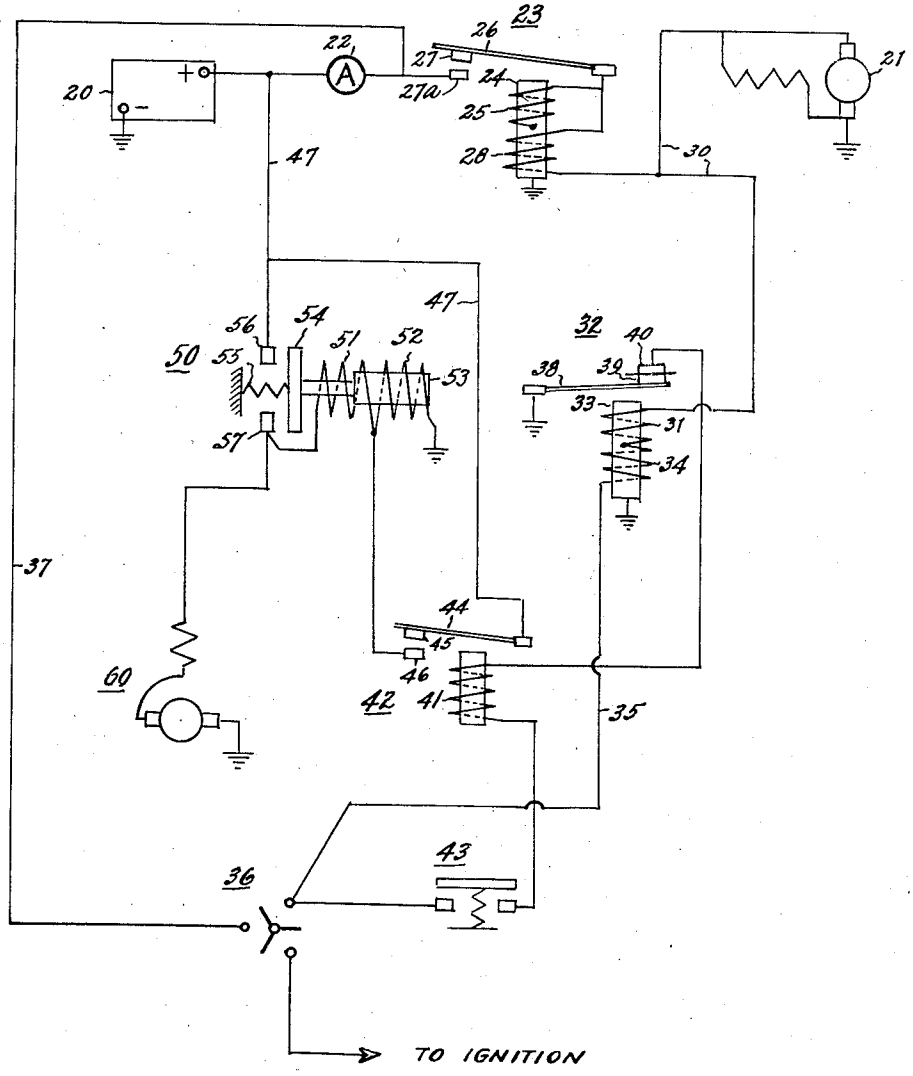
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ENGINE STARTER CONTROL SYSTEM

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INVENTOR
Lawrence C. Dermond
BY
Spencer Hardman & Fehr
his ATTORNEYS

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ENGINE STARTER CONTROL SYSTEM

Lawrence C. Dermond, Anderson, Ind., assignor to General Motors Corporation, Detroit, Mich., a corporation of Delaware

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This invention relates to engine starter control systems and, more particularly, to systems for use on automobiles having automatic transmissions. An automatic transmission is one which responds automatically to the use of the engine throttle or accelerator pedal to start the vehicle into motion and to change the ratio between engine speed and vehicle speed as required for various driving conditions. Certain automatic transmissions now in use are controlled initially by a manually operated status-controlling lever movable from a neutral position to a forward driving position or to a reverse driving position. When the lever is in "neutral" position, the transmission is in the non-operating status; when the lever is in "driving" position, the transmission will effect transmission of power from the engine to cause the vehicle to start and to move forward with increasing speed as the accelerator pedal is depressed; and when the lever is in "reverse" the vehicle backs up when the accelerator pedal is depressed. When the lever is in either forward or reverse driving position, the transmission of power from the engine to drive the vehicle ceases when the accelerator pedal is released.

