TEMPERATURE STABILIZATION OF THERMAL IGNITERS FOR OIL BURNERS

Filed Oct. 7, 1966 2 Sheets-Sheet 1

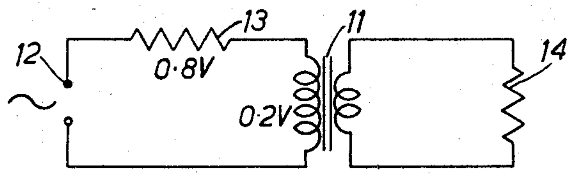

FIG. 1.

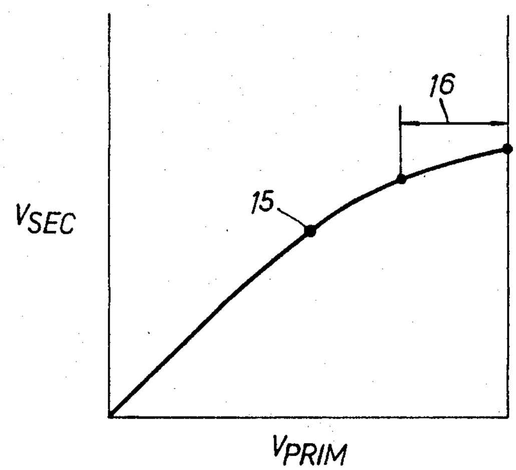

FIG. 2.

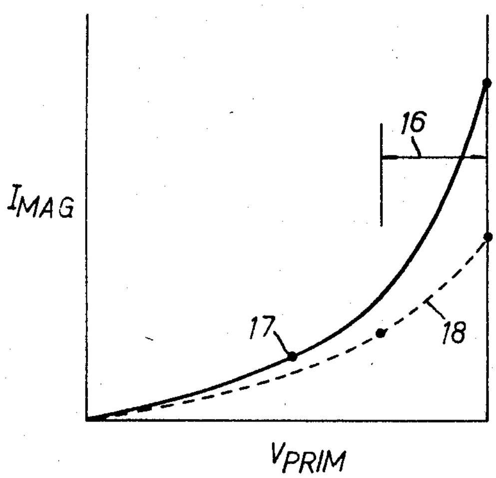

FIG 3

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TEMPERATURE STABILIZATION OF THERMAL IGNITERS FOR OIL BURNERS

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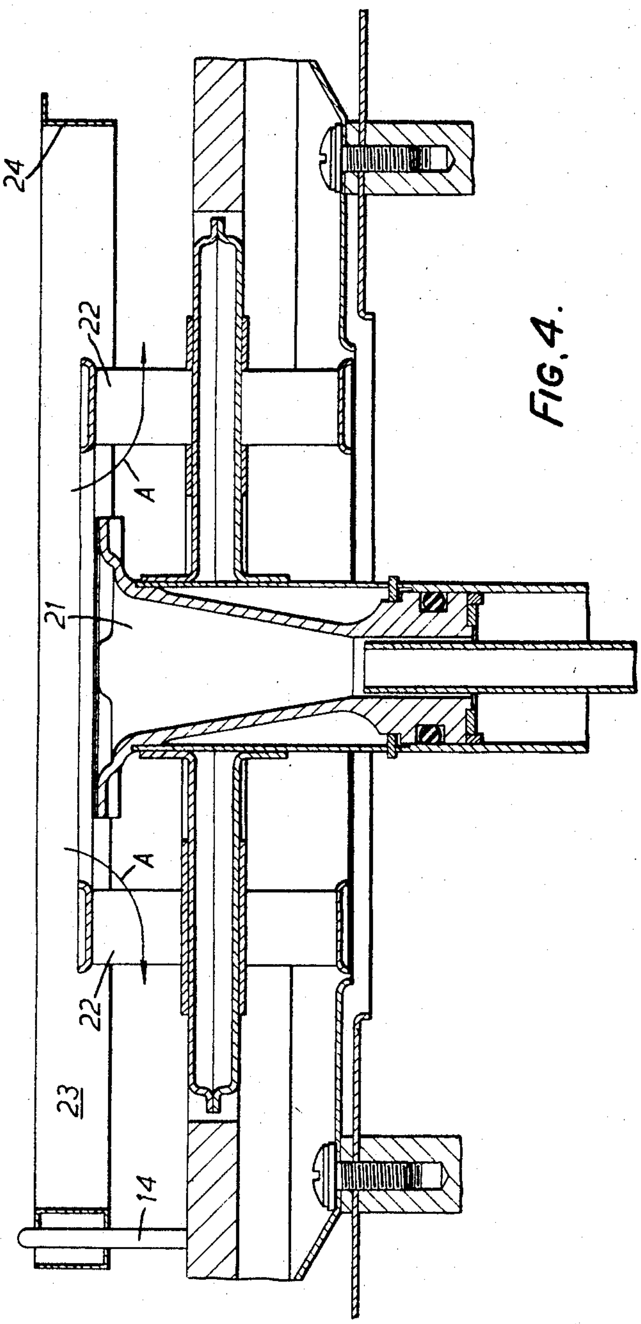

FIG. 4.

