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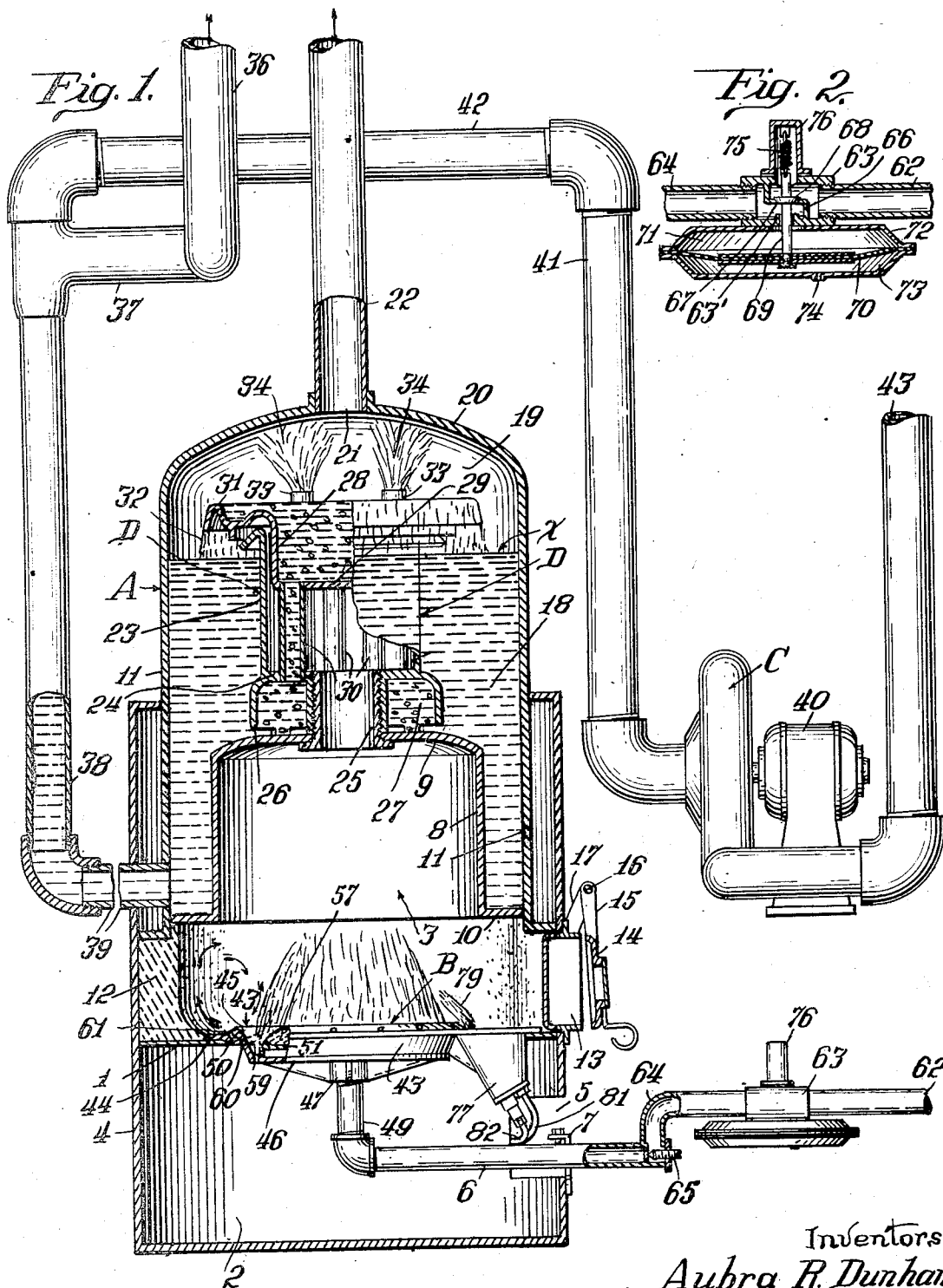
A. R. DUNHAM ET AL

