

[54] REMOTE FIRE STACK IGNITER

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[51] Int. Cl. F23d 13/20

[58] Field of Search..... 431/202, 264; 23/277 C

[56] References Cited

UNITED STATES PATENTS

2,460,016 1/1949 Kuhn 431/202
2,869,631 1/1959 Zink..... 431/202

3,729,287 4/1973 Strashok 431/202

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[57] ABSTRACT

An igniter mounted on a vent stack with an upper, flame cage near the top of the stack to ignite emissions from the stack. The igniter is a tube with a lower, open, flared end having a spark plug near the lower end and a solenoid-controlled valve which supplies propane fuel from a supply tank. Propane from the tank is supplied at the top under control of a second, solenoid-controlled valve. The valve controlling the lower supply is closed after ignition at the flame cage. The igniter is economical, practical, and highly reliable.

10 Claims, 2 Drawing Figures

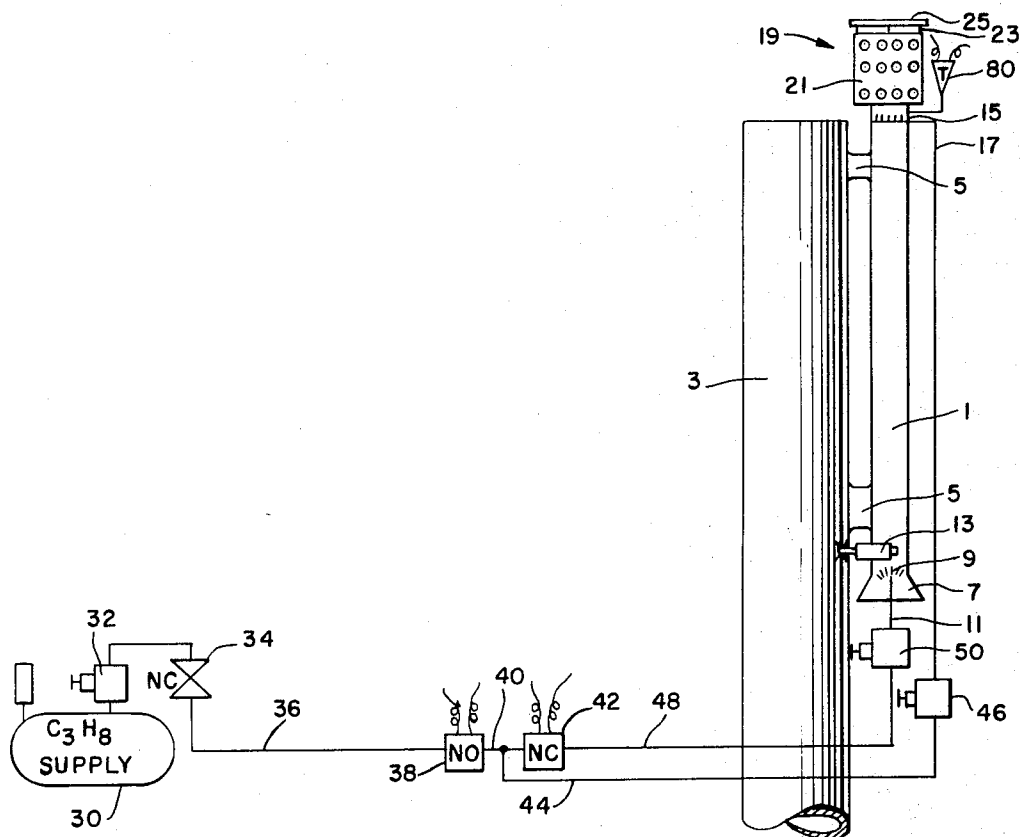


FIG. 1.

