Dec. 10, 1929. J. HASSELBRING, JR 1,739,069

STARTER FOR INTERNAL COMBUSTION ENGINES

Filed July 15, 1927 2 Sheets-Sheet 1

Fig. 1

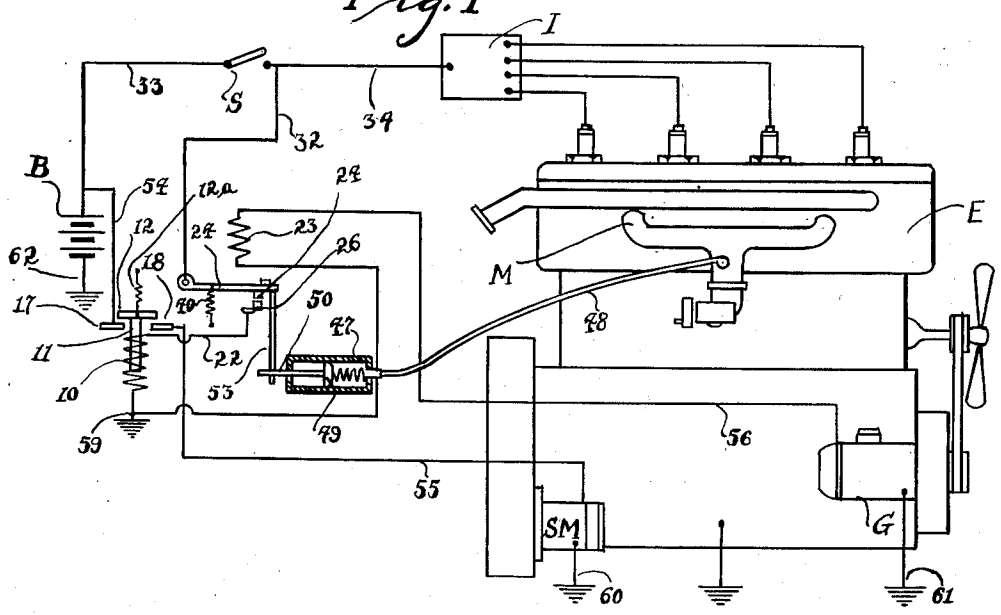
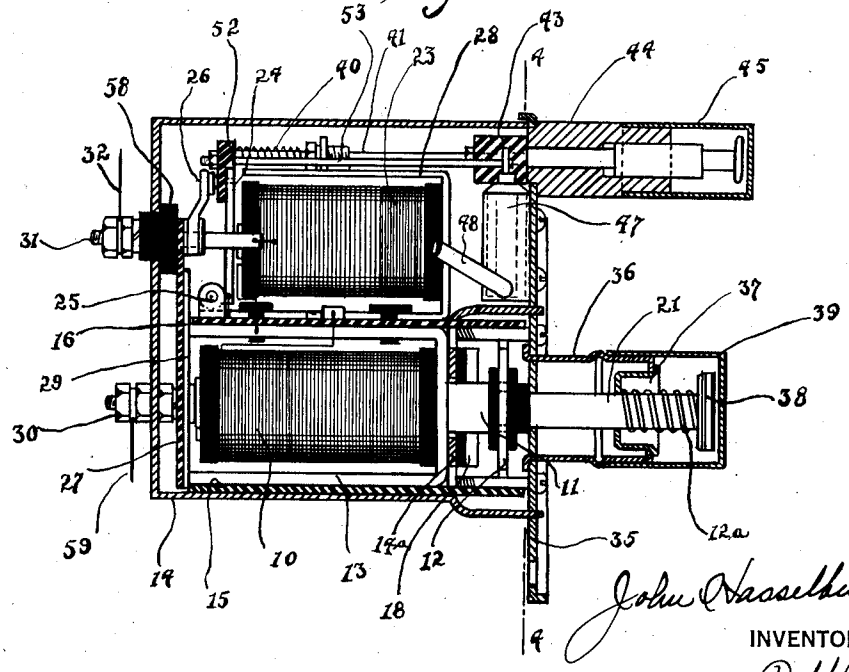


