

March 26, 1935.

R. M. G. PHILLIPS

1,995,780

AUTOMATIC CIRCUIT CONTROL APPARATUS

Filed Nov. 9, 1932

3 Sheets-Sheet 1

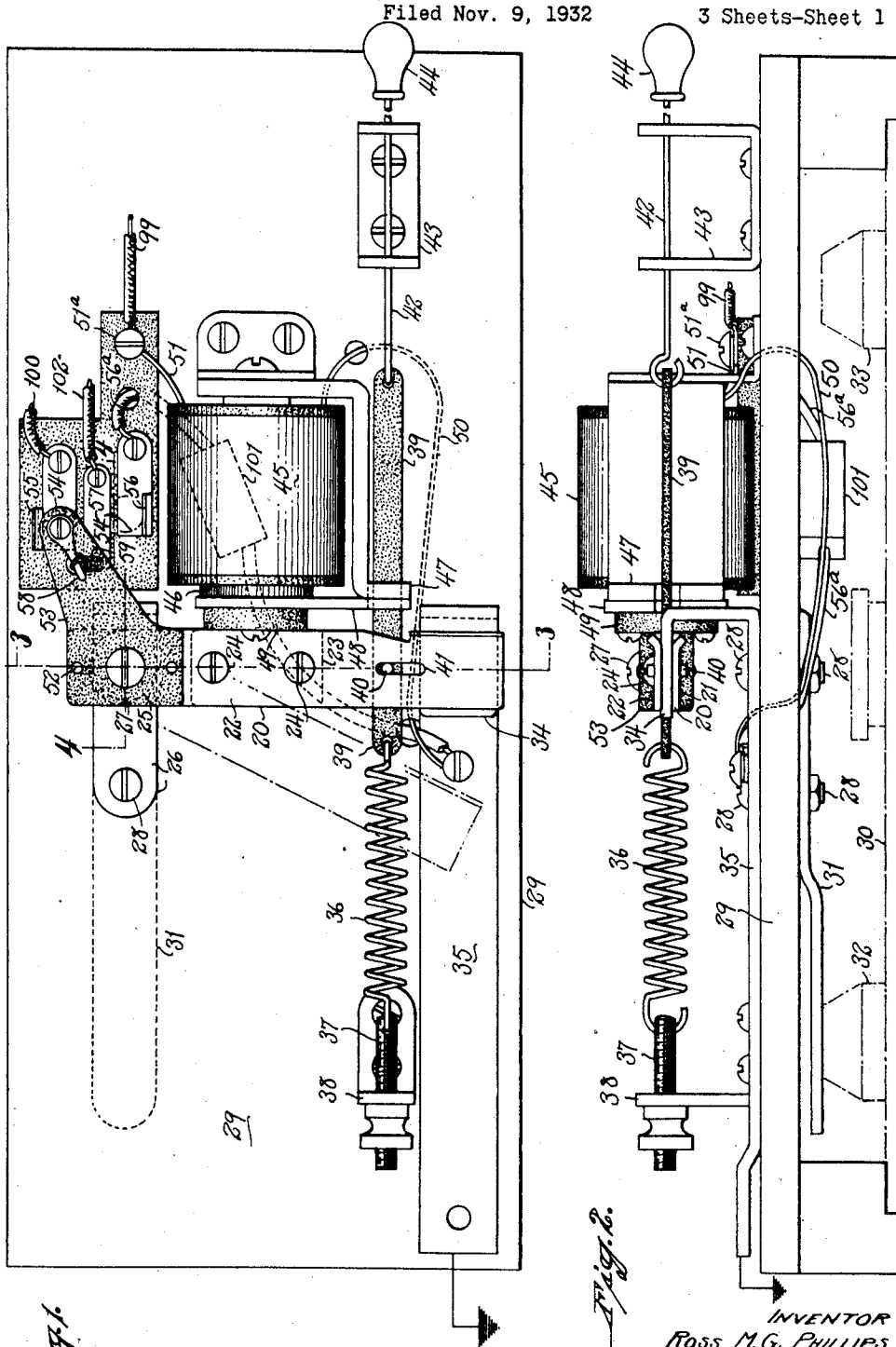


Fig. 1.

Fig. 2.

