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(12) # EUROPEAN PATENT SPECIFICATION

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(54) **A unit for controlling the operation of the preheating plugs of a diesel motor.**

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DE-A- 3 500 676
DE-C- 3 706 786

PATENT ABSTRACTS OF JAPAN, vol. 6, no. 89 (M-132)[967], 27th May 1982; & JP-A-57 26 275

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Description

The present invention relates to a unit for controlling the operation of the preheating plugs of a diesel engine, each of which includes a resistive heating element and means including a resistive element with a positive temperature coefficient for limiting the intensity attainable by the current flowing in the resistive element.

More particularly, the subject of the invention is a unit comprising:

means for sensing the current flowing in the plugs,

switch means associated with the plugs, and

control circuit means connected to the sensor means and the switch means and adapted to

- enable a current to flow in the plugs, through the switching means, when the unit receives a control signal at its input,
- provide an output signal which enables the engine to be started when the current flowing in the plugs falls below a predetermined value, and
- switch off the current flow in the plugs by means of the switch means after a time which is determined in a prefixed manner.

Patent Abstracts of Japan, Vol. 6, No. 89 (M-132)(967), 27 May 1982, JP-A-57 26 275 (Nippon Denso K.K.), 12.02.1982 discloses a circuit arrangement for detecting a disconnection of glow plugs. This circuit arrangement includes switch means associated with the plugs for controlling the supply of current thereto, a current detecting resistor in series with the plugs and two comparator circuits coupled to that resistor. The operation of this prior circuit arrangement is based on the fact that the plug temperature rises in proportion to the time elapsed, and for a same amount of temperature rise the time required is shorter when a plug is disconnected.

In the most recently produced preheating glow plugs, the current-limiting means comprise a further resistive element with a positive temperature coefficient which is connected in series with the resistive heating element. Such plugs have extremely short temperature rise times. It has therefore been possible to reduce the preheating time of diesel engines to values of the order of a few seconds.

Each time it is switched on, the current flowing in the preheating plugs assumes quite a high initial value. As the temperature increases, the resistance of the current-limiting resistive element of each plug increases, reducing the current intensity. The overall resistance of each plug then tends to stabilise and assume an approximately constant value, so that the current subsequently varies very little.

Units for controlling the operation of preheating plugs produced up to now are arranged to detect the intensity of the current flowing in the plugs and to enable the engine to be started only when the current intensity has fallen below a predetermined value. For this purpose, the control units usually include timers which switch off the current flow in the plugs after a period of time of predetermined fixed duration. Generally, this time period differs according to the type or brand of plugs used. Users are therefore advised always to use preheating plugs of the same type or brand, since the characteristic time period of the timer of the control unit may not be at an optimum if plugs of another type or brand are used.

The object of the present invention is to provide a unit for controlling the operation of the plugs, which is adapted to ensure optimal preheating with any type or brand of plugs.

According to the invention, this object is achieved by means of a control unit of the type specified above, whose main characteristic lies in the fact that the control circuit means comprise:

differentiating means for generating signals indicative of the time differential of the intensity of the current flowing in the plugs, and

comparator circuit means for switching off the current in the plugs by means of the switching means when the signals generated by the differentiating means assume a predetermined reference value.

Further characteristics and advantages of the control unit according to the invention will become clear from the detailed description which follows with reference to the appended drawings, provided by way of non-limiting example, in which:

Figure 1 is a diagram which shows part of an electrical system of a motor vehicle with a diesel engine, the system incorporating a unit for controlling the operation of the preheating plugs of the engine, and

Figure 2 is an electrical block diagram which illustrates the internal structure of the control unit shown in the diagram of Figure 1.

The diagram of Figure 1 shows the battery, indicated 1, of a motor vehicle provided with a diesel engine (not illustrated). The preheating plugs of the engine are indicated 2. In known manner, each of these plugs includes a resistive heating element 2a in series with which is connected a current-limiting resistive element 2b with a positive temperature coefficient.

The plugs 2 are connected in parallel with each other between an output 3a of a control unit 3 and earth. The control unit 3 has an input 3b which can be connected to the positive pole of the battery 1 by means of a manual-operated switch 4 which is normally open. This switch may be constituted by

a switch which can be closed, for example, by means of the key for starting the engine of the motor vehicle.

A lamp 5 conveniently mounted on the dashboard of the motor vehicle is connected between a further output 3c of the unit 3 and earth. During the periods when the engine is being preheated, the lamp 5 is kept lit: upon completion of the preheating, it goes out and thus signals to the driver that he can then start the engine.

The unit 3 has two further terminals 3d and 3e connected respectively to the two poles of the battery 1.

As shown in Figure 2, the excitation winding 6a of a relay 6 which controls a normally-open switch 6b interposed in a connection between the terminals 3d and 3a is arranged between the terminals 3b and 3e of the unit 3.

