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J. B. REPLOGLE

ELECTRICITY GENERATING AND STORAGE SYSTEM

Filed March 31, 1920

Fig. 1

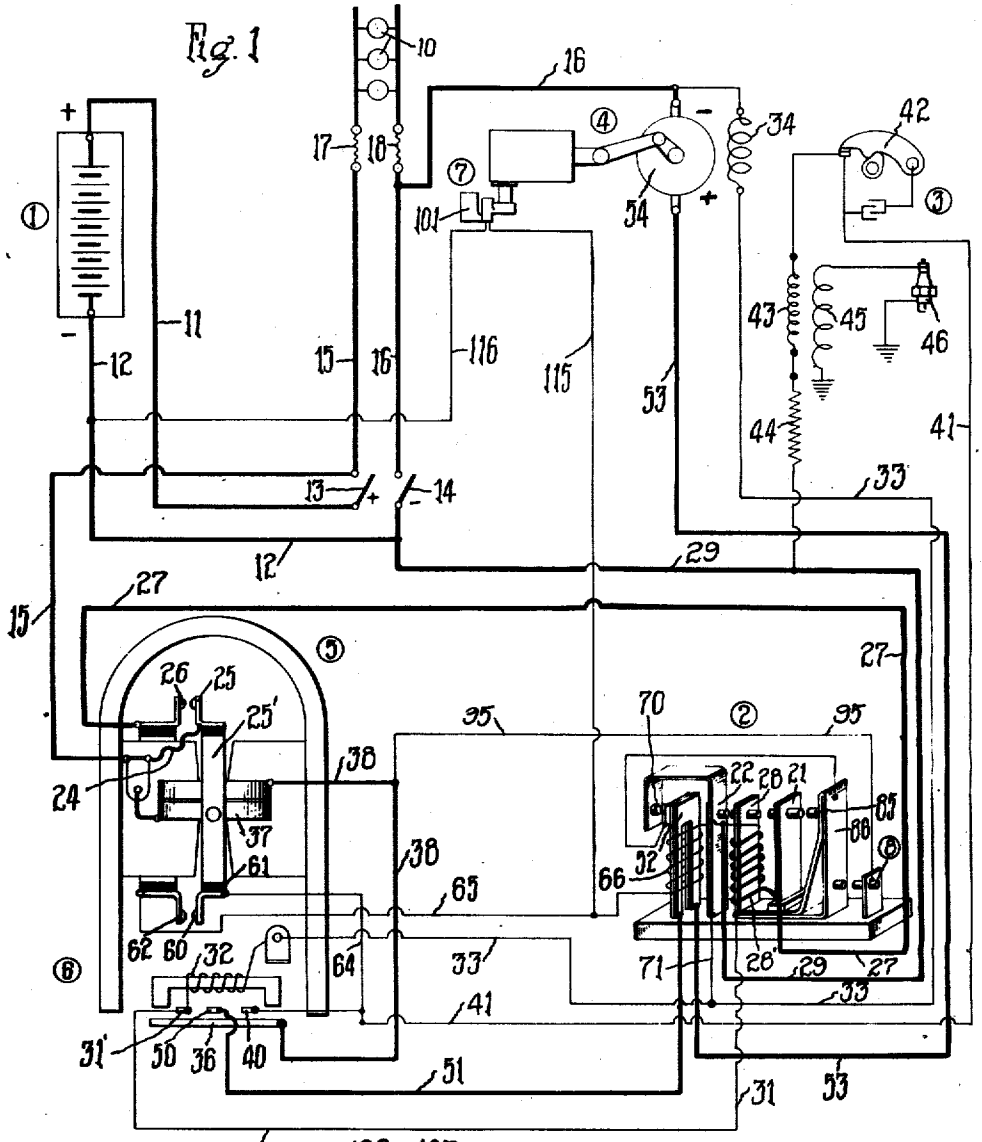
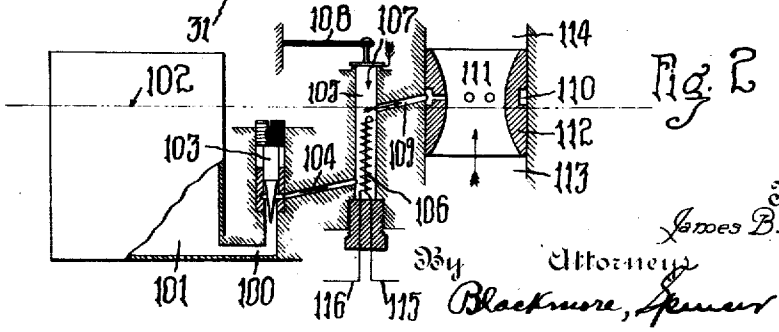


Fig. 2



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UNITED STATES PATENT OFFICE.

