

Oct. 8, 1968

K. G. ALBERT

3,404,674

HEAT EXCHANGE APPARATUS FOR THE EMPLOYMENT OF FLUE GAS HEAT

Filed July 25, 1967

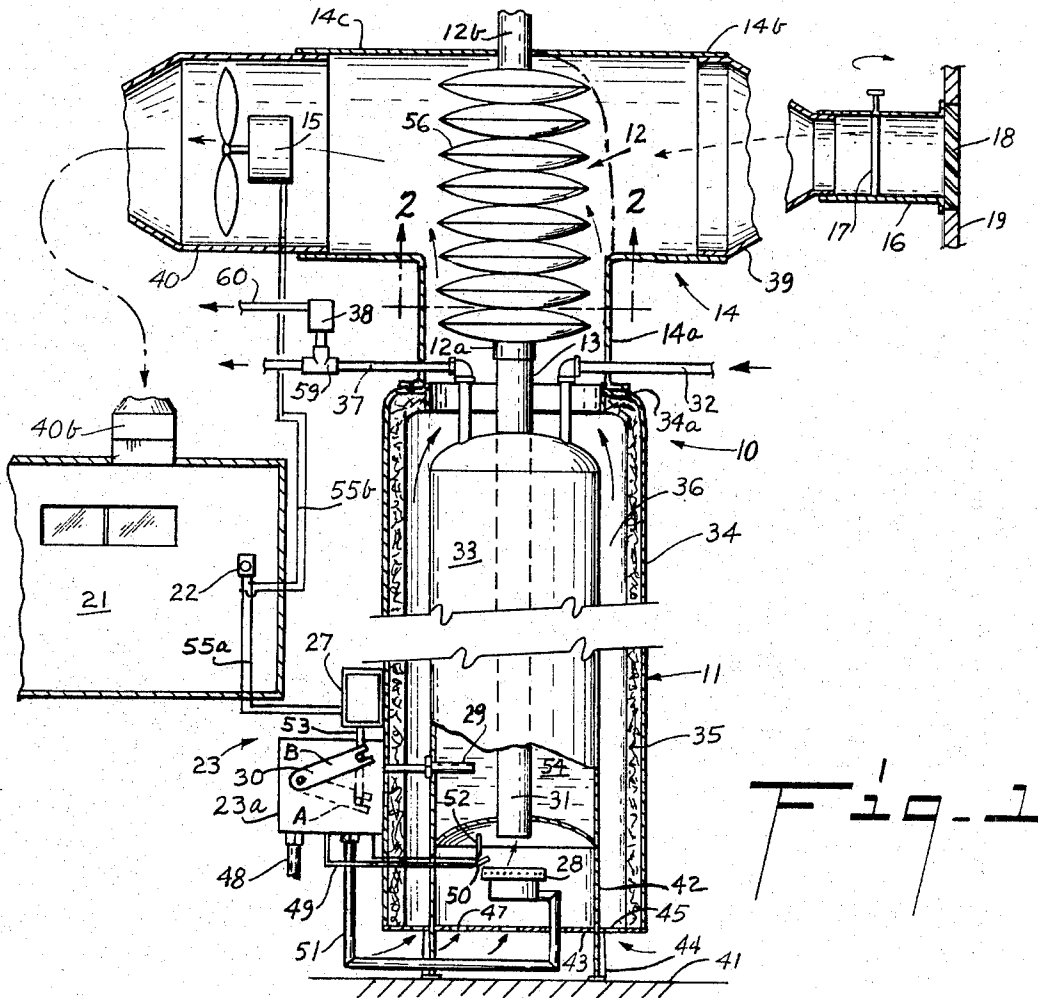


Fig. 1

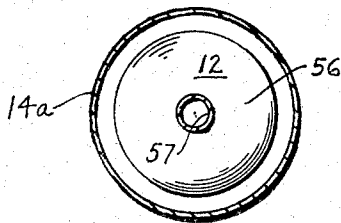


Fig. 2

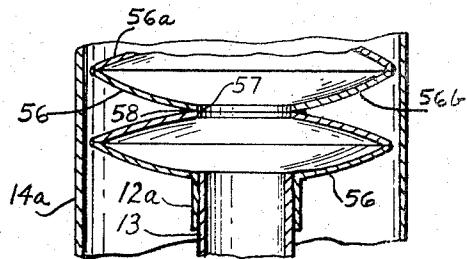


Fig. 3

INVENTOR.

