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3,304,003

HEATING SYSTEM

Filed June 15, 1965

3 Sheets-Sheet 1

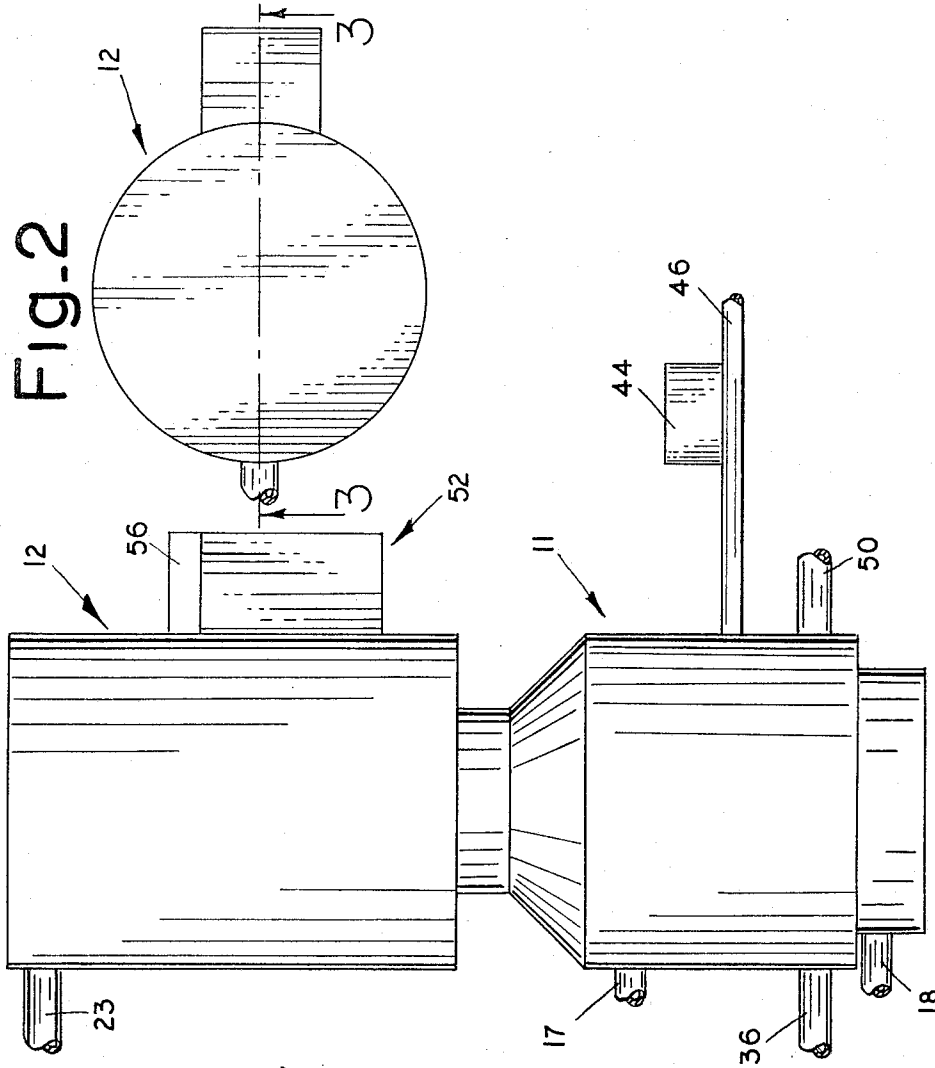


Fig. 1

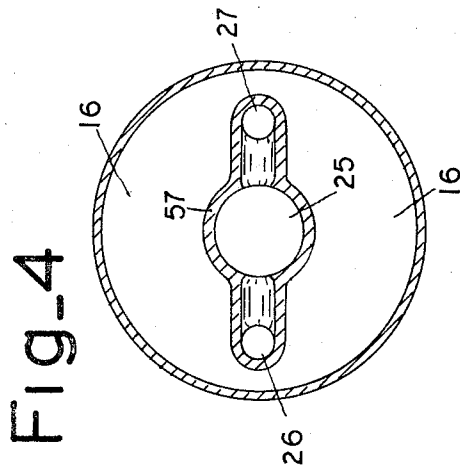


Fig. 4

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