

June 6, 1961

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WATER HEATER

2,987,061

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3 Sheets-Sheet 1

FIG. 1.

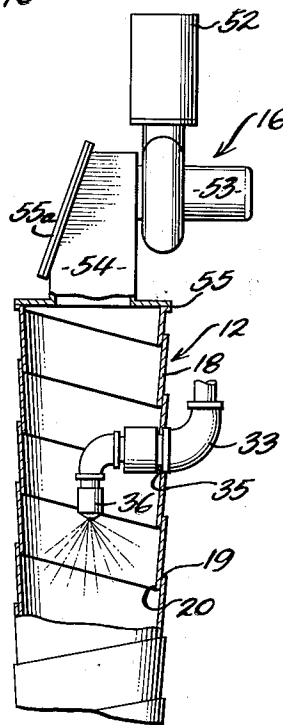
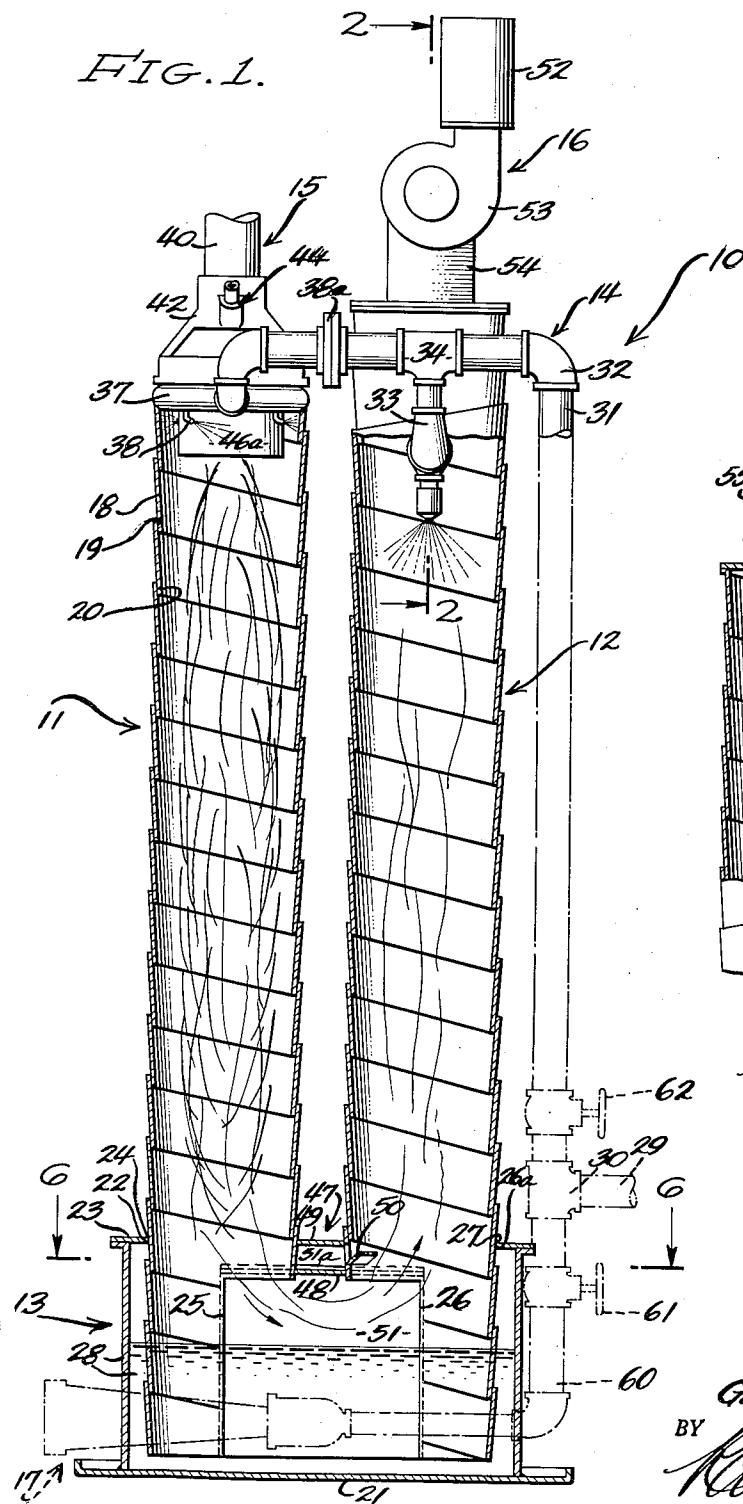


FIG. 2.

