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GLOW PLUG IGNITION SYSTEMS OR THE LIKE

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2 Sheets-Sheet 1

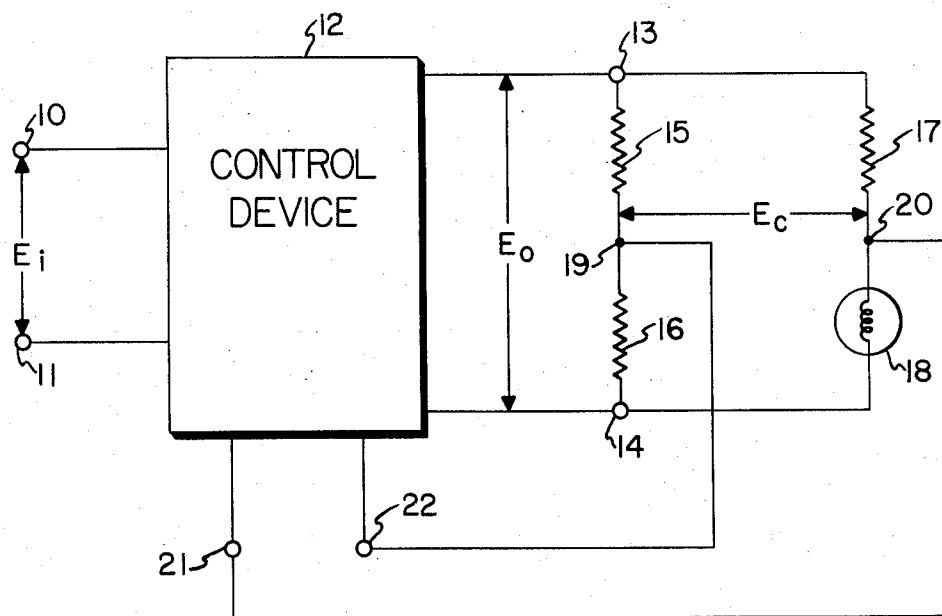


FIG. 1

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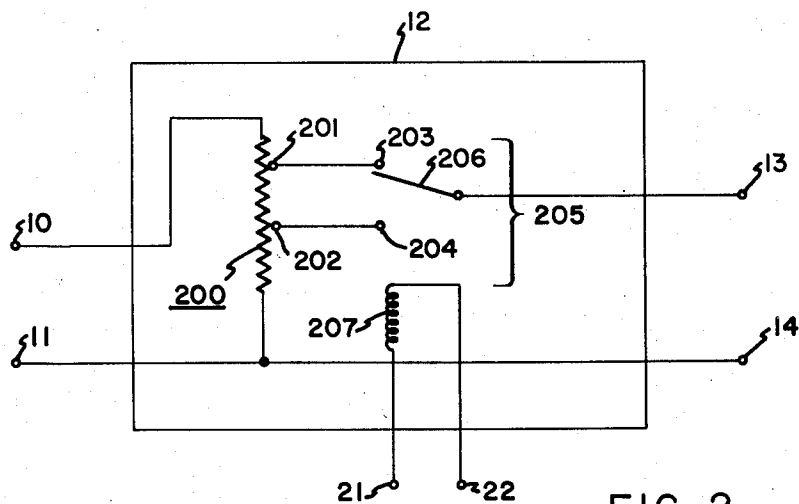


FIG. 2

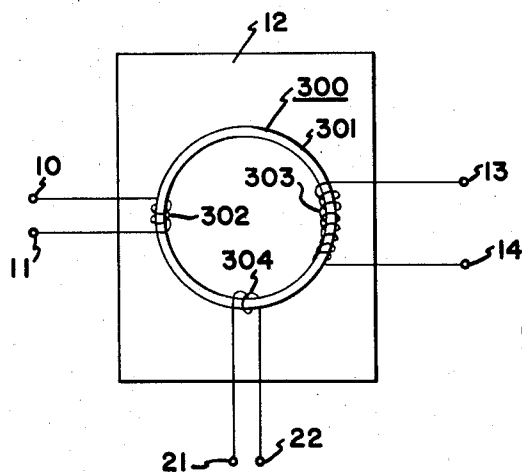


FIG. 3

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GLOW PLUG IGNITION SYSTEMS OR THE LIKE

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6 Claims. (Cl. 123—145)

This invention is related to glow plug ignition systems for gasoline engines, or other internal combustion engines, and more particularly to an improved glow plug ignition system which is temperature controlled, so that optimum operation may be facilitated.

In the past, there have been many types of glow plug ignition systems. Such systems currently in use have been proven somewhat unsatisfactory in that in starting an internal combustion engine associated therewith, glow plug burnout may occur as a result of large and varied current surges through the glow plug system. In addition, it is highly desirable, for optimum operation, that the glow plugs maintain a constant temperature throughout the entire period of running the combustion engine.

Therefore, it is an object of this invention to provide an improved glow plug ignition system.

It is a further object of this invention to provide an improved glow plug ignition system which will exhibit glow plug temperature control during the starting and throughout the running cycle of an associated internal combustion engine.

According to this invention, an input voltage, for example one derived from a generator associated with the engine incorporating the glow plug, drives a control device, e. g., magnetic amplifier, sensitive relay, or the like, which is coupled to the input terminals of a Wheatstone bridge circuit consisting of three impedance legs and a glow plug leg. The output from the Wheatstone bridge circuit is fed back into the input side of the aforementioned control device in such manner that, independent of the presence and magnitude of variations in the input signal driving the control device, the current through the glow plugs is controlled so that the operating temperature of the glow plug will remain substantially constant.

