Dec. 23, 1941. E. M. CLAYTOR 2,267,602

ELECTRIC CIRCUIT CONTROLLER

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Fig. 1

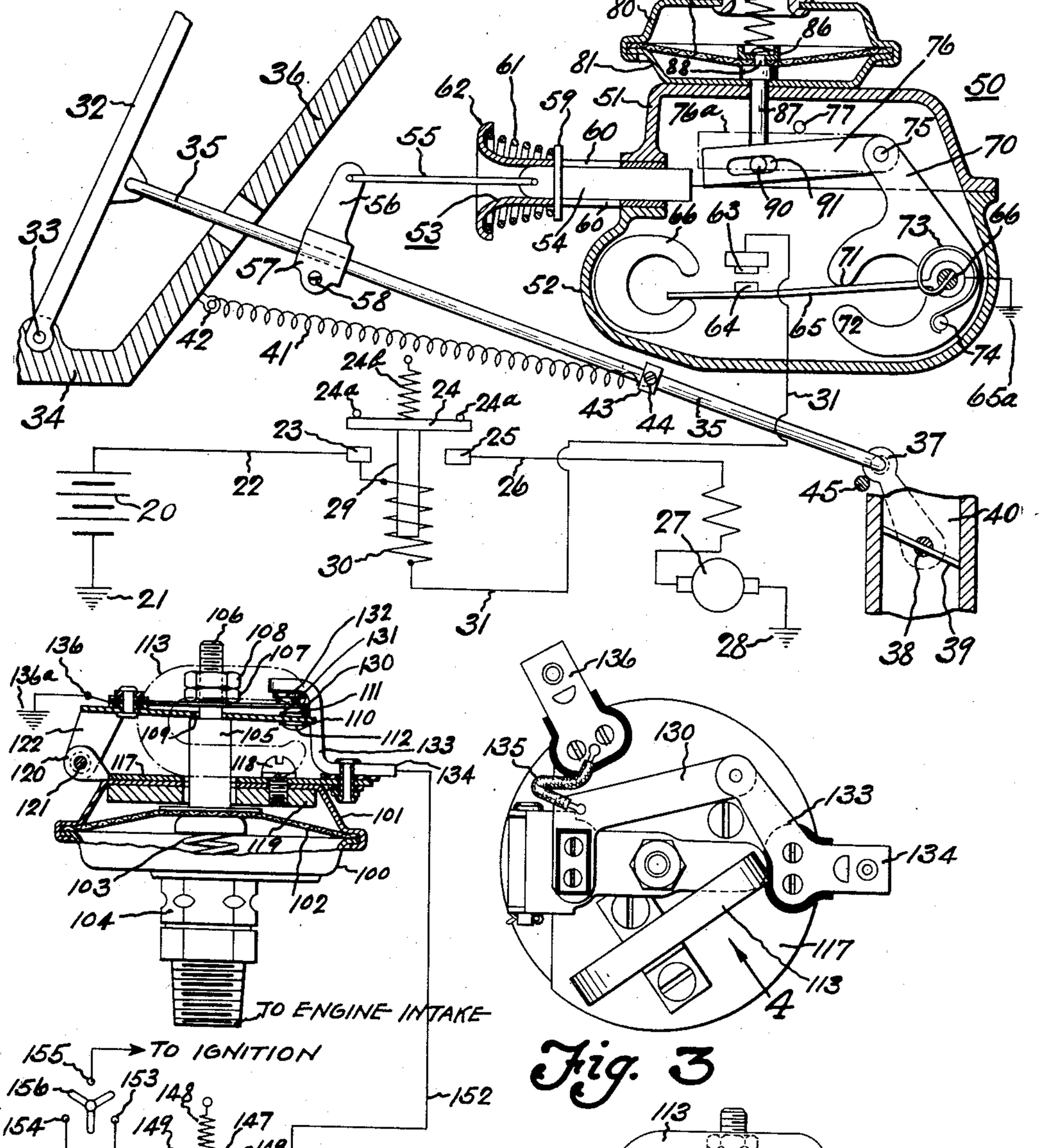

Fig. 2

Fig. 3

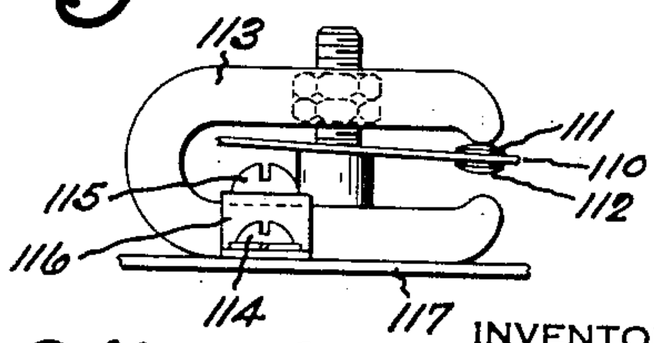

Fig. 4

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ELECTRIC CIRCUIT CONTROLLER

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11 Claims. (Cl. 200—59)

This invention relates to electrical circuit controllers comprising a movable contact member which is actuated by means having a lost-motion connection between the members.

It is an object of the invention to provide a simple and effective means for maintaining the movable switch contact member in either of its operating positions while the switch actuating member is being moved in either direction to take up the lost motion. To accomplish this object, I provide a permanent magnet, preferably of the horseshoe type and locate a portion of the movable contact member between the poles of the magnet. At least that portion of the movable contact member which is located between the poles of the magnet is made of magnetizable material. Either pole of the magnet will maintain the contact member in one of its positions of operation until the switch-actuating member is moved a distance sufficient to take up the lost motion and move the switch contact member to the other position in which it is retained by the other pole of the magnet.

It is also a part of the present invention to apply a lost-motion actuated permanent magnet control switch to the control circuit of the engine starting apparatus for internal combustion engines. I have disclosed in the present application two forms of engine starting apparatus in which such a switch is employed. In the first form of engine starter control the lost-motion mechanical actuator is pedal operated but is conditioned for operation or for non-operation by the means responsive to the operation of the engine, for example, by suction produced by the engine. In the second form of engine starter control circuit the lost-motion actuator is moved directly by a means responsive to engine suction and is not controlled manually.

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

In the drawing:

