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ELECTRICAL APPARATUS

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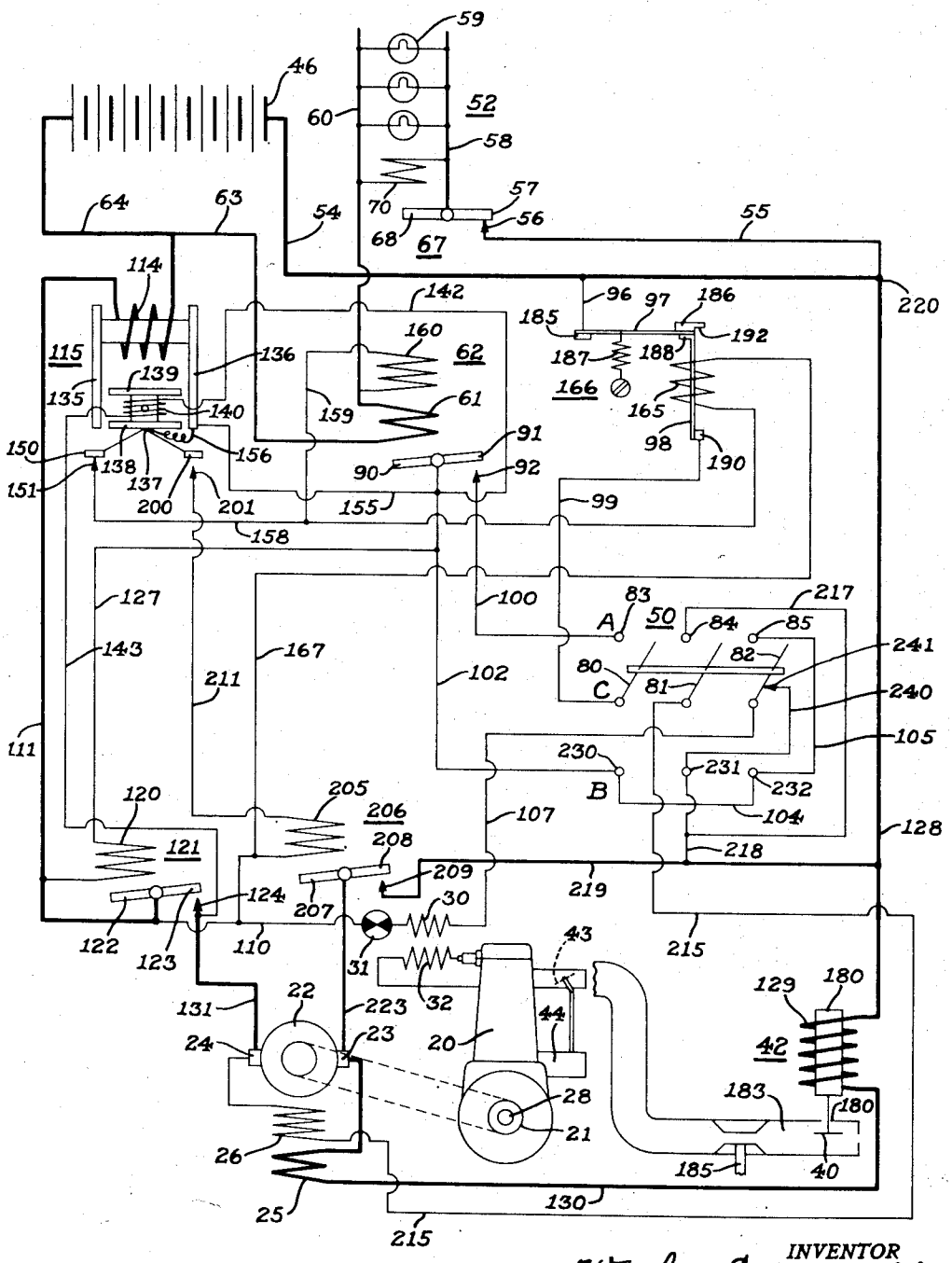

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ELECTRICAL APPARATUS

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The present invention relates to electrical generating systems and particularly to the type wherein a prime mover, such as an internal combustion engine, drives a generator for supplying current to a battery and a work circuit, there being a pulley or other similar device driven by the engine from which mechanical power may be transmitted.

One of the objects of this invention is to provide improved means for disconnecting the generator field winding in order to render the generator inoperative while at the same time the engine may continue to run for driving a mechanical load.

Another object of this invention is to arrange said means for accomplishing the foregoing object in such a manner so that the system may be selectively conditioned for operation, whereby said system may be rendered operative by a demand for current of a predetermined value by the work circuit, or rendered operative irrespective of a demand for current.

