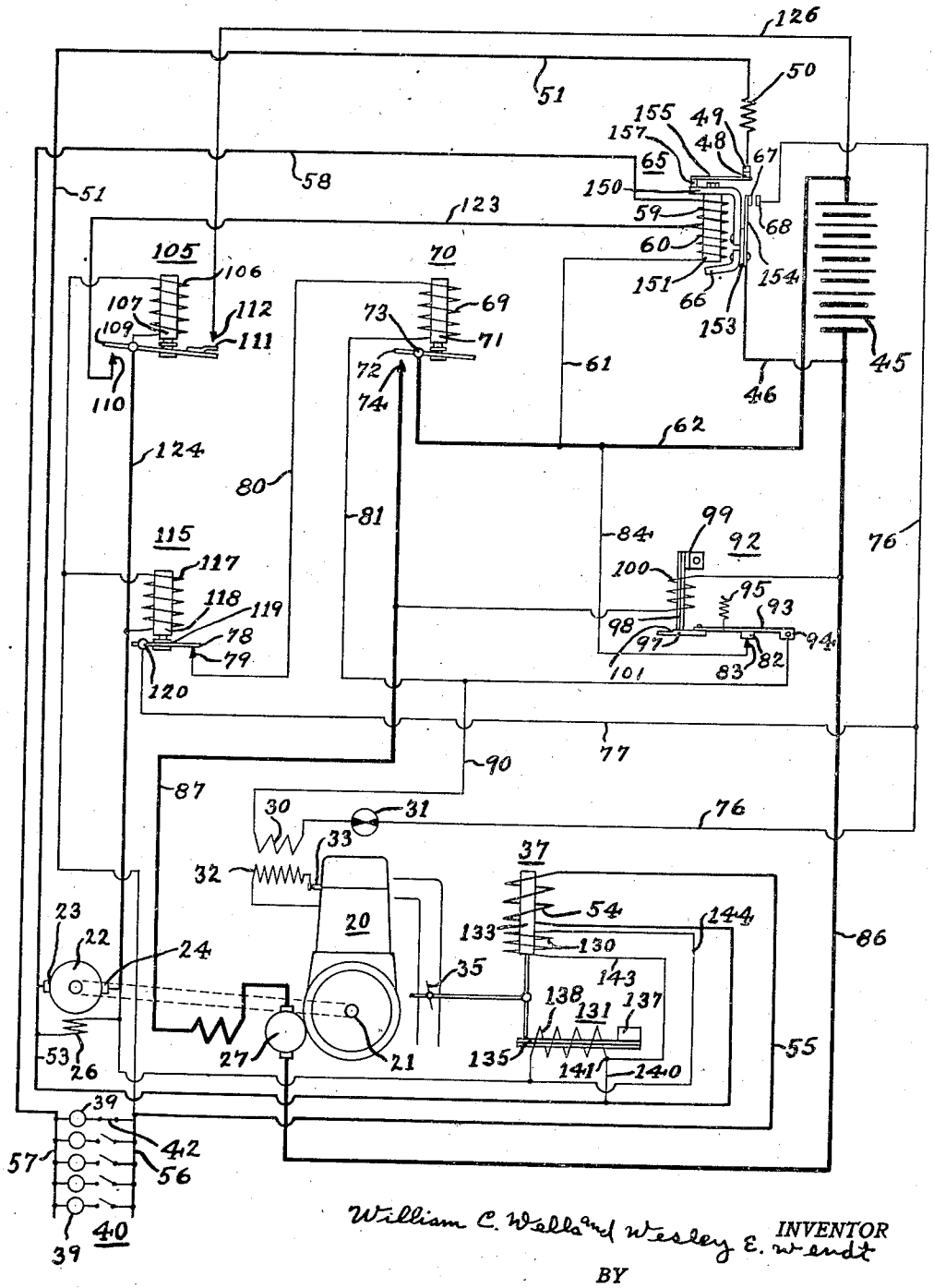
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ELECTRICAL APPARATUS

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## ELECTRICAL APPARATUS

Application filed August 30, 1929. Serial No. 389,493.