KRIS G. ALBERT

BY

Wm. E. Ford

ATTORNEY

1

3,404,674

HEAT EXCHANGE APPARATUS FOR THE EMPLOYMENT OF FLUE GAS HEAT

Kris G. Albert, 3411 Timmons Lane,
Houston, Tex. 77027

Filed July 25, 1967, Ser. No. 655,802
10 Claims. (Cl. 126—101)

ABSTRACT OF THE DISCLOSURE

The invention comprises heat exchanger apparatus and controls for using flue gas heat to heat selected air and directing it to a space to be heated within a predetermined temperature range. The controls include a solenoid actuated by a space temperature controlling thermostat, at its lower temperature limit, so that the solenoid operates an aquastat including a thermostat in the medium that a burner normally heats, to raise the operative temperature range at which the flue gas emanating burner ordinarily turns on and off. When the air directed over the heat exchanger raises the space temperature to its predetermined upper limit, the aquastat acts to return the burner controls to turn the burner on and off, as under ordinary conditions.

The invention relates to means for using flue gas in heat exchange relation with selected air to heat a selected space, controls raising the range of the burner controlling thermostat responsive to the demands of the space to be heated, and when this is accomplished the controls for the burner being reset for normal burner operation to heat the medium which it ordinarily heats.

It is a primary object of the invention to employ the residual heat in flue gas from a burner designed for a primary purpose and direct selected air over the flue gas in heat exchange relation for the purpose of heating a preselected space, the thermostat which controls the turning on and off of the burner for primary purpose heating being reset to operate the burner within a higher temperature range until the space heat requirements are satisfied, at which time controls return the burner to normal operation.

It is also another object of the invention to employ residual flue gas heat to heat selected air in manner that a preselected space may be heated until its requirements are satisfied, at which times controls return the burner operation which provides the flue gas, to operate within a lower temperature range at which the burner normally operates.

It is also an important object of the invention to employ residual flue gas from the burner of a hot water heater, and to direct preselected air, comprised at least in part of jacket air, over the flue gas in heat exchange relation, then to direct the air thus heated to a preselected space to be heated; the space thermostat then to take over control and operate an aquastat control device to reset the hot water heater thermostat to operate the burner at a higher temperature range until the space is heated to a predetermined desired temperature, the space thermostat then operating to reset the water heater thermostat to a lower temperature range setting to turn the burner on and off as normally designed for operation of the water heater.

It is yet another and important object of this invention to provide heat exchanger apparatus of this class for the employment of flue gas, in which a relief valve control by-pass is provided from the hot water heater discharge and set at a predetermined higher temperature above normal water heater upper temperature control limit, while the water heater thermostat temperature range is set by space thermostat operation; the relief valve thus

2

operating to bleed off hot water to make way for the admission of cold water into the hot water heater so that the burner runs under space thermostat until space temperature control setting requirements are met.

It is another and special object of this invention to provide heat exchanger apparatus for flue gas employment of this class, in which the flue gas is passed through a heat exchanger installable on the top of a conventional water heater.

It is also a further object of the invention to provide flue gas employing heat exchanger apparatus of this class which may include a T-shaped duct with lower leg to seat upon, or to be installed around, the top of a conventional water heater, a blower being installed in a horizontal leg and reversible in summer to ventilate out another horizontal leg.

