

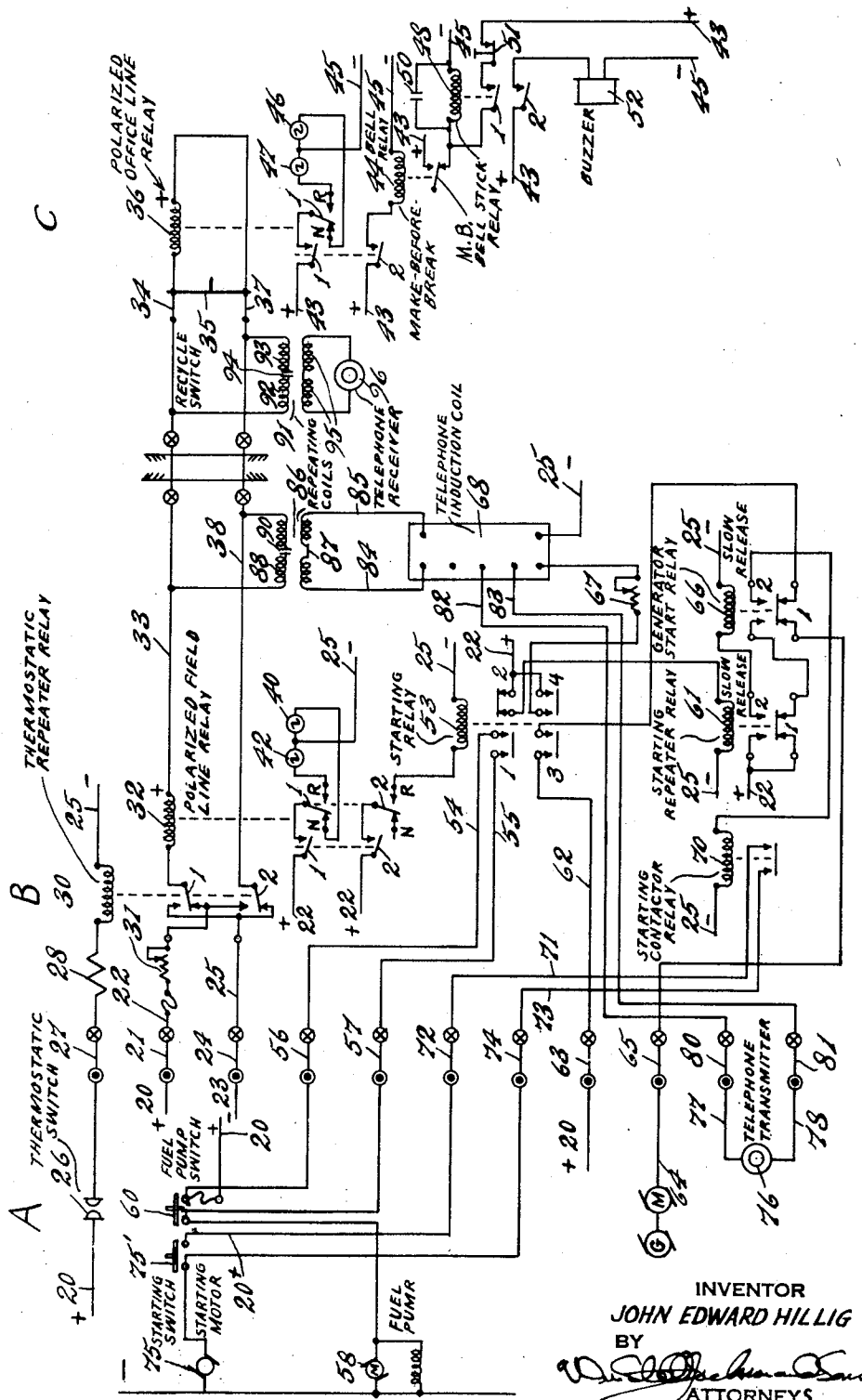
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REMOTE STOP-START SYSTEM FOR DIESEL ENGINE

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REMOTE STOP-START SYSTEM FOR DIESEL ENGINE

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13 Claims. (Cl. 290—2)

The present invention relates to a system to maintain a predetermined temperature on a diesel engine located at a remote point.