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ELECTRICITY GENERATING AND STORAGE SYSTEM.

Application filed March 31, 1920. Serial No. 370,235.

To all whom it may concern:

Be it known that I, JAMES B. REPLOGLE, a citizen of the United States, and a resident of Detroit, county of Wayne, and State of Michigan, have invented certain new and useful Improvements in Electricity Generating and Storage Systems, of which the following is a full, clear, concise, and exact description, such as will enable others skilled in the art to which the invention relates to make and use the same, reference being made therein to the accompanying drawings, which form a part of this specification.

The present invention relates to a system of generating and storing electricity wherein an internal combustion engine is automatically set in operation to cause the generation of electricity for charging a battery whenever the electrical condition of the latter demands such action, and wherein the engine is shut down when the electrical condition of the battery is restored to normal; and its object is to insure better starting and running conditions, in so far as the vaporization of fuel is concerned, than has been attained heretofore.

To this end the invention provides automatic means so constructed and arranged as to heat the fuel or fuel mixture when the engine is being cranked for starting purposes. Again, the invention provides manually controlled means superposed on the automatic engine starting means and available for starting the engine, together with means automatically operating to heat the fuel or fuel mixture under such conditions.

By the use of an electric heater operating in the general manner stated the desired results are attained with a minimum expenditure of energy, but it is possible to employ other types of heaters in the same general relation.

In the drawings:

Fig. 1 shows the complete circuit, the various component elements or devices appearing diagrammatically. These features of construction otherwise than the heater and heater circuit, are substantially the same as described and covered by application for U. S. Patent, Serial No. 298,160 filed May 19, 1919 by James B. Replogle and John M. Lea.

Fig. 2 is a diagrammatic sectional view showing the preferred relation of the heater to the carbureter.

In order to understand the present invention, it will be necessary to refer to the main constituent elements of the apparatus as a whole, that is, the basic elements covered by the above identified application, as well as the additional and modifying features entering more particularly into the present case. These are:

1st. The storage battery (1).

2nd. A temperature compensated voltage control device, a thermostatic safety cut-out and a minimum environment temperature control device which are preferably embodied in a single piece of apparatus (2). This apparatus is made up primarily of four thermostatic blades mounted on a single base and having their metals or thermal elements arranged in the same order.

The purpose of the voltage control device is to initiate the starting of an engine-generator unit to supply current to the battery when the voltage of the latter falls to a predetermined value and to interrupt the charging operation when the voltage attains a predetermined high value; that of the thermostatic safety cut-out is to interrupt the supply of current to the starting motor in the event the engine fails to start and to break the main circuits generally under abnormal conditions; and that of the environment temperature control device is to initiate the operation of the engine for self-heating whenever the surrounding temperature falls below a predetermined exceptional and undesirable minimum. It will be understood, however, that the present invention is of application to systems wherein these general functions are accomplished in other ways or wherein no full equivalent is found, for example, wherein the environment temperature control device is omitted.

3rd. An ignition apparatus (3) so arranged that it will function on a voltage between the limits at which the battery is to be maintained.

4th. A generator-engine unit (4) the generator part of which has sufficient energy to crank the engine properly when running as a motor connected to the battery, and which will deliver the proper current when driven by the engine as a generator.

5th. A polarized relay (5) for rendering the thermostatic safety cut-out inoperative except when current flows from the battery to the generator acting as a motor to crank the engine.

6th. A main contactor or switch (6) which is adapted to connect the battery with the engine and to supply current to the ignition circuit.

In accordance with the present invention, I associate with the above-mentioned elements a carbureter heater of such nature that the fuel mixture is heated under the conditions heretofore stated. The actual construction of the heater is, of course, subject to wide variation, but I prefer to arrange the part in the manner diagrammatically shown in Fig. 2 wherein 100 indicates a passage leading to a source of fuel supply such as the chamber 101 wherein the fuel is maintained at about the level of the line 102, by any desired means (not shown). From the passage 100, the fuel flows past the regulating valve 103 and through the passage 104 to the well 105 wherein the resistance coil or heater 106 extends below the normal level of the fuel, the upper end of said well being restricted more or less in its communication with the atmosphere by the valve 107 which is operated by the thermostat 108. The rich mixture of fuel and air derived from the well is drawn through the mixture passage 109, the groove 110 and ports 111 to the venturi 112 where it mixes with the main air supply entering through the passage 113 and flows to the engine through the main mixture passage 114. Under conditions of relatively high temperature, the valve 107 opens to a relatively large extent as compared to its opening when the temperature is relatively low, consequently the mixture supplied the engine is automatically rendered richer as the temperature falls.

