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F. S. BLOOM

2,117,270

APPARATUS FOR PRODUCING PROGRESSIVELY DELAYED COMBUSTION

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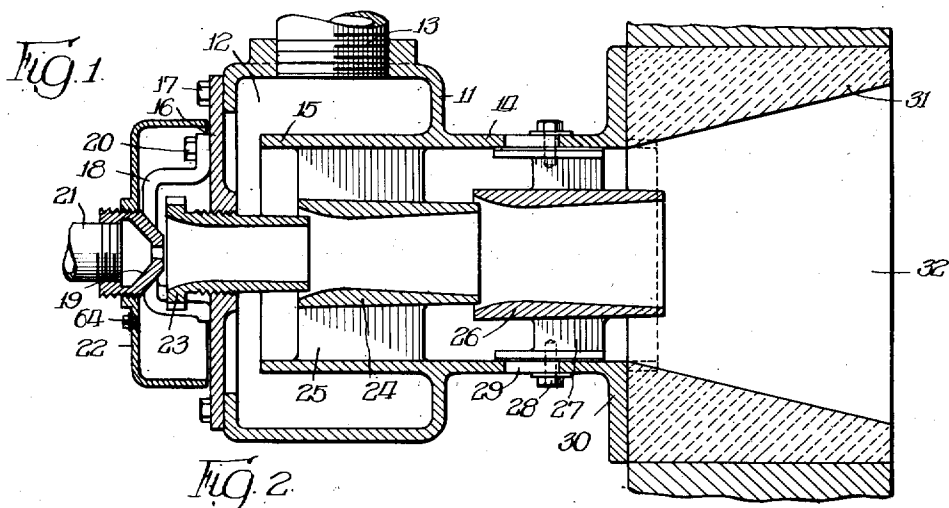


Fig. 2

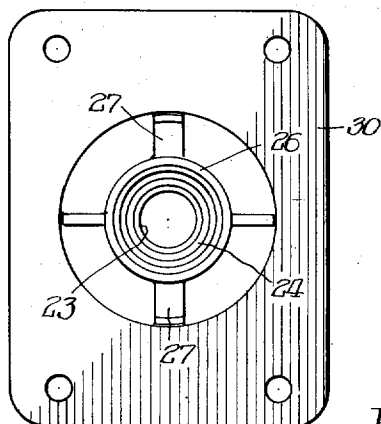


Fig. 4

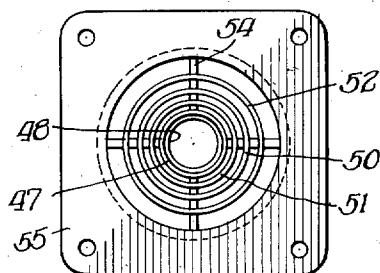
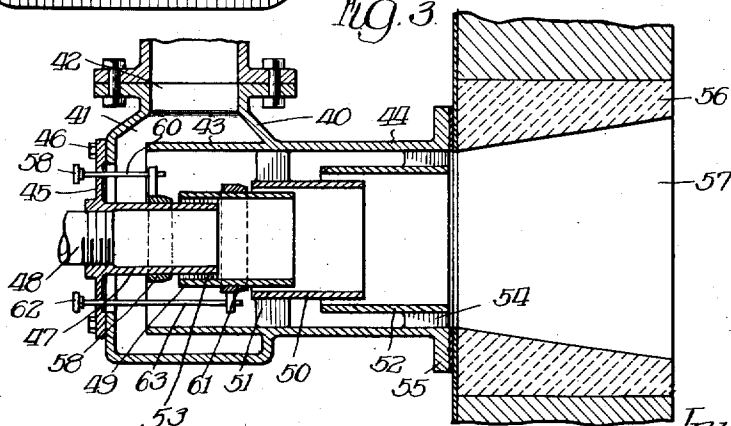


Fig. 3



Inventor:
 Fred S. Bloom,
 By *Wilkinson Huxley Byron & Knight*
 attys

UNITED STATES PATENT OFFICE

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APPARATUS FOR PRODUCING PROGRESSIVELY DELAYED COMBUSTION

Fred S. Bloom, Pittsburgh, Pa.