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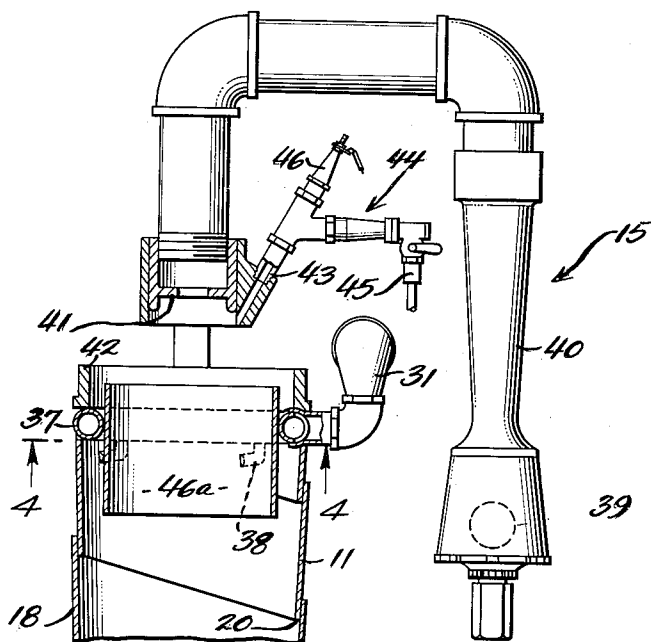


FIG. 3.

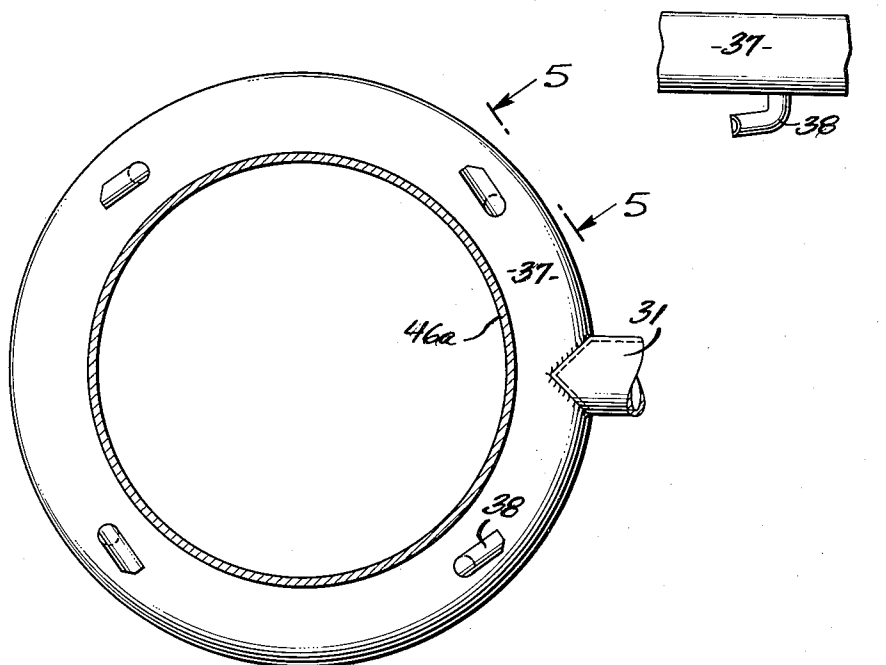


FIG. 4.