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 drawings:

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

Referring to the drawing, the numeral 20 designates a prime mover, preferably an internal combustion engine, having a shaft 21 which drives an electrical apparatus or generator 22 having main brushes 23 and 24 connected with the armature of the generator and having a starting series field 25 and a shunt field winding 26. A pulley 28 may be carried by the shaft 21 for driving a mechanical load such as a work machine, water pump or the like.

The ignition apparatus comprises an ignition coil primary 30 and an ignition coil secondary 32 which may be connected with an engine spark plug 33.

A choke 40 for forming a proper mixture of gasoline and air for starting the engine is adapted to be actuated by the control 42. A throttle 43 for regulating the speed of the engine is adapted to be actuated by an engine speed responsive governor 44.

The generator 22 functions as a motor and as a generator and is adapted to rotate the shaft 21 of the engine when acting as a starting motor, receiving current from a storage battery 46. During the starting of the engine, the current through the series winding 25 and the shunt winding 26 is cumulative to produce a sufficient starting torque for cranking the engine.

In accordance with this invention I have provided a switch 50 for selectively conditioning the system for operation. That is, the switch 50 is so arranged that when placed in one position the system will be rendered automatically operative upon a demand of a predetermined value by the work circuit, and rendered automatically operative when placed in a second position irrespective of a demand for current. The switch also includes third position for disconnecting the generator field winding, during operation of the system, in order to render the generator inoperative while at the same time the engine may continue to run, the ignition current being supplied by the battery. These positions of said switch are designated A, B and C in their order hereinbefore stated, and which are more fully described hereinafter.

When the load demand by the service line 52 is less than a predetermined value the storage battery 46 is adapted to supply such demand. The current to the line will flow from the battery through the following circuit: battery, wire 54, wire 55, contacts 56 and 57, service main 58, translating device 59, service main 60, current coil 61 of starting switch relay 62, and wires 63 and 64 to the other side of the battery.

A low voltage cut-out 67 is adapted to separate contacts 56 and 57 when the voltage of the battery is abnormally low. The low voltage cut-out includes a pivoted armature 68 which carries contact 57, and a magnet coil 70 having its ends connected across the work circuit in parallel with the translating devices. When the voltage of the battery is less than a predetermined low value, the coil

70 will not be energized sufficiently to hold the armature 68 in the position shown in the drawing. Thus the armature 68 will descend by gravity to separate the contact 57 from contact 56, thereby interrupting the flow of current from the battery to the work circuit.

Assuming that the switch 50 is placed in the "A" or a closed circuit position whereby the switch blades 80, 81 and 82 engage contacts 83, 84 and 85 respectively, the system will be placed in readiness for operation when the demand for current by the line is in excess of a predetermined value. When there is a load demand for current in excess of a predetermined value, for example 9 amperes, the ampere turns of the current coil 61 are sufficient to lift armature 90 upwardly to engage a contact 91 with a contact 92. The closing of contacts 91 and 92 allows current to flow from the battery through the ignition and various other circuits necessary for rendering the engine operative to drive the generator to supply current to the work circuit and battery. The circuit from the battery to the ignition is as follows: battery, wire 54, wire 96, blade 97, bi-metallic thermostatic blade 98, wire 99, blade 80, wire 100, contacts 92 and 91, wires 102, 104 and 105, blade 82, wire 107, ignition coil primary 30, timer 31, wires 110 and 111, series winding 114 of a reverse current relay 115 and wire 64 to the other side of the battery. The closing of contacts 91 and 92 also allows current to flow from the battery to a magnet coil 120 of a starting switch 121. The energization of coil 120 causes an armature 122 to be drawn upwardly to engage contact 123 with a contact 124. The circuit from the battery through coil 120 is as follows: battery to wire 102 is as previously described, from wire 102 through wire 127, coil 120, wire 111, winding 114 and wire 64 to the other side of the battery.

The closing of contacts 123 and 124 establishes a cranking circuit between the battery and generator which may be traced as follows: battery, wire 54, wire 128, winding 129 of control 42, wire 130, series winding 25, wire 131, contacts 124 and 123, wire 111, winding 114 and wire 64 to the other side of the battery.

The current flowing through the winding 114 of reverse current relay 115 during cranking is adapted to magnetize the frame of relay including side plates 135 and 136 whereby said plates will be, for example, north and south poles respectively. The relay 115 also includes a rocking armature 137. The armature 137 includes side plates 138 and 139 and a shunt winding 140, which winding is connected across the battery. The circuit from the battery through the shunt winding 140 is as follows: battery, wires 54 and 96, blades 97 and 98, wire 99, blade 80, wire 100, contacts 91 and 92, wire 102, wire 142, shunt winding 140, wire 143, contacts 124 and 123, wire 111, winding 114 and wire 64 to the opposite side of the battery. The side plates 138 and 139 are adapted to be magnetized by the shunt winding 140. When no current is flowing in the windings 140 and 114, the armature 137 is in the position shown in the drawing, it being resiliently held in such position by a spring (not shown). When current flows through the series winding 114 during cranking like poles of the relay frame and armature will repel to further assist in maintaining the rocking armature 137 in the position shown in the drawing whereby a contact 150 engages contact 151.