It is an object of the invention to provide a starter control system in which the starting operation is effected in response to the closing of the ignition switch only when the transmission status-controlling lever is in "neutral" position and to prevent the use of the engine starter while the engine is self-operative and to require the opening and reclosing of the ignition switch before the engine can be started again.

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:

The figure of the drawing is a wiring diagram of the present invention.

Referring to the figure, a battery 20 is charged by a generator 21 driven by the vehicle engine. The charging circuit includes ammeter 22 and cut-out relay 23 having a core 24 surrounded by magnet coil 25 responsive to generator voltage. When the generator voltage attains a certain value relay armature 26 is attracted to close contacts 27 and 27a which complete the charging circuit. Then coil 28 responsive to current output is energized to maintain the relay contacts 27 and 27a closed so long as the generator is charging the battery regardless of fluctuations of generator voltage between certain limits. However, if the generator voltage falls so low that the battery begins to discharge through the generator the relay contacts 27 and 27a open due to reversal of current in winding 28.

Wire 30 connects generator 21 with winding 31 of relay 32. Winding 31 is connected to grounded core 33. A second winding 34 also connected with core 33 is connected by wire 35 with ignition switch 36 connected by wire 37 with battery 20. Grounded relay armature 38 carries a contact 39 normally engaging a contact 40 connected with magnet coil 41 of a starter control relay 42. Coil 41 is connected with battery 20 through a switch 43 and ignition switch 36. Switch 43 is closed only when the transmission status-controlling lever is in neutral position and is open when the lever is in forward or reverse driving positions.

Relay 42 includes an armature 44 carrying a contact 45 normally separated from a contact 46. Armature 44 is connected with battery 20 through wire 47. Contact 46 is connected with armature attracting coil 51 and armature holding coil 52 of starting motor solenoid switch 50 having an armature 53 for moving a contact 54 against the action of a spring 55 into engagement with contacts 56 and 57 in order to connect battery 20 with starting motor 60.

When the engine is at rest contacts 39 and 40 of relay 32 are closed. When the transmission status-controlling lever is in neutral position, the switch 43 is closed. Therefore the closing of switch 36 effects energization of relay coil 41 to effect the closing of relay 42. The closing of relay 42 causes energization of coils 51 and 52 to effect closing of solenoid relay 50 which connects the starting motor 60 with the battery 20 to effect the engine starting operation. During the engine starting operation the coil 34 of relay 32 is energized; but coil 34 is so designed that it alone will not effect the attraction of armature 38 of relay 32 to interrupt the circuit of coil 41 of relay 42 by opening contacts 39 and 40. So these contacts remain closed during the starting operation.

When the engine becomes self operative, the generator 21 driven by the engine impresses upon coil 31 of relay 32 a voltage sufficient to cause the combined effect of coils 34 and 31 to be strong enough to attract armature 38 to separate contacts 39 and 40. Once the armature 38 of relay 32 has been attracted, it will be held in attracted position by the magnetism derived from coil 34 alone.

The engine starter cannot be used while the engine is running because relay 32 maintains open circuited the coil 41 of starter relay 42. Even if the engine should stall, with the ignition switch on, the engine cannot be restarted except by moving the transmission controlling lever to neutral position to close switch 43 and by opening the ignition switch 36 to disconnect coil 34 of relay 32 to permit relay 40 to close and then by closing the ignition switch.

The present system can be used with a starting motor equipped either with an automatic shift responsive to starting motor rotation for moving the starter pinion into mesh with the engine flywheel gear or with a mechanical shift in which the movement of the pinion is effected by a mechanism operated by the solenoid armature 53. In case of a false start when the engine fails to remain self-operative after a few revolutions, the time consumed by the driver in turning the ignition switch 36 off and on again is sufficient to permit the starter pinion to come to rest, so that there will be no clashing of gear teeth when operating the starting motor again.

