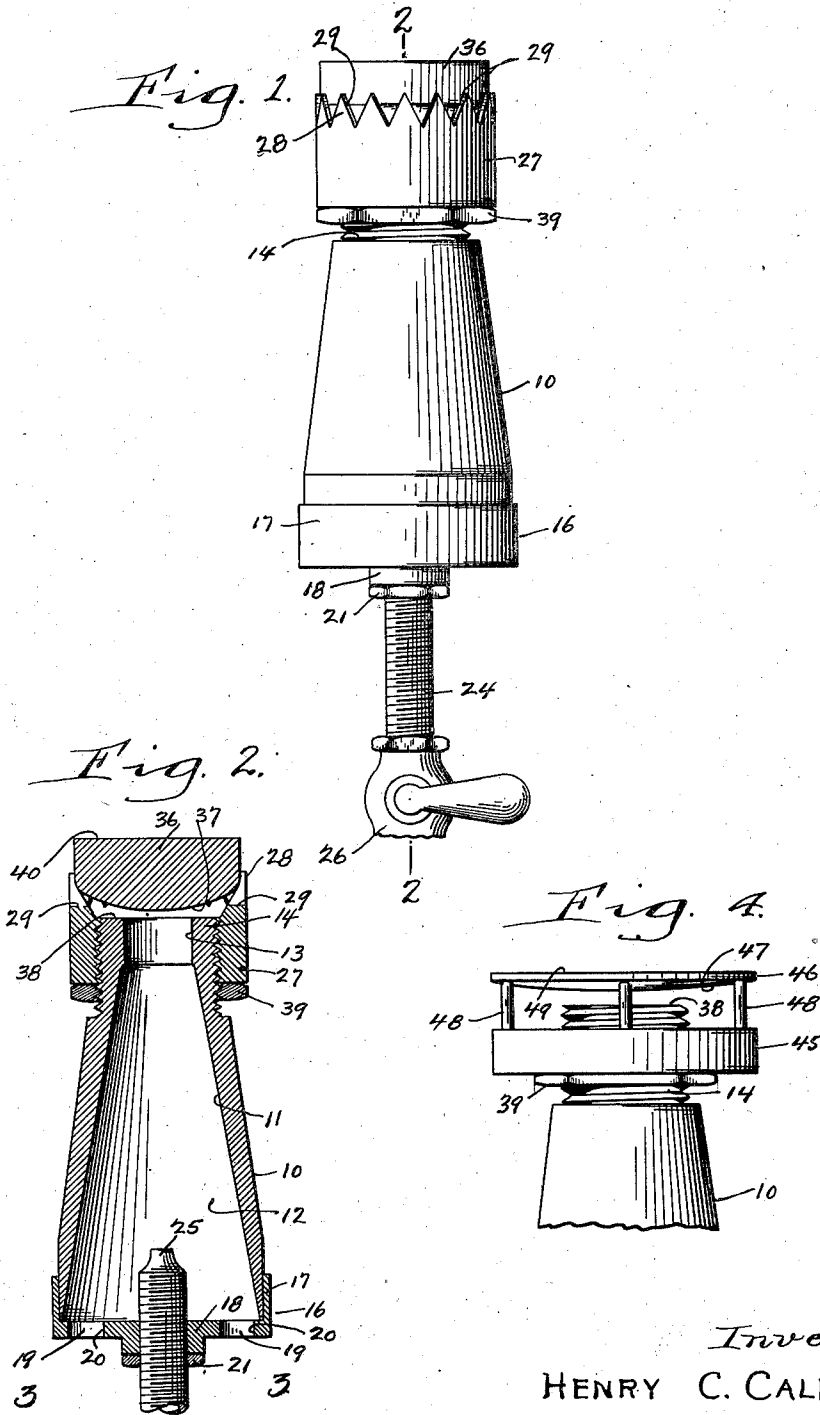


May 3, 1938.