Other and further objects will be apparent when the specification hereinbelow is considered in connection with the drawings, in which:

FIG. 1 is an elevational view, part in section and partially diagrammatic, of a preferred embodiment, with heat exchanger installed upon a conventional water heater in manner to circulate jacket air and external air, as desired, and to deliver the heated air to a space, as a room to be heated, the aquastat comprising an important part of the invention being shown diagrammatically as installed on a lower part of the water heater jacket;

FIG. 2 is a sectional bottom view, taken along line 2—2 of FIG. 1, showing heat exchanger section and vertical duct relationship; and

FIG. 3 is an enlarged, fragmentary, sectional elevational view taken through the two lowermost heat exchanger elements shown in FIG. 1.

Referring now to the drawings in which like reference numerals are applied to like elements in the various views, a special heat exchanger and conventional water heater 10, includes water heater 11 with heat exchanger 12 installed upon the upper end of the water heater flue pipe 13. A T-shaped duct 14 is installed above the water heater with lower leg 14a to seat upon the top 34a of the water heater outer jacket 34. Thus the heat exchanger 12, having a lower nipple 12a press-fitted or connected upon the water heater flue pipe 13, supports the heat exchanger 12 which upstands through the central portion of the T-shaped duct 14, with a vent or upper discharge pipe 12b extending from the top of the heat exchanger 12 upwardly through the top of the duct 14, centrally thereof, to be directed to discharge substantially spent flue gases, as desired.

The right leg 14b of the T-shaped duct 14 is shown having a reduction duct 39 connected thereto to which a reduced diameter terminal duct 16 is shown terminating outwardly in a louver 18 in a wall 19, representative, for instance, of the outer wall of the building. A damper 17 is shown installed across the outlet duct 16 to be turned to control the degree of air passage therethrough, as may be desired.

The left leg 14c of the T-shaped duct 14 is shown having a discharge duct 40 connected thereto, as an extension of the leg 14c, the duct 40 being carried by extensions which may comprise an elbow, as indicated by the phantom line with downwardly pointing arrowhead, to terminate downwardly in an inlet 40b into a room, plant, or other space 21 to be heated by the air passed over the heat exchanger 12. The duct 40b and the room or space 21 and its appurtenances are shown to reduced scale or substantially diagrammatically for purposes of clarity.

The water heater 11 is of conventional design in which an annular water chamber 33 supported from a base or floor 41 as by a cylindrical lower end 42 a base plate 43 extends across the lower end 42, and outwardly thereof,

and is shown supported by legs 44. This plate 43 peripherally supports the cylindrical plate jacket, or outer shell 34 of the water heater, and the cylindrical, insulative jacket material 35 therewithin. Fairly large diameter perforations 45 are equally, angularly spaced around the base plate 43 to admit room air into the annular space 36 between the insulation 35 of the jacket and the hot water heater shell 33. Also fairly large diameter perforations 47 are provided in the plate 43 generally below and outwardly of the burner 28 so that room air may pass between the legs 44 and upwardly through the openings 47 to support the combustion of burner gas and thereafter pass upwardly as part of the products of combustion through the flue gas pipe 31 and the heat exchanger 12 thereabove.

An aquastat 23 with box 23a is installed on the water heater outer shell or cylindrical plate 34 of the insulation jacket 35, and supply gas enters the aquastat box 23a through a supply gas conduit 48, and therein a small amount of gas is needed off to pass through a conduit 49 to carry pilot gas to the vicinity of the burner 28, as indicated at 50. The main gas supply continues from the aquastat housing 23 and as the conduit 51 delivers burner gas into the interior of the burner 28.

The thermostat 29 connects within the aquastat box 23a with a thermostatic igniter 52 in manner that, to whatever lower temperature the thermostat 29 is set to respond, it actuates the thermostatic igniter 52 to ignite the gas which is set free to flow from the supply line 49 via the gas line 51 upon actuation of the thermostat 29 at its lower control limit.

