

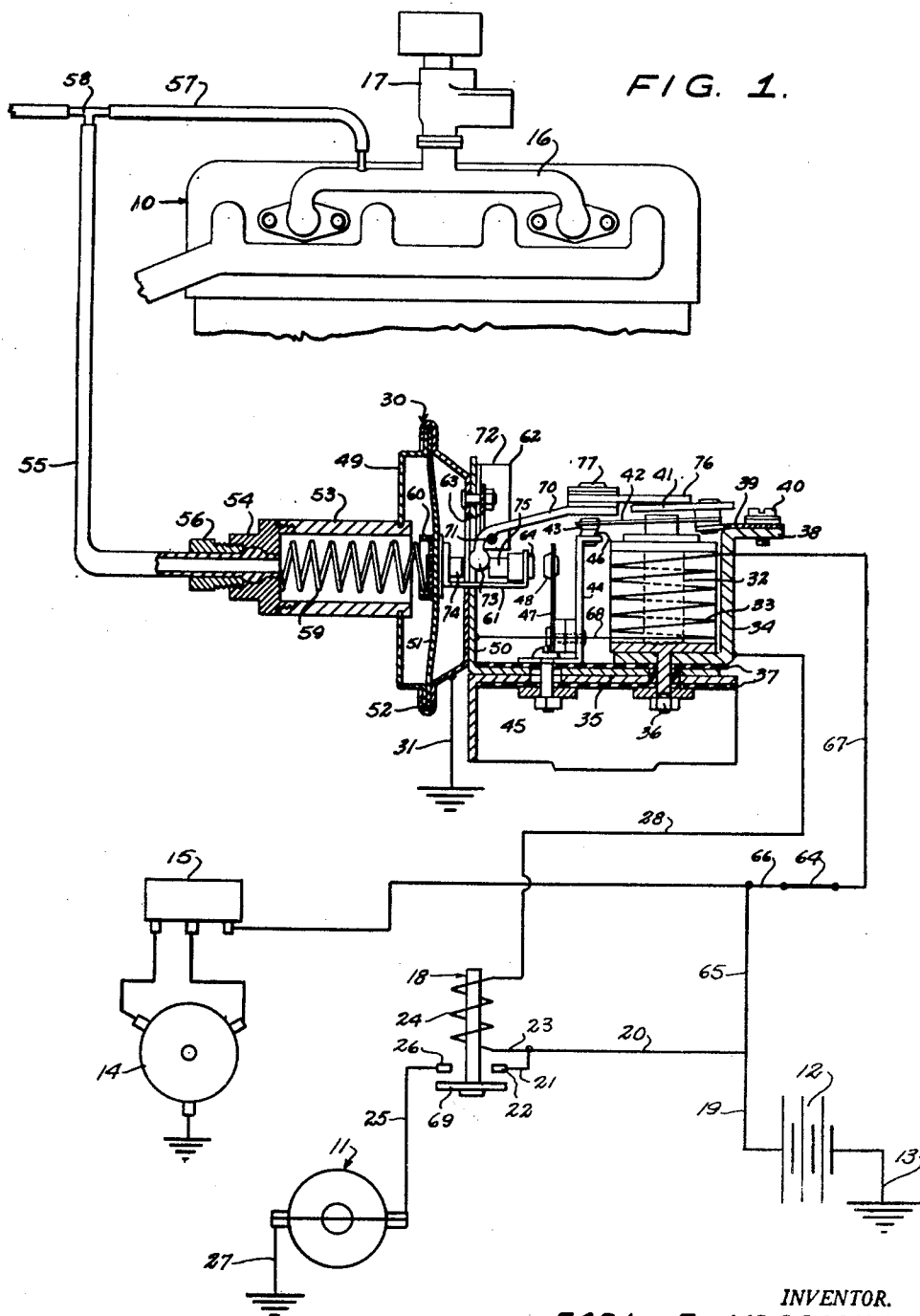
Feb. 14, 1950

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STARTER MOTOR CONTROL SYSTEM FOR
INTERNAL-COMBUSTION ENGINES

2,497,462

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2 Sheets-Sheet 1



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FIG. 2.

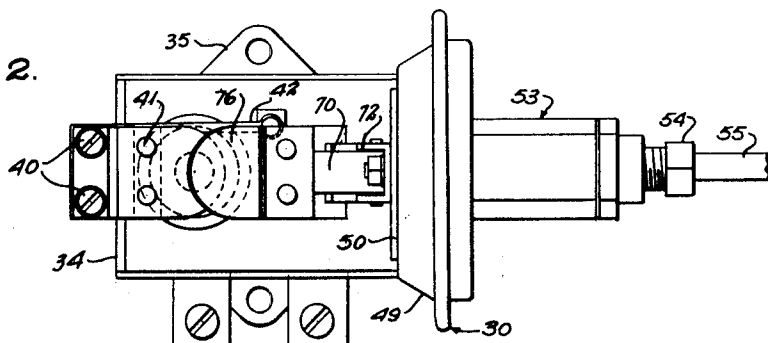


FIG. 3.

