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ELECTRIC IGNITION DEVICE FOR OILS AND GASES

Filed Feb. 24, 1964

FIG. 1

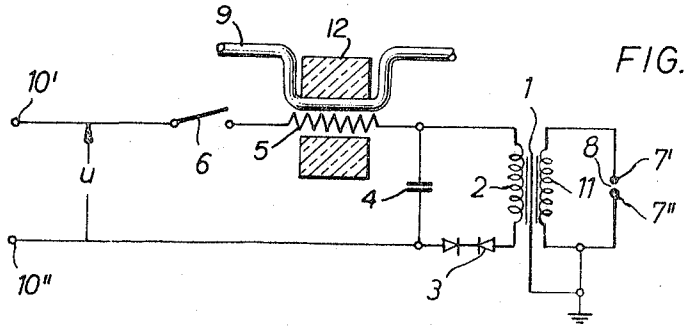


FIG. 2

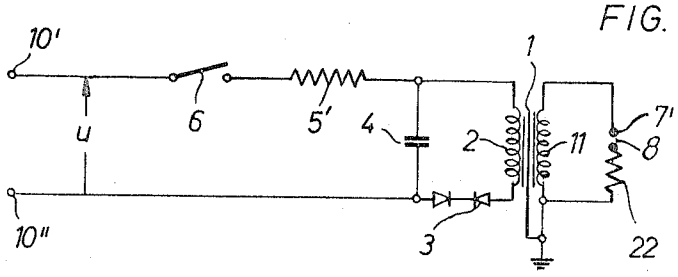


FIG. 3

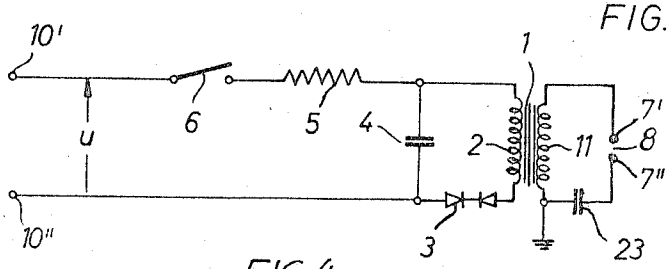
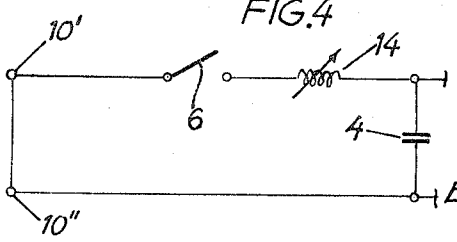


FIG.4



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ELECTRIC IGNITION DEVICE FOR OILS AND GASES

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This invention relates to an electric ignition device which can be used in oil furnaces of the vaporizing or atomizing varieties, and which can also be built into gas furnaces. More particularly this invention relates to an electric ignition system in which the primary winding of the ignition coil is energized by high amperage current.

With fuel oils in their different states of preparation and with the various kinds of combustible gases, different amounts of energy are required for fuel-air mixtures which are difficult to ignite.

Ignition devices with electric resistance elements for electrodes are known but have never come into general use because the unprotected hot ignition element is soon destroyed under the severe operating conditions. When used for the ignition of gas, there is also the possibility of the ignition element being cooled by the movement of cold gas to such an extent that prompt ignition may not occur.

Another disadvantage is that the ignition elements have to be accurately positioned around the edges of the burner so that ignition will be sure to occur, but without continual heating of the elements during normal operation.

For atomizing burners using fuel oil, high voltage spark ignition is now generally used. Efforts have also been made to use such spark ignition in pot or vaporizing burners, but these often operate in the region of incomplete combustion because of being under the influence of chimney draft. Such incomplete combustion causes the formation of soot which soon settles on the insulators of the electrodes and renders them less effective. The same danger of soot formation on the insulation of the electrodes is also encountered in atomizing or nozzle burners. In vaporizing burners there is also the possibility of insulating layers being formed between the electrodes so as to prevent a spark from the usually small ignition transformer from jumping across the ignition gap. It can also be very disadvantageous for a nozzle burner if the spark that has formed between the electrodes is blown out by the air blower or air movement due to insufficient energy in the spark.

High voltage spark ignition has been found suitable for the ignition of various gases such as city gas, propane, butane, and natural gas. The electric ignition energy for such gas-igniting sparks has heretofore usually been obtained from hand operated magnetic igniters or from circuit operated ignition systems.