Engagement of contacts 150 and 151 allows current to flow from the battery through the following circuits when contacts 91 and 92 of relay 62 are closed: battery, wires 54 and 96, blades 97 and 98, wire 99, blade 80, wire 100, contacts 91 and 92, wire 102, wire 155, relay side plates 136, wire 156, contacts 150 and 151, wire 158, wire 159, shunt winding 160 of relay 62, and return to the battery through coil 61, and wires 63 and 64; also current flows from wire 158 through a heating coil 165 of a cranking cut-out 166, wires 167, 110 and 111, winding 114 and wire 64 to the other side of the battery. During cranking operation the current flows through shunt winding 160 of relay 62 to cooperate with the current coil 61 to insure maintaining of contact between contacts 91 and 92. During cranking operation a heavy demand on the battery tends to reduce the ampere turns of the current coil 61 and would cause a chattering of contacts 91 if it were not for the shunt winding 160.

The flow of current through winding 129 of control 42 tends to raise the control plunger 180 upwardly, which plunger carries the choke 40. The upward movement of plunger 180 will cause the choke to shut off an air passage 181 thus decreasing the quantity of air passing through pipe 183 into the carburetor. Thus the gasoline flowing through pipe 185 will not be diluted to the same extent as when passage 180 is open. Thus the engine will be supplied a relatively rich starting mixture. The control 42 is adapted to function for a short interval, namely, only when a heavy demand for current is made on the battery during cranking which heavy demand is present for a short interval only.

Thus when there is a demand for current of a predetermined value by the work circuit, the engine will be started by supplying ignition thereto and will be cranked by the starting series field 25 in conjunction with the shunt field 26 of the generator.

If the engine should not start within a certain length of time, abnormal discharge of the battery is prevented by the cranking cut-out 166 which includes blade 97 and the bi-metallic thermostatic blade 98. The blade

97 is fixed at 185 and has a non-conductive block 186 secured thereto. The blade 97 is urged downwardly by a spring 187 to engage the flanged end 188 of blade 98, said blade being fixed at 190. The thermostatic blade 98 is in heat receiving relation to the heating coil 165. While the engine is cranking, current is passing through the heating coil as previously described. If the cranking of the engine should continue for an abnormal period, for example one to two minutes, the thermostatic blade 98 will be heated sufficiently to cause it to bow to the right, as viewed in the drawing, until the flanged end 188 moves to the right far enough to break its engagement with the blade 97 and is then retained in a shoulder 192 of the non-conducting block 186 by the downward movement of the blade 97. The separation of blades 97 and 98 will interrupt the flow of current to the ignition shunt 160 of relay 62, shunt winding 140 of relay 115, heating coil 165 of cranking cut-out 166 and magnet coil 120 of starting switch 121. When the coil is deenergized the armature 122 will descend by gravity to separate contacts 123 and 124, thus the starting circuit will be interrupted.

During normal operation when the prime mover becomes self-operative and attains a certain speed, the generator will function as a differentially wound generator, the current flowing from the generator to the battery over the cranking circuit. The current flowing through the series winding 114 of reverse current relay 115 will be reversed from that during cranking, since this winding is in series with the generator and battery. This causes a reversal of magnetism in the relay side plates 135 and 136 and consequently the like pole of the armature side plates 138 and 139 will be moved away from the like pole of relay side plates 135 and 136 causing the armature 137 to pivot and to separate contact 150 from contact 151, thereby causing a contact 200 to engage a contact 201. Thus the flow of current through heating coil 165 and shunt winding 160 of relay 62 will be interrupted, the contacts 91 and 92 then being controlled entirely by the series winding or current coil 61.

The closing of contacts 200 and 201 allows current to flow from the generator to a magnet coil 205 of a series shorting switch 206. The energization of coil 205 will cause the upward movement of armature 207 to engage a contact 208 with a contact 209. The current from the generator through coil 205 is as follows: generator, series field 25, wire 130, wires 128, 54 and 96, blades 97 and 98, wire 99, blade 80, wire 100, contacts 91 and 92, wire 155, relay side plate 136, wire 156, contacts 200 and 201, wire 211, coil 205, wire 110, contacts 123 and 124 and wire 131 to the other side of generator.

The closing of contacts 208 and 209 allows current to flow from the generator over wire 223, contacts 208 and 209, wire 219, wire 128 which joins wires 54 and 55 at connecting point 220 and thus short circuits the series field 25 and choke coil 129, since the circuit just described offers less resistance than the circuit through the series field and coil 129. It will be noted that wire 215, blade 81, contact 84, wire 217, wire 218, wire 219, contacts 208 and 209, and wire 223 completes the shunt field of the generator.

