June 10, 1941. K. F. HARTMANN 2,244,910

HEATER

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FIG_1_

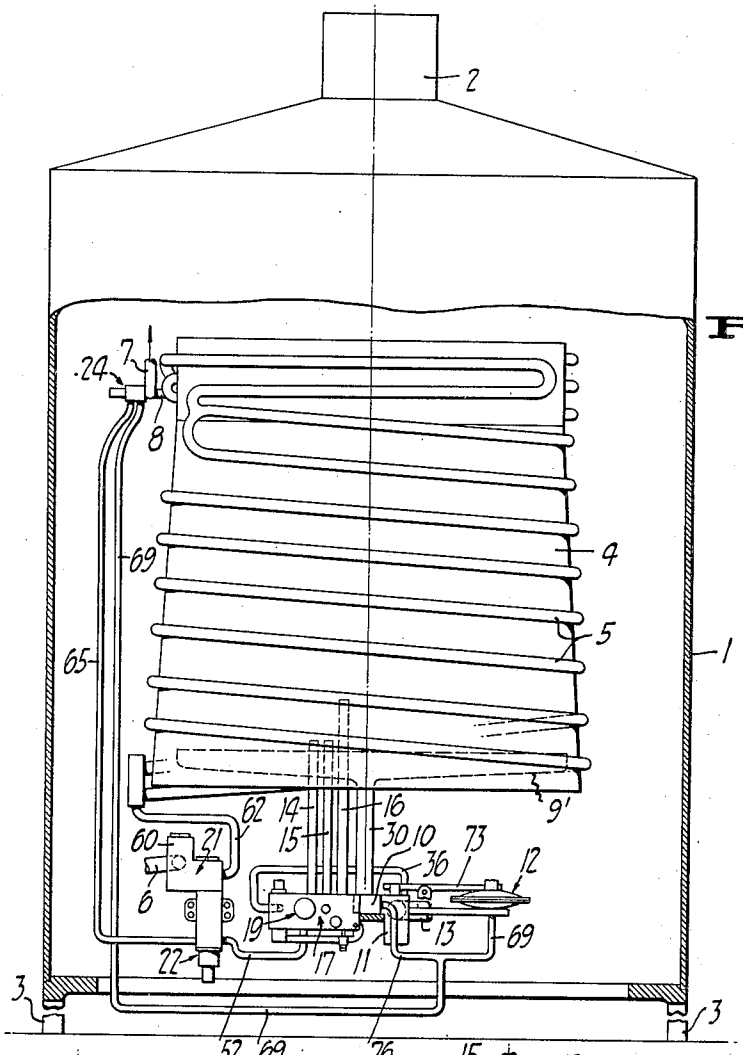
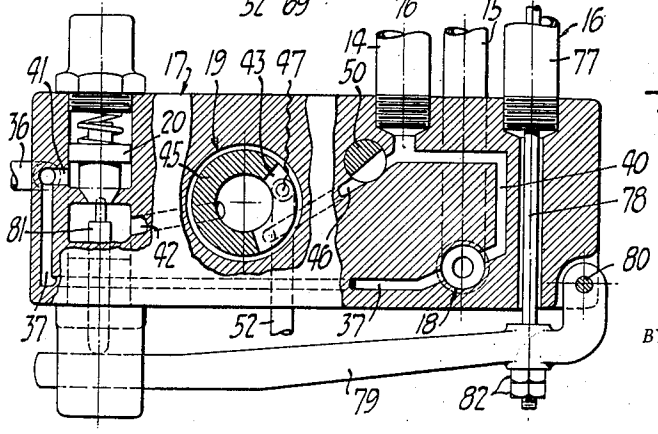


FIG_10_



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HEATER

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FIG. 2.