Application June 23, 1935, Serial No. 23,004

2 Claims. (Cl. 158-110)

This invention relates to a new and improved method and apparatus for producing progressively delayed combustion, commonly termed "long flame combustion", in furnaces, in which a material such as steel is required to be heated. These furnaces may be continuous in type, or they may have hearths in which the material to be heated lies stationary during the heating period. Under either circumstance of heating, it is desirable that heat due to combustion of fuel should not be concentrated in one place, but should be distributed over as much of the length of the furnace as possible.

It is well understood in the art that combustion is best delayed by avoidance of turbulence in the air and gas streams, and by projecting fuel and air for its combustion into the furnace in parallel currents with definite lines of junction, the process being slower as the parallel motion of fuel and air bodies is more nearly perfect.

It has been found when using natural gas, for example, that the absence of luminosity is a great detriment to satisfactory heating, as much more fuel is required, owing to the lack of radiant heat from the flame. It has been found that this condition is obviated if the coke oven or natural gas which may be used, is partly cracked before its admission to the furnace. In this way, carbon particles are released and give luminosity, and as a result, the flame radiates heat to a much greater extent than would otherwise be the case. I have found that the combination of the long flame together with cracking of the fuel very greatly improves furnace operation. However, it is of great importance that the cracking operation be under control of the operator and easily changed to suit furnace requirements.

It is an object of the present invention to provide a new and improved long flame burner and method of operation.

It is also an object of this invention to provide means and methods whereby the direction of flow of the fuel and air for its combustion are rendered substantially parallel.

It is another object of the invention to provide means and methods for bringing a limited and controlled quantity of air into contact with a current of gas, so that with a minimum degree of turbulence a cracking effect is produced.

An additional object of the invention is to provide means and methods to control the amount of air which comes into contact with the gas body in such a way that the amount of combustion necessary to raise the temperature of the gas sufficiently for cracking purposes is effected

without excess mixture of air or premature combustion.

Other and further objects will appear as the description proceeds.

I have shown certain preferred embodiments of my invention in the accompanying drawing, in which—

Figure 1 is a vertical, longitudinal section through one form of burner;

Figure 2 is a view of Figure 1 as seen from the right;

Figure 3 is a view similar to Figure 1 but showing a modified form of burner; and

Figure 4 is a view of the burner of Figure 3 as seen from the right.

Referring first to the form of construction shown in Figures 1 and 2, this form of burner is especially designed for use in smaller sizes, such as burners having capacities of 500 to 1000 cubic feet of natural gas per hour. The burner structure includes a housing 11 which encloses an air chamber 12 to which is connected the air intake pipe 13. The tubular discharge portion 14 of the housing has an extension 15 which projects into the air chamber 12 beyond the entrance from the air intake pipe 13. The rear end of the housing 11 is closed by a plate 16 which is secured to the housing by the bolts 17. By means of spider 18 the gas inlet nozzle 19 is supported from the plate 16, the plate being held in place by bolts 20. The gas inlet pipe 21 is secured to the nozzle 19. The hood 22 is threaded upon the outer face of the gas nozzle 19 and is thereby adjustable toward or from the closure member 16.

The initial air nozzle 23 is threaded into the closure plate 16 so that it may be adjusted toward and from the gas nozzle 19. The intermediate nozzle or air control tube 24 is supported from the inner face of the extended portion 15 of the tubular member 14 by means of the spider 25. The final air control tube 26 is supported from the tubular member 14 by means of the spider 27 and is held in adjusted position by means of the bolts 28 fitting through slotted openings 29 in the member 14. The burner assembly is provided with the flange 30 by means of which it may be secured to a port block 31 in which is formed the port passage 32.

The form of construction shown in Figures 3 and 4 is designed especially for use in connection with burners of larger gas capacity than the construction shown in Figures 1 and 2, although this burner may also be made in smaller sizes. The housing 40 encloses the air chamber 41 to which

air is led through pipe 42. This chamber 41 surrounds the inner tubular end 43 of the tubular discharge portion 44 of the housing. This portion 43 extends beyond the inlet opening from the pipe 42. The rear end of the housing 40 is closed by the closure member 45 held in place by the bolts 46. The gas introduction tube 47 may be formed integral with the closure member 45 as shown and the rear end of the tube is threaded to receive the discharge end of the gas inlet pipe 48.