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SUB-ATMOSPHERIC GAS BURNER

Filed Sept. 12, 1940

2 Sheets-Sheet 1



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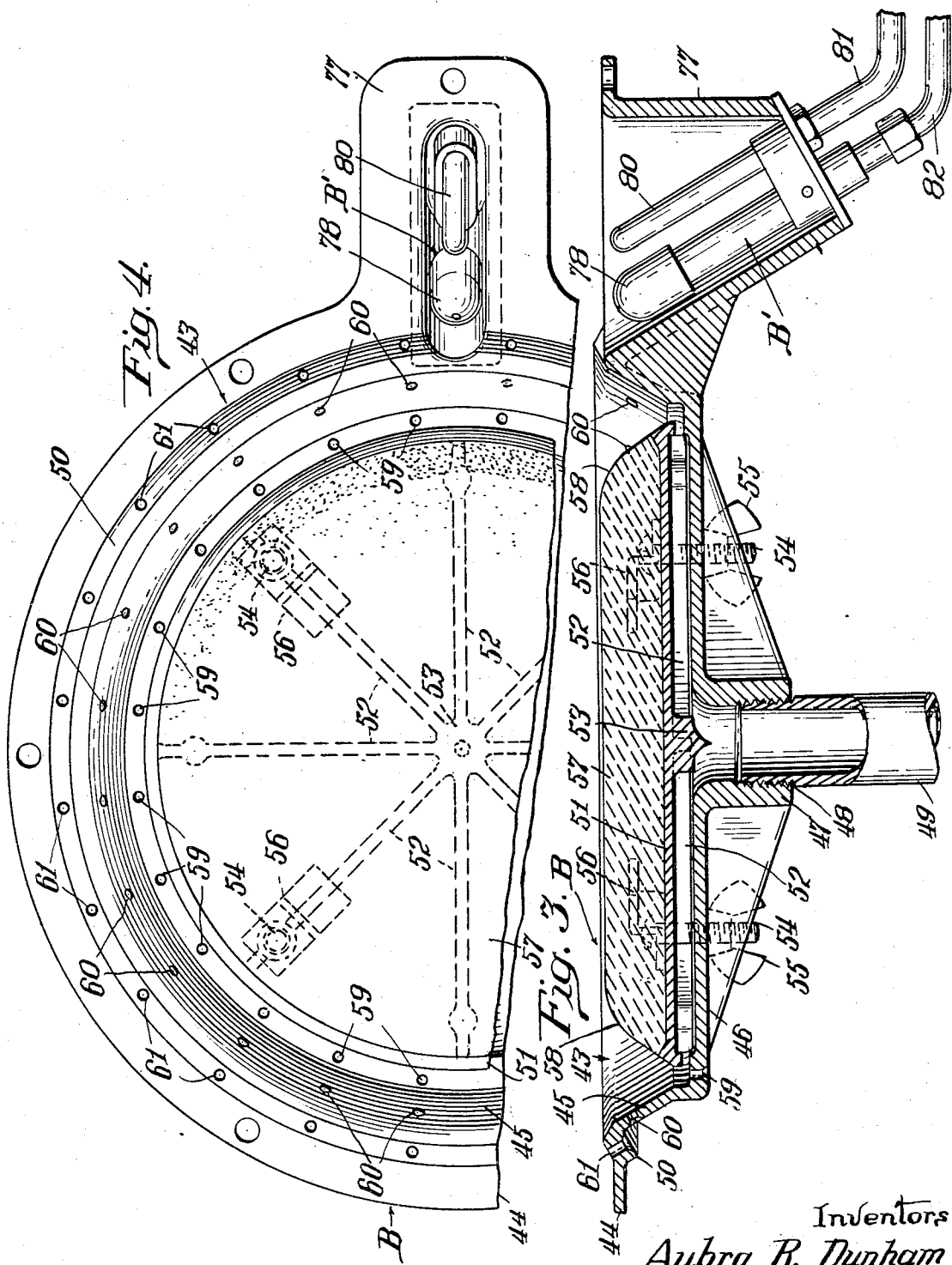
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UNITED STATES PATENT OFFICE

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SUBATMOSPHERIC GAS BURNER

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12 Claims. (Cl. 158—7)

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This invention relates to certain new and useful improvements in a gas burner, more particularly a burner especially adapted for use in a generator for producing heating medium consisting of a highly saturated mixture of steam and hot products of combustion for use in a heating system.

A heating system of this general type is shown in the patent to Dunham et al., 2,046,813, granted July 7, 1936. The fluid fuel is burned in proximity to an enclosed body or bodies of water and the products of combustion are passed in intimate contact with the water so as to form steam and the heating medium consisting of the products of combustion highly saturated with steam is delivered into radiators wherein the steam is condensed and a large portion of the heat from the products of combustion is used for heating purposes. The cooled noncondensable gases are exhausted from the system thus producing a partial vacuum and causing the continuous circulation of heating medium and also maintaining a partial vacuum in the generator so as to draw in the fuel and combustion air. The condensate from the steam is returned to the generator to be reconverted into steam.

