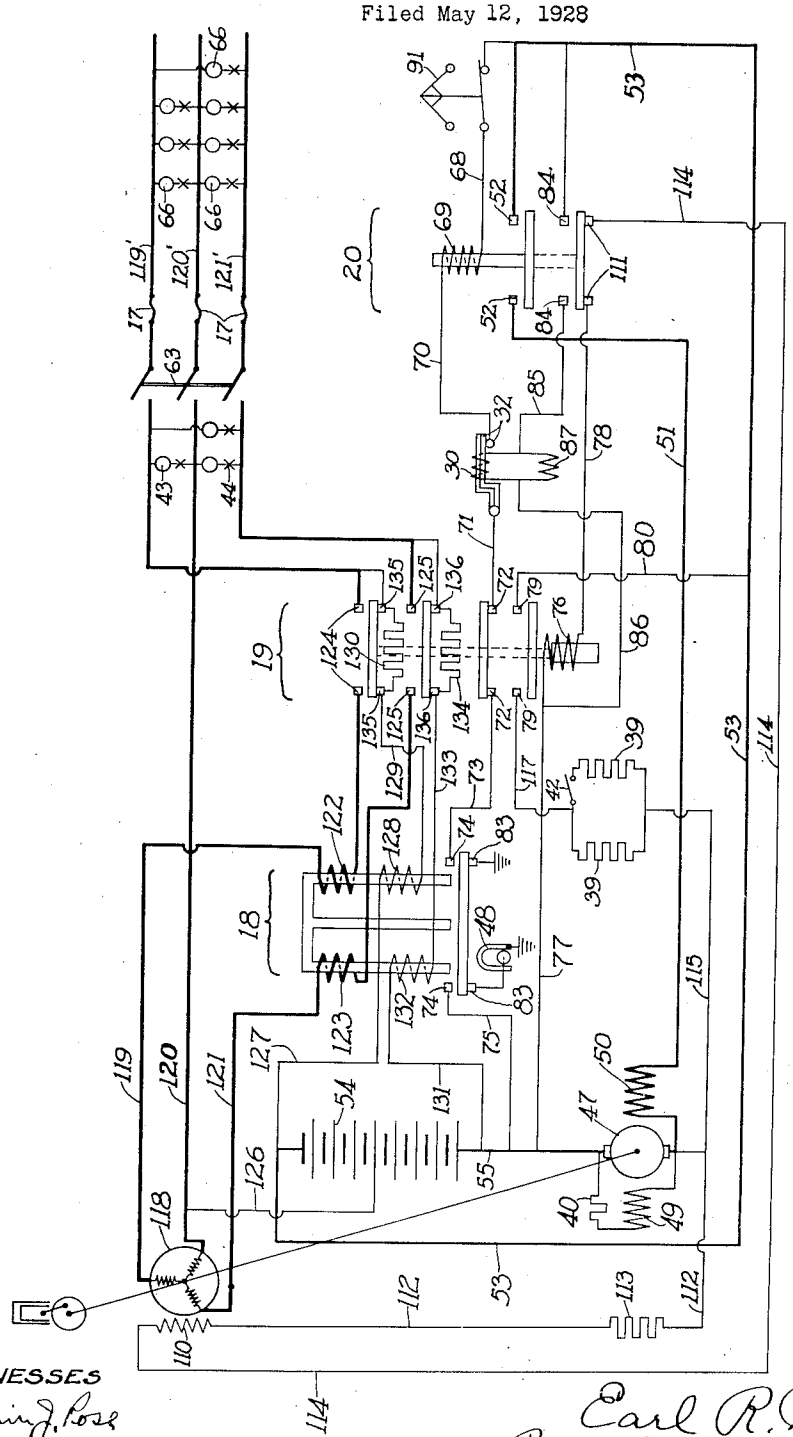
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AUTOMATIC GENERATING PLANT

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WITNESSES

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AUTOMATIC GENERATING PLANT.

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This invention relates to gas-engine-operated generating units of the demand-controlled type and has for its object to provide a unit of this character which will supply alternating current.

Another object of the invention is to provide an automatic unit for supplying current to three-wire distributing mains, controlled by the presence of a demand on any pair of mains.

Another object of the invention is to perfect details of construction of the control mechanism for automatic generating plants having either or both of these characteristics.