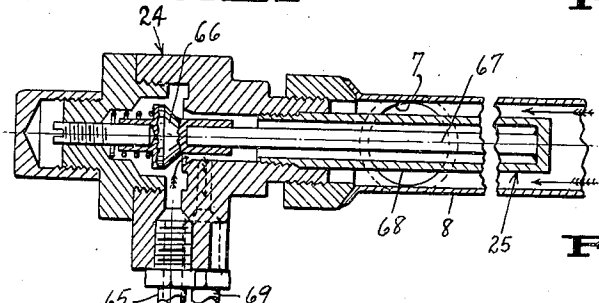


FIG. 3.

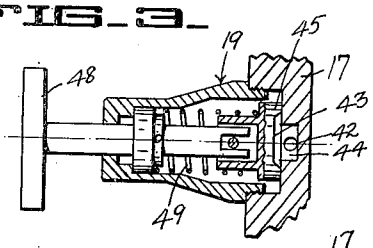


FIG. 4.

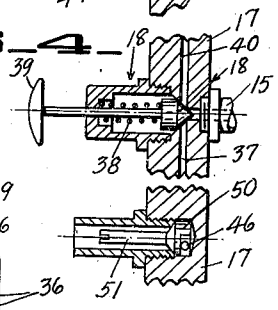
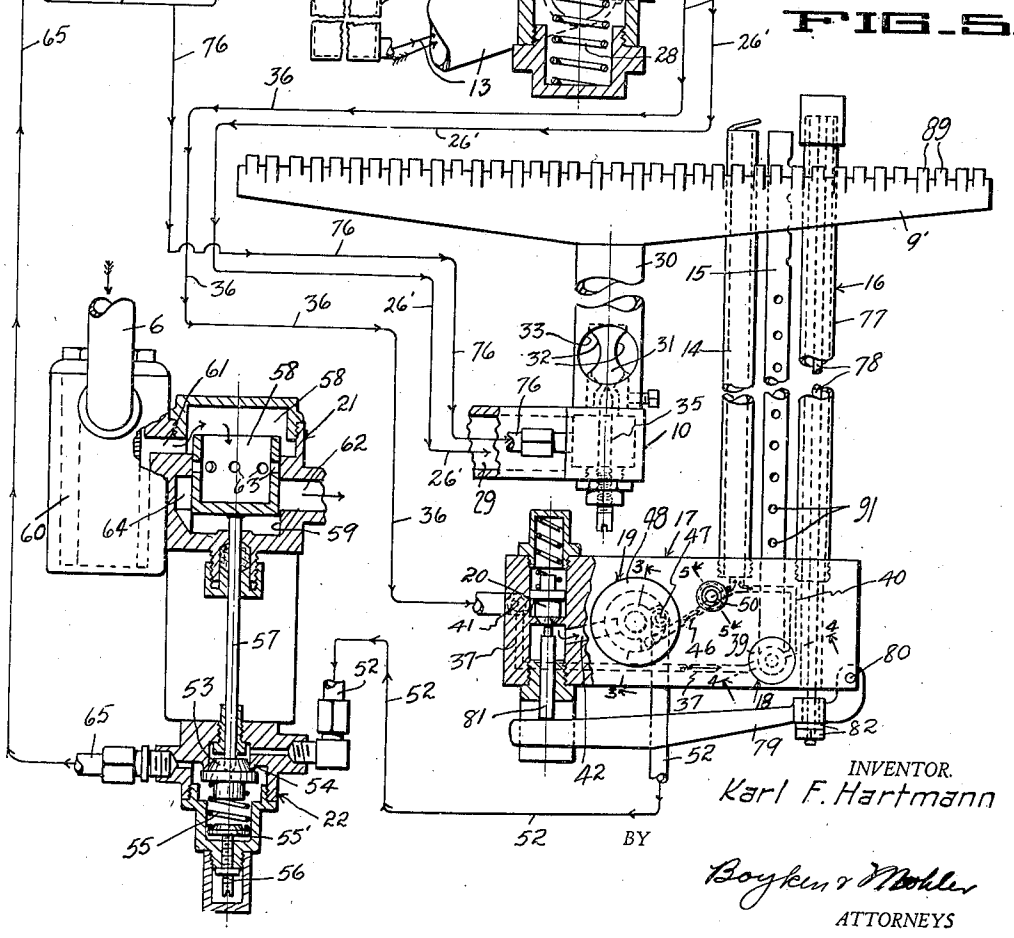


FIG. 5.



