Oct. 25, 1932. S. J. LONERGAN 1,884,764

BURNER STRUCTURE

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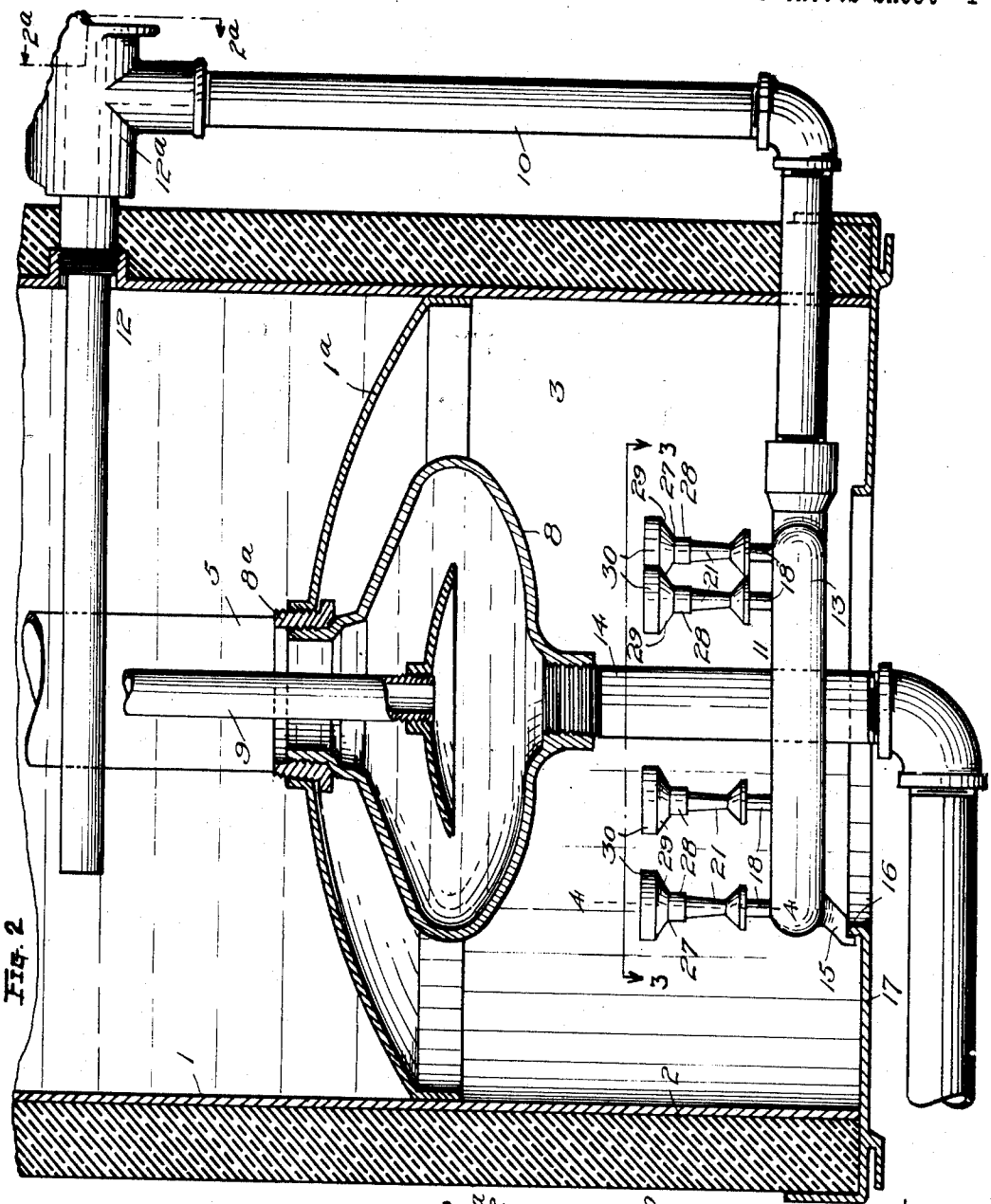


Fig. 2

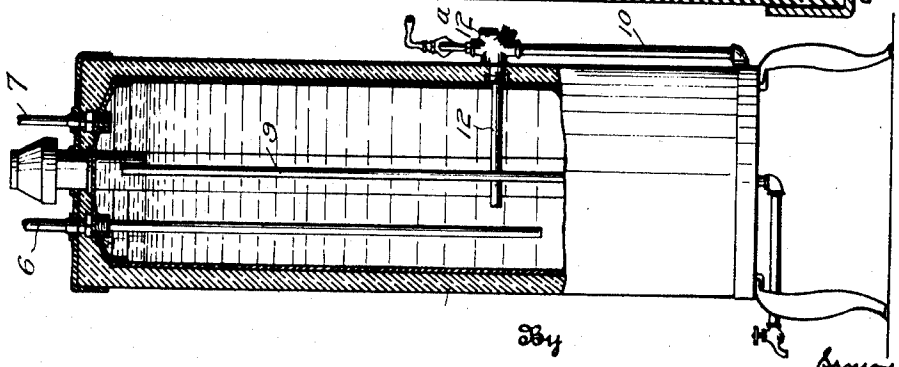


Fig. 1.

