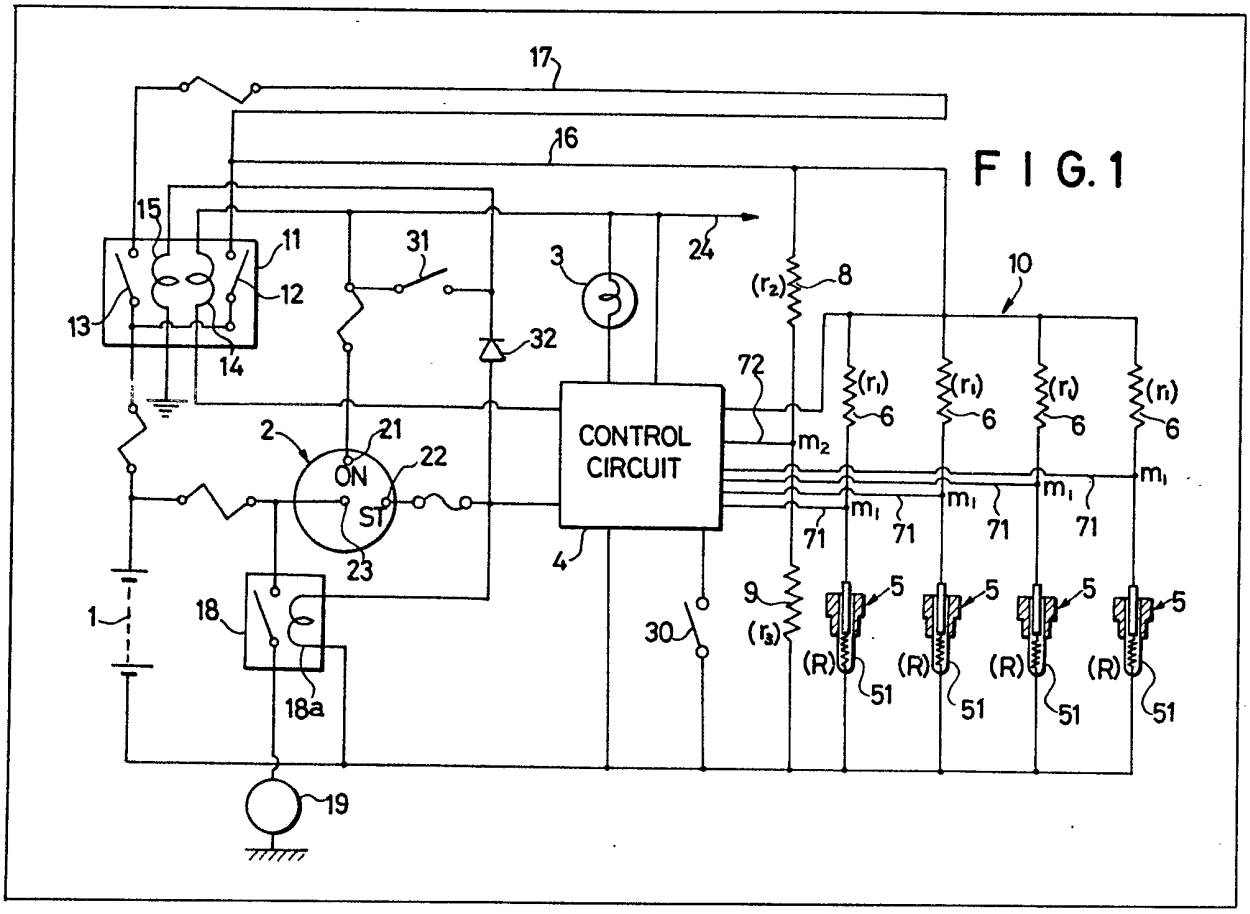
(12) UK Patent Application (19) GB (11) 2 024 940 A

