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H. FOERSTERLING

METHOD OF HEATING

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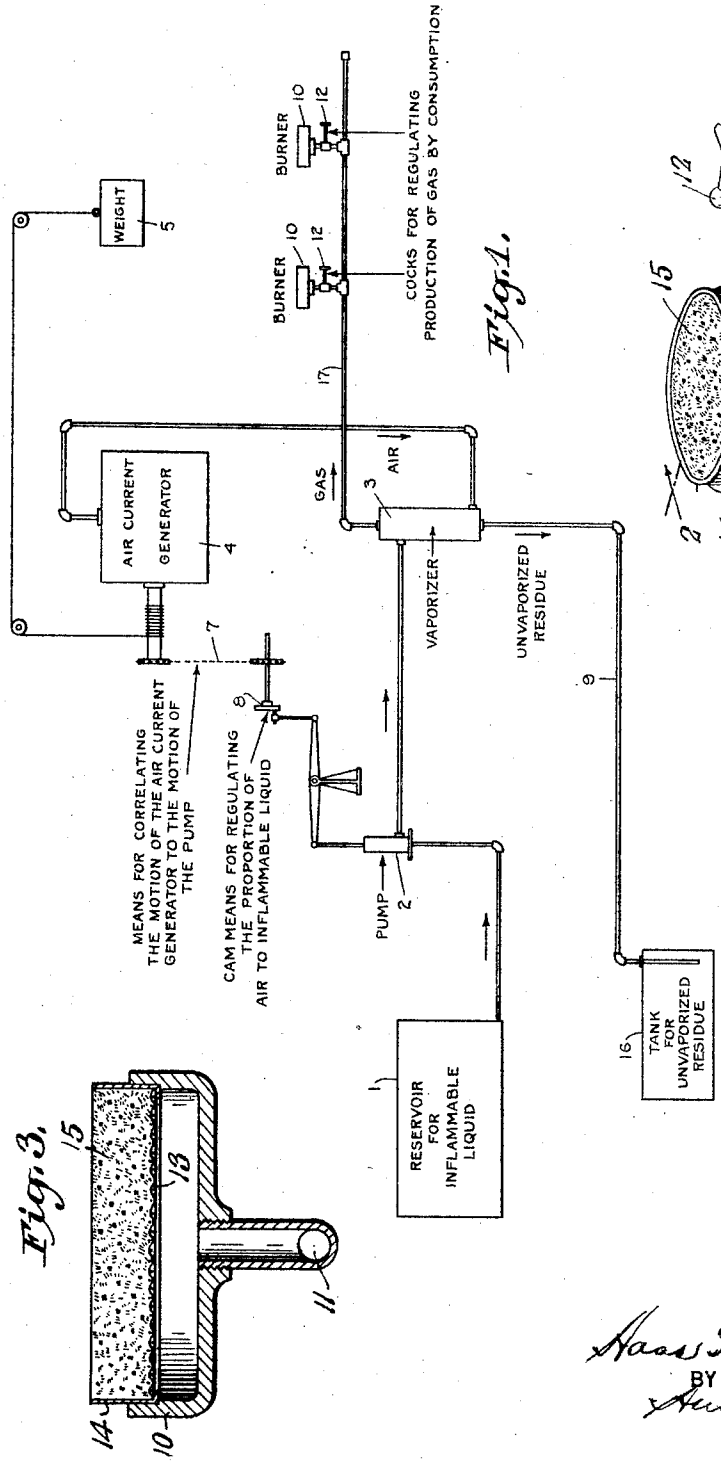


Fig. 1.

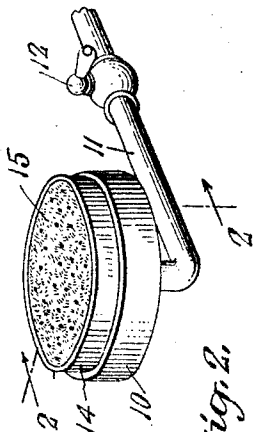


Fig. 2.

Fig. 3.

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METHOD OF HEATING.

Original application filed March 5, 1925, Serial No. 13,069. Divided and this application filed September 23, 1925. Serial No. 57,996.

This invention relates to the method of heating, and particularly by the utilization of air gas from an inflammable liquid.

In my copending application Serial No. 13,068, filed March 5th, 1925, I have described a method of and an apparatus for making air gas from an inflammable liquid such as gasoline. I have also described the construction of a burner suitable for burning such air gas.

