Feb. 6, 1968 H. T. THUNANDER 3,367,386

HEAT GENERATING APPARATUS

Filed Dec. 22, 1965 2 Sheets-Sheet 1

FIG. 1.

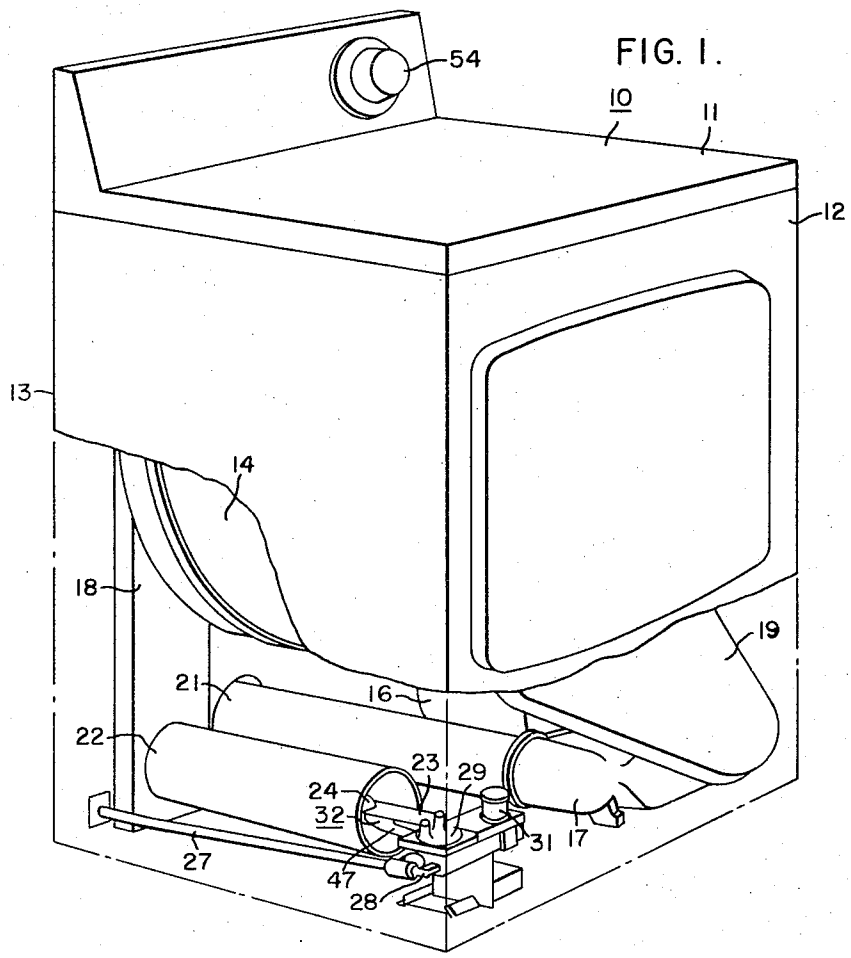
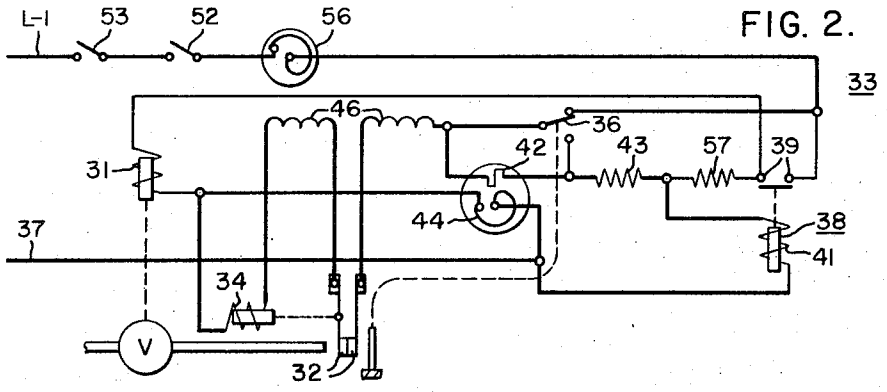


FIG. 2.



