March 5, 1968 HIROYASU KOIZUMI 3,372,306

PROXIMITY CONTROLLED AUTOMATIC CIGARETTE LIGHTER AND THE LIKE

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FIG. 1

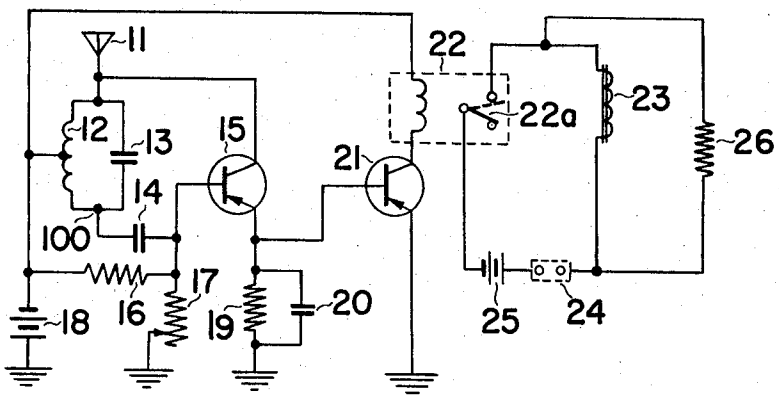
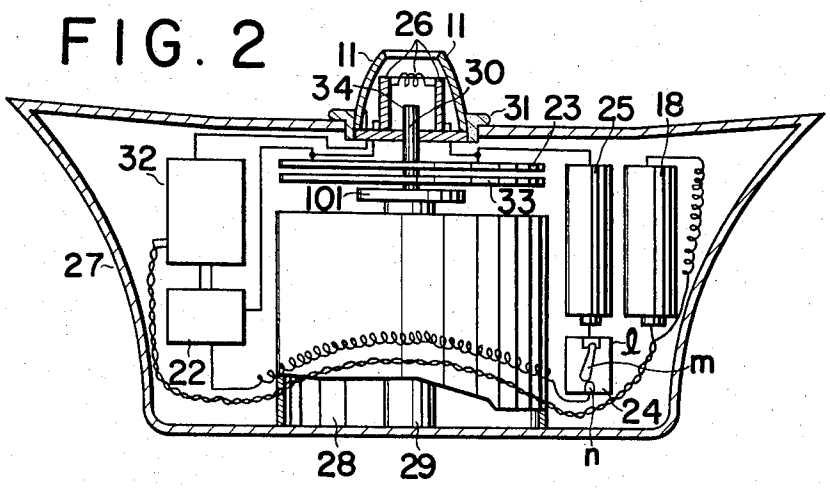


