

Oct. 6, 1936.

C. F. WARNER

2,056,699

ELECTRICAL CONTROLLING APPARATUS

Filed Aug. 28, 1934

2 Sheets-Sheet 1

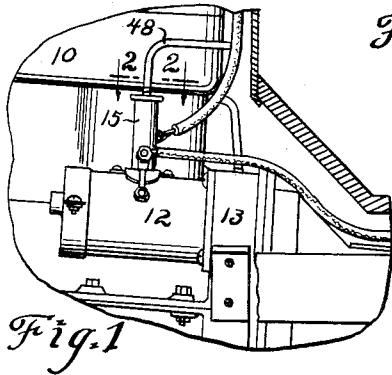


Fig. 1

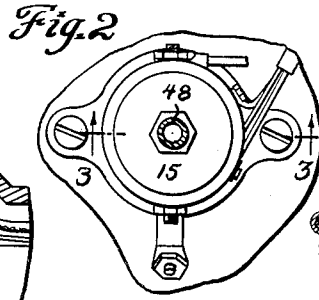


Fig. 2

Fig. 4

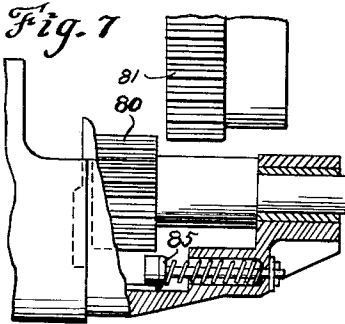


Fig. 7

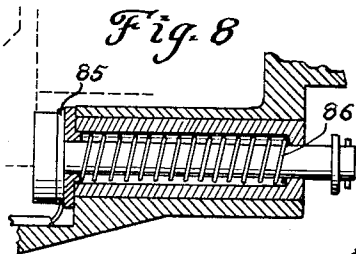


Fig. 8

Fig. 5

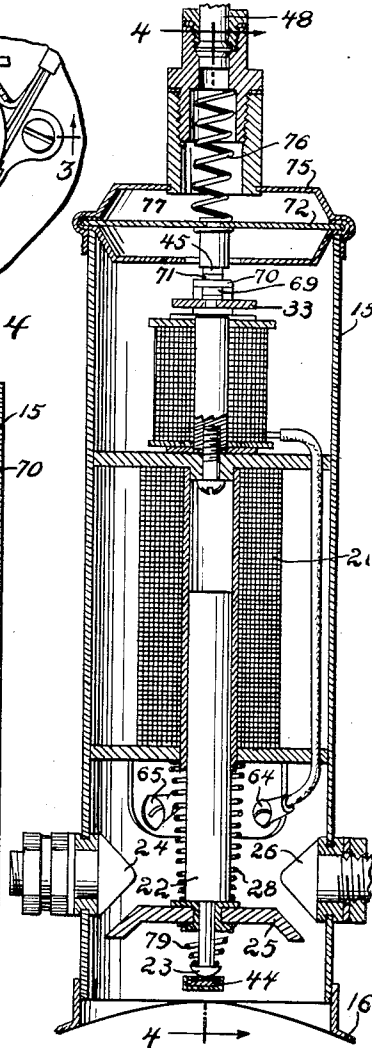
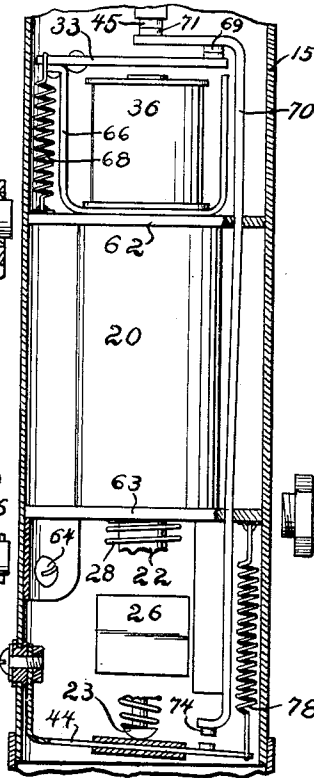


