Oct. 20, 1931. S. C. SPIVEY 1,828,514

ELECTRIC STARTING SYSTEM FOR AUTOMOBILES

Original Filed April 16, 1927 2 Sheets-Sheet 1

Fig. 1.

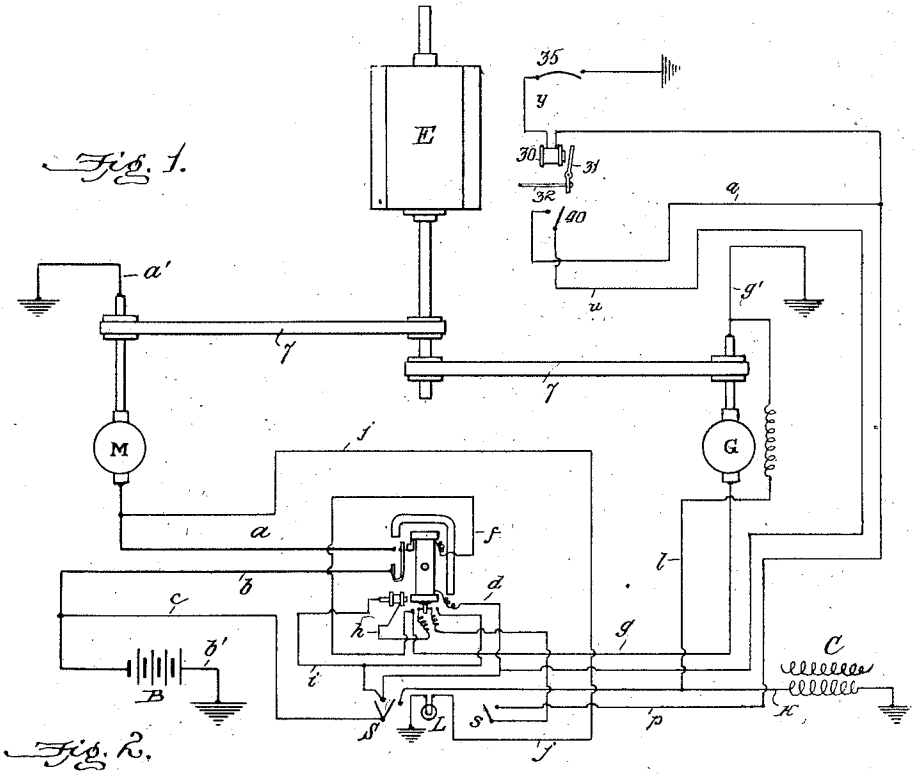
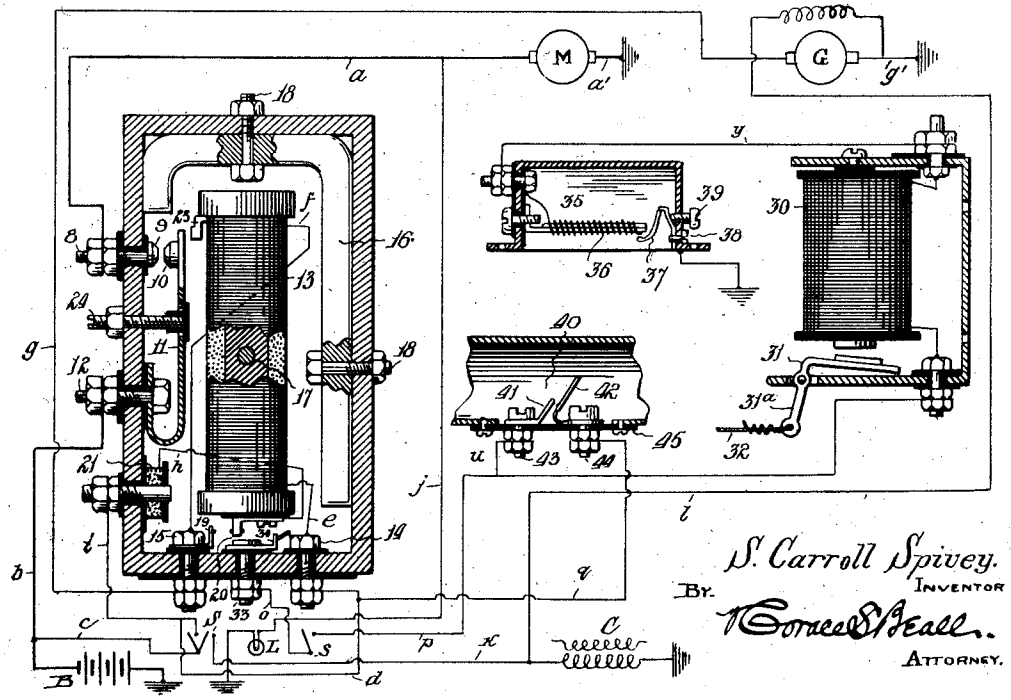