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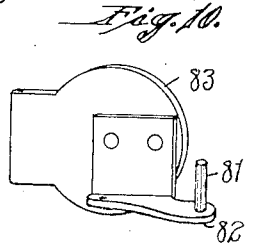
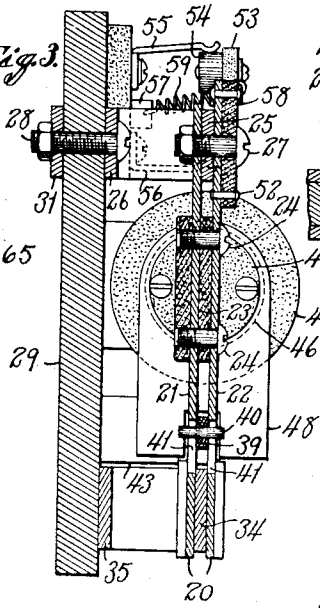
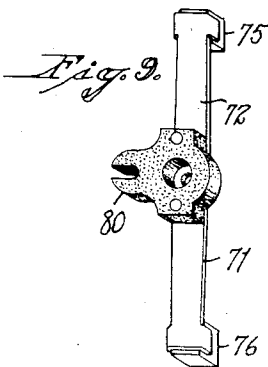
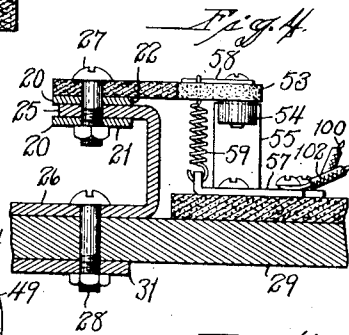
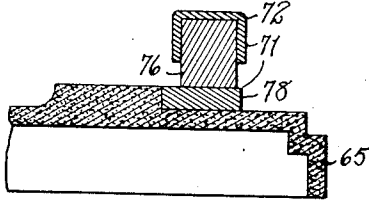
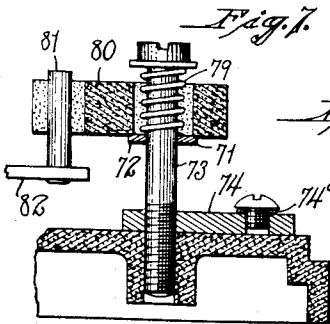
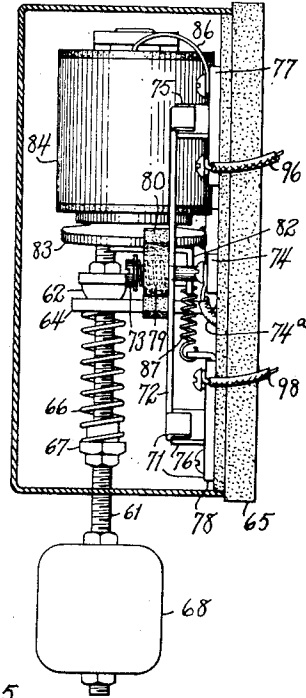
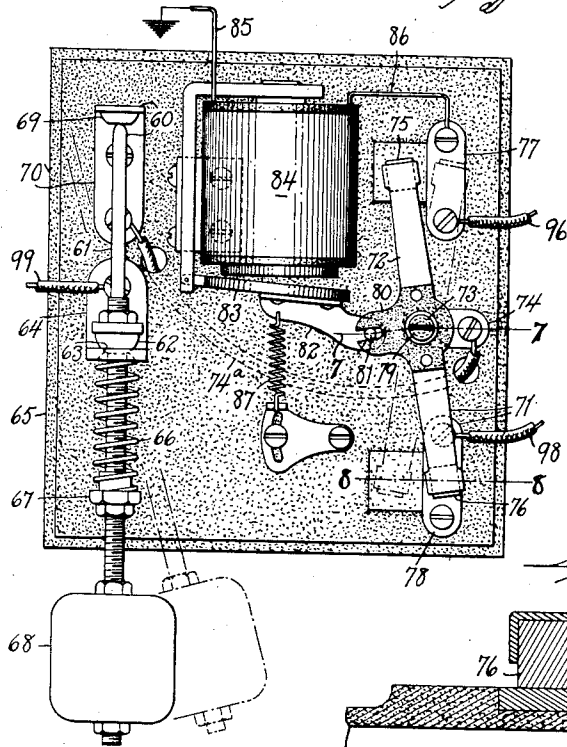
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Fig. 5.

Fig. 6.