The present improved burner is adapted to be mounted transversely within the lower portion of the generator and separates an upper combustion chamber from a lower air-supply chamber. The burner comprises a main lower metallic plate, and a smaller circular upper plate spaced slightly above the lower plate, and fuel gas is introduced centrally through the lower plate into the space between the plates and flows upwardly around the edges of the upper plate. Combustion air is drawn from the lower chamber through two concentric circular series of spaced holes in the main plate so directed that the air jets will meet and supply, together with the gas, a circular flame directed upwardly and inwardly into the combustion chamber. The air and gas are drawn in, in proper proportion, from separate sources each under substantially atmospheric pressure, by the vacuum existing in the combustion chamber.

The principal object of this invention is to provide an improved gas burner of the type briefly described hereinabove and disclosed more in detail in the specifications which follow.

Another object is to provide an improved burner which will not backfire, the air and gas being first mixed at the point of combustion so that the flame can be turned down to a minimum.

Another object is to provide improved means for mixing the air and gas so as to more definitely determine and position the flame.

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Another object is to provide an improved method and apparatus for properly proportioning and keeping substantially constant the rate of fuel and air supply to the burner.

5 Another object is to provide means for introducing free air around the base of the flame, for the several reasons hereinafter specified.

Another object is to provide an improved pilot-flame assembly.

10 Other objects and advantages of this invention will be more apparent from the following detailed description of one approved form of apparatus designed and operating according to the principles of this invention.

15 In the accompanying drawings:

Fig. 1 is an elevation, largely in central vertical section, of the generator with the improved burner installed therein, together with some portions of the heating assembly including the exhaustor for

20 maintaining the vacuum.

Fig. 2 is a vertical central section through the gas flow-control valve.

Fig. 3 is a vertical central section through the burner, on a larger scale.

25 Fig. 4 is a partial plan view of the burner assembly.

The general heating system will first be briefly described. Referring first to Fig. 1, the generator indicated at A encloses the new burner B in its lower portion, this burner resting on a transverse partition 1 and separating the space within the generator into a lower supply chamber 2 and an upper combustion chamber 3. The lower air chamber 2 is enclosed by the lower portion of the outer metallic shell 4, and an opening 5 in this shell permits the free entrance of air. The gas supply pipe 6 also passes in through this opening 5 and may be intermediately supported by any suitable bracket member 7. The upper portion of the combustion chamber 3 is enclosed by a cylindrical shell 8 having a dome-shaped top 9 and an outwardly extending lower flange 10 extending to the shell or housing 11 which holds the water supply. The lower portion of combustion chamber 3 is enclosed by an annular wall 12 of insulating material, within the outer shell 4, except for the opening enclosed by the metallic shell 13 open at its inner and outer ends and fitted into the outer wall 4. This opening is adapted to be closed by a door 14 suspended by arms 15 from a pivot rod 16 carried by bracket arms 17 on the fixed casing. This door 14 is so balanced that when there is no vacuum within the generator the door will hang slightly open as shown in Fig. 1. In normal operation, when the ex-

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hauster C is in operation and there is a partial vacuum within combustion chamber 3, the door 14 will be drawn into closed position so that the combustion chamber will be completely closed except for the air inlets through the burner B as hereinafter described. The space 18 within housing 11 and surrounding the inner shell 8 up to the level x is filled with water, and the space 19 within housing 11 above this water level and below the dome-shaped top 20 serves as a mixing chamber for the products of combustion and steam which flow out through outlet 21 into the supply pipe 22.

The mixing head D serves to conduct the products of combustion from combustion chamber 3 into the mixing chamber 19 so as to transfer a maximum of heat to the water, this portion of the apparatus being disclosed more in detail and claimed in the patent to Dunham et al. 2,169,683, filed August 15, 1939. This head comprises an outer cylindrical wall 23 which terminates above the water level x and which joins at its lower end with an intermediate horizontal partition 24 from which extends a central cylindrical member 25 enclosing a gas passage leading from combustion chamber 3. A skirt member 26 extends outwardly and downwardly from partition 24 and terminates somewhat above the top 9 of shell 8 so as to permit water to flow into the enclosed annular space 27 which becomes more highly heated than the larger body of water due to the fact that it is largely enclosed by the heated gases. An upper pan member 28 has its central bottom 29 positioned somewhat below the water level x and is supported by a plurality of vertical pipes or conduits 30 each having its lower and upper open ends fitted in the partition 24 and bottom 29 respectively so that water from the main body 18 will flow up through these pipes to maintain a normal liquid level at x within the pan 28. The upper portion of pan 28 is extended as shown at 31 so that a thin sheet of water 32 will overflow into the main body of water when the pan is filled as hereinafter described. Another series of vertical conduits 33, similar to the conduits 30 but longer, extend up through the pan 28 so as to discharge jets of water 34 from their upper ends into the domed mixing space 19.