Fig. 3

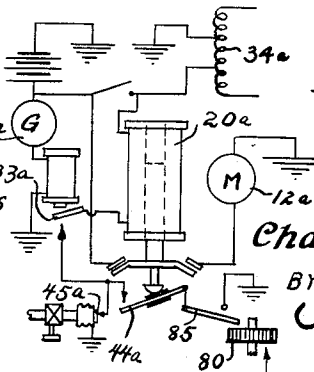
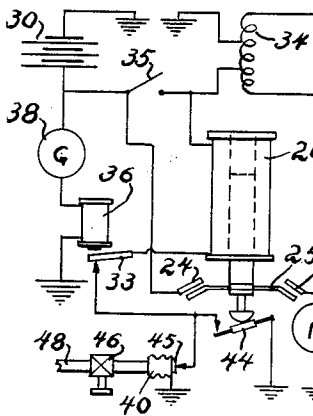


Fig. 6

INVENTOR,
Charles F. Warner

BY
Swan, Tye & Harden
ATTORNEYS.

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C. F. WARNER

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2 Sheets-Sheet 2

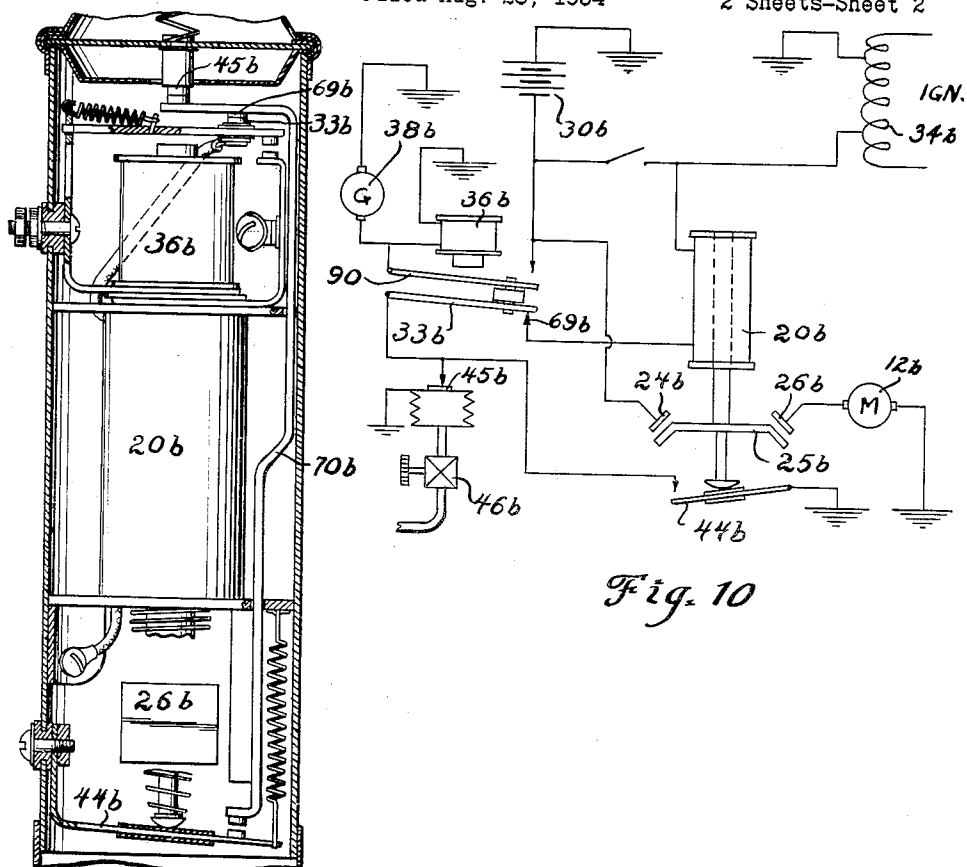


Fig. 9

INVENTOR.

