(12) UK Patent Application (19) GB (11) 2 085 073 A

(21) Application No **8032674**
(22) Date of filing **9 Oct 1980**
(43) Application published **21 Apr 1982**
(51) INT CL[3] **F02N 17/04**
(52) Domestic classification **F1B** 2F11 2F18A 2F23 2F3B 2FX5 **H2H** SM
(56) Documents cited **GB 946156**
(58) Field of search **F1H**
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(54) Cold start systems for diesel engines

(57) A cold start system for a diesel engine comprises a chamber, containing a heating element, mounted in the inlet manifold of the engine, means for metering fuel into the chamber and an electrical circuit for energising the element at an initially high rate so that the element reaches its operating temperature quickly, and thereafter at a lower rate, during which time the element is held at its operating temperature. The element is thereby reducing the heat-up period for the element without reducing the life of the element.

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The drawings originally filed were informal and the print here reproduced is taken from a later filed formal copy.

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FIG. 1

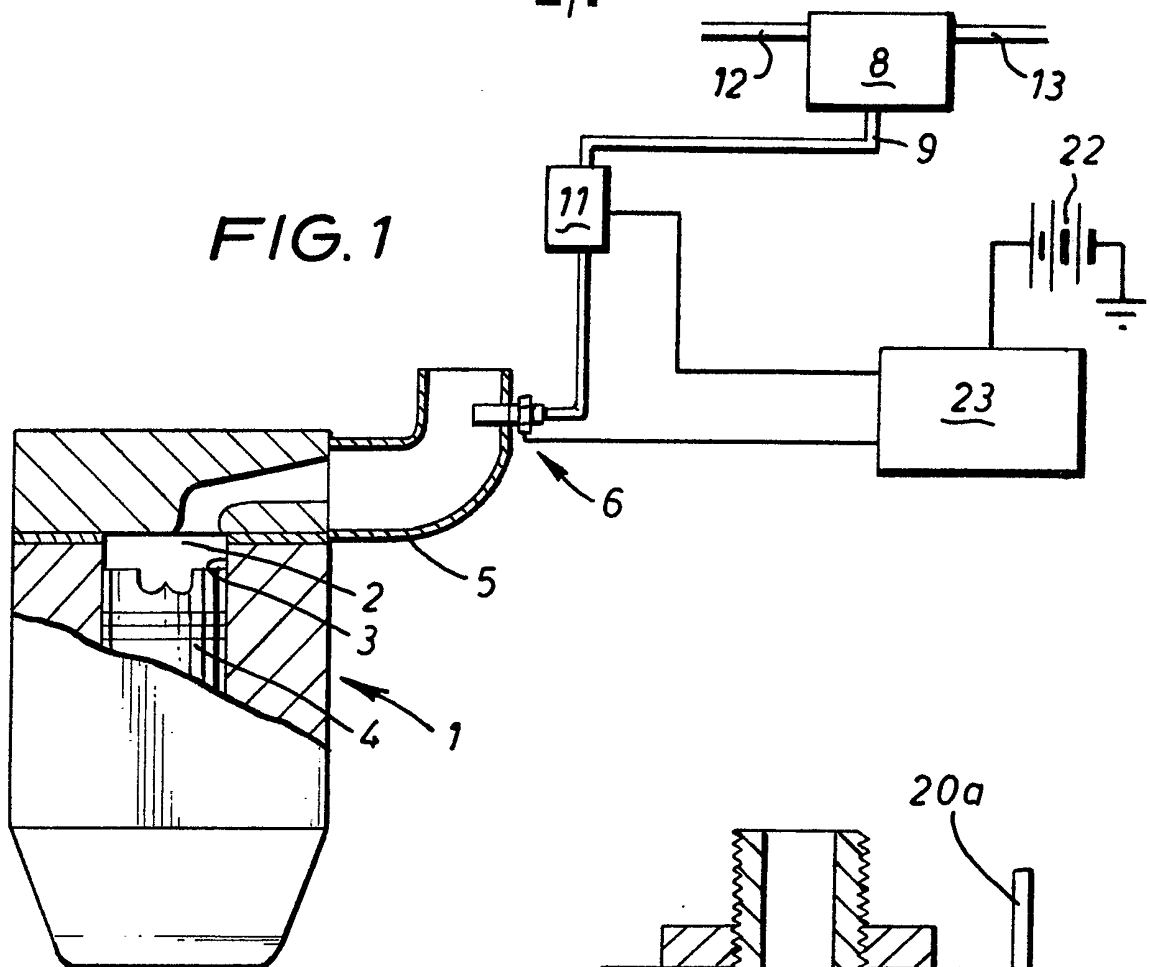
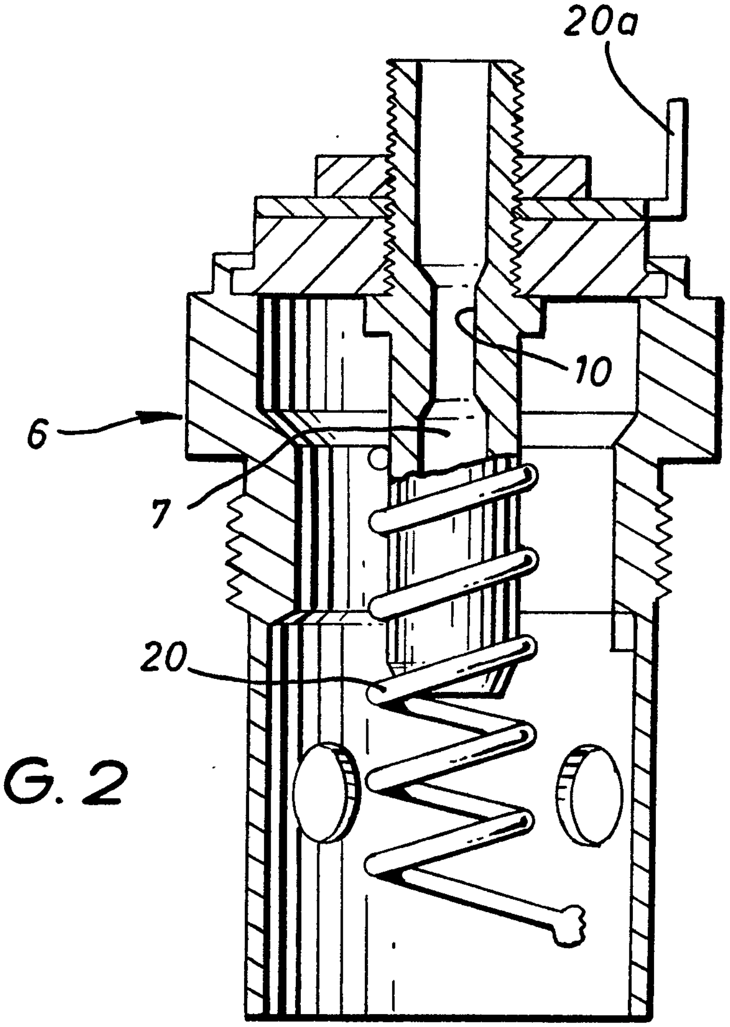