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FIG. 2a

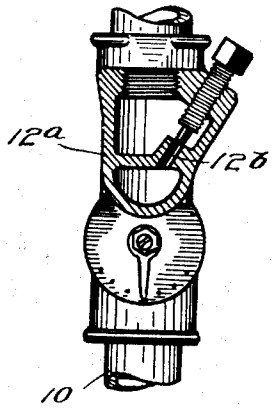


FIG. 10.

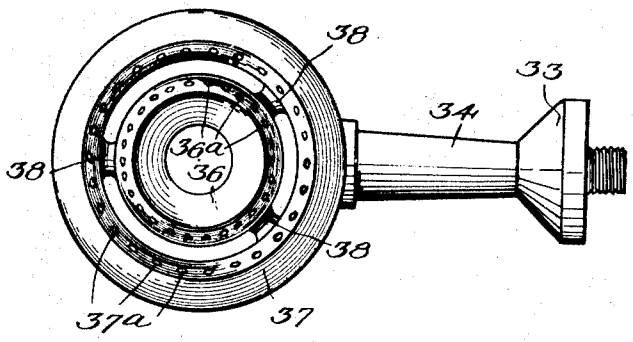
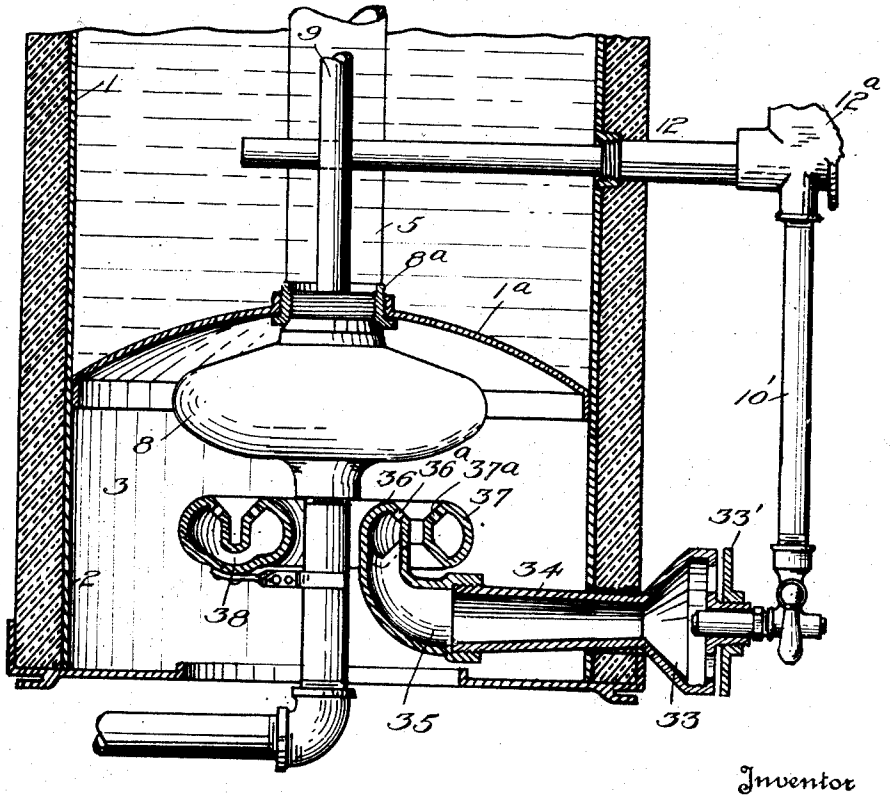


FIG. 9.



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BURNER STRUCTURE

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FIG. 3.