INVENTOR.
Charles F. Warner

BY

BY
Swan, Tye & Hardesty

ATTORNEYS.

UNITED STATES PATENT OFFICE

2,056,699

ELECTRICAL CONTROLLING APPARATUS

Charles F. Warner, Richmond, Va., assignor of one-sixth to Henry G. Dickerson, two-sixths to Charles S. Woodson, one-sixth to Joseph C. Fusco, and one-twelfth to Edward S. Dorin, all of Richmond, Va.

Application August 28, 1934, Serial No. 741,855

2 Claims. (Cl. 290—37)

This invention relates to automatic starting devices for engines of the sort used in automotive vehicles and the like, and aims particularly to provide improved means for automatically starting an internal combustion engine upon the closing of a single switch such as that controlling an electric ignition circuit, and for immediately restarting the engine in the event it should be accidentally stopped with the ignition on.

5 A further object is to eliminate the dangers incident to unwanted stalling of the engine of a motor vehicle.

Another object is to provide an extremely simple and inexpensive device of the character mentioned, incorporated in a novel structural arrangement enclosed within a single casing of small size, which completely seals and protects the mechanism and enables ready installation thereof upon a motor car, either as original or accessory equipment, with a minimum of trouble and expense.

Improvement and simplification of the mechanisms disclosed in my copending application Serial No. 664,656, filed April 5, 1933, and in my Patent No. 1,908,088, issued May 9, 1933 may be stated to constitute still further objects of the present invention.

Still another object is to provide starting apparatus possessing the aforementioned and other objects and advantages and which include safeguarding means preventing accidental closing of the starting motor circuit and interlocking said circuit and the generator circuit in such fashion that operation of the generator locks out the starting motor, yet in which no additional electrical apparatus is required in order to provide such interlocking and safeguarding interrelation of the generator and starting circuits.

Yet another object is to provide automatic starting means in combinations with a gasoline engine equipped with an electrical generator and storage battery system incorporating a generator cut out relay in known manner, in which such relay is so constructed and arranged as to operate safeguarding means adapted to prevent operation of the starting means when the generator is delivering a voltage higher than the trip voltage of the relay.

Other object and advantages will be apparent from the following description wherein reference is made to the accompanying drawings illustrating preferred embodiments of my invention and wherein similar reference numerals designate similar parts throughout the several views.

In the drawings:

Figure 1 is a view partly in side elevation and partly in section fragmentarily showing the engine and adjacent parts of a motor car of conventional construction, illustrating an electric starter of familiar design and the application of my invention thereto.

Figure 2 is an enlarged detailed view partly in horizontal section and partly in plan, taken substantially on the line 2—2 of Figure 1 and looking in the direction of the arrows.

Figure 3 is an enlarged substantially diametrical section of the unit, taken substantially on the line 3—3 of Figure 2 and looking in the direction of the arrows.

Figure 4 is a view similar to Figure 3 but taken at right angles thereto, substantially on the line 4—4 of Figure 3.

Figure 5 is a schematic diagram showing a preferred method of connecting the various elements of the mechanism.

Figure 6 is a similar schematic diagram of a somewhat modified arrangement.

Figures 7 and 8 are fragmentary detailed sections of switching means incorporated in the modified construction.

Figure 9 is a sectional elevation similar to Figure 3 of a modified construction; and

Figure 10 is a schematic diagram showing the wiring arrangement preferably employed with such modified construction.

Referring now to the drawings, in which I have shown embodiments of my invention arranged to control the starting of a motor car engine, it will be seen that in Figure 1 an engine is fragmentarily shown equipped with an electric starter of the so-called "Bendix" type, the motor 12 of the starter projecting beside the engine, being supported by the flywheel housing 13. When the motor 12 is energized, the starter cranks the engine by means not necessary to be here described. Ordinarily such automotive engines are provided with electric ignition controlled by a key switch or the like, while the starter is controllable by a separate switch.