In operation, the highly heated gases from combustion space 3 will flow up through central passage 25 into the upper casing 23, flowing between and around the pipes 30 and 33, and thence out beneath the upper pan member 31 and into the mixing space 19. These gases will highly heat the water in the annular space 27 and in the pipes 30 and 33 and partially boil or vaporize this water so that its density will be reduced and the water will be forced up to fill the pan 28, and overflow at 32 into the main body of water. Also jets or fountains of water will be thrown up at 34 into the mixing chamber 19 and against the domed top 20. It will be noted that the gases flowing out from beneath the pan 31 will flow through the dispersed liquid 32 and also in contact with the upper surface x of the water pool 18, while the liquid of jets 34 is being dispersed through the heated gases in mixing chamber 19 and against the inner surface of dome 20. This tends to cool the dome and also wets the inner surface so as to vaporize and mix with hot dry gases and increase the heating medium. Also the water surrounding inner shell 8 and the mixing head D will be highly pre-heated so that a comparatively large volume of steam will be quickly formed and mixed with the combustion gases to form the heating medium that flows upwardly

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through pipe 22 to the radiating system. The lower portion of the generator is insulated by the air space between outer shell 4 and inner shell 11, although other insulating material could be used in this space.

The heating medium loses the greater portion of its heat in the radiating system, the steam being condensed and giving off its latent heat, and the temperature of the non-condensable combustion gases being considerably lowered. The condensate flows back from the radiating system through the pipes 36, 37, 38 and 39 into the main body of water 18. It will be noted that the pipe 39 is shown with a central portion broken away, and it is to be understood that at this point means (such as shown in the Dunham Patent 2,169,683 already referred to) may be provided for replenishing the water supply if necessary, draining excess water and sediment, and maintaining the proper water level x in the generator. An exhaustor or pump C, driven by motor 40, is connected through piping 41, 42 and 37 with the return pipe 36 and through this piping non-condensable gases are withdrawn from the radiating system and then discharged from the pump through the vent pipe 43. The vacuum created in the radiators by the condensation of steam and by the withdrawal of gases through the venting system by pump C will cause a partial vacuum extending back into the combustion chamber 3, this vacuum serving to draw in the combustion air and fluid fuel, and also to maintain the circulation of heating medium through the radiators. Incidentally, this vacuum will hold the pilot-door 14 closed.

The improved burner B, which forms the particular subject matter of this invention, will now be described. This burner comprises a main plate 43 of generally circular form having an outer horizontal flange 44 which rests on and is secured to the horizontal partition 1 in the housing 4, this partition having a central opening corresponding to the general outline of plate 43 inside of the flange 44. The plate 43 has a central downwardly dished portion comprising the outer inwardly and downwardly sloping wall 45 leading to the horizontal bottom wall 46 having a central downwardly extending inlet nipple 47 internally threaded at 48 to receive the gas-feed pipe 49. The upper edge of sloping wall 45 (which extends somewhat above the peripheral flange 44) is connected with flange 44 by a short downwardly and outwardly extending flange 50.

A smaller upper circular plate 51 fits within the dished portion of the lower plate, this upper plate 51 having a series of ribs 52 extending radially from a central hub 53, these ribs resting on the upper surface of wall 46 of the lower plate so as to space the two plates apart. The ribs 52 serve to divide the stream of gas flowing in through pipe 49 and direct this gas equally through the radial passages between ribs 52 toward all edge portions of the plate 51, around which edges the gas flows upwardly into the combustion chamber. A plurality of threaded stems or bolts 54 provided with wing-nuts 55 project down through the plates so as to hold them firmly in assembled relation. Metallic anchor members 56 held by the upper end of bolts 54 are imbedded in a cover member 57 of refractory material which is cast over the top of plate 51, this refractory cover member having rounded edges 58 as shown.