The use of ignition transformers of the kind generally used for nozzle burner ignition could heretofore not be put to general use on other types of burners because of the high cost of installation of the necessary transformers for gas ignition.

In this invention use is made of a high-voltage discharge device formed of a heavy duty diode. It is, therefore, desirable in this invention to be able to keep such a heavy duty diode permanently connected in a circuit having the usual voltage and carrying a current of 1000 amperes or more.

According to this invention, a capacitor is connected to a resistor and across a source of electricity of usual voltage. The capacitor will then become charged, but will get discharged when the voltage of its charge becomes equal to the "pass through" voltage of the circuit diode. The capacitor then discharges through the primary winding of an ignition transformer, whose turns-ratio relative

to its secondary is such that high-voltage peaks are produced. The resistor and the capacitor can be so proportioned that 100 to 10,000 impulses per second are generated. If an ohmic resistor is used as a charging resistor for the capacitor, the heat that is generated thereby can be used advantageously for prewarming the fuel oil.

The object of this invention is to provide an ignition system that would be suitable for general use.

A second object is to provide a circuit whose component parts are so selected that ignition energy can be obtained in any desired form, duration, amperage and voltage from any of the usual direct or alternating current voltages.

It is a further object of this invention to provide an ignition generator which will be relatively stable and which will have a low internal resistance as compared with the usual ignition transformers.

A further object is to provide an ignition system which will be able to produce very high current-voltage impulses so that the ignition sparks will not be affected by low insulation resistance, or be blown out by air currents, or be obstructed by oil films between the electrodes.

The invention also presents the further advantage of using the heat that is necessarily generated by the resistance of the circuit for preheating the fuel oil or the air that is used to support combustion. Furthermore, the electric impulses generated by this system are of such short duration that they will not be dangerous if parts of the circuit are contacted manually.

Other objects and advantages of this invention will become apparent from the following detailed description taken in connection with the attached drawings in which:

FIGURE 1 is a basic circuit diagram showing the use of a heavy duty diode and means for preheating the fuel;

FIGURE 2 shows a modification of FIGURE 1;

FIGURE 3 shows a further modification of FIGURE 1;

FIGURE 4 shows a further modification which uses inductive reactive means in place of the resistor 5 of FIGURE 1 when the heat generated by the said resistor is not needed.

The circuit in FIGURE 1 comprises an ignition coil 1 whose primary winding 2 is connected in series with the diode 3, while parallel to this branch there is a capacitor. This diode 3 could be a heavy duty double diode of the Zener type. Ahead of this circuit is a resistor 5 which can also serve as a prewarming resistor together with a switch 6.

The prewarming of the fuel is indicated by having the fuel carrying pipe 9 come in contact with resistor 5 prior to the fuel's being introduced to the combustion area associated with the electrodes 7', 7''. Suitable insulator means 12 are shown around the pipe and resistor element to make more effective use of the heat from the resistor 5. The electrodes 7', 7'' of the spark gap 8 are connected to the secondary winding of the ignition coil 11.

If an alternating potential of 220 volts is applied to terminals 10', 10'' and the switch 6 is closed, the capacitor 4 will be charged across the resistor 5.

The heavy duty diode 3 does not permit current to pass until the voltage drop across it reaches a certain potential. In this example, the diode would be selected or adjusted to permit current flow when the voltage drop across it reaches 220 volts. When the current passes through the diode 3, the capacitor 4 will discharge across the primary coil 2.

This discharge occurs during an extremely short period of time, during which the current strength will change quickly, provided the primary winding does not have too high an inductance. In the circuit illustrated, the primary winding should have only a few turns. With a turns ratio

of about 1:50 for the ignition transformer, and with the secondary winding **11** having 1000 turns, there could be voltage peaks of about 10,000 volts.

In comparison with ignition transformers which have 20,000 to 30,000 turns, these voltage peaks are produced by a secondary winding of relatively low resistance, generally less than 200 ohms. If the capacitor **4** is of the order of a few microfarads, then the primary coil **2** will receive impulse currents of several hundred amperes. With the above mentioned turns ratio of 1:50, impulse currents of over 1 ampere can occur in the secondary in addition to the usual losses. Since these high current and voltage impulses occur in the low-resistance secondary **11**, they will not be seriously affected by relatively low insulation resistance of the electrodes.