This application has been divided and the subject matter of the time delay circuit is embodied in co-pending application Serial No. 786,855, filed January 14, 1959, for Remote Stop-Start System for Diesel Engine.

The purpose of the invention is to insure that a diesel engine, especially a diesel locomotive, will at all times be held at a temperature within normal operating range.

A further purpose is to start a diesel engine at predetermined intervals during idle periods in response to the temperature drop in the engine, without requiring that personnel be normally present at the diesel location.

A further purpose is to provide personnel at a remote location with continuous detailed information as to the condition of a remotely located diesel engine, including information as to whether the temperature is above or below a predetermined temperature, as to whether or not the diesel engine is operating, and as to whether the indicating system is itself fully operative, or has undergone any change.

A further purpose is to start the fuel pump on a diesel engine when the temperature drops below a predetermined level, and after a desired interval of fuel pump operation, to operate the engine starter and then cut off the starter after a desired starting time.

A further purpose is to provide audible means for determining the condition of the diesel engine at a remote location, permitting observation of the sound of engine operation, whether normal or abnormal, as well as the sound made in starting.

A further purpose is to require acknowledgment of an indication as to changed condition of a diesel engine by remotely located personnel.

Further purposes appear in the specification and in the claims.

In the drawings I have chosen to illustrate one only of the numerous embodiments in which the invention may appear, selecting the form shown from the standpoints of convenience in illustration, satisfactory operation, clear demonstration of the principles involved.

The drawing is an electrical circuit diagram useful in explaining the invention.

In the prior art considerable difficulty has been encountered in cool and cold weather due to the fact that diesel engines, especially diesel locomotives, lose temperature rather rapidly during storage, and may fall to a temperature which is either so low that starting by usual methods is impractical, or even to a temperature at which freezing of water systems is likely to occur.

The present invention automatically protects against any such difficulty by automatically starting and stopping a diesel locomotive to control the temperature and maintain it between predetermined limits, which will protect against freezing, and which will provide the temperature most favorable for restarting.

The system of the invention makes it possible not only

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to determine when the starting functions are taking place, but also to establish when the diesel engine has actually started, and guard against running down the battery in case the diesel engine fails to start promptly.

The invention also provides information constantly available at a remote location such as an operation office, as to whether or not the electrical system itself is in good operating condition, or whether on the other hand some trouble such as an open circuit or a shunt has developed.

In accordance with the invention, I provide equipment at the diesel engine at location A, equipment at a convenient wayside point at location B, and equipment at an office at location C, the locations A, B and C being connected by a pair of wires, as later described.

The diesel engine battery positive connection 20 is made through plug connector 21 to lead 22, and the diesel engine battery negative connection 23 is made through plug connector 24 to lead 25. Located suitably in the diesel cooling system is a thermostatic switch 26, which is connected to the positive side of the diesel battery at 20, and through plug connector 27 and current limiting resistor 28 connects to the coil of tractive type thermostat repeater relay 30 which has first and second nonindependent front and back contacts. The opposite side of the relay coil is connected to the negative side of the battery by lead 25.

From lead 22 to a suitable fuse the positive side of the battery is connected through adjustable current limiting resistor 31 to the thermostat repeater relay back contact 30-1 and to relay front contact 30-2. Similarly the negative lead 25 is connected to relay front contact 30-1 and to relay back contact 30-2. Thermostat repeater relay movable contact 30-1 is connected to the coil of field line relay 32, the opposite side of which is connected to line 33, which extends through one of the poles 34 of recycle switch 35 and then through the coil of office line relay 36, then through the opposite pole 37 of recycle switch 35 and through line 38 back to thermostat repeater relay movable contact 30-2.

Field line relay 32 is a polarized relay having two front contacts and two nonindependent polar normal and reverse contacts. The No. 1 normally open neutral contact is connected between plus battery lead 22 on the one side and normal polar movable contact No. 1 on the other side. Normally open neutral contact No. 2 is connected between plus battery lead 22 on the one side and normal polar movable contact No. 2 on the other side. Normal polar fixed contact No. 1 is connected to hot indicator (suitably a lamp) 40, the opposite side of the hot indicator being connected to negative battery lead 25. Reverse polar fixed contact No. 1 is connected at one side to cold indicator (suitably a lamp) 42, the opposite side of the cold indicator being connected to the negative battery lead 25.