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FIG. 6.

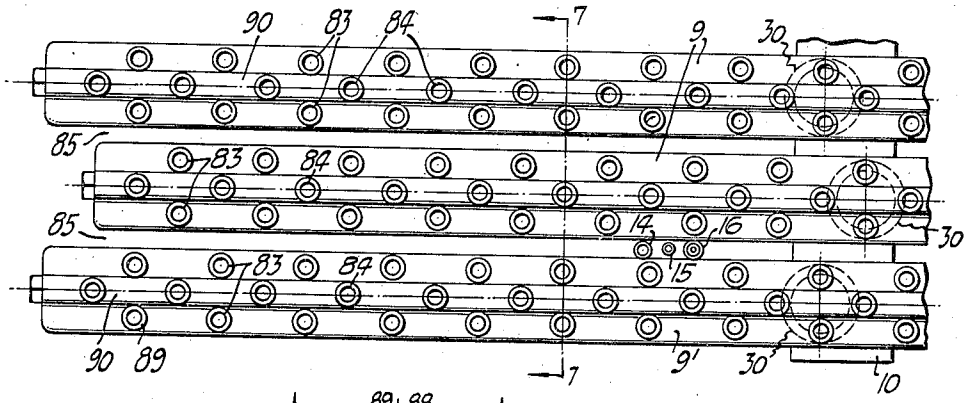


FIG. 7.

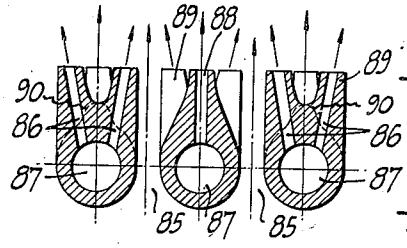


FIG. 8.

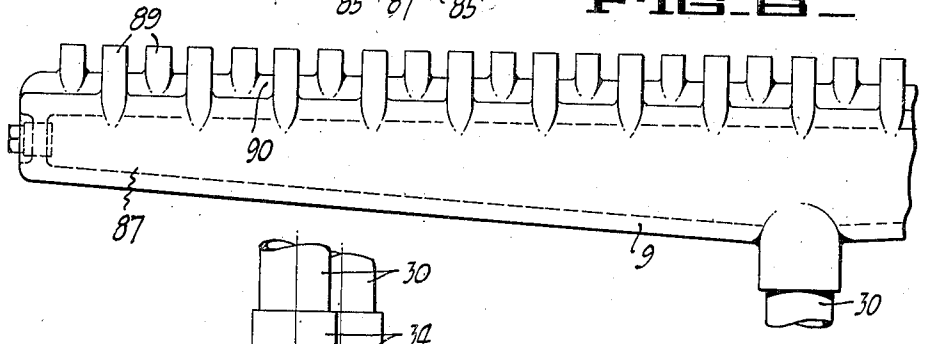
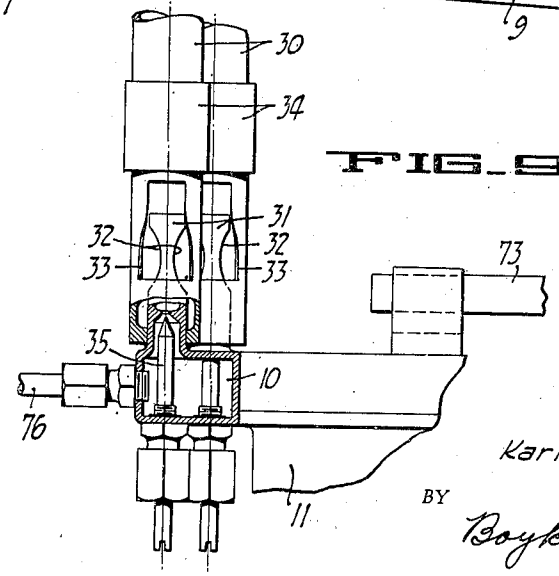


FIG. 9.