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HEAT GENERATING APPARATUS

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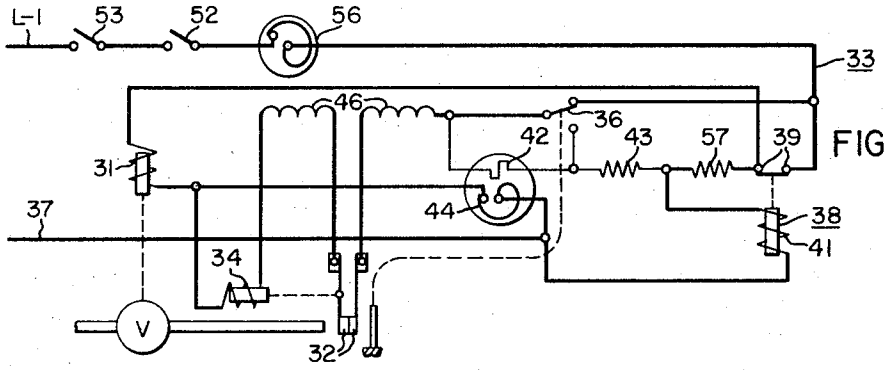


FIG. 3.

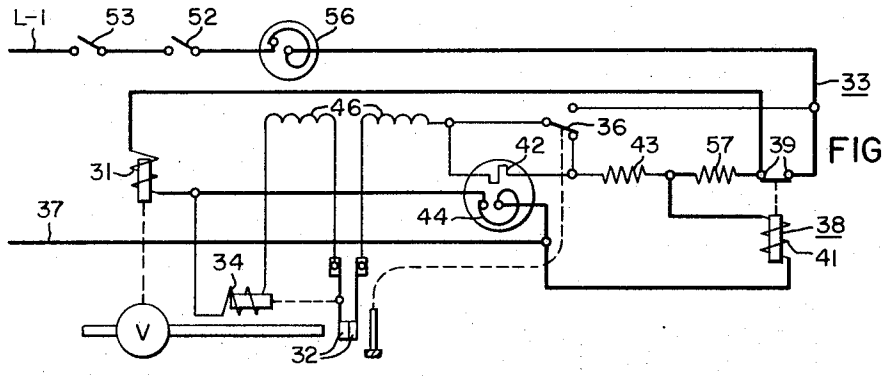


FIG. 4.

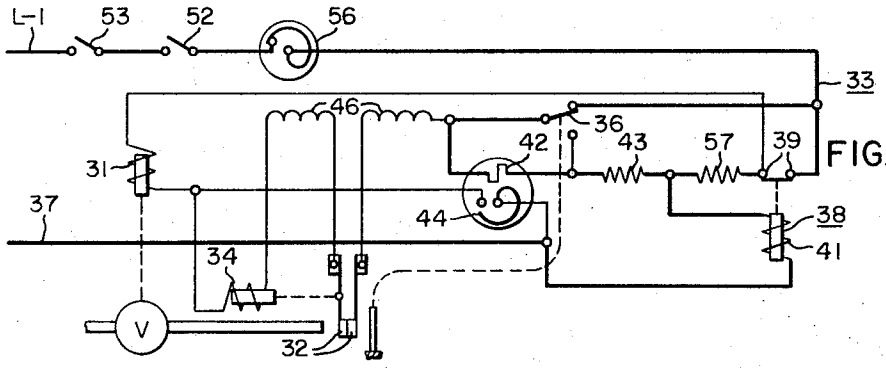


FIG. 5.