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METHOD OF BURNING GAS
Filed Nov. 6, 1935

2,116,096

2 Sheets-Sheet 1



Inventor,
HENRY C. CALDWELL

by

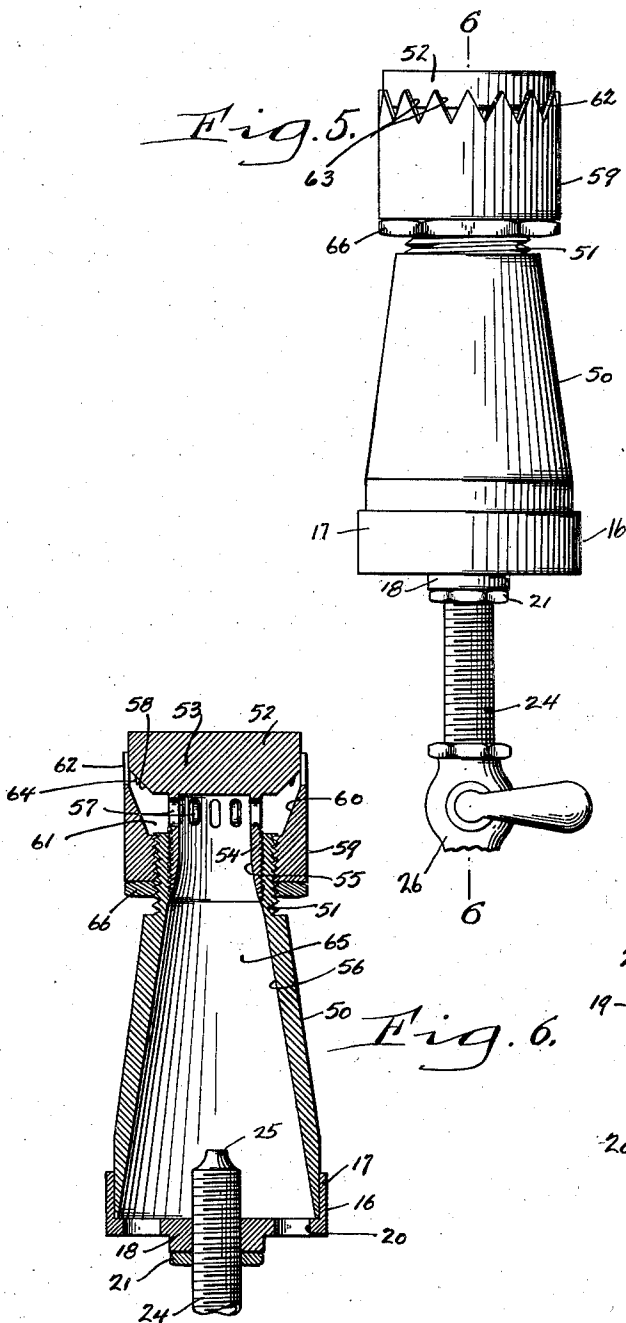
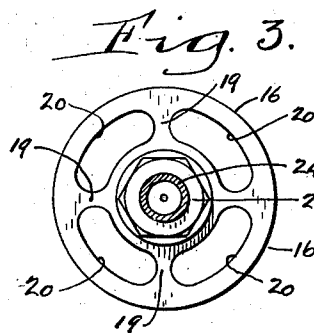
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2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

2,116,096

METHOD OF BURNING GAS

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York

Application November 6, 1935, Serial No. 48,538

3 Claims. (Cl. 158—117.5)

My method relates in general to burning gas and more particularly to methods of burning which are applicable to surface heaters such, for instance, as gas ranges or other devices.

It is well known to those skilled in the art that in burning gas under the Bunsen process, the gas is let into a mixing tube which is usually of Venturi form so as to increase the velocity of the gas and air passing therethrough. Air is admitted immediately back of the outlet of the gas spud in adjustable quantities. The mixture then passes through a mixing tube and is burned in a spreader and above a number of small, restricted outlets. It is well known that if sufficient air is supplied at the mixer of such a Bunsen burner, the burner will tend to backfire, igniting the gas at the spud or nipple. To prevent this, insufficient air is supplied through the mixing tube and secondary air is then added at the small ports above which the elements of combustion are burned. In such Bunsen practice, the gas flowing into the mixing tube causes air to be induced through a restricted air opening into the mixing tube. Such induction of air causes a slight reduction in the velocity of the gas; the travel of the elements of combustion through the rather long mixing tube further reduces the velocity; and the passage through and expansion in the mixing tube and spreader, and burning above the small ports at the outlet or burning point of the burner also decreases the velocity.

Under my process, it is essential that the gas travel far enough through the free air or through a protective chamber sufficiently large to supply more than enough air to create a proper mixture of combustible elements and that the speed of travel of these elements to the point of combustion shall be maintained as great as possible.

One of the principal objects of my method has been to pass the gas as it comes from the main through free air far enough to attain a proper mixture, at which point it is burned without restriction and with minimum loss of the velocity given to the combustion elements by the gas as it flows from the main.

