Nov. 15, 1938. J. E. LOEFFLER 2,136,449

GAS BURNER

Filed March 18, 1935

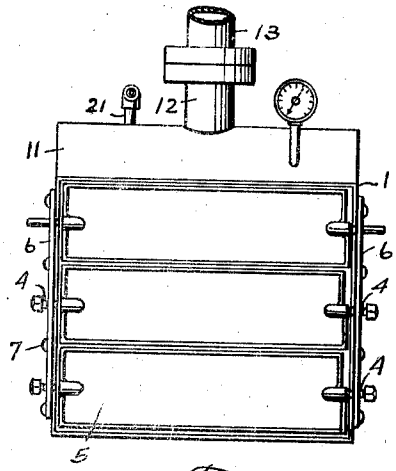


Fig. 1.

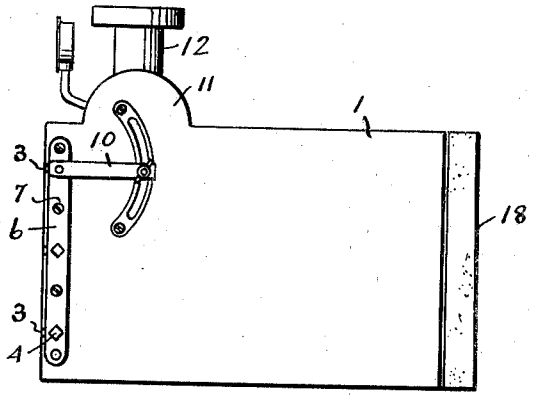


Fig. 2.

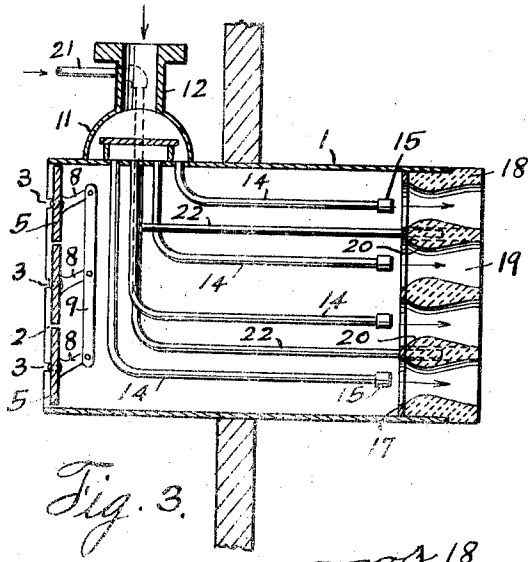


Fig. 3.

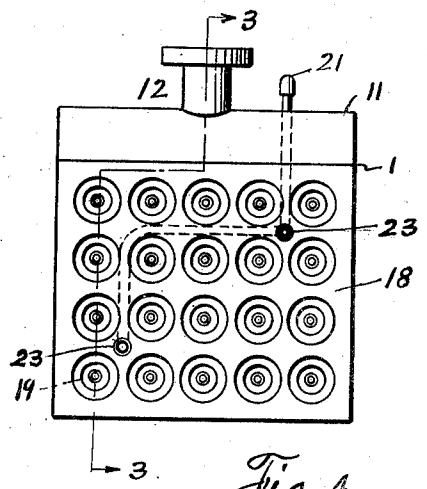


Fig. 4.

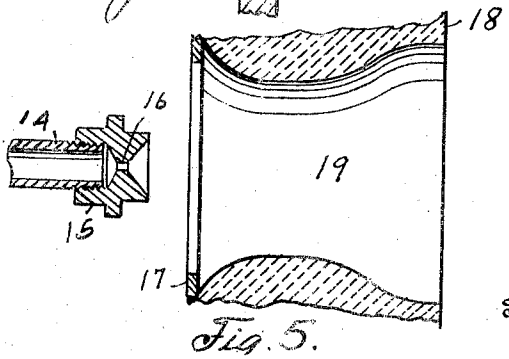


Fig. 5.

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2,136,449

GAS BURNER

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Application March 18, 1935, Serial No. 11,611

2 Claims. (Cl. 158—104)

This invention relates to a gas burner and has more particular relation to a multi-gas-jet refractory burner; the invention embodies, as one of its features, a novel refractory member through which the fuel mixture passes, and in which progressive combustion takes place.