Fig. 2.



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Fig. 3.

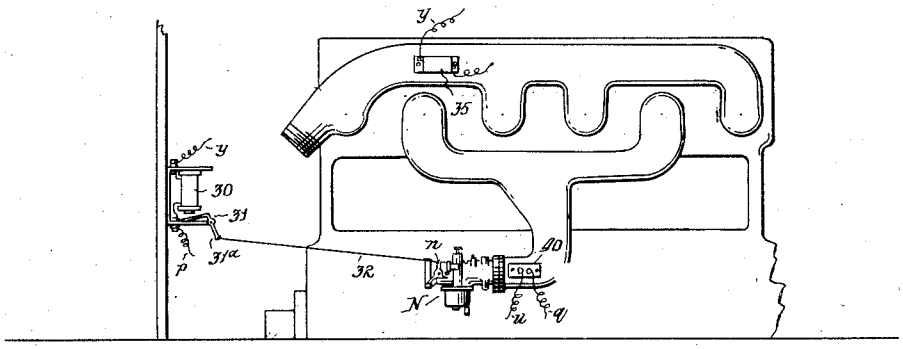


Fig. 5.

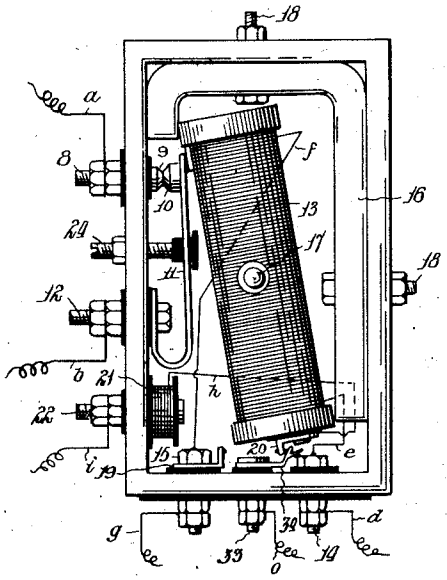


Fig. 6.

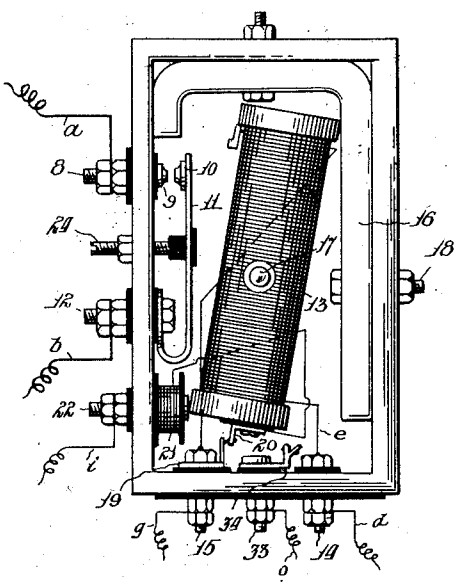
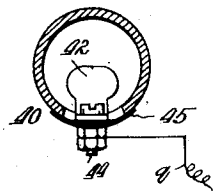


Fig. 4.



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UNITED STATES PATENT OFFICE

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ELECTRIC STARTING SYSTEM FOR AUTOMOBILES

Application filed April 16, 1927, Serial No. 184,382. Renewed March 9, 1931.

My invention is an improvement in electric starting systems for automobiles and relates more especially to an arrangement for controlling the circuits between the storage-battery, electric-motor and generator, with provision for automatically priming the carbureter in starting the engine and under certain conditions during the running of said engine; the present invention being an improvement on the starting system shown and described in my prior Patent No. 1,618,683, dated February 22, 1927.