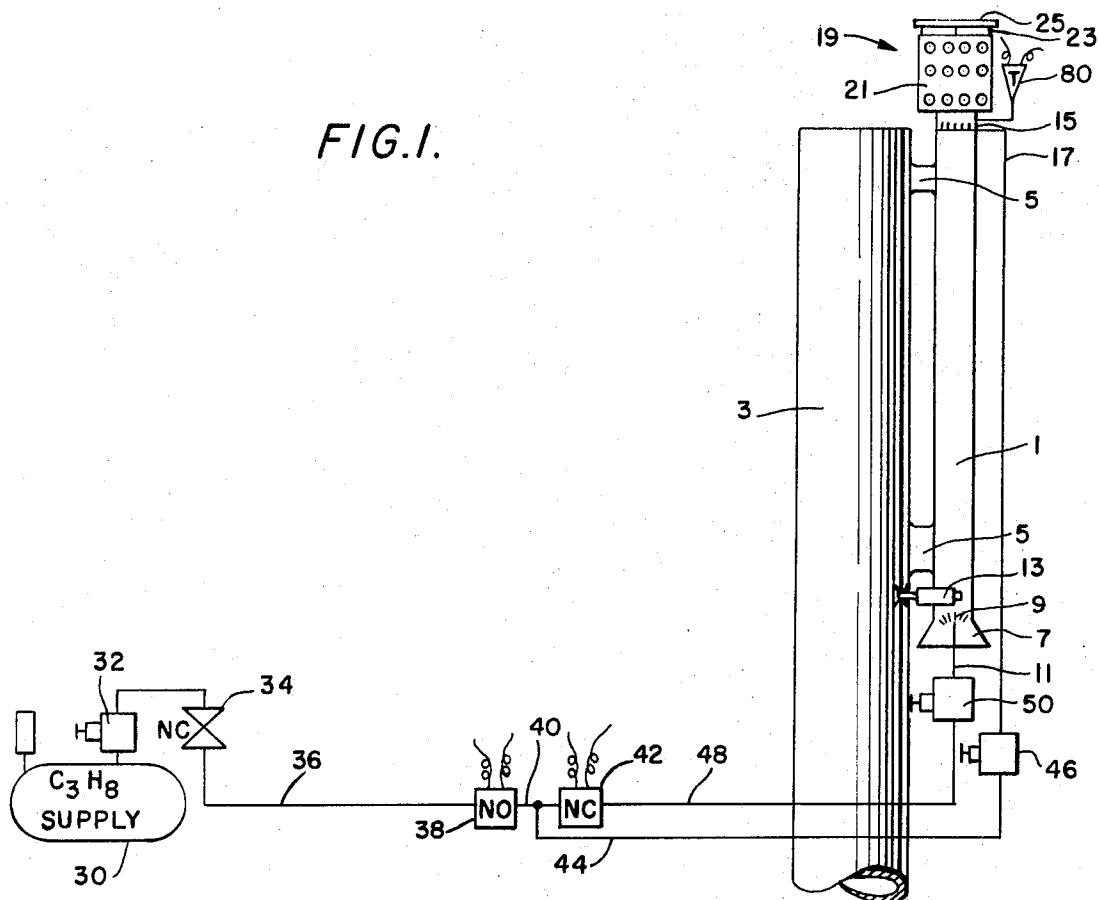
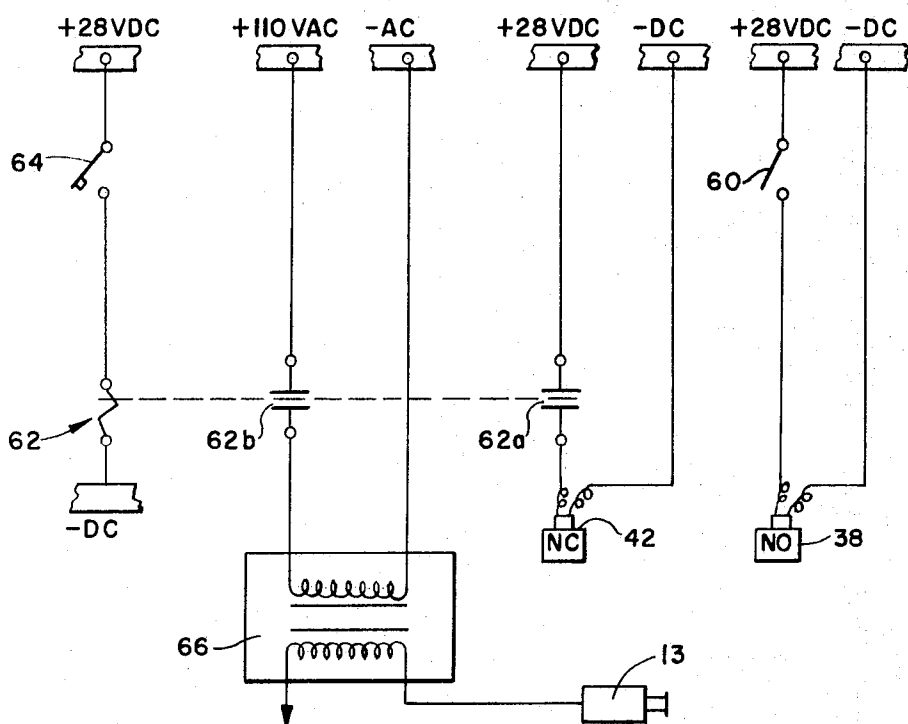


FIG. 2.