The present system can be manufactured and installed at a cost less than required by a system in which the starter circuit is controlled by a switch responsive to engine intake vacuum.

In the present system, the switch 36 is a manually operable means for effecting the connection of the starting motor 60 with the current source 20. The relay 32 constitutes an automatic means for effecting disconnection of the starting motor 60 from the current source 20. Relay 32 responds to self operation of the engine above a certain speed to effect disconnection of the starting motor from the current source when the voltage impressed upon the magnet coil 31 by the engine driven generator is sufficient to cause relay contacts 39 and 40 to open. Relay 32 has provisions (the magnet coil 34) for maintaining contacts 39 and 40 open so long as the manual means (switch 36) remains in circuit closing status, said provisions operating independently of the status of the engine.

While the embodiment of the present invention as herein disclosed, constitutes a preferred form, 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. An engine starter control system having a current source and a starting motor, a main electromagnetic switch for connecting the starting motor in circuit with the current source, an electromagnetic control switch for controlling the operation of said main switch, a plurality of manually operable switches, one of which is the ignition switch, at least two of which must be closed in order to effect the closing of said control switch, means operated by the generator for causing the control switch to be opened when the engine starts to run under its own power, and means for preventing reclosing of the control switch in the event that the engine stalls until one of said manually operable switches has been opened and reclosed.

2. An engine starter control system having a current source and a starting motor, a main electromagnetic switch for connecting the starting motor in circuit with the current source, an electromagnetic control switch for controlling the operation of said main switch, a plurality of manually operable switches, one of which is the ignition switch, at least two of which must be closed in order to effect the closing of said control switch, means operated by the generator for causing the control switch to be opened when the engine starts to run under its own power and means for preventing reclosing of the control switch in the event that the engine stalls until the ignition switch has been opened and reclosed.

3. An engine starter control system having a current source and a starting motor, a main electromagnetic switch for connecting the starting motor in circuit with the current source, an electromagnetic control switch for controlling the operation of said main switch, a plurality of manually operable switches, one of which is the ignition switch, at least two of which must be closed in order to effect the closing of said control switch, means operated by the generator for causing the control switch to be opened when the engine starts and the generator is operating at a predetermined speed, and means, operable when the engine stalls and the generator stops or operates at a speed below said predetermined speed, to prevent the reclosing of the control switch until one of said manually operable switches has been opened and reclosed.

4. An engine starter control system having a current source and a starting motor, a main electromagnetic switch for connecting the starting motor in circuit with the current source, an electromagnetic control switch for controlling the operation of said main switch, a plurality of manually operable switches, including an ignition switch and a switch adapted to be closed when the transmission lever of the vehicle is in neutral position, said last named switches being operable to control the action of said control switch, means operable by the generator for causing the control switch to be opened when the engine starts to run, and means for preventing the reclosing of the control switch in the event that the engine stalls when operating under load, until the ignition switch has been opened and reclosed and the transmission lever has been restored to neutral position.

5. An engine starter control system having a current source and a starting motor, a main electromagnetic switch for connecting the starting motor in circuit with the current source, a second electromagnetic switch for controlling the action of the main switch and which must be closed in order to enable the main switch to be closed, a generator driven by the engine, means for creating a sufficient flow of current in the winding of said second electromagnetic switch when the generator is operating at a predetermined speed to effect the opening of said second switch in order to cause the starting motor to become inoperative, a plurality of manually operable switches including an ignition switch which must also be closed in order to cause the starting motor to become operative, and means to cause a sufficient flow of current in the winding of said second electromagnetic switch to hold said second switch open while one of said manually operable switches is closed, so that if the engine stalls after being started it cannot be restarted until said last named manually operable switch is opened and reclosed.

6. An engine starter control system having a current source and a starting motor, a main electromagnetic switch for connecting the starting motor in circuit with the current source, a second electromagnetic switch for controlling the action of the main switch and which must be closed in order to enable the main switch to be

closed, a generator driven by the engine and an ignition switch both of which control the operation of said second electromagnetic switch, said last named switch having a compound winding in circuit with both the generator and the ignition switch, said winding being so constructed and arranged that it is not energized sufficiently to effect opening of the control switch except when the generator is operated by the engine but is energized enough to hold the switch open after it has been opened by action of the generator so long as the ignition switch remains closed.