A circular series of equally spaced upwardly directed air holes 59 are formed in the flat cen-

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tral portion 46 of plate 43 adjacent the outer periphery of the top plate 51. A second series of inwardly and upwardly directed air holes 50 are formed in the sloping wall 45. The holes 50 in the second row are positioned radially outward from the holes 59 in the first row, pair by pair, so that the two jets of air of each pair will converge and impinge against one another and, with the gas drawn from between the plates 51 and 46 form a combustible mixture which will burn with a circular flame directed upwardly and inwardly above the central refractory member 57. The jets will impinge at such an angle as to slow down the final velocity of the air streams and mix with the gas so that the flame will remain substantially fixed and will not wander or blow out.

A third row of openings 61 directed upwardly and outwardly are formed in the narrow inclined wall 50 of the lower plate 43. The air drawn in through this outer row of holes 61 does not directly enter the flame at all, but is quite important to the successful operation of the burner, especially since no combustible mixture is formed until the gas and air are separately drawn into the chamber. This free air from the outer row of openings tends to stabilize the operating conditions around the base of the flame. When these outer holes are lacking, ignition takes place and the flame starts but soon a circulation of dead gases tends to sweep down and into the base of the flame causing the flame to rise up and tend to blow away from the jets. The flame will go out in spots and then reignite with explosive force tending to throw the pilot door 14 open and then pull it shut with a bang. This action may continue to a point where the entire flame is snuffed out, including the pilot flame. By introducing sufficient free air around the base of the flame the above action is prevented. If sufficient of this free air is introduced, the main flame continues to burn down near the burner, the pilot is not affected, and there is no tendency for the flame to sputter or blow the door open. However, if too much air is brought in around the outside of the burner yellow flames will appear. The exact quantity of this free air desired will vary somewhat with the character of the gas and the velocity of flame propagation with different gases. This can be determined by experience in any given locality and with any particular character of gas. The lower ends of air inlet holes 59, 60 and 61 are all rounded so as to facilitate the inflow of air.

The gas will flow in under city-supply pressure through pipe 62, to the suction controlled valve 63, which operates as a zero pressure regulator to furnish gas at slightly lower than atmospheric pressure through pipe 64, metering valve 65, and pipes 6 and 40 to and through the burner B. The metering valve 65 may be a suitable needle-valve and will be given a fixed manual adjustment which will depend upon the quality and character of the gas being used.

The valve 63 comprises an internal web 68 having a valve opening 67 that may be closed by the valve 69 carried by stem 69 secured at its lower end to a diaphragm 70 separating the upper gas chamber 71 in diaphragm casing 72 from the lower chamber 73 open to the atmosphere at 74. The valve 69 also includes a loose guide 63' for the stem 69. A centering spring 75 enclosed in an upper housing extension 76 exerts an upward pull on the upper end of stem 69 so as to carry the weight of the floating parts. The spring is

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adjusted so that the valve member 68 just barely falls shut without the aid of gas pressure. The spring also tends to hold the valve centered so as to minimize friction between the valve parts and the valve-seat and guide. When a partial vacuum is developed in the combustion chamber 3, this will partially evacuate the pipes 40 and 6 and reduce the pressure in upper chamber 71 so that the atmospheric pressure in lower chamber 73 will force the diaphragm 70 upwardly and open valve 63 so as to admit gas from the supply pipe 62. Obviously, the more valve 63 is opened the greater will be the flow of gas into the combustion chamber.

This suction controlled valve 63 opens by a slight vacuum from the combustion chamber and tends to feed gas to the needle valve at a substantially constant pressure slightly below atmospheric.

The first step to get proper gas and air ratio control is to reduce the gas pressure in pipe 64 to substantially atmospheric pressure, and the vacuum in the combustion chamber will then be able to draw air from the normal atmospheric pressure source 2 through the air inlets 59, 60 and 61 in the same proportion that it draws gas through the needle valve 65 and thence through the burner. Valve 63 is also a safety valve because the exhauster must be running and creating a vacuum in the combustion chamber before valve 67 will open and any gas can be drawn into the burner.

With the apparatus properly designed and adjusted the proportionate flow of air and gas into the combustion chamber will remain substantially constant so as to provide a proper mixture, although the size of the flame can be increased or decreased by changing the vacuum in chamber 3, and within reasonable limits the size of the flame will increase or decrease to correspond with the demands for heating medium.