FIG. 2



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FIG. 3

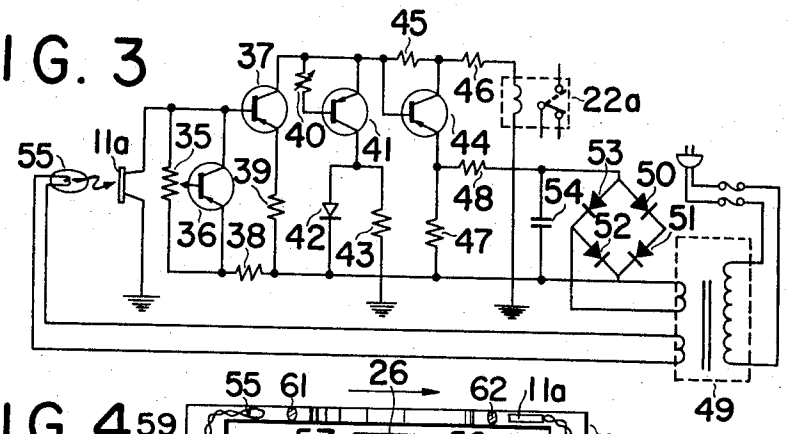


FIG. 4

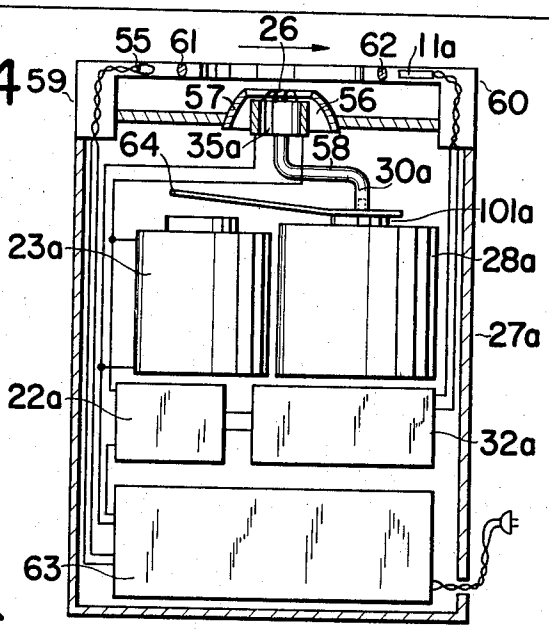
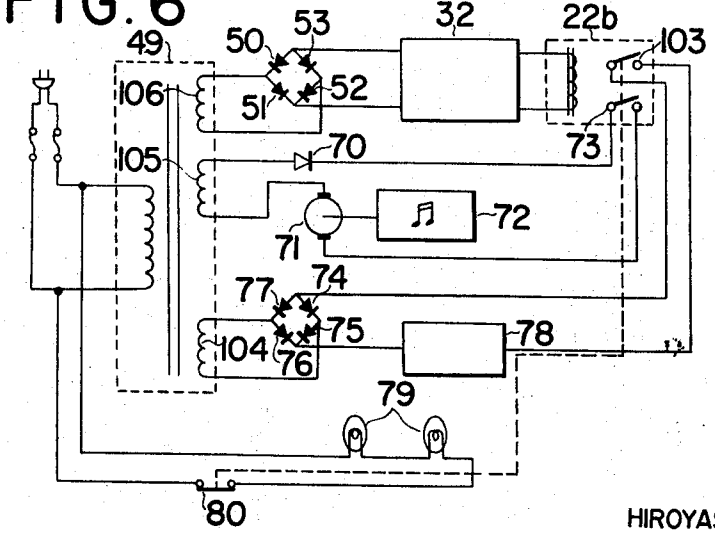


FIG. 6



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FIG. 5b

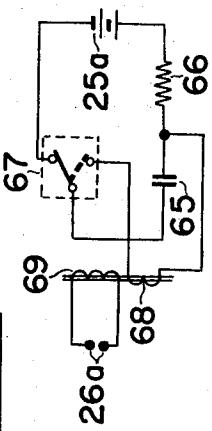


FIG. 5a

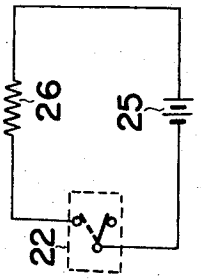
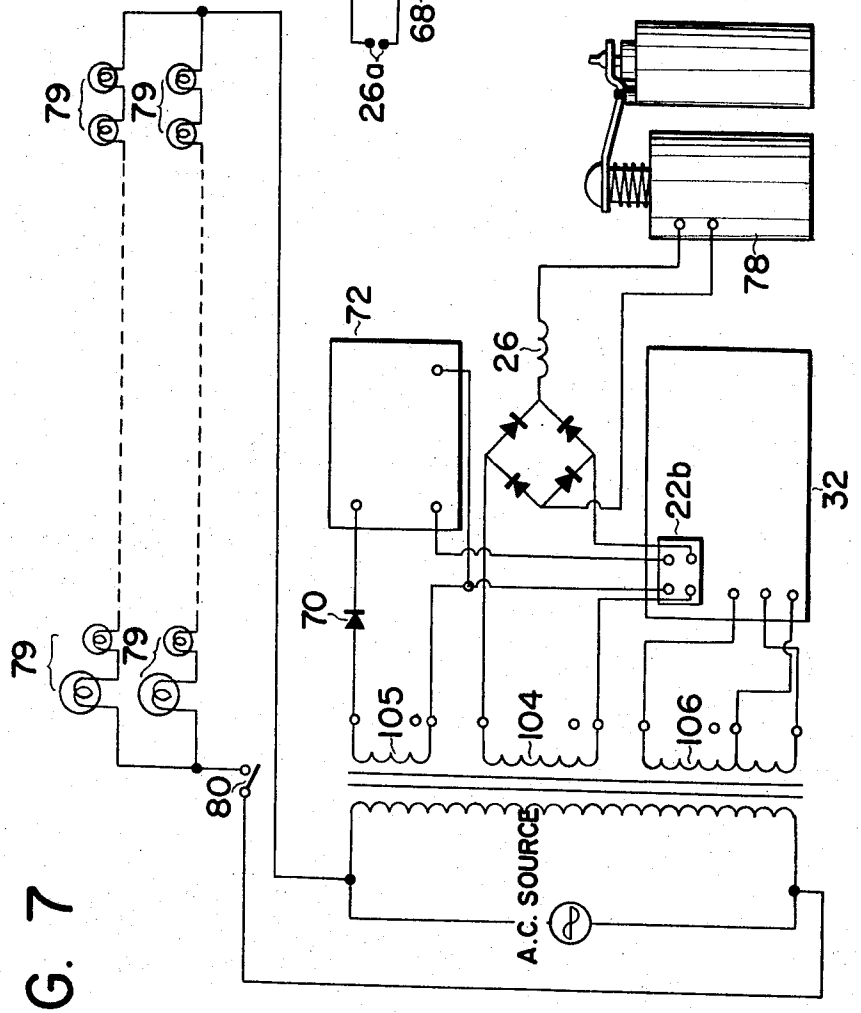


