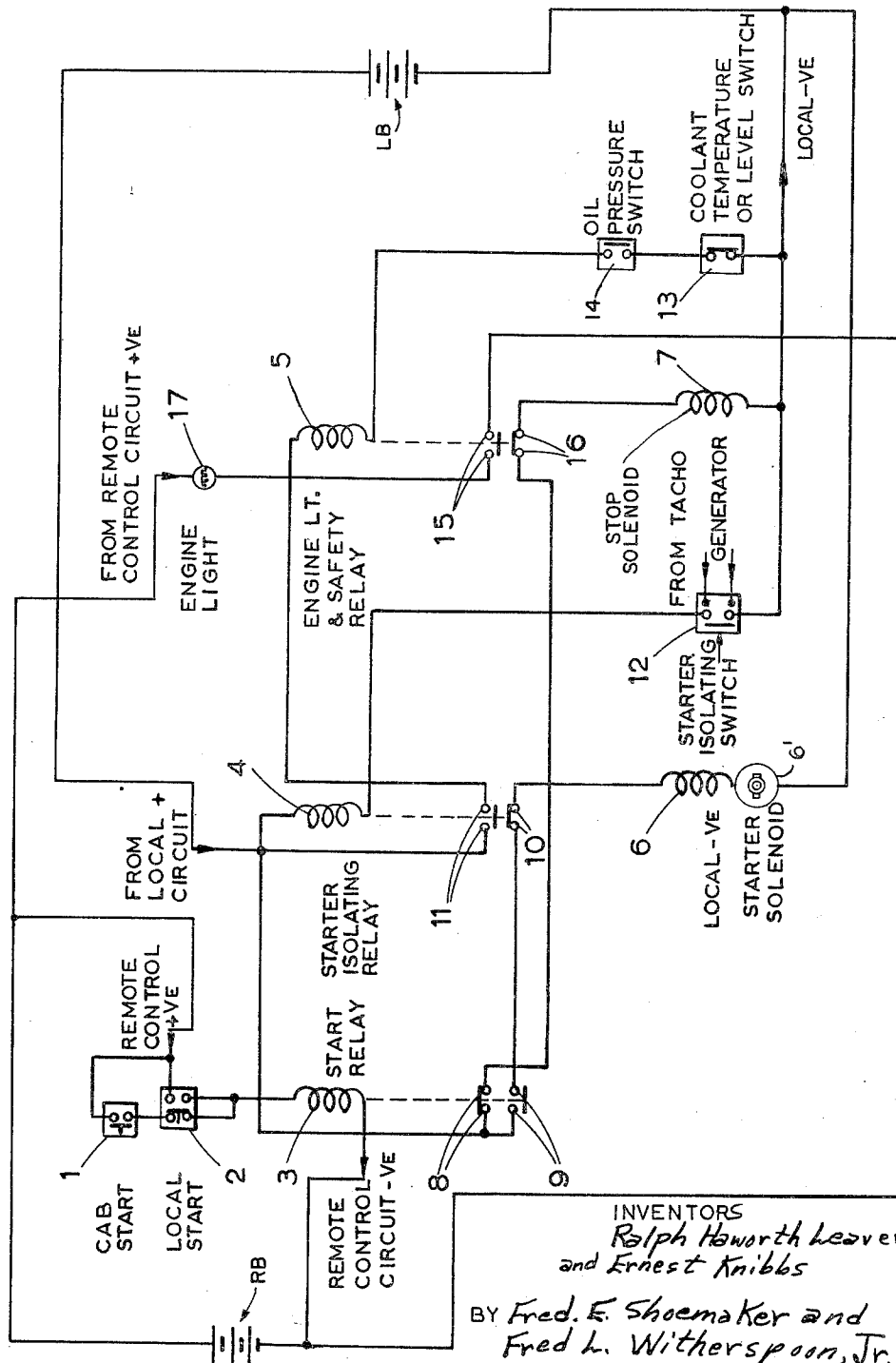


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ENGINE STARTING SYSTEMS

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1

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ENGINE STARTING SYSTEMS

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This invention relates to engine starting systems generally, but particularly to starting systems used on diesel railcars, diesel locomotives and stationary engine equipment where a number of engines need to be operated together and all started by means of a single starter button or other starting device situated at a remote point, for example in the driver's cabin. Individual starting buttons or the like are also usually provided associated with each engine for individual starting or testing.

It is customary to provide in the driver's cabin signal lights which indicate to him whether each engine has started. This light signal can be actuated by an engine speed sensitive switch or by an engine oil pressure sensitive switch or both. It is also customary to provide as a safety device, means whereby an engine is "shut down" automatically if the oil pressure and coolant level and temperature are incorrect.

It will be apparent that, should any one or more of these safety devices be in operation to shut down the engine, unless further provision is made, the driver, on pressing the button and holding it depressed will start the engine in question and the starter pinion will be ejected from engagement. Then the automatic safety device will stop the engine and the cycle will be repeated. This could cause damage to the electric starter mechanism.

It is an object of the present invention to overcome and to prevent this happening. The novelty of the invention lies in the provision of a safety circuit which ensures that, if the operator's finger is kept on the starter button, and the engine is started, but for some reason, the oil pressure or some other variable such as coolant temperature is not at an acceptable value, the device which under normal circumstances would "shut down" the engine is over-ridden whilst the starter button remains depressed. The electric starter is therefore prevented from re-engaging and repeating the cycle.

The engine in question continues to run until the starter button ceases to be depressed, when the normal safety device takes over and "shuts down" the engine.

One embodiment of the control device will now be described with reference to the accompanying drawing. The single FIGURE shows a wiring diagram of a starter system in accordance with the invention.