Within one side portion of the lower burner plate 43 (preferably the side adjacent the door 14) is formed a depressed well 77 for housing the pilot burner B'. This pilot burner comprises a small gas jet 78 so inclined that the flame 79 (Fig. 1) will project inwardly sufficient to ignite the main burner when the combustible mixture is flowing. At the same time this jet 78 is housed within the well 77 so that the jet will not blow out when the door 14 is opened. When the main burner is extinguished and the exhauster C is not operating, that is when the vacuum is broken in chamber 3 and the heating medium is no longer circulating, the door 14 will fall open (see Fig. 1) and the gases from the pilot-burner can vent through this door opening. In this way the pilot-burner can continue in operation at all times. In the example here shown, a thermo-couple 80 is positioned adjacent the pilot-burner 78, this thermo-couple acting, when heated, to hold open a supply valve in the main fuel-pipe. In case the pilot burner should be extinguished the thermo-couple 80 will cool off and permit this valve to close. The cable 81 leading from the thermo-couple 80 and the gas supply pipe 62 for the pilot-burner may conveniently enter the generator through the air inlet opening 8.

This improved burner will not "backfire" since the gas and air enter the combustion chamber separately and are not mixed until they reach substantially the point of combustion, consequently the burner can be turned down to a minimum. By using a number of small inlet

air holes or orifices producing forceful air jets which inspire the gas, a better gas and air mixture is obtained which gives a shorter hotter flame and makes it possible to use a smaller combustion chamber. By arranging these small jets in a circle, ignition starts at one side and moves around rapidly but not with the explosiveness that would result if all the gas and air were introduced at one point with a single jet. By arranging the combustion air jets in pairs which strike one another so as to create eddies, the flame is held in place and the increased turbulence tends to mix the air and gas and improve the mixture so that combustion takes place almost instantly. The gas and air are both pre-heated to some extent in passing through the burner orifices thus aiding in combustion. The burner plates 43 and 51 are preferably made of aluminum so that heat will be drawn down to pre-heat the combustion materials, but the refractory covering 57 on the upper plate serves to protect this portion of the burner from too much heat. This refractory plate also creates a central hot zone where combustion can take place with the best results.

This apparatus is adapted to operate under a rather small vacuum, but a greater vacuum than natural draft will as a rule produce. Such a system has the advantage that there is no outward leakage. It will also be noted that while the usual gas burner operates by inspiring the combustion air into the gas which enters under pressure, in the present burner the combustion air jets are drawn or sucked into the burner and the gas is inspired into the mixture by the force of the air jets. There will never be an excess of fuel since the gas is drawn in by the air and is also controlled by a cut-off valve responsive to the degree of vacuum within the combustion chamber.

It will also be noted that this improved burner can readily be used as a conversion burner unit in existing boilers or heating plants by transversely sealing this burner within the combustion space and installing a suction or exhaust means acting on the stack or vent.

We claim:

1. A gas burner comprising a main metallic plate adapted to separate an air-supply chamber from a combustion chamber, said plate being centrally dished so that the plate comprises a central substantially circular horizontal portion surrounded by an upwardly and outwardly sloping rim extending to a main outer horizontal portion, an upper substantially circular metallic plate having downwardly projecting radial ribs which rest on the flat-central portion of the main plate within the dished recess and support the upper plate in spaced position above the main plate, the main plate having an opening in its central portion for receiving gas from a supply-pipe said gas flowing outwardly between the radial ribs and upwardly around the circumferential edge of the upper plate and cover, a circular series of upwardly directed air-holes adjacent the edge of the upper plate, and a second concentric circular series of upwardly and inwardly directed air-holes formed in the upwardly sloping rim of the dished portion of the main plate so that the air from these holes will impinge against the air from the inner holes and combine with the gas to supply a circular flame projecting upwardly and inwardly into the combustion chamber.

2. A gas burner comprising a main metallic plate adapted to separate an air-supply chamber from a combustion chamber, said plate being

centrally dished so that the plate comprises a central substantially circular horizontal portion surrounded by an upwardly and outwardly sloping rim extending to a main outer horizontal portion, an upper substantially circular metallic plate having downwardly projecting radial ribs which rest on the flat-central portion of the main plate within the dished recess and support the upper plate in spaced position above the main plate, a covering of refractory material mounted on the upper surface of the upper circular plate, the main plate having an opening in its central portion for receiving gas from a supply-pipe said gas flowing outwardly between the radial ribs and upwardly around the circumferential edge of the upper plate and cover, a circular series of upwardly directed air-holes adjacent the edge of the upper plate, and a second concentric circular series of upwardly and inwardly directed air-holes formed in the upwardly sloping rim of the dished portion of the main plate so that the air from these holes will impinge against the air from the inner holes and combine with the gas to supply a circular flame projecting upwardly and inwardly into the combustion chamber.