FIG. 7



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PROXIMITY CONTROLLED AUTOMATIC CIGARETTE LIGHTER AND THE LIKE

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Claims priority, application Japan, Sept. 15, 1964, 39/52,564
6 Claims. (Cl. 317—85)

ABSTRACT OF THE DISCLOSURE

In an electrically ignited gas fueled cigarette lighter, opening and closing of the fuel valve which connects the liquid reservoir with the discharge nozzle of the lighter is effected automatically upon placing a cigarette or the like at a predetermined position close to the outlet opening of said nozzle, by means of an electric proximity control circuit including sensing means influenced by the cigarette, to effect a current change in said circuit suitable for the the opening of said valve via a solenoid or the like control device. According to one embodiment, the control circuit is in the form of a self-running high-frequency oscillator subjected to the varying capacity between said sensing means and the metal mass of the device, to start and stop the oscillation of the circuit. Alternatively, the proximity control is by means of a light beam being intercepted by the cigarette and impinged upon a photoelectric cell forming part of the control circuit. Simultaneously with the opening of the fuel valve, a heater also controlled by said circuit and disposed in the vicinity of the capacitative or optical sensing means may be energized to ignite the fuel jet, whereby to completely dispense with any manual operations in the use of the lighter. Upon removal of the lighted cigarette, the circuit returns to its normal or rest condition ready for a renewed operation.

The present invention relates to improvements relating to automatic gas lighters for lighting cigarettes or the like.

Conventional gas cigarette lighters are provided with manually operable means, such as push buttons, for initiating the gas discharge, as well as to ignite the same by sparking, electric heating, or the like igniting means.

A main object of the present invention is to provide an automatic gas lighter capable of initiating the gas discharge and lighting of a cigarette or the like body automatically upon its being brought to a position in close proximity of the igniting means of the lighter.

The foregoing and further objects, novel features and advantages of the invention will become more apparent from the following detailed description of a few preferred practical embodiments, reference being had to the accompanying drawings in which:

FIG. 1 is a circuit diagram of an electric proximity circuit suitable for the purpose of the invention, a feature thereof being the provision of electrostatic sensing means for detecting the presence of the cigarette or the like body to be lighted;

FIG. 2 is a schematic vertical sectional view of a first practical embodiment of an automatic gas lighter constructed according to the invention and embodying the circuit shown by FIG. 1.

FIG. 3 is an electric diagram illustrative of an alternative proximity circuit suitable for use by the invention and embodying a photoelectric detector as sensing means;

FIG. 4 is a schematic vertical section of a practical embodiment of the invention, utilizing the circuit shown in FIG. 3;

FIG. 5*a* shows a lighting circuit embodying a heating resistor suitable for the purpose of the invention;

FIG. 5*b* shows a modified lighting circuit embodying a pair of discharge electrodes in place of the heating resistor of FIG. 5*a*;

FIG. 6 shows still another modified circuit suitable for use by the invention and containing rectifier means for the operation of a lighter by commercial A.C. current; and

FIG. 7 shows an operating circuit for use by the invention including a musical box and a plurality of colored signal lamps.

Like reference numerals denote like parts in the different views of the drawings.