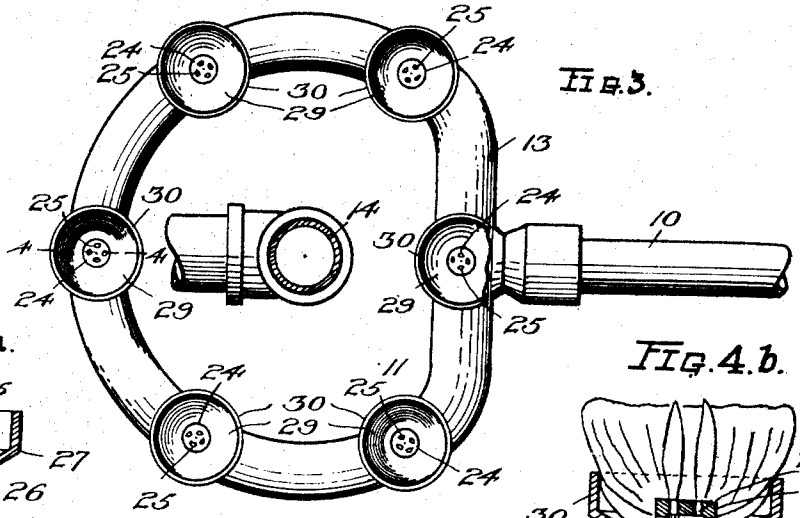


FIG. 4a.

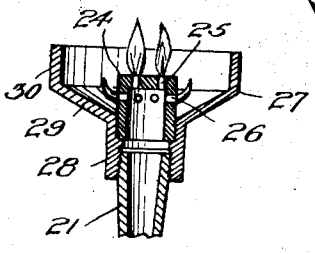


FIG. 4b.

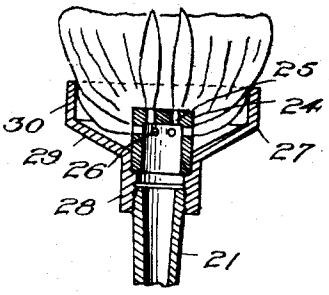


FIG. 7a.

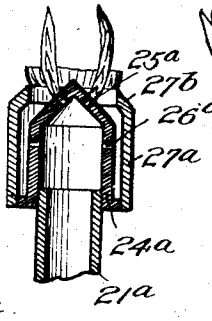


FIG. 7b.

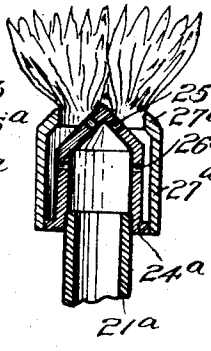


FIG. 7.

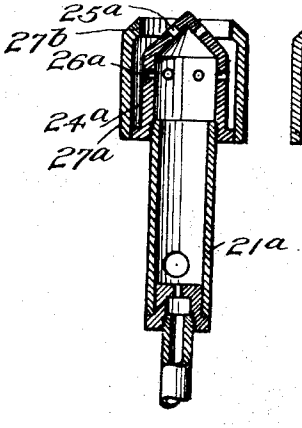


FIG. 6.

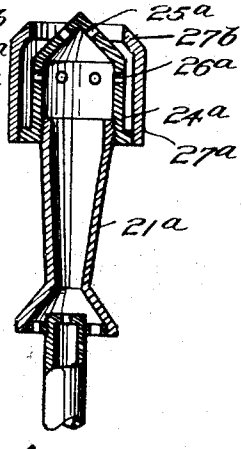


FIG. 5.

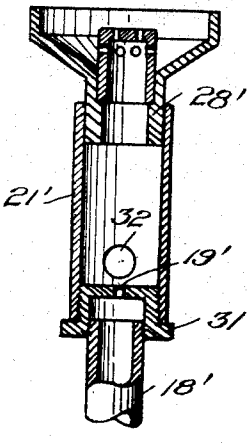


FIG. 8.

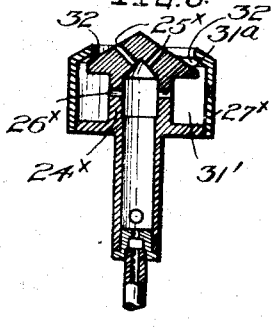
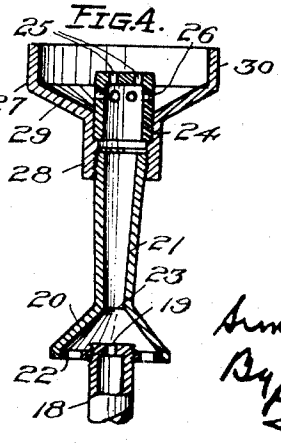


FIG. 4.



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Patented Oct. 25, 1932

1,884,764

UNITED STATES PATENT OFFICE

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BURNER STRUCTURE

Application filed December 28, 1927. Serial No. 243,145.