The most common system of operating low-pressure gas burners embodies the utilization of the available draft to draw in the necessary air for a proper combustion, allowing the gaseous fuel to flow into the furnace through a large number of relatively small openings or orifices arranged through the air-openings in such way as to secure in some cases a limited amount of mixing, and in other cases, practically no mixing of the air and gas. This system results in rather slow combustion. Heretofore, low-pressure multi-jet burners have been best adapted to moderate capacities, although some large installations have been made with them possessing excessive ratings; however, in such cases, mixtures are inclined to be late, and there is considerable flame, especially when crowding.

Other methods have been utilized to maintain consistent air-gas ratios, but usually with these methods, adjustment of the gas is made automatically, and the air is either allowed to flow at a fixed rate, or by manual operation. With these methods, it is, of course, possible for the experienced operator to set the air and gas for any given load. However, if the load fluctuates rapidly over wide ranges, the economy is usually very poor.

Present day practice emphasizes more and more the importance of the effect of heat transferred by direct radiation. For instance, in central stations and isolated boiler plants, the steam generators are set high, and the furnace walls are even covered with heat absorbing tubes; and among the petroleum refineries, the furnaces of the cracking and distillation units are commonly erected circular with heat absorbing tubes spaced all around the inside of the furnace walls —all to make the greatest possible use of the radiant heat transfer.

It is known that catalysts have been successfully employed to accelerate various processes of oxidation extremely dissimilar in character, thus in the process of surface combustion, the catalytic material induces the complete combustion of gaseous fuels for the production of intense and localized heat, while on the other hand, the incandescent mantle exhibits similar localized combustion for the production of light.

It is apparent, therefore, that the limiting factors affecting all gas burners are gas pressure and size of burner openings for the gas supply, the available furnace draft, the size of the air-supply openings, and the arrangement for obtaining a proper mixture of gas and air as quickly as possible.

One of the objects of this invention is to provide a low-pressure refractory gas burner with a plurality of jets to operate on the principle of utilizing the energy of the velocity head of one fluid to draw in or inspirate another fluid; after which the velocity head of the mixture is converted to a static head suitable to overcome boiler or furnace draft losses, resulting in a low draft loss through the burner, operating on low gas pressure and entraining all air for combustion.

Another object of the invention is to provide a low pressure refractory gas burner with a plurality of jets or inspirators containing novel features in design of the inspirators which, by certain modifications of the venturi, causes them to hold the proportions of air and gas automatically in constant ratio regardless of the rate of gas supply; gas being the entraining medium. Intimate mixing of the air and gas is maintained by the venturi, and the quantity of excess air thereby measured and controlled and not requiring such adjustment as would necessitate the attention of a skilled operator.

Another object of the invention is to provide a low pressure refractory gas burner with a plurality of jets in combination with a plurality of modified Venturi openings combined with a refractory radiant member composed of accurately shaped Venturi combustion chambers lined with suitable material for accelerating combustion by catalytic activity so that the mixture of the gas and air passing through these chambers impinges directly upon the interstices of the refractory surface. The intensely hot surface of the pores, once the refractory member is heated, has an accelerating effect on the speed of combustion so that these two conditions, each increasing the other in turn, build up intense localization of the combustion raising the mass to incandescence. Once temperature is attained, it can be considered that the gases issuing from the molded chambers are completely burned gases at a temperature approaching the theoretical flame temperature. Since the very short flame is localized in the zone of combustion, heat is transferred practically entirely by radiation; this not only causes much more rapid and greater heat liberation, but gives more uniform distribution

of heat to every part of the furnace. There is, moreover, no flame impingement against the furnace refractories, nor does the flame touch the tubes.

Another object of the invention is to provide a low pressure refractory burner composed of a plurality of jets in combination with a refractory member composed of a plurality of Venturi chambers in which the burning of a homogeneous mixture of air and gas in quantitative proportions for complete combustion is effected in a restricted and localized catalytic zone so designed that a condition of incandescence is maintained. These conditions cause tremendous acceleration of the rate of combustion, and produce a source of heat which is practically without flame, and yet comes very close to making available the total energy of the gas by radiation.

Another object of the invention is to provide a low pressure refractory gas burner whose simplicity of construction lends itself to economical manufacture and to minimum maintenance cost, and which does not require the service of skilled mechanics for effecting its installation, and which is so constructed that its various parts may be easily and quickly replaced by similar corresponding parts of the same sizes or of different sizes for repair purposes and for varying its capacities.