Referring more particularly to FIGS. 1 and 2, the numeral **11** represents a detector or sensing device made of conductive material, for instance iron, copper or the like, and being electrically connected to one terminal of the coil **12** and condenser **13** of a parallel-tuned resonant circuit. The opposite end of said circuit is electrically connected, through a junction **100**, to an electrode of a coupling condenser **14**, the opposite electrode of which is connected to the base electrode of an input transistor amplifier **15**. Numeral **16** denotes a fixed resistor and **17** and **18** represent a variable resistor and battery, respectively, resistor **17** being inserted in the ground return lead of said base electrode and battery **18** shunting resistor **17** in series with resisstor **16**. Numeral **19** denotes a biasing resistor shunted by a by-pass capacitor **20** and inserted in the emitter return lead of the transistor. The circuit **11–20**, with a suitable tap point of coil **12** being connected, on the one hand, to the source **18**, and, on the other hand, to the emitter of transistor **15** via the output circuit of a power transistor **21**, constitutes a conventional detector-oscillator circuit designed to normally oscillate at a constant frequency, for instance 10 megacycles per second.

If a foreign body having a high dielectric constant such as a cigarette, is brought to a position in close proximity of the detector **11**, the capacitance between the latter and the metal mass (ground) of the device will be increased, whereby to vary the capacitance of the oscillator circuit from the predetermined resonance value in an increasing sense, as well as to increase the by-pass or ground capacity of the circuit **12**, **13**, in such a manner as to result in the interruption of the resonant operation of the circuit. This altered condition acts to impress a D.C.-voltage, through the intermediary of the filter composed of resistor **19** and condenser **20**, upon the emitter electrode of transistor **15**, whereby a biasing current is caused to flow through the power or output transistor **21** electrically coupled with transistor **15**. As a consequence, the collector current of the transistor **21** will be increased to an extent sufficient to actuate the contact **22***a* of relay **22** electrically connected to the collector electrode of the transistor **21**, whereby to operate said contact from the open position shown by full line to its closed position shown by dotted line in the drawing.

A fuel valve-operating circuit, comprising an electromagnet **23**, a safety switch **24**, a current source **25** and the relay **22** is connected as shown to the output circuit of the transistor **21**. There is further provided a lighting circuit comprising an electric heating resistor **26**, the safety switch **24**, current source **25** and relay **22** also connected to the output of transistor **21** in the manner shown. Both said circuits will be collectively referred to hereinafter as the "lighter-operating circuit" of the device. When the contact of relay **22** is closed in the afore-described manner, the valve-operating and lighting circuits are also closed, whereby a burner valve (not shown) and the heat-

er 26 are energized, as will be more fully described with reference to FIG. 2.

On the other hand, if the cigarette is removed from the vicinity of detector 11, the by-pass capacitance of the detector and oscillator circuit will be restored to its normal value so that the oscillator is subjected to the renewed oscillation to be ready for further use. At the same time, the relay 22 is de-energized, whereby to open its contact which is returned to its position shown by full line in FIG. 1. In this way, the lighter-operating circuit is de-energized and restored to its normal or non-operative condition.

In the aforementioned embodiment, a Hartley type oscillator circuit is shown as part of the detector circuit. As will be understood, other known LC-oscillator circuits may be readily employed for the same purpose and with equal results.

In the practical embodiment of the invention shown by FIG. 2, numeral 27 represents the casing of the lighter being in the form of a deep dish or receptacle. A fuel reservoir 28 containing a quantity of liquefied gas, such as propane, butane or the like, is mounted within the casing 27 and provided at its bottom with a conventional filling valve 29, the latter being merely indicated in the drawing. Numeral 30 denotes a conventional burner nozzle which is slidably arranged relative to a valve body 101 fixedly mounted on top of the reservoir 28. Although not shown, the valve body includes a conventional burner valve maintained in fluid communication with the lower end of nozzle 30. The nozzle is urged by a bias spring (not shown) mounted in the body 101 and positioned normally at a higher level as shown. In this manner, the burner valve is kept in its closed position. When pressure is exerted upon the top end of the nozzle and, as a consequence, the latter is lowered against the action of said spring, the burner nozzle is caused to open, whereby to establish a gas discharge from the reservoir 28 through the nozzle opening 34. The detector 11 is formed into a cowling and fixedly attached, through the intermediary of an insulator socket 31, to the upper wall of the casing 27. The cowling 11 acts as a protection against wind or drafts, after the fuel has been ignited. Numeral 32 denotes in block form the afore-described detector-oscillator circuit, exclusive of the detector proper 11. Relay 22 is also shown in block form in FIG. 2. Relay magnet 23 is shaped in the form of a disc and fixedly mounted on the casing 27 or fuel reservoir 28. A disc-shaped armature 33 is arranged normally at a small distance from and in parallel to the magnet 23 with the nozzle 30 being fixedly attached to the disc 33.