This invention relates to a gas burner structure capable of supporting combustion and operating efficiently for heating where the gas pressure is normal or varies over a wide range and of remaining lighted where the gas pressure drops or is cut down to a very low or minimum point, as for example the minimum flow through a suitable by-pass without danger of back-firing. The burner therefore (*a*) lends itself advantageously for use where the pressure of gas from or in the supply mains may drop to a point slightly above the existing atmospheric pressure and (*b*) may be adequately and positively controlled by a relatively simple thermostat mechanism, more particularly a thermostat mechanism of the slow acting type; for which reasons the burner is well adapted for use in connection with a hot water storage and supply tank where the rise and fall of the temperature of the water actuates and controls the thermostat, which in turn partially or entirely shuts off the gas supply, except that through a by-pass, or allows the full or normal supply of gas to flow to the burner.

In practice I have used the burner for burning artificial and natural gas for heating purposes, for example, for heating liquid, such as water.

One object of the invention is to provide a burner capable of effecting combustion of the maximum amount of gas with minimum height of flame.

Another object of the invention is to construct an improved burner which is capable of supporting combustion under greatly varying gas pressures and where the pressure is reduced or drops to a minimum or slightly above existing atmospheric pressure.

Another object of the invention is to construct an improved gas burner capable of operating efficiently under maximum gas pressure, that is, where the valve in the supply line is fully or partially open and of supporting combustion when the gas supply is cut down to the minimum, as set by a by-pass whereby it may advantageously serve as a pilot, and of supporting combustion of the gas supplied at varying pressures between the maximum and minimum.

In burners of the Bunsen type, as ordinarily constructed, where the pressure of the mixed air and gas fuel supplied to the burner is very much reduced and the speed of flow of the fuel correspondingly lessened, there occurs, a flash or flare back of the flame into the interior of the burner. The reason for this is that the flow of fuel through the burner ports or openings, due to the decrease in pressure of the fuel, is so reduced that its speed is below the speed of flame propagation throughout the mixture supplied for burning. In my improved burner, which is intended to support combustion of fuel supplied at a wide range of pressures, the flow of the fuel through the burner openings or one or more thereof at the minimum pressure, for which the burner is designed, is greater than the speed of flame propagation of the gas being burned, the result being that when the fuel is cut down to a minimum, as limited for example by a by-pass, the fuel will continue to burn from the burner openings or ports or one or more thereof in a small jet or jets but without the tendency or danger to flare back. The burner is thus adapted to serve as a pilot burner at a minimum pressure and when the fuel is supplied at increased pressures, even up to the maximum, the fuel will burn from the burner openings or ports with flames of increased size and intensity, the flame from each opening instantly increasing in size.

I have found that the best results to secure this feature of my invention are obtained by making each of the burner openings or ports of small cross sectional area and apportioning the combined area of the several ports to the minimum pressure of fuel which may be supplied to the burner so that the flow of the fuel therethrough is greater than the velocity of flame propagation.

Another feature of the invention consists in providing the burner with what I term a primary port or ports and a secondary port or ports. While the primary and secondary ports may be all of the same size, or all of different sizes if desired, the former, namely the primary ports, are so arranged that the flow of fuel to and through them is free and unobstructed, whereas the flow of fuel to and

through the secondary ports is more or less obstructed. Thus, as shown in certain illustrated embodiments of my invention, the primary ports or passages are in direct line with the fuel flow, whereas the secondary ports or passages are disposed at an angle to the direction of the fuel flow, this change in direction required for the fuel to pass through the secondary ports resulting in a diminished flow to and through the latter, this arrangement being one, though perhaps the most simple and satisfactory, means for obstructing or retarding the fuel flow to and through the secondary ports. The result of this feature of the invention is that the pilot flames at the primary ports, when the gas pressure is at the minimum, are larger than those at the secondary ports, and the same are maintained should for any reason the flow of fuel to the burner be momentarily or for a short period reduced below the intended minimum or to such extent that the small flames from the secondary ports or openings become extinguished; the result being that at least the primary ports will be maintained if the pressure should be reduced and effect a prompt lighting of the secondary port or ports upon the increased supply of gas.

A still further object is to construct a burner having one or more burner elements each capable of supporting combustion independently of their relation one to the other.

Other objects of the invention will be apparent to those skilled in the art to which my invention relates from the following description taken in connection with the accompanying drawings, wherein

Fig. 1 is a view, partly in elevation and partly in section, of a water heater of the storage type having a burner structure embodying my invention.