Fig. 2



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Fig. 3

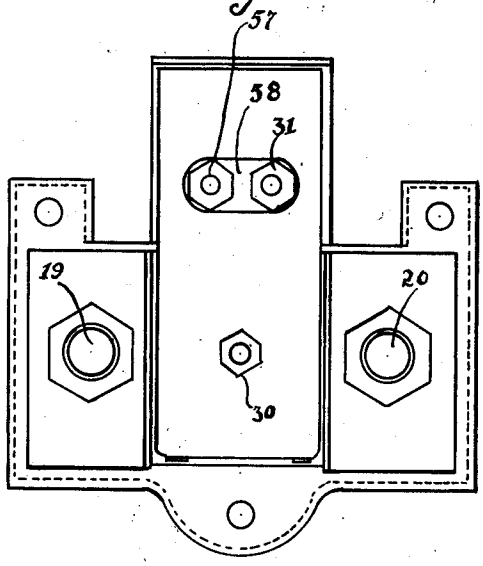


Fig. 4

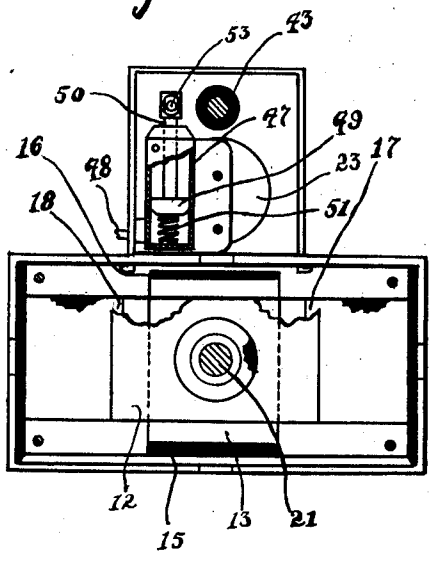
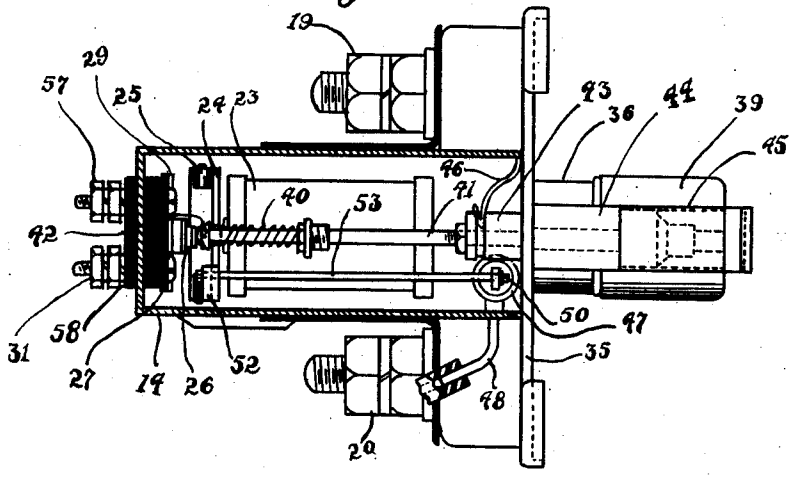


Fig. 5



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UNITED STATES PATENT OFFICE

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STARTER FOR INTERNAL-COMBUSTION ENGINES

Application filed July 15, 1927. Serial No. 205,948.

My invention relates to starters for internal combustion engines, and more particularly to a controlling mechanism by which the closing of the ignition switch will cause the application of power to the starting motor, and when the engine comes to speed under its own power, the circuit to the starting motor will be automatically interrupted, the various parts being so inter-related, however, that in the event of failure of the engine power, the circuit to the starting motor will be automatically closed to insure the immediate re-starting of the engine.

Devices having the general characteristics above referred to have been extensively manufactured and used, but, with some constructions of motors and some generators, it has been found that there is an undesirable delay in the actuation of the mechanism utilizing the generator circuit for interrupting the circuit to the motor, due to an improper functioning of the generator, particularly in old cars.

To correct the above condition, I have provided a starter in which the means controlling the application of power to the starting motor, which means is a magnetic switch in circuit with the usual storage battery, may be made inoperative as a result of the opening of a switch actuated by either a magnet included in the generator circuit, or by a solely mechanical device actuated by a suction device connected with the intake manifold of the engine, or by a conjoint action of the magnet and the suction actuated mechanism.

By thus utilizing two distinct agencies which may operate simultaneously or independently one of the other, applicant has found in actual practice that he secures a reliability in the action of the device which extends its field of use to types of motors and generators with which the purely electrical starting device could not be commercially used because of extraordinary service demands which were almost invariably found to be the result of generator conditions and not of conditions in the starter itself.