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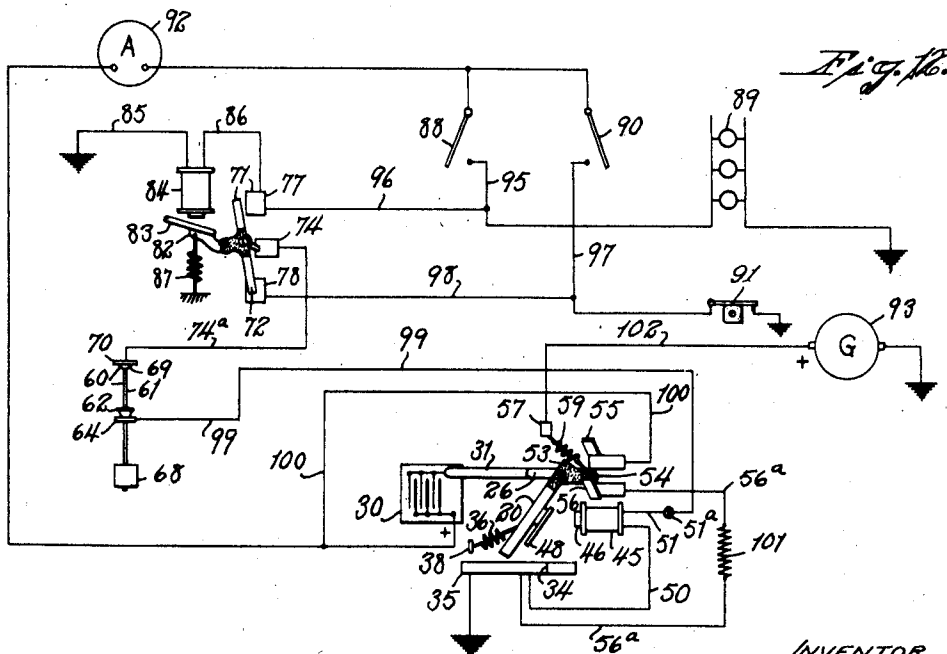
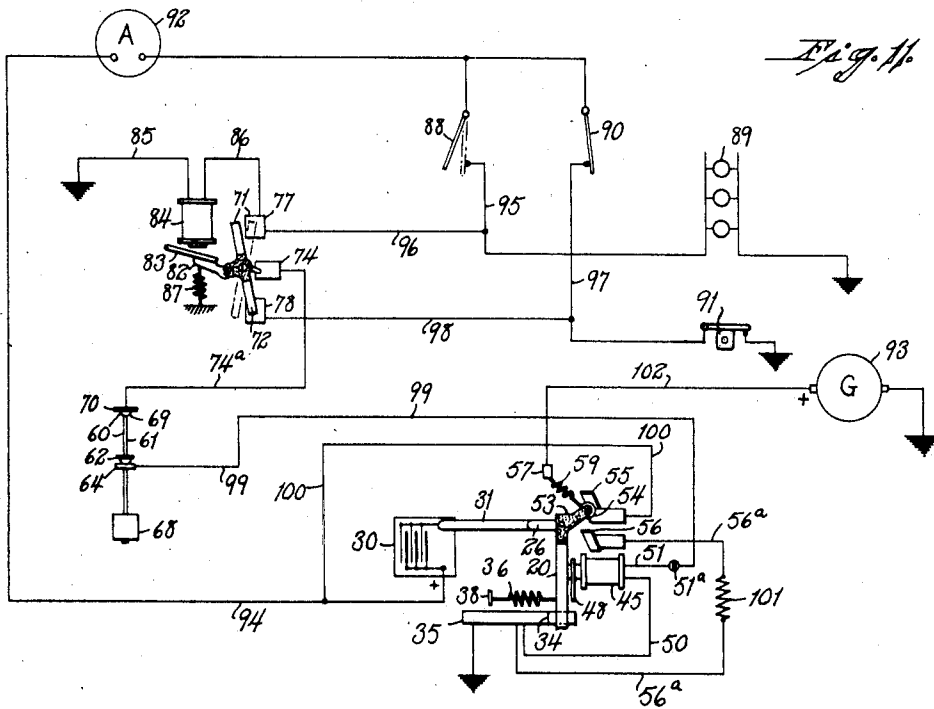
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AUTOMATIC CIRCUIT CONTROL APPARATUS

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3 Sheets-Sheet 3



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UNITED STATES PATENT OFFICE

1,995,780

AUTOMATIC CIRCUIT-CONTROL
APPARATUSRoss M. G. Phillips, West Haven, Conn., assignor
to Malcolm P. Nichols, New Haven, Conn.

Application November 9, 1932, Serial No. 641,868

14 Claims. (Cl. 171—313)

This application constitutes a continuation in part of my co-pending application filed February 27, 1929, Serial No. 343,018, entitled "Automatic circuit-breaking apparatus", patented December 6, 1932, No. 1,890,233.

My present invention relates to an improvement in automatic circuit-control apparatus and relates in particular to apparatus of the character referred to for controlling the electric circuits of automobiles, airplanes and other vehicles, though not so limited.

The main object of my present invention is to provide an improved apparatus to guard against the inadvertent drainage of the battery of a vehicle, to prevent short circuits in the wiring system thereof and to guard against fires in the event of a collision.

Another object of my present invention is to provide reliable and effective automatic means for breaking the main battery circuit of a vehicle or the like upon the turning off of one or more subsidiary circuits to thus, when the vehicle is idle, guard against accidental fires and to prevent inadvertent drainage of the battery, due to short circuits, etc.

A further object of my present invention is to provide automatic means whereby maintenance of the main battery circuit is made dependent upon the maintenance of one or more subsidiary circuits.

A further object is to provide means which will automatically break the main battery circuit, as just above described, and disconnect the generator from the said battery.

A still further object of my present invention is to provide reliable and effective means whereby, upon the turning off of one or more of the subsidiary circuits, the generator will be automatically disconnected from the battery and be connected to a conductor independent of said battery for completing a circuit to thus prevent the overheating of the said generator when not connected to the said battery.