Fig. 2 is a fragmentary section (enlarged) of the lower portion of the heater shown in Fig. 1, one embodiment of my improved burner structure being shown in side elevation.

Fig. 2*a* is a section on the line 2*a*—2*a* of Fig. 2.

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

Fig. 4 is a section on the line 4—4 of Figs. 2 and 3.

Fig. 4*a* is a view of a burner structure showing the primary ports in operation.

Fig. 4*b* is a view of a burner structure showing the primary and secondary ports in operation for heating purposes.

Fig. 5 is a vertical section of a burner structure of slightly modified construction.

Fig. 6 is a vertical section showing another embodiment of my burner structure.

Fig. 7 is a vertical section of a burner element of the type shown in Fig. 6, but of slightly modified construction.

Fig. 7*a* is a fragmentary section of the burner head, such as shown in Figs. 6 and 7, showing the primary ports in operation.

Fig. 7*b* is a view similar to Fig. 7*a*, but showing both the primary and secondary ports in operation.

Fig. 8 is a sectional view of another embodiment of my invention.

Fig. 9 is a fragmentary sectional view of a heating apparatus showing a further embodiment of my invention.

Fig. 10 is a plan view of the burner structure shown in Fig. 9.

Referring to Figs. 1, 2, 3, 4, 4*a* and 4*b*, 1 indicates a tank for holding liquid, such as water, the side wall of the tank extending downwardly, as shown at 2 and forming a fire chamber 3 below the tank bottom 1*a*. The sides and top of the tank may be suitably insulated and the wall 2 may be formed with an opening and provided with a door therefor (not shown). The bottom 1*a* is formed with an eccentrically arranged opening in which fits the lower end of a flue 5. The flue 5 extends through the tank 1, as shown in Fig. 1.

6 indicates a supply pipe leading from a source of water supply. 7 indicates the discharge pipe for the heated water leading to points or stations for use. 8 indicates a spreader mounted in the upper portion of the fire chamber 3 and having at its upper end a neck threaded into a ring 8*a* suitably secured in an opening formed centrally of the bottom 1*a*. Within the spreader is a centrally arranged deflecting and guide wall around which the water flows and enters a concentrically arranged pipe 9 leading upwardly through the neck of the spreader and terminating in the upper portion of the tank 1. 10 indicates a conduit or pipe for supplying the combustible medium, such as natural or artificial gas, to a burner structure indicated as an entirety at 11.

12 indicates as an entirety a thermostat mechanism controlling a valve to cut off the gas to the burner structure when the temperature of the water in the tank rises to a predetermined degree. The mechanism 12 comprises suitable thermostat elements extending into the tank 1, as shown in Figs. 1 and 2, an operating means (not shown) enclosed in a casing 12*a* and actuated by these elements and a valve (not shown) in the casing 12*a*. The thermostat mechanism may be of any desired form or construction, for example, it may be similar to that shown in Letters Patent No. 1,402,189 granted to Miley W. Thomas or Letters Patent No. 1,367,935 granted to Carl M. Yoder, each of which shows a thermostat mechanism of the slow valve closing type; or such thermostat mechanism may be of the snap acting type such as shown in Letters Patent No. 1,581,712 granted to Carl M. Yoder. Since the burner, as will later appear, serves as a pilot,

the casing 12*a* is provided with a relatively small by-pass 12*b* around the valve therein, for supplying a predetermined minimum quantity of gas, whereby a pilot jet is maintained. The by-pass is preferably controlled by a suitable valve.

The burner structure 11 is constructed to provide (*a*) one or more pilot flames when the gas is supplied at a low or minimum pressure relative to normal, as through the by-pass 12*b*, and (*b*) a relatively larger heating flame of minimum height when the gas pressure increases above the minimum. In such construction I provide in the burner wall one or more primary ports in direct relation to or at a point opposite or substantially opposite the point of gas supply, and dispose the remaining port or ports, herein referred to as secondary ports, in such relation to the primary port or ports and the flow of the gas thereto that gas under low pressure does not flow freely to them; this latter result being accomplished by either (*a*) arranging the secondary flame ports at an angle to the gas flow to the primary ports, so that the gas cannot readily flow into them and permitting the drawing up influence due to the burning of the gas at the primary ports to further reduce the tendency of the gas to enter these secondary ports, or (*b*) providing a deflecting wall which, supplemented by the influence of the pilot flame from the primary port or ports, will reduce the tendency of the gas when supplied at a low rate or pressure from reaching the secondary flame ports; but when the gas is supplied as maximum pressure or at any pressure above the minimum up to the maximum, the flames from both the primary and secondary ports will be increased and co-operate to effect heating, the flames therefrom combining into a single flame of large area and minimum height, so that the burner may be advantageously arranged below but in relatively close relation to the wall to be heated.