It is assumed in order to provide typical illustrative conditions that the vehicle fragmentarily shown in Figure 1 is equipped with a battery, as 30, a generator, as 38, electric ignition energizable through an auto transformer 34 and controllable by an ignition switch 35, and that the engine 10 incorporates an intake manifold (unshown) in which a partial vacuum is formed when the engine is running.

My improved automatic starter will first be

described in conjunction with Figures 1 and 5, in order that the operation of its various elements may be understood, after which mechanical features of construction will be considered.

- 5 Considering first the electrical elements of my improved controlling system, it will be seen that the battery 30 is arranged to energize an ignition transformer 34 in the conventional manner when the ignition switch 35 is closed, and that
10 the generator 38 is also arranged in series with the battery in the conventional manner. The starter motor 12 is controllable by means of a magnetically operable switch 25 arranged in series therewith and operable by means of a solenoid 20, one end of whose winding is connected to the ignition circuit on that side of the ignition switch 35 which is dead when the switch is open, while the other end of the winding is connected in series with a magnetic switch 33,
15 which is in turn connected in series with another magnetic switch 44, operable by the same solenoid 20 which serves to operate the switch 25. From the switch 44 a circuit is completed back to the battery 30 through ground, as will be
20 readily apparent.

Switch 44 is shunted by another switch 45, mechanically operable by means of a vacuum power unit 40. The vacuum unit is so connected to the intake manifold (unshown) of the engine that the power unit opens the switch when the pressure in the power unit 40 is sufficiently reduced by starting of the engine, while when the engine is at a standstill and switch 45 accordingly closed, a shunt circuit to ground is provided around the switch 44. A bleeder valve
30 46 is arranged in the tube line 48 by which the vacuum power unit is connected to the intake manifold, and acts as a delaying agent preventing instantaneous operation of the vacuum power switch in either direction.

Switch 33 is operable by means of an electromagnet 36 arranged in series with the generator 38. The generator is of course mechanically driven by the engine 10. The electromagnet 36
45 is so designed that it is operative to open the switch 33 only when the current delivered by the generator 38 exceeds a predetermined potential; e. g. three-quarters volt. It goes without saying that the solenoid must be constructed to stand and operate upon any voltage up to the maximum delivered by the generator.

When the solenoid 20 is deenergized, switches 25 and 44 are yieldably held open, while switch 33 is yieldably maintained closed until a sufficient current at a potential above one volt is supplied to the magnet 36. As indicated above, vacuum power switch 45 is yieldably maintained closed until a sufficient pressure reduction takes place in vacuum unit 40 (in response to starting
50 of the engine).

The operation of this arrangement, although doubtless readily apparent, may be summarized as follows:

When the engine is at rest, turning on the
65 ignition by closing the switch 35 results in completing a circuit through solenoid 20, as one end of its winding is connected to the high side of the battery by the closing of the switch while the other end is connected to ground through switches 33 and 45. Solenoid 20 immediately closes switch 25, which then completes a circuit to the starting motor 12 through contacts 24—
70 26, the former of which is directly connected to the high side of the battery, while the latter is connected to the starting motor which is in turn

connected to ground. Switch 44 is closed simultaneously with switch 25, and completes a shunt circuit to ground so that the opening of switch 45 which results from the starting of the engine is prevented from deenergizing the solenoid 20.
5 Such closing of switch 44 maintains the energization of the solenoid 20 and so of the starter motor 12 until switch 33 is opened by electromagnet 36. This, as stated above, is accomplished as soon as generator 38 builds up a potential of one volt, which is in turn dependent upon the attainment of a predetermined speed by the engine 10. When the switch 33 in this fashion breaks the solenoid circuit, switches 25 and 44 are immediately opened, and it will be
10 seen that closing of switch 45 cannot thereafter energize the solenoid and so cause cranking of the engine unless the engine is turning at insufficient speed to insure the delivery of current to magnet 36 above the predetermined potential. 20
By the same token any release of the switch 33 which permits it to close while the engine is running is not effective to energize the solenoid because switch 45 is held open by the vacuum unit during running of the engine, while switch 25
44 is of course closable only after completion of the solenoid circuit. Any accidental stopping or stalling of the engine while the ignition switch is closed, however, results in operation of the starter 12 as soon as switches 33—45 have both
30 closed, the closing of switch 33 taking place as soon as the current in solenoid 36 drops below $\frac{3}{4}$ volt, while switch 45 closes when the engine comes to a standstill and the requisite pressure feeds into power unit 40 through the bleeder
35 valve 46. It will be seen that the bleeder prevents fluttering or spasmodic operation of the switch 45 due to any erratic performance of the engine.