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UNITED STATES PATENT OFFICE

2,244,910

HEATER

Karl F. Hartmann, San Francisco, Calif., assignor of one-half to Morgan J. Doyle, San Francisco, Calif.

Application August 27, 1938, Serial No. 227,135

2 Claims. (Cl. 236—23)

This invention relates to heaters generally, and particularly to gas water heaters of the so-called "instantaneous" type.

One object of the invention is the provision of improved means for controlling the gas for more efficiently maintaining the flow of gas proportional to the water temperature thereby insuring high heat transfer efficiency.

Another object is the provision of improved burners in a heater and an improved arrangement of burners for delivering the maximum heat from the fuel.

Another object is an improved control for the flow of gas to the burners in which relatively small pressure variations in the gas to one burner functions to control the flow of gas to the main burners of which said one of the burners may be a unit.

Other objects and advantages will appear in the description and drawings.

In the drawings, Fig. 1 is a vertical sectional view through a heater indicating in elevation the position of the various elements of my invention relative to the hot water coil, and to the burners.

Fig. 2 is a schematic layout, showing the various elements of the invention partly in section and partly in elevation, the inlet and outlet ends only of the water coil being shown.

Fig. 3 is an enlarged sectional view taken along the line 3—3 of Fig. 2.

Fig. 4 is an enlarged sectional view taken along the line 4—4 of Fig. 2.

Fig. 5 is an enlarged sectional view taken along the line 5—5 of Fig. 2.

Fig. 6 is an enlarged plan view of several of the main burners in my heater, the burners being shown broken off at one of their ends to accommodate the sheet.

Fig. 7 is a sectional view taken along the line 7—7 of Fig. 6.

Fig. 8 is an elevational view of one of the burners of Fig. 6.

Fig. 9 is a part sectional part elevational view of the gas inlet manifold and spuds for feeding gas to each of the burners of Fig. 8.

Fig. 10 is an enlarged part sectional view of the valve block carrying the pilot operated valve, showing more clearly the various ducts in said block.

Referring to Fig. 1, which generally illustrates the various elements in a heater, the outer housing is designated 1, which housing is provided with any suitable flue 2 at its upper end, the lower end being substantially open for admission of air for combustion, and legs 3 are adapted to support the housing elevated above the floor although it is obvious that wall brackets or any other conventional means may be employed instead.

Within the housing 1 is a conventional vertically extending, open-ended, tubular shell 4, provided with one or several runs of water pipes 5 in the form of a coil wound around the same and extending backward and forward across the open upper end of the shell substantially the same as shown in United States patent of October 18, 1932, No. 1,883,733. No claim is made to the shell and water coil per se, since any conventional coil may be used that provides a cold water inlet and a hot water outlet.

In the drawings, the cold water inlet conduit is indicated at 6 and the hot water outlet at 7, the return run of pipe extending across the upper open end of the shell from which the water of highest temperature is drawn being indicated at 8.

The various elements hereinafter described are shown in detail in Figs. 2 to 9, more particularly in Fig. 2, while the principal elements are generally indicated in Fig. 1 in their relation in the heater.

Within the lower end of shell 4 is a horizontal row of horizontally elongated burners 9, disposed in parallel, side by side relation, as best indicated in Fig. 6, the end burner 9' being indicated in Fig. 2. Each of the burners receives gas from a manifold 10 and gas to the manifold is admitted through a main gas valve 11, which valve is actuated to open and close by actuation of a diaphragm type pressure device 12. The gas inlet conduit to the main gas valve is best indicated in Fig. 2 at 13, the source of gas under pressure being indicated at 13'.

