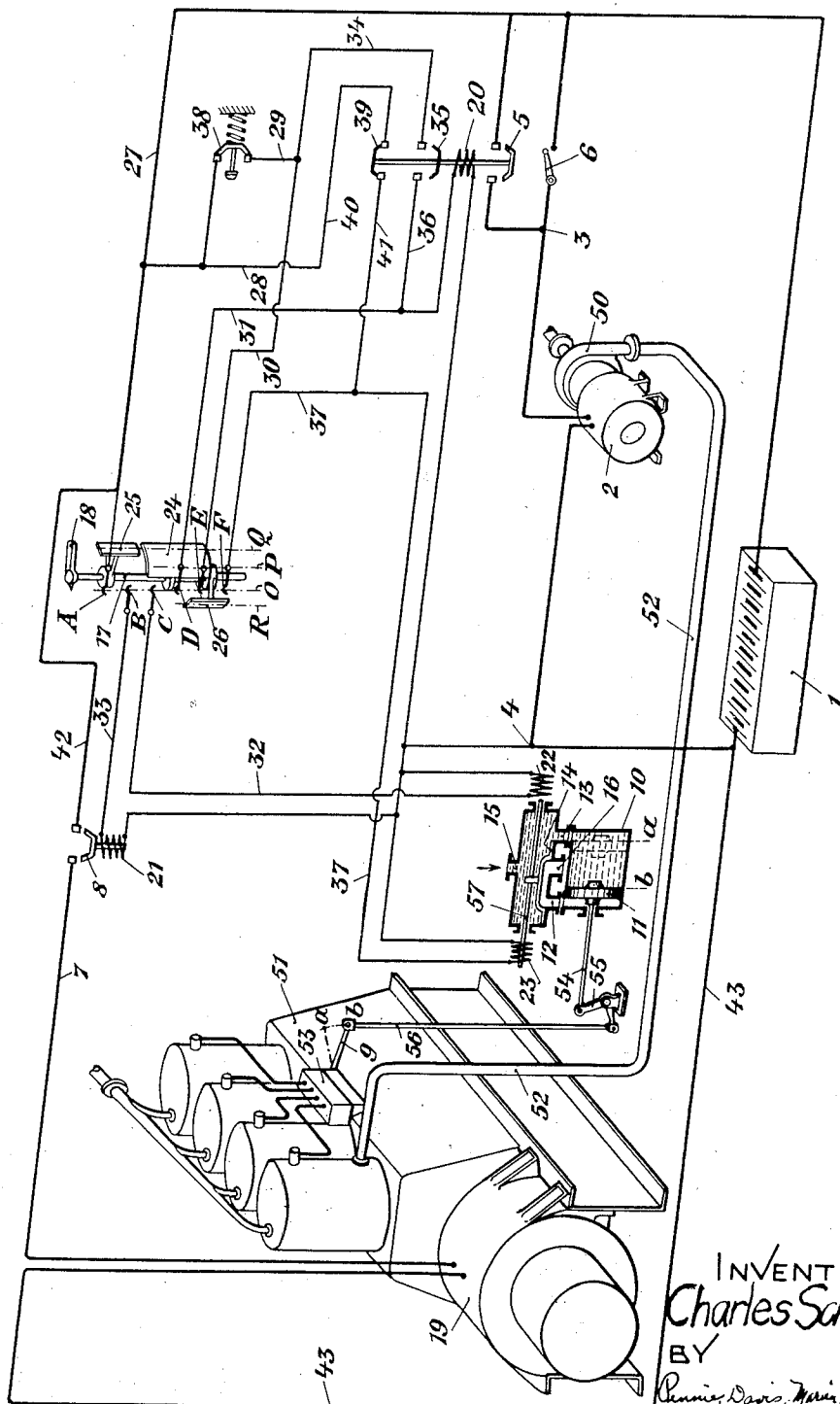


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INTERNAL COMBUSTION ENGINE, MORE PARTICULARLY
FOR THE PROPULSION OF VEHICLES
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INTERNAL COMBUSTION ENGINE, MORE PARTICULARLY FOR THE PROPULSION OF
VEHICLES

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This invention relates to a control system for an internal combustion engine of the type provided with an electric starting motor and an electrically driven pump for circulating cooling medium through the engine, and having means such as a throttle or injection device for controlling the fuel supply to the engine.