Another object of the invention is to use for this purpose, as far as possible, the standardized automatic switching equipment of automatic generating units in general use for supplying direct current to two wire distributing mains.

With the above and other objects in view the invention consists in automatic generating plants as herein claimed and all equivalents.

Referring to the accompanying drawings, the figure constitutes a diagram of circuit connections of an automatic generating plant exemplifying the present invention.

In these drawings the three magnetic switches employed for the automatic control of gas-engine-operated generators are indicated by the reference characters 18, 19 and 20, respectively, the first of which is the control switch for starting or stopping the power plant in the presence or absence of a load on the mains, the second is the generator relay for connecting the service generator with the line when it has attained a functioning speed, and the third is the cranking switch for causing the cranking of the engine. These three switches and their functions correspond closely with present practice in the automatic control of generator units supplying direct current to two-wire distributing mains as, for instance, with the switches designated by the same reference characters in my Patent 1,661,208 for large automatic generating plants, dated March 6, 1928. The differences adapting these switches for use with alternating current and with three-wire distributing mains will appear from the description thereof which follows.

A gas-engine-driven exciter generator is indicated at 47 and the magneto 48 of the gas engine is separated therefrom for convenience. The generator is provided with a shunt field 49 having a resistance element 40 in series therewith.

A series field 50 of the generator, effective when it is operated as a motor for cranking the engine, is connected by a wire 51 with one of the motor starting contacts 52 of the cranking switch 20, the other of said contacts being connected by a wire 53 with one terminal of the storage battery 54, the other terminal of which is connected by a wire 55 with the other terminal of the generator to complete what is herein referred to as the cranking circuit.

A wire 68 leading from the battery terminal lead 53 and containing a governor switch 91 connects with one end of the winding 69 of the cranking switch 20, the other terminal of which is connected by wire 70 to one of the contacts 32 of the thermostatic switch, the other of said contacts being connected by a wire 71 with one of the pair of back contacts 72 of the generator relay 19, the other of which is connected by a wire 73 with one of the pair of contacts 74 of the control switch 18, the other of which contacts is connected by a wire 75 with the other terminal of the battery, thus completing what is herein referred to as the cranking control circuit.

The magnet winding 76 of the generator relay 19 forms a coil across the terminals of the generator with the alternator field winding 110 in series therewith and controlled by back contacts 111 of the cranking switch 20. Its circuit may be traced from one terminal of the generator through wire 112 including a resistance 113 to the alternator field winding 110, and then through wire 114 to one back contact 111 of cranking switch 20, and from the other back contact 111 through wire 78 to winding 76 of the generator relay 19, and from said winding through wire 77 to the other terminal of the generator.

For recharging the battery there is a circuit controlled by the closing of the generator relay 19; from one terminal of the generator through wire 115, a variable charging resistance 39, wire 117 to one contact 79 of generator relay 19, and from the other contact 79 through wire 80 and battery lead 53 to the battery 54, and through wire 55 to the other terminal of the generator. This

is herein referred to as the battery charging circuit and the rate of charge may be varied by the operation of the switch 42, which serves to connect the two resistance units 39 in parallel.

Instead of connecting the generator 47 to the mains to supply the load it is now used only to excite the alternator and to recharge the battery and to operate the generator relay 19. For supplying the load an alternator 118 is used which is driven by the gas engine as indicated by mounting it on the same shaft with the armature of the generator 47. The three-terminal alternator may be three phase, as shown, or it may be two phase or single phase, or the three-wire system may be supplied with current by two direct current generators having the usual three-terminal relation for the Edison three-wire system. Whatever the type of generator that is used for supplying the three-wire leads 119, 120 and 121, the outside wires 119 and 121 respectively include series windings 122 and 123 of the control switch 18, and also pairs of contacts 124 and 125 of generator relay 19, which are closed when said generator relay is operated so as to connect the alternator to the service mains 119′, 120′ and 121′. Between any pair of wires of the service mains may be connected translating devices 66 controlled by their respective switches, the presence of any such load on any pair of service mains being depended on for controlling the operation of the generating unit.

