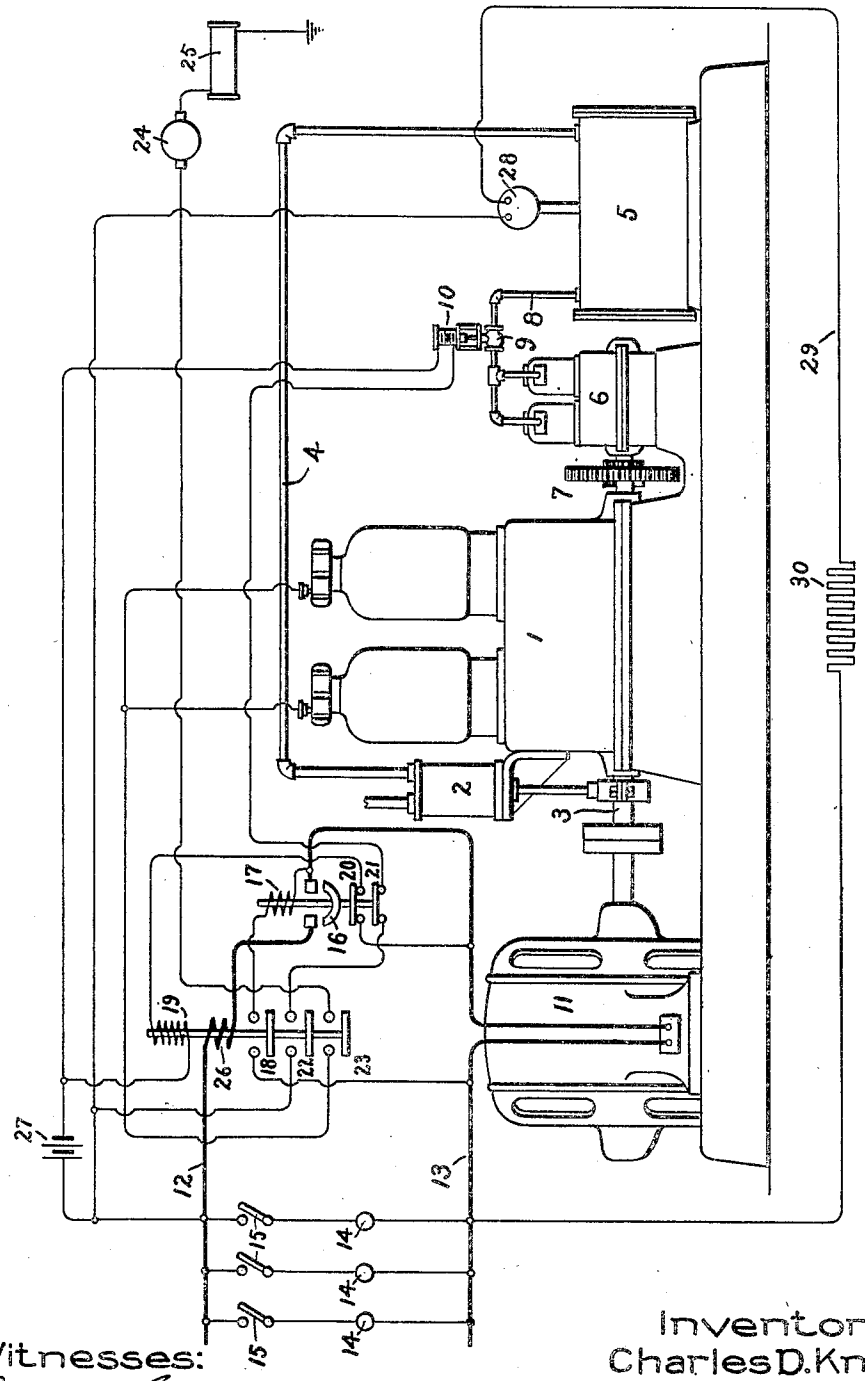
C. D. KNIGHT & W. O. LUM.

SELF STARTING DIRECT CONNECTED GENERATOR.

APPLICATION FILED OCT. 14, 1910.

1,028,364. Patented June 4, 1912.



Witnesses:
J. Ellis Glen.
J. Earl Ryan.

Inventors:
Charles D. Knight,
Walter O. Lum,
by Albert G. Davis
Their Attorney

UNITED STATES PATENT OFFICE.

CHARLES D. KNIGHT, OF SCHENECTADY, AND WALTER O. LUM, OF AMSTERDAM, NEW YORK, ASSIGNORS TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

SELF-STARTING DIRECT-CONNECTED GENERATOR.

1,028,364. Specification of Letters Patent. Patented June 4, 1912.

Application filed October 14, 1910. Serial No. 587,031.

To all whom it may concern:

Be it known that we, CHARLES D. KNIGHT and WALTER O. LUM, citizens of the United States, residing at Schenectady, county of Schenectady, State of New York, and at Amsterdam, county of Montgomery, State of New York, respectively, have invented certain new and useful Improvements in Self-Starting Direct-Connected Generators, of which the following is a specification.