At the office, the office line relay 36 may conveniently be a duplicate of the field line relay but with only one set of polar contacts. Normally open neutral contact No. 1 of the office line relay 36 is connected at one side to the positive side of office battery 43, and at the other side to polar movable contact No. 1. Normally open neutral contact No. 2 of office line relay 36 is connected at one side to the positive office battery 43 and at the opposite side to the coil of bell relay 44, whose opposite side is connected to negative office battery 45.

Polar fixed contact N1 of office line relay 36 is connected to one side of hot indicator (suitably a lamp) 46, the opposite side of which goes to negative side 45 of the office battery. Polar fixed contact R1 of office line relay 36 is connected to one side of the cold indicator (suitably a lamp) 47, the opposite side of which is connected to the negative side 45 of the office battery. Bell relay 44

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is a traction relay with a make-before-break contact on both opening and closing. The front contact of the bell relay 44 is connected to the positive side 43 of the office battery and the back contact of this relay is connected to the coil of bell stick relay 48, the opposite side of which is connected to the negative office battery 45.

The coil of bell stick relay 48 is shunted by capacitor 50. Normally open No. 1 contact of bell stick relay 48 is connected at one side to the back contact of bell relay 44 and at the other side to acknowledging push button 51 and then to the positive side 43 of the office battery.

One side of normally open bell stick relay contact No. 2 is connected to the positive side 43 of office battery and the opposite side is connected through buzzer 52 to the negative side 45 of the office battery.

The No. 2 polar reverse fixed contact R2 of field line relay 32 is connected to one side of the coil of starting relay 53, the opposite side of which is connected to the negative side 25 of the diesel battery.

The starting relay 53 has four sets of contacts, three of which are normally open and one of which is normally closed. Normally open contacts No. 1 connect through leads 54 and 55 and plug connectors 56 and 57 respectively to the positive side of battery 20 and to the diesel fuel pump motor 58, the opposite side of the motor connecting to negative battery. The usual diesel fuel pump operating switch 60 is shown.

Normally closed contacts No. 2 of starting relay 53 connect at one side to the positive side of the battery 22, and also to one side of normally open contacts No. 4 and at the other side connect to one side of starting repeater relay 61, the opposite side of which connects to negative battery lead 25. Normally open contacts No. 3 of the starting relay connect at one side to lead 62 which connects through plug connector 63 to positive battery 20. The opposite one of the contacts No. 3 of starting relay 53 connects to one of the normally closed contacts No. 1 of generator start relay 66.

The opposite one of the normally open contacts No. 4 of starting relay 53 from the one described above connects through current limiting resistor 67 to the power supply of induction coil 68 of the telephone communication system, to energize such system, the opposite side of this winding being connected to negative battery lead 25.

The starting repeater relay 61 is a time delay relay having regular pick up and slow release as well known in the art. The positive side 22 of the battery is connected to one of the normally closed contacts No. 1 and one of the normally open contacts No. 2 of the starting repeater relay. The opposite contact No. 1 of the starting repeater relay is connected to one of the normally open contacts No. 2 of the generator start relay 66. The opposite one of contacts No. 2 of the starting repeater relay is connected to one side of the coil of the generator start relay 66, the opposite side of which is connected to the negative lead 25 of the battery.

The generator start relay 66 is a tractive type relay with a time delay, having regular pick up and slow release. The contact No. 1 opposite to that described connects through plug connector 65 to one side of the starting motor on the motor-generator set 64, the opposite side of which is connected to negative battery. The contact No. 2 opposite from that described, connects with one side of the coil of starting contactor relay 70, the opposite side of which is connected to the negative lead 25 of the battery. The starting contactor relay 70 is a tractive type having one set of normally open contacts, which are connected respectively through lead 71 and plug connector 72 to the positive side 20 of the battery, and through lead 73 and plug connector 74 with the starting motor 75 whose opposite side is con-

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nected to negative battery. A usual starting switch is shown at 75'.