The suction actuated mechanical means acts directly upon the movable contact of the magnetic switch, the magnet of which is in circuit with the generator, and except with a complete failure of the generator, will merely aid the magnet in affecting the interruption of the circuit or be aided by the magnet since the action of the magnet and the suction device are interdependent to the extent that each will function more readily as the result of the action of the other.

While starters embodying the invention are particularly designed to meet conditions due to a failure or partial failure of the generator, the device nevertheless will function as well with a generator which is delivering the proper E. M. F., and thus is adapted for use with various grades of cars without regard to the generator conditions in the car.

It will be readily understood that the conditions, to meet which I have provided the starter herein described, are extraordinary conditions and may be only temporary, but where a device of this kind is used, the operator relies upon the device, and the construction described affords a safeguard which ensure reliability as to the re-starting of the engine so that even a temporary failure of the generator to supply sufficient E. M. F. to actuate the magnet of the generator switch, will not result in a hazard due to the stalling of the engine.

The construction and arrangement of parts is such as to permit adjustment of the mechanical suction actuated means in relation to the magnet armature, carrying the movable contact of the switch, to ensure the proper movement of the armature under the control of this mechanism, and to facilitate the assembly of the device, and the mode of connecting the device with the armature is such as to prevent short-circuiting through said mechanisms.

The device embodying the invention is so constructed that the usual emergency devices, permitting the manual closing of the circuit from the battery to the starting motor, and the opening of the circuit to the magnet controlling the movable contact of said switch, in the event of a complete failure of the generator and of the suction actuated mechanism, may be used. Where the suction actuated mechanism is used, the likelihood of the neces-

sity for the use of this last named control is reduced to a minimum. It is desirable, however, to include this feature in the device.

The invention consists primarily in a starter for internal combustion engines, of the class in which power from an electric source is temporarily applied by an electric motor to an engine having an ignition system drawing its supply from said source, and a generator is driven from said engine, a normally open primary magnetic switch having a movable contact controlling a circuit from said source to said starting motor, and a winding, a secondary magnetic switch having a movable contact controlling a circuit from said source of the winding of said primary magnetic switch, and a winding in a closed circuit with said generator, a suction device operatively connected with said engine intake, mechanical connections between same and the movable contact of said secondary switch, and a manually operative switch in circuit with said source of power, with said ignition system and through the contacts of said secondary magnetic switch with the winding of said primary magnetic switch; and in such other novel features of construction and combination of parts as are hereinafter set forth and described, and more particularly pointed out in the claims hereto appended.

Referring to the drawings,

Fig. 1 is a diagrammatic showing of the application of a starter embodying the invention to an internal combustion engine;

Fig. 2 is a section through said starter;

Fig. 3 is an end view from the left of Fig. 2;

Fig. 4 is a section on the line 4—4 of Fig. 2; and

Fig. 5 is a view from the top of Fig. 2 with the top of the casing broken away.

Like numerals refer to like parts throughout the several views.

In the accompanying drawings, an ordinary internal combustion engine is shown, conventionally, at E, this engine having associated therewith, in the usual relation, a generator G and a starting motor SM. The engine manifold is shown at M and the ignition system at I. The construction and arrangement of the foregoing parts is immaterial to the invention which relates solely to a control device associated with these mechanism, which device is manufactured as a separate article of commerce for installation with such engines.

The device proper comprises what I have termed a primary magnetic switch, the contacts of which serve merely to control the circuit from a source of electrical energy, a secondary battery B, to the starting motor SM.

This primary magnetic switch comprises a solenoid consisting of a winding 10 and a movable core 11 supporting a movable bridge contact member 12 which is insulated from the core in the manner shown, or in any other desired manner. The spool of the winding is supported from a metallic yoke 13 within a metallic case 14, being insulated therefrom by strips 15 and 16 of vulcanite, fiber or any other suitable insulating material. Supported from a metallic plate 14^a are spaced fixed contacts 17 and 18, these contacts being insulated from the plate 14^a in any suitable manner and being spaced apart sufficiently to afford clearance for the movable core 11 of the solenoid. One of the contacts 17 is in electrical connection with a binding post 19, and the other contact 18 is in electrical connection with a binding post 20, the former of said binding posts being in direct electrical connection with a battery B, and the latter in direct electrical connection with the motor SM.