In the several embodiments of my invention I prefer to provide a series of primary and secondary ports of such size and number that the maximum amount of gas may be consumed or burned without overheating an insulated container in the event the heated water therein is not drawn off. I also prefer to provide as many or substantially as many primary ports as I do secondary ports of substantially the same size.

I have shown herein two general embodiments of my invention, one in which one or more burner structures may be provided below the surface to be heated and mounted upon a common gas distributing pipe, as shown in Figs. 1 to 8, inclusive, and the other in which one set of primary jet ports and secondary jet ports are mounted below the surface to be heated, as shown in Figs. 9 and 10.

Referring to Figs. 1 to 4*b*, inclusive, 13 indicates a manifold or gas distributing pipe to which the supply pipe 10 is connected in a well known manner. In the illustrated form of construction, the manifold 13 is substantially of annular shape, thus providing space for a drain pipe 14 leading downwardly from the spreader 8. The pipe 10 extends horizontally through openings in the insulation and wall 2 and supports one side of the manifold 13; the other side of the manifold may be provided with a foot 15 adapted to engage an upstanding flange 16 provided on the inner edge of an annular plate 17 forming the bottom of the fire chamber 3. The upper side of the manifold 13 is provided with one or more openings, in each of which is mounted a nipple 18, one opening for each burner structure. As shown in Fig. 3, I provide six burner structures, but this number may be increased or diminished according to the size and shape of the manifold and the desired heating capacity. While I have shown the burner structures as being substantially uniformly spaced, they may be otherwise arranged without affecting their operation, either when the gas supply is normal or during variation of such supply or when the supply is reduced to a minimum for the pilot flame.

The nipple 18 for each burner structure is formed in its end wall with a restricted opening 19 which delivers the gas into a mixing chamber 20 provided by enlarging the lower end of a supply tube 21, such end having a ported wall 22 to admit air. The supply tube 21 is preferably provided with a restricted portion 23 to insure proper air induction. The upper end of the supply tube 21 is connected with a nozzle member 24, the end wall of which is formed with one or more small openings 25 (preferably four) which serve as the primary jet or combustion ports and the side wall of which is formed at uniformly spaced points in its circumference with one or more small openings 26 (preferably of the same size as the ports 25) which serve as the secondary combustion ports. As shown, (*a*) the ports 25 are relatively small in size and in the illustrated form of construction I provide four such ports the combined cross sectional area of which and that of the secondary ports is proportional to the minimum pressure of fuel for which the burner is designed, the purpose being to insure a flow of the mixed air and gas through the ports or openings, when the pressure is at the minimum, greater in speed than the speed or velocity of flame propagation, so as to prevent back-firing, and (*b*) the ports 26 are arranged concentric to the port or ports 25. 27 indicates an annular member surrounding the nozzle member and arranged to direct the flame burning from the secondary ports upwardly,

whereby such flame and the flame from the primary ports 25 will combine or commingle into a single flame of relatively large area and of minimum height, thus permitting the burner to be disposed below but in relatively close relation to the wall to be heated, which wall in the illustrated application of my invention is the spreader 8. In the event the gas pressure becomes abnormally low and the flame emitted from the secondary ports 26 goes out, but such pressure fluctuates slightly so that seepage of gas through the ports 26 results, the annular member 27 will deflect this escaping gas upwardly and cause it to be consumed by the flame from the ports 25. The annular member 27, in the form shown in Figs. 2, 3, and 4, comprises a neck 28, an outwardly flaring wall 29 and a vertical side or annular wall 30, preferably terminating in a plane slightly above the end wall of the nozzle member 24. By preference, the upper end of the tube 21 is threaded into the lower end of the neck 28 and the nozzle member 24 is tightly fitted into the upper end of the neck, the intermediate portion of the neck serving as a conduit for the gas from the tube 21 to the nozzle member 24.

Fig. 5 shows a construction in which the nipple 18′ is threaded into a cap 31 and the latter is threaded into the lower end of a cylindrical supply tube 21′. The side wall of the tube is formed with one or more air inlet openings 32 for supplying air to the gas flowing through the port 19′ formed in the cap 31. In this form of construction the tube 21′ is sweated on or otherwise secured to the exterior wall of the neck 28′.

Figs. 6 and 7 show forms of constructions similar to those shown in Figs. 4 and 5, respectively, except that in each the nozzle member and the surrounding member are of slightly different construction.

