Jan. 8, 1924. 1,480,146

G. D. BRADSHAW

PROCESS OF AND APPARATUS FOR BURNING GAS

Filed Dec. 4, 1919

Fig. 1.

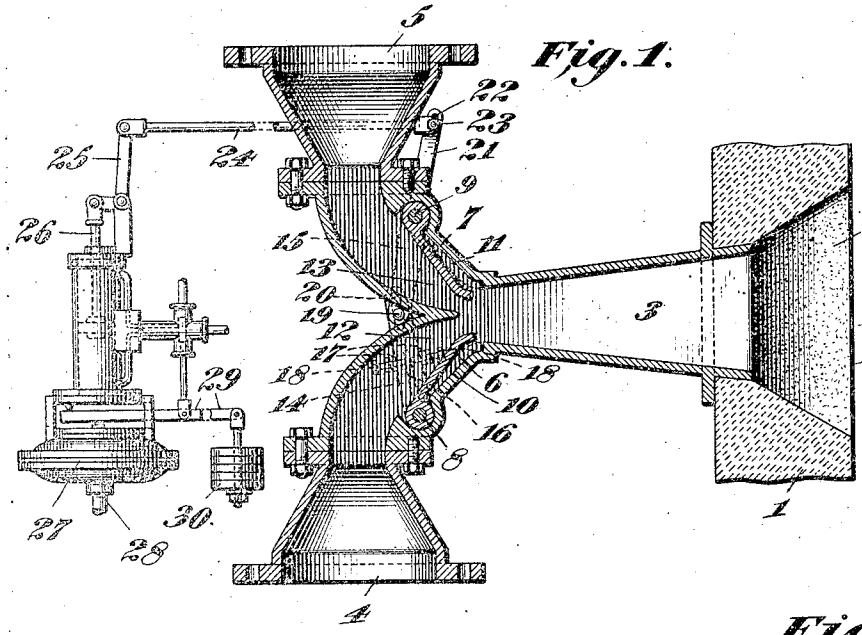


Fig. 2.

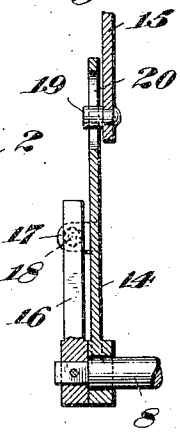


Fig. 3.

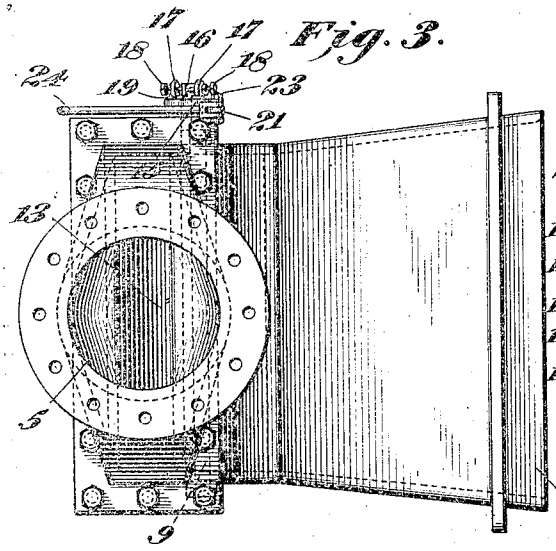
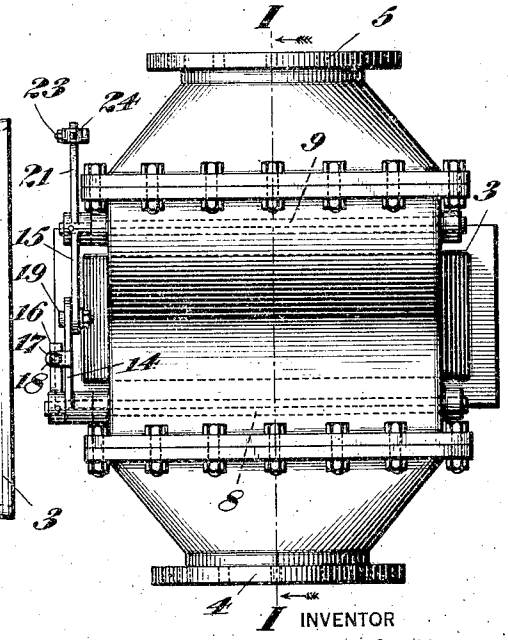


Fig. 4.



INVENTOR

Grant D. Bradshaw.

BY

Geo. E. Thackray

ATTORNEY

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UNITED STATES PATENT OFFICE.

GRANT D. BRADSHAW, OF PITTSBURGH, PENNSYLVANIA.

PROCESS OF AND APPARATUS FOR BURNING GAS.

Application filed December 4, 1919. Serial No. 342,414.

