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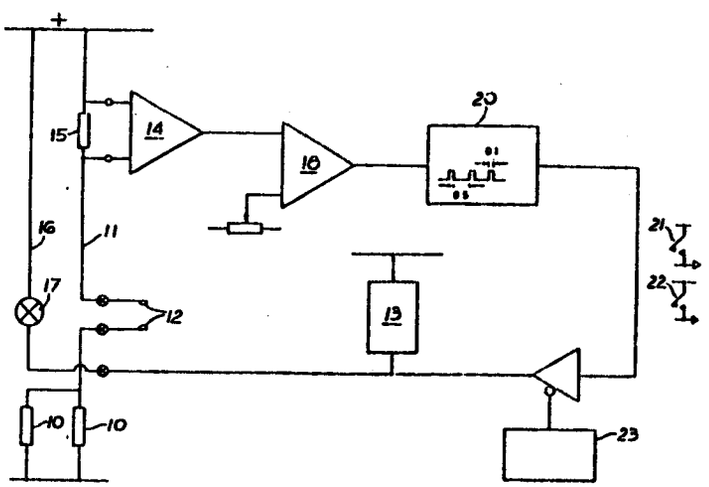
(54) Engine preheat controller.

(57) Compression ignition engine starting system includes one or more fast acting non-self-limiting electrically powered glow plugs (10) for fast cylinder warm up and actuating means including a current sensor (14) responsive to the level of curent consumed by the plugs (which level is a function of their temperature), a comparator (18) determining whether the current exceeds a predetermined level and, if it does, bringing into operation a timer (20) which passes current to the plugs for successive spaced limited periods only while they are above a given temperature to avoid overheating them.



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ENGINE PREHEAT CONTROLLER

This invention relates to the control and operation of electrically powered pre-heating devices, for example glow plugs, used to facilitate start-up from cold of diesel or other compression ignition engines.

The increasing use of diesel engines in light duty vehicles, particularly private motor cars, has led to a demand for quick and easy starting procedures so that start-up from cold can be achieved with little or no more difficulty than in the case of an engine having an electrical ignition system.

It has long been known to provide electrically powered glow plugs in cylinders of the engine to preheat them for starting and, in the past, particularly with heavy duty engines as in commercial vehicles, heating has been slow, an appreciable waiting period being necessary after switching on before starting could be achieved by cranking the engine. Glow plugs for this purpose as originally developed were slow to heat up but were self-limiting in that they would not be damaged or overheated however long current was applied to them.

In more recent times glow plugs have been developed which act much more quickly, i.e. attain their full operating heat in a very short period but they have the disadvantage that they are not self-limiting, if current is applied to them continuously they will continue to heat beyond their safe working temperature until they burn out.

The object of the invention is to provide

actuating means for preheating devices, particularly the last mentioned fast acting non-self-limiting glow plugs, which are simple and reliable in operation and which give speedy start-up of the engine from cold without any substantial risk of burning out or overloading the heating devices.

According to the invention there is provided actuating means for one or more electrically powered preheating devices (10) used to facilitate start-up from cold of a compression ignition engine characterised by switching means (12) through which a circuit (11) supplying power to the device or devices is operatively connected; current sensing means (14) for monitoring the level of current being taken by the device or devices in use, said current level being a function of the temperature at which the device or devices are operating; comparator means (18) connected to an output from said sensing means for determining whether or not a value representing said current exceeds a predetermined threshhold value; and timing means (20) controlled by an output from the comparator means and operating to actuate said switching means to pass current to the device or devices for successive spaced limited predetermined periods only while the device or devices are above a predetermined temperature to avoid overheating but permitting the device or devices to operate continuously while below said temperature.

Preferably the or each preheating device is a fast acting non-self-limiting glow plug.

The switching means is conveniently a relay operated by a circuit of the actuating means,

and the timing means is an oscillator operating to generate on/off pulses of predetermined frequency and duration.

The overriding control means may include overriding timing means disabling the actuating means after a predetermined period from initiation of its operation if the engine is not started during that period.

One example of the invention is now more particularly descibed with reference to the accompanying drawing being a block diagram of an engine preheat controller.

The controller is shown connected into the electrical circuit of a passenger car or other vehicle having a diesel or other compression ignition engine. The engine has fast acting non-self-limiting glow plugs 10 each in a respective cylinder in known manner (two only shown in the diagram) which are powered from the battery of the vehicle through a lead 11 by way of switching contacts 12 of a relay 13 referred to further hereafter.

Lead 11 is also connected through a current sensing unit 14 of known kind arranged in parallel with a shunt resistor 15.