The features of the present invention which are believed to be novel are set forth with particularity in the appended claims. The present invention, both as to its organization and manner of operation, together with further objects and advantages thereof, may best be understood by reference to the following description, taken in connection with the accompanying drawing, in which:

Figure 1 is a schematic diagram, partially in block form, of a glow plug ignition system according to the present invention.

Figures 2 and 3 illustrate particular devices which may be employed as the control device incorporated in the circuit of Figure 1.

In Figure 1 an input voltage is applied to input terminals 10 and 11 of control device 12. Output terminals 13 and 14 of control device 12 are coupled together through a first branch consisting of resistors 15 and 16, and a second branch consisting of a resistor 17 and glow plug 18. As is apparent, resistors 15, 16, 17 and glow plug 18 constitute a Wheatstone bridge circuit. Junction 19, of resistors 15 and 16, and junction 20, of resistors 17 and glow plug 18, are coupled to feed-back terminals 21 and 22, respectively, of control device 12.

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The circuit shown in Figure 1 operates as follows: Input signal E_1 to control device 12 is translated through control device 12 to appear as output signal E_o , which is impressed across the Wheatstone bridge circuit, consisting of resistors 15, 16, 17 and glow plug 18. We shall assume that, in the first instance, the value of E_1 is such that the current through glow plug 18, and hence the temperature of the heating element in glow plug 18, is at its desired value. Now let us assume that input voltage E_1 and hence output voltage E_o , increases positively. This means that since there is an increased voltage across terminals 13 and 14 of control device 12, the current through glow plug 18 will be increased. Hence, glow plug 18 will experience a temperature rise and a consequent increase in internal resistance. Thus, the ratio of resistance between resistor 17 and glow plug 18 will change, and consequently, a voltage will appear between junction terminals 19 and 20, which we shall designate as E_c . Voltage E_c is simultaneously applied to feed-back terminals 21 and 22 of control device 12 which, by virtue of the internal design of control device 12, will reduce voltage E_o to compensate for the change in input voltage E_1 . This reduced output voltage E_o' will reduce the current flow through the legs of the Wheatstone bridge, and accordingly will reduce the current, and hence the temperature and effective resistance of glow plug 18. Thus, the resistance of glow plug 18 will be returned to its initial and desired value. As indicated earlier, control device 12 may be a magnetic amplifier in an A. C. system, or a relay in a D. C. system which reduces the voltage applied to the Wheatstone bridge, and hence to glow plug 18, as the resistance of glow plug 18 rises. This is illustrated in Figures 2 and 3. In Figure 2, control device 12 includes a voltage divider 200 coupled across input terminals 10 and 11 and having taps 201 and 202 coupled respectively to contacts 203 and 204 of single-pole double throw relay 205. Relay 205 is also provided with arm 206 coupled to output terminal 13 and also relay winding 207 coupled across feedback terminals 21 and 22.

The operation of the apparatus of Figure 1 employing the apparatus of Figure 2 is as follows. A feedback voltage derived from the bridge of Figure 1 energizes relay 205 so as to impress a lesser voltage across output terminals 13 and 14 by virtue of the relay switching in a lower voltage divider tap, i. e. tap 202. This condition is preserved until the bridge is restored to balance.

In Figure 3, magnetic amplifier 300 is provided with a core 301, an input winding 302 coupled across input terminals 10 and 11, an output winding 303 coupled across output terminals 13 and 14, and an appropriately wound control winding 304 coupled across feedback terminals 21 and 22.

The circuit of Figure 1 employing the device of Figure 3 operates as follows. In the presence of excessive input voltage, the feedback voltage developed by the bridge of Figure 1 is fed to the control winding 304 of magnetic amplifier 300 so as to reduce core flux and hence the magnetic coupling of the input winding 302 to the output winding 303, thereby reducing the voltage across the bridge and hence across glow plug 18. Such voltage reduction will lower the temperature and hence the resistance of a glow plug 18 so as to restore the bridge to balance. This technique has proven very effective in guarding glow plug ignition systems against starting current surges.

Accordingly, this invention devises a means whereby, regardless of the magnitude of the input signal and fluctuations thereof, the resistance, and hence the temperature, of glow plug 18 will remain substantially constant. Experiment has confirmed the foregoing analysis, and the desirability of the subject invention.

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While particular embodiments of the present invention have been shown and described, it will be obvious to those skilled in the art that changes and modifications may be made without departing from this invention in its broader aspects, and, therefore, the aim in the appended claims is to cover all such changes and modifications as fall within the true spirit and scope of this invention.

I claim:

1. A glow plug ignition system including, in combination, a control device having first and second input terminals for coupling to a source of input voltage an input circuit coupled to said input terminals, first and second output terminals, and output circuit coupled to said output terminals, and first and second feedback terminals; first and second impedances coupled together in series between said first and second output terminals; a third impedance and a glow plug also coupled together in series between said first and second output terminals; the junction of said first and second impedances and the junction of said third impedance and said glow plug being coupled respectively to said first and second feedback terminals of said control device; said control device also including means coupled to said feedback terminals and responsive to voltages therefrom for varying the coupling between

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said input circuit and said output circuit of said control device.

2. Apparatus according to claim 1 in which said control device comprises a magnetic amplifier.

3. An apparatus according to claim 1 in which said input circuit comprises a voltage divider having first and second taps; said means comprises a relay having a relay winding coupled to said feedback terminals, first and second relay contacts coupled to said taps respectively, and a relay arm coupled to said first output terminal to constitute at least in part said output circuit.

4. Apparatus according to claim 1 in which said first, second and third impedances include resistors.

5. Apparatus according to claim 2 in which said first, second and third impedances include resistors.

6. Apparatus according to claim 3 in which said first, second and third impedances include resistors.

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