

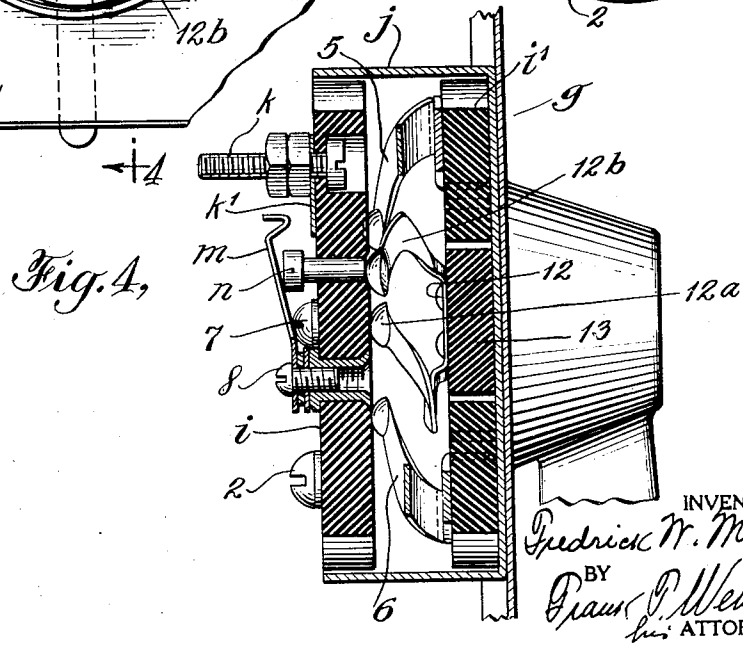
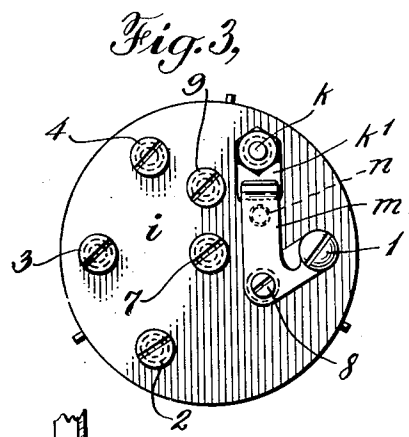
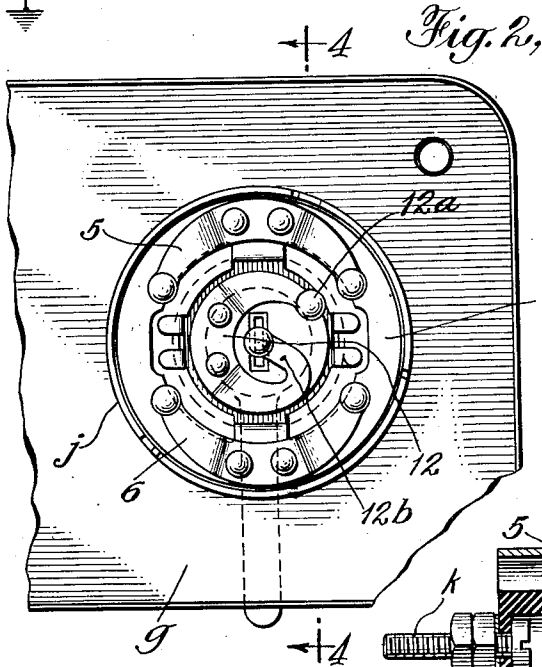
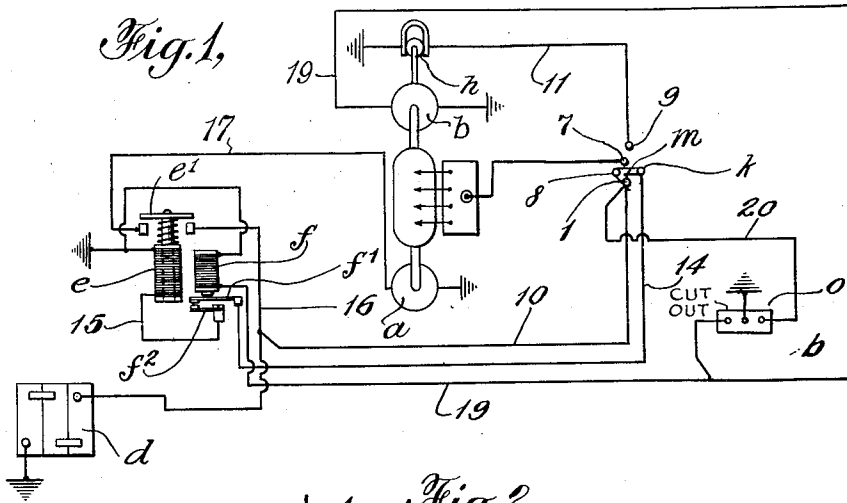
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F. W. MABY

