by engine suction for blocking movement of the contacting closing member when the engine is self-operative and comprising a suction chamber member connected with the engine intake, a diaphragm closing one side of the chamber member, a spring opposing movement of the diaphragm by engine suction and returning the diaphragm to normal position when the engine stops, and a blocker attached to the diaphragm and extending obliquely to the plane of movement of said part and located by the diaphragm, when in normal position, out of the path of movement of the part, and located by the diaphragm, during engine operation, in the path of movement of the part, said blocker being resilient whereby, in the event the member is retained in switch closing position when the engine becomes self-operative, the blocker is caused to bend by virtue of engagement with said part when the blocker is moved by the diaphragm actuated by engine suction, the release of the member permitting the first mentioned spring to retract the part from the blocker to permit the latter to flex into blocking position in the path of movement of the part.

3. Control apparatus according to claim 2 in which the blocker comprises two spring fingers fixed to the diaphragm and movable thereby in a direction transverse to the direction of movement of the part which is movable with the switch closing member, said fingers being spaced at their fixed ends and extending obliquely to the plane of movement of said part and toward each other whereby their free ends are in engagement, the space between the arms receiving said part when the diaphragm is in normal position, whereby, in the event the switch closing member is not released when the engine becomes self-operative, the fingers are caused to separate by virtue of their engagement with said part when the fingers are moved by the diaphragm actuated by engine suction, the release of the member permitting the first mentioned spring to retract the part from the spring fingers to permit them to flex together with their free ends in blocking position in the path of movement of the part.

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