Figure 1 is a structural and wiring diagram illustrating the first form of engine starter including the present invention;

Figure 2 is a structural and wiring diagram illustrating the second form of engine starter control circuit embodied in the present invention;

Figure 3 is a plan view of the circuit controller unit shown in section in Figure 2; and

Figure 4 is a fragmentary view looking in the direction of arrow 4 of Figure 3.

In Figure 1, 20 designates a storage battery grounded at 21, connected by wire 22 with starter switch contact 23 connectible by a contact 24 with a contact 25 connected by wire 26 with an electric starting motor 27 grounded at 28. The contact 24 is connected with a solenoid armature 29 cooperating with an electromagnet 30 which is connected with contact 23 and by wire 31 with an automatic circuit controller 50 to be described.

The controller 50 is manually controlled by accelerator pedal 32 pivoted at 33 upon the floorboard 34 of an automobile. Pedal 32 is connected by a rod 35 passing through the automobile toe board 36 and connected with a throttle valve lever 37 carried by throttle valve shaft 38 which carries butterfly valve 39 which controls the fuel intake passage 40. Valve 39 is normally retained in engine idling position by spring 41 fixed at one end to an eye 42 attached to the automobile toe board 36 and fixed at the other end to a collar 43 attached by set screw 44 to the rod 35 in the desired position of adjustment. The spring 41 urges the valve lever 37 counterclockwise into engagement with a stop 45 in which position the butterfly valve 39 is in engine-idling position.

The controller 50 comprises a two-part housing consisting of members 51 and 52 supporting a guide tube 53 providing a guide for a bar 54 connected by flexible wire 55 with the ear 56 of the clamp bracket 57 which can be fixed to the rod 35 in the desired position of adjustment by tightening a screw 58. The bar 54 carries a cross pin 59 which extends through longitudinal slots 60 in the tube 53. A spring 61 is located between a flange 62 of the guide tube 53 and the pin 59 tends to urge the bar 54 toward the right. The spring 61 is weaker than the spring 41; hence the spring 41 contracts to hold the spring 61 in compressed condition as shown.

