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ELECTROLYTIC PILOT IGNITER

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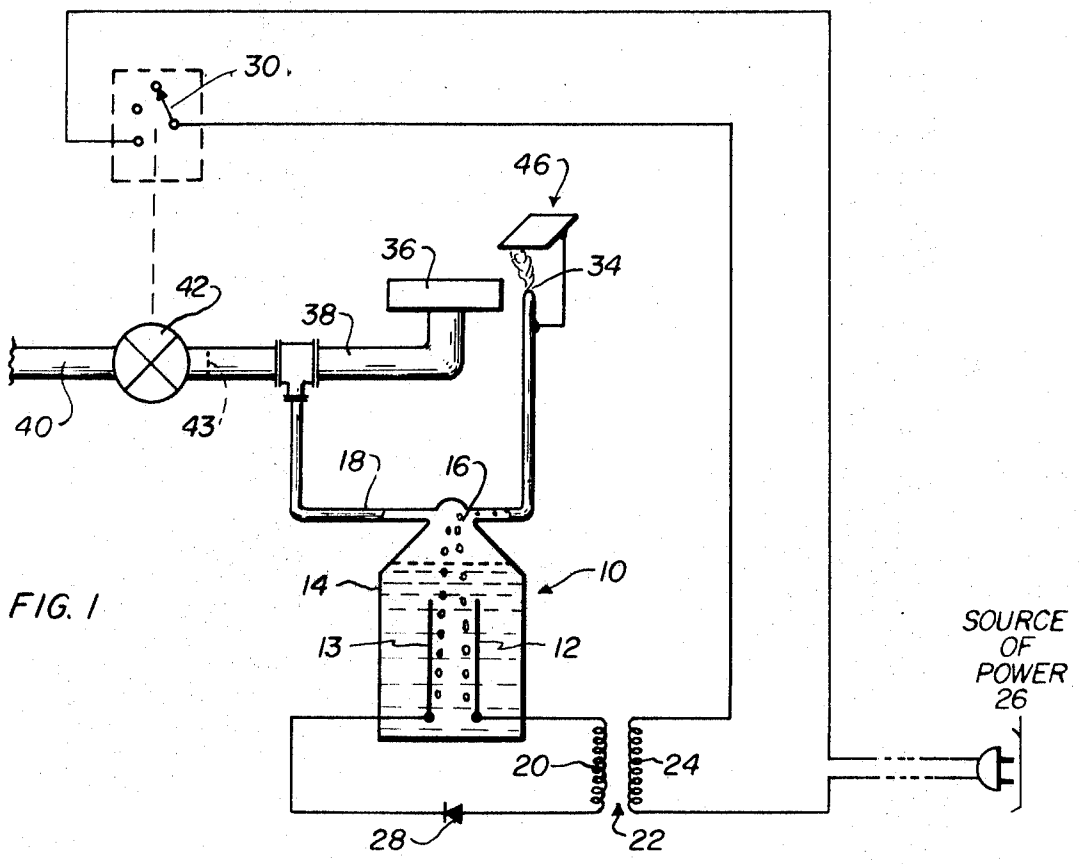


FIG. 1

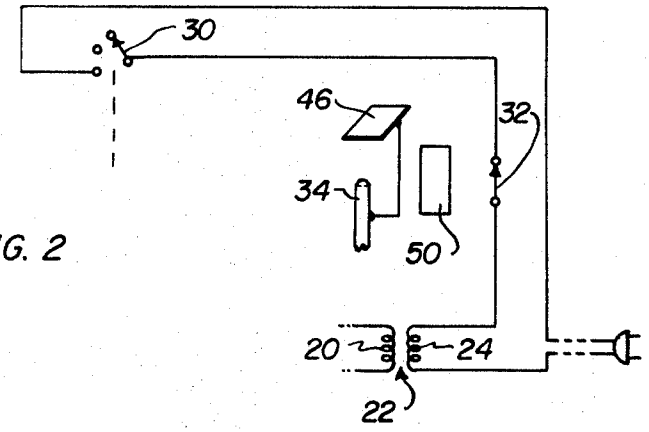


FIG. 2

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ELECTROLYTIC PILOT IGNITER

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ABSTRACT OF THE DISCLOSURE

A pilot igniter which includes, generally, a cold solid catalyst affixed in operative relationship with a gas pilot to be ignited and an electrolytic cell which is adapted to be energized to form hydrogen and oxygen which is mixed with the gas being conveyed to the gas pilot. The hydrogen is reacted by the cold solid catalyst to, in turn, ignite the gas mixture. The oxygen enhances the ignition. Suitable switching means are provided and are operated to control the flow of gas to the gas pilot, and to energize and de-energize the electrolytic cell to control the flow of hydrogen, and oxygen, which is mixed with the flow of gas to the pilot.