A pilot burner 14, lighter burner 15 and a thermostat device 16, are all preferably mounted on a single valve block 17, which valve block carries manually operated valves 18, 19 (Figs. 3, 4) automatically actuated valve 20 (Fig. 2), which latter valve is operated by expansion and contraction of the thermostat device 16 by heat from the main burners. Communicating gas ducts within the block will be later described more in detail. A water motor 21 of the piston type, actuates a gas valve 22 to open and close the flow of gas through the valve to a thermally actuated valve 24, which latter valve is held open at all times when the heat within the last run of the hot water pipe 8 is not excessive or dangerous, and in which latter case the valve will close by reason of thermostat device 25 in said pipe 8.

Referring to the detailed structure shown in Fig. 2 the gas from the main gas main enters the valve housing, generally indicated at 11 on one side of movable disk valve 26, which valve is normally urged toward seat 27 by a coil spring 28.

The manifold 10 is preferably formed as a part of the valve housing 11 and passageway 29 on the opposite side of seat 27 from the inlet conduit 13 leads to the manifold 10, which manifold supports vertically extending pipes 30, each of which pipes support one of the main gas burners and conducts gas thereto. Within the lower ends of each of the pipes 30 is a relatively short, vertically disposed spud 31 of smaller diameter than the diameter of the pipes 30, so as to be spaced from the walls of the latter.

The spuds 31 are provided with relatively large, horizontally aligned openings 32 in two opposite sides thereof and the two opposite sides of the lower ends of pipe 30 at right angles to the openings 32 are provided with horizontally aligned openings 33. The openings 33 may be circular as shown in Fig. 2 or vertically elongated as shown in Fig. 9, and as shown in the latter view, I preferably provide a sleeve 34 adapted to slide vertically to any desired degree for varying the size of openings 33 as desired. The upper end of spuds 31 terminate, preferably, adjacent the upper ends of openings 33.

This structure has been found to eliminate backfiring of the burners when the burners are turned out or are lighted, or when the gas is at abnormally low pressure.

The gas to each burner may be controlled as desired by a needle valve 35 extending through the lower wall of the manifold toward a seat within the spuds.

When the valve 26 is closed, no gas will flow to the manifold.

A small gas pipe 36 extends from valve 11 to the block 17 and communicates at the block with an open duct 37 therein leading to the lighter valve 18, which lighter valve is normally held in closed position by a spring 38 (Fig. 4), the valve being adapted to be pulled open against compression of the spring by a handle 39. A duct 40 in the block, and also normally closed at one end by valve 18, extends to the lower end of the pilot burner 14, and the lighter tube, also closed at its lower end by valve 18, extends directly from said valve. Thus, all flow of gas in duct 37 and line 36 past valve 18 is stopped when the valve 18 is seated in closed position, but when the latter is opened, gas from the main line 13 will pass to the pilot and lighter tube simultaneously.

From the side of valve 26 opposite the pipe 36, gas may pass from line 13 into manifold passageway 29 for passage to the main burners 9, 9' when valve 26 is opened.

From the gas line 36, where it connects with block 17, a short duct 41 in said block leads to one side of the valve 20 and when valve 20 is actuated to open by reason of heat applied to the thermostat device 16, the gas will be permitted to pass to the opposite side of valve 20 where it passes into a duct 42 to the manually operated valve 19.

Said valve 19 (Fig. 3) is of the flat, rotary, annular, disk type in which the seating surface of the disk is cut away at part of its axially facing seating surface as at 43 and the seating surface of the block is centrally recessed at 44, in alignment with a central recess in the movable valve disk 45. The duct 42 communicates with said central recess 44 and said central recess in the valve disk for passage radially of the axis of said disk through the cutout portion 43. Said cutout portion 43 is normally over one of the open ends of ducts 46, 47 (Fig. 2), but upon rotating the disk, both ducts will be closed by the disk. However, the valve is normally in open position at all times, but may be turned by a handle 48, and the disk is resiliently urged to seating position by a coil spring 49 (Fig. 3).