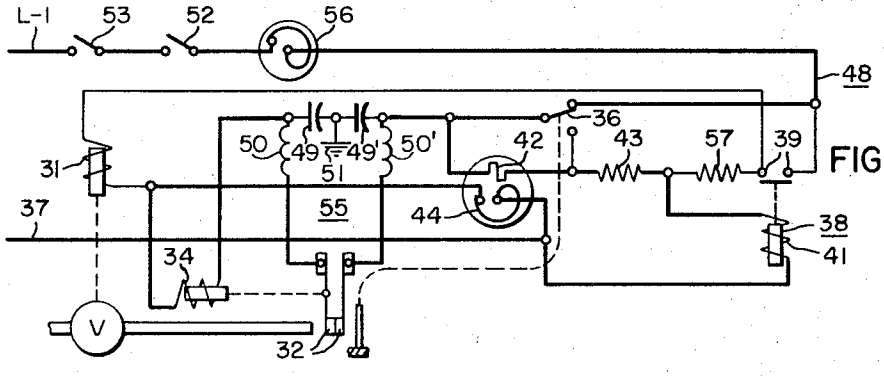


FIG. 6.

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HEAT GENERATING APPARATUS

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4 Claims. (Cl. 158—28)

This invention relates, in general, to gas or oil-fueled heat generating apparatus and, more particularly, to automatic ignition means therefor.

Ignition systems of the type heretofore utilized for igniting the main burner of heat generating apparatus of the type herein contemplated, for example, a gas clothes dryer, have traditionally incorporated a standing pilot comprising a small continuously burning flame contiguous the outlet of the burner.

Within the past few years several manufacturers have replaced the standing pilot with electric arc igniters of the type comprising a pair of electrical contacts mounted on relatively movable arms, the contacts being positioned in the exhaust path of the oil or gas burner of the heat generating apparatus. The contacts being normally closed and having a voltage applied thereacross are rapidly opened and closed by means of a vibrator coil of the type used in a doorbell circuit. When the contacts open or separate an arc is generated which serves to ignite the gas or oil emanating from the burner.

As is well known, an electric arc or spark produces electrical oscillations which may spread either along the wires of the circuit containing the contacts or may be radiated from the spark itself or the wires. These oscillations which are of the greatest magnitude at the beginning of each spark occupy all frequencies, consequently, television and radio reception is adversely affected.

The gravity of the problem in conjunction with the operation of a gas clothes dryer will be appreciated from a consideration of the operation of a typical gas clothes dryer. For example, at a certain point in the drying operation, cycling of the burner and heat supply commences and continues until termination of the drying operation. The duration of the cycling may be as long as twenty minutes and as many as two to three cycles, during which ignition takes place, may occur per minute. The duration of each ignition is approximately seven to ten seconds, making it possible to have a total ignition time of about 20–30 seconds out of every minute for a period of twenty minutes.

One solution for reducing or minimizing the interference produced by an electrical spark or arc has been to provide means preventing the initiation of the spark, for example, as by various quenching methods. This solution is obviously not workable in an application, such as herein contemplated, where the spark is necessary for ignition of the fuel.

Another solution has been to allow generation of wide band noise but provide means for stopping its distribution. One arrangement for accomplishing this comprises a low pass impedance in series with the supply line and a high pass impedance between the two supply lines or between lines to ground. In addition, it is sometimes necessary to provide shielding around the parts between the arc and the filter. Moreover, due to the wide band nature of the interference, it is often necessary to use a series of suppressors, one for each frequency band. While the foregoing arrangement is workable, it is expensive and therefore undesirable from an economic standpoint.

According to the invention, the spark is allowed to occur but it is included in a circuit which does not allow rapid changes of current in the spark itself. In

one embodiment, the spark is included in a loop in series with a capacitance and an inductance so as to form a series tuned circuit. If the quality of the circuit is sufficient good oscillations will primarily take place at one single frequency. This frequency is selected so that it is well outside the radio and TV bands. It may be 150,000 c./s. With such an arrangement, there is no need to intercept a broad band of frequencies and the generated frequency may be allowed to spread. If desired, it may be intercepted by a filter which has high attenuation at that frequency.