To all whom it may concern:

Be it known that I, GRANT D. BRADSHAW, a citizen of the United States, and a resident of the city of Pittsburgh, county of Allegheny, and State of Pennsylvania, have invented certain new and useful Improvements in Processes of and Apparatus for Burning Gas; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to a process of burning combustible gas or gases and a burner therefor with special reference to the combustion of blast furnace or producer gases, etc., but my process and apparatus can be used or adapted for any kind of combustible gas. My process and burner are designed to mix the gas and the air for combustion in substantially constant or proper proportion by supplying relatively measured quantities of same and are independent of the amount or pressure of gas which is supplied by the blast furnace or other gas producer, while at the same time maintaining a substantially uniform pressure in the burner passages.

The principles of my process and apparatus consist in maintaining a substantially constant gas pressure in the burner passages and in the mains and communicating pipes adjacent thereto by varying the size of the gas outlet in the burner, and controlling the area of the same by means of a regulator connected to the gas pipe or main leading to the burner, so that the pressure on this outlet is maintained substantially constant, and under such conditions the amount or volume of gas supplied to the burner will be proportional to the area of the throat through which the gas passes. I accomplish this regulation although the gas main delivers different quantities at different times. If, on the other hand, the size of the gas outlet should be constant, the gas pressure would rise and fall. At the same time, air under substantially constant pressure is supplied to the burner and the amount of air passing therethrough will also be proportional to the area of the air throat through which it passes. The gas and air throats are each provided with a damper or regulating means, which may be flap or swing valves, and these are adjusted and interconnected so that the area of the gas and air throats are at all times proportioned in such a way that the ratio of air to gas will at all times be substantially constant independent of the amount of gas flowing at any particular time.

Having thus given a general description of my invention, I will now, in order to make the matter more clear, refer to the annexed sheet of drawings which forms part of this specification and in which like characters refer to like parts.

Figure 1 is a vertical transverse sectional elevation through the gas burner taken on the line I—I of Figure 4 and showing a regulating device attached thereto; Figure 2 is a detail of the crank arm adjusting mechanism; Figure 3 is a top plan view of the gas burner; and Figure 4 is a rear elevation of the burner.

Referring now to the characters of reference on the drawings:—1 represents the furnace wall, which may be that of a boiler furnace or a hot blast stove or other apparatus in which the heat of combustible gases is utilized, 2 is the flue opening which is shown as of tapering form to facilitate the flow of the gases therethrough, 3 is the nozzle or throat of the burner which is shown tapering to assist in the flow of the gases and to reduce the friction and resistance therein, 4 is the gas inlet opening which is connected to the gas pipe or main, 5 is the air inlet opening which is connected to the outer air where it may receive air at ordinary atmospheric pressure, or preferably is connected to the main of a blast fan provided with a regulating device, so that air is delivered at any suitable predetermined and substantially constant pressure, 6 is a valve shown of the flap type adapted for controlling the area and flow of gas in the burner, 7 is a similar valve for controlling the area and flow of air to the burner, 8 is the shaft on which the gas valve is pivoted, 9 is the shaft on which the air valve is pivoted, 10 is a recess for receiving the gas valve so that when fully opened the gas opening is substantially smooth and flush to facilitate the flow therein, 11 is a similar recess adapted to receive the air valve, 12 is the converging passage in the burner controlled by the gas valve 6, 13 is a similar converging air

passage controlled by the air valve 7, 14 is a crank arm attached to the outer end of the shaft 8 and adapted to operate the gas valve 6, 15 is a crank arm attached to the outer end of the shaft 9 and adapted to operate the air valve 7, 16 is an adjusting arm mounted on the end of the shaft 8 which fits between the adjusting ears 17 on the crank arm 14 and is provided with adjusting bolts 18, whereby the angular relation between the crank arm 14 and the adjusting arm 16 can be arranged in such a way that the valves 6 and 7 can be set in any desired relation, to make the areas of the gas opening and the air opening of such sizes and proportions as will produce the best mixture of air and gas for combustion. 19 is a stud or pin secured in the crank arm 15 and adapted to operate in the slot 20 of the crank arm 14, and 21 is an arm upwardly extending from the hub of the crank arm 15. The slight angular rotation in either direction of the arm 21 will move the gas valve 6 and the air valve 7 in order to regulate and control the air and gas openings respectively. A movement of the arm 21 in a right-hand direction, as viewed in Figure 1, will serve to close the valves 6 and 7, and in a contrary direction will tend to open them. The upper end of the arm 21 is provided with a slot 22, which receives the pivot bolt 23, by which the connecting rod 24 is pivoted thereto to permit any movement desired, and this rod 24 in turn is pivoted to the bell crank lever 25, which is connected with the regulator, illustrated generally at the left of Figure 1. 26 is the shaft or rod of the regulator, 27 is the flexible diaphragm of said regulator, 28 is a gas pipe connection to the regulator which is connected to the gas pipe or main which supplies gas to the opening 4. The regulator is further provided with an arm or lever 29 which carries a suitable number of weights 30, and this weight could be made more or less, and the weights can also be shifted upon the lever to adjust the apparatus to operate at any predetermined pressure. This regulator may be of any of the well known types, and the details of its construction form no part of my present invention.