The duct 46 leads to the pilot past a manual control valve 50 (Fig. 5) which valve is used to regulate the amount of gas passing through the duct to the pilot. The valve is of the rotary type with a stem 51 for turning the same.

From duct 47, extends a gas pipe 52 which conducts gas to the gas valve 22 that is controlled by the water motor 21.

Valve 22 comprises a movable disk valve member 53 within the valve block 22, which valve is held closed against a valve seat 54 by a coil spring 55, the tension of which spring is varied by a cap 55' that is engaged by a screw 56. The side of the valve disk 53 opposite the spring 55 is engaged by one end of a piston rod 57, the opposite end of which rod carries a piston 58 within a cylinder 59 in the block 21.

The water for actuating the motor enters a conventional filter chamber 60 through the cold water intake conduit 6 and from the filter chamber passes through passageway 61 into cylinder 59 and over the outer end of the cylinder. This water is, of course, under pressure, being connected direct to a water main. When the water pressure in cylinder 59 on the opposite side of the piston is relieved by opening a faucet (not shown) in the hot water line from the heater, and which line connects with discharge port 62, the piston will at once be moved downwardly by the water to fully open gas valve 53 irrespective of the degree of opening of the faucet, since the spring 55 that normally forces the valve 53 and the piston, upwardly, is adjusted to permit the piston to readily move under a slight differential in pressure at opposite sides thereof. The ports 63 in the piston uncover an annular recess 64 in the wall of cylinder 59, which recess communicates with port 62 to permit full flow of water through the piston, as desired.

When valve disk 53 is closed, no gas flow is possible through line 52 past the valve, but upon opening valve 53 the gas passes the valve to a gas line 65 leading to the valve housing 24, which housing contains the valve actuated by the thermostat 25, and which thermostat is responsive to temperature in the outgoing hot water line 8.

A taper, disk valve 66 in housing 24 connects with one end of a rod 67, and the opposite end of the rod is welded or brazed to a cap closing the outer end of a longitudinally expansible and contractable copper pipe 68, said rod extending into said pipe. The opposite end of pipe 68 is connected to the valve housing and the pipe 68 extends into and is spaced from the sides of the hot water outlet pipe 8. When the water in pipe 8 is cold, the valve 66 is wide open, and gas from line 65 passes the valve opening and into one end of gas line 69, which gas line connects at its opposite end with a chamber at one side of a flexible, pressure responsive diaphragm 70 in the diaphragm device 12.

The valve 66 is not intended to fully close unless a dangerously high heat develops in the

hot water line of the heater, and the thermostat device is positioned at the point of greatest heat.

The diaphragm 70 carries a pin 72 that engages a lever 73 pivoted at 74, and the outer end of lever 73, or the end on the side of pivot 74 opposite pin 72, engages a pin 75 which latter pin engages valve 26 for moving said valve to and from closed position according to the degree of movement of the diaphragm.

A branch line 76 extends from gas line 69, said branch line extending to the one burner 9' in said bank or row of main burners, said line 69 feeding gas directly into the spud at the lower end of said burner.

The thermostat device actuating the pilot valve 20, is similar to the device 25 that is in the hot water line, comprising a copper pipe 77 enclosing a rod 78 which rod is secured to the upper end of said pipe. The lower end of pipe 77 is secured to the valve block 17 and rod 78 extends at its lower end through the block and through a lever 79, which lever 79 is pivoted at 80 at one side of rod 78 and the opposite end at the opposite side engages a pin 81, which pin connects with valve member 20 for opening the valve member upon the lever being drawn toward the pin. The rod 78 is secured to the lower side of lever 79 by nuts 82, and upon the pipe 77 being heated by the main burners or burner 9' above which it extends at its upper end, the pipe will expand, carrying rod 78 upwardly to pivot lever 79 for opening the valve 20. Pipe 77 also receives sufficient heat from pilot 14 and the lighter tube, when the latter is ignited, to cause opening of said valve 20.