The first air control tube 49 is supported from the second air control tube 50 by means of spider 53. The air control tube 50 is supported in turn from the housing 44 by the spider 51. The tube 52 is supported from the outer housing member 44 by means of spider 54. The assembly is provided with a flange 55 to engage the port block 56 which is provided with the burner discharge port 57. The sleeve 58 is supported upon the gas introduction tube 47 and is adjustable by means of knob 59 and the control rod 60. Movement of the sleeve 58 back and forth varies the effective opening between the tube 47 and the air control tube 49. Similarly the sleeve 61 is slidably carried by the tube 49 and is adjustable by the knob 62 and the control rod 63. Movement of the sleeve 61 serves to vary the effective discharge area between the tube 49 and the second air control tube 50.

Referring first to the form of construction shown in Figure 1, it is apparent that the gas stream which is introduced through the nozzle 19 draws with it an adjustable quantity of air as the gas enters the tube 23. The amount of air is controlled by the adjustment of the hood 22 to provide the desired clearance from the closure member 16. This air is drawn from the atmosphere and is independent of the air which is supplied through pipe 13 and which is preferably under moderate superatmospheric pressure. It will be apparent that the tubular portion 15 of the housing serves to deflect the air as it enters from the pipe 13 and insures a substantially uniform distribution of air around the periphery of the tubular portion. This air under pressure surrounds the air control tubes 24 and 26. The amount of air entering between the discharge end of the tubular member 23 and the air control tube 24 is controlled by adjusting the tubular member 23 back and forth in its supporting member, the closure member 16. It will be apparent also that this adjustment will have some effect on the primary air port in under the edge of the hood 22. The amount of air which will be drawn in or permitted to enter through the passage between the first air control tube 24 and the second air control tube 27 is adjusted by movement of the tube 26 toward or from the tube 24.

In the form of construction shown in Figures 3 and 4, all of the air utilized is supplied through the pipe 42. The amount which enters within the control tubes 49 and 50 is modified by the adjustment of the sleeves 58 and 61, as has already been described. It will also be understood that the relative pressures of the air and gas introduced into both forms of burners will have a material effect on the relative quantities of air drawn in at the several points. The parallel streams of air and gas pass through the port block where cracking takes place and luminosity is imparted to the flame.

It will be seen from Figure 1 that the stream of gas which is directed through nozzle 19 is surrounded by a stream of air which flows in be-

tween nozzle 19 and the adjustable tube 23. A relatively small amount of air is entrained at this point. An additional amount of air is entrained between tubes 23 and 24. This in turn surrounds the gas air stream passing through tube 23. Likewise, air admitted between tubes 24 and 26 again surrounds the stream. It will be noted that the admission of air at both latter points is controlled and usually only sufficient is admitted to give a satisfactory luminosity to the flame. Preferably, all these tubes have a Venturi contour, in order to reduce turbulence to a minimum. The bulk of the air passes around tube 26 and envelops the stream of gas as it passes into the furnace. The parallel flow of the streams delays combustion and gives long flame characteristics.

Similar results are obtained with the burner shown in Figures 3 and 4, which has corresponding adjustments. These types of burner have the great advantage of being able to definitely control the rate of mixing of air with the gas; in other words, it can be adjusted from a heavy, long, luminous flame condition to the condition obtained with a clear flame burner. This is due to the ability to entrain more or less air with the gas without causing sufficient turbulence to affect the ability to direct the flame after it enters the furnace.

The rate of flame propagation of any gaseous mixture is dependent upon two factors; intimacy of the mixture of air and gas, and upon the quantities of oxygen in contact with the gas molecules. Therefore, in a gas burner design wherein I do not want extreme intimacy of mixture between all the gas and air which would give me extremely quick burning, and also do not want an extremely slow rate of flame propagation which would cause my flame to burn away from the port blocks, it is necessary to mix my air very carefully around the outside periphery of the gas stream in such a manner that the air does not mix with the center core of the gas stream, but does mix intimately in the outside layer of the gas stream. By this means I am able to get partial and quick burning of a small portion of my gas which is sufficient to maintain combustion in the port block and the burner, and to heat the center gas core to such a temperature that cracking of carbon from the hydrocarbons of my gas takes place, and that resultant combustion progresses slowly from the center of the gas stream as the outside air mixes with it as the flame flows down through the furnace. The luminous flame which I obtain transfers quantities of heat at a much lower flame temperature than a clear flame and this results in the effect of "softness" referred to above.