REMOTE FIRE STACK IGNITER

ORIGIN OF THE INVENTION

The invention described herein was made by an employee of the United States Government and may be manufactured and used by or for the Government for governmental purposes without the payment of any royalties thereon or therefor.

BACKGROUND OF THE INVENTION

This invention relates to igniter devices and systems to ignite exhausts from vent stacks to accomplish burning of such exhausts, and, more specifically, this invention relates to such devices and systems having remote control.

In many applications exhaust gases and other materials issuing from smoke stacks and other vent stacks are ignited so that they are burned as they leave the stack. In this manner potential pollutants are decomposed and rendered innocuous.

To accomplish such burning, ignition devices have been mounted on the stacks which have the capability of providing flame to the stack gases as they leave the stack. Typically, such devices burn continuously to thereby continuously support the burning of emissions from the stack.

Some common prior igniter systems have employed a mixture of fuel and oxygen in which the oxygen is contained and supplied by mechanical means. Substantial practical and economic problems in controlling the mixture have resulted, and the devices as a whole have been somewhat complex.

U.S. Pat. No. 2,460,016 to Kuhn discloses a igniter mounted along the side of a stack as is that of the subject invention and aspirating air from the lower portion of the igniter, as is broadly the same as the subject invention. Ignition is by a spark plug near a lower fuel source and a second fuel source supplies fuel near the top of the igniter.

A fundamental difference of the Kuhn disclosure from the instant invention is that in Kuhn the fuel source to the igniter consists of the same emissions as are vented by the major stack. Thus, the device would not function at all when the waste gas pressure is not substantially above atmospheric pressure. When waste gas pressure is near atmospheric, the gases would apparently exit entirely through the stack, rather than pass through the much smaller ducts of the igniter system.

Also, the device of the Kuhn disclosure is not adapted to standby operation, so as to be in operation during periods when waste gases contain insufficient combustible material to sustain burning.

The device of the Kuhn disclosure requires continual control of the settings of the valves controlling the waste gases. Such operation requires the operator to be at the actual location of the valves, which, from practical considerations, must be near to the stack. Accordingly, the device is not suitable for use with hazardous gases.

The device of the Kuhn disclosure employs air openings located circumferentially at the lower end of the igniter tube, with the bottom of the tube closed. This results in a sump at the bottom of the tube which traps rain water entering from the top and through the air openings near the bottom. Also, the air openings are on

a plane with normal wind flow, which can interfere with the aspiration process.

The device of the Kuhn disclosure contains no physical protection of the top flame to prevent flame-out caused by wind and other weather conditions. Tests conducted in pursuance of the instant invention have shown that high velocity winds will extinguish the upper jet flame without a protection device.

Finally, the subject matter disclosed in Kuhn is expensive and poorly functional in many respects. The large valve to the waste stack is an expensive and cumbersome item. The upper fuel input appears to be a simple open pipe which would function with low combustion efficiency. The device has no flame detector and therefore would not function with the burning of colorless flames, such as are produced from the products of liquid hydrogen.

U.S. Pat. No. 3,537,091 to Rodman et al. discloses a stack igniter mounted along the sides of the stack. Ignition is by a spark plug within pipes spaced away from the top of the stack. This invention differs fundamentally from the instant invention in that air is supplied through a separate supply pipe, with the quantity controlled by the valve in that pipe. Devices of that type have been termed "flame front generators" and have been unsuccessful in applications for which the instant invention is useful. In the use of those devices, difficulty is encountered with not being able to properly adjust the mixture ratio for ignition owing to ambient temperature changes during day-to-day operation. The device is also susceptible to flame-out during normal operation owing to temperature change of oxidizer and fuel, supplied as compressed gases. Readjustment of the oxidizer-fuel ratio is required for ignition after flame out, and such mixture control can not be effectively accomplished remotely. The entire device is also complicated with excessive hardware.

U.S. Pat. Nos. 3,529,910 to Potts et al. and 2,802,521 to Campbell et al. disclose ignition systems of only general relevance and similarity to the instant invention. Both employ spark ignition. Campbell discloses a steel shroud around the sides, but not the top, of the flame area to protect the flame from wind currents while also forming a mixing chamber.