The various features of novelty and invention will appear from the detailed description taken in connection with the accompanying drawings, and as set forth in the appended claims.

With the above and other objects in view, the invention has particular relation to certain novel features of construction, operation, and arrangement of parts, an example of which is given in this specification and illustrated in the accompanying drawing, wherein:

Figure 1 shows an outer end view of the burner.

Figure 2 shows a side view.

Figure 3 shows a longitudinal sectional view, taken on the line 3—3, of Figure 4.

Figure 4 shows an inner end view, and

Figure 5 shows an enlarged fragmentary vertical sectional view.

Referring now more particularly to the drawing wherein like numerals of reference designate the same parts in each of the figures, the numeral 1 designates the casing, having an air inlet port or opening 2 at its outer end. At the outer end of the casing 1, there are the transverse aligned upper intermediate and lower marginal notches 3 cut in the sides of the casing to receive the stub shafts 4 at the ends of the dampers 5. These shafts are mounted to rotate in suitable bearings in the vertical side straps 6, 6, which are fitted to the side of the casing and secured thereto by suitable screws, as 7. Inwardly extended levers 8 are secured to the shafts 4, and their inner ends are pivotally connected to the side links, as 9. Secured to one of the stub shafts 4, is an adjusting lever 10, which may be adjusted to control the shutter opening, and which may be secured at any fixed place of adjustment in any conventional manner, such as illustrated in Figure 2. On the casing 1, and preferably extending transversely entirely across the casing, is a manifold 11 having a connection 12 for the attachment of an intake gas pipe 13 through which the fuel may be admitted to the burner. Leading from the manifold 11, there are a plurality of discharge pipes 14 which are spaced apart, and whose discharge ends are preferably turned in parallel relation, and terminate in gas jets, as 15. The gaseous fuel is introduced through the pipe 13, and into the manifold 11 and is discharged in the desired quantities through the pipes 14 and the jets or nozzles 15. These nozzles 15 have the restricted outlet ports 16 and are flared forwardly from said ports.

The forward end of the casing 1 is provided with a transverse plate 17 set back a sufficient distance to permit the reception of a radiant member 18 which is fitted into the forward or inner end of the casing, as illustrated more accurately in Figure 3. This refractory radiant member is provided with a plurality of Venturi openings 19 therethrough which are aligned in front of the nozzles 15. These openings are circular in cross section and the plate 17 has corresponding openings registering with the openings 19. In longitudinal cross-section, the openings or passageways 19, are preferably in the form of modified venturi, the channels thereof constituting passageways for the gas. The openings of the gas jets 15 are arranged with respect to the Venturi passageways 19 so that the jets of gas issuing through the nozzle openings 16 will enter the passageways 19. The streams of gas issuing from the nozzles or jets 15, and entering the passageways 19 will therefore be flanked on all sides by the hot surface of the radiant member 18.

In order that air necessary to support combustion may be drawn into the passageways 19, and this air and the fuel gas may be proportionately mixed to form combustionable material, gas under low pressure is introduced through pipe 13 into the manifold 11, and is permitted to escape through the pipes 14 and nozzles 15. As the gas escapes through the ports 16 of said nozzles, the rapidly flowing streams of gas cause a reduction of pressure in the immediate vicinity thereof, and thereby entraining along with them in proportion to the speed, volume, and density of the streams, a quantity of air which is permitted to flow in through the air inlet port 2 at the outer end of the casing 1. The shutters 5 are provided to regulate the effective opening of the port 2 in an obvious manner, and as hereinbefore explained. When the desired proportions between the gas and air is obtained, the shutters 5 may then be secured in fixed position so that the quality of the combustible mixture will remain the same, thereafter, while the amount of gas entering through the pipe 13 is varied within reasonable limits by suitable control valve (not shown).