It will be evident that the system includes a telephone transmitter 76 which is placed in the diesel adjacent to the starting functions, having lines 77 and 78 which connect through plug connectors 80 and 81 with lines 82 and 83 which are connected with the input taps of the telephone induction coil 68. The telephone induction coil output taps are connected by leads 84 and 85 to a repeater coil 86, including primary windings 87 and secondary windings 88 spaced by an internal capacitor 90. The secondary windings are connected across the lines 33 and 38.

At the office, a repeater coil 91 has its coils 92 and 93 and series internal capacitor 94 connected across the lines 33 and 38, and on the other side the coils 95 are connected to telephone receiver 96.

Operation

Assuming that the diesel locomotive arrives at its terminal point, and is to remain idle, the plug connectors are inserted to interconnect the diesel locomotive itself, including the equipment shown at A, with the wayside.

Prior to the connection of the plug connectors, there has been no operative electrical connection in the system, and the indicators at the wayside and at the office have indicated the fact that no connection has been made to the diesel. All relays are then deenergized. The system can at any later stage be restored to inactive position by opening switch 35.

Initially assuming that the temperature of the diesel water is at or above the predetermined temperature, the contacts of the thermostatic switch are closed, but on the other hand if the temperature of the diesel water drops below the predetermined temperature, the thermostatic switch opens.

When the coupling is made between the diesel engine and the wayside station, the line is energized, and field line relay 32 and office line relay 36 are energized, but being polar, assume a position which is determined by the polarity established by the thermostat repeater relay 30. If it be assumed first that the temperature of the diesel water is at or above the predetermined temperature, thermostatic switch contacts 26 are closed and thermostat repeater relay 30 is energized so that the field line relay and the office line relay close their normal polar and front neutral contacts. Thus current flows from the positive side of the battery through current limiting resistor 31, No. 2 front contact of thermostat repeater relay 30, line 38, switch pole 37, office line relay 36, switch pole 34, line 33, field line relay 32, No. 1 front contact of thermostat repeater relay 30 and negative side of battery.

When the office line relay 36 is energized, it closes its No. 1 front neutral contact and its No. 1 normal polar contact, energizing the hot indicator, suitably an electric light. At the same time the office line relay closed its No. 2 neutral contact, energizing the bell relay 44, which energizes the bell stick relay 48 during transit by means of its make-before-break contact. The energization of the bell stick relay 48 closes its No. 1 contact which acts as a hold contact since it is in circuit between the positive side of the battery through acknowledgement push button 51 to the coil of the bell stick relay and the opposite side of the battery. Energization of the bell stick relay also closes its No. 2 contact connecting the battery to the bell or other audible signal 52.

Thus it will be evident that when a changed condition appears there will not only be a visible showing of the condition as by the indicator 46, but also an audible signal which will remain to proclaim the existence of a change until it is acknowledged by personnel in the office through opening the push button switch 51, which

permits the bell stick relay to drop out and the buzzer to cease operation.

On the other hand, if there should be any condition which either shorts the line or provides an open circuit in the line, these indications will not exist and office personnel will be aware of the fact through the absence of an indication. If the open circuit or shunt should occur and should cause the office line relay to energize, the make-before-break contact of the bell relay causes the bell stick relay to pick up and remain energized until acknowledgement takes place.

When the field line relay 32 is energized, its No. 1 neutral contact is closed, energizing the hot indicator 40, suitably a light, by means of the normal No. 1 polar contact. At the same time, neutral contact No. 2 closes but no circuit can be completed since the normal No. 2 contact is not being used.

It will be evident that the operation of one of the indicator lights 40 or 42 serves not only to indicate the temperature condition but demonstrates to the train conductor that the system is properly connected.

When the plug connectors have been connected, the starting relay 53 through the normally closed No. 2 contact energizes the starting repeater relay coil 61 and by closing the No. 2 contacts of this relay energizes the coil of the generator start relay 66 so that these relays are energized as long as the water temperature remains warm. Although these relays 61 and 62 have a slow release, they are of the well known type which have an instantaneous pick-up.