The generator then functions as a shunt wound generator and supplies current to the translating devices in the work circuit and supplies charging current to the battery. The flow of current through the work circuit is as follows: to connecting point 220 the same as previously described, wire 55, contacts 56 and 57, service main 58, translating device 59, service main 60, coil 61, wire 63, winding 114, wire 111, contacts 123 and 124, and wire 131 to opposite side of generator. The flow of current from the generator over battery charging circuit is as follows: to connecting point 220 the same as previously described, wire 54, battery, wire 64, winding 114, wire 111, contacts 123 and 124 and wire 131 to opposite side of generator.

In the event it is desired to render the system operative and there is no demand for current of a predetermined value, or in the absence of a demand for current, the switch 50 may be placed in the "B" or a closed circuit position for rendering the system operative. When the switch 50 is in the "B" position the blades 80, 81 and 82 will engage contacts 230, 231 and 232 respectively. When this occurs current may flow through wire 99, blade 80 directly to wire 102 instead of passing through contacts 91 and 92. Thus a predetermined current demand is unnecessary to render the system operative since current passes to wire 102 without the necessity of energizing the coil 61 to draw up the armature 90 to close contacts 91 and 92. When current flows to wire 102 the system will be rendered operative as previously described.

In the event the system has been operating, either with the switch 50 in the A or B position and it is desired to disconnect the generator field 26 from the generator in order to render the generator inoperative while at the same time allow the engine to continue to run, the switch 50 may be placed in the "C" or open position. When the switch 50 is placed in the "C" position no current can pass through the blade 80 to wire 102, thus rendering the electrical switches and relays inoperative. Also the shunt field is interrupted by the separation of blade 81 from either the contact 84 or contact 231. However, the ignition current will be supplied from the battery as follows: battery, wire 54, wire 128, wire 218, wire 240, contact 241

which engages blade 82 when the switch 50 is in the open position, wire 107, ignition coil primary 30, timer 31, wires 110 and 111, winding 114, and wire 64 to the other side of the battery.

When it is desired to render the system inoperative the switch 50 may be placed in the "A" position. When the switch 50 is placed in the "A" position and the demand for current by the work circuit is less than a predetermined value the ampere turns of the current coil 61 will not be sufficient to hold the armature 90 in the position whereby contact 91 engages contact 92, thus the armature 90 will descend by gravity to seperate said contacts. The separation of contacts 91 and 92 prevents the flow of current to wire 102 thus rendering the electrical switches and relays inoperative to render the system inoperative.

From the foregoing description it will be noted that I have provided means for placing the system in readiness for operation upon a demand for current of a predetermined value by the work circuit, and that said means may be placed in a second position whereby said system may be rendered operative irrespective of a demand for current. It will also be noted that the aforesaid means may be actuated to interrupt the generator, during operation thereof, to allow the engine to operate as a free engine when driving a mechanical load. This is advantageous since the interruption of the generator field allows the armature to rotate as a flywheel only to utilize the entire energy of the engine for the mechanical load.

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 an internal combustion engine, a work circuit, a generator having a field, said generator being adapted to operate as a motor for cranking the engine and as a generator for supplying current to the work circuit when driven by the engine, and electrical apparatus adapted to be positioned for rendering the engine operative upon a demand for current of a predetermined value by the work circuit, said electrical apparatus having a second position whereby said engine may be rendered operative irrespective of a demand for current by said work circuit, and said electrical apparatus having a third position for interrupting the generator field while maintaining said engine operative.

2. An electrical generating system comprising in combination an internal combustion engine, a control circuit, a work circuit having a current coil in series with said work circuit for controlling the control circuit, a generator having a field, said generator being adapted to operate as a motor for cranking the engine and as a generator for supplying current to the work circuit when driven by the engine, means including said current coil responsive to a demand for current of a predetermined value for controlling said control circuit for rendering said engine operative, and said means also including means for controlling said control circuit irrespective of a demand for current for rendering said engine operative, said second named means being arranged for interrupting the generator field while maintaining said engine operative.

3. An electrical generating system comprising an internal combustion engine, an ignition apparatus, a control circuit, a work circuit having a current coil in series therewith for controlling the control circuit, a generator having a field, said generator being adapted to operate as a motor for cranking the engine and as a generator for supplying current to the work circuit when driven by the engine, means including said current coil responsive to a demand for current of a predetermined value for controlling said control circuit for rendering said engine operative, and said means also including means for controlling said control circuit and said ignition apparatus irrespective of a demand for current for rendering said engine operative, said second named means being arranged for interrupting the generator field while maintaining said engine operative by maintaining said ignition apparatus operative.

In testimony whereof I hereto affix my signature.

WESLEY E. WENDT.