This invention relates to systems of electric distribution in which the generator is driven by an internal combustion engine, and its object is to provide such a system, having a plurality of lamps or other translating devices, with means for automatically starting the engine whenever the first lamp or device is switched on and for automatically stopping the engine when the last device is turned off. An equipment of this kind is of great advantage in isolated lighting systems for houses, stores, and the like, and especially for railway cars, as it takes no power from the locomotive. One or more cars in a train may be equipped, and all the cars may be supplied from one generator, or if desired, each car may have its own equipment, and interconnections may be provided whereby one equipment could supply current for other cars in addition to its own.

The invention contemplates the use of compressed air for starting the engine. In addition to the air tank and the means for storing pressure therein and utilizing it for starting purposes in any suitable manner, we provide also an electrically operated valve for starting, a battery and a relay for closing the circuit of said valve as soon as any translating device in the load circuit is switched on, an electromagnetic line switch controlled by said relay, and interlocks controlled by the line switch for opening the relay circuit and also that of the starting valve. A holding coil in series with the line keeps the relay contacts closed so long as the engine and generator are running.

The accompanying drawing is a diagrammatic representation of a lighting set embodying our improvements.

The engine 1 may be driven by gas, gasolene, oil or alcohol and may be operated on either the two-stroke or four-stroke cycle, as desired. A multi-cylinder engine is preferred because its speed is more uniform. In any event, the engine will of course have the usual speed governor and other accessories, which for the sake of simplicity have been omitted from the drawing. Should there be any objection to tapping one of the engine cylinders in order to obtain the fluid pressure to be stored for starting purposes, a small air pump 2 may be provided, driven from the engine shaft 3 in any suitable manner. The delivery pipe 4 of said pump leads to a closed storage tank 5, and the clearance between the pump piston and the head of its cylinder is preferably so calculated as to prevent the accumulation of abnormal pressure in said tank.

When the engine is of such a design as to prohibit starting by the introduction of the compressed air directly into one or more of the engine cylinders, a small separate air-driven motor 6 is provided, preferably geared to the starting shaft of the engine by spur gear and pinion 7. This motor is connected with the air tank by a pipe 8 controlled by a starting valve 9 which is operated by an electromagnet 10.

The generator 11 is preferably direct connected to the engine. The mains 12 and 13 supply current to the lamps 14 arranged in parallel and each controlled by its individual switch 15, as usual. A line switch 16 controls the main circuit. It is provided with an electromagnet 17 for closing and keeping it closed. The coil of said magnet is connected across the load circuit and is in turn controlled by an interlock 18 operated by a relay 19. The relay coil is controlled by an interlock 20 on the stem of the line switch. The electromagnet 10 of the starting valve is controlled by an interlock 21 on the line switch and also by an interlock 22 on the relay. A third interlock 23 on the relay controls the ignition circuit for the engine, deriving current from the magneto 24 and spark coil 25. The relay is also provided with a holding coil 26 in series with the main 12.

A separate source of current, such as the battery 27, is connected with the electromagnet 10 of the starting valve through the interlocks 21 and 22. One pole of said battery is also connected to the coil of the relay 19 and thence to the main 12 on one side of the line switch. The other pole of said battery is connected to the main 12 on the other side of said line switch.

At 28 is an automatic switch connected across the mains 12 and 13 and adapted to be held open by the air pressure in the tank 5 until said pressure drops below a predetermined minimum, when said switch will close and remain closed until the normal air pressure is restored.

The operation is as follows: The drawing shows the engine at rest, and all the lamps turned off. Now assume that one or more lamps are switched on. This closes a circuit from the battery through the lamp or lamps, the generator, the interlock 20 and the closing coil 19 of the relay, which at once picks up and closes all the interlocks 18, 22 and 23. The ignition circuit of the engine is closed by the interlock 23. Another circuit may also be traced from the battery through the interlock 22, the interlock 21 and the magnet 10 of the starting valve. The energizing of this magnet opens the valve 9 and the air stored in the tank 5 will be admitted to the motor 6, which begins to rotate the engine shaft 3. The tank 5 is of sufficient capacity to supply air to run the motor long enough to insure the starting of the engine. As soon as the generator voltage is sufficient, the coil 17, whose circuit has been closed by the interlock 18, will close the line switch 16, and this operation will lift the interlocks 20 and 21 and open the circuits of the starting valve 9 and the starting coil 19 of the relay. The valve 9 will thereupon drop and stop the air motor. The relay, however, will be held up in closed position by the series holding coil 26, thus keeping the circuit of the coil 17 of the line switch and also the ignition circuit closed through the interlocks 18 and 23, respectively. The lamps can be turned off, one by one, without affecting the operation of the engine, until the last lamp is switched off, open-circuiting the generator. The failure of line current will deënergize the coils 17 and 26, permitting the relay to drop and open the ignition circuit, thereby stopping the engine. At the same time the deënergized coil 17 drops the line switch. The parts then will have returned to the position shown in the drawing, ready to be started into operation again by simply closing one of the lamp switches 15. If at any time while the plant is standing idle the air should leak from the tank sufficiently to reduce the pressure to the minimum at which the automatic switch 28 will close, a circuit can then be traced from the battery 27 through said switch and thence by the conductor 29 and resistance 30 to the main 13, through the generator and the interlock 20 to the relay starting coil 19 and back to the battery. This will cause the relay to pick up and start the engine and air pump 2, which will raise the pressure in the tank until the automatic switch 28 opens this emergency circuit and shuts down the engine. In other words, the switch 28 parallels the operation of cutting a lamp into circuit.