Acting upon the movable contact member 12 is a spring 12^a surrounding a stem 21 carried by the core 11 and insulated from the contact 12, this spring having a normal tendency to hold said contact 12 out of engagement with the contacts 17 and 18 so that the primary magnetic switch is a normally open switch.

The winding 10 of the magnetic switch is in electrical connection through the lead 22 with the battery B through the contacts of a secondary magnetic switch consisting of an ordinary spool magnet 23 having an armature 24 pivoted at 25, which armature co-operates with a fixed contact 26 carried by an insulating strip 27 and passing through and insulated from the case 14. The magnet 23 is supported from a metallic yoke 28 which in turn is supported from the plate 16 of insulating material.

Carried by the strip 27 of insulating material is a reinforcing metallic plate 29 in electrical connection with the yoke 13, said plate being in electrical connection with a binding post 30 forming the ground connection for the solenoid winding 10 and the magnet 23.

The fixed contact 26 is in electrical connection with a binding post 31 which is insulated from the casing 14 and is in electrical connection through the lead 32 with a manually operated switch S. Said switch S, the manually operative ignition switch, is in electrical connection with the battery B through the lead 33 and with the ignition system I through the lead 34. By this arrangement the circuit from the battery B to the winding 10 can be closed only simultaneously with the closing of the circuit to the ignition system I, and by reason of there being included in the circuit between this switch and said winding, the contacts 24 and 26 of the secondary magnetic switch, the circuit to said winding 10 may be opened without disturbing the circuit to the ignition system. At the same time irrespective of the other mechanisms of the device, the circuit to the magnet 10 cannot be closed if the switch S is open.

The top of the casing 14 is closed by a top plate 35 carrying a nipple 36 encircling the stem 21 of the core 11 and supporting a cupped spring seat 37 for the spring 12a. Said stem 21 is provided with a button 38 by which the contact 12 may be manually operated in the event that the automatic features of the device should become inoperative. The top of the nipple is closed by a slip cap 39.

The movable contact 24 of the secondary magnetic switch, is acted upon by a spring 40 having a normal tendency to engage said contact with the fixed contact 26 so that when the magnet 23 is de-energized, the contacts 24 and 26 will close the circuit to the winding 10 of the primary magnetic switch, and when energized, the magnet 23 will open this circuit. The spring 40 encircles a rod 41, one end of the spring engaging a seat upon this rod, and the other end of this spring engaging the contact 24. The end of the rod 41 passes through an opening in said contact and is enlarged at 42 so that the rod may be used to hold the contact 24 out of engagement with the contact 26, the enlarged head 42 being so spaced from the contact as to prevent interference with its movements under normal working conditions.

The rod 41 has in the length thereof an insulating portion 43 to prevent grounding of the circuit to the winding 10 through this rod and the casing 14, and the end of the rod projects beyond the top 35 and through a bearing 44 carried thereby, so as to permit the manual movement of the rod if it be desired to permanently separate said contacts 24—26. The exposed end of the rod is a protecting slip cap 45.

The insulated portion 43 of the rod 41 is provided with a peripheral recess adapted to be engaged by a latch spring 46 to hold the rod in position with the contacts 24 and 26 separated in the manner above referred to.

With the conditions heretofore described, the closing of the switch S will, when the device is functioning under normal conditions, close the circuit from the battery B to the winding 10 of the primary magnetic switch, and when the winding of the secondary magnetic switch 23 is energized by the generator, this circuit will be interrupted by the movement of the armature contact 24, but as stated above, in the event of the improper functioning of the generator, particularly at lower engine speeds, the magnet 23 may not be energized with sufficient rapidity, and thus continued powed would be applied to the motor SM after the engine is operating under its own power. Furthermore, with the slowing down of the engine the magnet 23 may be prematurely de-energized with the possibility of the clashing of gears resulting from the untimely application of power to the starting motor.

In view of the lack of mechanical skill of a very high percentage of operators of automobiles, the above conditions, however infrequently they may occur, are a source of considerable trouble and may develop at any time in almost any automobile.

To avoid this condition, I provide a suction device operatively connected with the engine manifold M and provide mechanical connections between this device and the movable contact 24.

This suction device comprises a small cylinder 47, the axis of which is at right angles to that of the pivot 25. One end of this cylinder communicates, by means of tubing 48, with the intake manifold M of the engine E, and has the usual vent opening toward the opposite end thereof.