STARTER FOR INTERNAL COMBUSTION ENGINES

Filed April 23, 1925



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# UNITED STATES PATENT OFFICE.

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## STARTER FOR INTERNAL-COMBUSTION ENGINES.

Application filed April 23, 1925. Serial No. 25,197.

My invention relates to starters for internal combustion engines, and more particularly to a construction of starter the functioning of which is controlled by the switch in the circuit to the ignition system of the engine.

In automobiles now commonly used, the starting motor and the ignition system for the engine, either receive their power from a storage battery, or while the starting motor receives its power from the storage battery only, the ignition system for the engine may receive its power either from this storage battery or from a magneto driven by the engine.

My invention relates to a starter containing mechanisms so combined and operating that power will be applied to the starting motor as a result of the closing of the circuit to the ignition system of the engine, the circuit to said starting motor being automatically interrupted by a magnetic switch mechanism energized by a current from a generator operated by the engine to cause the interruption of the circuit to the starting motor and keep this circuit open until the speed of the engine is so reduced or the engine has stopped, whereupon the circuit to the starting motor will be automatically reclosed, thus applying the power of the starting motor thereto and preventing the stalling of the engine.

This functioning of the starter above described is assured because the starting motor circuit is opened or closed primarily by the same switch controlling the circuit to the ignition system of the engine, thus co-ordinating the starting mechanism with the engine ignition so that power cannot be applied to the starting motor unless the ignition system is functioning, and the ignition system will and must be operative when the starter functions automatically, to prevent the stalling of the engine in the manner above described.

The above described starter is broadly considered not my invention, my invention relating more particularly to a mechanism by which a starter of the type described, may be used in conjunction with an internal combustion engine, the ignition system of which receives power either from a storage battery, or from a magneto, as determined by the setting of a switch so constructed that the starting motor may be placed in

circuit with the battery and prevent the stalling of the engine in the manner above described, notwithstanding that the ignition system of the engine at the time is receiving power from a magneto. The construction is such that the working conditions throughout the starter will be the same whether the ignition system is receiving power from the storage battery or from the magneto, and that when the switch is used to disconnect the ignition system from both the storage battery and the magneto, the circuit from the storage battery to the starting motor will be opened simultaneously with the opening of the ignition circuit.

The controlling devices of the starter may be used in conjunction with various types of starting motors and means for coupling same to the engine, commonly known as starting systems, requiring merely a proper change in the wiring of said systems in connection with said devices. My improvement in the starter of the said type is merely to facilitate the installation of such starters in connection with engines the ignition systems of which may be used with a storage battery or with a magneto, while permitting the utilization of the same switch mechanism controlling the circuits to the ignition system in the usual manner but so modified as to make the battery circuit available as a source of power for the starting motor whether the ignition be functioning upon the battery circuit or upon the magneto circuit.