My preferred method of constructing and assembling the controlling apparatus is best shown in Figs. 3 and 4. As there indicated, a combined support and casing 15 of tubular formation and preferably magnetic metal is provided. At its base a supporting flange 16 enables its attachment to the starting motor 12 or any other suitable support. Starter motor contacts 24—26 are carried by but insulated from the casing tube and project into the interior thereof in such manner that connection between them may be established by contact element 25 when drawn into engagement therewith by the solenoid 20 acting through the slidable core 22. The insulating end plates 62—63 of the solenoid are press-fitted into the casing tube, and support the solenoid and connected elements as well as the electromagnet 36,
45 which is secured to the outer face of end plate 63.

One end of the winding of magnet 36 is connected to a binding post 64 from which connection to the generator may be made, while the other end of the winding is grounded. The magnet 36 acts upon the switch arm 33, which is hinged on a bracket 66 to which one end of the solenoid winding is connected. Spring 68 normally holds switch arm 33 in engagement with a contact 69 carried by a conductor and contact bar 70. Also carried by bar 70 is a contact 71 adapted to cooperate with switch contact 45 of the vacuum power unit. The contact is mounted in the center of the movable diaphragm 72 of the unit. The casing of the unit, designated 75, forms a closing head for the upper end of the main casing 15, to which it is secured in a manner best indicated in Fig. 3. A spring 76 resists the tendency of vacuum created in chamber 77 to open
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switch contact 45, and may also serve to connect the contact 45 to the grounded casing if the diaphragm be formed of insulating material. The bar 70 is supported by the plates 62—63, through which it extends in the manner best indicated in Fig. 4, and terminates near the bottom of the casing where it carries another switch contact 74 engageable by a contact carried by switch arm 44, which when the core is drawn into the solenoid provides the shunt ground connection described above. A spring 78 which is of course weaker than spring 28, urges the switch 44 into closed position when the head 23 of core 22 is retracted. The switch element 25 may be loosely mounted on but insulated from the reduced end portion of the core, and resiliently positioned by means of a spring 79. A binding post 65 is provided adjacent the binding post 64, to which the other end of the winding of solenoid 20 is connected, both such binding posts being insulated from the casing.

When the unit has been installed in suitable position upon the car, as in the manner indicated in Figs. 1 and 2, it is only necessary to run wires from binding posts 64—65 to the generator and the ignition side of the switch 35 respectively, from post 26 to the starter motor, and from post 24 to the high side of the battery, and then to connect the vacuum power unit to the intake manifold as by means of a tube 48, after which the apparatus is ready to function in the manner described above.