This invention relates to electrical generating systems of the type which include preferably an internal combustion engine, a storage battery, a work circuit and electrical apparatus operated by the engine for supplying current to the storage battery and to the work circuit; and more particularly to the automatic control for such systems.

One of the objects of the present invention is to provide improved means for controlling the operation of the electrical apparatus to thus maintain a substantially constant voltage output therefrom. In electrical generating systems employing an internal combustion engine for driving a generator, a voltage coil responsive to the voltage of the generator is used for controlling a throttle valve for the engine to thus control the speed of the engine and consequently the voltage of the generator. Voltage coils of this type gradually vary in effectiveness as they gradually become heated by current flow therein and therefore the voltage of the generator when starting will be different than after the system has been in operation for some time. It is a more specific object of the present invention to compensate for this change in effectiveness of the voltage coil whereby the voltage of the generator is maintained substantially constant at all times.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawing, wherein a preferred form of the present invention is clearly shown.

In the drawing:

The figure of the drawing is a wiring diagram illustrating the present invention.

In the drawing, 20 designates a prime mover herein shown, for the purpose of illustration, as an internal combustion engine having a shaft 21 which drives a relatively high voltage generator 22 having main brushes 23 and 24 connected with the armature of the generator, and having a shunt field winding 26.

The engine is started by a relatively low voltage series motor 27 which is normally disconnected from the engine, but may be connected automatically with the engine for cranking the latter whenever current is supplied to the motor; and which is automatically disconnected from the engine when the engine becomes self-operative. As various devices for connecting and disconnecting the starting motor are well known to those skilled in the art, illustration thereof is deemed unnecessary. One form of mechanical connection which may be used for this invention is described and claimed in the co-pending application of Frank F. Starr, Serial No. 47,717, filed April 3, 1925.

The ignition apparatus comprises an ignition coil primary 30, an ignition timer 31 and an ignition coil secondary 32 which is connected with an engine spark plug 33.

A throttle 35 for regulating the speed of the engine is adapted to be actuated by a throttle control 37.

To start the engine automatically in response to a demand for current by a translating device 39 contained in the work circuit 40, one of the switches 42 is closed, thereby causing current to flow from a storage battery 45 through the following circuit: battery 45, wire 46, contact 48, contact 49, resistance 50, wire 51, wire 53, series winding 54 of throttle control 37, wire 55, service main 56, switch 42, translating device 39, service main 57, wire 58, magnet coil 59, magnet coil 60, wire 61, and wire 62 to the other side of the battery. Coil 60 is of relatively high resistance and, therefore limits the flow of current from the battery to the work device. The energizing of coils 59 and 60 which form a part of starting switch relay 65 causes an armature 66 to be drawn upwardly to connect a movable contact 67 with a stationary contact 68. When contacts 67 and 68 are closed, current will flow from the battery through the magnet 69 of a starting switch 70 which includes a plunger 71 which, when moved upwardly, will cause a contact 72, which is pivoted at 73, to engage a contact 74. The circuit between the battery and the magnet 69 is as follows: battery 45, wire 46, contacts 67 and 68, wire 76, wire 77, contacts 78 and 79, wire 80, magnet 69, wire 81, contacts 82 and 83, wire 84, and wire 62 to the other side of the

battery. The closing of contacts 67 and 68 will connect the ignition coil primary 30 with the storage battery through the following circuit: wire 46, contacts 67 and 68, wire 76, timer 31, primary 30, wire 90, wire 81, contacts 82 and 83, wires 84 and 62 to the other side of the battery. Thus, the engine will be started by supplying ignition thereto and cranking the engine by the starting motor 27.

If the engine should not start within a certain length of time, abnormal discharge of the battery is prevented by a cranking cut-out 92 which includes the contacts 82 and 83. The contact 82 is attached to a lever 93 which is pivoted at 94 and is urged upwardly by a spring 95. Upward movement of the lever 93 is restrained by the engagement of a non-conducting block 97 attached to the lever 93 with the lower end of a bimetallic thermostatic blade 98 fixed at 99. The blade 98 is in heat receiving relation to a heating coil 100 which is connected across the battery terminals by connecting one end of the coil 100 with the wire 86, and the other end with a wire 87. If the cranking of the engine should continue for an abnormal period, the bimetallic blade 98 will be heated sufficiently to cause it to bow toward the left, as viewed in the drawing, until the lower end of the blade 98 moves past the shoulder 101 of the non-conducting block 97. When this occurs, the lever 93 will move upwardly and separate the contact 82 from the contact 83. This operation will thus disconnect the coil 69 from the battery 45, so that the plunger 71 will descend by gravity to move the contact 72 away from the contact 74. Thus the starting circuit will be interrupted.