The invention consists primarily in a starting device for internal combustion engines embodying therein the combination with a motor adapted to be operatively connected with an engine shaft, a generator driven from the engine, an electric battery, a magnetic switch controlling the circuit from said battery to said motor, and a second magnetic switch in circuit with said generator and controlling the circuit from said battery to said first named magnetic switch, whereby when the engine is operating under its own power, the circuit to said motor will be opened, of a manually operative switch having a fixed contact, a binding post in electrical connection therewith, electrical connections between said contact, said binding post and said battery, a fixed contact adapted to be electrically connected with a magneto driven from the engine, a movable switch member electrically con-

nected with the engine ignition system and adapted to be selectively engaged with either of said fixed contacts, and electrical connections between said binding post and said second magnetic switch whereby said manually operative switch may be actuated to close the circuit from said battery to the ignition system and simultaneously cause the closing of the circuit to said motor, or to close the circuit from the magneto to the ignition system while still permitting the closing of the circuit from said battery to said motor; 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 electrical conditions in a starter embodying my invention;

Fig. 2 is a plan view of the movable contacts of the manually operative switch mechanism;

Fig. 3 is a plan view of the insulating plate carrying the fixed contacts of said switch mechanism and illustrating the construction by which the ignition system may be operated upon the magneto; and

Fig. 4 is a section on the line 4—4 of Fig. 2 upon an enlarged scale, and including a fragmentary portion of the movable contact controlling the circuits to the ignition system.

Like letters refer to like parts throughout the several views.

In the embodiment of the invention shown in the drawings, the starter includes a motor *a* adapted to be connected in any desired manner with the shaft of an internal combustion engine for applying starting power thereto, a generator *b* such as is commonly used in connection with internal combustion engine starting engines; an ignition system *c* for the engine; and a source of electrical energy such as an ordinary secondary battery *d*. The battery is usable for simultaneously supplying current to the ignition system *c* and the motor *a* when starting an engine. The generator *b* is used for recharging the battery *d*, and also for controlling one of a pair of magnetic switches by which the circuit from the battery *d* to the motor *a* is automatically controlled.

The battery *d* is placed in circuit with the motor *a* by means of a magnetic switch *e*, the magnet controlling the armature of which may also be placed in circuit with said battery by means of a second magnetic switch *f*, the magnet of which is in circuit with the generator *b*.

The construction of these magnets is such that when the generator is inoperative, the magnetic switch *f* is so set as to close the circuit from the battery *d* to the magnet of

the switch *e*, this circuit, however, having arranged therein, a manually operative switch *g* by which the application of power to the motor *a* and to the ignition system *c* is simultaneously controlled. The circuit to the magnetic switch *f* and the contacts forming a part of said switch and included in the circuit to the switch *e* are normally closed, and the circuit from the battery *d* to the motor *a* is normally open, while the manually operative, or ignition switch, is opened.

By the above construction, the circuit to the motor *a* can be closed only at a time while the circuit to the ignition system from said battery *d* is also closed, and the second magnetic switch, when the engine is operating under its own power, will cause the automatic opening of the circuit from said battery to said starting motor without, however, interrupting the circuit from said battery to the ignition system.

This general construction and arrangement of parts broadly is not my invention, the magnetic control mechanisms being now manufactured for installation in connection with old and well known forms of starting motors to vary the functioning of said starters to conform to the conditions above referred to.

The manually operative switch *g* may also be used to connect the ignition system *c* with a magneto *h*.

It has been found in actual practice that complicated wiring arrangements are required in installing a starting device having the above characteristics in a vehicle in which the ignition system for the engine may be connected, either with the storage battery *d* or with the magneto *h*. Special controls for the starter circuit are required when the ignition system is run from the magneto, which has made the use of the starter impracticable with a certain well known automobile made in very large numbers.

The construction illustrated in the accompanying drawings includes a combination with this well known form of starter, of a special construction of switch mechanism which will obviate this difficulty and permit the ignition system *c* to be operated either from the storage battery *d* or the magneto *h*, without, in any way modifying the automatic functioning of the magnetic controls for the starter.