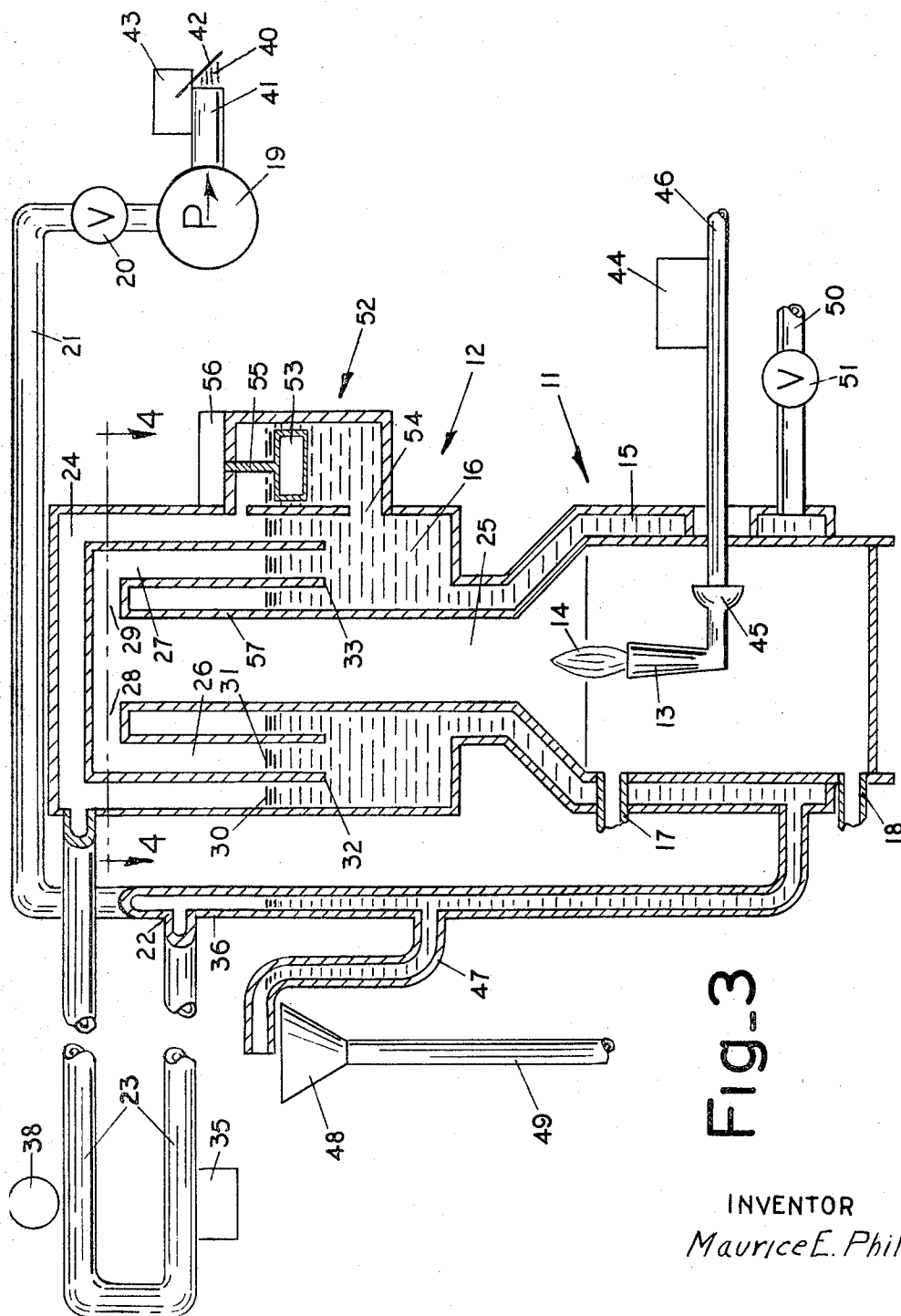
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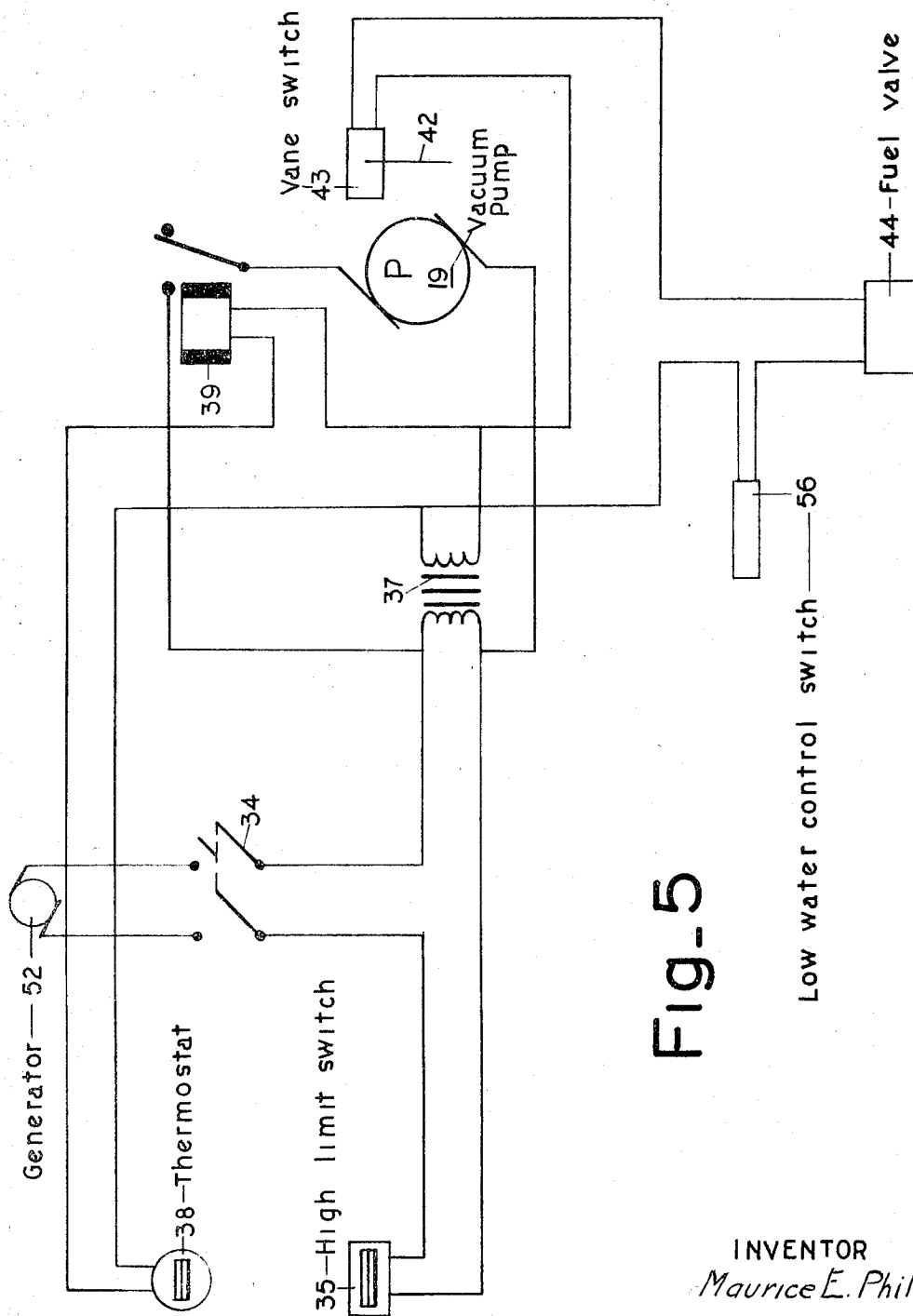