The projected streams of gas from the ports 16 are directed toward the centers of the passageways 19, and as the gas streams leave the orifices 16, they possess a certain amount of kinetic energy, or energy of forward motion. This energy is, in part, transferred to the air immediately surrounding the adjacent or mixer sections of the passageways 19, and the restricted throats thereof imparting a forward movement to said air. Atmospheric air flows into the mixer ends or sections 20 of the passageways 19 to replace that which has moved on into and throughout the passageways 19. As is obvious, from an inspection of Figure 3, the Venturi passageways 19 expand toward their outlet or delivery ends and are of sufficient length and so designed as to cause the mixture of reacting gases to impinge directly upon and scour the interstices of the circumferential surfaces. These surfaces are composed of a lining accurately molded and bonded, consisting of a mixture of thoria and

ceria in such proportions as to cause the same to exert the maximum catalytic activity. The thoria serves the role of a non-conductor, thereby serving as a heat insulating surface; thus the inside circumferential surfaces of the Venturi passageways 19 are heated up to the temperature of the flame and radiate at this temperature, while the ceria behaves as an oxygen carrier during the combustion of the gases, thereby promoting the reaction, in turn catalytically insuring that combustion proceeds at its maximum velocity.

Natural gas is particularly well adapted to be used as a fuel with this type of burner as its predominant constituent is methane. This gas has the property of decomposing into carbon monoxide under partial combustion, and the latter in the presence of the available heat and above catalysts into an acetylene; progressing further the acetylene tends to polymerize into benzine, both, in burning produce powerful radiant heat emissions because of high density. This reaction, observed from the rear, or outer ends of the Venturi passageways 19, appears as a thin greenish-blue, conically shaped flame, while observed from the peep-hole of the furnace, and focusing on the inner, or discharge ends of the passageways 19; the luminosity appears lemon yellow.

It will be observed that for producing the mixing, no special mechanical devices are required. It has been found that when the burner has been properly selected for a given task, and provided with proper nozzles 15 and the shutters 5 adjusted, the mixtures ultimately produced by the burners are very accurately proportioned within the wide ranges of burner capacity, resulting in the most efficient combustion of the gas fuel. The subordinate tubes 14 which support the nozzles 15 cause only very slight restrictions to the passage of air for combustion through the casing 1. Also, they offer small surface for the accumulation of foreign matter. These tubes 14, as will be observed, are air-cooled, thereby preventing the formation of carbon deposits in the tubes or the nozzles 15. The casing 1 is preferably formed of steel, as this has been found more satisfactory in actual use than a cast iron casing. It will be noted that the refractory radiant member 18 is inserted into the inner end of the casing 1, and the nozzles 15 are threaded on the pipes 14, and the air supply shutters are assembled in a unit which may be readily fitted to the outer end of the casing and secured thereto by the screws 7. This simple manner of connecting the few parts makes them readily replaceable by new parts, or parts of different sizes, and contributes materially to standardization of manufacture.

A pilot line 21 enters the casing, as shown, and separates into the two branches 22, 22, which terminate in the bores 23, 23, of the radiant member 18, thus providing ample pilot flames for the burner. In operation, the proper size of the nozzles 15 are secured on the pipes 14, depending on the kind of gas to be consumed. The air shutters are next set in proper position to give the correct mixture, it being, of course, possible to effect the shutter adjustment, either when the burner is idle, or when in use. A setting of the shutters having been made, the quantity of gas, under low, medium, or high, pressure, is admitted through the pipe 13, the flow of gas being regulated by a suitable regulating valve (not shown) either manually or automatically. The projecting streams of gas from the ports 16 entering the Venturi passageways 19, not only entrain a proportional amount of air into the casing chamber, but also set up a general forward movement of the air in said chamber.

The drawing and description disclose what is now considered to be a preferred form of the invention, by way of illustration only, while the broad principle of the invention will be defined by the appended claims.

What I claim is:

1. In a burner, a casing enclosing a chamber, the forward wall of the casing being composed of refractory material, said forward wall having a forwardly directed passageway therethrough, a nozzle in the chamber aligned with the passageway and having a flared nozzle opening directed to discharge the fuel against the walls at the inner ends of the passageway, gas supply means for supplying gas, under pressure, to the nozzle, a shutter unit bodily attachable to and removable from the casing for controlling the flow of air through the casing.

2. In a burner, a wall composed of refractory material having a forwardly directed Venturi passageway whose walls, intermediate the ends of the passageway, are cylindrical for an appreciable length, the inner end of the passageway being flared and the outer end of the passageway presenting, in cross sectional contour, an ogee curve, a nozzle aligned with and spaced behind the passageway and having an outlet opening flared and arranged to discharge the fuel in a conical shape against the flared walls of the passageway at the inner end thereof.

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