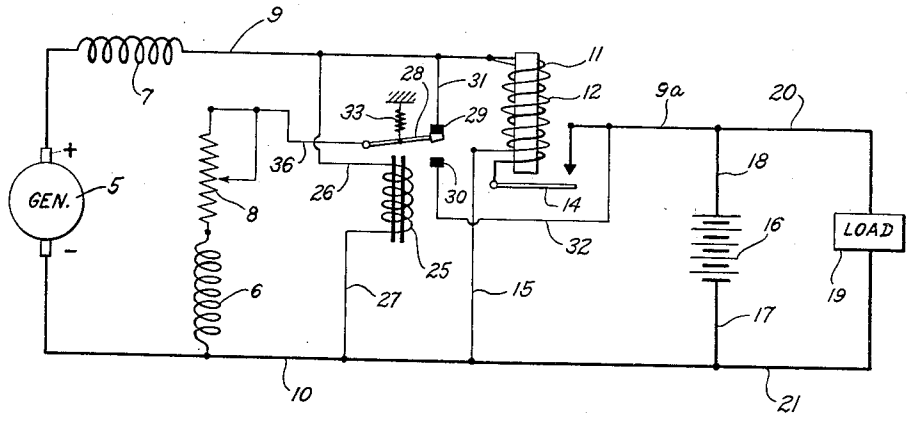
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ELECTRICAL APPARATUS

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ELECTRICAL APPARATUS

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This invention relates to electric current generating and battery charging systems such as are employed on motor vehicles, and particularly to certain improvements to be associated with the reverse current cut-out commonly employed in such systems to open the battery-generator circuit and prevent the discharging of the battery when the voltage of the generator becomes less than that of the battery.

In conventional compound generators the characteristics are frequently such that a reverse current of insufficient value to cause an immediate opening of the contacts of the reverse current cut-out may at the same time be sufficiently strong to produce a reversal of polarity in the generator itself, due to the relationship or relative strengths of the series and shunt fields of the generator. That is, when the reversal of current occurs, such reversal produces a bucking effect in the series field of the generator, which bucking effect reduces the effective voltage across the terminals of the shunt field to such an extent that the polarity of the machine may be reversed before the reverse current cut-out function. More specifically, an object of the invention is to provide means for maintaining the shunt field of the generator comparatively free of the influence of such series field "bucking" tendency, whereby the strength of the shunt field may be held at a sufficient value to prevent reversal of the polarity of the generator.

A feature of the invention, therefore, is the provision of a system having two safeguards against reverse current tendencies, instead of the usual single safeguard; the first safeguard functioning during the initial stage of current reversal, and continuing to function until the usual safeguard—the opening of the conventional cut-out—has had sufficient time to become effective.

In the embodiment of the invention herein illustrated and described, the shunt field controlling means operates to establish an alternate path after the initial excitation, or "building up" of the generator has taken place. By reason of this alternate path, any reversal of current which would ordinarily be sufficiently strong to create a danger of reversal in polarity in the generator, will have no effect upon the strength of the shunt field, which will be energized at full battery voltage, and danger of reversal, thereby nullified. It is to be understood however, that the method and means employed for this purpose in the preferred embodiment as shown are merely illustrative and do not define the limits of the invention, reference being had for the latter purpose to the appended claims.

In the drawing, the single figure is a diagrammatic representation of the electrical circuits and parts involved in the preferred embodiment of the invention, such parts including the generator armature 5 with the usual shunt and series windings 6 and 7 respectively, the former being in series with a variable resistance 8 and in shunt across the out-put feeds 9 and 10. Feed 9 preferably includes the usual series winding 11 of the reverse current relay and the usual shunt or voltage winding 12, the former being connected with the battery through the normally closed armature switch 14 and the latter having connection with the second feed 10 through the instrumentality of the lead 15.

The battery adapted to be charged by the generator is indicated at 16 with one terminal connected to feed 10 by way of lead 17 and its other terminal to the second section 9a of the line 9 by way of lead 18. The lighting or other power consuming load 19 adapted to be supplied by the generator and/or battery is supplied by the extensions of lines 9a and 10 indicated at 20 and 21.