In each of these latter views the nozzle member 24*a* is threaded at its lower end directly onto the upper end of the delivery tube 21*a* and its upper end wall is of conical shape, the primary jet ports 25*a* being formed in this conical wall and the secondary jet ports 26*a* being formed in the side wall of the member. The flame deflecting member comprises a wall 27*a* surrounding but spaced from the side wall of the nozzle member 24*a* and by preference the upper portion of the wall 27*a* is turned inwardly, as shown at 27*b*, and disposed substantially parallel to the conical end wall, thus forming an annular opening or nozzle for the flame, as shown in Figs. 7*a* and 7*b*. The chamber between the nozzle member 24*a* and the wall 27*a* is closed at its lower end by a flange provided on the lower end of the nozzle member.

Fig. 7*a* shows the burner operating when the supply of gas is at the minimum pressure; Fig. 7*b* shows the flames burning from the primary and secondary ports under increased gas pressure and combined into a single flame of low height.

In the embodiment shown in Fig. 8, the annular flame directing wall 27*x* is spaced from the side wall of the nozzle member 24*x* to form a relatively larger chamber 31′ and the conical end wall of the nozzle member is extended laterally as shown at 31*a* to form a closure for the chamber and a relatively narrower annular passage 32 for the gas from the secondary ports 26*x* to flow through for combustion. As shown, the upper edge of the wall 27*x* extends inwardly to deflect the flame toward the flame burning from the primary ports 25*x*.

With the supply of gas at maximum pressure or at any pressure above the minimum, both primary and secondary ports are cooperative to effect perfect combustion and the resulting flame will be of large area and of minimum height, as shown in Figs. 4*b* and 7*b*. In the event the gas supply falls to a relatively lower pressure, for example, by reason of the operation of the thermostat mechanism 12, the secondary jet ports 26 are automatically reduced and nearly go out, as shown in Fig. 4*a* but the primary ports 25, having a direct relation with the supply pipe, continue to burn in a quiet manner as a pilot flame. Accordingly, it will be seen that when the gas pressure drops, all danger of the burner going out or back firing of the primary ports is eliminated, for reasons already set forth. In actual use and by demonstration of my burner structure, I have found that even when the gas supply is reduced abnormally, the primary jet ports of the burner will continue to burn, as shown in Figs. 4*a* and 7*a*.

Referring to Figs. 9 and 10, the gas supply pipe 10′ projects into a mixing chamber 33 provided on the outer end of a pipe or injection tube 34, the supply of air to the chamber being controlled by a plate 33′ threaded on the pipe end, whereby it may be adjusted relative to the mouth of the chamber. The inner end of the section 34 connects with an inlet 35. 36, 37, indicate a pair of related gas distributing members, to one of which the inlet 35 is connected. The gas distributing members have portions disposed side by side, but where each is continuous, for example, of annular shape as shown in the drawings, one is arranged within the other. At spaced points throughout their lengths, the members 36, 37, are connected by passages 38, the walls therefor being preferably formed integrally with the walls of the members 36, 37. The gas distributing member to which the inlet 35 is connected, that is, the inner member 36 in the present illustrated form of construction, constitutes the primary gas distributing member and the other member constitutes the secondary gas distributing member. The gas distributing

member 36 is formed with a series of openings 36*a* which serve as the primary jet ports and the gas distributing member 37 is formed with a series of openings 37*a* which serve as the secondary jet ports. As shown, the upper portions of the gas distributing members 36, 37, are shaped, preferably having walls inclined in opposite directions, so that the flames emitted from the two series of ports will extend toward each other and hence commingle at their outer portions to effect a spreading out of the two flames and at the same time insure sufficient aeration. This arrangement will also insure the lighting of the secondary ports 37*a* from the pilot flame burning from the primary ports 36*a*, upon increase of the gas pressure, in the event the ports 37*a* have gone out.

When the gas pressure is low, the gas flows through the inlet 35 into the gas distributing member 36 and out through the primary ports 36*a*, the outer side wall of the distributing pipe deflecting the gas upwardly to the ports 36*a* and hence obstructing its flow into the pipe 37; when the gas pressure is increased, there is an increased flow of gas through the passages 38 into the gas distributing member 37 and out through the secondary ports 37*a*.