The controller 50 includes a stationary contact 63 to which the wire 31 is connected. Contact 63 is engaged by the contact 64 carried by an arm 65 which is pivoted on a stud 66 carried by housing member 52. At least the free end portion of contact arm 65 is magnetizable and is located between the poles of the C-shaped permanent magnet 66 secured to housing 52. The magnetizable portion of arm 65 is wider than the pole faces of permanent magnet 66 in order to pick up stray flux. The faces of the pole of magnet 66 are rounded so as to limit the contact with arm 65 to a small area in order to concentrate the flux. The contact 64 is held separated from

the contact 63 by engagement of the magnetizable contact arm 65 with the lower pole face of magnet 66. The contact 64 is held in engagement with the contact 63 by engagement of the magnetizable end in contact arm 65 with the upper pole of magnet 66.

The contact arm 65 is moved up and down by the lost-motion mechanical actuator including a lever 70 pivoted on the stud 66 and having fingers 71 and 72 spaced apart the distance greater than the width of contact arm 65, thereby providing a lost-motion connection between lever 70 and contact arm 65. Lever 70 is urged counterclockwise, so that its finger 71 will normally engage contact 65, by a coiled leaf spring 73 having its inner end passing through a groove or cross notch in the stud 66, and having its outer end engageable with a pin 74 carried by lever 70. The upper end of lever 70 is connected by pin 75 with a motion-transmitting part or bar 76 which is shiftable from the full line position, shown in Figure 1, to the dash line position 76*a*, in which position it is limited by a stop 77. The means for moving the bar 76 is responsive to engine intake suction and comprises a diaphragm box which includes members 80 and 81, between the flanges of which the periphery of a flexible cloth diaphragm 82 is clamped. Member 81 is secured to the upper side of the housing member 51. Member 80 carries a tubular bushing 83 to which a pipe leading to the engine intake passage is connected. Bushing 83 provides a shoulder 84, serving as a stop for the upper end of a compressed spring 85, the lower end of which bears against a cup washer 86 located on the upper side of the diaphragm 82. Diaphragm 82 is connected with a rod 87 having a reduced portion 88 passing through the diaphragm 82 and washer 86 and riveted over against the washer. Rod 87 has a reduced portion 89, the lower end of which extends at right angles to the main portion of the rod, as indicated at 90. The portion 90 extends through an elongated opening 91 in the bar 76.

The mode of operation of the engine starting device shown in Figure 1 will now be described. When the engine is at rest the diaphragm 82 will be down, as shown, since spring 85 urges the diaphragm downwardly until the larger portion of the rod 87 engages the bottom of the diaphragm box member 81. To start the engine the operator presses the pedal 32 clockwise to open the fuel valve 39 by moving the rod 35 toward the right. This movement of the rod 35 carries the lug 56 of the clamp bracket 57 toward the right thereby tending to put slack in the flexible wire 55, whereupon the compressed spring 61 is released to move the rod 54 into engagement with the bar 76, thereby moving the lever 70 clockwise against the resistance of the coiled leaf spring 73. This causes the finger 71 to be moved away from the contact 65 and the finger 72 to be moved into engagement therewith whereupon the lost motion is taken up and contact 64 is moved into engagement with contact 63 and held in that position during the starting of the engine. Contact 64 remains in engagement with contact 63 during the engagement of contact arm 65 with the upper pole face of magnet 66, although the arm 70 may waver from contact-closing position due to the fact that the operator may not evenly apply foot pressure against the pedal 32.