My present invention contemplates a starting system in the operation of which the closing of an electric-switch on the instrument-board of the automobile will establish a circuit from the storage-battery to energize a polarized relay adapted to operate a switch connecting the motor in direct circuit with the storage-battery for starting the engine geared to said motor and to the generator, the action of the polarized relay in conjunction with cooperating devices comprising the system and wire connections therefrom to the storage-battery and generator serving to control the circuits for cutting out the electric-motor when the engine is running and effect a positive operation of the movable electro-magnet forming a part of the polarized relay.

A further object of my invention is to include in the electrically controlled system for starting the engine by the motor an arrangement for priming the carbureter in the starting of the engine and while the same is running under certain conditions requiring a richer mixture of the fuel gas, the priming devices operating automatically with respect to the running of the engine.

With these principal objects in view my invention consists of the electric starting system comprising the instrumentalities arranged and operating in the manner hereinafter fully described, and what I particularly claim as my invention is set forth in the appended claims.

In the accompanying drawings:

Figure 1 is a diagrammatic view illustrating an electric starting system in accordance with my present invention.

Fig. 2 is a view illustrating the preferred forms of construction of the several instrumentalities for carrying out the operation of the system.

Fig. 3 is an elevation showing the location of the electrically controlled priming devices operating in conjunction with the automobile engine.

Fig. 4 is a detail sectional view of one of the devices, on the line 4—4 of Fig. 2.

Figs. 5 and 6 are detail views of the polarized relay illustrating different positions of the movable electro-magnet.

The electrical devices for controlling the operation of the starting motor and priming the carbureter are employed in connection with a storage-battery B, electric starting motor M, electric generator G, and internal combustion engine E, all as commonly employed in the operation of an automobile with the motor and generator geared to the engine in the usual manner (belt connections 7 being shown in the diagram for convenience of illustration).

The motor M is electrically connected to the storage-battery B by the main wires *a* and *b* with an automatic switch interposed and forming part of the polarized relay hereinafter described, the circuit being completed by ground wires *a'* and *b'* extending from the motor and battery respectively, and the operation of the electric starting system is controlled by a manually-operated double contact switch S one contact-point of which is connected by wire *c* to the battery, tapping wire *b*, and the other contact-point connected by wires *d*—*e* to one end of the movable electro-magnet connected from the other end of its coil by wires *f*—*g* to the generator grounded by wire *g'*; the change in the polarity of the electro-magnet in conjunction with the permanent magnet or horse-shoe magnet—by change in the direction of current from battery and generator as hereinafter explained—actuating said electro-magnet to operate the automatic switch in the main circuit between the battery and motor and to close an auxiliary circuit including a fixed electro-magnet cooperating with the movable electro-magnet for holding the latter away from the automatic switch, said auxiliary circuit being

from the generator by wire *g* to a make and break contact with wire *h* connected to said fixed electro-magnet with the core of the latter connected by wire *i* to the storage-battery through wires *c b*. In order that the driver of the automobile may be assured that current is being supplied from the storage battery to the electric-motor there is a pilot light L located on the instrument-board or within sight of the driver and connected by wire *j* to the main wire *a* between motor and switch, with a ground wire from the lamp to complete the circuit, and this lamp may also serve to illuminate the instrument-board for the operation of the choke-rod, &c. Furthermore, the ignition coil C is connected in circuits from the storage-battery and the generator, respectively, by wire *k* extending from the grounded ignition coil to a contact-point of the manually-operated switch S and by wire *l* to the generator; other wire connections and electric devices, hereinafter described, being also provided in the present instance for automatically priming the carbureter in starting the engine and maintaining its driving speed.