(21) Application No **7923164**
(22) Date of filing **3 Jul 1979**
(23) Claims filed **3 Jul 1979**
(30) Priority data
(31) **53/083731**
(32) **10 Jul 1978**
(33) **Japan (JP)**
(43) Application published **16 Jan 1980**
(51) **INT CL³** **F02P 19/02**
(52) Domestic classification **F1B** 2D11A
(56) Documents cited **None**
(58) Field of search **F1B**
(71) Applicants **Isuzu Motors Limited, No. 22—10, Minami Ooi 6-chome, Shinagawa-ku, Tokyo, Japan**
(72) Inventors **Hideo Kawamura, Tsutomu Kitagawa, Isamu Ootsubo**
(74) Agents **Marks & Clerk**

(54) **System for controlling preheating of an engine having glow plugs**

(57) Current from a battery 1 selectively flows through a quick heating circuit 16 having an extremely small resistance value or a stabilizing circuit 17 having a relatively large resistance value compared to the glow plugs 5. When the glow plugs 5 are heated up and their resistance value reaches a value corresponding to a predetermined temperature, the current flow through the quick heating circuit 16 is rapidly terminated.

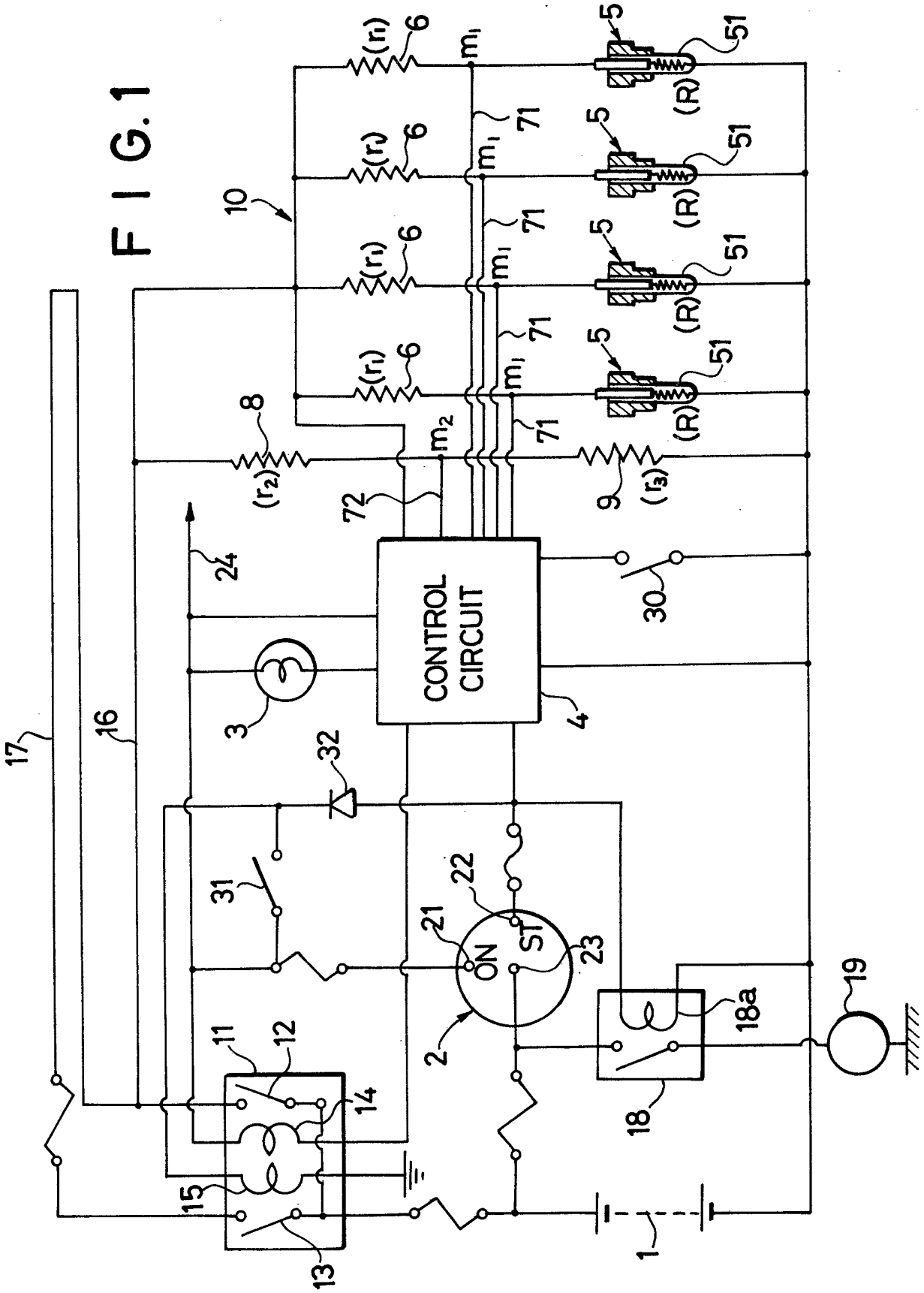


F I G. 1

GB 2 024 940 A

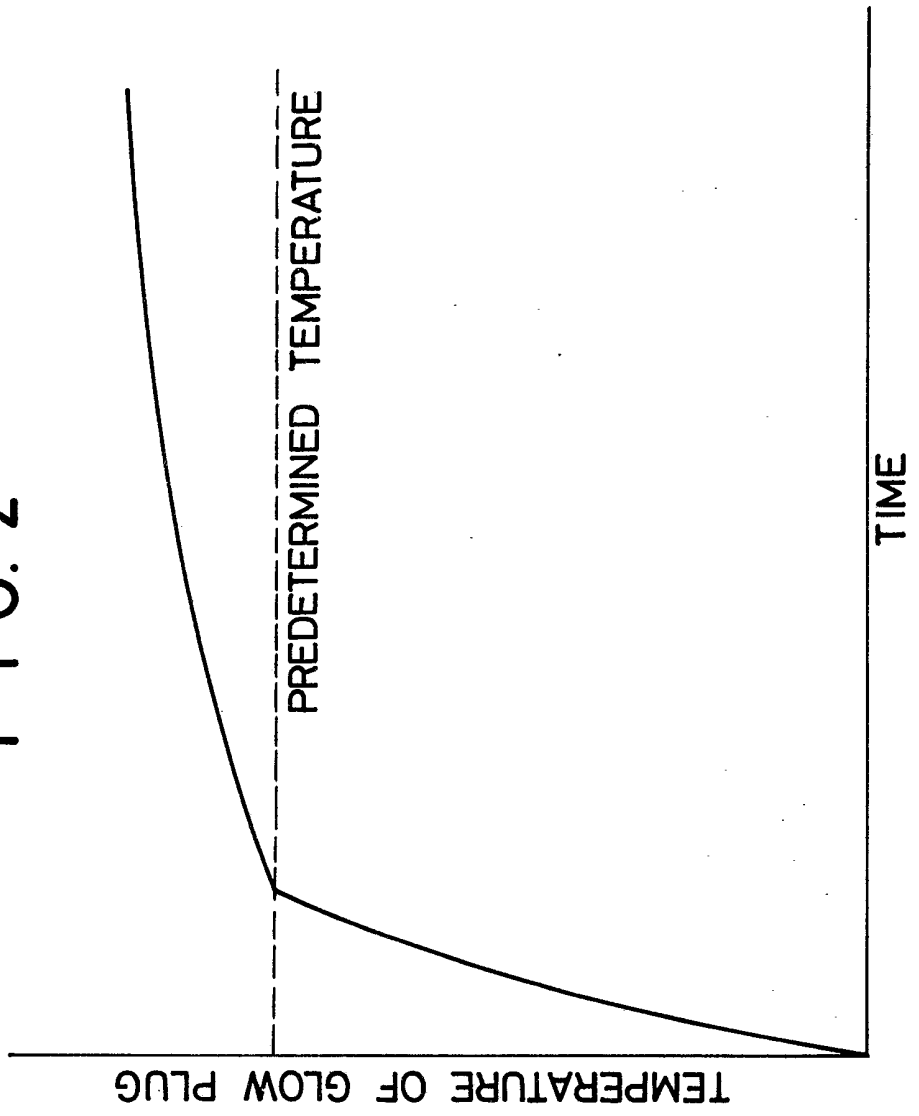
2024940

FIG.1



2024940

FIG. 2



SPECIFICATION

System for controlling engine preheating

This invention relates to a control system for preheating an engine and, more particularly to a control system for preheating an engine having a glow plug.