Another object has been to provide sufficient air around the stream of gas so that the gas may be supplied with ample air without causing a reduction of the velocity of the gas coming from the supply spud.

Another object has been to provide a method in which there shall be an unrestricted flow of combustible elements at maximum speed.

A further object of my invention is to provide a method in which combustion of the fuel elements shall occur at the point where the gas and air have been mixed sufficiently to produce a combustible mixture.

Moreover, in my method fluctuations of pressure in the gas main do not materially affect the

combustion and do not result in the creation of soot and smoke.

Furthermore, due to the fact that in my process the gas passes through the free air a sufficient distance, substantially all of the air needed to support combustion is provided without the necessity of providing for secondary air at the point of burning.

It is another characteristic of my process that combustion may occur substantially within the mouth of the burner and below the spreader thereof, but such ignition and combustion usually occur immediately outside of the burner.

It is further characteristic of my invention that the air, which is supplied to the stream of gas in ample quantities to produce combustion at the desired place, is controlled at the mouth of the burner.

Furthermore, my method is such that the elements of combustion are ignited at the place where they reach their complete, explosive mixture, and it is also at this place that the heat generated is used for heating articles which, under my process, may be placed directly on top of and in contact with the burner. Heat is, therefore, transmitted directly to the article by conduction as well as by radiation and reflection. In other words, my process is particularly effective for direct surface heating.

My process is much superior to those of the prior art in that it is more efficient in providing a way of securing and maintaining a greater degree of heat from a given amount of combustible elements than has heretofore been possible. Also my process is capable of being carried out in a simpler and less costly way than has heretofore been possible in combustion burners.

In the accompanying drawings, forming part of this application, I have shown a number of forms of apparatus whereby the above objects may be carried out, it being obvious that other forms may be used in accomplishing the results above set forth. In the drawings:

Fig. 1 is an exterior view of one form of my invention.

Fig. 2 is a sectional view thereof taken on line 2—2 of Fig. 1.

Fig. 3 is a bottom, sectional view taken on line 3—3 of Fig. 2.

Fig. 4 is a fragmentary, exterior view of a modified form of invention showing a different type of spreader.

Fig. 5 is an exterior view of a modified form of burner.

Fig. 6 is a sectional view taken on line 6—6 of Fig. 5.

In carrying out my invention, it is necessary in order that the Fire Underwriters and American Gas Association requirements be met, that a protective body or chamber of some sort be placed

about the gas stream for surrounding the space through which the gas is projected, thereby protecting the stream against outside disturbances. In the form of invention shown in Figs. 1 to 3, therefore, to which reference is to be made, such a single-chambered, protective body is shown at 10. This body is tubular in form and is provided with a central opening 11 which is preferably conical in shape and flaring downwardly. The body, therefore, provides an air space 12 which is relatively large and is so proportioned that it contains more than enough air than is required by the gas stream to properly support combustion. The mouth 13 of the burner is formed at the upper end of the opening 11 in the body. The body is formed at its upper end with a neck 14 which is exteriorly screwthreaded.

The burner body is carried by a body support 16 having an upstanding ring 17 which encircles the bottom edge of the body 10 and serves to centrally support the same. The body support is also provided with a central hub portion 18 which is connected to the ring portion 17 by means of a plurality of arms 19, thus leaving air spaces 20 between the ring portion and the hub portion for the entrance of air. The hub portion is provided with an interior screwthread which engages with an exteriorly screwthreaded gas outlet pipe 24. This outlet pipe is of considerable length so that the spud 25, either formed thereon or attached thereto, may be moved up or down within the air space 12 of the tube by rotation of the body support upon the pipe, for purposes to be hereinafter described. A lock nut 21 is preferably provided on the outlet pipe for locking the position of the body support after it has been adjusted. The outlet pipe 24 is provided with any suitable type of shut-off cock 26 by which the gas may be either turned on or off, or may be regulated if desired.