When contact 64 engages contact 63 solenoid magnet 30 is connected to the battery through the following circuit: wire 22, contact 23, magnet armature 31, contacts 63 and 64, contact arm 65 and ground connections 65*a* and 21. The movable contact 24 will be attracted downwardly away from stop 24*a* and against the resistance of spring 24*b*. Then the motor starting circuit will be closed and the motor 27 will operate to crank the engine. When the engine becomes self operative, the suction in the intake passage will be such that the diaphragm 82 will move upwardly against the action of the spring 85 thereby moving bar 76 from the position shown in full line to the dot-dash line position of 76*a*. In this position the left end of the bar 76 is clear of the right end of bar 54. Therefore, spring 73 will be released to move the lever 70 in a counterclockwise direction thereby causing its finger 71 to engage the contact arm 65 and move it downwardly against the lower pole face of magnet 66 and thereby separate contact 64 from contact 63 causing disconnection of the solenoid magnet from battery 20 whereupon the engine starting motor 27 will cease to function.

The bar 76 can not drop from the position 76*a* so long as the bar 54 is directly underneath it. This feature is used to advantage since it makes it impossible to bring the left-hand end of bar 76 into alignment with the right-hand end of the bar 54 so long as the engine is operating. When the throttle valve 39 is in idle position, suction will be sufficiently great to hold the bar 76 in the position 76*a*. During operation of the engine at full load and low speed when the valve 39 is wide open, the bar 54 will be underneath the bar 76, but the bar 76 can not drop although the engine intake suction is very low and insufficient to overcome the spring 85. Immediately the engine picks up in speed with the falling off of load the driver will release pressure on pedal 32 to withdraw the bar 54 toward the left and past the left-hand end of bar 76; but, by this time, the engine intake suction will have increased so that the bar 76 is lifted into the position 76*a*.

In case the engine should stall then the engine suction would decrease to zero and the bar 76 would drop down into alignment with the bar 54. The driver would instinctively press the pedal 32 to open the fuel valve to make the engine run; and this act would, of course, effect the restarting of the engine.

In the second form of engine starter, shown in Figures 2, 3 and 4, the restarting is effected automatically, the starting circuit being closed at one point by the closing of an ignition switch and closed at another point by an automatic switch embodying another form of the present invention. This automatic switch is not manually actuated but is actuated automatically directly by means responsive to engine intake suction.

The suction responsive means comprises diaphragm box members 100 and 101, between the flanges of which is clamped the periphery of a cloth diaphragm 102 urged upwardly by a spring 103, the lower end of which rests against a shoulder provided by a tubular bushing 104, the lower end of which may be connected by a suitable coupling with a pipe leading to the engine intake. The diaphragm 102 is fixed to a rod 105 having a reduced upper end 106, which threadedly receives nuts 107 and 108. The reduced portion 106 is joined with the larger portion of the rod 105 by a shoulder 109. The reduced portion 106 of rod 105 passes through a larger hole in a switch armature arm 110, carrying buttons

111 and 112, engageable respectively with the upper and lower pole faces of a C-shaped electromagnet 113, which is secured by screws 114 and 115, and a clamp bracket 116 to a base 117. At least the end portion of the arm 110 and the buttons 111 and 112 are made of magnetizable material.

The base 117 is attached by one or more screws 118 to diaphragm box member 101, the screws being threaded into a plate 119 fixed to the inner surface of the box 101. Plate 117 provides spaced ears 120 supporting a cross pin 121 which provides a pivotal support for ears 122 integral with the armature lever 110. It will be noted that the space along the reduced end 106 of the rod 105 and between the shoulder 109 and the nut 107 is greater than the thickness of the armature lever 110. This construction provides a lost-motion connection between lever 110 and its actuating rod 105. Lever 110 insulatingly supports a resilient contact arm 130 carrying a contact 131 engageable with a contact 132 carried by bracket 133 insulatingly supported by the plate 117 and providing a terminal 134. Leaf spring contact arm 130 is connected by a flexible conductor 135 with a terminal 136 insulatingly carried by plate 117.

The engine starter circuit comprises a battery 140 grounded at 141 and connected by wire 142 with a starter switch contact 143 having another stationary contact 144 connected with the engine starting motor 145 grounded at 146. Contacts 143 and 144 are bridged by movable contact 147 normally urged by a spring 148 against stop 149. The contact 147 is fixed to a solenoid armature 150 which is attracted downwardly by an electromagnet 151 when energized. Magnet 151 is connected with the terminal 134 by a wire 152 and with a contact 153 provided on the ignition switch which includes stationary contacts 154 and 155 and a three-prong movable contact 156.