The process and operation of my burner is as follows:—Gas under pressure is supplied to the opening 4 from any suitable source, and air under suitable pressure is also supplied to the air opening 5, and these two streams of gas and air unite in the throat or nozzle of the burner 3, and in general the normal pressure of the air supplied as compared with the normal pressure of gas supplied is so adjusted by my burner that the ratio of air to gas is correctly proportioned for combustion. In order to make this clear, one type of gas which I use and burn has approximately the following analysis:—

	Per cent.
CO (carbonic oxide)	26.
H (hydrogen)	3.
N (nitrogen)	58.
CO_2 (carbon dioxide)	12.8
CH_4 (methane)	.2
	100.

The above analysis is by volume, and with gas of such analysis this would require about eight-tenths of a volume of air to one volume of gas for proper combustion. In the utilization of gas from blast furnaces or gas producers, etc., it should be noted that the volume of gases issuing from such apparatus is so large that no attempt is ordinarily made to hold them in gas tanks or other holders, as such constructions would be too large, expensive and unwieldy. My invention, however, enables all the gas issuing from a blast furnace or other gas producers to be utilized, whether this quantity be great or small; and although fluctuations of the pressure and quantities of gases from a blast furnace or other gas producer are usual, my process and gas burner readily takes care of this. All the gases that can be delivered from a blast furnace or other source can be used for heating boilers or other purposes and if at any time a greater amount of gas should be delivered from the blast furnace, my process and burner would allow this excess to be utilized and the quantity of auxiliary coal or other fuel could consequently be reduced, with resultant economy. In other words, my process and burner permit the full utilization of greater or lesser quantities of combustible gases, even though the supply, pressure and volume of the same vary from time to time and this is a novel and distinctive feature of my invention.

The operation of my burner, therefore, acts as a gas bleeder and by the variation of the gas throat area the burner is able to maintain a constant pressure in the gas supply pipe. The air is supplied to the burner as heretofore stated and is preferably kept at a substantially constant pressure by means of a pressure regulator connected to the discharge pipe of the fan blower or otherwise and controls either the speed of the fan itself or a damper at the fan outlet in order to give a practically constant pressure at the burner. The air throat valve damper is adjustably connected to the gas throat damper in such a way that the air valve is opened and closed in harmony with the gas valve. Prior processes and constructions have all attempted to throttle or

close the gas valve as the gas quantity increases in order to maintain the proper combustion mixture, whereas by means of my process and burner I do substantially the opposite, as I open the gas valve in case the pressure or supply increases and allow the pressure to be constant, thereby utilizing the full supply of gas delivered at all times, and without increasing the gas pressure which for other reasons might be detrimental to the operation of the apparatus which supplies the gas.

Although I have described and illustrated my invention in considerable detail, I do not wish to be limited to the exact and specific details thereof as shown and described, but may use such modifications in, substitutions for, or equivalents thereof, as are embraced within the scope of my invention, or as pointed out in the claims.

Having thus described my invention, what I claim and desire to secure by Letters Patent is:—

1. A gas burner comprising a gas inlet passage, an air inlet passage adjacent thereto, each of said passages being controlled by a valve, said valves being connected together and automatically regulated by the gas pressure, whereby substantially uniform gas pressure is maintained at the gas inlet.

2. A gas burner comprising a gas inlet, an air inlet adjacent thereto, the area of each inlet being controlled by a valve, said valves being connected so as to move simultaneously, the valve operating mechanism being connected to a regulator operated by the gas pressure from the gas supply main.

3. A gas burner comprising a gas inlet, an air inlet adjacent thereto, valves adapted to control each of said inlets, the operating mechanism of said valves being interconnected and connected to a regulator operated by the gas pressure in the gas main, whereby the valves are opened and closed to maintain substantially uniform pressure at the gas inlet.

4. A gas burner comprising a gas inlet and an air inlet joined together in approximately parallel relation, each of said inlets being operated by a valve located therein, said valves being connected so as to operate simultaneously to increase and decrease the inlet areas, the operating mechanism of said valves being connected to a regulator connected to the gas supply main, whereby substantially uniform gas and air pressure are supplied to said burner.

5. A gas burner provided with a gas opening connected with a source of gas supply of varying quantity, an adjacent air opening connected with a source of air under substantially constant pressure, valves controlling the areas of each of said openings, said valves being interconnected, operating together and regulated by a regulator connected with the gas supply main, whereby substantially constant pressure is maintained on the inlet side of said gas valve.

6. A gas burner provided with a gas opening connected with a source of gas supply of varying quantity, an adjacent air opening connected with a source of air under substantially constant pressure, valves controlling the areas of each of said openings, said valves being interconnected, operating together and regulated by a pressure regulator connected with the gas supply main, whereby substantially constant pressure is maintained in the gas supply main at said gas opening.

In witness whereof I hereunto affix my signature.

GRANT D. BRADSHAW.