March 27, 1962 R. A. SIZE 3,026,867

SOLUTION HEATING APPARATUS AND SYSTEM

Filed June 30, 1958

Fig. 1.

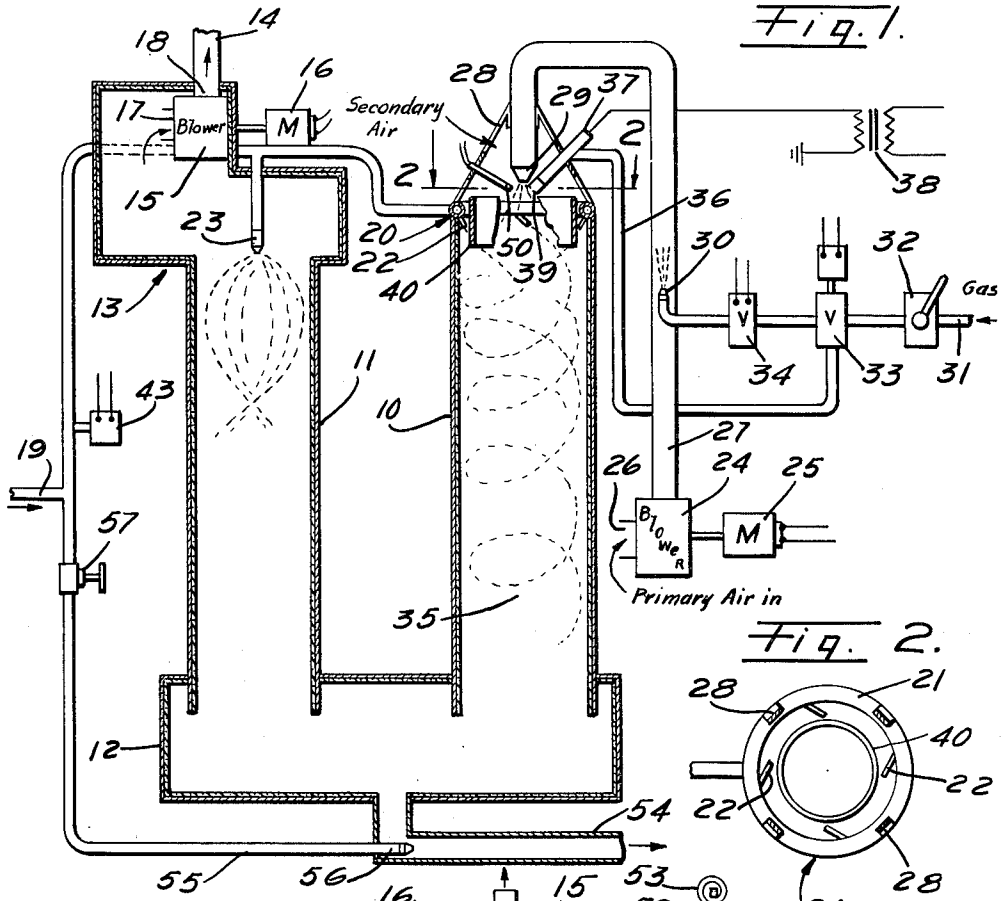


Fig. 2.

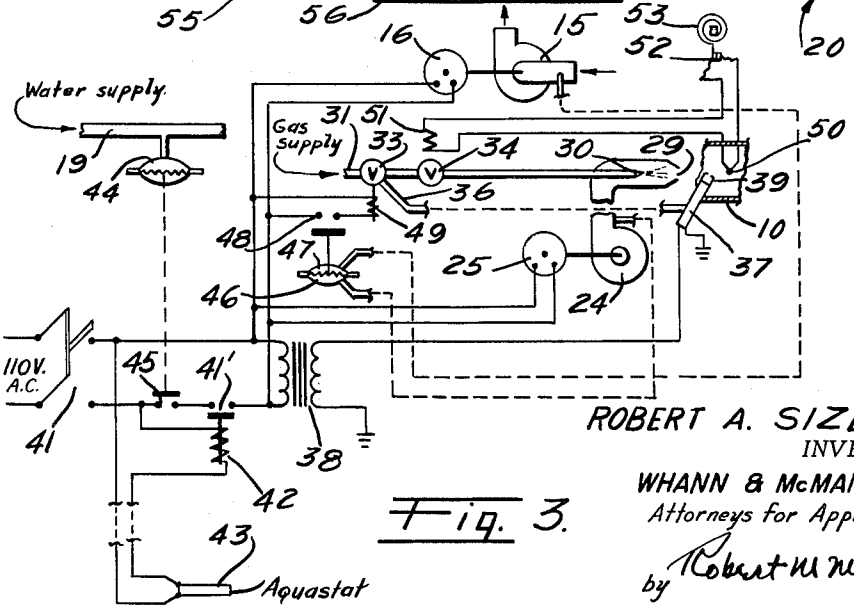


Fig. 3.