Fig-5

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HEATING SYSTEM

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This invention relates to a novel system for heating in which a fuel is burned in a combustion chamber and steam, generated in another chamber located and specifically designed for economical absorption of the heat of combustion, is mixed with the flue gases including the products of combustion, and the mixture of the flue gases and steam is circulated through devices designed to utilize the energy in the mixture for heating.

An object of the invention is to economical use of the fuel burned by a near perfect utilization of the heat of combustion.

Another object of the invention is elimination of the conventional chimney commonly used in connection with a heating system burning fuel in a combustion chamber.

Another object of the invention is automatic control of the water level in a steam heating system by simple means.

A further object of the invention is the provision of safety features in a steam heating system.

Other objects and advantages of the invention may be apparent as it is more fully understood from the following description and the accompanying drawings which together disclose a preferred embodiment.

Referring to the drawings:

FIGURE 1 is an elevation of the combustion chamber and heat absorbing means with piping broken away.

FIGURE 2 is a plan view of the combustion chamber and heat absorbing means of FIGURE 1 with piping broken away.

FIGURE 3 is a section taken along the line 3-3 of FIGURE 2 with piping and accessories making up the heating system shown in full.

FIGURE 4 is a section taken along the line 4-4 of FIGURE 3.

FIGURE 5 is a wiring diagram showing the interconnection between the parts of the system shown in FIGURE 3.

A preferred embodiment of the invention is illustrated in drawings 1 to 5 inclusive which define a system for absorbing and transferring the heat of combustion of a fuel to water producing steam and circulating this steam together with the flue gases including the products of combustion of the fuel through a radiating system or a conducting system for final utilization of the heat of combustion to the greatest possible degree of efficiency.

Referring to FIGURE 1, an absorption chamber 12 is situated above and connected rigidly to a combustion chamber 11 wherein a fuel of any combustible variety is burned. I have chosen to illustrate my invention by means of a system burning a gas fed through pipe 46 (FIGURE 3) in a burner 13 producing a flame 14. The combustion chamber 11 is completely surrounded by jacketing water 15 which absorbs some of the heat radiated from flame 14, and this heat is carried by conduction and convection to the water 16 in absorption chamber 12. The products of combustion in most cases are water and oxides of carbon and hydro-carbons of the original fuel. The oxygen is supplied by the air admitted to the combustion chamber through vents 17 and 18. These vents preferably lead to an abundant supply of air as found beyond the outer wall of a building. To insure a sufficient supply of air at all times I have provided in this system a vacuum pump 19 which connects to the system through valve 20 and pipe 21, thence through T fitting 22 and radiation pipes 23, back to the steam chamber 24 of ab-

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sorption chamber 12. It will at once be seen that under the influence of vacuum pump 19 a lowered pressure, less than atmosphere, will be induced over water 16 in absorption chamber 12. Up to this time air in combustion chamber 11 has been at atmospheric pressure because of the free connection with outside air through vents 17 and 18. This atmospheric pressure also exists in flue 25 and in superheater pipes 26 and 27 connected to flue 25 by short horizontal pipes 28 and 29. When vacuum pump 19 is set in motion, the air at reduced pressure induced over the surface of water 16 as at 30 and the air at atmospheric pressure over water 16 within superheater pipes 26 and 27 as at 31 are at imbalance which will tend to cause the water level in superheater tubes 26 and 27 to be lowered and to cause the level of the water in absorption chamber 12 to rise. When the level of the water in superheater tubes 26 and 27 reaches the lower end of the superheater tubes at 32 and 33 the air in tubes 26 and 27 will travel downward through the tubes out the lower ends at 32 and 33 and then bubble up through water 16 into steam chamber 24 and thence through pipes 23 and 21 and vacuum pump 19 and be exhausted to the atmosphere.

