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E. J. WEBER

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SPARK IGNITION SYSTEM FOR GAS BURNERS

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FIG. 2.

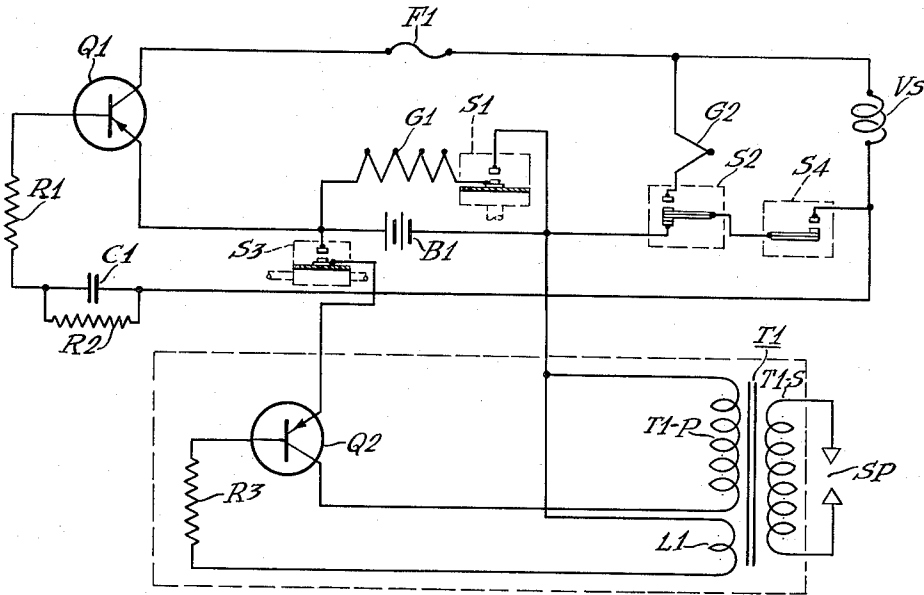
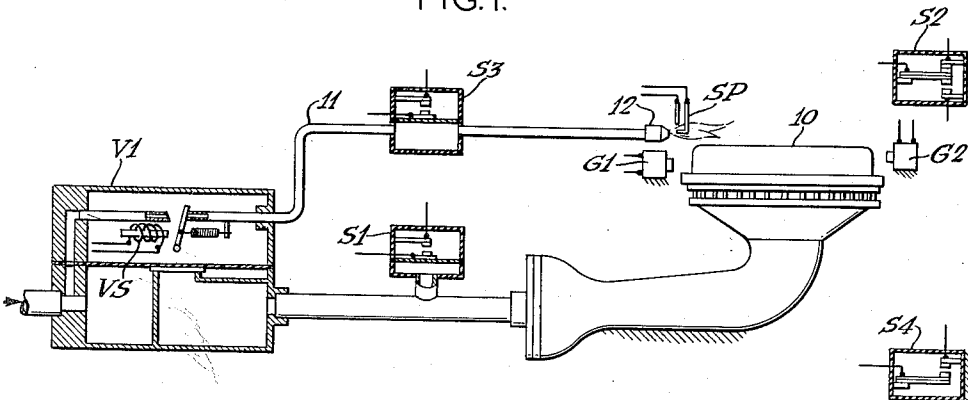


FIG. 1.



INVENTOR;

EARL J. WEBER

BY

Howson & Howson

ATTYS.

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3,174,534

SPARK IGNITION SYSTEM FOR GAS BURNERS
Earl J. Weber, Bay Village, Ohio, assignor to American
Gas Association, Incorporated, New York, N.Y., a cor-
poration of New York

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5 Claims. (Cl. 158-125)

This invention relates to an ignition system for gas burners, especially to a self-contained ignition system of the "cold" type wherein during the off period there is no consumption of energy and no flame, not even a pilot flame; which requires no outside energy supply; and which continuously maintains itself in operating condition as to energy supply; and has for an object the provision of improvements in this art.

One of the particular objects of the invention is to provide a self-contained battery-started ignition system which quickly shifts from battery current to flame-generated current upon starting and which after starting automatically recharges the battery from flame-energized means.

Another object is to provide a system which will immediately sense false starts and cut off the gas supply.

Another object is to provide an ignition system which is of the fail-safe type.

Another object is to provide an ignition system of the character desired which will be composed of few, simple and inexpensive parts.

The above and other objects as well as certain features of novelty and advantages will be apparent from the following description of an exemplary embodiment thereof, reference being made to the accompanying drawings, wherein:

FIG. 1 is a semi-diagrammatic view showing the physical arrangement of elements of a burner and ignition system embodying the invention; and

FIG. 2 is a wiring diagram showing the electrical connections of said system embodying the invention.