Other objects will appear from the following taken in conjunction with the accompanying drawings.

In the accompanying drawings:

Fig. 1 is a top or plan view of the main switch unit;

Fig. 2 is a view thereof in edge elevation, showing the same applied to the top of a storage battery, which latter is represented by broken lines;

Fig. 3 is a transverse sectional view taken on the line 3—3 of Fig. 1;

Fig. 4 is a broken detail sectional view taken on the line 4—4 of Fig. 1;

Fig. 5 is a face view of the unit which includes the automatic selecting-switch and the collision-switch;

Fig. 6 is an edge view thereof;

Fig. 7 is a broken detail sectional view taken on the line 7—7 of Fig. 5;

Fig. 8 is a similar view on the line 8—8 of Fig. 5;

Fig. 9 is a perspective view of the selecting-switch blade, detached;

Fig. 10 is a perspective view of the swinging armature which actuates the selecting-switch blade;

Fig. 11 is a schematic representation of my improved apparatus together with various electrical circuits, the ignition-switch being shown as closed, as is also the main switch; and

Fig. 12 is a corresponding view, but showing the lighting-switch, ignition-switch and main switch in their open-circuit positions.

The particular apparatus herein chosen for the illustration of my invention includes, as shown particularly well in Figs. 1 to 4 inclusive, a main switch which is generally designated by the numeral 20, and which, in the preferred embodiment of my invention as will hereinafter appear, is adapted to accomplish three major functions, i. e., first, to open and close the main battery circuit; second, to connect and disconnect the generator with respect to the battery; and third, to provide a return circuit for the generator when the latter is disconnected from the battery in order to prevent damage to the generator due to overheating, etc.

The main switch 20 above referred to includes two complementary switch-blades 21 and 22 held in spaced relationship by a spacer 23 of insulating material and united into a unitary swinging-member by means of screws 24. The switch-blades 21 and 22, just referred to, are respectively located on the under and upper sides of the offset arm 25 of a sheet-metal bracket 26 and are pivoted and electrically connected to the said arm by means of a bolt 27.

The bracket 26 is secured by any suitable means such as bolts 28 to the upper face of a rectangular mounting-plate 29, preferably formed of insulating material and so shaped as to be accommodated upon the top of a storage battery 30 represented by broken lines in Fig. 2, and diagrammatically represented in Figs. 11 and 12. The bolts 28 serving to hold the bracket 26 to the plate 29 extend downwardly through the latter and elec-

trically interconnect the former to a resilient contact-arm 31 located on the under face of the said plate and adapted to rest upon one of the two battery-terminals 32 and 33, as indicated in Fig. 2.

The free ends of the blades 21 and 22 are respectively adapted to have frictional engagement with the upper and lower surfaces respectively of the offset arm 34 of a bracket 35 secured to the upper face of the mounting-plate 29 in spaced relationship to the bracket 26, and adapted in any approved manner to be electrically connected to the chassis of the vehicle upon which it is mounted, so as to be thereby interposed in the electrical circuit, as will hereinafter appear.

For normally urging the blades 21 and 22 into the position in which they are shown by broken lines in Fig. 1, in which they are electrically disconnected from the bracket 35, I employ a helical spring 36 hooked at one end into an adjusting-screw 37 mounted in the upper end of the upstanding arm of an L-shaped bracket 38 secured to the upper surface of the plate 29. The opposite end of the spring 36 is hooked through a suitable perforation in a resetting-link 39 formed of insulating material and extending between the respective blades 21 and 22 near the free ends thereof and connected thereto by a transverse pin 40 riding in slots 41, one of which latter is formed in each of the said blades 21 and 22. The end of the resetting-link 39 opposite the spring 36 has hooked into it a pull-rod 42 guided in a suitable bracket 43 and having a pull-button 44 at its outer end.

For the purpose of normally holding the free ends of the complementary switch-blades 21 and 22 in electrical engagement with the bracket 35 against the counterurge of the spring 36, I employ an electromagnet 45 suitably supported upon the plate 29. The complementary poles 46 and 47 of the magnet 45 are adapted to attract and hold an armature 48 secured to the switch-blades 21 and 22 and insulated therefrom by an extension 49 of the spacer 23, before referred to.

One lead 50 of the magnet 45 is connected to the bracket 35 while its opposite lead 51 is connected to a binding-post 51^a, which latter is electrically interconnected into the circuit, as will hereinafter appear.

The blades 21 and 22 of the main switch have secured to them, adjacent their pivoted arm by means of rivets 52, a laterally-offsetting arm 53, formed of insulating material and carrying at its outer end a contact-stud 54 adapted, when the switch-blades 21 and 22 are in their circuit-closing position, to engage a contact 55 and, conversely, when the said blades are in their open-circuit position, to engage a complementary contact 56.