As shown in Figs. 2, 5 and 6 of the drawings the cooperating parts of the polarized relay are mounted in a box through one side of which extends a binding-post 8 forming one of the contact-points, as 9, of the automatic switch for closing the main circuit from the storage-battery to the motor and to which wire *a* is connected, the other contact-point, 10, being at the outer end of a spring member 11 connected to and supported in the box by binding-post 12 to which wire *b* is attached, the spring-actuated switch being closed by movable electro-magnet 13 in conjunction with the horse-shoe magnet 16, the latter being secured in the box by bolts 18, and the closing of the switch takes place when the poles of the magnets 13 and 16 are attracted by current passing in one direction through the coil of the electro-magnet, the current then passing from grounded storage-battery B by wires *b c*, switch S and wires *d e* to lower end of coil and from upper end of coil by wires *f g* to grounded electric-generator G (see diagram Fig. 1). By reference to Fig. 2 it will be noted that wire *d* from switch S is connected to binding-post 14 through an end of the relay-box for connecting wire *e* of the coil of electro-magnet 13 thereto, and that in like manner wire *f* from the other end of said coil is connected to a binding-post 15 extending through this end of the relay-box to connect with wire *g* extending to the generator. When the circuit hereinbefore traced is completed—with the generator at rest and switch S closed—the source of current through the electro-magnet 13 will be from the storage-battery and said electro-magnet is then attracted to the poles of the permanent magnet so that the engaging-piece 23 at the upper end thereof will strike the spring member 11 of the switch closing said switch to complete a direct circuit by wires *b* and *a* from the storage-battery to the motor for driving the latter in starting the automobile engine E. Now when the engine is started or cranked and the generator develops sufficient current to change the direction of the flow of current through the coil of the electro-magnet—that is from generator G by wires *f g* to the coil and from the coil by wires *e d*, switch S and wires *c b* to the storage-battery—the polarity of the electro-magnet is changed and under the influence of the horse-shoe magnet it is moved to release the spring-member of the automatic switch to break the circuit from the storage-battery to the motor; this arrangement and operation being similar to that shown and described in my prior patent hereinbefore referred to with the exception that in the present instance the electro-magnet is pivoted at its center instead of at one end.

The electro-magnet 13 is pivoted centrally so that it will be balanced against accidental movement by any vibration of the automobile when it is being driven over an uneven road surface, insuring in the present instance a positive action of the starting system under such conditions, the centrally pivoted electro-magnet for this purpose cooperating with a fixed electro-magnet for holding said movable electro-magnet away from the automatic switch and so that the polarized relay may operate to connect the storage-battery with the motor in case the automobile becomes stalled from any cause—it being understood that in the operation of the present starting system switch S remains closed while the automobile is being driven. For the purposes just mentioned the polarized relay includes a fixed electro-magnet 21 on a combined core and binding-post 22 with the inner projecting end of the core in juxtaposition to the lower end of the movable electro-magnet 13 so that these cooperating electro-magnets will be held together by currents of electricity passing through the same. The fixed magnet 21 is connected to the generator by wires *h g* with an interposed make and break device operated by the movable electro-magnet and consisting of a contact member 19 attached to the binding-post 15 to which wire *g* is connected with a cooperating contact member 20 attached to the lower end of the electro-magnet, and this circuit to include the fixed electro-magnet is completed through the grounded storage-battery by wire *i* from binding post 22 to wires *c* and *b* leading to the storage-battery. It will be understood that enough current passes through the coil of the movable electro-magnet to cooperate with the energized fixed electro-magnet in keeping contacts 19—20 together for maintaining the

fixed electro-magnet energized, or in other words this position of the parts will be maintained as long as the electric-generator is discharging current through the storage-battery, but when the electromotive force of the generator falls below that of the storage-battery electro-magnet 13 will swing to normal position and in this position it will quickly respond to current from the storage-battery that will change its polarity for the operation of the automatic switch in the manner hereinbefore described, consequently when the automobile engine is running smoothly the electro-magnet will be held away from the automatic switch for open position of the same, and if the engine begins to stall or choke—reducing the electromotive force from the generator—said electro-magnet will be immediately released from the fixed electro-magnet and then polarized by change in the direction of current to operate the switch for driving the automobile engine by the motor in circuit with the storage-battery. It will be obvious therefore that the automobile engine will be automatically cranked as soon as it begins to stall or choke—an important consideration in slowing down in traffic jams or should the engine become choked in climbing a hill for it will be necessary only to apply the brakes and operate gear-shift—and as the starting system responds to the slowing up of the engine to crank it by the motor there will be a saving in the life of the storage-battery. When the engine is to be stopped, for parking the automobile, the manually operated switch S is opened and of course the operation of this switch can be controlled by a key-lock to prevent anyone from operating the electric-motor without authority. The foot operated push button and generator cut-out or circuit breaker is dispensed with in the installation of this starting system.