The manually operative switch mechanism *g* is, as to its general construction and arrangement of parts, old and well known and extensively used. It contains two sets of fixed contacts supported by a plate of insulation material and two sets of movable contacts co-operating with said sets of fixed contacts respectively, one set of movable contacts being key-controlled and the other

set being lever-controlled. The key-controlled set of movable contacts controls the circuit to the ignition system of the engine and may be so set as to place this system in circuit either with the battery *d* or the magneto *h*, or may be set in a neutral position to interrupt both circuits to the ignition system. The other set of movable contacts is used exclusively for supplying current from the battery *d* to the lighting system of an automobile, and is shown in the accompanying drawings merely because both sets of contacts are connected with the battery *d* through a single fixed contact, which contact is also utilized in the embodiment of the invention shown for closing the circuit from the battery *d* to the switch *e* by means of the magnetic switch *f*. In thus utilizing the general arrangement of contacts in this switch mechanism for completing the circuit, as described, to the magnetic switch control of the starter, I am enabled to install the controls for the starter in a machine utilizing this switch without disturbing any of the electrical conditions found in the machine, apart from those incidental to the operation of the starting mechanism itself.

The electrical connection by which the closing of the circuit from the battery *d* to the ignition system will cause the simultaneous closing of the circuit to the magnetic switch *e* while permitting the circuit from the magneto *h* to the ignition system *c* without causing the interruption of the circuit from the battery to the said magnetic switch is also so constructed that when the key-controlled set of contacts is in the neutral position, it will interrupt the circuit from the battery to the switch *e* and thus prevent the application of power to the motor *a* while the circuit to the ignition system is interrupted.

The set of contacts used in the lighting system is carried by a plate *i* of insulating material, and includes four fixed contacts with their respective binding posts, 1, 2, 3 and 4, the movable contacts co-operating therewith being in the form of resilient members 5 and 6 electrically connected together in the manner shown and carried by a movable ring *i'* of insulation. The contacts 1 to 4 extend through the plate *i* so as to be engaged by the contacts 5 and 6 in the usual manner and with the usual effect. These contacts in their functioning do not relate in any way to the starter mechanism of my invention excepting that the contact 1 is connected with the battery *d* and in addition to furnishing power for the lighting system, is also used for furnishing power to the engine ignition system and to the starting mechanism in a manner which will more fully appear hereinafter.

The set of contacts carried by the plate *i*

for the ignition system consists of a contact 7 centrally of said plate, which is circular in form, and contacts 8 and 9, the first of which is in electrical connection with the fixed contact 1, and the other of which is in electrical connection with the magneto *h*.

The conductor wires for the lighting system are not shown in the accompanying drawings, since the illustration of this system is not essential to the understanding of the present invention, the wire connecting the contact 1 with the battery *d*, however, being shown at 10 and the wire connecting the contact 9 with the magneto *h* being shown at 11.

Co-operating with the contacts 7, 8 and 9 is a movable contact 12 carried by a rotatable block of insulating material 13, said contact 12 being made of spring metal and having two spring arms, one of which, 12<sup>a</sup>, is constantly engaged with the fixed contact 7 and the other of which 12<sup>b</sup> may be selectively engaged with either of the contacts 8 or 9 by the turning of the block 13. This block is usually turned by means of a special key which prevents the unauthorized application of power to the ignition system. When the key is so positioned that it may be removed from its engagement with said block, the contact 12<sup>b</sup> will be positioned at a point substantially halfway between the fixed contacts 8 and 9, or in a neutral position. The foregoing switch construction is old and well known in this art, but description thereof is necessary to an understanding of the invention, particularly as to the means for controlling the circuit to the ignition system by which power may be furnished thereto either from the battery *d* or from the magneto *h*.