A second lead 16 from the battery is connected through an indicator light 17 to the operating circuit of the controller now described.

Sensing means 14 operates to monitor the current passing to plugs 10, the current level being a function of the temperature at which they are operating; as the temperature rises the current

level falls. Output from sensing device 14 is applied to a comparator 18 which provides an output signal dependent on whether or not the sensed current is above or below a predetermined threshhold level representing the safe operating temperature of the plugs at which optimum heating effect is obtained without risk of their burning out or becoming damaged through overloading.

The controller further includes timing means in the form of an oscillator 20 which, in this example, provides on/off pulses each of 0.1 seconds duration at intervals of 0.5 seconds, the output from the oscillator controlling the operation of relay 13.

When starting the engine from cold a key operated or other "ignition" switch 21 is turned on to apply current to the circuit of the controller and indicator light 17 will be lit. Relay contacts 12 will close to pass current to plugs 10 and, while they are cold and until they reach their operating temperature the current level sensed by unit 14 will exceed the threshhold and the output from comparator 18 will be applied to clamp the oscillator so that its output is not pulsed and the relay is held on continuously.

The plugs heat rapidly and the current level drops until it falls below the threshhold, i.e. the plugs have reached the desired temperature level. When this happens comparator 18 releases oscillator 20 freeing it to generate the pulsed on/off output which turns off relay 13 except during each brief 0.1 second on period.

During each of these periods the application of current to the plugs 10 enables the sensing unit 14 to sample their temperature as a function of the current level, if they have cooled below the threshhold e.g. because an attempt to start the engine has been delayed, pulsing will cease and relay 13 will be continuously switched on to bring the plugs back to heat. If the sampling indicates that the plugs are still at the safe maximum heat then the pulsing continues, the brief on period not being long enough to cause them to overheat or become damaged.

To avoid unnecessary drain on the battery a second timer (23) is provided to cut off totally the current to the plugs after about 90 seconds. This timeout is reset on selecting ignition (21) and startup (22).

On starting the timer (23) is reset so that after cranking, the controller will continue to operate to cut down on emissions. Time of (23) depends on the ambient temperature.

The invention provides a simple, speedy and reliable facility for starting diesel type engines from cold which can be controlled and operated so far as is apparent to a user of the vehicle, e.g. a private car, in an almost identical fashion to and at substantially the same speed as the familiar procedures for switching on and starting up from cold a petrol fuelled engine with electrical ignition.

CLAIMS

1. Actuating means for one or more electrically powered preheating devices (10) used to facilitate start-up from cold of a compression ignition engine characterised by switching means (12) through which a circuit (11) supplying power to the device or devices is operatively connected; current sensing means (14) for monitoring the level of current being taken by the device or devices in use, said current level being a function of the temperature at which the device or devices are operating; comparator means (18) connected to an output from said sensing means for determining whether or not a value representing said current exceeds a predetermined threshhold value; and timing means (20) controlled by an output from the comparator means and operating to actuate said switching means to pass current to the device or devices for successive spaced limited predetermined periods only while the device or devices are above a predetermined temperature to avoid overheating but permitting the device or devices to operate continuously while below said temperature.

2. Actuating means as in Claim 1 characterised in that the switching means includes a relay (13) operated by a circuit of the actuating means.

3. Actuating means as in Claim 1 or 2 characterised in that the timing means includes an oscillator (20) operating to generate on/off pulses of predetermined frequency and duration.

4. Actuating means as in Claim 1, 2 or 3 characterised by including overriding control means (23) for

selectively rendering the actuating means inactive.

5. Actuating means as in Claim 4 characterised in that the overriding control means includes overriding timing means (23) operatively disabling the actuating means after a predetermined period from initiation of its operation if the engine fails to start within that period.

6. A starting system for a compression ignition engine including one or more electrically powered fast acting non-selflimiting glow plugs (10) characterised by actuating means as in any preceding claim.

7. A system as in Claim 6 characterised in that the actuating means is arranged to continue to operate for a selectively determined period after the engine has started.