A sensor, indicated 7, is adapted to provide an electrical signal indicative of the current flowing to the plugs 2 in operation. This sensor may be constituted, for example, by a Hall-effect device. Alternatively, a shunt resistor arranged in series with the plugs 2 could be used as the sensor, whereby the voltage established across it is indicative of the current flowing to the plugs.

The unit 3 also includes a circuit unit, generally indicated 8, which includes a differentiating circuit 9 and two threshold comparators, indicated 10 and 11.

The sensor 7 is connected to the comparator 10 which compares its signal with a reference signal provided by a generator 12 constituted, for example, by a voltage divider. The sensor 7 is also connected to the input of the differentiating circuit 9 whose output is connected to the input of the comparator 11. A reference signal generator, indicated 13, is also connected to the latter.

The output of the comparator 11 is connected between the terminal 3b of the unit 3 and the excitation winding 6a of the relay 6.

The output of the comparator 10 is connected to the non-earthed terminal of the indicator lamp.

In order to switch on the preheating plugs 2, the user closes the switch 4 (Figure 1). A current consequently flows through the winding 6a of the relay 6, causing the closure of the switch 6b and the supply of current to the plugs 2. As a result of the increase in the resistance of the resistive elements 2b of the plugs, the current they consume is progressively reduced. When, on the basis of the signals provided to the sensor 7, the comparator 10 detects that the current in the plugs 2 has fallen below a predetermined value, its output switches to low level and causes the lamp 5 to be switched off.

When the comparator 11 detects that the differential (that is, the variation with time) of the current flowing in the plugs 2 has become less than a predetermined value, its output switches to low level, resulting in the de-activation of the relay 6 which opens the switch 6b and causes the current supply to the plugs 2 to be switched off.

The current supply to the plugs is therefore switched off on the basis of the monitoring of the variation with time of the current flowing therein. By virtue of this characteristic, the unit 3 ensures optimal preheating of the engine regardless of the characteristics (and hence regardless of the type or brand) of the preheating plugs used.

Claims

1. A unit for controlling the operation of the preheating glow plugs (2) of a diesel engine, each (2) of which includes a resistive heating element (2a) and means (2b) including a resistive element with a positive temperature coefficient for limiting the intensity attainable by the current flowing in the resistive element (2a),

the unit comprising:

means (7) for sensing the current flowing in the plugs (2),

switch means (6) associated with the plugs (2), and

control circuit means (8) connected to the switch means (6) and adapted to

- enable a current to flow in the plugs (2), through the switching means (6), when the unit (3) receives a control signal at its input (3b),
- provide an output signal (3c) which enables the engine to be started when the current flowing in the plugs (2) falls below a predetermined value, and
- switch off the current flow in the plugs (2) by means of the switch means (6) after a time which is determined in a prefixed manner,

characterised in that the control circuit means (8) comprise:

differentiating means (9) for generating signals indicative of the time differential of the intensity of the current flowing in the plugs (2), and

comparator circuit means (11, 13) for switching off the current in the plugs (2) by means of the switching means (6) when the signals generated by the differentiating means (9) assume a predetermined reference value.

Patentansprüche

1. Steuerungseinheit der Vorglühkerzen (2) eines Diesel-Motors, wobei jede Vorglühkerze (2) ein Widerstands-Heizelement (2a) und Einrichtungen (2b) beinhaltet, die ein Widerstandsele-

ment mit positivem Temperaturkoeffizienten zur Begrenzung der durch den Stromfluß im Widerstandselement (2a) erreichbaren Stromstärke aufweisen,

wobei die Einheit umfaßt:

Einrichtungen (7) zur Messung des Stromflusses in den Kerzen (2),

mit den Kerzen (2) verbundene Schalteinrichtungen (6) und

mit den Schalteinrichtungen (6) verbundene Steuerstromkreiseinrichtungen (8), die angebracht sind, um

- einen Stromfluß über die Schalteinrichtungen (6) in den Kerzen (2) zu ermöglichen, wenn die Einheit (3) ein Kontrollsignal an ihrem Eingang (3b) empfängt,
- ein Ausgangssignal (3c) zur Verfügung zu stellen, das es ermöglicht, den Motor zu starten, wenn der Stromfluß in den Kerzen (2) unter einen vorgegebenen Wert sinkt, und um
- den Stromfluß in den Kerzen (2) nach einer Zeit, die auf zuvor festgelegte Weise bestimmt ist, durch die Schalteinrichtungen (6) zu unterbinden,

dadurch gekennzeichnet,

daß die Steuerstromkreiseinrichtungen (8) umfassen:

Differenzierungseinrichtungen (9) zur Erzeugung von Signalen, die das Zeitdifferential der Stromstärke des Stromflusses in den Kerzen (2) melden, und

Vergleicheinrichtungen (11, 13) zum Ausschalten des Stromes in den Kerzen (2) durch die Schalteinrichtungen (6), sobald die von den Differenzierungseinrichtungen (9) erzeugten Signale einen vorgegebenen Bezugswert annehmen.