The contact-stud 56 is, as before described, insulated from the switch-blades 21 and 22 by the insulating character of the arm 53 and is electrically connected to a terminal-plate 57 by a tang 58 and a helical spring 59. The contact 56 is, as shown, electrically connected to the bracket 35 by a wire 56^a.

In conjunction with the main switch, just above described, I employ a so-called "collision-switch," generally designated by the numeral 60 and electrically interposed in the circuit of the electromagnet 45 of the main switch, as will more fully hereinafter appear.

The collision-switch 60 includes a stem 61 having adjustably mounted upon it, about midway of its length, a spherically-contoured bearing 62

seated in a similarly-contoured socket 63 formed in the upstanding arm of a bracket 64 secured to a mounting-plate 65, which latter is preferably formed of insulating material. The stem 61, just above referred to, extends through the offsetting-reach of the bracket 64 and is encircled by a helical compression-spring 66 seated at one end against the adjacent face of the bracket 64 and at its opposite end against the adjustable spring-seat 67 threaded upon the said stem. The spring 66 exerts a constant effort to hold the bearing 62 firmly seated in the socket 63 and in electrical engagement therewith.

The lower end of the stem 61 of the collision-switch 60 has secured to it a weight 68, while its opposite end is normally electrically engaged with a contact-boss 69 mounted upon the offsetting arm of an L-shaped bracket 70.

By the above arrangement, the stem 61 and the bearing 62 serve to normally electrically interconnect the brackets 64 and 70 respectively. Furthermore, the stem 61, by virtue of its bearing 62, is capable of movement in any lateral direction to swing its upper end out of engagement with the contact-boss 69 and thus break the circuit to the electromagnet 45 of the main switch, as will hereinafter appear. The lateral swinging movement of the stem 61, just above referred to, will take place in the event of a collision in which the vehicle upon which it is mounted may become involved.

Also mounted upon the plate 65, which mounts the collision-switch, is a selecting-switch, generally designated by the numeral 71 which includes a pivotal blade 72 mounted intermediate its ends upon a stud 73 offsetting from a terminal-plate 74 secured to the mounting-plate 65 before referred to. The terminal-plate 74 is connected by means of a conductor 74^a to the bracket 70 of the collision-switch 60.

Mounted in the opposite ends respectively of the blade 72, above referred to, are contact-shoes 75 and 76, respectively adapted to have sliding engagement with contact-plates 77 and 78 secured to the mounting-plate 65 before referred to. A helical spring 79 encircling the stud 73 serves to press the blade 72 inwardly toward the plate 65 and thus tends to maintain the shoe 75 in engagement with the plate 77, or the shoe 76 in engagement with the contact-plate 78, dependent upon the position of said blade.

Secured to and laterally offsetting from the blade 72 is a bifurcated arm 80 receiving a coupling-pin 81 mounted in the outer end of a bracket 82, forming a feature of a pivotal armature 83.

The armature 83 is adapted on occasion, as will hereinafter appear, to be attracted by an electromagnet 84 for swinging the blade 72 from the position in which it is shown in full lines in Figs. 5 and 11, to the position in which it is shown by broken lines in the same figures. The said electromagnet 84 has one of its leads 85 grounded, as shown, and its other lead 86 connected to the contact-plate 77 before referred to. A helical spring 87 exerts a constant effort to swing the armature 83 away from the electromagnet 84 and hence tends to hold the switch-blade 72 in the position in which it is shown in full lines in Figs. 5 and 11.

Having described the main switch, collision-operated switch, and selecting-switch of my improved apparatus, I shall now proceed to describe their interrelationships with respect to each other

and with respect to the electrical circuits, etc., of an automobile.

In Figs. 11 and 12 of the drawings, I have shown the main switch, collision-switch and selecting-switch associated with certain common features of an automobile, including a light-switch 88 which controls the supply of current to the lights 89, an ignition-switch 90 controlling the supply of current to the ignition system of the automobile which is represented in Figs. 11 and 12 by a distributor 91. The figures referred to also diagrammatically include an ammeter 92 and a generator 93, which latter is adapted in the usual manner to charge the storage battery 30, and includes, as is usual practice, a built-in automatic cut-out, which serves to prevent the battery from being drained through the generator when the same is idle, or when the same is not operating at speeds sufficiently high to generate the required voltage for charging the said battery.

As shown in Figs. 11 and 12, the plus side of the battery 30 is connected by a conductor 94 to both the light-switch 88 and the ignition-switch 90 and has interposed in it the ammeter 92 before referred to. The light-switch 88 is connected by a light wire 95 to the lights 89 and a wire 96 is tapped into the said light wire and connects the same with the contact-plate 77 of the selecting-switch 71. The ignition-switch 90 is connected by an ignition wire 97 to the distributor 91 and a wire 98 serves to connect the said ignition wire with the contact-plate 78 of the selecting-switch 71.

As before pointed out, the terminal-plate 74 of the selecting-switch is connected by a conductor 74^a with the bracket 70 of the collision-switch 60, and the stem 61 of the latter serves to electrically interconnect the bracket 70 with the bracket 64. The bracket 64 in turn is connected by a conductor 99 to the binding-post 51^a of the main switch electromagnet 45.

