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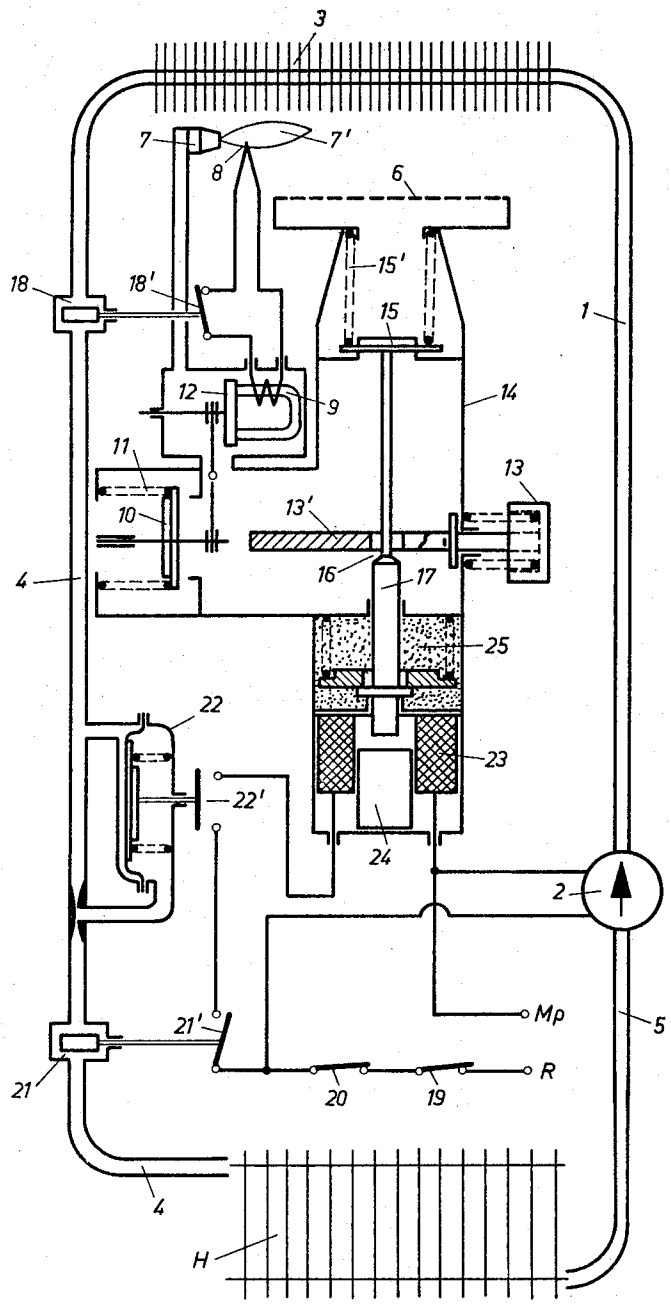

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GAS-HEATED CONTINUOUS-FLOW HEATER FOR HOT-WATER CIRCULATION HEATING

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ABSTRACT OF THE DISCLOSURE

A hot water heating system has a gas heater, a radiator (which might be any type of heat utilization apparatus) and an electric pump to circulate the water thru a water circuit which includes the heater, the radiator and the pump. The gas heater includes a main burner and a pilot light. Through a main gas valve gas is supplied from the mains to both the pilot light and to the main burner. A push rod is provided to open the main gas valve, with the main valve being held open by an electro-magnet provided that the pilot light is burning. A thermo-electric device supplies electricity to the electro-magnet through a circuit which includes a switch controlled by a thermostatic element in the water circuit to open the switch in the event of excess temperature in the water circuit.

Between the main gas valve and the main burner is a safety valve which is normally urged toward the closed position by a spring. The safety valve is opened by an electro-magnet and a dashpot is connected thereto so as to slow the opening of the safety valve. The electromagnet for the safety valve is connected in a series circuit including four switches. One of these switches is controlled by a flow sensing device in the water circuit to close the switch only when water circulation is occurring. A second switch is controlled by a thermo-responsive element in the water circuit to close the switch only when the water temperature is below a given measurement. The portion of the circuit that includes these two switches and the safety valve electro-magnet are connected in parallel with the water pump for the water circuit. The third switch is the house thermostat switch or the like, and the fourth switch is the main disconnect switch. The push rod to operate the main gas switch has an interlock with the safety valve, operating so that if the safety valve is open, the push rod cannot be moved so as to open the main gas valve. The main gas valve can only be opened by the push rod when the safety valve is closed.

Background of the invention

The present invention relates to a gas-heated continuous-flow heater serving as heat source for a hot-water circulation heating. It is known in such apparatus in connection with a circulating pump to provide a differential pressure switch acting as water-deficiency safety device, controlling a safety valve in the gas path. Commonly, the differential pressure switch with a slow-ignition device acts directly on the safety valve of the gas path. Therefore, a relatively large diaphragm switch is used as differential pressure switch.