What we claim as new and desire to secure by Letters Patent of the United States, is,—

1. The combination with an electric generator, of an internal combustion engine for driving the same, a source of energy for starting said engine, an electromagnetic device for controlling said energy, a load circuit for said generator, and electromagnetic means for closing the load circuit and simultaneously cutting off the starting energy.

2. The combination with an electric generator, of an internal combustion engine for driving the same, a source of energy for starting said engine, an electromagnetic device for controlling said energy, a load circuit for said generator, and an electromagnetic switch controlled by the potential of said generator arranged to close the load circuit and simultaneously cut off the starting energy.

3. The combination with an electric generator, of an internal combustion engine for driving the same, a source of energy for starting said engine, an electromagnetic device for controlling said energy, a load circuit for said generator having translating devices therein, a switch for each translating device, means for applying the starting energy to the engine when one of said switches is closed, and electromagnetic means for closing the load circuit when the potential of the generator reaches a predetermined value and simultaneously cutting off the starting energy.

4. The combination with an electric generator, of an internal combustion engine for driving the same, a source of energy for starting said engine, an electromagnetic device for controlling said energy, a load circuit having translating devices therein, a switch for each translating device, an electromagnetic switch controlled by the potential of said generator for closing the load circuit, a relay arranged to be operated when a translating device switch is closed, and contacts on said relay controlling the electromagnetic switch.

5. The combination with an electric generator, of an internal combustion engine for driving the same, a source of energy for starting said engine, a load circuit having translating devices therein, a switch for each translating device, an electromagnetic switch for closing the load circuit, a relay arranged to be operated when one of said translating device switches is closed and provided with contacts for controlling the electromagnetic switch and applying starting energy to the generator.

6. The combination with an electric gen-

erator, of an internal combustion engine for driving the same, a source of energy for starting said generator, a load circuit having translating devices therein, a switch for each translating device, an electromagnetic switch controlled by the potential of the generator for closing the load circuit and simultaneously cutting out the starting energy, a relay arranged to be operated when one of the translating device switches is closed and provided with a contact for controlling the electromagnetic switch and applying starting energy to the generator.

7. The combination with an electric generator and an internal combustion engine for driving it, of a source of fluid pressure for starting said engine, an electromagnetic valve controlling said pressure, a main line switch controlling the circuit of said valve, a relay also controlling said circuit, and means for actuating said relay when the load circuit of the generator is closed.

8. The combination with an electric generator and an internal combustion engine for driving it, of a source of fluid pressure for starting said engine, an electromagnetic valve controlling said pressure, a main line switch controlling the circuit of said valve, a relay also controlling said circuit, and means for actuating said relay when the load circuit of the generator is closed, said means comprising a starting coil for said relay, and a separate source of current in series therewith and both connected in shunt to the line switch.

9. The combination with an electric generator and an internal combustion engine for driving it, of a source of fluid pressure for starting said engine, an electromagnetic valve controlling said pressure, a main line switch controlling the circuit of said valve, a relay also controlling said circuit, means for actuating said relay when the load circuit of the generator is closed, said means comprising a starting coil for said relay, a separate source of current in series therewith and both connected in shunt to the line switch, and an interlock on said main line switch for opening the circuit of said starting coil when said line switch is closed.

10. The combination with an electric generator and an internal combustion engine for driving it, of means for automatically starting said engine when the load circuit is closed, a relay for effecting said starting, an electromagnetic line switch, and an interlock operated by said relay and controlling the actuating circuit of said line switch.

11. The combination with an electric generator and an internal combustion engine for driving it, a source of fluid pressure for starting said engine, an electromagnetic valve controlling said fluid pressure, an electromagnetic line switch, a relay having a holding coil in series with the load circuit, a starting coil for said relay, a battery in circuit therewith and with the starting valve, interlocks on said relay controlling the starting valve circuit, the ignition circuit of the engine, and the circuit of the electromagnetic line switch, and interlocks on said line switch controlling the starting valve circuit and the circuit of the starting coil of the relay.

In witness whereof, we have hereunto set our hands this 13th day of October, 1910.

CHARLES D. KNIGHT.
WALTER O. LUM.

Witnesses:
BENJAMIN B. HULL,
HELEN ORFORD.