The co-ordination and operation of the various parts may be more fully pointed out, it being understood that the battery is connected to the power consuming devices, for example, the lights 10, through the medium of the conductors 11—12, the blades 13—14 of a double pole service switch, the conductors 15—16, and the fuses 17—18.

Normal thermostat heating circuit, voltage within proper limits,

Assuming that the voltage of the battery (1) is within the limits to which the low voltage thermostat blade 21 and the high voltage thermostat blade 22 are adjusted, say 102 volts and 122 volts in the event the power consuming devices are of the 110 volt type, and that the armature of the polarized relay (5) is in counterclockwise position, current will flow from the positive pole of the battery through the conductor 11—13—15, the conductor 24, the contact 25 of the polarized relay (5), the contact 26, and the conductor 27 to the blade 21, through the winding 28′ of the thermostat blade 28 and the conductor 29—12 back to the battery. The heating coil or winding 28′ is thus connected directly across the battery terminals and heats the blade 28 more or less according as the battery voltage is high or low. High battery voltage will cause blade 28 to be heated above normal and thus deflected towards blade 22 and low battery voltage results in a subnormal temperature of the blade 28 which causes it to be deflected towards blade 21.

Voltage low, thermostat directing current through main contactor winding and generator field.

The voltage in the battery dropping to the permissible minimum (102 in the case stated), the thermostat blade 28 makes contact with the blade 21, and a flow of current takes place from the positive pole of the battery to blade 21, as above described, thence through blade 28, conductor 31, the winding 32 of the relay or main contactor (6), the conductor 33, field 34 of the generator (4), and the conductor 16—14—12 back to the negative side of the battery, thereby exciting the field of the generator and energizing contactor winding 32 which attracts the armature 36 to establish the following conditions.

Field circuit after main contactor or relay operates.

When armature 36 is attracted, current from the positive side of the battery (1) flows through the conductor 15, the series winding 37 of the polarized relay (5), and the conductor 38 to the bar 36 of the main contactor (6), (the conductor 38 being always in electrical connection with the bar 36), and thence through the coil 32 and conductor 33 to the field 34 of the generator to the negative side of the battery as already described.

It will be observed that this circuit gives an alternate path for the current which travels through contact 25 and thermostat blades 21—28; therefore should the wound blade 28 be withdrawn from contact with the blade 21 or the circuit be broken at 25, rupture of the generator field current will not result.

Ignition circuit

Current from the positive side of the battery also passes from the bar 36 through the contact 40, conductor 41, breaker 42, primary coil 43, resistance unit or coil 44 and conductor 29—12 to the negative side of the battery, and acts on the secondary coil 45 and spark plug 46. If the engine

and associated parts are in normal operating condition, the ignition will be in position to cause the operation of the engine on the latter being cranked.

Armature circuit and safety cut-out circuits.

The current flows at the same time from the bar 36 through the contact 50 and conductor 51, through the furcations of the blade 52 of the thermal safety cut-out device, conductor 53, armature 54 of the generator (4), and conductor 16 to the negative side of the battery. This circuit connecting the relay winding 37, bar armature 36, thermostat blade 52, and generator armature 54 in series with the battery, is shown in heavy lines in Fig. 1 and may be termed the charging circuit. Relay winding 37, bar armature 36, and thermostat blade 52, being connected between the positive poles of the battery 1 and generator 54, are said to be in the positive side of the charging circuit.

The field 34 having previously been excited, as explained heretofore, the current passing through the armature 54 causes it to act as a motor, cranking the engine to which it is attached.

The current flowing for motoring purposes, however, swings the armature 25′ of the polarized relay (5) clockwise, to cause the contact 60 (carried thereby and insulated therefrom at 61) to touch the rigid back contact 62, and thereby send current from the bar 36 through contact 40, conductor 64, contacts 60—62, conductor 65 to the winding 66 of thermostat blade 52, from which it passes to the negative side of the battery through the conductor 29—12. At the same time current is directed through the conductor 115 to the heater 106, whereby the fuel passing to the engine is heated, and thence through the conductor 116—12 back to the battery. Winding 66 and heater 106 are thus connected in parallel with one another across the terminals of the battery.