During normal operation, when the prime mover 20 becomes self-operative and the generator has attained a relatively high voltage, a load switch 105 will automatically connect the dynamo 22 with the work circuit 40. The switch 105 includes a magnet coil 106 having its ends connected across the dynamo 22. When the voltage across the brushes of the dynamo 22 exceeds a certain amount a plunger 107 of the load switch 105 will be actuated in order to move the contacts 109 and 110 into engagement. Before contact 109 engages contact 110 a contact 111 will first engage a contact 112. This feature is provided to insure closing of the battery charging circuit before the work circuit is closed.

The engine cranking circuit is interrupted after the engine becomes self-operative, by a stop cranking relay 115 which includes contacts 78 and 79, a magnet winding 117 connected across the dynamo and a magnetizable plunger 118 having lost motion connection 119 with a contact 78 which is pivoted at 120. When the dynamo voltage reaches a certain relatively low value, the magnet coil 117 will be sufficiently energized to actuate the plunger 118 in order to separate the contact 78 from the contact 79. When this occurs the circuit between the battery 45 and the magnet winding 69 of the starting switch 70 will be interrupted, thereby permitting the plunger 71 to descend and the contact 72 to be separated from the contact 74. After the plunger 118 has been moved sufficiently by the magnet 117 to separate the contact 78 from the contact 79, the plunger 118 will be maintained in this position, the speed of the engine and the corresponding voltage of the dynamo will fall materially below the speed and voltage producing the separation of the contacts 78 and 79. Thus, the possibility of reconnecting the starting circuit after the prime mover is self-operative has been eliminated, although the engine speed might become comparatively low.

During normal operation the dynamo 22 functions to supply current to the translating device 39 contained in the work circuit 40 and supplies charging current to the battery 45. The flow of current from the dynamo through the work circuit is as follows: brush 23 of dynamo 22, wire 53, series winding 54 of control 37, wire 55, service main 56, switch 42, translating device 39, wire 58, magnet coil 59 of relay 65, wire 123, contacts 110 and 109 and wire 124 to the other side of the dynamo. The flow of current from the dynamo 22 through the battery charging circuit is as follows: brush 23 of dynamo 22, wire 51, resistance 50, switch contacts 49 and 48, wire 46, the relatively low voltage storage battery 45, wire 62, wire 126, contacts 112 and 111 and wire 124 to the other side of the dynamo.

The throttle control 37 also includes a shunt winding 130, a thermostatic element 131 and a plunger 133 which is operatively connected with the throttle 35 and a bi-metallic thermostatic blade 135 of the thermostatic element 131. The blade 135 forms a resilient support for plunger 133 and is adapted to hold the same in position when the windings 54 and 130 are deenergized. During operation of the system the series winding 54 and the shunt winding 130 are adapted to oppose one another, the series winding 54 tending to move the plunger 133 downwardly to open the throttle, increasing its effectiveness as the load increases, while the shunt winding 130 tends to move the plunger 133 upwardly to close the throttle. In actual practice the shunt winding 130 is wound inside the series winding 54, but for the purpose of a clear illustration the windings have been shown one above the other.

After the shunt winding 130 becomes energized, the winding is adapted to heat gradually, due to the flow of current therethrough, to thus cause the resistance thereof to increase thereby varying the effectiveness of this winding. In order to overcome this disadvantage the thermostatic element 131 has

been provided. The device 131 includes the bi-metallic thermostatic blade 135 which is fixed at 137. This blade is adapted to be heated or cooled and thereby moved to compensate for the change in the voltage coil 130. In the present case, the arrangement is such that thermostat is heated for such compensation and preferably this heating is accomplished by heating coil 138. The blade 135 is in heat receiving relation to the coil 138, and after a certain length of time the blade 135 will be heated sufficiently to cause it to bow upwardly to thus compensate for the variation in effectiveness of the shunt winding 130. In this manner the voltage output of the dynamo 22 is maintained substantially constant at all times. The circuit from the dynamo 22 through the shunt winding 130 and through the heating coil 138 is as follows: brush 23 of dynamo 22, wire 53, wire 140 to connecting point 141 where the current divides; part flowing through wire 143, shunt winding 130 and wire 144 to the other side of the dynamo; the other part of the current flowing from connecting point 141 through heating coil 138 and wire 144 to the other side of the dynamo.