The neck 14 of the body is of considerable length and upon its screwthreaded exterior is mounted an adjusting ring 27. This ring is provided with an upstanding wall 28 which is formed with a plurality of notches 29 in its edge surface. These notches extend, as clearly shown in Fig. 2, a considerable distance along the peripheral surface of the ring. The wall 28 is relatively thin and it is bored out so as to provide an annular recess 35 for the reception and support of the lower end of a spreader 36. This spreader is provided with a lower, substantially convex surface 37 which is centrally arranged above the mouth 13 of the burner, and also with a flat upper surface 40. Between the lower surface 37 of the spreader and the upper surface 38 of the neck is provided an annular space which may be varied as to size by the rotation of the ring 27 provided for controlling the amount of air passing through the mouth of the burner. A lock nut 39 is placed upon the neck 14 and is engageable with the adjusting ring to lock it when it has been adjusted to the desired position. I have found it advantageous to make the spreader 36 of copper; since, as above pointed out, in the carrying out of my process the article to be heated, which may be a cooking utensil, may be placed in direct contact with the spreader and be supported thereby if desired, whereby heat which is generated is conducted to the article by conduction as well as by radiation and reflection.

Referring now to the form of invention shown in Fig. 4, an adjusting ring 45 is provided and it is screwthreaded to the neck 14 of the body 10 of the burner. Arranged above the adjusting ring is

the spreader 46 which is a relatively thin plate as compared to the other form of invention and which is preferably provided with a convex lower surface 47 and a substantially flat top surface 49. The spreader may be held in interspaced relation with the adjusting ring 45 by means of a plurality of separating pins 48. In this form of apparatus, the annular space surrounding the mouth of the burner body is formed between the upper surface 38 of the neck and the lower convex surface 47 of the spreader and the size of such space may be varied by rotating the ring 45.

Referring now to the form of invention shown in Figs. 5 and 6, the body part 50 is similar to the body part of the form shown in Figs. 1 to 3, inclusive, except that the neck 51 is provided with internal screwthreads. Arranged above the body is the spreader 52 which is provided with a head 53 and with a downwardly extending sleeve 54. The sleeve 54 is provided with exterior screwthreads which engage with the interior screwthreads of the neck 51. The sleeve is provided with a centrally arranged passageway 55 which communicates with the central opening or passageway 56 of the body part forming an air space 65. The upper end of the spreader sleeve is formed with a number of laterally arranged ports 57, the combined area of which is greater than the cross-sectional area of the passageway 55. The spreader sleeve is considerably smaller in diameter than the diameter of the head 53 and the outer periphery of the head is provided at its lower edge with a chamfered surface 58. The arrangement of parts is, of course, such that the ports 57 are located above the upper surface of the neck 51 when the sleeve is permanently screwed down therein. The outside periphery of the neck, like in the other form of invention, is provided with exterior screwthreads, and mounted thereon is an adjusting ring 59. This ring is provided in its upper portion with a counter bore 60, providing a combustion space 61 which is in communication with the ports 57. Rising from the portion of the ring where the space 61 is provided, is a thin wall 62 in which is formed a plurality of notches 63. These notches are so cut as to extend some distance across the peripheral face of the ring, and they, together with the spreader body 52, provide a plurality of orifices 64 for the burner. A lock nut 66 is carried by the neck 51 and serves to lock the ring 59 in its adjusted position. The body support for this form of burner is identical with the support 16 used in the other form of the burner and it is carried by the hub 18 of the support. A similar gas outlet pipe 24 is used.

While the burner is designed, of course, so that it may be operated at a rate of gas flow which is lower than the rate for which the burner was designed, the highest efficiency possible in my process is brought about by operating the burner at the maximum rate. Under these conditions the gas in the main will be supplied to the gas outlet pipe and to the orifice thereof at the maximum gas main pressure with the result that the gas stream coming from the gas orifice will pass through the body at maximum velocity. As the gas stream emerges from the orifice of the gas outlet pipe and passes into the air space 12 of the body 10 of the form of Figs. 1 to 4, inclusive, it is mixed with free air in this space. Under my process the burner is first adjusted for the kind of gas to be burned by screwing the body support 16 up or down upon the gas outlet pipe to a point where the upper end of the mouth 13 of the body will be at such distance from the outlet of the