This invention relates to an improved ignition process for igniting natural gas and to the apparatus for carrying out the same.

Most gas appliances such as, for example, gas ranges and ovens, hot water heaters and the like, have a continuous standing pilot for igniting their main burners, to operate the appliance. Many manufacturers have attempted to eliminate the need for such a continuous standing pilot, by using a heated wire ignition system or electric spark generators to ignite the pilot and/or the main burner. Such systems, however, are objectionable since they are costly and, furthermore, present considerable maintenance problems.

In the past, gas appliances such as those mentioned above were operated on manufactured gas, and the latter contained a large fraction of hydrogen. Substantially, if not all, gases containing a large fraction of hydrogen can be catalytically ignited, using a true catalytic ignition system, that is, an ignition system employing a cold catalyst, such as a platinum catalyst, having no external energy supplied to it to make it active. The cold catalyst, when exposed to such a gas, would heat up to a high enough temperature to ignite the gas. Accordingly, a true catalytic pilot igniter for these gas appliances could be constructed.

Presently, most, if not all, gas appliances operate on natural gas rather than manufactured gas, and natural gas contains mostly methane. Numerous attempts have been made by those skilled in the art, to construct a true catalytic igniter for natural gas, however, none of these attempts have been successful. In fact, the reports given on these prior attempts generally conclude that methane cannot be catalytically ignited by a solid catalyst below approximately 200° F. Accordingly, presently no known cold catalyst exists for natural gas, particularly methane. True catalytic ignition systems therefore are not now in use.

These reports, however, do propose several alternatives such as, for example, using two different catalysts. The first catalyst is pre-ignited and provides for the initial temperature. The second catalyst is heated by the first and provides for the temperature boost to the ignition level.

Another alternative is to use electrical energy to provide for the initial temperature rise, and a catalyst for the further temperature increase to ignition level. Accordingly, in this case, the catalyst merely reduces the amount of required electrical energy.

These proposed alternatives may function to provide ignition of the natural gas, however, they are generally impractical and have not been accepted by the industry.

A recent patent, U.S. Pat. 3,299,675, concerned with a gas-fueled lighter, recognizes the fact that most combustible gases, in particular methane, butane, propane, etc., if they oxidize at all in the presence of a platinum-based catalyst, lead to slow combustion and cannot reach a temperature sufficient to generate a flame. This shortcoming, according to this patent, is eliminated and ignition assured by the exothermic decomposition of peroxide on a catalyst and by the favorable presence of monatomic oxygen produced by this decomposition. Such a system may be practical for the particular application disclosed, a gas-fueled lighter, however, it is impractical for general application in gas appliances such as gas ranges and ovens, hot water heaters and the like. For example, the apparatus and mechanism required to contain and to convey the peroxide to the catalyst is overly complex, too difficult to install and maintain, and prohibitively costly. Also, it is generally well known that peroxide is extremely unstable, and storing peroxide, in the concentration suggested, in sufficient quantity to satisfy the requirements for the applications toward which the present invention is concerned would create an extremely hazardous condition.

Accordingly, it is an object of the present invention to provide an improved apparatus and ignition process for igniting natural gas.

More particularly, an object is to provide an improved apparatus and true catalytic ignition process for igniting natural gas, using a cold catalyst.

Still another object is to provide improved apparatus and true catalytic ignition process for igniting natural gas, wherein a small amount of hydrogen is mixed with the natural gas and is ignited catalytically.

A still further object is to provide improved apparatus and true catalytic ignition process of the above type, wherein the hydrogen mixed with the natural gas is formed by electrolysis of water.

A further object is to provide improved apparatus and true catalytic ignition process of the above type wherein only a small amount of hydrogen is mixed with the natural gas for a few seconds to start the ignition reaction.

Another object is to provide improved apparatus and true catalytic ignition process of the above type wherein very little water is consumed during each ignition, so that only a small water supply, approximately 12 ounces, need be provided to operate the igniter to provide more than the average number of ignitions which normally would be made each day for an extended period of time, approximately one year, before the water supply need be replenished.