Within the cylinder 47 is a piston 49 having a stem 50. Acting against the end of said piston toward the point of connection of the cylinder 47 with the manifold M is a restoring spring 51 which, as will more fully appear hereinafter, will co-act with the spring 40 in engaging the contact 24 with the contact 26.

Adjacent the free end of the contact 24 is a block 52 of insulating material, secured to which is a stem 53 passing through an opening in the piston stem 50, as shown more particularly in Fig. 4 of the drawings. This construction is adopted merely because it affords a simple flexible connection between the parts 53 and 50 which permits swinging movement of said stem 53 with reciprocatory movement of the piston stem 50. By thus utilizing mechanical means operated by the suction in the manifold M for oscillating the contact armature 24 in connection with the magnet 23, I effectively guard against the circuit being or remaining closed through the contacts 24 and 26, due to a failure, or partial failure, of the generator G.

Referring more particularly to Fig. 1 of the drawings, the lead between the battery B and the binding post 19 is shown at 54, and the lead between the binding post 20 and the starting motor is shown at 55.

The winding of the magnet 23 is connected with the generator by the line 56, the connection at the controller being through the binding post 57.

Both of the binding posts 31 and 57 are carried by an insulating block 58 set in the bottom of the casing 14.

The common ground connection for the winding 10 of the primary magnet and the winding of the secondary magnet 23 is shown at 59, and the ground connections for the starting motor SM and the generator G and the battery B are shown respectively at 60, 61 and 62.

The operation of the herein described starter is substantially as follows:—

When an engine is at rest, the switch S is

open, and the magnets of the primary and secondary magnetic switches are de-energized. When in this condition, the bridge contact 12 is held by the spring 12ª out of engagement with the spaced contacts 17 and 18, and the movable contact 24 will be engaged with the contact 26, the primary magnetic switch being normally open and the secondary magnetic switch being normally closed. There being no suction in the manifold M, the spring 51 will so position the piston 49 that the stem 53 will place no restraint upon the action of the spring 40 in engaging the contact 24 with the contact 26, in fact, said springs 51 and 40 assisting each other in so positioning the contacts.

From the foregoing it will be noted that to cause the application of power to the starting motor SM, it is merely required to close the switch S by hand, the closing of this switch not only closing the circuit to the winding 10 of the primary magnetic switch, but the circuit to the ignition system I also. When the switch S is once closed, the latter circuit remains closed so long as the engine is running, and the former circuit is in a condition to be closed through the contacts 24 and 26 at any time when the working conditions in the engine require the application of power to the starting motor.

The traction of the magnet of the primary magnetic switch will impart movement to its core 11 in a manner to engage the bridge contact 12 with the spaced contacts 17 and 18 and thus close the circuit direct from the battery B to the starting motor SM and cause the application of power to the motor M through the usual mechanisms connecting the motor SM with the shaft of the engine E, thus turning the engine over in a manner to cause the introduction of an explosive mixture to the cylinders and the ignition of such mixture, in the usual manner.

If the generator G is functioning properly the normal tendency to race an engine when starting it, will result in a quick energizing of the magnet of the secondary magnetic switch by the flow of the generator current through the windings 23 thereof, the traction of this magnet moving its pivoted contact armature 24 in a manner to disengage it from the fixed contact 26 and thus interrupt the circuit to the winding 10 of the primary magnetic switch. The de-energizing of this magnet will permit the spring 12ª to disengage the contact 12 from the contacts 17 and 18 and thus interrupt the circuit to the starting motor SM. The magnet of the secondary magnetic switch, under normal working conditions, will remain energized so long as the engine is operating at a speed to cause the generator to supply current sufficient to energize the magnet of this switch, and this condition exists even when the engine is running at idling speed.

When the engine speed falls below that necessary to cause the generation of sufficient current to energize the magnet of the secondary magnetic switch, or when the engine stops, the circuit from the battery B to the winding 10 will be immediately closed, so long as the switch S is closed, by the re-engagement of the contacts 24 and 26. This same condition results if there is a failure or partial failure of the generator.

If the stoppage of the engine results from the opening of the switch S, the engine will remain dead. If such stoppage results from any other condition the circuit from the battery B to the motor SM will be closed through the contacts 12, 17 and 18 so as to cause the immediate application of the power of said motor to the engine to cause a re-starting thereof.