The instant invention differs from known prior systems in that it is simple and efficient, especially in its positive control of igniter fuel from a separate source while obtaining oxygen by aspiration, with protection of the flame with a hood device.

SUMMARY OF THE INVENTION

It is a primary object of this invention to provide a stack igniter which operates reliably and requires no proximity of the operator to the combustible materials involved.

It is, similarly, a primary object of this invention to provide a practical, economical, and reliable stack igniter.

It is a related object of this invention to provide a stack igniter which separates control from the products operated upon to assure a high degree of safety.

It is another object of this invention to provide a stack igniter which functions in the absence of waste emissions and as a standby igniter to ignite waste emissions as they occur.

It is another object of this invention to provide a stack igniter which is simplified in operation and does not require continual or frequent adjustment.

It is another, more specific object of this invention to provide a stack igniter with protection of the igniter flame to prevent loss of that flame.

In accordance with this invention the igniter comprises an elongated conduit open at the bottom with a fuel input source and a ignition source near the lower end. A second fuel input source is located near the upper end. Fuel is supplied from a source under constant conditions of content and pressure. The top of the igniter is surrounded by a vertical, perforated shield and a continuous, flat top member is spaced above the vertical shield to form a cage to protect the upper flame. Control is remote, by simply controlling the opening and closing of valves and the firing of the ignition source.

These and other objects, features, characteristics, and advantages will be apparent from the following description of a preferred embodiment of the invention, as illustrated by the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 illustrates the structure and over-all arrangement of the stack igniter.

FIG. 2 illustrates the electrical system of the preferred embodiment for remote operation.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The main body 1 of the assembly is an 8 foot long, 1½-inch steel tubing. The tubing is mounted vertically on a vent stack 3 by bolted straps, welded stand-offs 5 or the like. A common 4-inch by 1½-inch concentric pipe reducer 7 is welded to the lower end of the tube 1 to facilitate the mounting of the lower fuel injector 9, which is mounted in the center of reducer 7.

The lower ignition system comprises a lower fuel injector 9, which includes a pipe 11, terminated by an orifice, located below spark plug 13, which is mounted in the wall of tube 1.

An upper fuel injector 15 is located at the top of tube 1. It includes a pipe 17, the end of which is mounted on the side of tube 1 and extends into the tube 1 perpendicular to the long axis of tube 1. The pipe 17 has a series of five orifices spaced along pipe 17 in the tube 1, through which the fuel is supplied.

Located above tube 1 is the flame shield and deflector unit 19, mounted by welded supports to tube 1. Flame cage 19 comprises a metal sheet 21 mounted vertically surrounding the flame area and having a number of holes located throughout its surface. Support struts 23 extend vertically and are welded to support a continuous, horizontal sheet 25, which serves as a roof.

The fuel supply system comprises a regulated supply of liquid propane 30, with a manual valve 32 to close the supply completely, followed by a manual regulator 34. Regulator 34 connects to pipe 36, and pipe 36 leads to normally open solenoid valve 38. Valve 38 leads through pipe 40 to normally closed solenoid valve 42, and to pipe 44, which bypasses valve 42 and connects to manual, ¼-inch needle valve 46. Normally closed valve 42 leads through pipe 48 to manual, ¼-inch needle valve 50. The other side of manual valve 46 con-

nects to pipe 17. Similarly, the other side of manual valve 50 leads to pipe 11.

PRELIMINARY ADJUSTMENTS

Manual valves 34, 46, and 50 are adjusted prior to normal use to bring the system into operation as desired for a particular installation. The fuel supply container 30 is a standard commercial grade tank which comes equipped with liquid level gage, regulator, pressure gage, and shutoff valve. The supply regulator is adjusted to supply 30 - 0 + 20 p.s.i.g. to the solenoid valves 38 and 42. Further adjustment during operation is not required.

The valves 46 and 50 are adjusted to provide the proper flow rates for prompt ignition and good combustion stability at the upper flame system.

The handles of the manual valves are then lock wired in place since no further adjustments are needed. Flow control is thereby fixed and is completely unaffected by waste gas flow and pressure.

BASIC OPERATION

Initial operation is the ignition of the lower part of tube 1 by energizing the spark plug 13 while valves 38 and 42 are open. This provides fuel to both the lower and upper fuel injectors 9 and 15 as the spark ignites the fuel from the lower injector 9.