Revendications

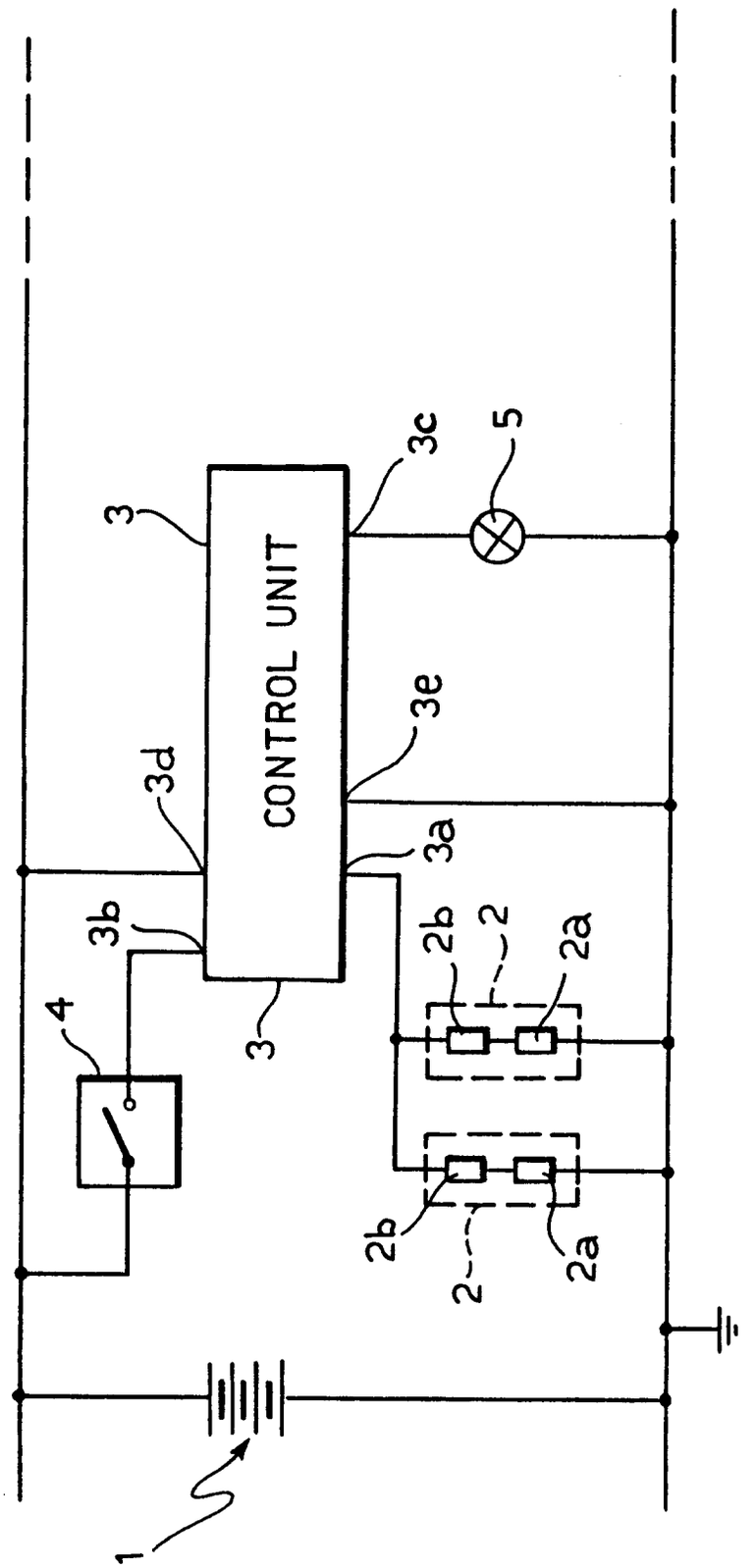
1. Bloc de commande de bougies (2) de préchauffage à incandescence d'un moteur Diesel, dont chacune (2) comprend un élément chauffant résistif (2a) et des moyens (2b) comprenant un élément résistif à coefficient de température positif destiné à limiter l'intensité accessible par le courant passant dans l'élément résistif (2a) ; le bloc comprenant :