While with devices of this kind the convenience of applying the power to the starting motor to the engine by a mere closing of the switch S is an important factor, the main advantage of the use of a device of this kind is the feature of the immediate re-starting in the event of stalling of the engine, without any action of the device.

The above characteristics and the mode of operation of the device are well known, many thousands of such devices now being in use throughout the United States and other countries.

The present invention has to do with the inclusion in the old form of device of the suction actuating means supplementing the action of the magnet of the secondary magnetic switch for preventing the closing of the circuit to the magnet of the primary magnetic switch in the event of a partial or complete failure of the generator and still secure the same mode of operation as is above described.

The operative effect of this mechanism will now be described.

When power is applied to the engine E by the starting motor SM, the sub-atmospheric pressure within the manifold M will evacuate air from the cylinder 47 and thus cause the atmospheric pressure upon one side of the piston 49 to move this piston inwardly of the cylinder 47 against the tension of the spring 50. The movement of the stem 50 of the piston will, through the rod 53, tend to impart oscillatory movement to the armature contact 24. If the generator is functioning properly the speed of movement of this armature will probably be so great as to complete the opening movement of the contacts 24 and 26 without assistance from the piston. If, however, there should be any lag in the movements of the contact 24, the movement of the piston 49 will assist in such movement and thus relieve the magnet to an extent to ensure a quick action of the contact. On the other hand, if there should be a complete failure of the magnet, the piston 49 will itself

complete the opening movement of the contacts 24—26. It has been found in actual practice, that the effective sub-atmospheric pressure in the manifold M, when the motor SM is running, measures about 9 inches upon a vacuum tube, and when an engine is running at speed this sub-atmospheric pressure increases to 25 inches and remains fairly constant. Of course with the 9 inches of sub-atmospheric pressure action of the piston will not move the contact 24, but with a greater number of inches of sub-atmospheric pressure, the action of the piston will be both positive and rapid. If a choke be used when starting the engine, and ordinarily this is only done when an engine is cold, the effective sub-atmospheric pressure in the manifold will be increased and ensure a more positive action and a more rapid action of the piston 49.

While an engine is running, if there should be a failure of the generator, the action of the piston 49 will prevent the application of power to the motor SM by the maintenance of an open circuit at the contacts 24 and 26. If there should be a material reduction of the engine speed or a complete stoppage thereof other than by the opening of the circuit at the switch S, the spring 51 will not only move the piston 49 outwardly of the cylinder 47 preparatory to the next actuation of the piston, but will cause the application of any power in excess of that required to move the piston, to the rod 53 and thus assist the spring 40 in imparting movement to the contact 24 to engage it with the contact 26.

By employing the double control for the contact 24 herein referred to, an effective safeguard is afforded against a partial or complete failure of the generator, and at the same time the two controls are so co-ordinated that each will assist the other even though the generator be functioning properly.

By using an elongated opening in the stem 50 through which the rod 53 passes, not only is a flexible coupling between these parts secured, but the rod 53 may have movement with the armature contact 24 under the control of the magnet of the secondary magnetic switch to a limited extent and thus relieve the piston 49 from the starting load of this armature. In fact when a generator is functioning properly the piston 49 may actually receive movement inwardly of the cylinder 47 by the thrust of the rod 53.

It will be noted that the springs 40 and 51 always assist each other in closing the contacts 24 and 26, and that the action of the piston always assists in the action of the magnet of the secondary magnetic switch. While the spring 51 may resist the movement of the armature 24 under magnetic traction, this resistance, as well as that of the spring 40, will be compensated for by the effective sub-atmospheric pressure within the cylinder 47.

It is not my intention to claim broadly the construction and arrangement of the electrical features of the device, the invention residing in the combination with these magnetic controls of the mechanical means utilizing sub-atmospheric pressure developed by the actuation of the engine and so co-ordinated with these electrical controls, as to ensure greater reliability in their functioning, the actuation of the device in the event of a partial or complete failure of the generator to supply the necessary current to prevent the closing of the primary magnetic switch while an engine is operating, and the interruption of the circuit between the starting motor whenever the engine is operating under its own power.

It is not my intention to limit the invention to the precise details of construction and combination of parts shown in the accompanying drawings, it being apparent that such may be varied without departing from the spirit and scope of the invention.