For adjusting the spacing of the contact-points 9 and 10 of the automatic switch 11, as well as for limiting the outward or opening movement of the spring member thereof, I provide an adjusting screw 24 having a fiber head at its inner end against which the spring member abuts and a nut threaded on its outer end against the side of the relay-box to secure the adjustment. This arrangement limits the open throw of the automatic switch and permits free movement of the electro-magnet 13 away from the same. It will be understood that the engine is practically at a standstill when contacts 9—10 close for the motor to crank the engine before the latter becomes stalled, for though the armature 13 swings over against the spring member 11 contacts 9—10 are not closed until the required pressure is applied to said armature, the pressure increasing with the slowing down of the engine, and of course the amount of pressure required to move the armature may be regulated by the aforementioned adjusting screw 24. Furthermore, it will be understood that when the engine is started switch-member 11 is automatically released before the generator reverses the current through the coil 13, for it is not absolutely necessary that the current through this coil be reversed to release said switch-member to open the circuit to the starting motor inasmuch as when the engine is started the generator immediately begins generating current below that of the storage battery thus increasing the resistance of the circuit from the storage battery through said coil and before said generator produces current greater than that of the storage battery to then reverse the current through the coil causing it to swing over sufficiently to close contacts 19—20 at lower end thereof; in other words, the weakening of the current through the coil decreases the pressure against the spring member 11 causing contacts 9—10 to open before said coil or armature returns to normal or central position that is the starting motor is cut out of circuit the instant the engine starts.

In order to increase the utility of the starting system by providing for an automatic operation of the lever by which the carbureter is primed to enrich the fuel mixture on starting the engine either initially or in case it should begin to stall I include certain electric devices controlled by the operation of the polarized relay and also by the operation of the engine. For this purpose there is provided an electro-magnet 30 having a pivoted armature 31 with arm extension 31^a connected by rod 32 to the priming-lever n of carbureter N, said electro-magnet being energized and deenergized under the influence of the engine cooperating with associated devices in circuit with the storage-battery and generator and controlled by a manually operated switch s located on the instrument-board of the automobile, the electric connections being from one contact-point of said switch by wire o to binding-post 33 extending through the relay-box and having spring-actuated contact-member 34 cooperating with binding-post 14 hereinbefore referred to and connected by the wire d to main switch S in circuit with the storage-battery by wires c and b, while the other contact-point of the switch s is connected by wire p to the electro-magnet 30 and on to ground by wire y with a make and break device in the form of an electric-thermometer 35 interposed in the circuit between the electro-magnet and ground, whereby when the circuit is closed by the electric thermostat as hereinafter explained the armature 31 will be attracted to the magnet and operate rod 32 to prime the carbureter. Any form of electric thermostat may be employed, that shown in Fig. 2 of the drawings being a conventional type comprising a wire wrapped rod

36 adapted when heated to break contact with member or contact-point 37 and open the circuit, contact-member 37 being in the form of a bent spring secured to the casing by screw 38 and adjustable by set-screw 39 to vary the gap between the contact-points for governing the operation of the thermostat. Electro-magnet 30, controlling the operation of the priming lever is also energized independently of the relay and contact 34 by means of a circuit make and break device 40 operated by back pressure in the manifold intake pipe of the automobile engine, whereby when the engine begins to stall and back fires to the carburetor this back pressure will close the circuit to operate the priming-lever to enrich the fuel-mixture. This can be accomplished in various ways or by the simple device shown in Figs. 2 and 4 of the drawings comprising contact-members 41 and 42 connected respectively to the binding posts 43 and 44, with wire connections to provide a circuit around switch *s*, to wit: binding post 44 is connected by wire *q* in circuit with the storage-battery through main switch S and wires *c b*, while binding-post 43 is connected by wire *u* to wire *p* leading to the electro-magnet 30, thus providing a circuit controlled by the main switch alone and operated by said make and break device 40 in conjunction with the thermostat 35, the normal position of the latter closing the circuit, that is the contact-points are together until the rod is heated sufficiently to separate them. So that the member 42 may be actuated by back pressure of gases in the manifold intake pipe it presents sufficient surface to be actuated by the usual back-pressure and the spring portion thereof by which it is connected to binding-post 44 will return it to normal open circuit position.