The flame front originating at the area of the lower injector 9 propagates upward through the inside of tube 1 and ignites the fuel at the upper injector 15. When flame is established at the upper injector 15 (which is within 5 seconds), the valve 42 is closed and the spark is terminated.

Combustion at the upper injector 15 is continued by the fuel supplied through the valve 38 and pipe 44. All necessary air is automatically aspirated from the bottom of tube 1.

ELECTRICAL REMOTE SYSTEM

FIG. 2 is a schematic illustration of the electrical system by which the remote operation of the preferred embodiment is accomplished. One, independent circuit, shown at the right in FIG. 2, includes the normally open solenoid valve 38. Control of the solenoid 38 is simply by the opening and closing of switch 60, which completes a circuit through solenoid 38 and including a 28 volt dc source as shown.

Normally closed solenoid valve 42 is in a similar circuit with a 28 volt dc source. That circuit is closed by the activation of relay 62, shown in the circuit on the left, which is activated by the closing of manual switch 64 to thereby apply 28 volts dc across relay 62. Activation of relay 62 closes relay contact switch 62a to thereby energize valve 42.

Spark plug 13 is electrically connected to the output of transformer 66, which receives a 110 volt ac input and is wound and otherwise adapted to produce an output of 10,000 volts ac across spark plug 13. The input of transformer 66 is connected in a circuit containing a source of 110 volts ac, and relay contact switch 62b is closed by the closing of relay control switch 64.

In operation the manual control switches 60 and 64 may be located a great distance as desired from the actual igniter elements and the vent stack to which the igniter is attached. Operation is by closing the switch 64, while leaving switch 60 open. This opens valve 42 to provide fuel to the lower injector 9 and also activates

the spark source 13. Since valve 38 is open, upper injector 15 is also supplied with fuel. A flame front originates at the area of lower injector 9 and automatically propagates upward through the tube 1, where it ignites the gas from upper injector 15.

Upon visual observation of the flame at the top of tube 1, the operator opens switch 64. That terminates the spark and the flow of fuel to lower injector 9. Alternatively, this operation can be automatic, which can be of particular importance where the flame is invisible. For automatic operation a standard flame detector 80 is employed (FIG. 1) to observe flame at the top of tube 1 and to open switch 64 in response to that observation of flame. (The flame detector 80 may be used to signal the need for re-ignition in the event of flame-outs.)

When the igniter is to be turned completely off, switch 60 is closed, thereby closing normally open valve 38 and stopping the flow of fuel to both injectors 9 and 15.

STRUCTURAL DETAILS AND MODIFICATIONS

The igniter system is designed to be remotely operated from a control panel located in a safe area. Accordingly, it may be used with highly hazardous vent systems such as those for liquid hydrogen and for liquid carbon monoxide. Vent stacks of any diameter can be accommodated by employing more than one of the igniters, as desirable. Also, such multiple assembly installation is recommended for increased reliability, although single units have been widely employed with much success.

The entire igniter assembly is preferably fabricated from stock material, primarily steel, readily and commonly available. The spark plug and other essential parts of the electrical system are all off-the-shelf items of the low cost variety commonly used in industry.

Similarly, ordinary shop tooling is used for parts fabrication and unit assembly owing to the wide tolerance design features. In the preferred embodiment, both gas injectors 9 and 15 are simply common tube fittings with gas outlet holes drilled with ordinary drill bits. The manual valves 46 and 50 provide for adjustments necessary owing to the wide tolerance injector holes.

The optional flame detector 80 may be a commercial flame rectifier unit or simply an ordinary thermocouple, such as a monitoring device.

OPERATIONAL FEATURES

The preferred igniter system has exhibited excellent reliability in all phases of required operation. It is superior to other known systems in simplicity in operation, in low costs of fabrication, installation, and operation, and in maintenance requirements. After preliminary adjustment, operation is by two switches, which are readily controlled from a blockhouse or other remote safe area.

The salient feature of the device is that oxidizer requirements are satisfied by aspiration on an automatic basis, which avoids any stored oxidizer supply system. This also eliminates the problem of mixing which is common to systems which employ pressure regulated fuel and oxygen supplies.

Since air is aspirated at a point 8 feet below the vent stack exit, gases expelled from the stack will not interfere with igniter mixture ratio. The operation of the unit is not greatly affected by variations in gas density

caused by normal temperature changes during the operating period, and while the total energy produced by the unit may change, sufficient energy will be retained to provide for combustion of the vent gases leaving the vent stack.