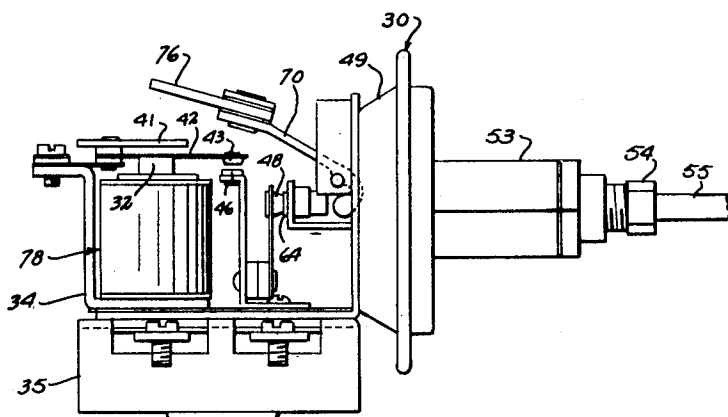
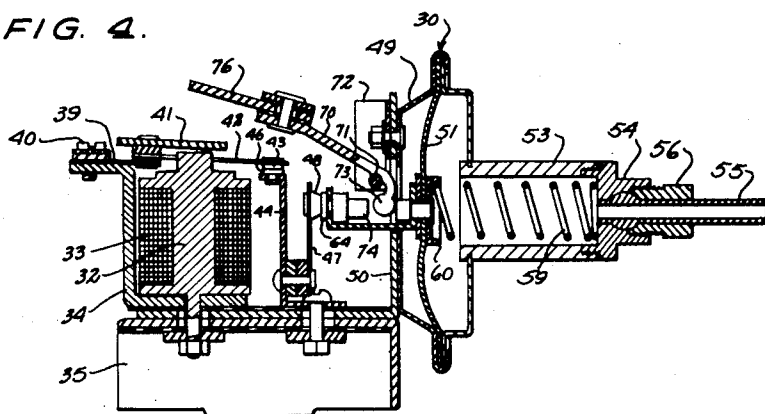


FIG. 4.



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STARTER MOTOR CONTROL SYSTEM FOR
INTERNAL-COMBUSTION ENGINES

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3 Claims. (Cl. 298—38)

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This invention relates to starter motor control circuits for internal combustion engines, and more particularly to a starter motor control system for energizing the starter motor upon closing of the engine ignition switch and including means positively precluding energization of the starter motor while the engine is running.

It is among the objects of the invention to provide an improved ignition switch-operated, starter-motor control system for an internal combustion engine which system is effective to energize the engine-starting motor upon closing of the ignition switch, de-energize the starting motor upon starting of the engine, and thereafter maintain the starting motor deenergized until the ignition switch is turned off and on again regardless of whether or not the engine remains in operation, which positively precludes accidental energization of the starting motor during engine operation, even though the engine intake manifold pressure should rise to near atmospheric pressure, the generator drive should break or the temperature of the engine or its cooling fluid drop below a predetermined value, and which is simple and inexpensive in construction and can be applied to an existing engine ignition and starting system without material modification of such system.

Other objects and advantages will become apparent from a consideration of the following description and the appended claims in conjunction with the accompanying drawings, wherein:

Figure 1 is a diagrammatic illustration of a fragmentary portion of an internal combustion engine and an engine starter motor control system, illustrative of the invention;

Figure 2 is a top plan view of the control unit for precluding accidental energization of the engine-starting motor while the engine is in operation;

Figure 3 is a side elevation of the control unit illustrated in Figure 2; and

Figure 4 is a longitudinal, medial cross-section of the starter unit showing the parts in a somewhat different operative position from that illustrated in Figure 3.

Referring to the drawings, in detail, and particularly to Figure 1, the internal combustion engine, generally indicated at 10, has a starting motor 11, a battery 12, one side of which is grounded at 13, a battery charging generator 14 having a relay cut-out connected thereto, and an intake manifold 16 to which is connected the carburetor 17.

The primary starting motor circuit extends from the ungrounded side of the battery 12 to a

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ground connection through the starting motor 11 and includes an electro-magnetic switch, generally indicated at 18. As illustrated, this circuit includes wires 19, 20 and 21 leading from the battery to one terminal 22 of the switch 18, and a branch wire 23 leading to one side of the coil 24 of the electro-magnetic switch, a wire 25 leading from the other terminal 26 of the switch 18 to one side of the starter motor 11, and a conductor 27 which grounds the opposite side of the motor 11.

This primary starting motor circuit is well known to the art and does not constitute a part of the present invention, except in the combination thereof with the novel circuit control means, later to be described.