The novel means of the present invention for maintaining full strength in the shunt field 6 even on those occasions when there is a reversal in the direction of current flow in the windings of the reverse current device, takes the form of a second relay including a winding 25 connected across the main lines 9 and 10 as indicated at 26 and 27 and having associated therewith an armature 28 movable into contact with either of two conducting plates 29 and 30, the former being in connection with main feed 9 and the latter being in connection with the second section of the feed 9a through the provision of a connecting lead 32, suitable means such as the tension spring 33 being provided to maintain the said armature 28 in the upper position during starting of the generator, the setting of the spring and the design of the coil 25 being preferably such that the electro-magnetic field produced by the flow of current through said coil is insufficient to draw the armature 28 downward into contact with the plate 30 during the starting or building up period of the generator but becomes sufficient to produce such downward movement at the completion of the building up period. Or in other words, when the voltage across the lines 9 and 10 (and hence the voltage across the coil 12 of the reverse current cut-out) becomes sufficient to insure closing of the switch 14. When both these switch movements—that

is, of the armatures 28 and 14—occur, the excitation of the shunt field will thereafter proceed through the conductors 9, 11, 14, 32, 30, 28 and 36 and will continue in this manner during the entire period of operation of the generator, except on occasions when there is a tendency for a reversal in the direction of current flow—that is, a tendency for the current to flow from the battery into the generator. The operation on such occasions will be as follows:

As the current begins to flow in a reversed direction through the series winding 11 of the reverse current cut-out, there is of course a certain time lag in the opening of the switch 14, during which time the above described bucking effect will occur in the series field winding 7. The shunt field winding, however, will be maintained at full strength by reason of the direct connection with the battery constituted by the lead 32 and including the contact 30 with which the armature 28 is engaged. This battery excitation through this direct path between the battery and the shunt field 6 will continue to constitute the means for maintaining the shunt field at full battery strength until after actual opening of the switch 14. When such opening occurs, the above described bucking effect ceases and there is then no further necessity of maintaining full strength of current flow in the shunt field.

So long as the voltage across the generator terminals remains at or above the predetermined value, the coil 25 holds the strength of the magnetic field acting upon the armature 28 at such a value that the spring 33 is unable to return the armature 28 to a position of engagement with the contact plate 29, and such return will be delayed until just prior to the return of the generator rotor to a condition of rest, at which time the return of the armature 28 to contact with conductor 29 will serve to place the parts in condition for self-excitation of the generator on the occasion of the next starting thereof, on which occasion the cycle of operation above described will of course be repeated.

There is thus disclosed a system in which the reversal effects of the operating current of reverse current cut-out devices are nullified by maintaining the shunt field excitation at a value equivalent to operating conditions until after complete opening of the reverse current relay or cut-out and the effect of the reverse current has expired.

What is claimed is:

1. In a system of the class described, a battery and generator connected for energization of the former upon rotation of the latter, a reverse current cut-out between the generator and battery, a shunt field constituting part of the generator, means for energizing said field by current taken from the generator, means for energizing said field by current taken from the battery, and selective means for rendering said energizing means successively effective, said selective means comprising a switch connecting said shunt field with the generator during the initial excitation period and movable substantially simultaneously with the closing of said reversed current cut-out to a position insuring excitation of said shunt field directly from the battery.

2. In a system of the class described, a battery and generator connected for energization of the former upon rotation of the latter, a reverse current cut-out between the generator and battery, a shunt field constituting part of the generator, and means for preventing a reversal in polarity of the generator regardless of the strength of the current passing through said reverse current cut-out, said means including a switch movable to connect said shunt field with the battery side of the reverse current cut-out as soon as the generator voltage has built up to the normal running value.

3. In a system of the class described, a battery and generator connected for energization of the former upon rotation of the latter, a reverse current cut-out between the generator and battery, a shunt field constituting part of the generator, and means for preventing a reversal in polarity of the generator regardless of the strength of the current passing through said reverse current cut-out, said last named means including an electro-magnetic device subjected to the same voltage as that across the terminals of the generator and a switch controlled by said electro-magnetic device to directly connect said shunt field with the battery independently of said reverse current cut-out as soon as the said terminal voltage reaches the normal running value.

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