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United States Patent Office

3,026,867

Patented Mar. 27, 1962

3,026,867

SOLUTION HEATING APPARATUS AND SYSTEM

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Filed June 30, 1958, Ser. No. 745,509
2 Claims. (Cl. 126—350)

The present invention relates generally to heating apparatus for the heating of a fluid medium such as water by means of hot gases of combustion, and is more particularly concerned with apparatus of this character wherein the liquid and the hot gases are brought into direct and intimate contact.

The apparatus of the present invention in its broad concept is susceptible of general use and application, but for illustrative purposes will be considered herein and described in connection with its use for the heating of water in swimming pools.

The invention embodies inherent advantages which make it particularly desirable and useful for the heating of the water in swimming pools. The invention has for one object the provision of apparatus of the herein described type which operates with 100% combustion, which is more efficient than conventional types of heaters; which has low stack temperatures; which is economical to maintain; and is so constructed that the apparatus will have long life and a minimum of deterioration due to use.

A further object is to provide in apparatus of this type an arrangement wherein the heating will be accomplished directly rather than through heat exchange media which are apt to become inefficient over long use due to the liming of the surfaces and formation of scales, as in the case of boilers.

Another object is to provide heating apparatus which may be constructed and operated with glass linings in the heating chambers, thus prolonging and increasing the life of the equipment, and cutting down maintenance.

Still another object is to provide heating apparatus which is susceptible of use in connection with swimming pools, and wherein the water of the swimming pool may be directly heated by hot gases in such a manner that the products of combustion create a slight acid condition in the water which kills the bacteria and algae, thus making it unnecessary to utilize muriatic acid as now required with conventional heaters for swimming pools.

A still further object is to provide an improved control system which incorporates spark gap ignition, thus providing a more safe installation and a more economical heater than where a standing pilot light is utilized.

Further objects of the invention will be brought out in the following part of the specification, wherein detailed description is for the purpose of fully disclosing the invention without placing limitations thereon.

Referring to the accompanying drawings, which are for illustrative purposes only:

FIG. 1 is a view diagrammatically illustrating a solution heating apparatus and system according to the present invention;

FIG. 2 is a sectional view, taken substantially on line 2—2 of FIG. 1, to show details of construction of the water nozzle arrangement for the first stage of the heater; and

FIG. 3 is a view schematically illustrating the control system of the heating apparatus of the present invention.

For illustrative purposes, there is diagrammatically shown in FIG. 1 heating apparatus according to the present invention. In general, the apparatus comprises a pair of upstanding tubular wall columns 10 and 11 which constitute respectively the first stage and second stage heating sections of the apparatus.

The columns 10 and 11 are formed of suitable metallic tubing and are interconnected at their bottom ends by means of a box-like structure 12 which serves as a sump,

as well as a flow connection for hot gases from the first stage column to the second stage column.

The uppermost end of the second stage column 11 is enclosed by a box-like superstructure 13 which forms an interconnection between the uppermost end of the second stage and a vent pipe 14. The superstructure also houses in its upper portion a suction blower 15 driven by an electric motor 16 which may be positioned exteriorly of the box 13. The blower has an inlet 17 in communication with the interior of the box 13, while a discharge connection 18 of the blower connects with the vent 14.

The uppermost end of the first stage column is open. The blower 15 thus produces an induced draft which will draw air into the uppermost end of the first stage to supply secondary combustion air for a combustible gas mixture, as will hereinafter be described, and also draw hot gases downwardly through the first stage into the second stage where the gases pass upwardly and thence through the blower and out the vent 14.

Water is introduced into both the first stage upper end and the upper end of the second stage, in such a way as to flow downwardly over the inner surfaces of the walls of the columns and act as a cooling and insulating medium. It is therefore possible to utilize glass lining for the first stage column, the sump box 12, the second stage column as well as the interior of the box 13 and the blower housing therein. This is a very desirable feature of the invention in that it prevents deterioration and prolongs the life of the equipment over conventional heating apparatus utilizing boiler structures which are subject to liming and scale formation.

Water is supplied through a supplying connection 19 to the uppermost end of the first stage column 10 where it is introduced through a nozzle structure as generally indicated at 20. This nozzle comprises a tubular header ring, as shown in FIG. 2, which distributes the water to a plurality of angularly inclined nozzles 22 with their discharge ends pointing in a direction to cause the entering streams to spiral around the inner wall surface of the column 10 during the passage downwardly thereover. Thus the wall surface is covered with a spirally moving continuous sheet of water.