According to the invention there is provided, for use with such an engine, a control system comprising connections between the means for controlling the fuel supply to the engine and the switches controlling the starting motor and the motor for the pump for supplying cooling medium, such connections being so arranged that upon operation of the starting motor the pump motor is switched on, and can thereafter only be switched off simultaneously with or subsequently to the cutting off of the fuel supply.

Preferably a further independent switch is provided for switching off the pump motor at any time, and in such a case the arrangement is such that operation of said independent switch to switch off the pump motor cuts off the supply of fuel to the engine.

A convenient embodiment of the invention is illustrated by way of example in the accompanying diagram.

In this example the storage battery 1 supplies energy for driving the motor 2, of the pump 50 for delivering cooling medium to the internal combustion engine 21 through the conduit 52. The circuit of the pump motor 2 can be closed and opened either by the automatically controlled switch 5 or by the independent hand-operated switch 6. The starting motor 19 of the internal combustion engine 51,—which may of course, when not acting as a motor act as a generator in the known way, is supplied with energy from the battery 1 through wires 21 and 42, switch 8 and wires 7 and 43, although of course another source of energy separate from the battery 1 may supply the current for this purpose.

The lever 9 regulates the charge delivered by the fuel pump 53 of the engine 51, which in the present example is of the compression ignition type. The lever 9 is adapted to be

moved through the coaction of the rod 54, lever 55, and lever 56, by means of the servo-motor piston 11 which slides in the cylinder 10, and is controlled in such a manner that it assumes the one position *a* for the starting and the running of the engine and the position *b* for stopping the engine. The admission of a pressure transmitting fluid to cylinder 10 is controlled by a slide valve 14 in such a manner that the pressure transmitting fluid enters cylinder 10 through either pipe 12 or pipe 13, so that the piston 11 is moved either to position *a* or position *b*. The pressure transmitting fluid enters the chest of the valve 14 through the pipe 15 and can escape from either end of the cylinder 10, according to the position of the slide valve 14, through port 16.

The switch 5 controlling the motor for driving the cooling water pump, the switch 8 controlling the starting motor, and the slide valve 14 for the servo-motor piston 11 controlling the fuel supply to the engine are rendered interdependent with respect to their operation by being jointly controlled by a drum controller 17 in such a manner that before operation of the starting motor 19 the pump motor 2 is switched on, and can thereafter only be switched off simultaneously with or subsequently to the cutting off of the fuel supply to the engine, as by servo-motor piston 11. To this end the controller 17, can be brought by means of lever 18 into four different positions O, P, Q and R. In the position O, none of the six contacts A, B, C, D, E and F is electrically connected to another, so that no current can pass through any of the control magnets 20, 21, 22 and 23 controlling switches 5 and 35, 39 and 8 and valve 14. The switches are in the position shown in the drawing, and the lever 57 is in its extreme lefthand position. In this position of the control system, the circuit through the pump motor 2 and the circuit through the starting motor 19 are open, so that both motors are inoperative.

When it is desired to start the engine, the drum switch or controller 17 is moved into the position P in which the three contacts C, D and E are electrically connected to-

gether by means of the drum segment 24, so that current will pass through the wires 27, 28, 29 and 30 and the contact E to sliding contacts C and D.

5 The control current from the contact D passes through wire 31 to the control magnet 20 of the switch 5 whereby the latter will be closed and the pump motor started.

10 The current from contact C passes through wire 32 to the control magnet 22 which thereupon moves the slide valve into the extreme righthand position.

Thereupon the pressure transmitting fluid entering by pipe 15 passes via pipe 12 into the left side of servo-motor cylinder 10, forcing piston 11 at the right side into the position *a*. The pressure transmitting fluid displaced from the right side of cylinder 10 by this movement of piston 11 will pass through the pipe 13 into the exhaust recess of the slide valve 14 and thence to the discharge port 16. By this movement of the piston 11 the lever 9 is moved to the position *a*, thereby putting the fuel injection device of the engine into proper position for operation.

25 If now the drum controller 17 is moved farther to the position Q, the contacts A and B, hitherto isolated, will be connected together, whereby current will pass via wire 27, contacts A and B and drum segment 25, and wire 33 to the control magnet 21, which thereupon closes switch 8 and enables the starting motor 19 to be energized to start the engine 51.

35 When the engine commences to fire and starts up under its own power, the drum switch 17 can be returned to the position O thereby breaking all mutual connections between the contacts A, B, C, D, E and F.