The middle terminal 120 of the alternator is connected by a wire 126 with a middle tap of the battery 54, while the outside terminals 119 and 121 are connected respectively with the opposite terminals of the battery through automatically controlled resistances of generator relay 19 and through coils of control switch 18. A wire 127 leads from one terminal of the battery to a coil 128 of control switch 18, from which a wire 129 including a resistance 130 connects with terminal 119; while a wire 131 leads from the other terminal of the battery to a coil 132 of control switch 18, from which a wire 133 including a resistance 134 connects with terminal 121. The resistances 130 and 134 terminate in back contacts 135 and 136 respectively of the generator relay 19, so that when said generator relay is not operated it serves to bridge said contacts to exclude the resistances, but when the generator relay is operated the resistances are in circuit with the coils 128 and 132.

In order that the power plant may cease to operate when there is no load on the mains, the magneto 48 of the engine is grounded by a pair of back contacts 83 closed by the opening of the control switch 18.

The heating coil 30 of the thermostatic switch for disconnecting the contacts 32 of the cranking circuit when the engine fails to crank within a reasonable time, is in a circuit controlled by the cranking switch 20, which may be traced from the battery through wire 53, contacts 84, wire 85, heating coil 30, and wires 86 and 77 to the battery. Preferably there is also included in this circuit in parallel with the heating coil 30 a magnet coil 87 for operating a carbureter choke to assist in starting the engine.

The service generator or alternator 118 has its three terminals 119, 120 and 121 connected with the service mains 119′, 120′ and 121′ respectively, by means of a knife switch 63 provided with fuses 17, and test lamps 43 controlled by switches 44 connect the three pairs of generator terminals for testing the operation of the unit while the knife switch is open. The knife switch will, of course, remain closed while the generating plant is in service.

In operation, with the power plant at rest, the automatic starting of the unit is accomplished by the closing of any load circuit on any pair of service mains. This causes either the winding 128 or the winding 132 of the control switch 18, or both of them, to become energized to close said control switch. Should the starting demand occur on mains 119′ and 120′, current will flow from the battery through wire 127, winding 128, wire 129, across the bridged contacts 135 to service main 119′, through the load 66 and back through the service main 120′ and wire 126 to the middle tap of the battery. Should the starting demand occur on mains 120′ and 121′ current will flow from the battery through the middle tap 126, to service main 120′, through the load 66, and back through service main 121′, bridged contacts 136, wire 133, winding 132, and wire 131 to the battery. Should the starting demand occur on mains 119′ and 121′, current will flow from the battery through wire 127, winding 128, wire 129, across the bridged contacts 135 to service main 119′, through the load 66, and back through the service main 121′, bridged contacts 136, wire 133, winding 132, and wire 131 to the battery.

The closing of the control switch 18 by energizing either or both of the windings 128 and 132, as above mentioned, removes the ground from the engine magneto 48, so that it may be operative, and closes contacts 74 to establish the cranking control circuit through winding 69 of the cranking switch 20. This causes the cranking switch to close and thereby close the cranking circuit from the battery through the generator 47, which operates as a motor to start the engine. As the engine comes up to speed the governor switch 91 opens the cranking control circuit to interrupt the cranking circuit. When generator 47 functions it energizes the coil 76 to close the generator relay

19, which connects the alternator with the line by closing contacts 124 and 125. This operation also establishes the battery recharging circuit by closing contacts 79.

The alternator now supplies the mains, and though the cranking switch 20 is open, the generator relay 19 and the control switch 18 remain closed, being held so by their windings remaining in circuit. Although the current flow through windings 128 and 132 of the control switch is reduced by the inclusion of resistances 130 and 134 so that it is almost negligible, the current windings 122 and 123, which become energized by the same movement of the generator relay 19 that included said resistances, serve to keep the control switch in its raised or closed position as long as the load remains on the service mains.

With the resistances 130 and 134 in circuit, current passing through windings 128 and 132 is insufficient to operate the control switch, but is sufficient to hold it in its operated position with the aid of either current coil 122 or 123. The current coils 122 and 123 thus control the release of the armature of the control switch 18, permitting it to close the magneto grounding contacts 83 to stop the engine.

The pole piece of the magnet of control switch 18 is preferably provided with a central neutral magnetic leg for any unbalanced flux due to various electrical loads so that the armature will be properly energized at all loads.