In the second stage column 11, water is introduced at the center of the upper end of the column through a spray nozzle 23 of the type which is designed to produce a whirling discharge. Thus, the entering water is broken up into fine particles in the second stage which move through the column interior with a whirling motion as they move from the top towards the bottom of the column.

For heating the water, a hot flame and hot gases of combustion are utilized. For this purpose, a burner is utilized which will now be described. Primary air is supplied from a pressure blower 24 driven by an electric motor 25. The blower has an inlet 26 connected with ambient atmospheric air, and an outlet connected with a tube 27 which is supported at its discharge end by a burner cage structure 28 at the uppermost end of the first stage column 10 in such a manner that a connected burner nozzle 29 will discharge a combustible mixture axially into the uppermost end of the first stage column. Between the nozzle 29 and the blower 24, a combustible gas is injected into the primary air through a main gas nozzle 30. Gas is supplied from a suitable source through a supply connection 31 which contains a manually operable stop cock 32 permitting the gas to be turned on or off manually. Thence, the gas flows through a solenoid actuated main and pilot control valve 33 and thence through a temperature controlled safety valve 34 which will subsequently be explained in further detail.

The combustible mixture, which is thus fed from the tube 27 into the top of the first stage column 10 through the nozzle 29, is then mixed with secondary air which

enters by induced flow through openings in the cage 28 in the manner previously explained. When ignited, the burning mixture produces a flame which may extend a considerable distance down the first stage column 10 and may even extend to a point as far as indicated by the numeral 35.

In order to ignite the mixture at the uppermost end of the first stage column 10, gas under the control of the solenoid main and pilot control valve 33 is conducted through a pipe 36 to a pilot light and igniter 37 of conventional construction, and which is arranged to inject gas therefrom between spark gap electrodes 39. These electrodes are arranged to be energized from a high voltage transformer 38 which is so constructed as to produce a voltage of the order of ten thousand volts, and which is sufficient to produce a spark between the electrodes and ignite the gas. This type of igniter is economical of operation as compared to the use of a standing pilot. Moreover safer operation is obtained. In order to protect the nozzles 22 from the hot combustible gases adjacent the nozzle 29, a baffle ring 40 is placed inside the nozzles to provide a protective shield therefor.

It will be observed that in the first stage, the heated gases in their hottest condition are brought into intimate and direct contact with a substantially continuous sheet of spiraling water passing down over the interior wall surface of column 10. As hot gases give up heat energy to the water, these gases will be somewhat cooled and pass into the lower part of the second stage from whence they move upwardly through column 11. In this stage the contact area of the water is increased by introducing it in the form of a spray. Thus, the less hot gases transfer their heat to large areas of the water in spray form. The gases emanating from the upper end of the second stage have been cooled to such an extent that their heat energy has been substantially exhausted and the gases are carried out the vent in a cool condition. Due to the shielding effect of the water on the walls of the first and second stage columns these columns are in a cool condition rather than in a hot condition as in the case of conventional boilers, and exterior heat insulation is therefore not required.

The automatic control and safety shut-down system will now be described, reference being made to FIG. 3 of the drawings. The electric control supply is shown as being from a conventional 110 volt A.C. domestic service, although where necessary the supply may be from other voltages to which the control may be accommodated in a manner well-known to any electrician.

The usual starting sequence of operation will be substantially as follows:

The system is energized by first closing a main switch 41. The apparatus is then connected for automatic control, for example, by the opening and closing of electrically actuated switch contacts 41' operatively controlled by an actuating coil 42 which is energized from the 110 volt circuit through a temperature responsive device, in this case an Aquastat 43 which will open and close the coil circuit in response to temperature changes. When the Aquastat calls for heat, the contacts 41' will be closed, but will not start the apparatus unless the water supply is turned on. A pressure responsive switch 44 is connected with the water supply line 19, and when there is water pressure, this switch will close its contacts 45 which are in series with the contacts 41'. With contacts 41' and 45 both closed, the transformer 38 and the blower motors 16 and 25 will be energized.