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TEMPERATURE STABILIZATION OF THERMAL IGNITERS FOR OIL BURNERS

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5 Claims. (Cl. 317—98)

ABSTRACT OF THE DISCLOSURE

A stabilized voltage supply for energizing a hot surface electrical resistance heater, constituting an igniter and a fuel burner, has a conventional transformer which is caused to operate above a nominal operating point on a selected range of its drooping characteristic so that variations in the supply voltage will provide a minimum temperature of the igniter element to ignite the fuel and a maximum temperature below that at which the igniter element will be destroyed. In a preferred embodiment a resistor, having a high temperature coefficient of resistance, is inserted in the primary circuit of the transformer to cause it to operate in a desired range of the drooping characteristic and also to modify the magnetizing current characteristic of the transformer.

This invention relates to a stabilized voltage supply which is arranged to give a reasonably constant secondary voltage in spite of the sort of variation in primary voltage that might be experienced in practice from a mains supply.

One example of an application of such a stabilized supply is the heating of an electrical element which must be kept above a certain temperature, but which should not exceed this temperature substantially to prevent destruction. For example the supply can be used to enegize an electrical resistance heater in an igniter for an oil burner in central heating equipment, where a temperature approaching 1000° C. is necessary to ensure ignition but where a temperature much in excess of this might destroy the element.

According to the present invention the supply comprises a transformer circuit arranged, when connected to a mains supply for the transformer, to operate at a part of its characteristic where for a range of increase in primary voltage the change in secondary voltage is relatively slight. Thus the transformer may be arranged to operate at a point approaching core saturation when connected to a nominal 240 volts A.C. supply.

When operating in these conditions the flux density will be high-approaching saturation; and the magnetizing current will also be high.

In order to restrict the magnetizing current to a value where the losses are not enormous, a current limiting resistance must be included in the primary circuit.

The secondary of the transformer may be coupled to an electrically heated igniter for a liquid fuel which may be arranged to be at a temperature of about 1000° C. when the primary is connected to the mains.

The transformer can be a sturdy, inexpensive, conventional transformer, and special design is not necessary because the operation will be intermittent, and only for short periods at a time.

Thus the invention is applicable whenever a stabilized voltage is required from an A.C. supply for short periods intermittently, where the cost of a special stabilizing circuit is not merited, and where inefficiency for the short periods can be tolerated.

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The invention may be carried into practice in various ways but one specific embodiment will now be described by way of example with reference to the accompanying drawings in which:

FIGURE 1 is a circuit diagram of a stabilized voltage supply circuit embodying the invention;

FIGURE 2 is a diagram showing the relationship of primary voltage to secondary voltage in a conventional transformer;

FIGURE 3 is a diagram showing the magnetizing current in a conventional transformer in relation to its primary voltage and also showing the effect on the magnetizing current of modifying the primary circuit in accordance with the invention; and

FIGURE 4 is a diagram representing a cross-section of a part of an oil burner showing how the igniter forming the load of the circuit shown in FIGURE 1 is positioned to ignite the fuel.

As shown in FIGURE 1 a transformer **11** is connected to the mains **12** through a resistor **13**. The values of the components are arranged to be such that about 0.8V volt appears across the resistor **13** while the remaining 0.2V volt appears across the primary winding of the transformer **11**, where V is the supply voltage. This 0.2V volt is sufficient to cause the transformer to operate with the core saturated during the peaks of primary voltage as will be described in more detail below. The secondary winding of the transformer **11** is connected to a resistive load **14** constituting the heating element of a conventional electrical resistance heater for igniting the fuel in the burner shown in FIGURE 4.

The element **14** might be of an 80/20 nickel chromium alloy which constitutes a reasonably constant load because the temperature coefficient of its resistance is quite low. It is of great importance that ignition of oil will take place very quickly when oil is delivered to the burner, in order that there shall not be a smell and flooding of the combustion chamber, and for this purpose it has been found to be important to have the igniter element at a temperature of at least 900° C., and preferably 1,000–1,050° C. The temperature is fairly critical because at 1,200° C. the element would be destroyed, and most other known heater element materials which would be satisfactory would also be destroyed at a temperature of about 1,200° C.

It would not be difficult to ensure that when ignition was required the element was raised to a temperature of 1,000–1,050° C. without reaching a temperature as high as 1,200° C. if the mains voltage remained constant. Unfortunately this is far from the case and mains voltage regulation is common throughout a day and from one season to another, and indeed a nominal 240 volt mains supply may vary between 190 and 245 volts. It is clear that at the lower end of this range, the element **14** would not be heated enough to ignite the fuel whereas at the other end of this range the element would be raised to a temperature at which it would be destroyed.