Pursuant to the invention of this application, the heating is effected by the utilization of an air gas produced by the method set forth in my application Serial No. 13,069, filed by me on March 5th, 1925, and entitled Method of producing air gas from an inflammable liquid, of which application this application is a division.

I have found that if I use less than approximately 3 cc. of gasoline in vapor form per one cubic foot of air the green inner core of the flame disappears quickly and the latter assumes a pale blue color. If I decrease the flow of gasoline still further, leaving the flow of air the same, the gas so produced will not burn at all, indicating that the lower explosion limit has been passed.

Hence the pale blue flame is a sign that the explosion limit is nearly reached. Such a flame is easily extinguished by the least draft of air, as for instance when caused by an open window and may not be considered for any practical use under ordinary conditions.

Such a gas has however just the right composition for effecting heterogeneous surface combustion of the nature as discovered by Bone in his U. S. Letters Patent Nos. 1,222,922, 1,223,248, 1,223,249 and 1,223,308.

While surface combustion is used to some extent in the industries for heating larger objects like boilers. furnaces and the like, it has not yet found a foothold in household uses. This undoubtedly is due to the fact that all the fuel gas which is used for domestic purposes requires an additional supply of air and such close regulation of air and gas as is necessary to obtain satisfactory results, cannot be expected from the average user of the cooking stove.

With my method of making an air gas from an inflammable volatile liquid it is however easy to produce a gas which has the ideal composition for carrying out heterogeneous surface combustion, by simply regulating the proportion of air to the inflammable volatile liquid accordingly. By my invention all adjustment of valves for producing the correct mixture of air and gas is done away with, and the operation of this efficient method of heating is reduced to the simple process of opening a gas valve, lighting the flame and shutting the valve when the heat is no longer required.

Further features and objects of my invention will be more fully understood from the following detail description and the accompanying drawings, in which—

Fig. 1 is a diagram showing one form of carrying out my invention;

Fig. 2 is a perspective view of one form of my heating burner; and

Fig. 3 is a section on line 3—3, of Fig. 2.

As is indicated in the diagram of Fig. 1 of the drawings, the method of my present application is advantageously carried out by means of the apparatus set forth in my aforesaid copending application, Serial No. 13,068 and my aforesaid copending application Serial No. 13,069. Stated in general terms, one form of such apparatus comprises a tank 1 serving as a reservoir for the inflammable liquid such as motor gasoline, to be vaporized. The pump 2 conveys the inflammable liquid from the reservoir 1 to the upper portion of the vaporizer 3. The air current generator 4 such as an air blower of the Tirrill fan type, or similar low pressure air blower, is operated by any suitable actuating means, such as the weight 5 suspended from one end of a cord, passing over suspending pulleys, the opposite end of which cord is wound over a winch secured to the shaft of the fan of the Tirrill blower or equivalent. The air current generator 4 is correlated to the motion of the pump 2, as by interconnecting the winch of the air current generator 4 by means of a chain drive 7, with the movable element of the pump. Preferably, such interconnection includes suitable means such as a regulatable cam 8 for regulating the proportion of the air to the quantity of inflammable liquid supplied by the pump 2 to the vaporizer 3.

The pump 2 feeds the inflammable liquid to the vaporizer 3 in the form of a thin moving stream which passes from the upper portion of the vaporizer 3 in counterdirec-

tion to the air current entering near the bottom of the vaporizer 3, whereby the volatile constituents of the inflammable liquid are vaporized to produce the desired air gas which is conducted from the top of the vaporizer 3 by the pipe line 17 to the one or more consumption units such as the burners 10, of the heterogeneous combustion type as is set forth more fully hereinafter.

When any burner 10 is lighted, upon opening its cock 12, the flow of the gas through the pipeline 17 reduces the pressure of the theretofore formed air gas in the pipeline 17 between the lighted burner or burners 10 and the outlet of the vaporizer 3, thereby also reducing the pressure of the air and of the air gas within the vaporizer 3 and thereby in turn reducing the pressure of the air in the air line from the air current generator 4 to the vaporizer and also reducing the pressure within the air current generator 4 whereupon the reduced pressure permits the fan of the Tirrill blower, or equivalent, to revolve under actuation of the weight 5, or equivalent, thereby driving the chain 7, cam 8 and finally the pump 2, the combined operations of which provide the proper proportions of air and of inflammable liquid to the vaporizer 3, whereupon additional air gas is formed and of a quantity corresponding to the quantity withdrawn from the pipeline 17 from the one or more burners 10 in use. Such additional air gas is of uniform composition to that previously formed.