When the diesel water temperature drops below the desired temperature level, the thermostatic switch 26 opens and deenergizes the thermostat repeater relay 30, which shifts the line polarity to the field line relay and office line relay. Accordingly the field line relay and office line relay now receive current of opposite polarity, shifting their polar contacts to the reverse position. At the office line relay this causes the No. 1 neutral contact to close, energizing cold indicator 47 through the No. 1 reverse polar contact. Likewise the procedure previously explained of closing the bell relay and bell stick relay occurs, as with every change in the system, and the buzzer continues to operate until acknowledged. At the field line relay 32, No. 1 neutral contact closes and energizes the cold indicator 42 through the No. 1 reverse polar contact. No. 2 neutral contacts close and energize the starting relay 53 through the No. 2 reverse polar contact. The energization of the starting relay 53 closes its No. 1 contacts and causes the fuel pump motor to start. This also opens its No. 2 contacts, deenergizing the starting repeater relay 61 which begins to drop, but is delayed by the time delay (which may be a pneumatic cylinder as well known). This time delay is sufficient to allow the fuel pump to build up the required pressure before operating the starter of the diesel.

After the time delay on the opening of the starting repeater relay 61 has terminated, it opens its No. 2 front contacts, deenergizing the generator start relay 66 and closing its No. 1 contacts. The generator start relay 66 itself has a time delay (which may be a pneumatic cylinder) and while it remains closed its No. 2 contacts in series with the now closed No. 1 contacts of the starting repeater relay energize the starting contactor relay 70. The energization of the starting contactor relay 70 causes the engine starter motor 75 to operate. As soon as the time delay on the generator start relay 66 terminates, the No. 2 contacts on the generator start relay 66 open, deenergizing the starting contactor relay and deenergizing the starter, but closing the No. 1 contacts of the generator starting relay which connects the starting motor of the motor generator set to positive battery 20.

The closing of the No. 4 contact of the starting relay 53 connects the positive side of the battery with the repeater coil to apply energy to the telephone communication lines. This therefore allows personnel at the office

to hear the operation of the starter and also to determine whether the diesel has started and whether the sound of the diesel operation is normal for equipment of that character.

When the time delay of the generator start relay 66 has completed, the starting operation stops whether or not the engine has been successfully started. Should the diesel engine, however, fail to start, personnel at the office can repeat the starting operation by opening and then closing the switch 35. When the switch 35 opens the office line relay 36, the field line relay 32 and the starting relay 53 drop out, and when the switch 35 closes again the complete sequence above described takes place, terminating in energizing the engine starter.

When the diesel water temperature reaches the desired level, the thermostat is actuated to close its contacts, and the procedure continues as above described in connection with the system when the temperature is above the predetermined level. The stopping of the fuel pump is all that is necessary to require the diesel to stop operation. It will be evident that if required ignition or other switches can be opened to stop the diesel engine.

When it is desired again to disconnect the diesel from the control system, it is merely necessary to disconnect the plugs by which the diesel is connected to the wayside station and this results in deenergizing the system entirely.

It will be evident that one of the great advantages of the system of the invention is that all indication and control at the remote point are established and maintained over a single pair of interconnecting wires, which may be normal telephone or other communication wires. The personnel at the remote point not only are kept fully informed as to the condition of the diesel by the light indicators, audible signal, and telephone, and also are able to recycle if the diesel fails to start, and are able to turn off the diesel entirely in case the behavior of the diesel as shown by the indicators or the sound of the diesel over the telephone suggests malfunctioning.

In view of my invention and disclosure variations and modifications to meet individual whim or particular need will doubtless become evident to others skilled in the art to obtain all or part of the benefits of my invention without copying the structure shown, and I, therefore, claim all such insofar as they fall within the reasonable spirit and scope of my claims.

Having thus described my invention what I claim as new and desire to secure by Letters Patent is:

1. In a system for controlling the temperature of a remotely located diesel engine having a fuel pump and a starter, thermostatic switch means of a diesel engine for determining the temperature of the engine, means for indicating the temperature at a remote point, means responsive to the position of the thermostatic switch means for energizing the fuel pump of the diesel engine, time delay means responsive to the energization of the fuel pump for energizing the starter, and time delay means for deenergizing the starter.