When the lighter-operating circuit is energized in the afore-described manner, upon closure of the contact of relay 22, the magnet disc 23 is energized and attracts the disc 33, whereby nozzle 30 is displaced upwardly, to allow the gasified fuel to escape in the form of a jet from the nozzle outlet opening 34. At the same time, the lighting circuit is energized so as to heat the element 26 for igniting the fuel jet. In this manner, a cigarette or the like combustible body may be lighted by merely bringing it to a position in close proximity of detector cowling 11.

Safety switch 24, FIG. 1, inserted between current source 25 and the valve-operating and lighting circuits, advantageously consists of a gravity-operated switch comprising an insulating base *l*, a movable gravity-operated contact *m* pivotably mounted thereon and a stationary contact *n* rigidly mounted on said base. Under normal conditions, the movable contact *m* depends substantially vertically so as to establish a conducting connection with the stationary contact *n*. Under abnormal conditions, such when the lighter is brought to an inclined position due to any cause, the movable contact *m* is urged by gravity action to a position as to be disengaged from contact *n*, whereby the lighter-operating circuit is disconnected from current source 25. In such a case, even with a foreign body occupying a position close to the detector 11, a fuel escape from the nozzle and heating of the element 26 are prevented, whereby to exclude unintentional fire hazard.

When a cigarette is lighted under normal conditions in the afore-described manner and then withdrawn from the detector 11, the oscillator circuit recovers its normal or oscillating condition, whereby the relay 22 will be operated to its de-energized position, or its movable armature 33 returned to its off-position shown by the full line in FIG. 1. The resultant dropping of the disc 33 together with nozzle 30 again closes the burner valve, whereby to interrupt the gas discharge.

It will be understood that the transistor for controlling relay 22 may be replaced by a vacuum tube, thyratron or the like. The gravity-operated safety switch may also be replaced by any equivalent and conventional device.

In the modified circuit shown by Fig. 3, a photoelectric detector 11*a* is employed in place of the capacity-sensitive detector according to FIGS. 1 and 2. Detector 11*a* is preferably a phototransistor energized by a reverse voltage in respect to its current passing direction as a junction rectifier.

The circuit shown in FIG. 3 comprises transistors 36, 37, 41 and 44 connected in cascade and following the detector or phototransistor 11*a*. The input transistor 36 cooperates with a temperature-sensitive variable coupling resistor 35, in such a manner, that with a reduction of the ambient temperature the resistance value is reduced correspondingly. As a consequence, the correspondingly increased dark current of transistor 36 will be shunted off the next transistor 37, whereby the latter is practically free from any influence caused by fluctuations of the ambient temperature. As will be understood, the transistor 37 acts as an amplifier. Resistors 38 and 39 are arranged as shown for controlling the collector-emitter voltage and current of both transistors 36 and 37. Variable resistor 40 and transistor 41 are provided and arranged so as to act in the same manner as described hereinbefore in reference to items 35 and 36, respectively.

Numeral 42 denotes a constant voltage or reference diode and 43 represents a resistor arranged for controlling the collector voltage and current of transistor 41. Resistors 45 and 46 are arranged for the same purpose in connection with transistor amplifier 44.

Resistors 47 and 48 are arranged to act as voltage dividers for controlling the emitter voltage of transistor 44. As a current source, batteries may be used as before. According to the present embodiment, however, a commercial A.C. current source is utilized. More particularly, such current, for instance 100 volts A.C., is supplied to the primary winding of a power transformer 49 and a lower voltage, say 12 volt is derived from one of the secondary windings and fed to a full-wave bridge-type rectifier comprising four diode elements 50, 51, 52 and 53. The rectified current is fed via a smoothing condenser 54 to the detector circuit described.

