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C. E. VAWTER

2,073,718

FUEL OIL BURNER IGNITION

Original Filed Nov. 20, 1930

Fig. 1,

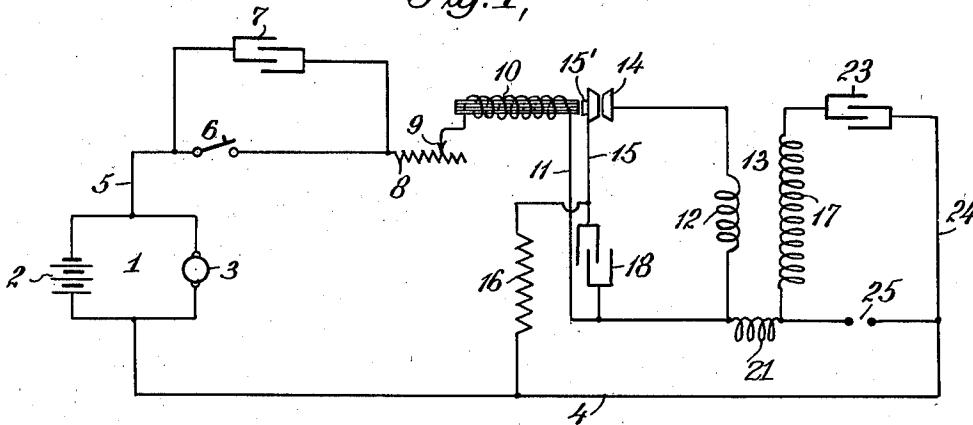


Fig. 2,

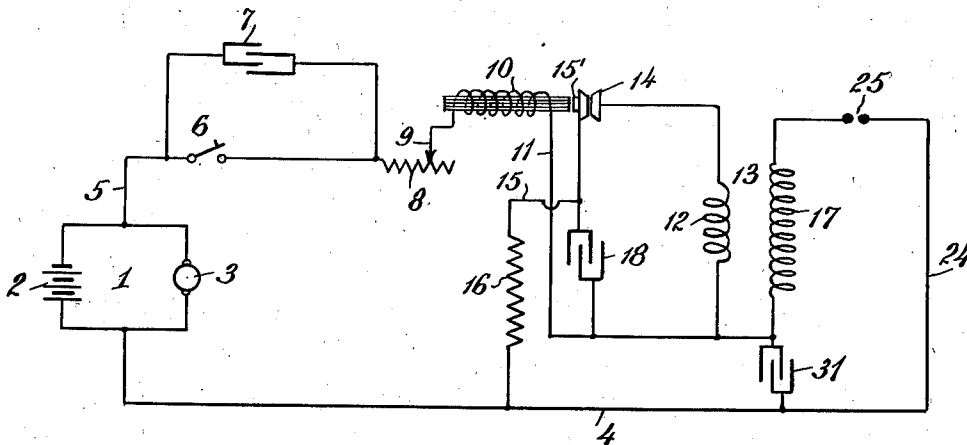
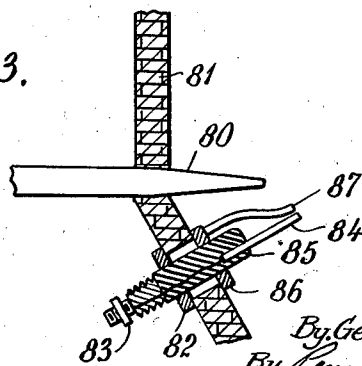


Fig. 3.



INVENTOR
Charles E. Vawter. Deceased
 By *Germanstown Trust Company, Executor.*
By Lennie Davis, Marvin A. Edwards
 ATTORNEYS

UNITED STATES PATENT OFFICE

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FUEL OIL BURNER IGNITION

Charles E. Vawter, deceased, late of Philadelphia, Pa., by Germantown Trust Company, executor, Philadelphia, Pa., assignor to Walter J. Laird, Wilmington, Del.

Original application November 20, 1930, Serial No. 496,999, now Patent No. 1,955,520, dated April 17, 1934. Divided and this application April 14, 1934, Serial No. 720,644

2 Claims. (Cl. 175-115)

The present invention relates to improvements in the process of igniting fuel oil in oil burners, and the present application is a division of an application Ser. No. 496,999 filed November 20, 1930, now Patent 1,955,520, which in turn is a continuation in part of an application Ser. No. 443,730 filed April 12, 1930, now Patent 1,955,519.