Assuming that but one burner 10 was lighted, under the conditions set forth hereinabove, and that now another burner 10 is lighted, and generally, under the condition of increased consumption, the above operations take place and in this instance the newly formed air gas is of a correspondingly increased volume and of the same, i. e., uniform, composition. Assuming, now, that one of the number of burners 10 is shut off, the newly formed air gas in this instance is of reduced quantity, its composition, however, being maintained uniform. Upon shutting off all of the consumption units, the withdrawal in this instance of the formed air gas in the pipeline 17 is nil, and accordingly the pressure of the air gas in the pipeline 17 and the pressure of the air within the vaporizer 3 and the remaining parts of the apparatus effects the cessation of the rotation of the fan in the Tirrill blower, or equivalent, and brings the production of the air gas in the vaporizer 3 to the stage of non-operation.

Accordingly, it is apparent that the regulation of the consumption of the air gas by means of the one or more cocks 12, or equivalent, also attains the regulation of the production of the air gas in respect to the quantity and also in respect to the stages of operation and non-operation according to the quantity and the stage of operation and non-operation of consumption.

Pursuant to my invention the air gas is consumed under heterogeneous combustion conditions, that is to say, without any additional i. e., secondary, supply of air to each burner 10 or equivalent.

In Fig. 1 of this application I show a very simple construction of a burner which can be used for a cooking stove in connection with heterogeneous surface combustion. 10 represents a cast iron shell to which is attached the gas piping 11 with a gas cock 12, 13 is a piece of strong mesh of fine wire, 14 is a sheet iron mantle extending somewhat above the casting 10 for conducting the heat away from the cast iron and 15 is a layer of loose, small pieces of ordinary fire brick as for instance passing through an 8 mesh sieve and being retained by a 13 mesh sieve, somewhat exaggerated in the drawings.

With a burner of 2.5″ diameter=4.9 sq. in. and a layer of granular material 1¼″ high, with a gas pressure of approximately 1″ of water, I have passed the mixed gas through at the rate of 17.5 cu. ft. p. h. or 3.6 cu. ft. of mixed gas p. h. and per sq. inch. This agrees pretty well with the disclosures of the aforesaid Bone patents.

In order to find out what the efficiency of such a burner is in comparison with the burner described in my aforesaid co-pending application the following tests were carried out.

In each case 1000 cc. of water was heated from 15° to 90° C. An aluminum pot measuring 7″ in diameter by 5″ high and provided with a cover was used. The temperature was taken at regular intervals. Instead of using a pump for passing the gasoline through the vaporizer and catching the unvaporized gasoline in a tank, the gasoline was fed from a graduated cylinder provided with a glass regulating cock and the recovered gasoline was caught in a regular measuring cylinder. The feeding was regulated by hand so that an approximately uniformly slow flow was obtained. The results were as follows:

1. Homogeneous flame combustion:

To heat 1000 cc. of water from 15 to 90° C. there were required 45 cc. of gasoline and recovered 28 cc. of gasoline; hence the used and vaporized gasoline=17 cc. of gasoline or 37.7% of vaporization. Assuming that 1 gal. of gasoline=124,000 B. t. u. the 17 cc. correspond to 554 B. t. u.

To heat 1000 cc. of water 75° C. there is required theoretically 297 B. t. u. Hence an efficiency of 53% was obtained. Other data taken: The time of heating was 18 minutes; the amount of air used was 5.25 cu. ft. The distance from the burner plate to the bottom of the pot was ¾″, the gas pressure was about 1″ of water; the gas-

cock used was of a 1/4" brass with a 1/8" bore, and wide open.

2. Heterogeneous surface combustion:

To heat 1000 cc. of water 75° C. there were required 35 cc. of gasoline

and recovered $\frac{18}{17}$ cc. of gasoline

hence the used and vaporized gasoline 17 cc. of gasoline=48.6% vaporization. As the same amount of gasoline was used as with homogeneous combustion the efficiency remains the same or equals 53%. The time of heating was 21 minutes, the amount of air used 6.72 cu. ft.; the distance from the burner to the bottom of the pot was 1/2". All other of the aforesaid data remained the same.