To start the engine with the apparatus shown in Figure 2, the operator closes the ignition switch thereby bringing the prongs of contact 156 into engagement with contacts 153, 154 and 155, thereby connecting the battery 140 with the engine ignition and thereby energizing magnet coil 151 through the following circuit: battery 141, wire 142, switch contact 154, contact 156, contact 153, coil 151, wire 152, terminal 134, bracket 133, contact 132, contact 131, contact arm 130, flexible wire 135, terminal 136 and ground connections 136*a* and 141. During the cranking of the engine the suction in the fuel intake pipe may increase slightly and tend to move the diaphragm 102 downwardly against the action of spring 103, but the movement will not be sufficient to cause nut 107 to engage the upper side of the armature arm 110. Although the shoulder 109 moves away from armature arm 110, this arm will not move downwardly because it is held up due to the engagement of button 111 with the upper pole of the magnet 113.

After the engine becomes self operative, the suction in the intake passage will be sufficient to cause the diaphragm 102 to move downwardly and to cause lost motion to be taken up between 105 and the armature 110, and the nut 107 will engage the upper side of the armature arm 110 and move it downwardly and bring the lower button 112 into engagement with the face of the lower pole of magnet 113. The contact arm 130 will be moved downwardly thereby separating its contact 131 from the stationary contact 133, thereby interrupting the connection between the magnet coil 151 and the battery 140, whereupon the engine starting motor 145 will cease to operate.

During the operation of the engine the intake vacuum will vary somewhat according to the engine operating conditions, and the rod 105 will move up and down but without causing the armature lever to move into contact-closing position, unless the engine suction has fallen to a subnormal value, that being a value below any which would exist during the operation of the engine. Therefore, the engine starter will not be operated while the engine is operating; but immediately the engine stops or operates at an excessively low speed, the spring 103 will be permitted to move the rod 105 to its upper position, shown in Figure 2, whereupon the engine starter control circuit will be re-established due to closing of contacts 131 and 132. This insures restarting of the engine automatically in case of a stall.

From the foregoing description of construction and mode of operation of the two engine starter control circuits involving the present invention, it is apparent that this invention includes a lost-motion-actuated, magnet-controlled switch in which a permanent magnet is used to hold a switch contact arm in either of two positions, while the switch actuator is moved to take up lost motion either in one direction or the other. In both forms of engine starter control circuits, the movement of the lost-motion actuator is controlled automatically by means responsive to engine operation; for example, in response to suction means operated by engine intake vacuum. In the first form of invention, the engine intake suction responsive device controls a mechanical connection between the accelerator pedal and the lost-motion actuator. In the second form of the invention, the engine suction responsive means directly operates the lost-motion switch contact actuator.

While the embodiments of the present invention as herein disclosed, constitute preferred forms, it is to be understood that other forms might be adopted, all coming within the scope of the claims which follow.

What is claimed is as follows:

1. A circuit controller for internal combustion engines or the like comprising a magnetizable circuit controlling arm movable between two positions, magnetic means retaining the arm in either position, an operating member for moving the controlling arm toward each of its two positions, a lost motion connection between said arm and said operating member, and means adapted to respond to a condition of engine operation for controlling the operation of said operating member.

2. A circuit controller for internal combustion engines or the like comprising a pivotally mounted circuit controlling arm having a magnetizable portion, and movable between two positions, magnetic means cooperating with the magnetizable portion of said arm to retain it in either position, an operating member for engaging and moving the controlling arm toward each of its two positions, a lost motion connection between said arm and said operating member, and means adapted to respond to operation of an engine control member for actuating the operating member.

3. A circuit controller for use with internal

combustion engines comprising a movably mounted circuit controlling arm having a magnetizable portion and movable between two positions, a permanent magnet having pole faces located on either side of said magnetizable portion to retain the arm in either position, an actuator, lost-motion connecting means between the arm and actuator, and means responsive to engine intake suction for controlling the operation of the actuator.