Still another object is to provide improved apparatus and true catalytic ignition process of the above type which requires only a small amount of electrical power to operate the same to provide an ignition.

Other objects of the invention will in part be obvious and will in part appear hereinafter.

The above objectives are accomplished with an ignition process which includes, generally, mixing a small amount of hydrogen with natural gas, impinging the mixture of hydrogen and natural gas onto a cold solid catalyst, that is, one at ambient temperatures, to cause the latter to heat up to a high enough temperature to ignite the mixture, and stopping the flow of hydrogen which is mixed with the natural gas after ignition has occurred. The natural gas flow continues and maintains a stable pilot.

The apparatus for providing the ignition process includes, generally, a cold solid catalyst affixed in operative relationship with a gas pilot to be ignited and an electrolytic cell which is adapted to be energized to form hydrogen and oxygen which is mixed with the gas being conveyed to the gas pilot. The hydrogen is reacted by the cold solid catalyst to, in turn, ignite the gas mixture. The oxygen enhances the ignition. Suitable switching means are provided and are operated to control the flow of gas to the gas pilot, and to energize and de-energize the electrolytic cell to control the flow of hydrogen, and oxygen, which is mixed with the flow of gas to the pilot.

The invention accordingly comprises the several steps and the relation of one or more of such steps with respect to each of the others and the apparatus embodying features of construction combination of elements and arrangement of parts which are adapted to effect such steps, all as exemplified in the following detailed disclosure, and the scope of the invention will be indicated in the claims.

For a fuller understanding of the nature and objects of the invention, reference should be had to the following detailed description taken in connection with the accompanying drawing in which:

FIG. 1 is a diagrammatic view generally illustrating the construction and electrical circuitry of an exemplary true catalytic pilot ignition system; and

FIG. 2 is a partial view of the ignition system of FIG. 1, illustrating an alternative arrangement of the electrical circuitry thereof.

Referring now to the drawing, the catalytic pilot ignition system can be seen to include an electrolytic cell **10** having a pair of electrodes **12** and **13** which are affixed within a reservoir **14**, preferably in vertically disposed spaced relation. The reservoir **14** includes means (not shown) for replenishing and maintaining the supply of the electrolyte material disposed within it, and has an opening **16** coupled to a pilot gas supply line **18**. The electrolyte material preferably and advantageously comprises water, but can be any suitable aqueous solution of acids, alkalis or salts. The reservoir **14** preferably has a capacity of approximately 12 fluid ounces, so that sufficient electrolyte material to provide for approximately 26 ignitions per day, each day, for one year, is available.

The electrodes **12** and **13** are electrically coupled to respective ones of the output terminals of a secondary winding **20** of a transformer **22**, the primary winding **24** of which is coupled to a source of power **26** which may be a 110 volt source normally found in most homes and offices. A rectifier **28** preferably is included in the coupling between the electrodes **12** and **13** and the secondary winding **20** of the transformer **22**, so that each of the electrodes is established or caused to assume a predetermined polarity. The rectifier **28** can be eliminated, if desired, however, improved results are provided with its use. A normally opened switch **30** is included in the electrical coupling between the primary winding **24** of the transformer **22** and the source of power **26** and is operative to control the energization of the transformer **22**, and hence the electrolytic cell **10**, in a manner described more fully below.

The catalytic pilot ignition system further includes a gas pilot **34** which is coupled to the pilot gas supply line **18**. The gas pilot **34** is in close proximity to and is operative to ignite a main gas burner **36** which is coupled to a main burner gas supply line **38**. The pilot gas and main burner gas supply lines **18** and **38** both are coupled to a main gas line **40** which is coupled to a source of a natural gas (not shown). The main gas line **40** includes a control valve **42** and an orifice **43** which is operative to control the flow of natural gas to the main gas burner **36** and the gas pilot **34** and which is coupled to and operative to open and close the normally opened switch **30**. The control valve **42** has three positions, an off position, an ignition position and a burner position. When in its off position, the flow of natural gas to the main gas burner **36** and the gas pilot **34** is cut off, and the switch **30** is open. When it is operated to the ignition position, natural gas is permitted to flow to the main gas burner and the gas pilot, and the switch **30** is closed to cause ignition of the gas pilot and hence the main gas burner, in the manner described below. After ignition, the control valve **42** is operated to its normal operating position and, in this position, the flow of natural gas continues, but the switch **30** is again opened.