To permit power to be furnished to the starting motor *a* by a mere closing of the circuit to the engine ignition system by the manually operative switch mechanism, and at the same time prevent application of power to said motor unless the power is at the same time applied to the ignition system when starting an engine; and to permit power to be applied to said motor for restarting the engine in the event of its stalling accidentally, irrespective of whether the manually operative switch is set to supply the ignition system with current from the battery *d* or from the magneto *h*, while at the same time precluding possibility of power being supplied the motor *a* except when current from one source or the other will be supplied the ignition system, I provide the plate *i* with a binding post *k* connected by the wire 14 with the armature *f'* of the magnetic switch *f*, which armature controls the circuit to the magnet of the switch *e* through the conductor wire 15 and contact *f*<sup>2</sup>.

The binding post *k* is so mounted in said plate *i* as to be insulated from the other fixed contacts carried by said plate, and is so countersunk in the plate as to be in a position where it will not be engaged by any movable contact within the housing *j*. This binding post *k* is electrically connected with a contact *k'* exteriorly of the housing *j*, and co-operates with a spring contact *m* which is in electrical connection with both contacts 1 and 8, thus serving as an electrical conductor connecting said contacts for furnishing power to the ignition system, and causing the closing of the ignition circuit to simultaneously cause the closing of the circuit to the armature *f'*. The contact *m* has its edge formed as shown to ensure an accurate contact thereof with the contact *k'*.

Intermediate the contacts 8 and 9, and like said contacts, concentric with the contact 7, is an insulated plunger *n* mounted in the plate *i*, beneath the contact *m* and in engageable relation therewith, this contact projecting within the plate *i*, to a point where, when the movable contact 12<sup>b</sup> is in its neutral position, it will act upon said plunger *n* and therethrough force the contact *m* out of engagement with the opposed contact *k'*, and thus ensure the opening of the circuit between the battery *d* and the armature of the magnetic control switch *f*, when the circuit to the ignition system is broken.

The motor *a* is placed in electrical connection with the battery *d* by means of the contact members *e'* of the magnetic switch *e*, and the conductor wires 16 and 17.

The contact *f*<sup>2</sup> is electrically connected with the winding of said magnetic switch *e* by the conductor wire 15.

The winding of the magnetic switch *f* is connected with the generator *b* by the conductor wire 19, the motor *a*, generator *b* and ignition system *e*, and battery *d* being grounded in the usual manner as indicated in Fig. 1 of the drawings. The generator *b* may also be connected to the battery *d* by a conductor wire 20 for re-charging the battery, having in its length thereof a cutout *o*. This, however, may be omitted.

While the operation of the device will be readily understood from the foregoing description, attention is directed to the fact that the use of the contacts *k'* and *m* connected with the binding post of the fixed contacts 1 and 8, and the binding post *k*, establishes a condition wherein the controls for the motor *a* are so co-ordinated with the control for the ignition system that the manually operative ignition switch will make or break the circuit to said controls, and therethrough to the starting motor simultaneously with the making or breaking of the circuit to the ignition system, and in case of the accidental stalling of the engine, will automati-

cally cause power to be applied to the motor *a* whether the ignition system is running from the battery *d* or from the magneto *h*.

The means by which the circuit from the battery *d* to the magnetic switch controls is broken as a result of the breaking of the circuit between the ignition system and the battery or the magneto, (the plunger *n*) prevents the application of power to the motor *a* at all times when the circuit to the ignition system is interrupted.

In installing a starter in an automobile using the old construction of switch mechanism herein referred to, it is merely necessary to disconnect the wires from the various contacts carried by the plate *i* and remove said plate from the housing *j* and substitute a similar plate also carrying the binding post *k*, contacts *k'* and *m*, and plunger *n*, as herein described therefor, and make the connections in the same manner as in the old switch and with the same contacts, and connect the binding post *k* with the armature *f'* as herein described.