4. A circuit controller for use with internal combustion engines comprising a movably mounted circuit controlling arm having a magnetizable portion and movable between two positions, a permanent magnet having pole faces located on either side of said magnetizable portion to retain the arm in either position, an actuator, lost-motion connecting means between the arm and actuator, and means responsive to engine intake suction for moving the actuator.

5. A circuit controller for use with internal combustion engines comprising a movably mounted circuit controlling arm having a magnetizable portion and movable between two positions, a permanent magnet having pole faces located on either side of said magnetizable portion to retain the arm in either position, an actuator, lost-motion connecting means between the arm and actuator, a manually operable member, and means responsive to engine intake suction for controlling a connection between the member and the actuator.

6. A circuit controller for use with internal combustion engines comprising a movably mounted circuit controlling arm having a magnetizable portion and movable between two positions, a permanent magnet having pole faces located on either side of said magnetizable portion to retain the arm in either position, an actuator, lost-motion connecting means between the arm and actuator, a bar movable in response to a manual control of the engine, a motion transmitting part connected with the actuator and normally located so as to be engaged by the bar, and means responsive to the self operation of the engine for moving the motion-transmitting part away from the path of movement of the bar.

7. A circuit controller for use with internal combustion engines comprising a movably mounted circuit controlling arm having a magnetizable portion and movable between two positions, a permanent magnet having pole faces located on either side of said magnetizable portion to retain the arm in either position, an actuator, lost-motion connecting means between the arm and actuator, a bar movable in response to a manual control of the engine, a motion-transmitting part connected with the actuator and normally located so as to be engaged by the bar, and means responsive to engine intake suction for moving the motion-transmitting part away from the path of movement of the bar.

8. A circuit controller for the starting circuit of an internal combustion engine comprising a movably mounted circuit controlling arm having a magnetizable portion and movable between two positions, magnetic means having poles located on opposite sides of said magnetizable portion to retain the arm in either position, an actuator, lost-motion connecting means between the arm and actuator, a bar movable in response to the control of the engine throttle, a motion-transmitting part connected with the actuator and normaly located so as to be engaged by the bar, and means responsive to engine intake suction for moving the motion-transmitting part away from the path of movement of the bar, said part being prevented from returning to operative position by the bar when engine intake suction falls off during operation of the engine.

9. A circuit controller for the starting circuit of an internal combustion engine comprising a movably mounted circuit controlling arm having a magnetizable portion and movable between two positions, magnetic means having poles located on opposite sides of said magnetizable portion to retain the arm in either position, an actuator, lost-motion connecting means between the arm and actuator, a bar movable in response to the control of the engine throttle, a motion-transmitting part connected with the actuator and normally located so as to be engaged by the bar, whereby movement of the actuator by the bar and part causes the starting circuit to be completed, a spring tending to resist the circuit completing movement of he actuator and to return actuator to a circuit interrupting position, and means responsive to engine intake suction for moving the motion-transmitting part away from the path of movement of the bar, whereupon the spring is released to move the actuator and movable arm into circuit-interrupting position.

10. A circuit controller comprising a magnetizable circuit controlling arm movable between two positions to close and open a circuit, magnetic means for retaining the arm in either one of its two positions after it has been moved thereto, a single operating member adapted to engage and move the controlling arm toward either of its two positions, said operating member being so constructed and so positioned with respect to the controlling arm that said member moves through a part of its range of movement before it engages the controlling arm when moving the latter toward either one of its two positions.

11. A circuit controller comprising a circuit controlling arm pivoted at one end and having a portion thereof at the opposite end magnetizable, said arm being movable between two positions to close and open a circuit, magnetic means cooperating with the magnetizable portion of said arm for retaining the arm in either one of its two positions, a single operating member adapted to engage the controlling arm at a point relatively near to the pivoted end in order to move said arm toward either of its two positions, said operating member being so constructed and so positioned with respect to the controlling arm that said member moves through a part of its range of movement before it engages the controlling arm when moving the latter toward either one of its two positions.

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