Two well-known forms of heat into which electricity can be translated are the spark and the arc. A spark is a disruptive discharge of sufficiently high voltage to break down the gas in the gap between two electrodes without previous ionization of the gas and consequent reduction of the resistance of the gap.

An arc discharge, on the other hand, takes place only after the resistance of the gap has been diminished by the ionization of the material between the electrodes. Thus, for example, it requires thousands of volts to produce a disruptive discharge between the spaced electrodes, but when the gap is once bridged by such a discharge, the resistance of the gap is so reduced by the ionization of the gas that it requires a relatively low voltage to maintain an arc discharge between the electrodes.

Heretofore, in oil burner ignition, transformers have been used with three amperes at 110 volts on the primary and twenty-five milliamperes at 10,000 volts for the spark ignition currents from the secondary. Twenty-five milliamperes, however, does not provide sufficient heat to efficiently ignite the oil. It is, accordingly, necessary to increase the voltage across the secondary of the transformer to obtain the current necessary to produce the desired heat. For example, to produce a minimum current required, such as a quarter of an ampere, would require 100,000 volts in the above described transformer system. Such a voltage would require insulation entirely too bulky and expensive for practical use. By converting a disruptive spark discharge into an arc discharge, however, the low voltage current passing between the electrodes can be increased enormously.

Considerable difficulties have been experienced with the ignition systems used in oil burners. If an insufficiently hot igniting flame is obtained, unburnt oil is permitted to accumulate, causing eventual failure of ignition and occasionally an explosion with disastrous effects may occur. It is well known that this difficulty in oil burners has seriously retarded their development.

The failure of oil to ignite is, as is well understood, due to the fact that the temperature of the igniting flame is below the flash point of the

oil, or even that the electrodes between which ignition is obtained are short circuited due to the accumulations of carbon from the oil on the electrodes.

Accordingly, the object of the invention is to provide an improved method or process for igniting low grade oils having a high flash point.

Other objects of the invention are such as will be clear from the detailed description of the invention which is to follow, in which:

Fig. 1 is a schematic circuit diagram of the improved ignition system.

Fig. 2 is a similar diagram containing certain modifications.

Fig. 3 is a diagrammatic illustration of the invention adapted for igniting oil, gas, or other combustible fluids.

Referring first to Fig. 1, the source of electrical energy 1 may be either direct or alternating current and preferably of 110 volts, although as low as 60 volts may be used.

The supply source may consist of either a battery 2 or a generator 3. One terminal of the source of energy 1 is connected to the common return conductor 4 and the other terminal is connected by the lead 5 to the control switch 6, which is shunted by the condenser 7. The condenser 7 is connected across the make and break contact 6 to prevent arcing thereat. This circuit is completed over a variable resistance 8, contactor 9, winding of the relay 10, conductor 11, the primary winding 12 of the transformer 13, through the contacts 14 and the armature 15' controlled by the relay 10, conductor 15, and resistance 16, back to the common conductor 4.

In this circuit, the resistance 8 is inserted in order to control the amplitude of the current which flows thereover. The relay 10 is energized by current which flows in this circuit to attract its associated armature 15' which thereby disengages the contact 14.

The transformer 13 is a high frequency transformer and therefore preferably has an air core. The primary winding 12 consists of relatively few turns of heavy wire so that its resistance is practically negligible.

A condenser 18 is connected between the interrupter 14 and the conductor 11 across the terminals of the primary winding 12, forming therein an oscillating circuit which is controlled by the interrupter 14. The capacity and inductive reactances are such that the natural frequency of the circuit is extremely high, although preferably below the radio broadcasting range of frequencies.

so that the apparatus will not interfere with radio reception.

Between one end of the primary winding 12 and the secondary winding 17 of the transformer 13, is connected an inductance 21 which excludes from the primary circuit all high voltage, high frequency currents from the secondary 17 which would otherwise pass directly across the common terminals of windings 17 and 12.