Referring back to Figs. 6 to 9, the main burners 9 and burner 9' are of cast metal, each burner being provided with three rows of spaced apertures respectively extending longitudinally of the body of the burner. The apertures 83 of the outer rows are disposed in opposed relation laterally across the upper edge of the burner, while the apertures 84 of the central row are offset longitudinally of the rows to positions midway between the apertures of the outer two rows, as best indicated in Fig. 6.

The burners themselves are spaced apart as at 85 thus providing for free flow of secondary air, for combustion, to the burner apertures, the primary air being admitted through openings 33 in the lower ends of the pipes 30.

Alternate burners are offset longitudinally so as to position the apertures of the outer rows of one burner of each pair opposite the apertures of the central row of the adjacent burner of the pair.

Divergently extending passageways 86 (Fig. 7) extend upwardly at an angle of about 10° relative to a vertical plane longitudinally bisecting each burner, the inner ends of the passageway opening directly into the longitudinally extending chamber 87 in each of the burners, which chamber is of decreasing cross-section in directions away from opposite sides of the gas pipes 30.

Vertical passageways 88 extend between the central apertures 84 and chamber 87. The upper ends of passageways 86, 88 extend through nipples 89 that project upwardly from the body of each burner, and the upper side of each burner is preferably formed with a relatively narrow ridge 90 to provide downwardly diverging opposite sides from the apex of each ridge.

The bodies of the burners are relatively flat in a vertical plane, so as to not take up excessive space when arranged in a row, and the arrows indicated in Fig. 7 clearly illustrate that the flow of secondary air to the gas ejected from the burner apertures is greatly augmented by reason of the arrangement of the apertures of the burners relatively, and the divergently directed passageways and apertures of the outer rows of apertures in each burner. In fact, I have found that this arrangement and construction enormously increases the B. t. u. output over burners in which the apertures are all vertically directed, or in which only divergent apertures are used.

In the general arrangement illustrated in Fig. 2, the heater is in inoperative position with the burners and pilot extinguished.

In operation, the operator opens the lighter valve 18, permitting gas to flow to the pilot 14 and to the lighter, and immediately the thermostat 16 expands opening the valve 20 which in turn permits gas to pass directly to the pilot through duct 46, and the flame from the pilot plays on the thermostat device 16 to hold the pilot valve 20 open, when valve 18 may be released, closing the line to the lighter burner and to the pilot, said lighter tube being ignited at the lower openings 91 when valve 18 is opened for carrying the flame to the upper end of the pilot and heating the thermostat at the same time.

The pilot light will now stay lighted, being fed gas from gas line 36.

Immediately upon opening the water line to flow of water through the water valve, the gas valve 53 will open, permitting gas passing valve 20 to the normally open valve 19 to pass to the open valve 24 through line 65 and back to both the diaphragm device 12 and to the burner 9'.

The burner 9' will, of course, be immediately lighted by the pilot, and the gas pressure against diaphragm 70 will cause the main valve 26 to open permitting gas to flow to the main burners 9, which will be ignited in turn, and the water passing through the coils 5 will be heated. Numeral 26' designates line to main burners.

The hot water passing through the discharge pipe 8 will cause the thermostat 25 to gradually move valve 66 toward closed position, which movement will not materially affect the flow of gas unless only a small stream of water is being withdrawn from the hot water faucet, in which case the closing movement of valve 66 will be augmented by reason of the temperature of the water and the pressure in line 69 will be decreased, causing valve 26 to move toward closed position for reducing the flame in the burners 9, but burner 9' will still continue to receive gas through line 76 which connects with the line 69.