FIG. 2



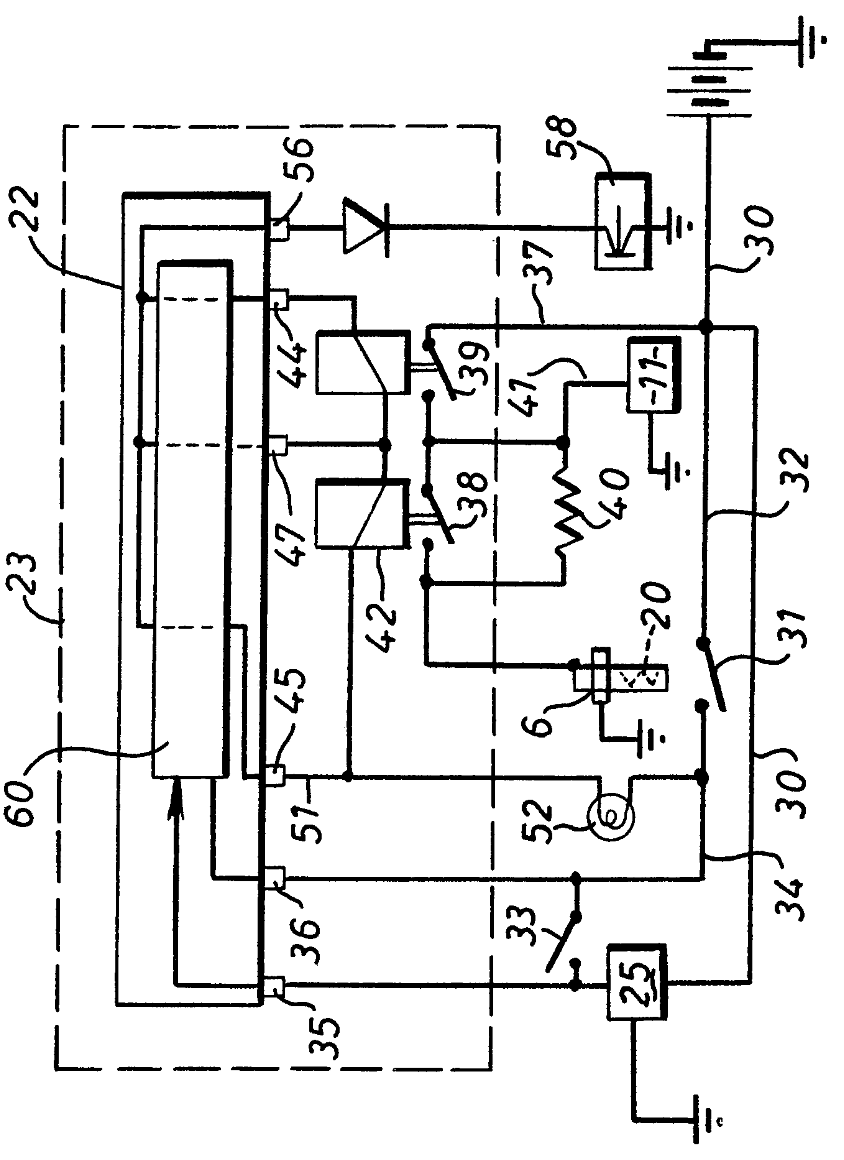

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FIG. 3

SPECIFICATION

Cold start systems for diesel engines

This invention relates to cold start systems for diesel engines.

Conventional systems for starting diesel engines at low ambient temperatures comprise a heating element, for example a glow plug or an electrical heating coil, which is usually mounted in the inlet manifold of the engine and which is heated electrically prior to ignition of the engine. Fuel supplied to the heating element ignites and heats the air entering the combustion chamber, which facilitates combustion as the engine is cranked.

Conventional cold start systems suffer from the disadvantage that a relatively long time delay is required to heat the heating element to the required temperature prior to ignition.

According to the present invention, there is provided a cold start system for a diesel engine comprising an electrical heating element for heating gases prior to combustion in the engine; means for metering diesel fuel into the region of the heating element; and an electrical control device for controlling the supply of electrical energy to the heating element, characterised in that the control device initially supplies electrical energy to the heating element at a relatively high rate, whereby the element is heated to a desired temperature, and thereafter at a low rate.

Since electrical energy is initially supplied to the heating element at a high rate, the element reaches its operating temperature quickly. When the operating temperature has been reached, the control device supplies electrical energy at a lower rate so that the heating element can be maintained at a desired temperature without causing deterioration of the element.

The heating element is preferably in the form of a coil of resistance wire.

The control device may operate to supply electrical energy to the element in any suitable manner. For example, the energy may be supplied as a series of pulses of the same voltage level, the frequency of the pulses decreasing after the initial period. In a simpler, and preferred form however, the control device supplies electrical energy to the heating element initially at a first voltage level and thereafter at a lower level. For example the control device may include a timer which switches DC voltage through a shunt resistance after a predetermined period.

In order to prevent damage to the system as a result of prolonged operation of the element, the control device preferably includes a switch for interrupting the supply of electrical energy to the heating element after a predetermined period.

Additionally, since it will not usually be necessary to preheat the diesel fuel above certain ambient temperatures, the control device may be arranged for operation only below a predetermined temperature.

A preferred embodiment of the invention will now be described, by way of example only, with reference to the drawings in which:—

Figure 1 is a schematic view of a cold start system according to the invention;

Figure 2 is an enlarged view of part of the system of Figure 1; and

Figure 3 is a diagram of an electrical circuit included in the system of Figure 1.

Referring to the drawings, a diesel engine 1 includes a series of combustion chambers, one of which is illustrated at 2, formed by cylinders 3 and pistons 4. Fuel is introduced into the chamber through a fuel injection nozzle (not shown), and air is drawn into the chamber from an inlet manifold 5 via an inlet valve (not shown).

A heating device in the form of a threaded plug of conventional construction is mounted in the inlet manifold 5. As best seen in Figure 2, the plug 6 includes an axial fuel passage 7 which communicates with a fuel reservoir 8 via a supply line 9 which incorporates a metering orifice 10 and a solenoid-operated valve 11. The reservoir 8 receives fuel from a pump (not shown) along a feed line 12 connected to the fuel tank, and is positioned at a higher level than the plug 6 so that, when the solenoid valve 11 is open, fuel flows into the plug 6 under gravity. Excess fuel from the reservoir is returned to the fuel tank along an overflow line 13.