As indicated in Figs. 6 to 8 inclusive, an additional safeguard against unwanted completion of the starter motor circuit may be provided in the form of an additional mechanically operable switch 85 arranged in series with switch 44a. In these views parts analogous to those previously described are indicated by like reference numerals distinguished by the letter "a". The switch 85 may be adapted to be mechanically closed by means such as the starter pinion 80, when the pinion has moved sufficiently far in the axial direction in which it is urged by the starter motor as it begins to crank the engine. It will be understood that this is in conformity with the common method of operation of the so-called Bendix starters, and that the switch is so arranged as to be yieldably held open when the pinion is disengaged, (under the influence of a spring 86) and thrown to closed position when the pinion has been moved into full engagement with the ring gear 81, to close the shunt circuit to ground, provided switch 44a is also closed. It is characteristic of starters of the variety here under consideration that when the engine is at a standstill, the starter motor, upon commencing to turn, first throws the starting pinion into engagement with the ring gear, while when the engine takes hold and turns under its own power, it throws the pinion out of engagement when it reaches a speed which would turn the pinion faster than the starter motor. By virtue of the provision of switch 85, when the pinion is so kicked out of engagement, the shunt ground circuit is broken, so that regardless of whether or not the generator breaks the circuit at switch 33a, the solenoid 20a is deenergized when the engine begins to fire properly. The circuit to the solenoid cannot be reestablished to again energize the starting motor until the switch 45a has been closed as a result of complete stopping of the engine.

Another important modification, which I regard as particularly advantageous because of its inexpensive character and the simplification of

the wiring connections of both the starting motor and the generator which it entails, is illustrated in Figs. 9 and 10. In this construction the electromagnet 36b is so arranged and connected as to operate both a cutout relay for the generator 38b, and the lockout contacts for the main solenoid of the automatic starting system. The generator is arranged in series with the winding of the coil, as shown, and the opposite terminals of both the generator and coil are grounded. The relay switch 90 is operated directly by the coil of this magnet in the usual or any desired fashion, and serves to connect the generator to the battery 30b to charge the latter whenever the generator voltage rises sufficiently above the battery voltage.

Mechanically operated by the same switch armature 90 are the additional contacts 33b—69b, which being normally closed when the coil 36b is deenergized, complete the circuit to the main solenoid 20b in similar fashion to the equivalent parts previously described. It will be understood that when the combined relay and locking coil 36b draws the armature to itself, it breaks the circuit to the main solenoid and so opens the starting motor circuit, since contact carrier 25b then falls away from contact points 24b—26b, while simultaneously connecting the generator to the battery for charging.

Shunt circuits to ground are additionally provided by the vacuum unit switch 45b and the solenoid-control switch 44b, also in similar fashion, the latter of course opening when the main solenoid is deenergized, and the former being opened as a result of the vacuum developed in the intake manifold, upon starting of the engine.

It will be understood that a mechanically controlled switch such as that designated 85 in Figs. 6—8 may also be included in series with switch 44b and for like reasons if desired.

The entire mechanism for both automatic control of the starter motor and for controlling the generator is thus combined in one simple and compact construction, housed in a single casing which may be affixed either to the generator or starting motor, or to the cowl directly above one or the other, and it will be appreciated that when such arrangement is used very little extra mechanism, and that of very simple and inexpensive construction, is required to be added to that used upon motor cars not provided with automatic starting means, in order to secure the advantages of this feature.

While it will be apparent that the illustrated embodiments of my invention herein disclosed are calculated to adequately fulfill the objects and advantages primarily stated, it is to be understood that the invention is susceptible to variation, modification and change within the spirit and scope of the subjoined claims.

What I claim is:

1. In combination with an internal combustion engine provided with electric ignition, a source of current and a manually operable switch for controlling such ignition, said battery also being provided with generator-charging means, and the engine being provided with electric starting means, means for controlling the operation of said starting means comprising a starter switch arranged in series with said starting means and the battery, a main solenoid for operating the starter switch arranged in series with said manually operable switch and the battery, a main control switch for said main solenoid arranged in series therewith, an auxiliary solenoid for operating said main control switch arranged in

series with said main control switch for preventing completion of a circuit to the main solenoid thereby at desired times, a pair of shunted control switches arranged in series with said control switch for preventing completion of a circuit to the main solenoid thereby at desired times, one of said shunt switches being operable by the main solenoid and the other by the engine, and addi-

tional means for opening the shunt circuit of one of said shunt switches in response to disengagement of said starting means.

2. Apparatus as set forth in claim 1 in which said additional means is arranged in the shunt circuit including the switch operable by the main solenoid.

CHARLES F. WARNER.