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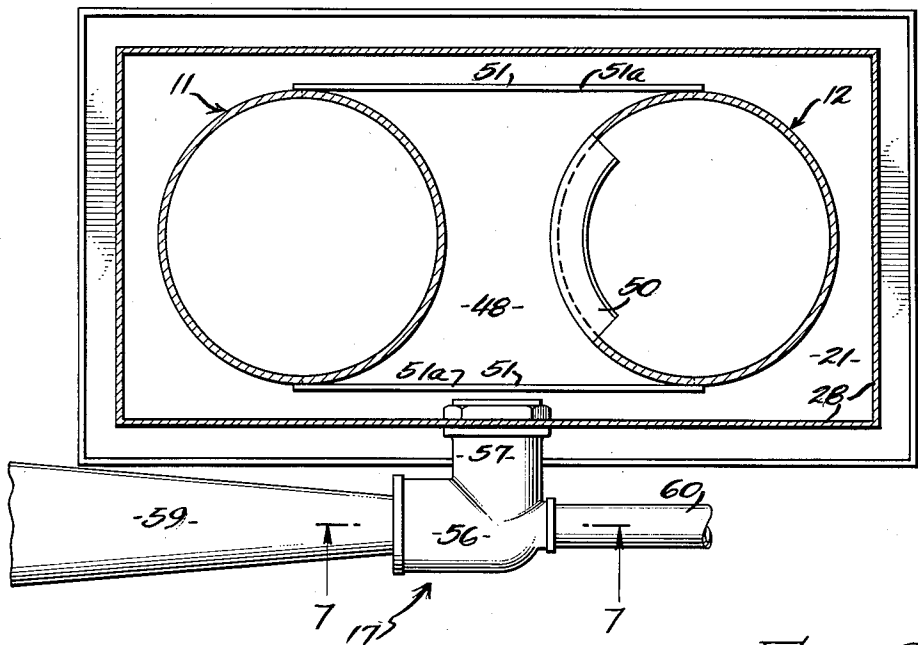


FIG. 6.

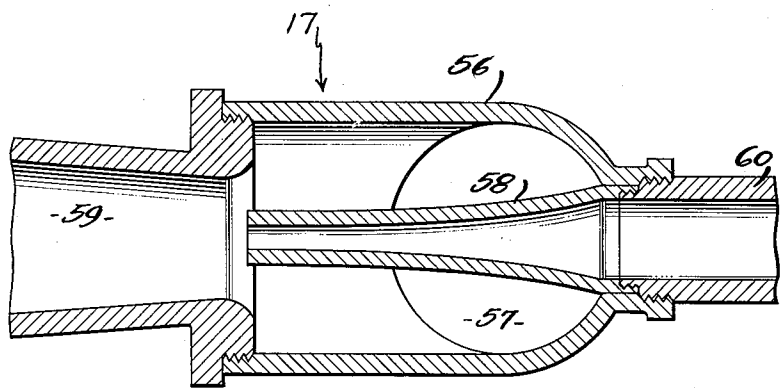


FIG. 7.

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WATER HEATER

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6 Claims. (Cl. 126—350)

The present invention relates to an improved heater and more particularly to an improved water heater which has special utility as a swimming pool heater or a heater of that type which is used for maintaining a relatively large body of water at a pre-determined temperature.

Water heaters of the type presently in use for maintaining swimming pools at a pre-determined temperature are of the boiler type wherein the water is circulated through tubes or coils which are located adjacent a heat source such as a gas flame and then back to the pool. While these heaters are capable of maintaining a swimming pool at a pre-determined temperature, the time necessary to bring the temperature of a swimming pool up to a suitable level is extremely long and their operation necessarily costly. For example, a swimming pool heater of any of the present common constructions will take on or about 20 hours to raise the temperature of an average 15' by 30' pool from 60° F. to 75° F. It follows, therefore, that the thermal efficiency of these heaters is extremely low, averaging only on or about 45%.

It is therefore a primary object of the present invention to provide an improved water heater of the type having special utility for use in connection with swimming pools and which is highly efficient in operation, is capable of raising the temperature of an average size home swimming pool to any desirable level in a much shorter length of time than heaters of the type presently in use, and which, because of its efficiency, is much more economical.

A further object of the present invention is to provide a water heater of the direct-fired type which is so constructed that its thermal efficiency ranges from 90% to 98%.