A catalyst **46** is positioned with respect to the gas pilot **34** such that the gas flowing from the gas pilot **34** is impinged upon it. It is generally well-known that some catalysts are adversely affected by heat or some combustion products. If the particular catalyst used is of this nature, it should be properly protected. This may be accomplished in several suitable fashions, for example by affixing the catalyst **46** to a bi-metallic element which upon being heated, is adapted to move the catalyst out of the pilot flame.

The operation of the catalytic pilot ignition system can be generally described as follows. Control valve **42** is manually operated to its ignition position, to permit natural gas to flow to the main gas burner **36** and the gas pilot **34** and to close the normally opened switch **30**. When switch **30** closes, the primary winding **24** of the transformer **22** is energized, from the source of power **26**, and current is induced in and flows through the secondary winding **20**, to electrodes **12** and **13** of the electrolytic cell **10**. Electrolysis occurs, for reasons well-known, and hydrogen and oxygen are produced. The hydrogen and oxygen is picked up by the natural gas flow through the opening **16** in the top of the reservoir **14** and is mixed with and carried by the natural gas flowing through the gas pilot supply line **18** to and through the orifice of the gas pilot supply line **18** and through the orifice of the gas pilot **34**. An important aspect is that the hydrogen and oxygen is picked up and mixed with the natural gas, by sweeping the latter over the top of the reservoir, before the hydrogen and oxygen have an opportunity to react with one another. The hydrogen, with oxygen, upon being impinged on the catalyst **46**, causes the latter to heat up to a temperature sufficient to ignite the hydrogen and hence the natural gas flowing from the gas pilot **34**. An added advantage results from the oxygen which is produced and likewise added to the gas stream, since this oxygen enhances the ignition process. The gas pilot **34**, upon being ignited, in turn, ignites the main burner flame. As indicated above, once the gas pilot is ignited, the control valve **42** is operated to its burner position, which operation opens the switch **30** and hence the energizing circuit for the primary winding **24** of the transformer **22**. The electrolytic cell **10** therefore is de-energized, stopping the generation and flow of hydrogen and oxygen into the natural gas stream in the gas pilot supply line **18**. The pilot flame and the main burner flame, however, remain lit. Stopping the generation of hydrogen and oxygen, once the gas pilot is ignited, conserves the electrolyte in the reservoir **14** so that very little of the electrolyte material is consumed during each ignition. Electrolysis takes place for only a very short time, approximately 3–5 seconds during each ignition, hence only approximately 1 ounce of water is required for 780 3-second ignitions. Accordingly, a 12 ounce supply will be sufficient for 26 ignitions per day, every day for one year.

Also, very little electrical power is required, since only approximately 2.5 volts and a current flow of 13.6 amps is required to operate the electrolytic cell **10**. Accordingly, it can be seen that less than 35 watts of electrical power is required.

To turn off the main burner **36**, and the gas pilot **34**, the control valve **42** is merely operated to its off position. In this position, the switch **30** remains open and power is cut off from the transformer **22**.

An alternative electrical circuit is illustrated in FIG. 2. In this circuit, a temperature sensor **50** is affixed in close proximity to the gas pilot **34** and is adapted to open a normally closed switch **32** when the gas pilot ignites, to stop the flow of electric current to the electrolytic cell. The temperature sensor **50** can be and preferably is coupled to and adapted to operate a conventional flame safety valve, in the event the gas pilot fails to ignite or is blown out or otherwise extinguished. The normally closed switch **32** is connected in a series circuit with the switch **30** and the source of power **26**. The control valve **42**, in this case, also can be merely a two position valve, having an off position and a burner position, since the switch **32** functions to open the energizing circuit for the electrolytic cell **10**. In all other respects, the ignition system operates in the above described fashion.

The catalyst **46** can be any catalyst that is active with hydrogen, such as for example, platinum or palladium. The catalyst **46** can be affixed to a refractory support such as alumina, silica, zirconia, thoria, any mixture of refractory material, and even metals, such as platinum itself, if desired. Furthermore, it is generally well-known that some catalysts will cause reaction to proceed faster and will heat up to a temperature sufficient to ignite the gas mixture (the natural gas, hydrogen and oxygen) quicker than others when hydrogen and oxygen is impinged on them. This reaction rate also is dependent on numerous other factors, such as the surface area of the catalyst, the orifice size and the flow rate of the gas mixture, to mention but a few of them. Accordingly, once the catalyst is selected, the required orifice size, the flow rate of the gas mixture and the proper proportion of natural gas, hydrogen and oxygen to provide ignition can be determined experimentally.