gas orifice in the pipe as to bring about, within narrow limits the most efficient combustible mixture. The body is then locked by means of the lock nut 21 and the burner does not thereafter have to be adjusted for the particular gas with which it is used. Since the amount of air passing through the burner and, therefore, the final character of the combustible mixture is controlled at the mouth of the burner, the final adjustment of the burner is made by means of the adjusting ring 27 which governs the size of the annular outlet space of the burner. It will thus be seen that the gas under the maximum gas main pressure is projected into and through free air and thus takes up sufficient air to bring about an efficient combustible mixture at the outlet space of the burner which is formed between the upper surface 38 of the neck and the curved surface 37 of the spreader. Ignition and combustion, under my process, may occur at substantially this same place and the speed of travel of the gas and the mixture is thereby not appreciably diminished in any way before combustion occurs. When combustion occurs within the mouth of the burner, the heated products of combustion pass outwardly through the openings formed by the notches 29 in the wall 28 of the adjusting ring and between the lower edge of the spreader body. As hereinbefore pointed out, the article being heated consisting, for instance, of a cooking utensil or the like, may be placed directly upon the top of and in contact with the spreader so that the heat generated is transmitted not only by conduction but also by radiation and reflection. Since ignition and combustion may occur within the burner mouth, the burner cannot backfire and any turning down of the gas at the gas cock 26 will serve to lessen the spread of the flame and will even draw the point of combustion down into the air space 12 of the burner.

From the foregoing it will be obvious, that an efficient combustible mixture is brought about by my process when the gas, under substantially full gas main pressure, has been projected through the free air space a sufficient distance to take up substantially all the air needed to support combustion when ignition and combustion takes place, which may be within the mouth of the burner. Substantially no secondary air, therefore, is needed since practically all the air is initially supplied to the stream of gas as it passes up through the free air space 12 of the burner body. While ignition and combustion may take place within the mouth of the burner and below the spreader 36, such ignition and combustion usually occur immediately outside of the spreader.

In carrying out my process by means of the burner shown in Figs. 1 to 3, inclusive, the body support 16 having been set for the kind of gas being used and the existing pressure thereof, the final character of the combustible mixture, as hereinbefore set forth, is controlled by the adjusting ring 27 which governs the size of the annular outlet space of the burner. As hereinbefore pointed out, all the air necessary to support combustion within the burner under my process is supplied to the stream of gas within and as it passes through the free air space 12. The regulation of the adjusting ring just above referred to controls the amount of air which is allowed to pass through the burner, the amount of gas remaining constant under normal conditions. By increasing the size of the outlet space, the amount of air in the mixture as it reaches the combustible

point within the burner is increased, whereas if this space is decreased by screwing down the adjusting ring, the amount of air at the place of combustion is decreased. In my process, therefore, the supply of air is controlled entirely at the outlet of the burner.

My method is carried out by the form of invention shown in Fig. 4 in exactly the same manner as that above described in connection with Figs. 1 to 3.

In carrying out the invention by the form of apparatus shown in Figs. 5 and 6, the combined exposed effective area of the outlet orifices 64 will be regulated by an up and down movement of the adjusting ring, such movement changing the position of the slots 63 of the wall 62 in relation to the lower peripheral edge of the body 53 of the spreader 52, thereby altering the size of the orifices. Lowering the adjusting ring will, of course, increase the size of the spaces between the notches and the lower edge of the spreader and raising the ring will decrease the size thereof. Such increase and decrease of size of the outlets does not, as in the other form of invention, in any way affect the quantity of gas passing up into the free air space 65 but does control the quantity of air which is taken from the space in producing the desired mixture for combustion.

While in the appended claims I use the term "free air", it is obvious, for reasons hereinbefore stated, that some sort of a protective chamber be provided. This chamber is, however, of such size as to allow a quantity of air to pass therethrough which will be more than enough, when mixed with the gas, to provide an efficient combustible mixture. Such chamber must not offer any obstruction or interference to the flow of the gas and air.

While I have shown burners having three forms of spreaders, it is obvious that many other forms of device may be used in carrying out my method.

Having thus described my invention, what I claim is:

1. A process of burning gas, comprising the introduction of gas into free air, thereby producing a gas and air mixture, regulating the volume of the mixture at substantially the place of burning, thereby controlling the amount of air contained in the mixture, and then burning the mixture.

2. A process of burning gas, comprising the introduction of gas into free air, thereby producing a gas and air mixture, protecting the gas stream as it passes through the air from the outlet to the place of burning, maintaining a substantially unobstructed flow of the gas and air during their intermixture, regulating the volume of the gas and air mixture at substantially the place of burning, thereby controlling the amount of air contained in the mixture, and then burning the mixture.

3. A process of burning gas, comprising the introduction of gas into free air, thereby producing a gas and air mixture, protecting the gas stream as it passes through the air from the outlet to the place of burning, maintaining such gas at substantially constant pressure, maintaining a substantially unobstructed flow of the gas and air during their intermixture, regulating the volume of the gas and air mixture at substantially the place of burning, thereby controlling the amount of air contained in the mixture, and then burning the mixture.

HENRY C. CALDWELL.