Reference is now made to FIGURE 2. A point **15** on the characteristic is the normal operating point for a conventional transformer. It is near the upper end of the linear part of the characteristic so that the operating voltages are linearly related to each other. In accordance with the present invention, however, the transformer is arranged to be operated at a point within the range **16** so that when the mains voltage is low, operation will be at the left hand end of this range **16** on the characteristic, whereas when the mains voltage is high, operation will be at the right hand end. It can be seen from FIGURE 2 that over this wide range of variation of mains voltage—and hence primary voltage—the range of variation of the secondary voltage is small, perhaps ⅕ or ¼ of this variation in the primary voltage. In this way a more nearly constant secondary voltage is achieved in spite of variation of the mains voltage, to ensure that the element is raised to a temperature high enough to ignite the fuel with certainty without being raised to a temperature at which it would be destroyed.

FIGURE 3 shows at the point **17** the magnetizing current of a conventional transformer at its normal operating point corresponding to the point **15** in FIGURE 2 but FIGURE 3 also shows that if operation is within the range **16**—corresponding to that range in FIGURE 2—the magnetizing current will become very large and indeed a small further increase in the primary voltage will produce an enormous increase in the magnetizing current which would likely destroy the transformer.

Accordingly, the resistance **13** is included in the circuit in order to limit the magnetizing current; the effect of this is to modify the magnetizing current characteristic to the curve shown at **18** in FIGURE 3. Over the operating range **16** the magnetizing current is higher than at **17** but is not great enough to destroy the transformer. Opertaion is inefficient and the transformer will be heated, but since ignition is only required intermittently and each operation will require energization of the element only for a period of less than say a minute, this can be tolerated.

The transformer can thus be an inexpensive standard transformer which can be quite small for the power handled, due to the high flux density at which it operates. Such a transformer is sturdy with no delicate parts, and is eminently suitable for a fuel burner in domestic central heating equipment.

The transformer might be conveniently a 5–1 step down transformer with 6 amps. secondary winding. It will be a transformer normally rated to operate at a primary voltage rather less than the voltage which will appear across it in the circuit shown in FIGURE 1 so that it operates on the part of its characteristic shown at **16** in FIGURES 2 and 3.

This condition can be reasonably easily established because the resistor **13** makes the primary circuit primarily resistive, and in a preferred form of the invention the resistor **13** is of a material having a high temperature coefficient of resistance; for example it might be a 70/30 nickel iron alloy. The increase in resistance of the resistor **13** accompanying an increase in its temperature tends to limit the current further and so helps in restricting the magnetizing current.

While in theory it is conceivable that the resistance **13** could be included in the transformer by winding the primary winding of high resistive material, or that the transformer might be designed for operation at a high magnetizing current if special provisions were made for cooling, it seems that these proposals are not likely to be practical, partly because of the high cost of a specially designed transformer. Thus, the invention is preferably always performed using the series resistor **13** but is not intended to exclude from the claims equivalent applications where series resistance is included in the primary circuit.

FIGURE 4 shows the element **14** in position in a fuel burner in a domestic central heating application. Detailed description is thought to be unnecessary as the ignition system is applicable to all kinds of oil burners and it will suffice to say that fuel passes from a distributor **21** in the vicinity shown by arrows A through a rotating fan **22** into an area shown generally at **23** where ignition is to take place. Normally combustion is self maintaining, but at ignition the element **14** is raised to a temperature of say 1,000° C. and readily ignites the fuel in its vicinity. The flame then spreads around a ring **24** surrounding the combustion area **23** so that combustion is well established and the element **14** can be de-energized.

A more detailed description of a burner of this kind is contained in British patent specification No. 910,505.

What I claim as my invention and desire to secure by Letters Patent is:

1. A stabilized voltage supply for a thermal igniter in a fuel burner system, comprising;
   - transformer means including a primary winding and a secondary winding,
   - a power supply connected to the primary winding,
   - igniter means of the electrical resistance heater type connected to said secondary winding, said igniter means being operable over a temperature range including a minimum temperature at which the fuel will ignite and an upper temperature below a critical temperature at which said heater element will be destroyed,
   - said transformer means having a drooping secondary voltage to primary voltage characteristic curve above a nominal operating point, and
   - means for operating said transformer within a selected range of said drooping characteristic, said range including a minimum operating point corresponding to said minimum temperature of said igniter means and a maximum point corresponding to said upper temperature of said igniter means, said means serving to stabilize the temperature of said igniter means within said temperature range with variations in the supply voltage provided to said transformer means.

2. A stabilized voltage supply in accordance with claim 1 wherein said transformer further comprises a core and said means for operating said transformer causes said core to be saturated for voltage supply levels above a selected peak value.

3. A stabilized voltage supply according to claim 2 wherein said means for operating said transformer includes a resistor connected in series with said primary winding and said power supply.

4. A stabilized voltage supply according to claim 3 wherein said resistor has a high temperature coefficient of resistance for reducing the magnetizing current of said transformer.

5. A stabilized voltage supply according to claim 4 wherein said resistor has a specific resistance so that said heater element operates within a temperature range of 1,000 to 1,050° C.

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