Further and continued starting operation of the apparatus is dependent upon the establishment of low pressure or suction in the intake of the blower 15, and the establishment of positive pressure in the outlet of blower 24. For such determination, a pressure switch 46 is provided, this switch having a diaphragm 47 upon one side of which the pressure of blower 24 acts to move the switch contacts 48 in a closing direction, and on the other side of which the suction or vacuum produced by blower 15 acts to move the switch contacts in a closing direction. However, neither of these forces acting singly are sufficient to close the contacts 48. Assuming that the blowers 15 and 24 are properly operating, the pressure switch closes its contacts 48 and thereby energizes an actuating coil 49 to open the solenoid main and pilot control valve 33, whereupon gas is supplied to the pilot light and igniter 37 through the pipe 36.

The transformer 38 being energized will cause a spark between the electrodes 39 which will light the gas to establish a pilot flame. It will be observed that at this time the temperature control safety valve 34 is closed so that gas is not yet being supplied to the nozzle 30. There is provided adjacent the igniter and pilot flame a thermocouple 50 which is adapted upon heating to generate an electric current. This thermocouple is connected with an actuating coil 51 of the temperature control safety valve 34 through a circuit containing normally closed contacts 52 of a high temperature actuated safety switch 53. When the coil 51 is energized, the valve 34 will open and supply gas to the main gas nozzle 30. This will take place when the pilot light has in fact been ignited and produces sufficient temperature to activate the thermocouple 50. Should a high temperature exist at any time in the ambient atmosphere surrounding the apparatus, the high temperature switch 53 will open its contacts 52 to deenergize the actuating coil 51, whereupon the safety valve 34 closes to cut off the main supply of gas to the nozzle 30. Disconnection from the 110 volt supply or actuation of either the contacts 45 or 41' to open position will operate to shut down the heating apparatus.

Provision is made for removing the heated water or other heated solution from the sump box 12 through a pipe 54 by which it may be conducted to a point of use, in this case the swimming pool. Under certain conditions, gravity flow might be sufficient to remove the heated water. However, in the disclosure in FIG. 1, water pressure from the supply 19 is conducted through a pipe 55 to a nozzle 56 which operates as an eductor. Forced flow in this manner may be controlled through the operation of a valve 57 in the pipe 55.

Various modifications may suggest themselves to those skilled in the art without departing from the spirit of my invention, and, hence, I do not wish to be restricted to the specific form shown or uses mentioned, except to the extent indicated in the appended claims.

I claim:

1. Water heater apparatus, comprising: a sump tank; a pair of upstanding tubular walled members interconnected at their lowermost ends by said sump tank and constituting first and second heater stages, and in which the first stage defines a combustion chamber; a glass lining on the inner wall surface of at least the first stage member; a fuel burner at the uppermost end of the first stage member for injecting a combustible fuel and primary air mixture to form upon burning with secondary air an elongated hot flame in said first stage member; means at the uppermost end of the second stage member for inducing flow of hot gases from the combustion of said fuel downwardly through the first stage member, through the sump tank and upwardly through the second stage member; means for spirally flowing a continuous sheet of liquid downwardly over the inner surface of the glass lining of said first stage member to be heated directly by the hot flame therein and shield the glas slining therein from said flame, the heated liquid therefrom being discharged into said sump tank; spray means at the uppermost end of said second stage member for introducing finally divided particles of liquid into the uppermost end of said second stage member for counterflow movement downwardly and mixing with the upwardly moving hot gases of combustion, said heated liquid being discharged from the lowermost end of the second stage member into said sump tank and the cooled gases of combustion being

discharged at the uppermost end of said second stage member; and means for conducting heated liquid from the sump tank to a point of use.

2. Water heater apparatus, comprising: a sump tank; a pair of adjacent vertical tubular walled members interconnected at their lowermost ends by said sump tank and constituting first and second heater stages, and in which the first stage defines a combustion chamber; a glass lining on the inner-wall surfaces of said first and second stage members and said sump tank; a fuel burner at the uppermost end of the first stage member for injecting a combustible fuel and primary air mixture to form upon burning with secondary air an elongate hot flame in said first stage member; means at the uppermost end of the second stage member for inducing flow of hot gases from the combustion of said fuel downwardly through the first stage member, through the sump tank and upwardly through the second stage member; means for spirally flowing liquid downwardly over the inner surface of the glass lining of said first stage member to be heated directly by the hot flame therein and shield the glass lining from said flame, the heated liquid therefrom being discharged into said sump tank; means at the uppermost end of said second stage member for axially introducing a whirling spray of finely divided particles of

liquid into the uppermost end of said second stage member for counterflow movement downwardly therethrough and along the inner surface of its glass lining for mixing with the upwardly moving gases of combustion, said heated liquid being discharged from the lowermost end of the second stage member into said sump tank and the cooled gases of combustion being discharged at the uppermost end of said second stage member; and means for conducting heated liquid from the sump tank to a point of use.

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