In an alternative embodiment (not shown) the reservoir 8 and valve 11 are replaced by an electrically-operated fuel pump.

A heating element in the form of an electrical heating coil 20 connected between the metal body of the plug 6 and a terminal 20*a* is mounted in the plug 6 and receives electrical energy along a lead 21 from a 12 or 24 volt battery via a control box 23 which also controls the operation of the valve 11.

The electrical circuit into which the coil 20 is connected is illustrated in detail in Figure 2. Referring to Figure 2, power from the battery is supplied to a starter motor 25 of the engine along line 30 and to an ignition switch 31 along line 32. The ignition switch 31 is connected to a power switch 33 for the starter motor by a line 34. The switches 31 and 33 are mounted in a single switch assembly for sequential operation. After closure of the ignition switch 31, the power switch 33 is closed causing operation of the starter motor. The power switch 33 and the line 34 are connected to input terminals 35, 36 of a control unit 22 in the control box 23. The coil 20 receives power from the battery via line 30, line 37 and two switches 38, 39 connected in series with each other, the first switch 38 being connected in parallel with a resistance 40. Power is fed to the solenoid operated valve 11 along a line 41 connected between the two switches 38, 39.

The two switches 38, 39 are operated by relays 42, 43 connected in series with each other and to two further output terminals 44, 45 of the control unit 22. A further input terminal 47 on the control unit 22 is connected between the two relays by a line 50. Terminal 45 is also connected, via line 51 to a warning lamp 52 and the line 34. An output terminal 56 on the control unit 22 is connected to earth via a temperature sensor 58 fixed, for example, in the cylinder block of the engine.

The control unit 22 is a micro circuit of conventional construction containing a timer circuit 60 and internal connections for the terminals 35, 36, 44, 45, 47 and 56 as indicated schematically in the drawings.

When the switch 31 is closed the timer circuit within the control unit 22 driven from the input terminal 36 connects the input terminal 47 with the output terminal 56 for a period of three seconds, and the input terminals 45 and 44 with the output terminal 56 for a further period of seventeen seconds. The temperature sensor 58 is arranged to connect the output terminal 56 to earth if it detects a temperature less than a predetermined minimum, e.g. less than −10°C. Under these conditions therefore, the relay 43 will close the switch 39 for 20 seconds and the switch 38 for three seconds. During the first three seconds of operation therefore, current can flow along line 37 through switches 38 and 39 and into the heating element 20. For the subsequent 17 seconds, electrical energy will be supplied to the element 20 at a lower rate, since the current will pass to the element 20 via the resistance 40. Consequently, the element 20 will be heated rapidly to its operating temperature during the first three seconds of operation, and will be maintained at that temperature thereafter. During the whole of the 20-second period the lamp 52 will be illuminated, indicating that the system is operating.

If during this period, cranking is stopped and the system is turned off the change in voltage level at terminal 35 resets the timer so that the system still supplies energy to the element at an initially high level when the system is operated again.

After the twenty second period, the switch 39 is opened, interrupting the supply of electrical energy to the heating element 20. This prevents the heating element 20 from becoming damaged in the event that the system is accidentally left with the ignition switch 31 closed.

It will be appreciated that, because the element 20 is supplied with a high voltage for a short period only, the element 20 can be operated at a voltage level higher than its normal voltage rating without reducing the life of the element. The relative lengths of the periods during which the element 20 will be selected according to the heating characteristics of the element 20. The figures given above are by way of illustration only.

CLAIMS

1. A cold start system for a diesel engine comprising an electrical heating element for heating gases prior to combustion in the engine; means for metering diesel fuel into the region of the heating element; and an electrical control device for controlling the supply of electrical energy to the heating element, characterised in that the control device initially supplies electrical energy to the heating element at a relatively high rate, whereby the element is heated to a desired temperature, and thereafter at a low rate.

2. A system according to Claim 1 wherein the control device supplies electrical energy to the heating element initially at a first voltage level, and thereafter at a lower voltage level.

3. A system according to Claim 1 or Claim 2 wherein the control device is operable only below a predetermined temperature.

4. A system according to Claim 1 wherein the control device interrupts the supply of electrical energy to the heating element after a predetermined period.

Printed for Her Majesty's Stationery Office by the Courier Press, Leamington Spa, 1982. Published by the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.