By means of this invention the automatic control for direct current two-wire service systems is adapted to three-wire service systems with either direct current or alternating current supply.

What I claim as new and desire to secure by Letters Patent is:

1. An automatic control system for a gas-engine-driven three-terminal generator supplying three-wire service mains, comprising in combination with such generator and service mains, a battery, a control switch, battery circuits between two pairs of the service mains including windings of the control switch to be energized for operating the control switch when either or both of said circuits are completed by the placing of a load on the service mains, a gas-engine ignition circuit and a cranking switch controlled by the control switch, a generator coupled with the gas-engine-driven three-terminal generator and connected by the cranking switch with the battery for cranking the engine, a generator relay operated by the last mentioned generator for connecting the three-terminal generator with the three-wire service mains, and series windings on the control switch included in two of the service mains.

2. An automatic control system for a gas-engine-driven three-terminal alternating current generator supplying three-wire service mains, comprising in combination with such generator and service mains, a battery, a control switch, battery circuits between two pairs of the service mains including windings of the control switch to be energized for operating the control switch when either or both of said circuits are completed by the placing of a load on the service mains, a gas-engine ignition circuit and a cranking switch controlled by the control switch, a generator coupled with the gas-engine-driven three-terminal generator and connected by the cranking switch with the battery for cranking the engine, a generator relay operated by the last mentioned generator for connecting the three-terminal generator with the three-wire service mains and for reducing the current flow through the battery circuits, and series windings on the control switch included in two of the service mains.

3. An automatic control system for a gas-engine-driven three-terminal alternating current generator supplying three-wire service mains, comprising in combination with such generator and service mains, a battery, a control switch, battery circuits between two pairs of the service mains including windings of the control switch to be energized for operating the control switch when either or both of said circuits are completed by the placing of a load on the service mains, a gas-engine ignition circuit and a cranking switch controlled by the control switch, a generator coupled with the gas-engine-driven three-terminal generator and connected by the cranking switch with the battery for cranking the engine, a generator relay operated by the last mentioned generator for connecting the three-terminal generator with the three-wire service mains, resistances in the battery circuits controlled by the generator relay, series windings on the control switch included in two of the service mains, and a field winding for the alternating current generator in circuit with the second mentioned generator to receive current therefrom, the circuits for said field winding and the generator relay being controlled by the cranking switch.

4. An automatic control system for a gas-engine-driven three-terminal alternator supplying three-wire service mains, comprising in combination with such alternator and service mains, a battery, a control switch having a pair of wound pole pieces and a neutral pole piece, battery circuits between two pairs of the service mains including windings of the control switch to be energized for operating the control switch when either or both of said circuits are completed by the placing of a load on the service mains, a gas-engine ignition circuit and a cranking

switch controlled by the control switch, a generator coupled with the gas-engine-driven alternator and connected by the cranking switch with the battery for cranking the engine, a generator relay operated by the generator for connecting the alternator with the three-wire service mains, resistances in the battery circuits controlled by the generator relay, and series windings on the control switch included in two of the service mains.

5. An automatic control system for a gas-engine-driven three-terminal alternator supplying three-wire service mains, comprising in combination with such alternator and service mains, a battery, a control switch having a pair of wound pole pieces and a neutral pole piece, battery circuits between two pairs of the service mains including windings of the control switch to be energized for operating the control switch when either or both of said circuits are completed by the placing of a load on the service mains, a gas-engine ignition circuit controlled by the control switch, a cranking switch in a circuit controlled by the control switch, a generator coupled with the gas-engine-driven alternator and connected by the cranking switch with the battery for cranking the engine, a generator relay operated by the generator for connecting the alternator with the three-wire service mains, resistances in the battery circuits controlled by the generator relay, series windings on the control switch included in two of the service mains, a field winding for the alternator in circuit with the generator to receive current therefrom, the circuits for said field winding and the generator relay being controlled by the cranking switch, a governor switch and a thermostatic switch and an interlock switch of the generator relay being all included in the cranking switch circuit, a circuit including a heating coil for the thermostatic switch and a choker coil and controlled by the cranking switch and supplied by the battery, and a battery-recharging circuit containing variable resistance connecting the battery with the generator and controlled by the generator relay.

In testimony whereof, I affix my signature.

EARL R. WITZEL.