3. A gas burner comprising a main metallic plate adapted to separate an air-supply chamber from a combustion chamber, said plate being centrally dished so that the plate comprises a central substantially circular horizontal portion surrounded by an upwardly and outwardly sloping rim extending to a main outer horizontal portion, an upper substantially circular metallic plate having downwardly projecting radial ribs which rest on the flat-central portion of the main plate within the dished recess and support the upper plate in spaced position above the main plate, the main plate having an opening in its central portion for receiving gas from a supply-pipe said gas flowing outwardly between the radial ribs and upwardly around the circumferential edge of the upper plate, a circular series of upwardly directed air-holes adjacent the edge of the upper plate, a second concentric circular series of upwardly and inwardly directed air-holes formed in the upwardly sloping rim of the dished portion of the main plate so that the air from these holes will impinge against the air from the inner holes and combine with the gas to supply a circular flame projecting upwardly and inwardly into the combustion chamber, and a third outer concentric series of air holes in the upper outer flat portion of the main plate and directed upwardly and outwardly.

4. A gas burner comprising a main metallic plate adapted to separate an air-supply chamber from a combustion chamber, said plate being centrally dished so that the plate comprises a central substantially circular horizontal portion surrounded by an upwardly and outwardly sloping rim extending to a main outer horizontal portion, an upper substantially circular metallic plate having downwardly projecting radial ribs which rest on the flat central portion of the main plate within the dished recess and support the upper plate in spaced position above the main plate, a covering of refractory material mounted on the upper surface of the upper circular plate, the main plate having an opening in its central portion for receiving gas from a supply-pipe said gas flowing outwardly between the radial ribs and upwardly around the circumferential edge of the upper plate and cover, a circular series of upwardly directed air-holes adjacent the edge of the upper plate, a second concentric circular

series of upwardly and inwardly directed air-holes formed in the upwardly sloping rim of the dished portion of the main plate so that the air from these holes will impinge against the air from the inner holes and combine with the gas to supply a circular flame projecting upwardly and inwardly into the combustion chamber, and a third outer concentric series of air-holes in the upper outer flat portion of the main plate and directed upwardly and outwardly.

5. In combination, a burner assembly adapted to be positioned transversely in a housing so as to separate a lower air-inlet chamber from an upper combustion chamber, said assembly comprising a main metallic plate, a substantially circular upper burner plate supported on and spaced from said main plate by a plurality of substantially radial ribs, and means communicating with the central portion of the space between the plates for supplying gas thereto under substantially atmospheric pressure, there being a substantially circular series of upwardly directed air-openings formed through the main plate and leading from the air inlet chamber into the combustion chamber at locations adjacent the outer edge of the upper plate so that jets of air directed upwardly from these openings will draw gas from between the plates into the combustion chamber, and means including a conduit communicating with said air openings for creating said upwardly directed air jets.

6. In combination, a burner assembly adapted to be positioned transversely in a housing so as to separate a lower air-inlet chamber from an upper combustion chamber, said assembly comprising a main metallic plate, a substantially circular upper burner plate supported on and spaced from said main plate by a plurality of substantially radial ribs, a top covering of refractory material on said upper plate, and means communicating with the central portion of the space between the plates for supplying gas thereto under substantially atmospheric pressure, there being a substantially circular series of upwardly directed air-openings formed through the main plate and leading from the air inlet chamber into the combustion chamber at locations adjacent the outer edge of the upper plate so that jets of air drawn upwardly through these openings will flow across the space between the plates to draw gas from said space into the combustion chamber, and suction means including a conduit communicating with said air openings for drawing said jets of air upwardly therethrough.

7. In combination, a burner assembly adapted to be positioned transversely in a housing so as to separate a lower air-inlet chamber from an upper combustion chamber, said assembly comprising a main metallic plate, a substantially circular upper burner plate supported on and spaced from said main plate by a plurality of substantially radial ribs, and means communicating with the central portion of the space between the plates for supplying gas thereto under substantially atmospheric pressure so that this gas will flow evenly between the ribs into the combustion chamber, there being a substantially circular series of upwardly directed air-openings formed through the main plate and leading into the combustion chamber at locations adjacent the circumference of the upper plate, a second series of air-openings concentric with the first series and being spaced outwardly in radial alignment with and inclined toward the openings of the first series so that the air streams

forced upwardly through both series of openings will impinge against one another to retard their rate of movement and form with the gas drawn from between the plates a circular flame projecting upwardly and inwardly into the combustion chamber above the upper plate and suction means communicating with said air openings for drawing air upwardly therethrough.