Assuming that the circuit is energized by an AC voltage of 50 cycles per second, then with a suitably chosen resistor **5** and capacitor **4** there could be from 1 to 100 chargings and dischargings per half cycle, corresponding to 100 to 10,000 impulses per second. This high impulse frequency, and also the above mentioned rapid current change, which itself would result in a very abrupt impulse, make the use of a ferrite material necessary for improved transformer efficiency.

The rapid and steep current and voltage impulses are comparable with the impulses of automobile ignition circuits, so that an accidental touching of the energized parts is not dangerous.

Since the resistor **5** under the same conditions can develop several hundred watts as heat energy, it is possible to make use of this for preheating the newly atomized oil or the gas to be ignited, as previously explained.

The circuit of this invention can also assume the form shown in FIGURE 2, which is especially useful if atomized oil or gas, which does not readily ignite, is to be heated directly at the place of ignition. By lowering the ohmic resistance of the resistor **5'**, the impulse frequency is increased, so that the resistor **22** in the secondary circuit will become heated by the rapid succession of impulses. Since this resistor **22** is advantageously in the secondary of the high voltage and lower amperage circuit, there will be no serious energy losses at the spark gap between electrode **7'** and resistor **22**. This resistor **22** can be of ceramic construction and can serve as either one or both of the electrodes of the spark gap.

In order to give the secondary circuit a frequency that will be more closely adjusted to that of the primary, the circuit of this invention can assume the form shown in FIGURE 3 where a high voltage capacitor **23** of the order of 100 μ μf. is connected in series with the winding and electrode **7''**. By suitably adjusting its capacity to the inductance of the secondary winding, a condition of resonance can be established which will cause feedback to the primary and cause the latter to deliver a maximum amount of energy. After the steep initial impulse there will be a succession of slower impulses which will have a beneficial effect on the spark and electrode temperatures. This circuit is used especially for fuel oils which are difficult to ignite.

In a further modification of the circuits of FIGURES 1 to 3, the ohmic resistor **5** can be substituted by an inductive reactance such as a choke coil **14** as shown in FIGURE 4. This modification can be used when the heat generated by the resistor **5** is not needed, while a high counter-ignition voltage from the stored electromagnetic energy of the iron core choke is desired for the diode. Furthermore, by suitable adjustment of the inductance of this choke it is possible to bring the impulse frequency to an optimum value so as to ensuer that the half wave energy of the alternating voltage is fully utilized against the impedance of the circuit.

Obviously, with ohmic resistors the circuits in FIGURES 1 to 4 can be energized by DC voltages.

The circuits of this invention have as their important advantage their adaptability to every purpose by the insertion of circuit elements of suitable construction.

It will be understood that this invention is susceptible to modification in order to adapt it to different usages and conditions and accordingly, it is desired to comprehend such modifications within this invention as may fall within the scope of the appended claims.

What is claimed is:

1. Electric ignition device for oil burners and for gas burners comprising: a transformer having a primary winding and secondary winding, a spark gap connected across said secondary winding, a high output diode in series with said primary winding on one side of said primary winding, a condenser connected in parallel with said primary winding and said high output diode, a resistance in series with said primary winding on the side of the primary winding opposite said high output diode, the side of said resistance opposite its connection to said primary winding and the side of said high output diode opposite its connection to said primary winding being adapted for direct connection to a conventional alternating source of domestic lighting current.

2. The ignition system as claimed in claim **1** in which said primary winding is adapted for carrying electric current impulses of at least 100 ampers.

3. The ignition system as claimed in claim **2** in which the impulse currents induced in the said secondary winding have a strength of more than 30 milliamperes.

4. The ignition system as claimed in claim **3** in which said secondary winding has a resistance of less than 200 ohms.

5. The ignition system as claimed in claim **4** in which impulse frequencies of 10,000 cycles per second are generated in said primary winding.

6. The ignition system as claimed in claim **1** in which secondary winding has a resistance of less than 200 ohms, and said resistance has means associated therewith for preheating fuel to be delivered to said spark gap electrode means.

7. The electric ignition system as claimed in claim **1** in which said spark gap comprises electrode means including at least one resistance type electrode which becomes heated in use.

8. The ignition system as claimed in claim **1** in which said transformer and the components connected thereto so proportioned as to produce only high voltage impulses of such short duration in the secondary winding that the impulses are not dangerous.

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