The contact 55 of the main switch 20 is, as shown, connected by a conductor 100 to the wire 94 and hence to the plus side of the battery 30. The complementary contact 56 of the main switch is connected by a conductor 56^a to the bracket 35, as before pointed out. The conductor 56^a has interposed in it a suitable resistance 101 for the purpose as will hereinafter appear.

As before pointed out, the contact-stud 54 which is adapted to alternately engage the contacts 55 and 56, is electrically connected to the terminal-plate 57 by the spring 59. The terminal-plate 57 in turn is connected to the output side of the generator 93 by means of a conductor 102, the opposite terminal of the said generator being grounded, as shown.

For the purpose of making clear the operation of the apparatus herein chosen for the illustration of my invention, let it be presumed that the ignition-switch of the vehicle upon which the apparatus is installed is in its closed-circuit position, and that the lighting-switch is in its open position. Let it further be supposed that the blades 21 and 22 of the main switch have been manually moved against the counter-urge of the spring 36 into position to electrically interconnect the brackets 26 and 35.

With the parts in the positions just above referred to, the blades 21 and 22 and associated parts of the main switch will be held in the position in which they are shown in Fig. 11 in the following manner.

Current will flow from the battery 30 through

the electromagnet 45 for energizing the same, by means of the conductor 94, ignition-switch 90, ignition wire 97, conductor 98, contact-plate 78, switch-blade 72, terminal-plate 74, conductor 74^a, bracket 70, stem 61, bracket 64, conductors 99 and 51, thence through the electromagnet and to the ground through the wire 50 and bracket 35 of the main switch.

Thus, with the main switch in the position above described, the battery circuit will be complete and the generator will be connected to the storage battery for charging the same, through the intermediary of the conductor 102, terminal-plate 57, spring 59, contact-stud 54, contact 55, conductor 100 and a short portion of the conductor 94.

Should now the lighting-switch 88 be moved into its circuit-closing position, as indicated by broken lines in Fig. 11, the electromagnet 84 of the selecting-switch 71 will be energized owing to its interconnection with the light wire 95 by the conductor 96, plate 77 and conductor 86. The energization of the electromagnet 84, as just described, will serve to cause the same to swing the switch-blade 72 of the selecting-switch 71 from the position in which it is shown in full lines in Fig. 11 to the position in which it is shown by dotted lines in the same figure, and thereby disconnect the said blade from the ignition circuit and connect it into the lighting circuit so that the current for maintaining the electromagnet 45 of the main switch in an energized condition, will now be derived from the lighting circuit rather than from the ignition circuit.

The electrical severance of the electromagnet 45 from the ignition circuit by the automatic action of the selecting-switch 71 is for the primary purpose of preventing the electrical interconnection of the light and ignition circuits which otherwise would occur. Immediately upon the opening of the light-switch 88, the spring 87 will serve to restore the switch-blade 72 to the position in which it is shown in full lines in Fig. 11.

From the above, it will appear that once the main switch 20 has been manually moved into its circuit-closing position, and either the ignition-switch or the lighting-switch, or both, is turned into its circuit-closing position, the electromagnet 45 will be constantly energized and serve to thereby hold the main switch 20 in its circuit-closing position, in which the main battery circuit is complete as well as the subsidiary lighting and ignition circuits. With the main switch in the position just referred to, the generator is electrically connected to the storage battery 30 for charging the same, as already described.

If now both the lighting and ignition switches should be moved into their open-circuit positions, as indicated in Fig. 12, the supply of current to the electromagnet 45 of the main switch will fail, whereupon the spring 36 will assert itself to move the switch-blades 21 and 22 and associated parts into the positions in which they are indicated in Fig. 12, with the effect of thereby rendering inoperative the main battery circuit and the subsidiary circuits deriving current therefrom.

Furthermore, when the main switch is moved into the position in which it is shown in Fig. 12, the generator is automatically disconnected from the battery by the movement of the contact-stud 54 out of engagement with the contact 55 and into engagement with the contact 56. The engagement of the stud 54 with the contact 56 will serve, however, to provide a complete local circuit for the generator, independently of the battery, etc., and

thereby prevent the generator from being damaged by overheating, etc. The local circuit provided for the generator, as just described, may be clearly traced in Fig. 12 and includes the resistance 101 which is preferably employed to prevent too

After the ignition and lighting switches have been opened to produce the movement of parts into the positions in which they are shown in Fig. 12, the electrical system cannot be restored to operativeness until the main switch has been moved by means of the finger-button 44 into its circuit position and one or the other of the switches 88 or 90 moved into its circuit position to energize the magnet 45 of the main switch and thus releasably maintain the said switch in the position into which it has been moved.