Another form of the invention allows generation of a somewhat broader band of frequencies. It consists of one or more inductive elements with low stray capacitance in series with the spark. This prevents generation of strong oscillations at high frequencies but allows generation from a very low frequency up to some cutoff frequency, which is determined by the circuit elements and the supply voltage. The elements are selected so that the cutoff frequency is below the radio and TV bands.

Accordingly, it is the general object of this invention to provide a new and improved automatic ignition and control means for heat generating apparatus.

It is a more particularly object of this invention to provide, in an electrical ignition system for heat generating apparatus, means for suppressing undesirable electrical oscillations.

Another object of this invention is to provide interference suppressing means which is simple in construction and inexpensive to manufacture.

These and other objects and advantages of the present invention will become more apparent when considered in view of the following disclosure and drawings, in which:

FIGURE 1 is a perspective view, partly broken away, of a gas clothes dryer incorporating the invention;

FIGS. 2–5 represent schematic circuit diagrams illustrating the sequential operation of one embodiment of the invention; and

FIG. 6 is a schematic circuit diagram of a modified form of the invention.

Referring to the drawings, especially FIG. 1, reference character **10** indicates generally a gas clothes dryer comprising a cabinet or casing **11** having front and rear walls **12** and **13**, respectively. A fabric receptacle or basket **14** supported within the cabinet **11** is adapted to be rotated about a substantially horizontal axis by means of a drive motor **16** mounted within the cabinet **11** below the fabric receptacle **14**. Air circulating means, not shown, disposed within a housing **17**, serves to force drying air into and out of the basket **14** through an inlet duct **18** adjacent the rear wall **13** and an outlet duct **19** adjacent the front wall **12**. The drying air is conveyed through an exhaust duct **21** communicating with the exterior of the dryer through the rear wall **13**.

In order that it may more effectively carry off the moisture from the clothes in the basket **14**, the circulated air is heated within a combustion chamber **22** by a stream of burning gas emanating from the port of a conventional gas burner **23**, the stream of burning gas or flame being held thereto by means of a flame spreader **24**. The flow of gas from a supply line **27** to the burner **23** is controlled by means of a main shutoff valve **28**, a pressure regulator **29** and a solenoid valve **31** (see FIGS. 2–6).

Ignition of the gas from the burner **23** is accomplished by means of a controlled spark or arc generated between two igniter contacts **32** (see FIGS. 1–6) positioned adjacent the flame spreader **24** so as to be in the path of the gas. The contacts **32** which are contained in an electrical ignition and control circuit **33** (see FIG. 2) are

caused to be rapidly opened and closed by means of a magnetic vibrator coil 34, the spark for igniting the gas occurring when the contacts are opened. Power is supplied to the vibrator coil 34 via power line L-1 and a normally closed flame sensor switch. The switch 36, the function and purpose of which will be more fully described hereinafter is a thermal control comprising a member having a high rate of thermal expansion and mounted so that the flame from the burner impinges directly thereon. The expansion of the member is multiplied by a lever which deflects a snap-acting normally closed (cold) switch to its open (hot) position thereby cutting the igniter contacts 32 and the vibrator coil 34 out of the circuit between the power line L-1 and the (neutral) or ground line 37.

Energization of the gas solenoid valve 31 is controlled by means of a relay 38 consisting of contacts 39 and a coil 41 to which current is supplied from the power line L-1 through the flame sensor switch 36, a bimetal time delay switch heater 42 and an electrical resistance element herein illustrated as a resistor 43. The heater 42 is wound about a bimetal time delay switch 44 comprising a bimetal element adapted to flex to a circuit opening position in response to heat dissipated by the heater 42. The operation of the delay switch 44 which functions as a safety device and the operation of the resistor 43 which serves to reduce the voltage across the igniter contacts 32 after a time delay inherent in the operation of the flame sensor switch 36, will be discussed in detail hereinafter.