The aquastat assembly 23 is controlled by a solenoid box 27 having an armature 53 which has a cross-member to be connected between the forks of a bifurcated arm 30 which is pivotally mounted upon pivot means within the aquastat box 23a. When the temperature of the space or room 21 is above its lowermost temperature to which the thermostat 22 in the room 21 is set to respond, the arm 30 occupies the position A shown in dotted lines in FIG. 1, and the thermostat 29 is preset at say a nominal 160 degrees to operate the burner 28 to turn on and off to keep the water 54 at this normal hot water heater nominal 160 degree range.

Now, when the temperature of the space or room 21 falls to the lowermost temperature at which the thermostat 22 is set to close circuit through the conductors 55a to the solenoid windings in the solenoid box 27, the solenoid is energized so that the armature 53 pivots the arm 30 upwardly to position B shown in full lines in FIG. 1, which pivots means within the aquastat box 23a to reset the thermostat 29 so that the gas turn-off point is raised substantially higher, say to a 200 degree nominal setting. At this point the thermostat 22 also closes circuit through the conductors 55b, parallel with the circuit 55a, to start the blower 15.

The blower 15 is indicated as drawing the jacket air from the space 36 between jacket 34 and water heater 33 to pass tortuously about and over the heat exchanger elements 56 of the heat exchanger 12, to be further described hereinbelow as to details of construction. The jacket air is previously preheated in passing around the water heater shell 33 and there is a further pick-up of B.t.u.'s from the flue gas heat so that it can be delivered in such a heated state as to bring the room or space 21 up to maximum temperature in short order to actuate the thermostat 22.

In case it may be desirable to mix other air, as outside air, with the jacket air, as if it should be desirable slowly to heat up the room or space 21, or in cases where otherwise it would be desirable to augment the jacket air, of relatively small volume, with an additional volume of air in some volume, the damper 17 may be turned to admit air, as through the louver 18, to pass by way of the duct leg 14b over the heat exchanger elements 56, the dotted line to the right of the heat exchanger 12 in FIG. 1.

The heat exchanger 12 may be of various constructions, and as shown in FIGS. 2 and 3, each element 56 is com-

posed of two peripherally connected, thin, metallic, concavely opposed, or dished plates, 56a, 56b. The plates 56a, 56b are bored centrally, substantially to the diameter of the flue gas pipe 13, and outwardly of the bores 57 the plates may be joined together as by welding 58, and/or other mechanical means.

In order to keep the burner 28 burning continuously, and thus continuously to supply flue gas through the heat exchanger 12, thus to bring the temperature of the space or room 21 up to desired temperature as quickly as possible, it is only necessary to install a T 59 in the hot water discharge line 37, and extend a by-pass line or drain 60 therefrom. A relief valve 38 may be installed therein, preset to open at a hot water temperature say of 180 degrees, or intermediate the normal position A setting of the solenoid actuated arm 30 and the overriding or upper limiting temperature of 200 degrees, position B setting of the solenoid actuated arm 30.

Thus the burner 28 is never shut off by the thermostat 29, as could otherwise happen should the hot water 54 reach the degree temperature of the raised setting of the thermostat 29, before the temperature of the space or room 21 reaches the upper limiting temperature at which the thermostat 22 is set to close down the blower 15 and to actuate the solenoid to move the arm 30 to position B. Rather, as the discharging hot water reaches the temperature of 180 degrees, the relief valve 38 opens to drain off hot water through the by-pass line 60, and the pressurized cold water supply line 32 urges cold water into the hot water heater shell 33 thus to lower the temperature of the hot water under burner heat, so that the burner 28 continues to burn and provide flue gas, as the thermostat 29 has not been affected by water at a temperature high enough to actuate it.

Obviously, the invention is not limited to the structures shown in the drawings as exemplary, but other structures are considered, and flue gas from other than hot water heaters may be used to supply a source of heat exchange heat, and certainly heat exchangers of other than the construction shown may be displayed. In fact the invention considers all the various constructions, combinations, and variations that may fall within the broad spirit of the invention, and within the broad scope of interpretation claimed for, and merited by, the appended claims.