Heterogeneous surface combustion in combination with an air gas, made from motor gasoline has shown the practicability of extracting from a given quantity of gasoline a greater percentage of vaporized proportion for gas making purposes than is possible with homogeneous combustion. The approximate figures are 45% vaporization against 35% with a corresponding actual consumption of approximately 2.5 cc. of gasoline as against 3–3.5 cc. per 1 cu. ft. of air.

As additional advantages of a combination of air gas in connection with surface combustion I like to mention the following.

It allows to bring the surface of the burner and the object to be heated practically close together. The distance between the burner and the bottom of the object to be heated in a regular gas stove is about 1 1/2". Such a distance is of course a source of great heat losses and particularly whenever a draft is created in proximity of the flame. It is obvious that the overall efficiency under actual working conditions as they exist in a kitchen throughout the year is in favor of a burner which can be set as closely as possible to the object to be heated. The electrically heated pot proves this where the means of heating and the object to be heated form one unit.

With homogeneous flame combustion it happens sometimes that the flame flashes back, when a sudden draft is created, as when a window or door is opened. Sometimes a gust of wind will even blow out the flame and if nobody is present unburnt gas may escape.

With surface combustion this is impossible; even the strongest wind can not extinguish the burner.

It is obvious that the amount of 2.5 ccm. of gasoline vaporized per one cubic foot of air is only approximate and may vary slightly with different types of gasoline; it may also depend somewhat on the construction of the burner used, as some burners will allow a regulation closer to the theoretically required quantities of fuel and air for complete combustion than others, but the exact regulation will not be difficult for those skilled in the art. The exact quantities of gasoline and air are those which produce a flame, which under homogeneous combustion conditions will show a blue color and which is easily extinguished with an open flame burner by a slight draft of air. An air gas which shows at the test burner these characteristics will give a flameless incandescent surface when a heterogeneous surface combustion burner is used.

It is obvious that when I say I can vaporize approximately 45% of gasoline and produce a gas suitable for heterogeneous surface combustion in comparison to approximately 35% with homogeneous flame combustion, such figures are only relative. They depend firstly, on the air temperature which governs the vapor tension and secondly, on the product itself. The figures stated refer to a motor gasoline of a composition which is sold on our market today. But it must be borne in mind that today's composition is not the same as it was 10 years ago and as it might be 10 years from now. Further, that the composition varies with different countries. Initial boiling points, final boiling point, percentages of fractional distillation to a certain temperature and the proportion which can be vaporized with a given amount of air are not fixed factors. Hence, in order to obtain the best results with a given quality of gasoline it becomes necessary to determine the proportion of air to gasoline, which however is a very simple thing with the apparatus I have described in my aforesaid copending application.

It will also be obvious that in place of motor gasoline, lower boiling grades may be used, in fact many other inflammable liquids the vapor tension of which is sufficient for producing with air a gas which will burn can be used.

Whereas, I have described my invention by reference to specific forms thereof, it will be understood that many changes and modifications may be made without departing from the spirit of the invention.

I claim:—

1. The method of producing heat by vaporizing a volatile inflammable liquid with the proper proportion of air to obtain a gas of substantially uniform composition and which contains a slight excess of oxygen over that required theoretically for the complete combustion of the combustible constituents of the liquid to carbonic acid and water, regulating the production of the gas by the consumption of the gas, and burning the gas under conditions suitable for heterogeneous combustion.

2. The method of producing heat by va-

porizing a volatile hydrocarbon with the proper proportion of air to obtain a gas of substantially uniform composition and which contains a slight excess of oxygen over that required for the complete combustion of the combustible constituents to carbonic acid and water, regulating the production of the gas by the consumption of the gas, and burning the gas under conditions suitable for heterogeneous combustion.

3. The method of producing heat by vaporizing a standard grade of motor gasoline with the proper proportion of air to obtain a gas of substantially uniform composition and which contains a slight excess of oxygen over that required theoretically for the complete combustion of the combustible ingredients to carbonic acid and water, thereby extracting a greater amount of volatile constituents from a given amount of motor gasoline than when no excess of oxygen is used over that theoretically required for the complete combustion of the combustible constituents to carbonic acid and water, regulating the production of the gas by the consumption of the gas, and burning the gas under conditions suitable for heterogeneous combustion.

In testimony whereof I have signed this specification this 18th day of September, 1925.

HANS FOERSTERLING.