Each engine has a complete starting system as shown in the diagram except for the fact that all the engines are usually started from a remote point by a single starter button situated for example in the driver's cab in the case of a multi-diesel engined vehicle.

The driver's starter button is indicated by reference numeral 1, while the button provided for local operation of the engine for example for testing purposes in the engine sheds is indicated by reference numeral 2.

The electric power supply for actuating the various relays shown is obtained from the usual train wire deriving current from a remote battery RB which may be the battery of one unit and for some uses current is obtained from the battery LB associated with the particular engine with which the starting system is associated. Connections to the batteries are made as illustrated.

The starting system for each engine includes three relays, namely a start or starter relay 3, a starter isolating relay 4 and an engine light and safety relay 5.

Either starter button brings the starter motor into

2

operation when pressed, through the medium of start relay 3, which has the effect of energising the local starter solenoid 6, to energize the starter motor 6' in the usual manner.

When either button 1 or 2 is pressed the stop solenoid 7 is de-energised as a result of contacts 8 associated with the start relay opening, contacts 9 being at the same time closed.

As a result of closing of contacts 9 current will pass to the solenoid 6 of the starter motor thus bringing the starter into operation. During this time contacts 10 of the starter isolating relay 4 will be closed. When the engine starts relay 4 will be energised thus opening its associated contacts 10 to render the starter motor inoperative and closing contacts 11.

Energization of starter isolating relay 4 may be under the control of a starter isolating switch 12 which may be operated by a variable voltage relay receiving its signal from an engine driven tachometer and set to operate at a low engine speed.

Relay 4, when energized, not only opens the starter circuit by opening contacts 10 but as a result of the closing of contacts 11 connects relay 5 to the local positive wire of the circuit.

Also in circuit with relay 5 are the various safety devices. If coolant and level are correct safety switch 13 will be closed, but until sufficient oil pressure due to the engine having started, is available to close the contacts of switch 14 relay 5 will not be energised. The contacts of relay 5 are indicated by reference numerals 15 and 16. Reference numeral 17 indicates the engine indicator light which is illuminated as a result of energisation of relay 5.

If the starting circuit should be prematurely broken at this stage, before oil pressure has built up, contacts 8 on relay 3 will close, thereby energising the stop solenoid 7 by way of the still closed contacts 16 of relay 5 thereby stopping the engine.

With oil pressure present, however, relay 5 will be energised closing contacts 15 which will cause the indicator light 17 to be illuminated and opening contacts 16 which will isolate the stop solenoid 7. If pressure is removed from either starting button 1 or 2, the engine will not stop but this will occur if at any time safety switches 13 or 14 should break the circuit through relay 5.

We claim:

1. In a starting system for an internal combustion engine having an electric starter and a source of electric current, in combination, a starter actuating solenoid, a starter circuit including said source and said starter actuating solenoid, a starter relay having normally open contacts in said circuit between said source and said actuating solenoid, normally closed contacts and a coil, a manual starter button having contacts arranged in a circuit to connect said relay coil to said source to close said normally open starter relay contacts and energize said starter actuating solenoid, an engine stop solenoid arranged to shut down the engine, a circuit connecting said stop solenoid to said source through said set of normally closed contacts on said starter relay; a starter isolating relay having a coil and having a normally closed set of contacts in the circuit connecting the starter-relay normally open contacts to the starter actuating solenoid and said source, and means having contacts closed in response to a condition indicating engine operation and connected in a circuit including, said last-mentioned coil and said source to open the starter actuating solenoid circuit and render the starter inoperative.

2. The system of claim 1 in which the last-mentioned means is a signal operated relay connected to be actuated by voltage from an engine driven tachometer.

3. The system of claim 1 in which the last-mentioned

3

means is a signal operated relay adapted to be actuated by lack of a signal from a starter motor relay coil.

4. The system of claim 1 in which there is a further relay having a coil, switches in series with said last-mentioned coil and with additional contacts on the starter isolating relay normally open but closed when the coil of the starter isolating relay is energized, said switches being constructed so as to be individually opened as a result of low oil pressure, high temperature of the engine coolant or low level of the latter, said further relay having contacts normally closed and in the circuit of the said stop solenoid whereby the latter is de-energized when all series switches are closed.

5. The system of claim 4 in which said further relay has a set of normally open contacts closed when its coil is energized to connect a signal device to said current source to indicate that the engine has started and is running.

6. An engine starting system including a source of electric current, a push-button type engine starting switch, a starter relay having a coil, means connecting said switch and coil in a circuit energized from said source whereby closure of said switch energizes said coil, normally open and normally closed contacts on said starter relay, a starter solenoid adapted to close a circuit to an electric starter motor, a circuit including said solenoid, said source and said normally open contacts on said starter relay whereby the solenoid is energized as a result of energization of said starter relay coil, a starter isolating

4

relay having a coil and having normally closed contacts in said starter solenoid circuit, a circuit including said source and engine rotation actuated contacts for energizing the starter isolating relay coil, a stop solenoid arranged to stop the engine when energized, a circuit for said stop solenoid including said source and said normally closed contacts on said starter relay, an engine safety relay having a coil and having normally closed contacts in said stop solenoid circuit, a circuit including said source, said engine safety relay coil and series connected switches, one of said switches being normally open and closed in response to engine oil pressure and at least one of said switches being normally closed and opened in response to excess engine coolant temperature.

7. The engine starting system of claim 6, having an engine indicator light, and in which said engine safety relay has a normally open pair of contacts, a circuit including said source, said last-mentioned contacts and said light, said starter isolating relay having a set of normally open contacts in circuit with said engine safety relay coil circuit.

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