Yet another object of the present invention is to provide a water heater of the direct-fired type composed of a substantially U-shaped heat exchange chamber in which a flame is aspirated downwardly in one leg or column of said chamber and the products of combustion upwardly in the other leg or column of said chamber, and the water to be heated is circulated at pre-determined rates down the inner surface of each of said legs into the closed end or sump portion of the chamber.

A still further object of the present invention is to provide a water heater which is highly efficient in operation, which can be economically manufactured, which is quiet and economical in operation, which in operation burns the algae out of the water being heated, and which has a cold stack during operation.

Other objects and advantages of the present invention will be apparent to those skilled in the art upon perusal of the following description and drawings in which:

FIG. 1 is a broken view in vertical section showing a water heater embodying the principles of the present invention.

FIG. 2 is a section taken on the lines 2—2 of FIG. 1, with parts broken away.

FIG. 3 is a broken, slightly enlarged sectional view of certain structure shown in FIG. 1.

FIG. 4 is a horizontal sectional view taken on the lines 4—4 of FIG. 3, slightly enlarged.

FIG. 5 is a view looking in the direction of lines 5—5 of FIG. 4, with parts broken away.

FIG. 6 is a horizontal sectional view taken on the lines 6—6 of FIG. 1, slightly enlarged and with parts broken away, and

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FIG. 7 is a vertical sectional view taken on the lines 7—7 of FIG. 6, slightly enlarged and with parts broken away.

Referring to the drawings, and particularly to FIG. 1 thereof, the water heater of the present invention is disclosed as comprising a heat exchange chamber 10 which is substantially U-shaped in construction and consists of a heat exchange column 11, a heat exchange column 12 and an interconnecting sump 13. The water, or other fluid to be heated, is directed to the heat exchange chamber 10 by a water inlet assembly, broadly designated as 14, and through appropriate nozzles and at pre-determined volumes into the upper end of each of the heat exchange columns 11 and 12 so that it flows downwardly by gravity on the inner surface of each of these columns and consequently into the sump. A burner assembly, broadly designated as 15, is located on top of the column 11, and a suction fan assembly, broadly designated as 16, is located on top of the column 12, whereby a flame can be aspirated downwardly in the column 11 and the gaseous products of combustion directed through this column into the sump and upwardly through the column 12. It will be appreciated, therefore, that the water being circulated through each of these columns is brought into direct contact with the heat generated by these gaseous products of combustion and the proportion of the water directed downwardly through these respective columns is so chosen as to utilize to the maximum the heat of these products of combustion present during operation in each column. As previously suggested, the water from each column flows by gravity into the sump, and a pump, broadly designated as 17, is associated with the sump for directing the heated water back to its source.

More specifically, the heat exchanger 10 is preferably fabricated of suitable sheet metal, and the column 11 is in the form of a pipe section preferably formed of a strip of sheet material 18 spirally arranged and welded at its seam 19. The overlap 20 of the sheet material strip is so arranged as to extend downwardly so that as the water flows through this column, it is caused to flow over the overlap which has a tendency to effect greater utilization of the heat generated in the column. The column 11 is so arranged relative to the sump 13 that it extends into the sump into substantially close relationship with respect to a bottom 21 of the sump and below the level of water maintained in the sump. It is received in a suitable opening 22 formed in a top 23 of the sump and welded therein at 24 so as to be in rigid relationship with respect to such sump. That portion of the column which is received in the sump has a cutout portion 25 which, as will be more fully appreciated hereinafter, permits the products of combustion to pass through the sump above the water level and upwardly through the column 12.

The column 12 is constructed in a manner similar to column 11 and also has a cutout portion 26 which is arranged so as to face the cutout portion 25 in column 11. The column 12 is likewise received in an opening 26a formed in the sump top 23 and welded therein at 27 so that the column 11, the column 12 and the sump 13 are formed as an integral unit.

The sump is preferably fabricated of suitable sheet metal, and, as previously suggested, has a bottom 21, a top 23, and suitable side and end members 28 so as to form a tank or boxlike structure.