The lead 4 may be grounded when desired, as for instance for welding apparatus or if it appears to be safer to do so, both terminals may be left ungrounded, in which case the transmission of high frequency disturbance to the supply line 15 is sometimes reduced.

It will be understood that the inductance 21, as well as the inductance of the relay 10, are wound with sufficiently heavy wire and are otherwise of appropriate construction for carrying the arc current from supply source 1 which will vary, depending upon the heating properties of the arc discharge desired for any particular purpose. The ohmic resistance of inductance 21 and also of the relay winding 10 are as low as possible so as to avoid overheating and to provide a more direct path for the arcing current over the arc gaps rather than through resistance 16, as will be explained more fully hereinafter.

The secondary 17 of the transformer 13 is connected in series with a condenser 23 which is connected over conductor 24 to one terminal of the arc discharge 25, the other terminal of which is connected to the opposite terminal of the secondary winding 17 of the transformer 13. Conductor 24 is also connected to the common return conductor 4.

In operation, the switch 6 is a manually or automatically operated switch mechanically designed to remain closed as long as it is desired to produce an arc at the electrodes 25. For operation, the contact 6 is closed, completing the circuit for the relay 10, described above. Relay 10 is energized and operates its armature 15' to disengage the contacts 14.

The current flowing over this circuit also results in the storing of a considerable amount of electromagnetic and electrostatic energy in the primary circuit, including the primary winding 12 of the transformer 13 and condenser 18.

When the interrupter contact 14 is opened as a result of the energization of relay 10, a spark is produced thereacross due to the high inductance of windings 10 and 12 in the circuit. As a result, high frequency oscillations are produced in the circuit including the condenser 18 and the inductance 12, similar to the phenomena of a spark oscillator used in radio sets. Although this energy dissipates itself in a minutely short period of time, the oscillations are, while in operation, of a very high frequency, determined, of course, by the constants of the oscillating circuit traced above and which, as stated hereinbefore, has a very high natural frequency.

During these oscillations, a high frequency voltage is generated in the secondary 17, the voltage induced in the secondary being higher than in the primary, inasmuch as this is a step-up transformer. As this transformer is for the purpose of stepping up high frequency voltages, the step-up action is not necessarily due to the increased number of turns. Such step-up in voltage in oscillating circuits can always be secured by a proper choice of capacity and inductance constants in the primary and secondary circuit, and these should be arranged in combination with the ratio

of turns of the windings, to give the necessary step-up voltage relation for the range of inherent capacities of the parts connected to the spark gap. As the energy dies out in the primary circuit, it builds up in the secondary circuit until a voltage is built up in the secondary circuit sufficiently high to jump the gap 25.

The passage of the disruptive discharge ionizes the gas between the electrodes of the gap, and this ionization reduces the electrical resistance of the gap to a sufficiently low value so that the potential from the supply source 2 is sufficient to cause the current from this source to flow through the primary circuit from relay 10 by way of conductor 11 through the winding 21 and across the gap 25. The disruptive discharge which takes place first and bridges the gap 25 is thereby converted into an arc discharge.

The small current produced by the oscillatory spark discharge which bridges the gap 25 and which has a correspondingly small heating value is thus suddenly transformed into a current which may be 100 or more times larger—say of the order of 1 ampere—and which is sufficient to produce an arc of intense heat. The intensity of this arc is, moreover, sufficient for igniting low grade oils and other fuels. It will be understood that a current of the order of 60 volts and 1 ampere as set forth in this specification is intended to indicate the characteristics of an arc which will maintain the gap ionized without destructive effect on the oil burner electrodes, but that larger currents can be used in order to increase the heating effect of the arc. When this system is employed for arc welding purposes, the operating current is, of course, larger than one ampere and such a current will be obtained in the circuit by the proper choice of the values of resistance 8 and the resistance of the winding 10 and 21 through which this current will flow.

The inductance of the relay 10, in addition to controlling the armature 15', functions also by means of its inductance to prevent the high frequency currents of the primary circuit from entering the supply source 1. The value of this inductance is made as low as possible, however, so as to reduce to the lowest possible extent its retarding action on the building up of the arc current across gap 25. By making resistance 16 non-inductive the time required for the current to build up in the primary circuit is as short as possible.