Operation of the igniter is independent of the presence and characteristics of the waste gases, and is therefore not susceptible to flame-out because of factors having to do with the waste gas system. The device is inherently useful as a standby pilot to ignite unscheduled vented waste gas as it appears.

Furthermore, the device has the wind protection shield 19, which is very effective in preventing flame-outs from wind and heavy rainfall. The vertical shield 21 protects the flame, as does the roof 25, and the roof 25 serves to deflect the flame in a horizontal plane toward the vent stack.

The open bottom end of tube 1 avoids water entrapment and minimizes the interference of wind with the aspiration process.

Other variations of the invention described will be apparent, and variations may well be developed which employ more than ordinary skill in this art, but nevertheless employ the basic contribution and elements of this invention. Accordingly, patent protection should not be essentially limited by the preferred embodiments disclosed, but should be as provided by law, with particular reference to the accompanying claims.

What is claimed is:

1. A vent igniter capable of burning waste gases at near atmospheric pressure comprising an elongated tube open at both ends adapted to be attached along a vent stack the emissions of which are to be ignited, a continuous fixed flow source of combustible fuel under pressure, said fuel source being separate and independent of said emissions to be ignited first fuel output means positioned near one end of said tube, second fuel output means positioned near the other end of said tube, conduit means for said fuel connecting said fuel source to said first and said second fuel output means, combustion initiating means located near said first fuel output means, control valve means to control fuel to said first fuel output means, and control means to selectively activate said combustion initiating means.

2. The vent igniter as in claim 1 also comprising a cage adapted to protect fire burning at the end of said tube from fuel from said second fuel output means from influences of the atmosphere, said cage comprising a perforated shield member surrounding the area immediately beyond said tube near said second fuel output means and a continuous member generally perpendicular to the long axis of said tube mounted near said perforated member with said perforated member located between said continuous member and said tube.

3. The vent igniter as in claim 1 in which the open end of said tube near said first fuel output means is flared outward, and said first fuel output means is mounted in the center of said flared part.

4. A vent igniter comprising an elongated tube open at both ends adapted to be attached along a vent stack the emissions of which are to be ignited;

a continuous source of combustible fuel under pressure;
first fuel output means positioned near one end of said tube;

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second fuel output means positioned near the other end of said tube;
 conduit means for said fuel connecting said fuel source to said first and second fuel output means;

combustion initiating means located near said first fuel output means;

control valve means to control fuel to said first fuel output means;

control means to selectively activate said combustion initiating means; and

a manually activated relay adapted to close two electrical circuits, one of said circuits activating said combustion initiating means and the other of said circuits activating a solenoid circuit to said control valve means to control fuel to said first fuel output means.

5. A vent igniter comprising an elongated tube open at both ends adapted to be attached along a vent stack the emissions of which are to be ignited;

a continuous source of combustible fuel under pressure;

first fuel output means positioned near one end of said tube;

second fuel output means positioned near the other end of said tube;

conduit means for said fuel connecting said fuel source to said first and second fuel output means;

combustion initiating means located near said first fuel output means;

control valve means to control fuel to said first fuel output means;

control means to selectively activate said combustion initiating means; and

wherein said source of combustible fuel is a source of hydrocarbon gas, said combustion initiating means

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is a spark plug, and said source of hydrocarbon gas is connected by a first conduit to a normally open solenoid valve, the output of said normally open valve is connected to said second fuel output means by a second conduit and is connected to a normally closed solenoid valve by a third conduit, and the output of said normally closed valve is connected to said first fuel output means.

6. The vent igniter as in claim 12 also comprising a manually operated relay adapted to close two electrical circuits, one of said circuits activating said combustion initiating means and the other of said circuits activating said normally closed solenoid valve.

7. The vent igniter as in claim 6 in which a first, manual adjustment valve is located in the conduit between said normally open solenoid and said first fuel output means and a second, manual adjustment valve is located in the circuit between said normally open solenoid and said second fuel output means.

8. The vent igniter as in claim 7 also comprising a cage adapted to protect fire burning at the end of said tube from fuel from said second fuel output means for influences of the atmosphere, said cage comprising a perforated shield member surrounding the area immediately beyond said tube near said second fuel output means and a continuous member generally perpendicular to the long axis of said tube mounted near said perforated member with said perforated member located between said continuous member and said tube.

9. The vent igniter as in claim 8 in which the open end of said tube near said first fuel output means is flared outward, and said first fuel output means is mounted in the center of said flared part.

10. The vent igniter as in claim 9 wherein said source of combustible fuel is a container of liquified propane.

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