As compared therewith, in the present invention the

safety valve is actuated indirectly by an electro-magnetic servo device operating with delay in opening direction, such as a solenoid with hydraulic brake, which device may be switched on by a contact controlled by the differential pressure switch. In other words this means that instead of the safety valve commonly actuated directly by a diaphragm switch with slow-ignition device, a magnet valve with a slow-ignition device such as an oil brake is utilized and is switched on and off by a relatively small and simple differential pressure switch.

Such a magnet valve with dynamic differential pressure-controlled contact results in a relatively small unit which may readily be accommodated on the apparatus instead of the large diaphragm switch. Further, additional considerable advantages result by the invention. The magnet valve cannot only be actuated by the dynamic differential pressure, but also by other control elements such as, for instance, a thermostat connected between heat exchanger and heating system or a return flow thermostat, for which purpose an addition magnet valve is otherwise required in the gas path. Above all, upon actuation of the magnet valve by a control element (thermostat) the slow-ignition device remains active. Instead of a magnet valve operating with solenoid, a valve also may be used which is actuated by an electric servomotor. As differential pressure switch a relatively small diaphragm system or a lever switch movable by the water stream or the like may be used.

By the invention also the problem is solved to provide for a control of the gas supply acting with slow-ignition, with circulating pump continuing to operate. Provision may be made that the electric circuit of the servo device having the differential pressure switch contact connected therein and the contact of a control thermostat is parallel to the electric circuit of the circulating pump. Then, by the control thermostat for instance in a connecting pipe between heat exchanger and heating system the gas supply may be cut off and turned on again with slow ignition, without the circulating pump being switched off and on again.

In continuous-flow heaters it is known to arrange a main gas valve in the gas path in front of the water-deficiency safety valve, maintained in open position by a thermo-electric pilot safety device and adapted to be opened manually by a stem. In prior art thermo-electric pilot safety devices of the type indicated there is provided an auxiliary valve connected with the stem of the main valve and maintaining the gas path closed until the opened main gas valve is retained by the retaining magnet excited by the thermo-electric current. Such an auxiliary valve may however, be dispensed with, if in further modification of the invention the stem of the main gas valve is locked in a manner known per se with an open water-deficiency safety valve. Then, the electro-magnetically controlled valve of the water-deficiency safety device simultaneously assumes the function of this auxiliary valve. In the electric circuit of the thermo-electric pilot safety device there may be provided in a manner known per se a circuit-breaker actuated by a thermostat arranged in the water circulation path. Thereby, at the least expense, all control possibilities are provided required for a continuous-flow heater serving as heat source for a circulation heating.

A continuous-flow heater of the type indicated is schematically illustrated in the drawing as embodiment of the present invention and described more fully as follows:

The water circulating in a heating circuit including pipe 1 is fed by means of a pump 2 through a heater 3 and via a line 4 connected between heater and heating system enters into the radiators H of a heating system. After heat emission thereof the water via a return flow line 5 and pump 2 returns to heater 3. For heating a burner 6 is used being controlled by a pilot flame 7'. The pilot flame 7' of pilot burner 7 heats a thermoelement 8 whereby an electromagnet 9 is excited in known manner. Through an armature plate 12, electromagnet 9 holds a main gas valve 10 in open position against a spring force 11 and keeps the gas available in dependence on the pilot burner flame for supply of the burner 6. By means of a push-button 13 on the gas section 14 for starting the apparatus the gas valve 10 may be opened through a slider 13', whereby pilot gas flows to the pilot burner 7, and the armature plate 12 caused to bear against the magnet 9. The auxiliary valve plate customary in such safety-gas sections, which interrupts the gas passage to the burner 6 until the armature plate 12 is retained in abutting engagement by the magnet 9, is replaced here by a safety valve 15. This is possible in that the push-button 13' may only be pressed in as long as the safety valve 15 is closed and a lock 16 formed by the stem 17 of safety valve 15 is opened. The thermo-electric circuit is controlled by a temperature-limiting device 18 and the electric switch thereof 18'. The temperature-limiting device 18 is incorporated in line 4 in close vicinity to the heat exchanger 3.

The safety valve 15 loaded by a spring 15' is controlled by a solenoid 23 via stem 17, which retracts its solenoid core 24 and raises stem 17. Stem 17 has connected therewith a hydraulic brake 25 or dashpot delaying the upstroke.