To set the heating system in operation master switch 34 (FIGURE 5) is closed completing a circuit from generator 52, which represents the power source, through high limit switch 35, which is a bimetallic thermostatic switch physically attached to the piping of the radiation section of the system at a point near the condensate return 36 (FIGURE 3). High limit switch 35 is normally closed and opens with a rise in temperature. The closing of master switch 34 now energizes transformer 37 providing low voltage across the secondary winding which connects through thermostat 38 to relay 39. Thermostat 38 is located near the space or object to be heated and has a bimetallic element that causes the thermostat to close when heat is required. Since the system when starting up is cold, thermostat 38 will pass current through relay 39 to vacuum pump 19 setting it in action pumping air through the system as explained above. There is at all times a pilot flame or fire burning at burner 13 (FIGURE 3) whose combustion is supported by the oxygen content of air passing by convection in and out of vents 18 and 17 in combustion chamber 11. As soon as master switch 34 (FIGURE 5) is closed energizing transformer 37 and relay 39 and setting vacuum pump 19 in action, the exhaust air 40 issuing from exhausts tube 41 of vacuum pump 19 (FIGURE 3) impinges on rotatably mounted vane 42 of vane switch 43 causing vane switch 43 to close and complete a circuit from the secondary of transformer 37 through fuel valve 44. I have included another safety feature in my heating system in the form of low water control switch 56 (FIGURES 3 and 5) which is located in the fuel valve circuit and acts to break the circuit to fuel valve 44 and shut down the fuel supply if the water level in the system reaches a dangerously low point. As may be seen from FIGURE 3, a float 53 buoyed up by water 16 entering through passage 54 to low water control switch 52 acts through push rod 55 to keep the contacts of low water control switch 56 closed at all times when the water is at a safe level. Should the surface 30 of water 16 be lowered to within 1/2 inch of the lower ends 32 and 33 of superheater tubes 26 and 27 contact between the points of low water control switch 56 would be broken closing fuel valve 44 and shutting down the fuel supply. When fuel valve 44 opens, fuel is fed in volume sufficient to provide a heating flame or fire at 14 whose combustion is supported by oxygen in the air now inspired through vents 17 and 18 and mixer 45 under the influence of the lowered pressure induced by vacuum pump 19 through valve 20, pipe 21, radiation pipes 23, steam chamber 24, water 16, superheater tubes 26 and 27, and flue 25.