In accordance with one embodiment of the invention as illustrated in FIGS. 2–5, there is provided in the circuit 33, a radio and television interference suppressor comprising a pair of inductance elements 46, one of which is connected in series with each of the igniter contacts 32. In practicing the invention illustrated in FIGS. 2–4, inductors rated at .1 millihenry and 125 milliamperes were connected through the contact arms 47 (see FIG. 1) carrying the contacts 32, with leads as short as practical from an installation standpoint, for example, 0.5 inch. Such an arrangement provided a circuit with a time constant of sufficient magnitude to prevent rapid changes in current flow and the undesired electrical oscillations attributable thereto.

A modified form of the invention shown in FIGS. 2–5, as illustrated in FIG. 6, comprises an ignition and control circuit 48 differing from the circuit 33 only in the means for suppressing the undesired electrical interference, all other elements being the same and therefore as in the circuit 33. In lieu of providing elements in series with the igniter contacts 32 to provide a rather long time constant, capacitor elements 49 and 49′ and inductance elements 50 and 50′ are placed in series with the contacts 32 to provide a closed loop 55 in the circuit 48 which loop is tuned to a frequency at which generation and distribution of electromagnetic waves do not interfere with TV or radio reception. Satisfactory suppression has been obtained with this form of the invention where the capacitances and the inductances of the suppressor elements provided a loop in the circuit tuned to approximately 160,000 cycles per second. Ceramic radio capacitors rated at 0.01 microfarads and 1600 volts D.C. were used for the capacitance elements 49 and 49′ while radio choke coils rated at .1 millihenry were used for the inductors or inductances 50 and 50′. The connection between the inductors 50 and 50′ and the contact arms 47, the capacitors 49 and 49′ and inductors 50 and 50′, and between the capacitors 49, 49′ and ground connections 51 are made as short as practical to minimize additional impedance in the circuit and to also minimize the possible radiation therefrom thereby eliminatnig the necessity of shielded leads. Typical lengths between the contact arms 47 and the inductors 50, 50′ are for example, 0.5 inch and for all other lengths, 1.0 inch.

OPERATION

With the door of the dryer 10 closed in order to close a door actuated switch 52, operation of the dryer is initiated through the closing of an on-off switch 53 (FIGS. 2–5) which is effected by means of a timer control knob 54 (see FIG. 1). As indicated in FIG. 2 by the heavy lines, current flow from the power lines L-1, initially is through the flame sensor switch 36 after which the flow is divided into two parallel paths, one path being through one of the inductors 46, the ignitor contacts 32, the other of the inductors 46, the vibrator coil 34 and the time delay switch 44. The other flow path is through the time delay switch heater 42, resistor 43 and relay coil 41. Flow of current through the relay coil 41 results in the closing of the contacts 39 thereby establishing a current flow path from the power line L-1 through the gas solenoid valve 31 and the time delay switch 44 (see FIG. 3). The circuit from the power line L-1 through the igniter contacts 32 has not at this time been opened but for sake of clarity this path has not in FIG. 3 been shown in heavy lines. It will be noted (FIG. 3) that a relay holding circuit is established through a register 57.

Current flow through the coil of the normally closed solenoid valve 31 effects opening thereof allowing gas to flow from the nozzle 26 and pass through the arc generated by the vibrating contacts 32. The gas is ignited and the resulting flame starts heating up the flame sensor switch 36. After about 7 to 10 seconds the switch 36 moves to its open or hot position as shown in FIG. 4 thereby deenergizing or opening the circuit (as indicated by the lighter lines, FIG. 4) through the igniter contacts 32. It will be apparent that rapid change in the current in the spark is prevented by either the inductors 46, illustrated in FIGS. 2–5, or by the elements of the tuned loop 55, illustrated in FIG. 6. Current continues to flow through the contacts 32 but only after it flows through the resistors 43 and 57 which serve to reduce the voltage so that the vibrator coil 34 will be inoperative.