- des moyens (7) de détection du courant passant dans les bougies (2) ;
- des moyens commutateurs (6) associés aux bougies (2) ; et
- des moyens de circuit de commande (8) reliés aux moyens commutateurs (6), et adaptés pour :
  . permettre le passage d'un courant dans les bougies (2) par l'intermédiaire des moyens de commutation (6), lorsque le bloc (3) reçoit un signal de commande à son entrée (3b) ;
  . fournir un signal de sortie (3c) qui permette la mise en marche du moteur lorsque le courant passant dans les bougies (2) tombe en-dessous d'une valeur prédéterminée ; et
  . couper le courant dans les bougies (2) par l'intermédiaire des moyens commutateurs (6) après un délai qui est prédéterminé, de manière préfixée,

caractérisé en ce que les moyens de circuit de commande (8) comprennent :

- des moyens de différenciation (9) pour générer des signaux indicateurs du différentiel de temps de l'intensité du courant passant dans les bougies (2) ; et
- des moyens de circuit comparateur (11, 13) pour couper le courant dans les bougies (2) par l'intermédiaire des moyens de commutation (6) lorsque les signaux générés par les moyens de différenciation (9) représentent une valeur de référence prédéterminée.

FIG. 1



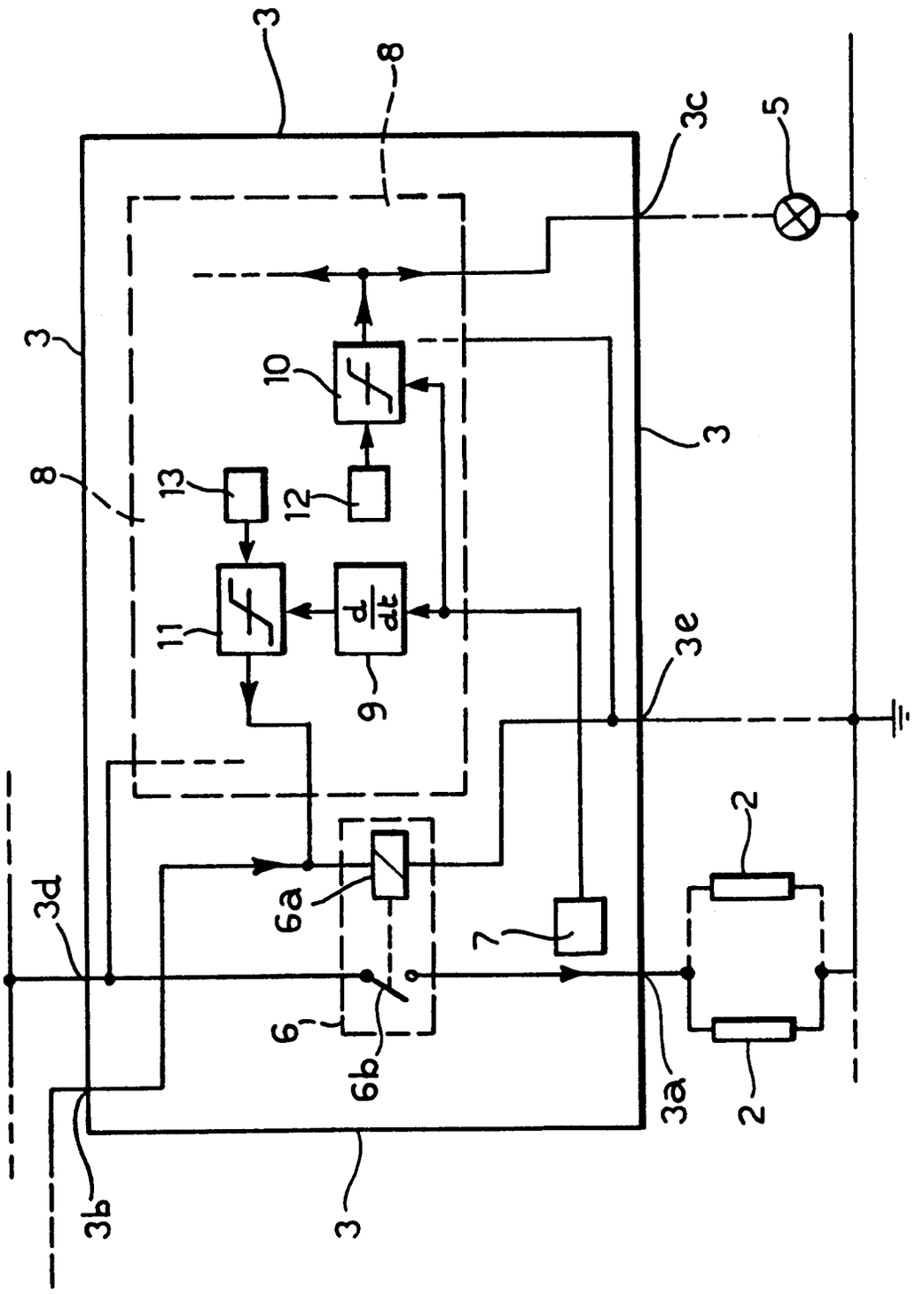


FIG. 2