As an example, in one experimental ignition system which was constructed and tested, a catalyst was fabricated by moistening a small piece of mullite (a commercial mixture of refractory metal oxides) with chloroplatinic acid and heating it to reduce the platinum salt to metallic platinum. The catalyst was affixed so that the gas mixture from the gas pilot was impinged upon it. The orifice of the gas pilot had a diameter of .0250 inch. A fuel mixture consisting of 54% hydrogen, 27% oxygen and 19% natural gas, flowing through a pilot orifice at a rate of 0.37 cubic feet per hour, was required to provide ignition and to provide a stable natural gas flame. This mixture corresponded to a flow of 0.07 cubic feet per hour of natural gas and a flow of 0.3 cubic feet per hour of hydrogen and oxygen in the proportions that they are produced by electrolysis of water. If the natural gas content was reduced much below this value, the flame would flash back through the pilot orifice; and if increased much above this value, the fuel mixture could not be ignited with the solid cold catalyst. When the pilot flame ignited, the flow of hydrogen and oxygen was subsequently stopped and the natural gas continued to flow at its established rate of 0.07 cubic feet per hour. This rate is a typical flow rate for a gas range top burner pilot.

It will thus be seen that the objects set forth above, among those made apparent from the preceding description, are efficiently attained and, since certain changes may be made in carrying out the above method and in the construction set forth without departing from the scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawing shall be interpreted as illustrative and not in a limiting sense.

It is also to be understood that the following claims are intended to cover all of the generic and specific features of the invention herein described, and all statements of the scope of the invention, which, as a matter of language, might be said to fall therebetween.

Now that the invention has been described, what is claimed as new and desired to be secured by Letters Patent is:

1. A catalytic ignition for igniting natural gas comprising, in combination: a gas pilot coupled to a source of natural gas; control valve means for controlling the flow of natural gas from said source to said gas pilot; a source of hydrogen comprising an electrolytic cell for providing and mixing hydrogen with the flow of natural gas from said source to said gas pilot; a catalyst active with hydrogen positioned with respect to said gas pilot such that the flow of natural gas and the hydrogen mixed with it is impinged upon and causes said catalyst to heat to a sufficient temperature to ignite the hydrogen and hence the natural gas; and means for controlling the flow of hydrogen from said source of hydrogen comprising a source of power coupled to said electrolytic cell, a normally open switch means electrically included in said coupling between said source of power and said electrolytic cell, said control valve means further being operable to open and close said normally open switch means.

2. A catalytic ignition system, as claimed in claim **1**, further including a normally closed switch means electrically included in said coupling between said source of power and said electrolytic cell, and temperature sensing means, said control valve means being operable to open and close said normally open switch means and said temperature sensing means being operable to open and close said normally closed switch means.

3. A catalytic ignition system, as claimed in claim **1**, wherein said electrolyte for said electrolytic cell comprises water.

4. A catalytic ignition system, as claimed in claim **1**, wherein said means for controlling the flow of hydrogen from said source of hydrogen further includes transformer means having a primary winding electrically included in said coupling between said source of power and said electrolytic cell and a secondary winding having its output terminals coupled to respective ones of the electrodes of said electrolytic cell.

5. A catalytic ignition system, as claimed in claim **1**, wherein said control means and said source of hydrogen are operative to deliver a fuel mixture to said gas pilot comprising 54% hydrogen and 27% oxygen at a rate of 0.3 cubic feet per hour and natural gas within a range of 17–21% at a rate of 0.07 cubic feet per hour.

6. A catalytic ignition for igniting natural gas comprising, in combination: a gas pilot coupled to a source of natural gas; control valve means for controlling the flow of natural gas from said source to said gas pilot; a source of hydrogen comprising electrically operated means for dissociating water or a water containing material for providing and mixing hydrogen with the flow of natural gas from said source to said gas pilot; a catalyst active with hydrogen positioned with respect to said gas pilot such that the flow of natural gas and the hydrogen mixed with it is impinged upon and causes said catalyst to heat to a sufficient temperature to ignite the hydrogen and hence the natural gas; and means for controlling the flow of hydrogen from said source of hydrogen comprising a source of power coupled to said electrically operated means, a normally open switch means electrically included in said coupling between said source of power and said electrically operated means, said control valve means further being operable to open and close said normally open switch means.

7. A catalytic ignition, as claimed in claim **6**, wherein said electrically operated means for dissociating water

or a water containing material comprises an electrolytic cell.

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