If for any reason the circuit is interrupted prior to completion of the drying operation, for example, by opening the loading door and therefore the door actuated switch 52 or by cycling of a control thermostat 56, the circuit to the relay 38 is opened. Since the solenoid 31 is controlled by the relay contacts 39, flow of gas is terminated. The relay 38 is not reclose until the flame sensing switch 36 has cooled to a point where it will reclose to effect re-energization of the vibrator coil 34; at this point the solenoid valve 31 will be reopened as discussed hereinabove.

If after a predetermined time interval, controlled by the line voltage to the circuit, the gas has not ignited; the current flowing through the time delay switch heater 42 will produce sufficient heat dissipation from the heater to cause the time delay switch 42 to open the circuit containing the solenoid valve 31 (see FIG. 5).

Since numerous changes may be made in the above described apparatus and different embodiments of the invention may be made without departing from the spirit thereof, it is intended that all matter contained in the foregoing description or shown in the accompanying drawings, shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. In a fuel burner control circuit adapted to be energized by a source of alternating current, normally closed valve means for controlling the flow of fuel to said burner, manually operable means for selectively effecting energization of said circuit, means for controlling the activation of said valve means upon actuation of said manually operable means, means for generating a spark in the path of the fuel flowing from said burner for causing ignition thereof, circuit interrupting means for effecting deactuation of said valve means in the absence of ignition of the fuel, said circuit interrupting means including delay means responsive to the heat

generated by the ignited fuel for reducing the energy supplied to said spark generating means to thereby render it inoperative, and means in said circuit for preventing the generation of undesirable electrical oscillations attributable to said spark generating means, said spark generating means comprising a pair of electrical contacts supported on a pair of contact arms and a vibrator coil for rapidly opening and closing said contacts; and said suppressing means comprises a plurality of inductive elements in series with said contacts to provide the current flowing in the circuit comprising the contacts and the inductive elements with a relatively long time constant thereby preventing rapid changes in current flow upon opening and closing of said contacts.

2. Structure as specified in claim 1, wherein one of said inductive elements is connected to one of said contact arms and another of said inductive elements is connected to the other of said contacts arms, the length of such connections being 0.5 inch or less.

3. In a fuel burner control circuit adapted to be energized by a source of alternating current, normally closed valve means for controlling the flow of fuel to said burner, manually operable means for selectively effecting energization of said circuit, means for controlling the activation of said valve means upon actuation of said manually operable means, means for generating a spark in the path of the fuel flowing from said burner for causing ignition thereof, circuit interrupting means for effecting deactuation of said valve means in the absence of ignition of the fuel, said circuit interrupting means including delay means responsive to the heat generated by the ignited fuel for reducing the energy supplied to said spark generating means to thereby render it inoperative, and means in said circuit for preventing the generation of undesirable electrical oscillations attributable to said spark generating means, said spark generating means comprising a pair of electrical contacts carried by a pair of relatively movable contact arms and a vibrator coil for rapidly opening and closing said contacts; and said suppressing means comprises a plurality of inductive and capacitive elements forming a circuit with said contacts wherein at least said inductive elements are in series with said contacts and the inductive reactance and capacitive reactance values are such as to provide a circuit tuned to a frequency at which generation and distribution of electromagnetic waves do not effect TV and radio reception.

4. Ignition means for use with the burner of heat generating apparatus, said ignition means comprising: an electrical circuit including contacts supported on relatively movable contact arms, said contacts being disposed in the path of fuel flowing from said burner, means for effecting rapid opening and closing of said contacts for generating a spark for igniting said fuel, means connected in series with said contacts for preventing the generation of undesired electrical oscillations attributable to said spark, said last-mentioned means comprises inductive and capacitive elements forming a closed loop with said contacts, the reactance values of which provide a tuned circuit having high attenuation at high frequencies.

References Cited

UNITED STATES PATENTS

1,723,908	8/1929	Alexanderson.	
2,594,059	4/1952	Nagel	158—28
3,059,693	10/1962	Hotchkiss	158—125
3,100,521	8/1963	Deubel	158—125

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