In the operation of the device, when it is desired to start an internal combustion engine which is at rest, it is merely necessary to shift the block 13 so as to engage the spring contact arm 12<sup>b</sup> with either the binding post 8 or the binding post 9, the spring contact arm 12<sup>a</sup> always being engaged with the contact 7. The result of this movement of the manually operative ignition switch, whether the arm 12<sup>b</sup> be engaged with the contact 8 or the contact 9, will cause a closing of the circuit from the battery *d* through the conductor 10, binding posts 1 and 8, contacts *m* and *k'*, binding post *k*, conductor wire 14, armature *f'*, contact *f*<sup>2</sup> and conductor wire 15, to the winding of the magnetic switch *e*. As this switch is energized, the contacts controlled thereby will be engaged, thus closing the circuit from the battery *d* to the motor *a*, which being coupled with the engine shaft in the usual manner, will apply power to the engine. The engine will immediately start under its own power because of the simultaneous closing of the ignition system circuit, and come to speed rapidly and cause the generator *b* to supply current sufficient to energize the coil of the magnetic switch *f* and cause movement of the armature *f'* sufficient to interrupt the circuit to the winding of the magnetic switch *e*. This permits the contacts controlled by said switch to separate, either by gravity or under the control of a spring, to interrupt the circuit to the motor *a*.

So long as the engine is permitted to run under its own power, the magnetic switch *f* will remain open, and the contacts *k'* and *m* will remain engaged so that in the event of the accidental stoppage of the engine, as a result of failure of the generator to maintain the current necessary to energize the

coil of said magnetic switch *f*, said switch will again be instantly closed to apply power to the starting motor *a* in the manner heretofore described, and thus automatically re-  
 5 start the motor. The electrical connections to the ignition system are not disturbed in any way by this accidental stalling of the engine, even though at the time the ignition system be operating from the magneto *h*.

10 In fact the construction is such that under no circumstances can the electrical conditions of the starter be disturbed by the stalling of an engine, or the driver be required to give any attention to the ignition switch.  
 15 Furthermore, the construction is such that a driver may at will, while the engine is running, use the manually operative switch to operate the ignition from either the magneto *h* or battery *d* without disturbing the  
 20 electrical conditions as to the starter.

When the manually operative switch is actuated to bring the contact 12<sup>b</sup> into its neutral position, which position is ordinarily determined by a key-controlled mechanism  
 25 for actuating this switch, said contact, by engagement with the plunger *n*, will cause the separation of the contact *m* from the contact *k'*, and thus prevent the flow of current from the battery *d* to the motor *a*.

30 In this manner, a construction is provided whereby when the engine is at rest, the circuit to the starting motor will be open, but will be automatically closed when the ignition switch is manually closed, and will be  
 35 again automatically opened when the engine is operating under its own power at a speed sufficient to cause the generation of current by the generator *b*. The various controls, however, remain in a position which will  
 40 ensure the automatic closing of the circuit to the starting motor immediately upon a failure of the generator to supply current sufficient to actuate the magnetic switch *f*, and the above conditions are true whether  
 45 the ignition switch is so set as to cause the ignition system to be in circuit with the battery *d* or the magneto *h*.

While I have referred to "stalling" of an engine, a complete stoppage is not necessarily implied, since the starting motor will have power automatically applied thereto before the engine completely stops.

It is not my intention to limit the invention to the precise details of construction 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:—

35 1. A starting device for internal combustion engines embodying therein the combination with a motor adapted to be operatively  
 40 connected with an engine shaft, a generator

driven from the engine, an electric battery, a magnetic switch controlling the circuit from said battery to said motor, and a second magnetic switch in circuit with said generator and controlling the circuit from said  
 70 battery to said first named magnetic switch, whereby when the engine is operating under its own power, the circuit to said motor will be opened, of a manually operative switch having a fixed contact, a binding post in  
 75 electrical connection therewith, electrical connections between said contact, said binding post and said battery, a fixed contact adapted to be electrically connected with a magneto driven from the engine, a movable  
 80 switch member electrically connected with the engine ignition system and adapted to be selectively engaged with either of said fixed contacts, and electrical connections between said binding post and said second  
 85 magnetic switch whereby said manually operative switch may be actuated to close the circuit from said battery to the ignition system and simultaneously cause the closing of the circuit to said motor, or to close the  
 90 circuit from the magneto to the ignition system while still permitting the closing of the circuit from said battery to said motor.