Having described the invention, what I claim as new and desire to have protected by Letters Patent, is:—

1. In a starter for internal combustion engines, of the class in which power from an electric source is temporarily applied by an electric starting motor to an engine having an ignition system and an intake, a generator is driven from said engine and independent circuits connect said source with said ignition system and said starting motor respectively, a normallly open primary magnetic switch having a movable contact controlling the circuit from said source to said starting motor, and a winding, a secondary magnetic switch having a movable contact controlling the circuit from said source to the winding of said magnetic switch, and a winding in the closed circuit from said generator, a suction device operatively connected with said engine intake, mechanical connections between same and the movable contact of said secondary switch, and a manually operative switch in the circuits to the ignition system of said engine, and through the contacts of said secondary magnetic switch to the winding of said magnetic switch.

2. In a starter for internal combusion engines, of the class in which power from an electric source is temporarily applied by an electric starting motor to an engine having an ignition system and an intake, a generator is driven from said engine and independent circuits connect said source with said igntion system and said starting motor respectively, a normally open primary magnetic switch having a movable contact controlling the circuit from said source to said starting motor, and a winding, a secondary margnetic switch having a movable contact controlling the circuit from said source to the winding of said magnetic switch, and a winding in the closed cir-

cuit from said generator, a spring acting upon the movable contact of said secondary magnetic switch having a normal tendency to close said switch, a suction device operatively connected with said engine intake, mechanical conections between same and the movable contact of said secondary switch, a spring having a normal tendency to restore said suction device to normal position and actuate said mechanical connections in a manner to assist said first named spring in the movement of the movable contact of said secondary magnetic switch, and a manually operative switch in the circuit to the ignition system of said engine, and through the contacts of said secondary magnetic switch to the winding of said magnetic switch.

3. In a starter for internal combustion engines, of the class in which power from an electric source is temporarily applied by an electric starting motor to an engine having an ignition system and an intake, a generator is driven from said engine and independent circuits connect said source with said ignition system and said starting motor respectively, a normally open primary magnetic switch having a movable contact controlling the circuit from said source to said starting motor, and a winding, a secondary magnetic switch having a pivotal contact and a fixed contact controlling the circuit from said source to the winding of said primary magnetic switch, and a winding in the closed circuit from said generator, a suction device operatively connected with said engine intake, a stem carried by and insulated from said pivotal contact and operatively connected with said suction device, and a manually operative switch in the circuits to said ignition system, and through the contacts of said secondary magnetic switch to the winding of said primary magnetic switch.

4. In a starter for internal combustion engines, of the class in which power from an electric source is temporarily applied by an electric starting motor to an engine having an ignition system and an intake, a generator is driven from said engine and independent circuits connect said source with said ignition system and said starting motor respectively, a normally open primary magnetic switch having a movable contact controlling the circuit from said source to said starting motor, and a winding, a secondary magnetic switch having a pivotal contact and a fixed contact controlling the circuit from said source to the winding of said primary magnetic switch, and a winding in the closed circuit from said generator, a spring acting upon said pivotal contact having a normal tendency to close said secondary magnetic switch, a suction device operatively connected with said engine intake, a stem carried by and insulated from said pivotal contact and operatively connected with said suction device, a spring having a normal tendency to restore said suction device to normal position and act upon said stem in a manner to assist said first named spring in the movement of said pivotal contact, and a manually operative switch in the circuits to said ignition system, and through the contacts of said secondary magnetic switch to the winding of said primary magnetic switch.

5. In a starter for internal combustion engines, of the class in which power from an electric source is temporarily applied by an electric starting motor to an engine having an ignition system and an intake, a generator is driven from said engine and independent circuits connect said source with said ignition system and said starting motor respectively, a normally open primary magnetic switch having a movable contact controlling the circuit from said source to said starting motor, and a winding, a secondary magnetic switch having a pivotal contact and a fixed contact controlling the circuit from said source to the winding of said primary magnetic switch, and a winding in the closed circuit from said generator, a cylinder, flexible connections between same and said engine intake, a piston in said cylinder, a stem carried by and insulated from said pivotal contact and operatively connected with said piston, and a manually operative switch in the circuits to said ignition system and through the contacts of said secondary magnetic switch to the winding of said primary magnetic switch.