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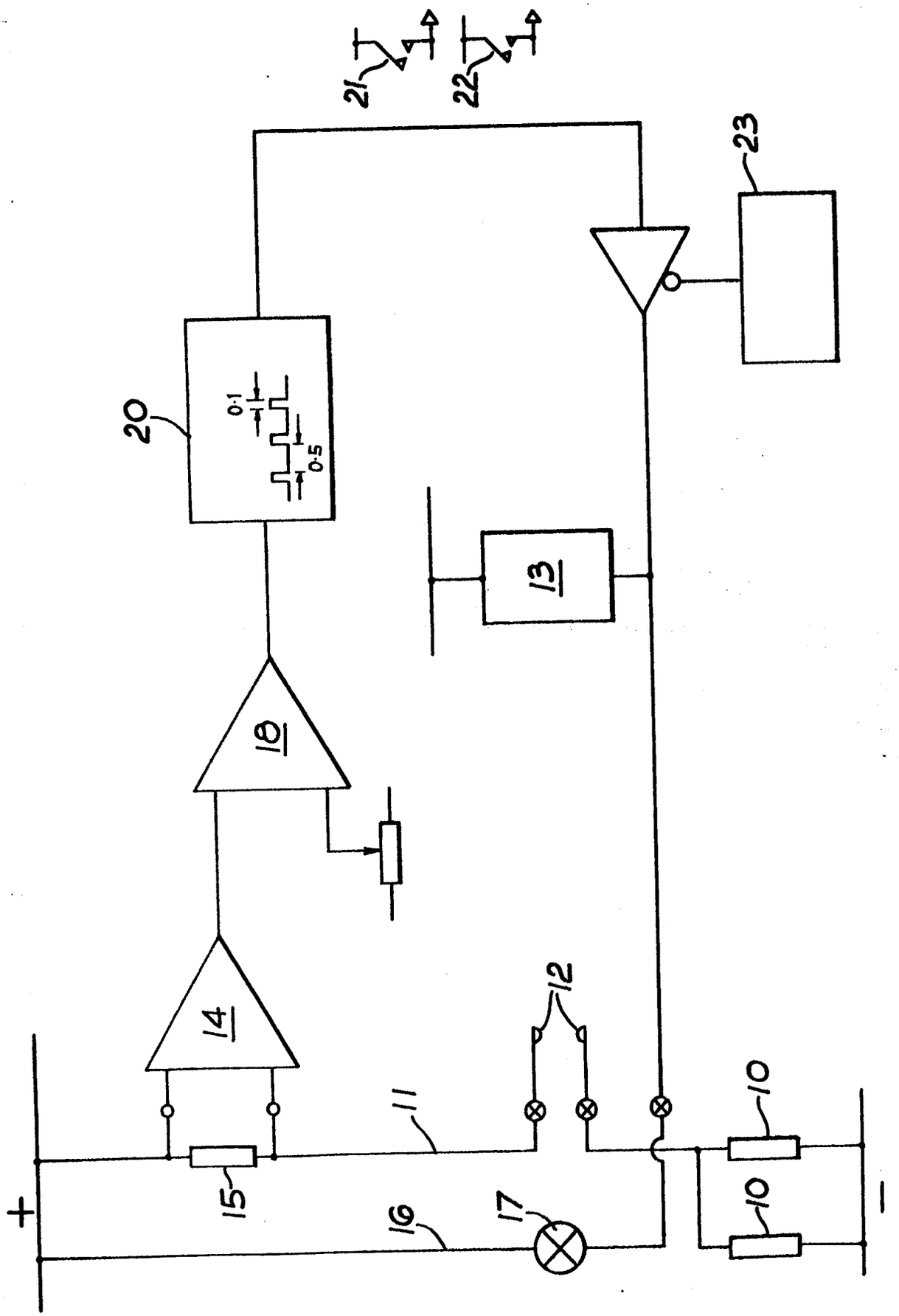

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EUROPEAN SEARCH REPORT

0209968
Application number

EP 86 30 3812

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int Cl 4)
X	DE-A-2 743 059 (BERU-WERK) * Figures 1-4; page 5, line 22 - page 9, line 26 *	1-6	F 02 P 19/02
A	PATENTS ABSTRACTS OF JAPAN, vol. 7, no. 163 (M-229)[1308], 16th July 1983; & JP - A - 58 70 060 (HITACHI SEISAKUSHO K.K.) 26-04-1983	1-6	
A	PATENTS ABSTRACTS OF JAPAN, vol. 8, no. 270 (M-344)[1707], 11th December 1984; & JP - A - 59 141 770 (TOYOTA JIDOSHA K.K.) 14-08-1984	1-7	
A	PATENTS ABSTRACTS OF JAPAN, vol. 8, no. 224 (M-331)[1661], 13th October 1984; & JP - A - 59 105 971 (TOYOTA JIDOSHA K.K.) 19-06-1984	1	TECHNICAL FIELDS SEARCHED (Int Cl 4): F 02 P

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	11-09-1986	GODIN CH.G.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

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