Besides, current is also derived from another secondary winding of transformer 49 and fed to a lamp 55 which serves to project a light beam, through lenses 61 and 62 FIG. 4, upon the photoelectric detector element 11*a*, the latter being in the form of phototransistor in the example illustrated. An electromotive force is thus induced in the phototransistor and the generated current is amplified by transistors 37 and 44, relay coil 22*a* similar to item 22 of FIG. 1 being connected between the collector and emitter electrodes of the output transistor 44. As a consequence, the relay coil 22*a*, being continuously energized, maintains its contact in open position, as indicated by the full line in FIG. 3. This contact is inserted in the lighter operating circuit in substantially the same manner as described in reference to FIG. 1.

Assuming now that a cigarette is brought into the light beam between the lenses 61 and 62, whereby the light received by the phototransistor is weakened or interrupted and the relay coil 22*a* is de-energized, the contact of the latter will be closed, as indicated in FIG. 3 by the dotted line. In this way, the lighter-operating circuit is activated

and gaseous fuel is delivered and ignited for the lighting of the cigarette. The lighter-operating circuit may be the same as or similar to that described in reference to FIG. 1.

As alternative photoelectric detectors, a CdS-element, solar cell, photoelectric cell or the like conventional photoelectric transducing device may be substituted for the phototransistor shown.

FIG. 4 schematically shows an automatic gas lighter construction embodying the circuit according to FIG. 3. In the latter, the numeral **27***a* represents a casing having a central upper opening **56** covered by a hollow wind shield **57** in the form of a cowling fixedly attached to the upper wall of the casing. A fuel reservoir or pressure vessel **28***a* is mounted, in any suitable manner, in the casing **27***a*. Reservoir **28***a* is fitted with a filling valve and a burner valve (not shown), only the body **101***a* of the latter being indicated in the drawing. A slidable nozzle **30***a*, similar to nozzle **30** of FIG 2, is arranged to cooperate with the valve **101***a*, in the same manner as described hereinbefore. According to the present embodiment, a flexible tube **58**, such as of polyvinyl chloride, is connected at its one end with the upper end of the nozzle and extends therefrom to the center of the opening **56**, to provide a burner outlet **35***a*, the latter being mounted upon the upper wall of the casing **27***a* in any suitable manner.

Disposed at both sides of the upper casing wall are two closed chambers **59** and **60**, one of which (**59**) houses a lamp **55** and a condensing lens **61**, while the other chamber (**60**) houses a condensing lens **62** and the phototransistor **11***a*. The lighter is again actuated upon closure of the contact of relay **22***a* shown in block diagram form in FIG. 4. The electric heating element **26** is mounted within the wind shield **57** and directly above the burner opening **35***a*. Numeral **32***a* denotes the detector circuit exclusive of the phototransistor **11***a* and numeral **63** represents the current supply circuit comprising the elements **49**–**54** of FIG. 3.

Normally, a concentrated light beam is projected by the lamp **55** and lens **61**, an open space being provided between both chambers **59** and **60** slightly above the wind shield **57** and heating element **26**, with said light beam passing through said space and being impinged upon the phototransistor **11***a*, as indicated by the arrow in the drawing. The output current of the phototransistor is applied, after suitable amplification, to the relay **22***a* for maintaining the relay contact in its open position, in the manner described.

If a cigarette or the like body is brought close to the heating element **26** and, as a consequence, the light beam emanating from the source **55** and projected unto the phototransistor **11***a* is weakened or interrupted, the output current of the phototransistor will be correspondingly reduced, whereby to de-energize the relay **22***a* and to close its contact. Upon subsequent energization of the lighter-operating circuit, an electromagnet **23***a*, similar to the electromagnet **23** of FIGS. 1 and 2, is energized, whereby to attract the free end of the valve-operating lever **64**, the opposite end of which is fixedly attached to the nozzle **30***a*. As a consequence, the fixed end of the lever **64** together with the nozzle is raised, to open the burner valve and to emit a gas jet from the nozzle. At the same time or after a short time lag, the heating circuit including the heating element **26** is energized so as to heat the latter to a sufficient temperature, to ignite the gas jet and to form a lighting flame. After lighting of the cigarette or the like, the latter is withdrawn by the user, whereby the circuit elements will recover their normal condition, to result in the automatic extinguishment of the lighter.

In FIG. *5a*, a standard lighting circuit employing an electric heating resistor **26** as lighting means is shown separately, the nature and function of which is readily understood from the foregoing.