In conventional diesel engines, it is possible to reduce the time for preheating by using a large amount of electric current in preheating the engine. However, there is a possibility that a heating element of the glow plug will be broken by heat generated as a result of the large amount of current. Therefore, such a method is not generally practical. Under such circumstances, it takes 20 to 30 seconds to preheat the glow plug. The conventional method is also disadvantageous because the engine starting characteristic is very poor.

According to the present invention there is provided a preheating control system for an engine having a glow plug comprising the glow plug, a battery, a quick heating circuit having an extremely small resistance value compared to the glow plug, a stabilizing circuit having a relatively large resistance value compared to the glow plug, and means to determine when the resistance of the glow plug reaches a resistance value corresponding to a predetermined temperature, whereby in use, the current flow from the battery through the quick heating circuit is rapidly terminated upon reaching said predetermined temperature.

This invention will now be described in more detail, by way of example, with reference to the accompanying drawings in which:—

Fig. 1 shows a preferred embodiment of a preheating control system according to the present invention; and

Fig. 2 is a graph showing the relationship of the temperature of the glow plug and lapse of time according to the system shown in Fig. 1.

Fig. 1 shows a control system for preheating a diesel engine wherein reference numeral 1 designates a battery or electric source, and 2 designates a key switch having a contact point 21 for an accessory circuit and for a preheating circuit, a starting contact point (ST) 22, and a fixed contact point 23. A display lamp 3 lights up when a predetermined temperature is reached. A control circuit 4 is shown and a glow plug 5 is provided in every cylinder, in this example there being four cylinders. A heating element 51 is provided for each glow plug, the element 51 having the property that the resistance value R thereof increases in compliance with the increase of the temperature. The resistance value R is repeatable at any temperature. Small resistors 6 are used as detectors having a predetermined resistance value r_1. Resistors 8 and 9 having resistance values r_2 and r_3 form bridge circuits 10 with the detecting resistors 6. Centre points m_1 and m_2 of the bridge circuits 10 are connected to the control circuit 4 through lead lines 71 and 72, respectively.

In the relation:

$$\frac{r_2}{r_1} = \frac{r_3}{R}$$

exists between the above-described resistors, an output signal is generated in a comparison circuit (not shown) disposed in the control circuit 4. The use of a control circuit per se is well known and the comparison function explained herein can be easily achieved. Also, as shown in Fig. 1, reference numeral 11 designates a relay having a relay contact point 12 on a quick heating circuit side and a relay contact point 13 on a stabilizing circuit side. Elements 14 and 15 are magnetizing coils for closing contact point 12 and 13 and are connected, as shown in Fig. 1, to a control circuit 4. A quick heating circuit 16 is connected to the contact point 12 side of the relay 11. A circuit 17 is connected to the contact point 13 side and defines a stabilizing circuit having a resistance for stabilizing a voltage. The circuit shown may be replaced by a simple resistor having an extremely large resistance value. It is to be appreciated that the quick heating circuit 16 has an extremely small resistance value compared to the glow plugs 5 and the stabilizing circuit 17 has a relatively large resistance value compared to the glow plugs. Both circuits are connected, as shown in Fig. 1, to the bridge circuits 10. A starter relay 18 is closed when a magnetizing coil 18a connected as shown is energised. Element 19 is a starter which is operated when the starter relay is closed.

The above described predetermined temperature establishment display lamp 3 is energised by receiving a signal from the comparison circuit in the control circuit 4. Hence the lamp 3 indicates when the predetermined temperature is reached.

A water temperature detecting switch 30 is closed when the temperature of the cooling water for the engine reaches a predetermined temperature, for example, 10°C. The above described display lamp 3 also serves as the display therefor. Additionally numeral 31 designates a manual preheating switch which is used when a part of the preheating system is out of order. A diode 32 is used for rectifying an electrical current flowing therethrough. The contact point 21 of the key switch 2 forms the preheating circuit and allows current to flow through a supply line 24 to each accessory when connected to the contact point 23.