7. An engine starter control system having a current source and a starting motor, a main electromagnetic switch for connecting the starting motor in circuit with the current source, a second electromagnetic switch for controlling the action of the main switch and which must be closed in order to enable the main switch to be closed, a generator driven by the engine and an ignition switch both of which control the operation of said second electromagnetic switch, said last named switch having a compound winding in circuit with both the generator and the ignition switch, said winding being so constructed and arranged that it is not energized sufficiently to effect opening of the control switch except when the generator is operated at a predetermined speed, but is energized enough to hold said switch open after it has been opened as long as the ignition switch remains closed.

8. An engine starter control system having a current source and a starting motor, a main electromagnetic switch for connecting the starting motor in circuit with the current source, a second electromagnetic switch for controlling the action of the main switch and which must be closed in order to enable the main switch to be closed, a generator driven by the engine and an ignition switch both of which control the operation of said second electromagnetic switch, said last named switch having a compound winding in circuit with both the generator and the ignition switch, said winding being so constructed and arranged that it is not energized sufficiently to effect opening of the control switch except when the generator is operated, but is energized enough to hold said switch open, after it has been opened as long as the ignition switch remains closed, entirely independently of the operation of the generator.

9. An engine starter control system having a current source and a starting motor, a main electromagnetic switch for connecting the starting motor in circuit with the current source, an electromagnetic control switch for directly controlling the action of the main switch and having contacts in circuit with the winding of the main switch, another electromagnetic control switch for indirectly controlling the action of the main switch and having contacts in circuit with the winding of the direct control switch, a generator and an ignition switch both of which control the operation of said last mentioned control switch, said last named switch having a compound winding in circuit with the generator and the ignition switch, said winding being so constructed and arranged that the entire winding is energized when the ignition switch is closed and the generator is in operation but only a part of such winding is energized by closing of the ignition switch, whereby such winding is not sufficiently energized to effect opening of the switch operated thereby except during operation of the generator, but is sufficiently energized to hold the switch open after its opening has been effected as long as the ignition switch remains closed.

10. An engine starter control system having a current source and a starting motor, a main electromagnetic switch for connecting the starting motor in circuit with the current source, a second electromagnetic control switch for controlling the action of the main switch and which must be closed in order to enable the main switch to be closed, an ignition switch, a generator driven by the engine, said control switch having two windings, one of which is in circuit with the generator and the other in circuit with the ignition switch whereby current is caused to flow through both said windings whenever the ignition switch is closed and the generator is being operated above a certain speed, the construction and arrangement of said windings being such that the effect of neither one alone is sufficient to effect opening of said control switch, but when the generator is operating above a predetermined speed the effect of both of said windings is sufficient to effect opening of the control switch in order to cause the starting motor to become inoperative and the effect of the winding in circuit with the ignition switch is sufficient after the control switch is opened to hold the latter open as long as the ignition switch is closed, whereby in the event the engine stalls after being started, the ignition switch must be opened and reclosed before the engine can be restarted.

11. An engine starter control system having a current source and a starting motor, a main electromagnetic switch for connecting the starting motor in circuit with the current source, an ignition switch, a generator operated by the engine, a second normally closed electromagnetic control switch adapted to remain closed during starting of the engine, said control switch having two windings grounded through the core of the control switch magnet, one of which is in circuit with the generator and the other with the ignition switch, whereby the windings are energized when the generator is in operation and at all times when the ignition switch is closed, the construction and arrangement of said windings being such that the effect of neither one alone is enough to effect opening of said control switch, but when the generator is operating above a predetermined speed, the effect of both of said windings is sufficient to effect opening of the control switch in order to cause the starting motor to become inoperative and the effect of the winding in circuit with the ignition switch is sufficient after the control switch is open to hold the latter open as long as the ignition switch is closed, whereby if the engine stalls after being started, it cannot be restarted until the ignition switch is opened and closed.

LAWRENCE C. DERMOND.