6. In a starter for internal combustion engines, of the class in which power from an electric source is temporarily applied by an electric starting motor to an engine having an ignition system and an intake, a generator is driven from said engine and independent circuits connect said source with said ignition system and said starting motor respectively, a normally open primary magnetic switch having a movable contact controlling the circuit from said source to said starting motor, and a winding, a secondary magnetic switch having a pivotal contact and a fixed contact controlling the circuit from said source to the winding of said primary magnetic switch, and a winding in the closed circuit from said generator, a spring acting upon said pivotal contact having a normal tendency to close said secondary magnetic switch, a cylinder, flexible connections between same and said engine intake, a piston in said cylinder, a stem carried by and insulated from said pivotal contact and operatively connected with said piston, a spring having a normal tendency to restore said piston to normal position and act upon said stem in a manner to assist said first named spring in the movement of said pivotal contact, and a manually operative switch in the circuits to said ignition system, and through the contacts of

said secondary magnetic switch to the winding of said primary magnetic switch.

7. In a starter for internal combustion engines, of the class in which power from an electric source is temporarily applied by an electric starting motor to an engine having an ignition system and an intake, a generator is driven from said engine and independent circuits connect said source with said ignition system and said starting motor respectively, a normally open primary magnetic switch having a movable contact controlling the circuit from said source to said starting motor, and a winding, a secondary magnetic switch having a pivotal contact and a fixed contact controlling the circuit from said source to the winding of said primary magnetic switch, and a winding in the closed circuit from said generator, a spring acting upon said pivotal contact having a normal tendency to close said secondary magnetic switch, a cylinder, flexible connections between same and said engine intake, a piston in said cylinder, a stem carried by and insulated from said pivotal contact and operatively connected with said piston, a spring having a normal tendency to restore said piston to normal position and act upon said stem in a manner to assist said first named spring in the movement of said pivotal contact, a reciprocatory stem operative upon said pivotal contact, means whereby said reciprocatory stem may be so positioned as to hold said pivotal contact out of engagement with said fixed contact, and a manually operative switch in the circuits to said ignition system, and through the contacts of said secondary magnetic switch to the winding of said primary magnetic switch.

8. In a starter for internal combustion engines, of the class in which power from an electric source is temporarily applied by an electric starting motor to an engine having an ignition system and an intake, a generator is driven from said engine and independent circuits connect said source with said ignition system and said starting motor respectively, a normally open primary magnetic switch having a movable contact controlling the circuit from said source to said starting motor, and a winding, an exposed stem carried by the movable contact of said primary magnetic switch whereby the circuit controlled thereby may be manually closed, a secondary magnetic switch having a pivotal contact and a fixed contact controlling the circuit from said source to the winding of said primary magnetic switch, and a winding in the closed circuit from said generator, a spring acting upon said pivotal contact having a normal tendency to close said secondary magnetic switch, a cylinder, flexible connections between same and said engine intake, a piston in said cylinder, a stem carried by and insulated from said pivotal contact and operatively connected with said piston, a spring having a normal tendency to restore said piston to normal position and act upon said stem in a manner to assist said first named spring in the movement of said pivotal contact, and a manually operative switch in the circuits to said ignition system, and through the contacts of said secondary magnetic switch to the winding of said primary magnetic switch.

9. In a starter for internal combustion engines, of the class in which power from an electric source is temporarily applied by an electric starting motor to an engine having an ignition system and an intake, a generator is driven from said engine and independent circuits connect said source with said ignition system and said starting motor respectively, a normally open primary magnetic switch having a movable contact controlling the circuit from said source to said starting motor, and a winding, an exposed stem carried by the movable contact of said primary magnetic switch, whereby the circuit controlled thereby may be manually closed, a secondary magnetic switch having a pivotal contact and a fixed contact controlling the circuit from said source to the winding of said primary magnetic switch, and a winding in the closed circuit from said generator, a spring acting upon said pivotal contact having a normal tendency to close said secondary magnetic switch, a cylinder, flexible connections between same and said engine intake, a piston in said cylinder, a stem carried by and insulated from said pivotal contact and operatively connected with said piston, a spring having a normal tendency to restore said piston to normal position and act upon said stem in a manner to assist said first named spring in the movement of said pivotal contact, a reciprocatory stem operative upon said pivotal contact, means whereby said reciprocatory stem may be so positioned as to hold said pivotal contact out of engagement with said fixed contact, and a manually operative switch in the circuits to said ignition system, and through the contacts of said secondary magnetic switch to the winding of said primary magnetic switch.

In witness whereof I have hereunto affixed my signature, this 8th day of July, 1927.

JOHN HASSELBRING, JR