According to a modification of FIG. *5a* shown by FIG. *5b*, a pair of discharge electrodes **26***a* are employed in place of the heating resistor **26**. In this case, the discharge circuit includes a current source **25***a*, condenser **65**, safety resistor **66** and switch **67**. When the switch, which may be arranged so as to function in the same manner as the relay **22** or **22***a* is closed, a voltage as high as 10,000 volts is induced in a spark coil **69** which is electromagnetically coupled with a primary coil **68**, one end of which is electrically connected to the junction between condenser **65** and resistor **66**, while the opposite end of the coil is connected with a normally open stationary contact of the switch **67**. It will be understood that as the switch is operated from the position shown to the last-mentioned stationary contact, ignition sparks are developed between the discharge electrodes **26***a* for igniting the gas jet in a manner similar as described hereinbefore.

According to a modified arrangement shown by FIG. 6, commercial A.C. current is utilized and a music box or a miniature magnetic tape recording and playback machine, shown in block form at **72**, is embodied in the lighter. Furthermore, in order to visually indicate the initiation and termination of the lighter operation, there are provided a plurality of lamps **79** included in the operating circuit. Relay **22***b* similar to **22** or **22***a*, power supply transformer **49**, detector circuit **32**, and a bridge comprising rectifiers **50**, **51**, **52** and **53** are substantially the same as described hereinbefore.

A further circuit comprising four rectifier elements **74**–**77**, a valve-operating device **78** of the type described and a relay contact **103** controlled by relay **22***b* acts as a lighter-operating circuit also similar to that described hereinbefore. The music box **72** or magnetic tape recorder is operated by a D.C. motor **71** arranged to be fed from one of the secondary windings **105** of transformer **49** through a rectifier **70** during closing of the relay contact **73** by the relay **22***b* in the manner described.

Colored lamps **79** are fed directly from the primary winding of the transformer **49** and controlled by a switch **80** which may in turn be controlled by relay **22***b* in unison with both relay contacts **73** and **103**, as indicated by the dotted line in the drawing. As a consequence, initiation and termination of the operation of the lighter may be accompanied by both musical sounds and visual signal indication.

In a still further modified lighter circuit schematically illustrated in FIG. 7, using the same reference numerals to denote like parts, the circuit arrangement is slightly altered, with the results being, however, the same as before.

In the foregoing, the invention has been described in reference to a few exemplary illustrative devices. It will be evident, however, that variations and modifications as well as the substitution of equivalent parts or circuits for those shown herein for illustration, may be made without departing from the broader scope and spirit of the invention as set forth in the appended claims. The specification and claims are accordingly to be regarded in an illustrative rather than in a restrictive sense.

I claim:

1. In a gas lighter comprising a liquefied gas fuel reservoir, a burner nozzle having an outlet opening and an inlet, the latter being fluidally connected with said reservoir, a casing for mounting said reservoir and said nozzle, an electric heater mounted in proximity of the outlet opening of said nozzle, and means for selectively closing and opening the inlet of said nozzle, a combination of: detector means mounted on said casing, a detector circuit electrically connected with said detector means for sensing a foreign body such as cigarette when it is brought to a position in close proximity of said detector means to thereby electrically influence said circuit, and an operating circuit electrically connected with said detector circuit for opening the inlet of said nozzle when said first circuit is influenced.

2. Gas lighter as set forth in claim 1, wherein said detector means is a capacitor means.

3. Gas lighter as set forth in claim 1, wherein said detector means is composed of a light source, a plurality of condensing lenses and photoelectric conversion means, said lenses being inserted in the passage of light beams emanating from said source and impinging upon said conversion means.

4. Gas lighter as set forth in claim 1, wherein said detector circuit is a capacitor-influenced, high frequency resonance oscillator circuit.

5. Gas lighter as set forth in claim 1, wherein said means for selectively closing and opening the outlet of said nozzle is a solenoid circuit electro-mechanically connected with said nozzle.

6. The combination with a gas-fueled cigarette lighter and the like including a liquified gas fuel reservoir, a discharge nozzle having an outlet opening and connected to said reservoir, and control valve means for closing and opening said nozzle; of an electric proximity control circuit including sensing means disposed in the vicinity of said opening, whereby to effect an instantaneous current change in either direction in said circuit upon placing of a cigarette or the like at and withdrawing it from a predetermined position in the vicinity of said opening, electrically controlled actuating means to open and close said valve means in response to the current changes in said circuit, electric fuel igniting means also disposed in the vicinity of said opening, and further means to energize said igniting means by said circuit simultaneously with the opening of said valve means.

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