In the preferred form of construction the two series of ports are small and substantially of the same size or diameter to insure a proper distribution of the gas and flame propagation both for pilot and for heating purposes, although in some instances it may be found desirable or advantageous to vary their relative sizes. By making the primary ports small it insures back pressure of the gas within the nozzle device or distributing member, when the pressure increases, followed with a quick, increased flow of gas through the secondary ports. By making the secondary ports relatively smaller and disposing them out of the path or flow of the gas to the primary ports, sufficient resistance to the flow of the gas to and through the secondary ports, when the gas pressure drops, is present or set up to cause or insure the gas flow to the primary ports, with resulting automatic reduction of the flame burning from the secondary ports. In the form of construction shown in Figs. 2 to 8, inclusive, the secondary ports are disposed at an angle to the direction of flow of the gas to the primary ports; in Figs. 9 and 10 the secondary ports are disposed at a point remote from the primary distributing member 36 and connected thereto by one or more relatively small passages.

My construction of burner is advantageous for two reasons, among others: First, it permits the valved by-pass to supply a very limited amount of gas to the burner structure to insure the functioning of the primary ports 25 as a pilot; and second, it permits the burner structure to give adequate service and remain in operation continuously, more particularly in those localities, such as large cities using gas for general heating where, during cold weather spells with resulting large demands on the gas supply mains, the pressure drops to where burners and pilots of ordinary types will back fire or go out. When the gas pressure increases or returns to normal, the pressure of the gas will force it to and through both sets of the ports 25, 26, (and ignite the latter if they have entirely gone out) to provide a flame for heating purposes as already described.

I have found by actual use of my improved burner structure, in connection with water heaters and other applications, that it may be effectively used as a combined heater and pilot since one series of ports support combustion and quietly burn on gas supplied at low pressure, without danger of back fire. It will be noted that the series of co-operative heating ports may be provided at the upper end of the supply pipe but in such relation to the primary ports that the gas or fuel will not readily flow to them. In this form of construction, one or more burner heads or elements may be grouped in any desired arrangement or relation without affecting the functioning and operation of each as a heater and a pilot.

From the foregoing description it will also be noted that I provide in each burner structure or burner head sets of correlated primary and secondary flame ports and that combustion is continuously supported (1) when the gas flow is at the minimum pressure, for example, as determined by a valved by-pass, (2) when the flow of gas is at the maximum pressure and (3) throughout the range of the gas flow between the minimum and maximum pressures; the sets of ports being so related that (*a*) the secondary ports automatically become reduced when the gas pressure drops and are automatically increased in size, or relighted by the primary ports, when the pressure increases and (*b*) when the pressure is increased and sufficient to supply gas to both sets of ports, the flames therefrom commingle into a single flame of large area and minimum height with proper aeration; it will also be seen that the operation of one set of ports or both sets thereof is controlled automatically by the gas pressure.

By reason of the correlation of the flame ports and the fact that combustion is supported throughout the entire range of gas pressure, my construction of burner lends itself for use with thermostatically controlled valves of the slow or gradually acting type to control the flow of the gas to the burner.

To those skilled in the art to which my invention relates, many changes in construction and widely differing embodiments and applications of the invention will suggest

themselves without departing from the spirit and scope thereof. My disclosures and the description herein are purely illustrative and are not intended to be in any sense limiting.

What I claim is:

1. A burner structure comprising a supply pipe and a nozzle member having a diameter substantially equal to the diameter of said pipe and connected thereto and having a port in its end wall arranged to alone support combustion under minimum gas pressure supply and to also support combustion under variations in pressure up to the maximum and a series of ports in its side wall co-operative with said port to additionally support combustion under increased gas pressures above the minimum, and a deflecting wall surrounding said nozzle member.

2. A burner structure comprising a supply pipe and a nozzle member having a diameter substantially equal to the diameter of said supply pipe and connected thereto and having a conical end wall, said end wall being formed with a plurality of divergent openings arranged to support combustion under minimum gas pressure supply, and the side wall of said member being formed with a plurality of openings co-operative with the first mentioned opening to support combustion upon the increase of the gas pressure.

3. In a burner structure, the combination of a gas supply member, a burner having a port in direct relation to said supply member and a series of ports indirectly related to said supply member whereby a major portion of the gas when supplied at minimum pressure flows to said first mentioned port but all of said ports are operative at pressures above the minimum to produce contiguous jets and a combined heating flame, and a deflecting wall surrounding said burner, the upper portion of said wall being inclined inwardly.

4. In a burner structure, the combination of a fuel supply member, a burner on said member having a conical end wall formed with a plurality of flame ports, a wall surrounding said burner, the free end of said wall extending inwardly and forming with said conical wall an annular flame burning opening, and means for supplying fuel into the space between said burner and wall.

In testimony whereof, I have hereunto signed my name.

SIMON J. LONERGAN.