It will be noted that the collision-switch 60 is interposed in the circuit supplying current to the electromagnet 45 of the main switch and that, therefore, in the event of a collision, the inertia of the weight 68 thereof will be such as to automatically cause the disengagement between the stem 61 and the contact-boss 69, as indicated by broken lines in Fig. 5, to thus cut off the supply of current to the electromagnet 45 and permit the spring 36 to assert itself and render the main battery circuit, together with the subsidiary circuits, dead.

From the foregoing, it will be seen that the selecting-switch 71 serves when both the lighting-switch 88 and the ignition-switch 90 are in their closed positions, to automatically prevent an interconnection between the said circuits, though attention may be here called to the fact that the contact-shoes 75 and 76 and the contact-plates 77 and 78 are so proportioned that before the shoe 76 is entirely disengaged from the plate 78, the contact-shoe 75 will have made engagement with the plate 77 and thus, for an instant, both the ignition and lighting circuits will be interconnected. This effect, however, is so slight in duration as to be altogether unobjectionable.

The foregoing description will also make clear the fact that when the user of the vehicle, etc., upon which my improved apparatus is installed, turns off both the lights and ignition, the major portion of the wiring, etc., will automatically become dead, and thus prevent fires and inadvertent short circuits during the absence of an attendant.

Occasionally operators of vehicles turn off the ignition and use the engine as a brake in coasting down a hill and if this should take place in the daylight, when the lighting-switch is not on but the generator is still running, not only would the main battery circuit be broken and the generator disconnected therefrom, as before described, but the generator will be automatically provided with what might be termed a "shunt" circuit, independent of the main battery circuit, to thus prevent the said generator from being damaged by overheating, etc.

The invention may be carried out in other specific ways than that herein set forth without departing from the spirit and essential characteristics of the invention, and the present embodiment is therefore to be considered in all respects as illustrative and not restrictive, and all changes coming within the meaning and equivalency range of the appended claims are intended to be embraced therein.

I claim:

1. An automatic apparatus of the class described, including a main switch having a circuit-control member normally urged into its

open-circuit position; an electrical circuit controlled by the said main-switch; electromagnet means constructed and arranged to hold the circuit-control member of the said main switch in its circuit-closing position; two manually-operable switches each connected into the electrical circuit which is controlled by the said main switch so as to cause a flow of current through the said electromagnetic means; an automatic selecting-switch electrically interposed between both of the said manually-operable switches and the electromagnetic means of the said main switch and movable to pass current selectively via one or the other of the manually-operable switches through the said electromagnetic means of the main switch; yielding means normally holding the said selecting switch in position to pass current via one of the said manually-operable switches; electromagnetic means energized via the other of the said manually-operable switches and connected to the said selecting-switch to move the same in position to pass current via the last-mentioned manually-operable switch.

2. An automatic apparatus of the class described, including a main switch having a circuit-control member normally urged into its open-circuit position; an electrical circuit controlled by the said main-switch; electromagnet means constructed and arranged to hold the circuit-control member of the said main switch in its circuit-closing position; a manually-operable ignition-switch and a manually-operable lighting-switch each connected into the electrical circuit which is controlled by the said main switch so as to cause a flow of current through the said electromagnetic means; an automatic selecting-switch electrically interposed between the ignition-switch and lighting-switch and the electromagnetic means of the said main switch and movable to pass current selectively via one or the other of the said manually-operable switches through the said electromagnetic means of the main switch; yielding-means normally holding the said selecting-switch in position to pass current via the said ignition-switch; electromagnetic means energized via the said lighting-switch and connected to the said selecting-switch to move the same in position to pass current via the said lighting-switch.

3. In a motor vehicle, the combination with a storage battery and generator thereof, of a battery-output circuit supplied by the said battery; current-translating means supplied by the said circuit; a main switch including a movable member controlling the said battery-output circuit and normally urged into a position to open the said circuit; electromagnetic means supplied by the said circuit and constructed and arranged to hold the said movable member of the said main switch in its circuit-closing position; and a manually-operable switch coupled into the said circuit in such manner that the supply of current to the said electromagnetic means is dependent upon the said manually-operable switch and the said movable member being in their circuit-closing position; whereby the movement of the said manually-operable switch into its open-circuit position automatically de-energizes the said electromagnetic means to permit the movable member of the main switch to move into its open-circuit position to cut the current supply to the said battery-output circuit and the features supplied thereby.

4. An apparatus of the class described, in combination, a storage battery; a battery-output circuit supplied by the said battery; current-translating means supplied by the said circuit; a manually-operable switch in said circuit; automatic

switch means including an electromagnet supplied by the said battery out-put circuit and controlled by the said manually-operable switch for automatically disconnecting the said battery from the said circuit and hence from the said electromagnet, current-translating means and the said manually-operable switch when the latter is moved into its open-circuit position.