2. A starting device for internal combustion engines embodying therein the combination  
 95 with a motor adapted to be operatively connected with an engine shaft, a generator driven from the engine, an electric battery, a magnetic switch controlling the circuit from said battery to said motor, and a second  
 100 magnetic switch in circuit with said generator and controlling the circuit from said battery to said first named magnetic switch, whereby when the engine is operating under its own power, the circuit to said motor will  
 105 be opened, of a manually operative switch having a fixed contact, a binding post in electrical connection therewith, a normally closed electrical switch, one member of which is in electrical connection with said  
 110 binding post, and the other member of which is in electrical connection with said contact and said battery, a fixed contact adapted to be electrically connected with a magneto driven from the engine, a movable switch  
 115 member electrically connected with the engine ignition system and adapted to be selectively engaged with either of, or positioned intermediate, said fixed contacts, electrical connections between said binding post and  
 120 said second magnetic switch whereby said manually operative switch may be actuated to close the circuit from said battery to the ignition system and simultaneously cause the closing of the circuit to said motor, or to  
 125 close the circuit from the magneto to the ignition system while still permitting the closing of the circuit from said battery to said motor, and means operative upon said normally closed switch, and engageable by  
 130

said movable contact when positioned intermediate said fixed contacts to interrupt the circuit between said binding post and said battery.

5 3. A starting device for internal combustion engines embodying therein the combination with a motor adapted to be operatively connected with an engine shaft, a generator driven from the engine, an electric battery, 10 a magnetic switch controlling the circuit from said battery to said motor, and a second magnetic switch in circuit with said generator and controlling the circuit from said battery to said first named magnetic 15 switch, whereby when the engine is operating under its own power, the circuit to said motor will be opened, of a manually operative switch having a fixed contact, a binding post in electrical connection therewith, a 20 normally closed electrical switch comprising a fixed member in electrical connection with said binding post, and a spring member in electrical connection with said contact and said battery, a fixed contact adapted to be 25 electrically connected with a magneto driven from the engine, a movable switch member electrically connected with the engine ignition system and adapted to be selectively engaged with either of, or positioned intermediate, said fixed contacts, electrical connections between said 30 second magnetic switch whereby said manually operative switch may be actuated to close the circuit from said battery to the ignition system and simultaneously cause the closing of the circuit to said motor, or to 35 close the circuit from the magneto to the ignition system while still permitting the closing of the circuit from said battery to said motor, and a plunger of insulating material mounted to engage said spring member and be engaged by said movable contact 40 when positioned intermediate said fixed contacts to interrupt the circuit between said 45 binding post and said battery.

4. A starting device for internal combustion engines embodying therein the combination with a motor adapted to be operatively connected with an engine shaft, a generator driven from the engine, an electric battery, a magnetic switch controlling the circuit from said battery to said motor, and a second magnetic switch in circuit with said generator and controlling the circuit from said battery to said first named magnetic 50 switch, whereby when the engine is operating under its own power, the circuit to said motor will be opened, of a manually operative switch having a fixed contact, a binding 55 post in electrical connection therewith, a normally closed electrical switch comprising a fixed member in electrical connection with said binding post, and a spring member in electrical connection with said contact and said battery, a fixed contact adapted to be 60 electrically connected with a magneto driven from the engine, a movable switch member electrically connected with the engine ignition system and having a spring arm adapted to be selectively engaged with either of, 70 or positioned intermediate, said fixed contacts, electrical connections between said binding post and said second magnetic switch whereby said manually operative switch may be actuated to close the circuit 75 from said battery to the ignition system and simultaneously cause the closing of the circuit to said motor, or to close the circuit from the magneto to the ignition system while still permitting the closing of the 80 circuit from said battery to said motor, and a plunger of insulating material mounted to engage said spring member and be engaged by said spring arm when positioned intermediate said fixed contacts to interrupt the 85 circuit between said binding post and said battery.

In witness whereof I have hereunto affixed my signature this 15th day of April 1925.

FREDRICK W. MABY.