8. In combination, a burner assembly adapted to be positioned transversely in a housing so as to separate a lower air-inlet chamber from an upper combustion chamber, said assembly comprising a main metallic plate, a substantially circular upper burner plate supported on and spaced from said main plate by a plurality of substantially radial ribs, and means communicating with the central portion of the space between the plates for supplying gas thereto under substantially atmospheric pressure so that this gas will flow evenly between the ribs into the combustion chamber, there being a substantially circular series of upwardly directed air-openings formed through the main plate and leading into the combustion chamber at locations adjacent the circumference of the upper plate, a second series of air-openings concentric with the first series and being spaced outwardly in radial alignment with and inclined toward the openings of the first series so that the air streams forced upwardly through both series of openings will impinge against one another and form with the gas drawn from between the plates a circular flame projecting upwardly and inwardly into the combustion chamber above the upper plate, there being a third circular series of air-openings through the main plate, outside of the second series and directed upwardly and outwardly and suction means for drawing air upwardly through said air openings.

9. In combination, a gas burner comprising a main plate adapted to separate an air supply chamber from a combustion chamber and including a centrally dished circular portion having a flat bottom portion connected by an upwardly sloping wall to an outer horizontal flange portion, an upper plate arranged in the dished portion of the main plate and having downwardly projecting radial ribs which rest on the flat bottom portion of the main plate and define shallow passages for directing gas from a central supply opening to the outer edge of the upper plate, means for delivering gas into said shallow passage at substantially atmospheric pressure there being a series of upwardly directed air holes formed in the main plate adjacent to the edge of the upper plate so that upwardly directed streams of air therefrom will flow across and in close relation to the discharge ends of said gas passages to withdraw gas therefrom and form an aerated gaseous stream and a second series of upwardly and inwardly directed air holes formed in the said sloping wall of the dished portion of the main plate in lateral alignment with the first mentioned air holes whereby streams of air from these holes impinge against the said aerated gaseous stream to reduce the velocity thereof and to mix therewith, and means for causing said streams of air to flow from said air holes.

10. In combination, a gas burner positioned transversely in a housing so as to separate a lower air inlet chamber from an upper combustion chamber, there being a gas inlet passage in the burner for delivering gas laterally at a location above the bottom of the burner, means

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for delivering gas to said gas inlet passage at substantially atmospheric pressure and the burner having also concentric rows of upwardly directed air openings, the inner row of which is positioned below the gas inlet, whereby jets of air directed upwardly from said air openings across said inlet withdraw gas therefrom to form an aerated gaseous mixture, and another row of said air openings being positioned with their axes inclined in a direction toward the first mentioned row of openings, whereby the air jets from said concentric rows of openings impinge at a location above the gas inlet to reduce their velocity and effect further aeration of the mixture, and suction means communicating through said housing with said air inlet openings for drawing said jets of air upwardly therethrough.

11. In combination, a burner assembly having a gas inlet passage therein and a series of air inlet openings positioned to direct jets of air across the discharge end of the gas passage, means for delivering gas to said gas inlet passage at substantially atmospheric pressure, and air jet producing means communicating with said air openings for forcing jets of air therefrom, whereby the gas is withdrawn from said passage by the inspirating action of the air jets; the burner assembly being also provided with a second series of air openings communicating with said air jet producing means and inclined toward the first mentioned series of openings so that the air jets from the second series of air openings impinge against the jets from the first mentioned series of openings to retard the velocity thereof and spread the gaseous mixture at a location beyond the gas passage.

12. In a heat generator in which a partial vacuum created in the upper portion of the generator creates a suction to draw air and fuel into a combustion space thereof; a casing enclosing said combustion space and an air supply chamber and having a door opening leading into said combustion space; a closure for said opening pivotally supported normally in a partially open position and adapted to be drawn to a closed position by said vacuum; a gas burner positioned to extend across the casing below said door opening to separate the combustion space of said casing from said air supply chamber and comprising a plate structure having gas and air ports to deliver gas and air into said combustion space

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and having also a depressed recess formed in one outer portion of the plate structure adjacent said door opening; and a pilot burner housed within said recess whereby the position of said pilot burner relative to said door opening permits the products of combustion from the pilot burner to vent through the partially open door of said casing upon cessation of the suction within the combustion chamber and the pilot flame is protected from the draft drawn through said door opening during the starting cycle of the burner.

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