The bifurcated thermostat element 52 is of course heated through the winding 66, and approaches the overhanging contact 70, which is mechanically and electrically connected to the high voltage blade 22. If the generator should be driven as a motor for more than a predetermined time, say one minute, the element 52 will make contact with the contact 70, in which case current will flow from the positive side of the battery through coil 37 of the polarized relay and armature or bar 36 and one side of the bifurcated blade 52 on the positive side of the charging circuit, and thence through contact 70, high voltage blade 22, conductor 71—33, generator field 34 and conductor 16—14—12 to the negative side of the battery. Inasmuch as this circuit is in parallel with the winding 32 of the main contactor (6), and is of relatively small resistance, current will be diverted from the latter and the bar or armature 36 will drop or open and disconnect the battery, ignition and generator from their respective contacts and break the circuit through the heater 106 to insure against loss of current when the generator is not operating as a motor.

Battery charged to maximum. System automatically disconnected.

Should the engine become self-operative before the safety cut-out operates as above described, the dynamo-electric machine (4), functioning as a generator, will cause a reversal of current in the charging circuit, so that current will then flow from the dynamo-electric machine (4) through bar armature 36 and winding 37 of polarized relay (5) to charge the battery. Such reversal of current in winding 37 causes armature 25′ to swing in a counter-clockwise direction back to its original position, thereby breaking the circuits through contacts 60—62 to heater 106 and winding 66 of the safety cut-out device, and at the same time reestablishing the original thermostat heating circuit through contacts 25—26 from positive side of the battery through heating coil 28′ on thermostat blade 28 to the negative side of the battery. The armature 25′ remains in its counter-clockwise position during the entire time that the dynamo-electric machine operates as a generator, and thus winding 28′ of thermostat blade 28 is connected across the battery while the battery is being charged. When through the charging operation the battery shall have reached the desired maximum voltage, the current through winding 28′ will attain such value that the temperature produced thereby will cause the blade 28 to approach and finally effect a contact with the blade 22.

When this takes place, the current departing from the positive side of the charging circuit at contact 31′, passes through conductor 31, to the wound voltage control blade 28, to and through the high voltage blade 22, conductor 71—33, generator field 34, and conductor 16—14—12 to the negative side of the battery. The current is thus diverted from the winding 32 of the main contactor (6); it therefore de-energizes, and permits the bar armature 36 to fall away from the contact 50, thereby opening the charging circuit at this point and disconnecting the battery from the generator. Falling away of the bar armature as described opens the engine ignition circuit at contact 40 thereby causing the engine to stop, and also opens the control circuits connected to contact 31′.

When the charging circuit is thus broken in response to the state of charge of the battery, it will be observed that the armature

25′ of polarized relay (5) remains in the counter-clockwise position which it assumed when the dynamo-electric machine (4) became operative as a generator to charge the battery, and the contacts 25—26 remain closed. The thermostat heating circuit is thus connected across the terminals of the battery and the winding 28′ remains operative to move the voltage control blade 28 into contact with the low-voltage blade 21 whenever the battery voltage falls to a predetermined low point, whereby to again set the engine in operation to charge the battery in the manner already described.

Minimum environment temperature control circuit.

In the event the environment temperature were permitted to fall too low, the system might fail to start or might become inefficient through any one of the several causes, such, for example, as the failure of the fuel to properly vaporize, the congealing of the cooling oil or other liquid for the engine, or the freezing and consequent destruction or impairing of the battery. Moreover, even where freezing does not take place, the internal resistance of a battery increases rapidly as the temperature falls, and it becomes desirable, therefore, where the likelihood of objectionably low temperature exists, to provide for starting up the engine whenever the temperature falls to a minimum predetermined safe point, so that the resulting engine heat may serve to maintain the immediate surroundings above the danger line.

This is accomplished in the present case by providing a rigid or temperature-independent contact 85, adapted to co-operate with the blade 21 at the predetermined minimum temperature to complete the initial starting circuit through the main contactor winding and generator field as follows: from the positive side of the battery through conductor 11—13—15, contact 25, contact 26, conductor 27, blade 21, contact 85, blade 86, conductor 31, winding 32, conductor 33, generator field 34, and conductor 16—14—12 to the negative side of the battery, whereupon the engine will start in the manner heretofore described and will continue to run until the blade 28 connects with the high voltage blade 22, as will be readily understood from the foregoing.