40 As, however, during starting of the engine the switch 5 was closed, thereby connecting wire 34 to wire 36 by the switch blade 35, the switch 5 will remain closed as the circuit through its control magnet 20 is now completed through wires 28, 29, 34 and 36. On the other hand the control circuit of the starting motor 19 is now broken so that the magnet 21 of the starting motor switch 8 is deenergized, and switch 8 therefore opens. 50 In order to stop the engine the drum switch 17 is moved into position R, thereby connecting together the contacts E and F by segment 26. By this operation connection is made, through wires 30 and 37, to the slide valve control magnet 23 which therefore moves the slide valve 14 to the extreme lefthand position and consequently moves the servo-motor piston 11 into its lowest position 60 *b* in which the fuel supply is cut off from the engine, which therefore stops. At the same time however, the circuit to the pump motor 2 is still unbroken because the circuit through the wire 34, contact plate 35, wire 36, and 65 the solenoid 20, is still unbroken, so that the

cooling water pump continues to operate even when the engine is stopped.

If it is now desired to stop the pump motor 2 the independent switch 38, which is normally spring-urged into the closed position, 70 is pressed upon, thereby breaking the circuit to the control magnet 20 and opening switch 5.

In the event of a premature depression of independent switch 38, or of any other interruption of the circuit to the control magnet 20 of the pump motor switch 5, opening of switch 5 brings the switch blade 39 into the closed position whereby connection is made through wires 40, 41 and 37 to the control magnet 23 which moves slide valve 14 into the extreme lefthand position, thereby moving the servo-motor piston 11 into position *b* and stopping the engine as previously described. 80 85

The circuit through the pump motor 2 can be closed at any time by the switch 6 when the automatically controlled system is for some reason out of order, whereby operation of the pump is ensured during the time that the fault in the control system is being rectified, such provision may of course be made in other ways than by inclusion of the switch 6. 90 95

It will therefore be seen that this control system so operates that the engine cannot be started without starting the cooling water pump, that this pump is operative for the whole time that the engine is running, that the pump will also continue to operate if the engine is stopped, and that stoppage of the pump immediately stops the engine. 100

Such operation ensures that the engine will never be running without efficient cooling, and damage due to over-heating and caused by carelessness is therefore obviated. 105

I claim:

1. A control system for an internal combustion engine having a fuel injection device, a starting motor and switch, a cooling water pump and motor and switch, and means for controlling the supply of fuel to the engine, comprising connections between the means for controlling the fuel supply to the engine and the switch controlling the starting motor and the switch controlling the pump motor, and means in said connection whereby the pump motor is switched on before the starting motor and can thereafter be switched off only simultaneously with or subsequently to cutting off the fuel supply. 110 115 120

2. A control system for an internal combustion engine having a fuel injection device, a starting motor and switch, a cooling water pump and motor and switch, and means for controlling the supply of fuel to the engine, comprising in combination controlling means arranged between the switch for the motor of the cooling water pump, the switch of the starting motor and the fuel injection device, 125 130

means for automatically switching on the cooling water pump upon starting the said internal combustion engine and means for causing the cooling water pump to continue its operation after the said internal combustion engine is stopped.

3. A control system for an internal combustion engine having a fuel injection device, a starting motor and switch, a cooling water pump and motor and switch, and means for controlling the supply of fuel to the engine, comprising in combination controlling means arranged between the switch for the motor of the cooling water pump, the switch of the starting motor and the fuel injection device, means for automatically switching on the cooling water pump upon starting the engine, means for causing the cooling water pump to continue its operation after the engine is stopped, and means for automatically interrupting the fuel supply to the engine during the running of the latter, when the motor of the cooling water pump is switched off.

4. A control system for an internal combustion engine having a fuel injection device, a starting motor and switch, a cooling water pump and motor and switch, and means for controlling the supply of fuel to the engine, comprising in combination controlling means arranged between the switch for the motor of the cooling water pump, the switch of the starting motor and the fuel injection device and means for automatically interrupting the fuel supply to the engine during the running of the latter, when the motor of the cooling water pump is switched off.

5. A control system for an internal combustion engine having a fuel injection device, a starting motor and switch, a cooling water pump and motor and switch, and means for controlling the supply of fuel to the engine, comprising in combination controlling means arranged between the switch for the motor of the cooling water pump, the switch of the starting motor and the fuel injection device and a bridging switch said switch being arranged in parallel with the switch controlled by said means, in the circuit of the motor for the cooling water pump.

In testimony whereof I have affixed my signature.

CHARLES SCHAER.