5. An apparatus of the class described, in combination, a storage battery; a battery-output circuit supplied by the said battery; current-translating means supplied by the said circuit; a manually-operable switch in the said circuit; a generator for charging the said battery; and automatic switch means including an electromagnet supplied by the said battery-output circuit and controlled by the said manually-operable switch for disconnecting the said battery from both the said generator and the said circuit and hence from the said electromagnet, current-translating means and the said manually-operable switch when the latter is moved into its open-circuit position.

6. An apparatus of the class described, in combination, a storage battery; a battery-output circuit supplied by the said battery; a manually-operable switch in said circuit; a generator for charging the said battery; and automatic switch means including an electromagnet supplied by the said battery-output circuit and controlled by the said manually-operable switch for disconnecting the said generator, electromagnet, and manually-operable switch from the said battery when the said manually-operable switch is moved into its open-circuit position.

7. An apparatus of the class described in combination, a storage battery; a main circuit supplied by said battery; a manually-operable switch in said main circuit; a generator for charging the said battery; a return circuit for the said generator, independent of the said main circuit; and automatic means under the control of the said manually-operable switch for disconnecting the said generator from the said battery and connecting the same into the said return circuit.

8. An apparatus of the class described, in combination, a storage battery; a main circuit supplied by said battery; a manually-operable switch in said main circuit; a generator for charging the said battery; a return circuit for the said generator, independent of the said main circuit; and automatic means under the control of the said manually-operable switch for disconnecting the said battery from both the said main circuit and the said generator, and connecting the said generator into the said return circuit.

9. An apparatus of the class described, in combination, a storage battery; a battery-output circuit supplied by the said battery; current-translating means supplied by the said circuit; a manually-operable switch in said circuit; an automatic switch-mechanism controlling the connection of the said battery to the said circuit and normally urged into position to disconnect the same; and electromagnetic means supplied by the said battery-output circuit for holding said automatic switch-mechanism in position to connect the said battery to the said circuit and hence to the said electromagnetic means, current-trans-

lating means and manually-operable switch, the energization of the said electromagnetic means being under the control of the said manually-operable switch.

10. An apparatus of the class described, in combination, a storage battery; a battery-output circuit supplied by the said battery; a manually-operable switch in said circuit; a generator for charging the said battery; an automatic switch-mechanism controlling the connection of the said battery to the said generator and normally urged into position to disconnect the same; and electromagnetic means supplied by the said battery-output circuit for holding the said automatic switch-mechanism in position to connect the said battery to the said generator, the energization of the said electromagnetic means being under the control of the said manually-operable switch and battery-output circuit in which the latter is interposed.

11. An apparatus of the class described, in combination, a storage battery; a main circuit supplied by the said battery; a manually-operable switch in said main circuit; a generator for charging the said battery; a return circuit for the said generator; an automatic switch-mechanism controlling the connection of the said generator to the said battery and to the said return circuit and normally urged into position to disconnect the generator from the said battery and connect the same to the said return circuit; and electromagnetic means for holding said automatic switch-mechanism in position to connect the said generator to the said battery for charging the same, the energization of the said electromagnetic means being under the control of the said manually-operable switch.

12. An apparatus of the class described, in combination, a storage battery; a battery-output circuit supplied by the said battery; a manually-operable switch in the said circuit; a generator for charging the said battery; an automatic switch-mechanism controlling the connection of the said battery to both the said circuit and the said generator, and normally urged into position to disconnect the same; and electromagnetic means supplied by the said battery-output circuit for holding the said automatic switch-mechanism in position to connect the said battery to both the said circuit and the said generator, the energization of the said electromagnetic means being under the control of the said manually-operable switch; whereby when the said automatic switch-mechanism is in position to disconnect the said circuit and the said generator from the said battery, the supply of current to the said manually-operable switch and electromagnetic means will be cut off.

13. An apparatus of the class described, in combination, a storage battery; a main circuit supplied by the said battery; a manually-operable switch in said circuit; a generator for charging the said battery; a return circuit for the said generator; an automatic switch-mechanism controlling the connection of the said battery to both the said main circuit and the said generator, and the connection of the said generator to the said return circuit, the said automatic switch-mechanism being normally urged into position to disconnect the said battery from both the said main circuit and the said generator, and connect the said generator to the said return circuit; and electromagnetic means for holding the said automatic switch-mechanism in position to connect the said battery to both the said main

circuit and the said generator, the energization of the said electromagnetic means being under the control of the said manually-operable switch.

14. An apparatus of the class described, including a battery; a battery-output circuit supplied by the said battery; lighting-means supplied by the said circuit; ignition-means supplied by the said circuit; a manually-operable lighting-switch controlling the supply of current to the said lighting-means; a manually-operable ignition-switch controlling the supply of current to the said ignition-means; automatic switch-means con-

trolling the supply of current to the said battery-output circuit and normally urged into position to open the said circuit; and an electromagnet also supplied by the said circuit and connected thereto in such manner that its current supply is dependent upon one of the said manually-operable switches being in its circuit-closing position and acting and energized to releasably hold the said automatic switch-means in position to connect the said battery to the said battery-output circuit.

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