The energizing circuit for the coil 24 of the electro-magnetic relay or switch 18 includes the wires 19, 20 and 23 leading from the battery to one side of the coil, a wire 28 leading from the other side of the coil to the circuit control, relay unit, generally indicated at 30, the unit 30 and a conductor 31 grounding the unit 30.

The control unit 30 includes an electro-magnetic relay including a core 32, a coil 33 surrounding the core, and a housing 34. The wire 28 is electrically connected to the housing 34 which housing is mounted on a support 35 by bolt 36 and insulated from the support by suitable layers of insulating material 37. At its end opposite the support 35 the housing 34 has an outwardly-extending apertured tongue 38, and a leaf spring 39 is secured to this tongue by a screw 40 and extends toward the upper end of the core 32 of the relay. A relay armature 41 is secured to the free end of spring 39 and positioned above the core 32, and a switch arm 42 is connected at one end to the spring 39 and extends past the core 32. This switch arm is provided at its end remote from the spring 39 with a switch contact 43. A bracket 44 is mounted on the support 35 by a screw 45 and insulated from the support. This bracket is positioned adjacent the relay coil 33 and carries on its upper end a switch contact 46 in alignment with the contact 43 on arm 42. When the coil 33 of the relay is energized, the magnetized core 32 attracts the armature 41 pulling the armature toward the core and moving the switch arm 42 to bring the contact 43 into electrically conductive engagement with the contact 46.

A spring arm 47 is secured to the bracket 44 near the support 35, or may be mounted on the support and insulated therefrom. This spring arm extends substantially parallel to the bracket 44 and carries at its free end a switch contact 48.

A hollow container 49, preferably of circular shape, is secured by an angle bracket 50 to the support 35, and contains a flexible diaphragm 51 marginally secured to the container intermediate the length of the latter by the beaded-over flange joints 52 which secure the two parts of the container together. A tubular fitting 53 is secured at one end in a central aperture provided in one end wall of the container 49, and an apertured cap 54 is threaded onto the end of the fitting 53 remote from the container. A tubular conduit 55 is secured at one end in the cap 54 by a suitable packing nut 56, and the other end of this tubular conduit is connected through a conduit 57 to the interior of the engine intake manifold 16. The conduit 57 may be a special conduit, or may be a conduit normally provided to connect the engine intake manifold with the windshield wipers of a vehicle, and the conduit 55 may be connected to the windshield wiper conduit 57 by a T-fitting 58.

A coiled compression spring 59 is enclosed in the tubular fitting 53 and bears at one end against the inner surface of the cap 54, and at its opposite end against an abutment 60 secured to the diaphragm 51 to resiliently urge the diaphragm in a direction away from the tubular fitting 53 and toward the angle bracket 50.

A U-shaped plunger 61 is secured to the diaphragm at the side of the latter opposite the abutment 60, and extends through suitable apertures 62 and 63 provided in the angle bracket 50, and in the end wall of the container 49 secured to the angle bracket. At its end remote from the diaphragm 51 this plunger carries a switch contact 64 in alignment with the contact 48 on the spring arm 47.

When the engine is not operating, the spring 59 moves the plunger 61 to bring the contact 64 into electrically conductive engagement with the contact 48, as illustrated in Figure 4.

An energizing circuit for the relay coil 33 extends from the ungrounded side of the battery through the relay coil and to ground at 31 and includes the engine ignition switch 64. This circuit includes the wire 19, and wires 65 and 66 leading to one side of the ignition switch, a wire 67 leading from the opposite side of the ignition switch to one side of the coil 33, and a wire 68 leading from the opposite side of the relay coil to the bracket 50 which is grounded through the housing 49 and conductor 31.

When the ignition switch is closed, the relay coil 33 will be energized and will remain energized until the ignition switch is re-opened.

Assuming that the engine is not in operation, and that the switch contacts 48 and 64 are in electrically-conductive engagement, as illustrated in Figure 4, energization of the coil 33 will magnetize the core 32 and cause the core to attract armature 41 thereby bringing switch contacts 43 and 46 into electrically-conductive engagement. The energizing circuit for the coil 24 of the first magnetic relay switch 18 will now be completed from the ungrounded side of battery 12 through the coil 24 and through the contacts 43—46 and 48—64 of the control unit 30 to ground at 31. Energization of the coil 24 of electro-magnetic switch 18 will cause the switch bar 69 to electrically inter-connect the terminals 22 and 26 completing the primary starting circuit from the ungrounded side of the battery through the electro-magnetic switch 18 and through the starting motor 11 to ground at 27. The starting motor 11 will now be energized to crank the engine.