Magnet coils 59 and 60, contacts 67 and 68 are included in the instrument 65 which serves to effect the operation of the starting apparatus and to close the ignition circuit and to maintain it closed until the current demand in the work circuit ceases, and to interrupt the flow of current to the battery when the current demand in the work circuit exceeds a certain amount.

The instrument or relay 65 comprises a magnetizable angle 150 attached to a core 151 located within the windings 59 and 60. The angle 150 supports the armature 66 by a flexible metallic hinge 153. The contact 67 is carried by a flexible metallic conductor 154 attached to the armature 66. The contact 48 is carried by a flexible, magnetizable metallic member 155 connected with the angle 150 by a non-magnetizable block 157. When the current flowing through coil 59, which is in the work circuit, exceeds a certain amount the magnetic path provided by the members 151, 150 and 66 will be saturated and some of the flux will stray into the region of the magnetizable member 155 to cause the same to be drawn toward the angle 150 to separate contacts 48 and 49. In this way the battery charging circuit is interrupted when the demand for current in the work circuit exceeds a certain amount.

From the foregoing description, it is apparent that we have provided a device for controlling the operation of the generating system, and have arranged for compensating the variation in effectiveness of such device. By this arrangement there is insured a substantially constant voltage output by the dynamo.

While the form of embodiment of the invention as herein disclosed constitutes a preferred form, it is to be understood that other forms might be adopted, all coming within the scope of the claims which follow.

What is claimed is as follows:

1. An electrical generating system comprising in combination a work circuit, electrical apparatus, a prime mover for driving the electrical apparatus, said electrical apparatus being adapted to supply current to said circuit, a throttle valve on the prime mover for controlling the output of the electrical apparatus, a coil for actuating said valve, said coil being adapted when energized for a predetermined length of time to vary in effectiveness, a voltage coil energized by the electrical apparatus, and a thermostat heated by said voltage coil and mechanically connected to said means for compensating such variation in effectiveness of said coil.

2. An electrical generating system comprising in combination a work circuit, electrical apparatus, a prime mover for driving the electrical apparatus, said electrical apparatus being adapted to supply current to said circuit, a throttle valve on the prime mover for controlling the output of the electrical apparatus, a shunt coil connected across the electrical apparatus, a winding connected in series with said work circuit, said coil and said winding being adapted to actuate said valve, said coil being adapted when energized for a predetermined length of time to vary in effectiveness, and an electrically operated thermostat heated by said voltage coil and mechanically connected to said means for compensating such variation in effectiveness of said coil.

3. An electrical generating system comprising in combination a work circuit, electrical apparatus, a prime mover for driving the electrical apparatus, said electrical apparatus being adapted to supply current to said circuit, a throttle valve on the prime mover for controlling the output of the electrical apparatus, a coil for actuating said valve, said coil being adapted when energized for a predetermined length of time to vary in effectiveness, and electrically operated means for compensating such variation of effectiveness of said coil, said means including a voltage coil energized by the electrical apparatus.

4. An electrical generating system comprising in combination a work circuit, electrical apparatus, a prime mover for driving the electrical apparatus, said electrical apparatus being adapted to supply current to said circuit, a throttle valve on the prime mover for controlling the output of the electrical apparatus, a shunt coil connected across the electrical apparatus, a winding connected in series with said work circuit, said coil and said winding being adapted to actuate said

valve, said coil being adapted when energized for a predetermined length of time to vary in effectiveness, and electrically operated means for compensating such variation of effectiveness of said coil, said means including a voltage coil energized by the electrical apparatus.

In testimony whereof we hereto affix our signatures.

WILLIAM C. WELLS.
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