What is claimed is:

1. For employment with a flue gas emanating burner, a medium to be heated by the burner, a first thermostat to control the turning on and off of the burner within a first predetermined temperature range of said medium, and an inlet of the medium into, and a discharge of the medium from burner heating proximity, the combination of heat exchanger means disposed to receive the flue gas therethrough, duct means to channelize air to be heated over said heat exchanger means and thence to a preselected space to be heated, blower means for the direction of the air through said duct means, a second thermostat in said space, an aquastat including said first thermostat, a solenoid, solenoid actuated means, and burner gas passage therethrough to said burner, said second thermostat being connected to operate at a lower space temperature to start said blower means and to actuate said solenoid to move said solenoid actuated means to change said first thermostat setting to operate at a higher temperature range, and to operate at a higher space temperature to stop said blower means and to actuate said solenoid to move said solenoid actuated means to change said first thermostat back to operate at said first temperature range.

2. The combination of a hot water heater and a heat exchanger and associated apparatus in which said hot water heater conventionally includes a water heating tank, an air jacket therearound, a cold water inlet into, and a hot water discharge from said tank, a flue gas pipe therethrough, a burner below said tank and flue gas pipe, and a first thermostat responsive to the temperature of the

5

water in the tank to turn the burner on and off within a first predetermined temperature range of the water, said heat exchanger and associated apparatus including heat exchanger means installable upon said flue gas pipe, duct means to a space to be heated, blower means in said duct means to blow air including jacket air to a space to be heated, a second thermostat in said space operable at a space temperature predetermined minimum to start said blower means, an aquastat including said first thermostat and a solenoid also operable by said second thermostat to shift the setting of said first thermostat to turn on and off said burner at a higher temperature range, whereby said burner is operated to supply flue gas through said heat exchanger until said space is heated to a predetermined maximum, said second thermostat then being operable to actuate said solenoid to shift the setting of said first thermostat to turn on and off said burner at a lower temperature range to satisfy only water heater requirements.

3. The combination as claimed in claim 1, in which a by-pass conduit is provided from said outlet having a relief valve therein to open at a predetermined temperature above the upper temperature limit of the first predetermined temperature range of the first thermostat and below said higher temperature range, thus to drain off said heated medium for entry of said medium via said inlet, whereby said burner burns continuously until said space is heated to requirements to set second thermostat in action as aforesaid.

4. The combination as claimed in claim 2, in which a by-pass is provided from said hot water heater tank discharge to open at a predetermined temperature above said first temperature range upper limit and below said higher temperature range, whereby to drain off the heated water for entry of cold water into said tank through said cold water inlet, whereby said burner burns continuously until said space is heated to said predetermined maximum, said second thermostat then being operable as aforesaid.

6

5. The combination as claimed in claim 2 in which said duct means includes a lower leg of substantially the water heater diameter, to fit thereon as an extension thereof.

6. The combination as claimed in claim 2 in which said duct means includes a lower leg of lesser than hot water heater diameter to sit thereupon and to receive jacket air upwardly thereinto.

7. The combination as claimed in claim 2 in which said blower means is reversible for summer usage, and in which said duct means includes a stale air outlet, whereby said blower means may evacuate jacket and other air, during off usage seasons.

8. The combination as claimed in claim 1 in which said duct means comprises an elbow.

9. The combination as claimed in claim 1 in which said heat exchanger means comprises successively disposed heat exchanger units of thin, concavely facing or dished plates joined together peripherally, and with central opening means through each unit of substantially flue gas pipe diameter, successive units being joined together by welding outwardly of said central opening means.

10. The combination as claimed in claim 2 in which said heat exchanger means comprises successively disposed heat exchanger units of thin, concavely facing or dished plates joined together peripherally, and with central opening means through each unit of substantially flue gas pipe diameter, successive units being joined together by welding outwardly of said central opening means.

References Cited

UNITED STATES PATENTS

1,506,775	9/1924	Roe	126—101
2,529,977	11/1950	Thomas	126—101
2,833,268	5/1958	Warren	126—101
3,033,192	5/1962	Bogren	126—101

JAMES W. WESTHAVER, *Primary Examiner.*