It is also to be noted that an ionizing arc is drawn between the interrupter contacts 14 whenever discharge takes place across the gap 25. The interrupter contacts 14 and the electrodes of gap 25 are connected in parallel with the source 1. Hence, normally, if an arc is established across the gap 25, it will not be maintained across the contacts 14, and if an arc is maintained across the contacts 14, it will not be established across the gap 25.

By placing the resistance 16 in series with the interrupter contacts 14, however, and choosing a value of this resistance which is large in comparison with the resistance of the winding 21, the current from the source 2, which chooses the path of least resistance flows through the coil 21 and the ionized gap 25, so that the arc is prevented from being maintained across interrupter 14 and will be established across the gap.

If for any reason, the arc, after it has been established, is extinguished while switch 6 is closed, the circuit for electromagnet 10 is opened at both its own armature 15', which is then in

its energized position disengaging contact 14 and also at gap 25. The electromagnet will therefore deenergize and armature 15' will engage contact 14. Thereupon, electromagnet 10 will again be energized over the circuit described in the above and the operations for producing an arc at gap 25 repeated. An automatic restarting arc is thus produced.

Referring now to Figure 2 of the accompanying drawing the modified circuits here shown are identical with the circuits of Figure 1 except for the omission of the impedance 21 between the primary and secondary windings 12 and 17, and the insertion of a discharge condenser 31 connected between the secondary 17 and the common return conductor 4, and which functions in the manner described in connection with condenser 23 in Figure 1 to produce an oscillatory circuit with the secondary winding 17 and the arc electrodes 25. With this arrangement, however, the arcing current flows through winding 17 and, accordingly the resistance of winding 17 must be made relatively small. Also to prevent arcing at contacts 14, the resistance of 16 must be made large with respect to the ohmic resistance of the secondary 17, in order to provide a path of least resistance through the secondary 17 to gap 25 for the arcing currents.

The apparatus for producing an arc discharge for ignition of oil burners is shown in Fig. 3 in which the walls of the furnace are diagrammatically illustrated at 81. A burner 80 projects through the walls 81 into the furnace, and it will be understood that from this burner an appropriate mixture of fluid fuel and air is discharged under suitable pressure into the combustion chamber within the furnace. Projecting through an opening in the wall there is a unit 82 comprising any desired form of arcing device, such as illustrated. In the device, shown for illustration, the high voltage terminal of the arcing electrodes 25 of either Figs. 1 or 2, is connected through the screw 83 to the electrode 84 which is secured to the body of insulating material 85. Connection to the other branch of the circuit is made by means of the fastening of the main portion of the unit to the grounded side of the system through the screw threaded collar 86 on

which is mounted the second electrode 87. Electrode 87 is usually permanently adjusted and shaped relative to electrode 84, so that for a short distance the electrodes are nearly parallel in order to increase their life.

This arcing apparatus has especial advantages in connection with oil burners. Thus, for example, it will ignite low grade oils that have a high flash point. Furthermore, instead of short circuiting the gap as in other systems, any carbon which accumulates on the terminals in this system actually aids operation, as it is burnt up by the arc. Also, any moisture which may collect does not have the effect on the high frequency current to the same extent as such moisture does on the low frequency currents. It will finally be noted that these systems work equally effectively on direct or alternating currents.

Although there is illustrated a form of the invention for igniting oil burners, it will be understood that this showing is diagrammatic and any other form may be used. Furthermore, any well known form of temperature control may be used in conjunction with the system.

It is not desired to limit the invention to the specific illustrations thereof herein given, except in so far as set forth in the following claims.

What is claimed is:

1. The improvements in the process of fluid fuel burner ignition which comprise maintaining a jump spark electric current of at least 10,000 volts and a few milliamperes, and then decreasing the voltage to about 60 and increasing the current sufficiently to prevent the cessation of current flow by the air and fuel blast from the burner.

2. The improvements in the process of fluid fuel burner ignition which comprise producing a jump spark electric current of at least 10,000 volts and a few milliamperes, converting the spark into an arc having a current of not less than about 1 ampere, and continuously maintaining either the arc or the spark.

GERMANTOWN TRUST COMPANY,
Executor of the Estate of Charles E. Vawter,
Deceased.

By C. S. SMYTH,
Vice President.