2. In a system for controlling the temperature of a remotely located diesel engine having a fuel pump and a starter, thermostatic switch means of a diesel engine for determining the temperature of the engine, means for indicating the temperature at a remote point, means responsive to the position of the thermostatic switch means for energizing the fuel pump of the diesel engine, time delay means responsive to the energization of the fuel pump for energizing the starter, and time delay means for deenergizing the starter in combination with recycle means for repeating the starter operations.

3. In a system for maintaining a predetermined temperature of a diesel engine located at a remote point, thermostatic switch means responsive to the diesel engine temperature, indicator means located at a remote point indicating the temperature of the diesel engine, means responsive to the position of the thermostatic switch means for starting the diesel engine, telephone means

communicating the sound of diesel engine operation to the remote point, and means operative at the remote point for recycling to restart the diesel engine.

4. In a system for remote operation of a diesel engine, thermostatic means responsive to the temperature of the diesel engine, electrical indicator means indicating the diesel temperature at a remote point, means at the remote point to indicate electrical circuit defects between the diesel engine and the remote point, means responsive to the position of the thermostatic means for starting the diesel engine and means effective at the remote point to recycle the starting means.

5. In a system for maintaining the temperature of a diesel engine at a predetermined level, the diesel engine having a fuel pump and a starter, a thermostatic switch responsive to the temperature of a diesel engine, a thermostat repeater relay, circuit means including the thermostatic switch and the thermostat repeater relay, a field line relay, circuit means including contacts of the thermostat repeater relay for changing the condition of the field line relay, a starting relay, circuit means including contacts of the field line relay for changing the condition of the starting relay when the thermostatic switch indicates a condition of too low temperature, circuit means including contacts of the starting relay for energizing the fuel pump of the engine, and time delay means responsive to the change in condition of the starting relay for energizing the starter of the engine, maintaining the starter in operation for a predetermined time and then deenergizing the starter.

6. In a system for maintaining the temperature of a diesel engine at a predetermined level, the diesel engine having a fuel pump and a starter, a thermostatic switch responsive to the temperature of a diesel engine, a thermostat repeater relay, circuit means including the thermostatic switch and the thermostat repeater relay, a field line relay, circuit means including contacts of the thermostat repeater relay for changing the condition of the field line relay, a starting relay, circuit means including contacts of the field line relay for changing the condition of the starting relay when the thermostatic switch indicates a condition of too low temperature, circuit means including contacts of the starting relay for energizing the fuel pump of the engine, a starting repeater relay, there being time delay means controlling change of condition in the starting repeater relay, circuit means including contacts of the starting relay for changing the condition of the starting repeater relay, a generator starting relay including time delay means controlling change of condition of the generator starting relay, a starting contactor relay, circuit means including time delay contacts of the starting repeater relay and the generator starting relay for changing the condition of the starting contactor relay when the starting repeater relay time delay expires and for again changing the condition of the starting contactor relay when the subsequent time delay of the generator starter relay expires, and circuit means including contacts of the starting contactor relay for energizing the engine starter.

7. In a system for maintaining the temperature of a diesel engine, including a fuel pump and an electric starter, thermostatic switch means responsive to the temperature of the diesel engine, a thermostat repeater relay, circuit means for changing the condition of the thermostat repeater relay in response to change of position of the thermostatic switch contacts, a polar field line relay, circuit means including contacts of the thermostat repeater relay for changing the polarity of the field line relay, a starting relay, circuit means including polar contacts of the field line relay for changing the condition of the starting relay, circuit means including contacts of the starting relay for energizing the fuel pump of the engine, a starting repeater relay having time delay, circuit means including contacts of the starting relay for changing the condition of the starting repeater relay, a

generator starting relay having time delay, a starting contactor relay, circuit means including time contacts of the starting repeater relay and time contacts of the generator starting relay for energizing the starting contactor relay a predetermined time after the starting repeater relay begins to change its condition, and for deenergizing the starting contactor relay at a predetermined later time, and circuit means including contacts of the starting contactor relay for energizing the starter.