The sensitiveness of the diaphragm 70 to movement is sufficient to maintain the temperature of the water delivered from the hot water line within a variation of about 2° F. since the only escape of gas from relatively small gas line 69 is through the burner 9', and not to all of the burners.

The control by a small "relief" burner, which is the term I use for burner 9', is particularly important, since the variation in pressure on the diaphragm is controlled by the rate at which the gas in line 76 may pass through the apertures of burner 9' and the control is not, as heretofore attempted, through variations in water pressure or through attempting to control the temperatures through variations in pressure in a gas line leading to the main burners.

Having described my invention, I claim:

1. In a gas heater the combination comprising

a burner, a main conduit connected with a source of gas under pressure for conducting gas under pressure to the burner, a movable pressure actuated diaphragm valve at a point in said conduit for controlling the flow of gas in the conduit to said burner, a second conduit connected with said source of gas under pressure, gas pressure actuated means responsive for movement to variations in the pressure of gas in said second conduit operatively connected with said movable valve for moving said valve between open and closed position thereof upon variations in pressure in said second conduit, said second conduit being restricted to pass a lesser volume of gas therethrough than the main conduit and said second conduit being formed with a relief port open at all times for discharging the gas therefrom, a water conduit positioned to be heated by said burner for heating the water within the water conduit, a thermo-responsive device in said water conduit responsive for movement to variations in the temperature of the water in said water conduit, a valve in said second conduit operatively connected with said thermo-responsive device for movement from normally open position toward closed position upon increase in temperature of the water, a normally closed water actuated valve in said second gas conduit and means in said water conduit responsive for movement to the dynamic pressure of water flowing in said water conduit connected with said water actuated valve and arranged and adapted to substantially fully open said water actuated valve upon substantially any flow of water in said water conduit, and both of said valves in said second conduit positioned between the point of connection between said second conduit and said main conduit and the point of connection of said second conduit and said pressure actuated diaphragm valve.

2. A gas water heater comprising in combination, a coil for water provided with an inlet and outlet at opposite ends of the coil, a main gas burner positioned below the coil for heating the water therein, a main gas conduit connected with a source of gas under pressure, a main valve connecting between said main gas conduit and main gas burner for controlling the flow of gas from the conduit to the burner, a second gas burner adjacent said main gas burner, a second gas conduit communicating between the main gas conduit at the side thereof adjacent the source of gas and said second gas burner, a pressure actuated device communicating with said second conduit for actuation thereof by gas pressure in said second conduit, main valve actuating means connecting between said device and said main gas valve for actuating the latter for movement between fully opened and closed position, a thermally responsive device at a point in said coil adjacent said outlet responsive for movement upon variations in the temperature of the water passing from said coil, a control valve in said second conduit positioned at a point before the gas therein passes to said pressure actuated device for controlling the flow of gas to said pressure actuated device, control valve actuating means connecting between said thermally responsive device and said control device for actuation of said control valve between fully opened and closed position by said thermally responsive device whereby the amount of gas passing to said pressure actuated device for actuating said device is controlled by actuation of the thermally responsive device in the coil, a water actuated device in said coil adjacent the inlet adapted to move in one direction upon flow of water in the coil from the inlet to the outlet thereof, a water controlled gas valve positioned in said second conduit at a point between said control valve and said main gas conduit, means operatively connecting between said water actuated device and said water controlled valve arranged and adapted to cause said water controlled valve to move to fully opened position upon flow of any amount of water past said inlet to said outlet, heat responsive means responsive for movement in opposite directions upon heating and cooling thereof positioned to be heated by a pilot burner, a pilot burner adjacent the main gas burner positioned to cause heating of said heat responsive device, a pilot actuated valve positioned at a point in said second conduit between said water actuated valve and said main gas conduit, and means operatively connecting between said heat responsive means and said pilot actuated valve for moving said valve to opened position upon movement of said heat responsive means when the latter is heated by said pilot burner.

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