The Heating System has now been set in operation and combustion gases rise by convection and because of the reduced pressure throughout the system induced by vacuum pump 19 (FIGURE 3). Heat absorption begins to take place by radiation from the flame or fire through the metallic walls of the combustion chamber to the jacketing water 15. This heat is transferred to the water 16 in the absorption chamber 12 by conduction and convection. It is to be understood that the outer surface of the combustion and absorption chambers is thoroughly covered by an insulating layer of material preventing as far as possible loss of heat outward. It is also to be understood that all heated pipes external to the combustion and absorption chambers are insulated except in the radiation section as represented by pipes 23. As the hot gases of combustion together with some heated air rise upwardly through flue 25 further absorption of heat takes place through the wall of the flue into water 16. I have shown a plain straight flue 25 for simplicity and ease of tracing the path of the flue gases; but it is to be understood that this flue might take a curving or zig zag path through water 16 to increase the area of contact with the water, and water tubes might be placed across the flue 25 connecting with water 16 which surrounds the flue 25 (FIGURE 4). This heating of water 16 through the wall of flue 25 will in time cause steaming and steam will rise to occupy steam chamber 24. As the products of combustion rise and contact the inner wall of flue 25 they will reach the upper section of the flue 57 which is above the surface of water 16. Here heat will be transferred through wall 57 to the steam collected in steam chamber 24 adding a certain amount of superheat to the steam. As the products of combustion rise to the top of flue 25 and are then conveyed by horizontal pipes 28 and 29 to superheater tubes 26 and 27, further absorption of heat by the steam in steam chamber 24 takes place through the walls of pipes 26, 27, 28, and 29 which will be heated to a temperature above wet steam temperature by the hot gases within and will add superheat to the already generated steam. The path of the gaseous products of combustion in superheater tubes 26 and 27 will be downward under the influence of the above noted imbalance in the system created by vacuum pump 19. After this imbalance reaches a point where water level 31 within tube 26 is depressed to the lower end 32 of tube 26, the products of combustion will start to bubble upward through water 16. This direct contact of the hot flue gases with water 16 will generate an additional quantity of steam in steam chamber 24, and the gaseous products of combustion bubbling up into steam chamber 24 will be added to the already superheated steam in steam chamber 24. I have experimented with different depths of submerision of the ends of superheater tubes 26 and 27 in water 16 and find that this depth is not critical. It has been determined, however, that a submersion depth of approximately 1 1/4 inches, as represented by the distance between water level 30 and end 32 of superheater tube 26 (FIGURE 3), makes an efficient system. For simplicity I have shown two superheater tubes 26 and 27 attached to tubes 28 and 29 leading from flue 25. A larger number of similar tubes may be used if desired or a single tube will in some cases give satisfactory results.

The steam and the products of combustion of the fuel now mixed to some degree and contained in steam chamber 24 will, under the influence of the imbalance created by vacuum pump 19, be conveyed from the steam chamber 24 into pipes 23 (FIGURE 3) which in this simplified form of the invention constitute the radiation section of the heating system. This radiation section may be extended to any convenient length and configuration and may include any of the well known forms of radiator or steam jacket for the transfer of heat to space or to a body or vessel such as a kettle to be heated.

Located in the proximity of the space or vessel to be heated is a thermostat 38 (FIGURES 3 and 5) tied into the control wiring through relay 39 to shut down vacuum

pump 19 when the heated space or vessel reaches the temperature setting of the thermostat. Shutting down of the vacuum pump causes vane 42 of vane switch 43 to drop to a vertical position (FIGURE 5) in which position the contacts of vane switch 43 are open and cause an interruption in the current flowing through the winding of fuel valve 44 shutting off the main supply of fuel to burner 13 leaving only a pilot flame. At the same time all circulation of steam mixed with the flue gases including the products of combustion through the radiation pipes is stopped by the shutting down of vacuum pump 19.

I have provided a further precaution against the loss of heat in the system in the form of high limit switch 35 (FIGURES 3 and 5) physically attached to the return side of radiation pipes 23 adjacent the condensate return 36. The high limit switch 35 has a bimetallic thermostat operating to break the attached circuit when a pre-set temperature is reached. As may be seen from FIGURE 5 this high limit switch is located in the main power supply circuit and its opening will cause shutdown of the entire system except for the pilot flame which continues to burn. The high limit switch is set to break contact at a temperature as low as possible to provide adequate heating of the load on the radiation section and still to prevent exhaustion of usable heat through exhaust 41 from vacuum pump 19. After the section of radiation pipes 23 to which high limit switch 35 is attached has cooled to a pre-set temperature and if the load to be heated has not reached the temperature called for by thermostat 38 the high limit switch will close, current will flow through relay 39 to vacuum pump 19, vane switch 43 will be closed by the exhaust from vacuum pump 19, fuel will flow through fuel valve 44 to burner 13, and the cycle will be repeated until the bimetallic element of thermostat 38 reaches its pre-set temperature; at which time the contacts of thermostat 38 will open, breaking the circuit to relay 39. This will cause the vacuum pump to shut down which in turn will cause vane switch 43 to open, closing fuel valve 44.