In this operation it will be noticed that current is supplied the heater 106 and finally cut off therefrom in the same general manner heretofore outlined with reference to the starting through the medium of the voltage control apparatus; i. e., the heater is heated only during the period in which the dynamo-electric machine operates as a motor to start the engine and the heater circuit is broken when the motoring ceases, that is, when the dynamo-electric machine operates as a generator to charge the battery, as heretofore described.

Manual starting circuit

In the event the system is disconnected through the operation of the safety cut out thermostat 52, the armature 25′ will be left in clockwise position as is more fully explained in the above identified application; and the circuits thus far described contain no means whereby the engine may again be manually started (except that the user might manually act directly on the armature to swing the latter) something which is desirable for obvious reasons, particularly when the failure is due to lack of fuel. It is, therefore, advisable to provide for conveniently manually starting the dynamo-electric machine as a motor to crank the engine, after which the voltage control blade 28 will contact with the high voltage blade 22 to cause the dis-connection of the system, as an incident to which the armature remains in counterclockwise position. One inexpensive and suitable means for accomplishing the desired purpose consists in a push botton or switch (8), connected to the positive side of the battery by the conductor 95 and adapted to complete a field and main contactor winding circuit through the conductor 86, conductor 31, main contactor winding 32, conductor 33, generator field 34, and conductor 16—14—12 to the negative side of the battery, whereupon the bar 36 closes upon its contacts to complete the charging circuit and the ignition circuit, as will be readily understood. Immediately when this takes place, current flowing from the battery to the generator for motoring purposes insures the positioning of the armature 25′ at the limit of its clockwise movement and current passing through the bar 36, the conductor 64, contacts 60—62 and conductor 65—115, heats the element 106. The current thus supplied the heater is ultimately cut-off in the manner heretofore indicated.

In other words, the heater is effective for vaporizing the fuel whenever the current flows from the battery to the generator for motoring purposes. The safety cut-out circuit through winding 66 is also closed at the same time as the circuit through the heating element 106. It is obvious that the minimum environment temperature control features might in some instances be omitted; likewise the manual starting switch (8), since the armature 25′ might be thrown to counterclockwise position by hand; and the actual details of the several parts may be modified or other equivalent units substituted therefor without sacrificing many of the advantages of the invention.

In the present state of the art it is of

course somewhat a matter of choice whether to employ starting and generating sets of the single unit type such as shown (wherein a single rotor operates both for starting and for generating) or of the double unit type wherein the starting device is separate from the generator, both types being well known in automotive service. The particular mechanism shown may therefore be regarded as comprising two electrical machines one of which operates as a starting motor and the other of which acts as a generator.

I claim:

1. An electricity generating and storage system comprising a battery, a hydro-carbon engine, a generator adapted to operate as a motor to crank the engine and to be driven thereby to charge the battery, an electric heater for the fuel passing to the engine, and automatic means for controlling the operation of the generator and engine in accordance with the electrical condition of the battery to maintain the latter within predetermined limits of voltage, means for initiating the operation of the generator to crank the engine when the environment temperature falls to a predetermined minimum and for substantially simultaneously initiating the flow of current to the heater to heat the latter.

2. In combination, a hydro-carbon engine including means for supplying an explosive fuel mixture thereto, a starting motor therefor, a supply circuit for the motor including a storage battery, means responsive to the condition of charge of the battery for controlling said circuit to initiate the operation of the engine, and thermostatic means for automatically initiating the operation of the engine at a predetermined temperature with a fuel mixture predetermined for the said temperature.

3. In an apparatus of the kind described, in combination, an engine including means for supplying an explosive mixture thereto, a starting motor therefor, a supply circuit for the motor, and means for connecting the motor with the supply circuit at intervals varying inversely with the temperature of the apparatus, said means having provisions for automatically varying the explosive mixture supplied to the engine according to the temperature of the apparatus.

4. In an apparatus of the kind described, in combination, an engine including means for supplying an explosive mixture thereto, a starting motor therefor, a supply circuit for the motor, and thermostatic means for connecting the motor with the supply circuit at intervals varying inversely with the temperature of the apparatus, said means having provisions for automatically varying the explosive mixture supplied to the engine according to the temperature of the apparatus.

In testimony whereof I affix my signature.

JAMES B. REPLOGLE.