In line 4 connected between heat exchanger and heating system there is incorporated a thermostat 21 closing a contact 21' at a predetermined temperature. A differential pressure switch 22 connected to line 4 closes a contact 22' in dependence on a water flow in line 4. The contacts 21', 22' are connected in series in the electric circuit of solenoid 23 and that part of the circuit is in parallel with the electric circuit of the circulating pump 2. In the circuit of circulating pump 2 and solenoid 23 there is connected the contact 19 of a main switch and a contact 20 of a room thermostat not shown. The thermo-electric pilot safety device being ready to operate, the electric main switch 19 of a line circuit is closed manually. Provided the room thermostat maintains its contact 20 closed, the pump 2 starts operating. The differential pressure switch 22 closes switch 22'. Thereby, when contact 21' is closed solenoid 23 is energized and the magnet core 24 is pulled up and raises lifting pin 17, the oil brake 25 delaying opening of the safety valve 15. Burner 6 now heats the circulating water through heater 3. When thermostat 21 reaches the adjusted temperature, it opens the circuit of the solenoid 23 via its switch 21', so that the safety valve 15 is closed by its spring 15' and heating is interrupted. However, the pump 2 continues to feed the water to circulate. Only when the thermostat 21 connected between the heat exchanger and the heating system cools off, is switch 21' again closed so that via the flow switch 22, 22' is closed because of water circulation, the solenoid 23 again opens the safety valve 15 with delay and starts the burner 6.

If contact 20 upon response of the room thermostat is opened, both the pump 2 and the solenoid 23 are switched off. Since there is then no water circulating, the flow switch 22 as additional safeguard interrupts the circuit of the magnet also via switch 22'. As the thermo-electric device 8 remains ready to operate, the apparatus automatically starts operating with closure of the room thermostat contact 20.

If the temperature in the line between heat exchanger and heating system and the temperature of the heat exchanger 3, respectively, increases unduly, the temperature-limiting device 18 responds and interrupts the thermo-electric circuit as at 18'. Then magnet 9 via the armature plate 12 releases the valve plate 10 which is moved into closed position by its spring 11 to shut off the gas. The burner 6 is extinguished.

Valve 10 may not be caused to assume its open position until stem 17 has returned into its position of rest. This can only happen, if the electric main switch 19 of the line circuit is being switched off. This also stops the circulating pump 2 and the flow switch in turn opens the electric circuit of solenoid 23 via switch 22' additionally for safety reasons.

In the meantime the temperature-limiting device 18 has cooled off again and has again closed its thermo-electric switch 18'. Now, for re-operation all requirements are fulfilled, particularly since thermostat 21 has likewise closed its switch 21' due to cooling-off thereof.

The invention is claimed as follows:

1. In a hot water heating system including a gas heater with a burner and pilot light, a radiator and an electric pump to circulate the water through the water circuit including the heater and radiator, and means through which gas is supplied to the burner and pilot light, the improvement comprising: a safety valve connected between the burner and said means and resiliently urged to the closed position; an electro-magnetic servo device including a solenoid and connected to the safety valve to force the valve to the open position upon the energizing of the solenoid; water differential controlled means connected in the water circuit and including an electrical switch which is open when water is not circulating and closed when water is circulating; a series electrical circuit including said switch and said solenoid; and means connected to said valve to slow the opening of the valve in response to said forcing when said solenoid is energized; whereby when water is circulating and said electrical circuit is closed, said safety valve will move slowly to the open position to supply gas to said burner if said gas supply means is supplying gas.

2. In a system as set forth in claim 1 wherein said means to slow the opening of the valve is a dashpot.

3. In a system as set forth in claim 2, including temperature responsive means connected to the water circuit to respond to the water temperature and including second electrical switch which is closed when said water temperature is below a given setting and is open when said water temperature is above said setting, said second switch being in said series electrical circuit.

4. In a system as set forth in claim 3, wherein said pump is connected in parallel with that portion of the series electrical circuit that includes said switches and said solenoid.

5. In a system as set forth in claim 4, wherein said gas supply means includes a main gas valve and main valve opening means including a thermo-electric safety device connected to the main gas valve to permit the opening of the main gas valve only when the pilot light is burning, said main valve opening means including an interlock operatively associated with said safety valve to prevent said main valve from being moved from the closed to the open position when said safety valve is in the open position.

6. In a system as set forth in claim 5, wherein said gas supply means includes temperature responsive means connected to the water circuit to respond to the water temperature and including a pilot electric control device connected to the thermo electric safety device to close the main gas valve with an excessive temperature in said water circuit.

7. In a system as set forth in claim 2, wherein said gas supply means includes a main gas valve and main valve opening means including a thermo electric safety device connected to the main gas valve to permit the opening of

the main gas valve only when the pilot light is burning, said main valve opening means including an interlock operatively associated with said safety valve to prevent said main valve from being moved from the closed to the open position when said safety valve is in the open position.

8. In a system as set forth in claim 7, wherein said gas supply means includes temperature responsive means connected to the water circuit to respond to the water temperature and including a pilot electric control device connected to the thermo electric safety devie to close the main gas valve with an excessive temperature in said water circuit.

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