As soon as the engine is started and begins to

operate, the air pressure in the engine intake manifold 16 is brought below atmospheric pressure and the diaphragm 51 is moved toward the tubular housing 53 against the force of spring 59 separating the contacts 48 and 64. This immediately breaks the energizing circuit for the coil 24 of the electro-magnetic switch 18, and this switch 18 opens interrupting the primary circuit to the starting motor 11 and discontinuing operation of the starting motor.

An arm 70 is pivoted by a pin 71 on lugs 72 attached to the angle bracket 50 at the opposite side of the latter from the container 49, and this arm has a rounded end of cam 73 disposed between two cam abutments 74 and 75 carried by the U-shaped plunger 61 at respectively opposite ends of the latter. The lever 70 carries an armature 76 on its end remote from the cam 73, which armature is electrically insulated from the lever at the connection 77 between the armature and the lever.

In the absence of manifold vacuum in the engine intake manifold 16 sufficient to compress the spring 59, the spring holds the contacts 48 and 64 in electrically-conductive engagement with each other, and at the same time holds the lever 70 and armature 76 in raised position, as illustrated in Figures 3 and 4. When the engine starts and the engine intake manifold moves the diaphragm 51 to compress the spring 59, the armature 76 is lowered to the upper end of the electro-magnetic relay core 32. The electro-magnetic coil 33 being continuously energized as long as the ignition switch 64 is closed, once the armature 76 has been brought to a position adjacent the end of the electro-magnetic core 32, the magnetization of this core will hold the armature in that position and maintain the contacts 48 and 64 separated as long as the coil 33 is energized. The starting motor thus cannot be re-energized after the engine has started without first de-energizing the electro-magnetic coil 33 by opening the ignition switch 64.

In the operation of the device the control unit 30 will first be in the condition illustrated in Figure 3 with the contacts 43 and 46 separated, and the contacts 48 and 64 in electrically-conductive engagement. The ignition switch 64 is then closed, completing the energization circuit for the coil 33 of the electro-magnetic relay, generally indicated at 78. Energizing the relay 78 causes the core 32 of this relay to attract the armature 41, closing the contacts 43 and 46 and thereby completing the energizing circuit for the coil 24 of the electro-magnetic relay switch 18. This closes the switch bar 69 with the contacts 22 and 26 and completes the energizing circuit for the starter motor 11. The starter motor now operates to crank the engine 10 and as soon as the engine starts and begins to operate, its intake manifold vacuum acts on the diaphragm 51, moving the diaphragm against the force of spring 59 to separate the contacts 48 and 64. This opens the energizing circuit for the coil 24 of the electro-magnetic relay switch 18 which causes this electro-magnetic relay switch to open and break the energizing circuit for the starter motor 11, de-energizing the starter motor and discontinuing its engine-cranking operation. When the plunger 61 is moved by the diaphragm 51 to separate the contacts 48 and 64, it simultaneously moves the armature 76 toward the adjacent end of the core 32 of the relay 78 to hold the contacts 48 and 64 separated, so that the energizing circuit for the coil of the electro-magnetic relay switch

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiment is, therefore, to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are, therefore, intended to be embraced therein.

1. A starter motor control system for an internal combustion engine having a starting motor, an ignition switch, a storage battery grounded at one side, and an intake manifold comprising a starting motor energizing circuit extending from the ungrounded side of the battery through the starting motor to ground and including a first electro-magnetic relay switch, an energizing circuit for said first electro-magnetic relay switch extending from the ungrounded side of the battery through said first electro-magnetic switch to ground and including a second electro-magnetic switch and a pressure-operated switch in series with said second electro-magnetic switch and pneumatically connected to the engine intake manifold, an energizing circuit for said second electro-magnetic relay switch extending from the ungrounded side of the battery through said second electro-magnetic switch to ground and including the engine ignition switch, and locking means for said pressure-operated switch moved by said pressure-operated switch upon the application of engine intake manifold vacuum to the latter and held by said second electro-magnetic switch upon energization of the latter to maintain said pressure-operated switch in open con-

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2. In an internal combustion engine starting system including a source of electrical energy, a starting motor, an energizing circuit for said starting motor, an electro-magnetic relay switch in said circuit, an engine ignition switch and an engine intake manifold, control means for said starting motor energizing circuit comprising an energizing circuit for said electro-magnetic relay switch, a second electro-magnetic relay switch and a pressure-operated switch included in series in said last-mentioned circuit, means pneumatically connecting said pressure-operated switch to the engine intake manifold for opening said switch by the intake manifold vacuum incident to engine operation, an energizing circuit for said second electro-magnetic switch including the engine ignition switch and effective to maintain said second electro-magnetic relay switch closed and energized as long as the ignition switch remains closed, and means moved by said pressure-operated switch and held by said second electro-magnetic switch in position to maintain said pressure-operated switch open as long as said second electro-magnetic relay switch remains energized to thereby preclude re-energization of the starting motor without opening the ignition switch.

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