Since one of the products of combustion in many instances is water, I have found that there is a build-up of water in my heating system if it is entirely closed except for the exhaust 41 (FIGURE 3). To compensate for this build-up I have provided an overflow pipe 47 leading from a point below the level of the ends of superheater tubes 26 and 27 along condensate return 36 up to the level 30 which it is desired to maintain. When the returned condensate in the return pipe 36 builds up the water in the system higher than level 30, water will flow from overflow pipe 47 into funnel 48 and downward through pipe 49 to the drain or other receptacle for waste water. I have provided a water inlet pipe 50 leading from a water main and valve 51 for use in starting up the system or replacing water after draining.

My absorption system may, with proper design, be arranged for attachment to commercially obtainable steam or hot water boilers in order to lower the initial cost of an installation.

The embodiment described above is merely illustrative of the present invention. Those skilled in the art may envision modifications of my invention which will fall within the spirit and scope of the invention as defined in the following claims.

I claim:

1. In a heating system comprising a combustion chamber in which a fuel is burned and an absorption chamber partially filled with water and a water jacket substantially surrounding said combustion chamber in direct connection with said water in said absorption chamber, a flue leading from said combustion chamber and conducting flue gases resulting from combustion of said fuel through said water and transmitting heat through walls of said flue to said water, generating steam; a further extension of said flue above the surface of said water transmitting heat to said steam, said flue terminating above said water and

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within said absorption chamber in one or more superheater tubes having outlets beneath the surface of and directly into said water, vacuum means connected through heat absorbing devices to said absorption chamber above the surface of said water withdrawing steam from said absorption chamber in sufficient volume to cause a pressure below atmospheric in said absorption chamber and drawing said flue gases from the submerged ends of said superheater tubes and upward through said water thence through said heat absorbing devices in a mixture with said steam and exhausting to the atmosphere.

2. In combination a combustion chamber in which a fuel is burned, an absorption chamber partially filled with water, a flue surmounted by one or more superheater tubes within said absorption chamber, said superheater tubes rising above the surface of said water and terminating below the surface of said water, a vacuum pump connected through heat absorbing devices to a point above the level of said water in said absorption chamber and drawing flue gases resulting from the combustion of said fuel through said flue, said superheater tubes or tube, said water, said heat absorbing devices and discharging to the atmosphere.

3. Electric controls for a heating system comprising a combustion chamber, an absorption chamber partially filled with water, and a vacuum pump drawing products of combustion of a fuel burned in said combustion chamber through said absorption chamber and through a heat utilizing device or devices and exhausting to the atmosphere; a thermostat located adjacent the area or object to be heated and actuated by a fall in temperature to close an electrical circuit and set said vacuum pump in motion; a vane switch located in a position to be actuated by impingement of gases exhausted by said vacuum pump upon

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a rotatably mounted vane which action closes said vane switch passing current to a fuel valve which opens, supplying fuel to a burner in said combustion chamber; a high limit switch actuated by a rise in temperature at a heat utilizing device functioning to shut down said heating system when said heat utilizing device reaches a preset temperature; and a low water control switch actuated by a float breaking a circuit to said fuel valve cutting off the flow of fuel to said burner when the level of said water in said absorption chamber is lowered to a predetermined point.

4. A heat absorption chamber designed for attachment to a heating boiler and to be partially filled with water; outlets for interconnection of the water in said absorption chamber and the water in said boiler; a flue in said absorption chamber located to register with a flue of said boiler, said flue extending upward through said absorption chamber and terminating above the surface of the water in said absorption chamber in one or more superheater tubes extending outwardly and downwardly from said flue and within said absorption chamber and terminating at a point beneath the surface of the water in said absorption chamber; and an outlet or outlets for connection of heat utilizing devices to said heat absorption chamber.

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