The system has been applied to a small space heater for purposes of operative demonstration but it could be applied to any automatic ignition gas heating system. The term gas heating includes any air mixed fuel burner system, but a conventional type gas burner is specifically referred to herein for purposes of illustration.

As shown herein, a main gas burner 10 is supplied with gas by a main gas valve V1 which is controlled by a solenoid VS. The main valve, when open, supplies gas by a branch or bleed line 11 to a pilot burner 12, the pilot burner being of the flame thrower type which projects a pilot flame to the main burner.

The pilot burner fuel is ignited by a spark device or plug SP (a model airplane spark coil system will serve to operate the igniter) which is disposed in the path of the pilot gas jet. The spark device SP is energized for the short time necessary by the transient flow of bleed gas through pilot pipe line 11 from the top of the diaphragm of the valve V1, which momentarily closes a pressure switch S3 to a source of electrical power such as a battery B1. Disposed in position to derive heat from the burner are a thermostat heat switch S2, and current generators G1 and G2 which are specifically referred to herein respectively as a thermopile battery charger G1 and a pilot generator G2.

The thermopile G1 is cut into circuit by a pressure-operated switch S1 which is responsive to steady pressure on a branch line 13 when the main burner valve V1 is turned on. A space heat-demand thermostat switch S4 initiates the operation of the entire system by energizing the solenoid VS to open the valve V1.

Referring now more particularly to the wiring diagram,

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it will be seen that the spark device SP is supplied with current by the secondary T1-S of a transformer or spark coil T1 having a primary T1-P supplied with current (initially) from a battery B1 through a high-frequency oscillator transistor Q2.

The battery can be a small rechargeable nickel-cadmium unit of known type, with an output of about 2.4 volts although a voltage as low as 1.2 volts will serve the purpose.

An additional winding L1 of the transformer provides a feedback oscillation-producing effect at the base of the transistor Q2, the feedback circuit including a series resistor R3, say 50-150 ohms.

The generator G1 is in shunt with the battery B1 so that when the switch S1 is closed by gas pressure after valve V1 is opened the battery will be recharged as soon as the thermopile current generating device G1 is made operative by burner heat.

Switch S3 closes to the igniter circuits (Q2, T1, etc.) when pressure is supplied to operate it by the opening of the main gas valve V1.

An important feature of the invention is the means for shifting from battery to auxiliary power and for insuring the existence and continuation of the flame as long as there is a demand for heat. Such means herein comprises a capacitor C1 in circuit with the solenoid VS of the main valve V1, the circuit being in shunt with the circuits through the battery for the solenoid of valve V1 and the spark igniter elements Q2, T1, etc.

A transistor Q1, which acts as a switch here, is in circuit with the solenoid of the fuel valve V1 and its base is in circuit with the capacitor C1 and a series resistance R1 (say 1000 ohms). A resistance R2 (say 100,000 ohms) is in shunt with capacitor C1 to assist in controlling its charging time and later to bleed off the charge in preparation for the next operation.

It will be noted from the wiring diagram that the heat switch S2 is a single pole double throw two-way device, preferably of the snap-over type, which when cold allows current to flow through from the battery B1 and when hot cuts out the battery and causes current to flow through the pilot generator G2 which operates the solenoid of the valve V1. A safety fuse F1 is placed in the line from the transistor Q1 to the solenoid VS of the gas valve V1.

In operation, when the temperature at thermostat S4 is high the switches are positioned as shown in FIGURE 2, the gas is turned off by valve V1, there is no flame in the system and no current flows. When the temperature at thermostat S4 falls below a certain level, S4 closes to complete the emitter, collector and base circuits of transistor Q1, battery B1 then supplying a negative bias to the base of transistor Q1 to render it conductive so that collector-to-emitter current flows in series with the solenoid coil VS. The latter solenoid current opens valve V1 to provide a steady gas flow to main burner 10 and a momentary gas flow through line 11 to pilot burner 12. As a result S1 is closed and held so closed while valve V1 is open, and switch S3 is momentarily closed by the momentary gas flow in it.

Closing of switch S3 connects battery B1 as an operating bias supply to transistor Q2 and its associated circuitry to produce oscillations therein and a spark discharge at electrodes SP, thereby to ignite the gas emanating from the pilot burner and from burner 10; switch S3 then reopens when the momentary gas flow is done, terminating the spark discharge. The closing of switch S1 connects thermopile G1 across battery B1 in the polarity to recharge battery B1 when G1 is heated by the burner flame; while this initially produces some additional current load on the battery, this is generally

small compared with that drawn by the low-resistance solenoid winding VS and hence does not interfere with operation. As G1 is heated by the burner it soon begins to generate a thermoelectric voltage and current for recharging battery B1, and continues to do so as long as the burner flame continues.