The operation of the electric devices for automatically priming the carbureter takes place in starting the engine and also during the running of the engine should it begin to stall. In starting the engine by the operation of the polarized relay to close the main circuit from storage-battery to motor, in the manner hereinbefore described, the movement of the electro-magnet 13 of the polarized relay closes the contacts 34—14 immediatly before closing the automatic switch 11 and establishes circuit through the electro-magnet 30 and thermostat causing the armature 31 to operate rod 32 connected to the priming-lever of the carbureter and the current passing through the thermostat quickly heats the rod to open the circuit which de-energizes the electro-magnet 30 to release the operating rod 32, and the circuit being open the thermostat cools again closing the circuit to operate the priming-lever. This operation is repeated until the engine is sufficiently cranked to release electro-magnet 13 of the polarized relay or the heat of the manifold exhaust pipe is sufficient to heat the thermostat and maintain the electric thermostat in open circuit position, it being understood that switch *s* is closed during this operation, and that the operation takes place automatically whenever switch 11 is closed to crank the engine by the motor. Switch S remains closed at all times, as the devices in the circuit controlled thereby are safety devices, and consequently said switch is opened only when it is desired to empty the carbureter of a rich mixture. By adjusting member 37 of the electric thermostat this device can be regulated to operate at more or less degree of heat and so that it may cut off long enough for the engine to empty the carbureter of the richer fuel-mixture.

The operation of the circuit make and break device located in the manifold intake pipe takes place during the running of the engine whenever there is a back-pressure of the gases in said pipe, usually due to a lean mixture and occurring more often during cold weather, in this instance said device operating to enrich the fuel-mixture by operating the priming-lever of the carbureter in the manner hereinbefore described.

I claim:

1. A starter for internal combustion engines including a storage battery, electric motor and generator, a circuit connecting the storage battery to the motor, and a circuit connecting the generator to the storage battery, of a polarized relay having an operating coil in the circuit from the generator to the storage battery, means controlled by said relay for opening the circuit between the storage battery and motor, and an electro-magnet in the circuit from the generator and responsive to the operation of the polarized relay for maintaining the circuit to the motor open.

2. A starter for internal combustion engines including a storage battery, electric motor and generator, a circuit connecting the storage battery to the motor, and a circuit connecting the generator to the storage battery, of a polarized relay having an operating coil in the circuit from the generator to the storage battery, means controlled by said relay for opening the circuit between the storage battery and motor, an electro-magnet in the circuit from the generator and responsive to the operation of the polarized relay for maintaining the circuit to the motor open, and a make and break device in the last mentioned circuit controlled by the polarized relay.

3. A starter for internal combustion engines including a storage battery, electric motor and generator, a circuit connecting the storage battery to the motor, and a circuit connecting the generator to the storage battery, of a polarized relay having an operating coil in the circuit from the generator to

the storage battery, means controlled by said relay for opening the circuit between the storage battery and motor, an electro-magnet in the circuit from the generator and responsive to the operation of the polarized relay for maintaining the circuit to the motor open, and means responsive to the operation of the polarized relay for opening the circuit in which the electro-magnet is included.

4. A starter for internal combustion engines including a storage battery, electric motor and generator, a circuit connecting the storage battery to the motor, and a circuit connecting the generator to the storage battery, of a polarized relay having an operating coil in the circuit from the generator to the storage battery, means controlled by said relay for opening the circuit between the storage battery and motor, an electro-magnet in the circuit between the generator and storage battery and responsive to the operation of the polarized relay for maintaining the aforesaid circuit open, means responsive to the operation of the polarized relay for opening the circuit in which the electro-magnet is included, an ignition coil, and a circuit to the ignition coil tapping the circuit from the generator to the storage battery.

5. A starter for internal combustion engines including a storage battery, electric motor and generator, a circuit connecting the storage battery to the motor, and circuits connecting the generator to the storage battery, of a polarized relay controlling the circuit from the storage battery to the motor and having an operating coil in one of the circuits from the generator to the storage battery, means controlled by the relay for opening said circuit, means holding the relay to maintain said circuit open, and means responsive to the other circuit from the generator for releasing said holding means.