8. In a system for maintaining a predetermined temperature at a remotely located diesel engine, having an electrical fuel pump and an electrical starter, thermostatic switch means responsive to the temperature of the diesel engine, a thermostat repeater relay, circuit means interconnecting the thermostatic switch means and the thermostat repeater relay, a polar field line relay, a polar office line relay, circuit means including contacts of the thermostat repeater relay for operating the field line relay and the office line relay, field temperature indication means for the temperature of the diesel engine, circuit means including polar contacts of the field line relay for selectively energizing the field temperature indicator means, office temperature indicator means and circuit means including polar contacts of the office line relay for selectively energizing the office temperature indicator means.

9. In a system for maintaining a predetermined temperature at a remotely located diesel engine, having an electrical fuel pump and an electrical starter, thermostatic switch means responsive to the temperature of the diesel engine, a thermostat repeater relay, circuit means interconnecting the thermostatic switch means and the thermostat repeater relay, a polar field line relay, a polar office line relay, circuit means including contacts of the thermostat repeater relay for operating the field line relay and the office line relay, field temperature indication means for the temperature of the diesel engine, circuit means including polar contacts of the field line relay for selectively energizing the field temperature indicator means, office temperature indicator means, a circuit means including polar contacts of the office line relay for selectively energizing the office temperature indicator means, an audible signal relay, an audible signal stick relay, circuit means including contacts of the office line relay for changing the condition of the audible signal relay, circuit means including contacts of the audible signal relay for energizing and sticking the audible signal stick relay in changed position, audible signal circuit means including contacts of the audible signal stick relay for energizing the audible signal, an acknowledgment switch and circuit means including the acknowledgment switch for releasing the audible signal stick relay.

10. In mechanism for maintaining a predetermined temperature on a remotely located diesel engine having an electrical fuel pump and an electrical starter, a thermostatic switch responsive to the temperature of the diesel engine, a thermostat repeater relay, circuit means including the thermostatic switch for changing the condition of the thermostat repeater relay, a polar field line relay, a polar office line relay, a recycle switch, circuit means connected to a source of direct current placing the field line relay, the recycle switch and the office line relay in series with contacts of the thermostat repeater relay, indication means at the field line relay, indication means at the office line relay, circuit means including polar contacts of the field line relay for selectively energizing the field line relay indication means, circuit means including polar contacts of the office line relay for selectively energizing the indication means at the office line relay, a starting relay, circuit means including polar contacts of the field line relay for changing the condition of the starting relay, circuit means including contacts of the starting relay for energizing the fuel pump, a time delay starting repeater relay, circuit means including the contacts of the starting relay for changing

the condition of the starting repeater relay, a time delay generator starting relay, circuit means including time delay contacts of the starting repeater relay for changing the condition of the generator starting relay, a starting contactor relay, circuit means including time delay contacts of the generator starting relay for changing the condition of the starting contactor relay, and circuit means including contacts of the starting contactor relay for energizing the starter.

11. In a system to control the temperature of a diesel engine having a fuel pump and a starter, thermostatic means for turning on the fuel pump, time delay relay means for turning on the starter at a predetermined interval after the fuel pump is turned on, and time delay relay means for turning off the starter at a predetermined time interval after the starter is turned on.

12. In a system to control the temperature of a diesel engine having a fuel pump and a starter, thermostatic means for turning on the fuel pump, time delay relay means for turning on the starter at a predetermined interval after the fuel pump is turned on, time delay relay means for turning off the starter at a predetermined time interval after the starter is turned on, electrical indicator means showing the condition of the diesel at a remote point and communicating with the diesel over a single pair of wires, and recycle means to permit repeated operation of the fuel pump and the starter at the remote point and operating over the same single pair of wires.

13. In a system to control the temperature of a diesel

engine having a fuel pump and a starter, thermostatic means for turning on the fuel pump, time delay relay means for turning on the starter at a predetermined interval after the fuel pump is turned on, time delay relay means for turning off the starter at a predetermined time interval after the starter is turned on, and indication and control means effective at a remote point and operative over a single pair of wires for showing the condition of the diesel, reoperating the fuel pump and starter from the remote point and turning off the diesel from the remote point.

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