The operation of this preferred embodiment according to the present invention will be hereinafter described. When the engine is started in a cooled ambient temperature, the fixed contact point 23 of the key switch 2 is connected to the preheating contact point 21 so that the relay contact point 12 is closed by the action of the magnetizing coil 14. Therefore, a large amount of current flows from the battery 1 through the quick heating circuit 16 to the heating elements 51 of the glow plugs 5 arranged in the cylinders to thereby quickly heat the heating elements. As the heating elements 51 are heated, the resistance

value R thereof increases. The resistance value R eventually reaches a resistance value Rs corresponding to the predetermined temperature. In this state, the following equation is established.

$$\frac{r_2}{r_1} = \frac{r_2}{R} = \frac{r_3}{R_{12}}$$

At this time, a signal is generated by the comparison circuit disposed in the control circuit 4 to thereby open the relay contact point 12.

Next, when the starting contact point 22 is connected to the fixed contact point 23, the starter relay 18 is closed by the action of the magnetizing coil 18a. Accordingly, the starter 19 is operated and at the same time the relay contact 13 is closed by the action of the magnetizing coil 15 to thereby supply a current from the battery 1 through the stabilizing circuit 17 to the heating elements 51 of the glow plugs 5. Therefore, a voltage drop is generated by the stabilizing circuit 17 and, when the voltage is continuously applied to the glow plugs, the heating elements 51 will not melt or be broken. Fig. 2 shows the relationship between the glow plug temperature and lapse of time according to the above-described system. As shown, the temperature of the glow plugs increases rapidly under the influence of the quick heating circuit. When the predetermined temperature is reached the stabilizing circuit is switched in and the temperature rise is retarded but the temperature is maintained near the predetermined level.

As mentioned, in the present invention, a resistance material whose resistance value increases in compliance with the temperature increase thereof is used, the resistance value corresponding to the predetermined temperature is detected, and by the resulting signal the quick heating circuit and the stabilizing circuit are switched over as the effective circuit. Therefore, it is possible to significantly reduce the time to heat the glow plugs to a predetermined temperature in engine starting and at the same time the current flowing through the glow plugs can be controlled after the temperature of the glow plug achieves the predetermined temperature. Further, it is possible to prevent the heating elements from being melted and broken due to excessive electric current flowing therethrough. The present invention therefore offers a preheating system for an engine having a high reliability. As in the above embodiment of the present invention, a more positive and reliable preheating device can be provided by the use of the water temperature detecting device 30, the manual preheating switch 31, and the display lamp 3.

CLAIMS

1. A preheating control system for an engine having a glow plug comprising the glow plug, a battery, a quick heating circuit having an extremely small resistance value compared to the glow plug, a stabilizing circuit having a relatively large resistance value compared to the glow plug, and means to determine when the resistance of the glow plug reaches a resistance value corresponding to a predetermined temperature, whereby in use, the current flow from the battery through the quick heating circuit is rapidly terminated upon reaching said predetermined temperature.

2. A system according to claim 1 in which the glow plug comprises a heating element having a repeatable resistance value at any temperature.

3. A system according to claim 1 or claim 2 in which said means to determine comprises a bridge circuit in which said glow plug forms one arm thereof, a detector resistor forms a second arm, and a pair of fixed resistors form third and fourth arms.

4. A system according to claim 1 or claim 2 further comprising means to selectively switch said quick heating circuit or said stabilizing circuit in series between said battery and said flow plug.

5. A system according to claim 4 in which said means to selectively switch comprises a relay having a pair of energizable coils and a pair of normally open contact points and a control circuit for selectively energising said coils.

6. A preheating system substantially as hereinbefore described with reference to and as shown in Figure 1 of the accompanying drawings.

Printed for Her Majesty's Stationery Office by the Courier Press, Leamington Spa, 1980. Published by the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.