6. A starter for internal combustion engines including a storage battery, electric motor and generator, a circuit connecting the storage battery to the motor, and two circuits connecting the generator to the storage battery, of a polarized relay controlling the circuit from the storage battery to the motor having an operating coil connected in one of the circuits from the generator to the storage battery, means controlled by said relay for opening said circuit, and means for holding the relay controlled by the other circuit from the generator to the storage battery.

7. A starter for internal combustion engines including a storage battery, an electric motor and generator, a circuit connecting the battery to the motor, and two circuits connecting the generator to the storage battery, of a polarized relay having an operating coil connected in one of the circuits from the generator to the storage battery, a permanent magnet having pole members of different lengths, the coil element of the relay being centrally pivoted and cooperating with said magnet, a spring-actuated switch in the circuit from the storage battery to the motor and controlled by said relay to close the circuit and electro-magnet in juxtaposition to one end of the coil element of the relay and having its coil connected in the other circuit between the generator and source of electric current, said electro-magnet attracting the relay coil element for open position of the aforesaid switch, and means responsive to the last mentioned circuit from the generator for deenergizing the electro-magnet.

8. In combination with an internal combustion engine, of a starter including a storage battery, electric motor and generator, a circuit connecting the storage battery to the motor, and two circuits connecting the generator to the storage battery; together with a polarized relay having an operating coil connected in one of the circuits from the generator to the storage battery, means controlled by said relay for opening the circuit between the storage battery and motor, an electro-magnet in the other circuit from the generator to the storage battery responsive to the operation of the polarized relay, a carburetor for the engine, and means responsive to the operation of said electro-magnet for priming the carburetor.

9. In combination with an internal combustion engine and carburetor, of a starter including a storage battery, electric motor and generator, a circuit connecting the storage battery to the motor, and circuits connecting the generator to the storage battery; together with a polarized relay having an operating coil connected in a circuit from the generator to the storage battery, an electro-magnet in one of the circuits from the generator responsive to the operation of the polarized relay, an electric thermostat included in the circuit with the electro-magnet, a circuit make and break device also in said circuit and located in the manifold intake of the engine, and means operated by the electro-magnet for priming the carburetor.

10. In combination with an internal combustion engine, carburetor and manifold intake pipe, of a starter including a storage battery, electric motor and generator, a circuit connecting the storage battery to the motor, and two circuits connecting the generator to the storage battery; together with a polarized relay having an operating coil connected in one of the circuits from the generator to the storage battery, means controlled by said relay for opening the circuit between the storage battery and motor, an electro-magnet in the other circuit from the generator to the storage battery responsive to the operation of the polarized relay, a circuit make and break device included in the circuit to the electro-magnet and located in the manifold intake of the engine, said cir-

cuit make and break device being operated by back pressure of gases in the manifold intake pipe, and means operated by the electro-magnet for priming the carburetor of the engine.

11. In combination with an internal combustion engine and carburetor, of a starter including a storage battery, electric motor and generator, a circuit connecting the storage battery to the motor, and two circuits connecting the generator to the storage battery; together with a polarized relay having an operating coil in one of the circuits from the generator to the storage battery, an electro-magnet and contacts responsive to the operation of the polarized relay included in the other circuit from the generator to the storage battery, and means operated by said electro-magnet for priming the carburetor.

12. In combination with an internal combustion engine, carburetor and manifold intake pipe, of a starter including a storage battery, electric motor and generator, a circuit connecting the storage battery to the motor, and two circuits connecting the generator to the storage battery; together with a polarized relay having an operating coil in one of the circuits from the generator to the storage battery, a make and break device in the other circuit from the generator to the storage battery, said make and break device being located in the manifold intake pipe and operated by back pressure therein, an electro-magnet in the circuit with said make and break device, contacts responsive to the operation of the polarized relay to include the electro-magnet in said circuit, and means operated by the electro-magnet for priming the carburetor.

13. In combination with an internal combustion engine, carburetor and manifold intake pipe, of a starter including a storage battery, electric motor and generator, a circuit connecting the storage battery to the motor, and circuits connecting the generator to the storage battery; together with a polarized relay having an operating coil in one of the circuits from the generator to the storage battery, an electro-magnet in another circuit from the generator to the storage battery responsive to the operation of the polarized relay, an electric thermostat in the circuit with the electro-magnet. a circuit make and break device in said circuit and located in the manifold intake, and means operated by the electro-magnet for priming the carburetor.

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