I have found in the operation of my burner that the flow of air through the concentric open areas and paralleling the flow of the gas stream is the result not only of static pressure of the air, but also the aspirating effect of the gas stream, or, in the case of the succeeding nozzle, of the air and gas stream together. It will be noted that the air chamber is so designed as to prevent direct flow of the incoming air into the nozzle, it being arranged so that all the air travels around and finally enters the large circular space around the gas nozzle. By this means a good distribution of the air flow is obtained. I have found that the use of a Venturi type tube or nozzle is of great assistance in smoothing out the flow and preventing turbulence. The form of construction has been designed to have an aspirating effect and thus prevent any back flow of gas into incoming air, even if there is considerable differ-

ence in the velocities of the air and gas streams. It is usually quite difficult to maintain equal pressures of air and gas at all times due to variations in the amount required for various operating conditions. This situation is met by the type of burner disclosed herein, which does not rely on equal velocities of air and gas for parallel flow.

The ability to regulate at will the amount of air entrained with the gas, by means of the adjustable collars shown in Figure 3, or by changing the location of the adjustable nozzles in Figure 1, is also of great importance, as different operations require different flames, and I can readily change from a long, soft flame to practically the condition obtained with the usual clear flame burner. I have found the addition of successively larger increments of air is of great advantage in reducing turbulence.

The type of construction which has been shown also provides means to light the burner from the outside of the furnace by the opening of the shutter 22. By revolving this shutter, available space is provided by which a flame from a gas torch, or similar means, may be drawn through the burner proper by the induction effect of the gas which flows from spud 19. This avoids all chance for explosion in the furnace, it eliminates undesirable lighting holes in the furnace wall, and is of material assistance to the operator when a large number of burners are in use.

The burner is applicable to the use of natural gas, coke oven gas, or 350 B. t. u. mixed coke oven and blast furnace gas, the long flame luminosity, which can be obtained, being approximately the same, using either natural gas or coke oven gas. With 350 B. t. u. mixed gas, the amount of luminosity which can be obtained is less than with the richer fuel.

While I have shown certain preferred embodiments of apparatus adapted for carrying out my invention, it will be obvious that it may be carried out in other forms of apparatus and in other ways, and I contemplate such changes and modifications as come within the spirit and scope of the appended claims.

I claim:

1. In a burner, a gas nozzle for directing a gas stream, an air chamber surrounding the gas nozzle, a passage extending at substantially right angles to the axis of the gas nozzle for admitting air to the chamber, deflecting means in the air chamber opposite the entrance of the air passage into the chamber and extending from the discharge side of the chamber substantially around the gas nozzle to distribute air from said passage around the gas nozzle, and overlapping spaced concentric substantially cylindrical tubular members of successively larger diameters surrounding the gas nozzle, the spaces between said tubular members providing a plurality of annular openings extending parallel with the axis of the gas nozzle whereby air is directed into parallel flow with the gas stream from the nozzle.

2. In a gas burner, an air chamber, a gas admission tube extending into one side of the chamber, an air admission pipe discharging into the chamber at approximately right angles to the gas tube, a cylindrical air control partition extending into the chamber from the side opposite the gas tube concentrically with said tube, the air control partition being larger than the gas tube and extending into the chamber beyond the end of the gas tube and also beyond the discharge of the air admission pipe into the chamber, and an air control tube within the air control partition adjacent the gas admission tube.

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CERTIFICATE OF CORRECTION.

Patent No. 2,117,270.

May 17, 1938.

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It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 3, second column, line 18, claim 1, after the comma and before "and" insert the words a discharge passage leading from the discharge side of the air chamber; line 21, same claim, after "nozzle" and before the comma, insert the words within the discharge passage; line 24, same claim 1, after "air" insert from the air chamber; lines 37 and 38, claim 2, strike out "and an air control tube within the air control partition adjacent" and insert instead the words the air control partition extending beyond the chamber to form a discharge passage, and an air control tube within the air control partition surrounding and spaced from; and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 5th day of July, A. D. 1938.

(Seal)

Henry Van Arsdale,
Acting Commissioner of Patents.

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