Meanwhile thermoelectric generator G2 is also heated by the burner flame until it reaches a temperature for which it develops sufficient current capacity and voltage to operate V1 when connected to solenoid coil VS. When G2 has reached this state, and only then, S2 has been heated sufficiently by the burner flame to switch to its "hot" position thereby to connect G2 across VS, at the same time opening the base-emitter circuit of transistor Q1 to terminate current flow through VS by way of Q1 and to remove all drain on battery B1. The manner of selecting the nature and position of G2 and S2 to provide this sequence of operation will be apparent to one skilled in the art. The burner then continues to operate until thermostat S4 is heated sufficiently to open again, which shuts off the gas supply and allows the system to return to its original condition.

The foregoing describes the operation when all components operate as desired without failure of ignition or of system elements. To provide complete "fail safe" operation, the capacitor-timing gas cutoff circuit R1, C1, R2 operates as follows. Initially on closing of thermostat S4, battery B1 supplies a substantial negative bias to the base of transistor Q1 to render it conductive as described above, the drop in bias voltage across C1 being initially small. However, as C1 charges the voltage across it increases, progressively decreasing the negative bias at the base of transistor Q1 until, if S2 is not earlier operated, Q1 will be cut off so as to re-close gas valve V1. The time required for capacitor C1 so to charge is made sufficiently long, by selection of the capacitance of C1 and the resistances of R1 and R2, so that if proper ignition has occurred S2 will operate before cutoff of Q1 so as to maintain V1 in its open state. However, if ignition fails for any reason, S2 will not operate and the capacitor-timing circuit will cut off the gas supply as desired in such circumstances, returning the system to its original condition. R2 bleeds off any charge remaining on capacitor C1 after successful ignition has heated the thermostat S4 to its opening temperature, to prepare the cutoff circuit for the next ignition cycle.

It will be seen that gas will not emanate from the burner for any appreciable time even if there is a failure in any of the switches, or if an open-circuit condition should occur in the circuitry including the capacitor, the transistors or the thermoelectric generators; similarly, if transistor Q1 or capacitor C1 should be shorted, fuse F1 will shut off the gas by burning out in response to current flowing through it for a period in excess of the time for which Q1 is normally permitted to remain conductive.

I claim:

1. An automatic-ignition gas burner system, comprising:

- a gas burner;
- a source of supply of gas for said burner;
- a normally-closed gas valve having a control element responsive to electrical voltage to actuate said valve, for supplying gas to said burner when said control element is actuated;
- a rechargeable battery;
- a control switch, a first thermal switch, and timing means in common series circuit with said battery and said control element for passing a current through said series circuit to open said gas valve upon initial closing of said control switch, and to effectively open said series circuit in response to operation of said timing means after a first predetermined time interval immediately following said closing

ing of said control switch, in the absence of flame at said burner, thereby to re-close said gas valve; igniter means for said burner, and means responsive to said closing of said control switch to actuate said igniter while said valve is open;

a first thermoelectric generator responsive to heating by flame from said burner to develop, in a second interval shorter than said first interval, a voltage and a current capacity sufficient to hold open said gas valve when said generator is connected to said control element;

said first thermal switch being actuatable in response to heating by flame from said burner to open said series circuit and to connect said first thermoelectric generator operatively to said control element after the end of said second time interval but before the end of said first time interval;

a second thermoelectric generator disposed to be heated by flame from said burner, and second normally-open switch means responsive to turning on of said valve to connect said second thermoelectric generator across said battery in the polarity to charge said battery; and

means for returning said timing means to its original condition following actuation of said thermal switch.

2. A system in accordance with claim 1, in which said igniter means comprises spark-discharged electrodes, an electric oscillator circuit for operating said electrodes, and normally-open switch means responsive to closing of said valve momentarily to connect said battery to said oscillator circuit as an operating bias supply therefor, and in which said control switch comprises a thermostat which closes for low temperatures and opens for high temperatures.

3. A system in accordance with claim 2, in which said timing means comprises an electronic switch having two connections controllably connectable to each other in series in said common series circuit and having a control connection for controlling said connecting of said two connections to each other, a bias circuit for supplying said control connection with bias from said battery to connect together said two connections when said thermostat is first closed and said first thermal switch is in its position to close said common series circuit, and a resistance-capacitance combination in series in said bias circuit for removing said bias from said control connection after a predetermined interval immediately following said first closing of said thermostat.

4. A system in accordance with claim 3, in which said electronic switch comprises a transistor, said two controllably connectable connections comprise the emitter and collector of said transistor, and said control connection comprises the base electrode of said transistor.

5. A system in accordance with claim 4, in which said resistance-capacitance combination comprises a pair of resistors in series in said bias circuit and a capacitor in shunt with one of said resistors.

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JAMES W. WESTHAVER, *Primary Examiner.*

FREDERICK L. MATTESON, JR., *Examiner.*