The inlet pipe assembly 14 consists of a pipe 29 which is directed from the body of water to be heated and is connected by a suitable T-joint 30 to an upwardly extending pipe 31. The upward extending pipe 31 is directed adjacent the top of each of the columns 11 and 12 by an elbow 32 and has a feed line 33 connected thereto by a suitable T section 34, the feed line 33 being directed through an opening 35 into the upper end of the column

12. A suitable spray nozzle 36 is fixed to the end of this feed line so that water being directed through the pipe will be caused to flow through the nozzle which is so constructed as to spray the water outwardly against the inner circumferential surface of the column, see FIG. 2. The upper end of the column 11 supports a pipe ring 37 on which is circularly arranged a plurality of downwardly extending jets 38, each of which is substantially L-shaped in configuration, welded to the water ring at one end and arranged at their discharge end to direct a stream of water tangentially against the inner circumferential surface of the column 11, see also FIGS. 4 and 5. It will be appreciated, therefore, that as the water is directed tangentially by each of these jets against the circumferential surface of this column, it will take a spiral path opposite in direction to the spiral of strip 18 as it moves by gravity downwardly through the column, and to that extent, therefore, is maintained in the column and subject to the heat generated in the column for a greater period of time than if sprayed by a nozzle, such as disclosed with reference to column 12, directly upon the inner walls of the column 11.

The inner diameter of the feed line 33 with reference to the inner diameter of the pipe 31 is so chosen that a predetermined percentage of the volume of water being continuously directed to the water is diverted into the column 12 through the nozzle 36, the remaining volume being directed into the column 11 through the circular water pipe 37 and jets 38, and an orifice 38a is provided for maintaining the proper water pressure at the nozzle 36 and the jets 38. In a water heater of average size for use in connection with the average size home swimming pool, this distribution will be on or about 40% through column 11, 20% through column 12 and the remaining to the pump 17 as will be more fully appreciated hereinafter.

The burner assembly 15, as previously suggested, is located adjacent the top of the column 11 and so situated as to direct a flame downwardly into the column. This assembly comprises a gas inlet 39 and a gas and air proportional flow mixer 40 which discharges through a retention nozzle 41 into a cage 42, the cage being located on top of the circular water pipe. A pilot nozzle 43 of a spark ignited pilot assembly 44 is fixed by wending into the cage 42 adjacent the exit end of the retention nozzle 41; and a gas inlet 45 is provided for directing a supply of gas through this assembly to the nozzle which is ignited by activating a spark plug 46. The details of the spark ignited pilot assembly and the gas and air proportional flow mixer do not constitute a part of the present invention, and any assembly of this general type is suitable and contemplated as being usable in a water heater embodying the principles of this invention. In any event, it will be appreciated that when the water heater is activated or put into operation, a proper gas and air mixture will be directed through the gas and air proportional flow mixer to the retention nozzle and will be ignited by the flame directed into the cage by the pilot nozzle. The aspirated flame is directed downwardly into column 11 through a splash guard 46a.

The top wall of the sump located between the columns 11 and 12 is in the form of a sandwich 47 comprising a bottom member 48 and a top member 49, each of which is preferably formed of sheet metal. The column 12 between the top member 49 and the bottom member 48 is cut, and a portion 50 is bent inwardly and downwardly so as to act as a trap for directing the water moving downwardly on the inner wall in that region into the sandwich formed by the top and bottom members. The opposite sides of the bottom member of the sandwich are fixed as by welding between a pair of spaced-apart side plates 51 which are welded to the columns 11 and 12 adjacent the lower ends thereof. The plates 51 are of such size as to substantially enclose the cut-out portion 25 with the cut-out portion 26 and direct the gaseous products upwardly into the column 12. The bottom edge of each of the plates 51 is preferably even with the lower edge of each of the columns 11 and 12 or at least below the mini-

mum level of water maintained in the sump. The upper edge 51a of each of the plates 51 extends upwardly beyond the bottom member 48 so that during operation a pre-determined level of water is trapped and maintained on the bottom member at all times, and any water in excess of this pre-determined amount will flow over the sides of the respective plates 51 and consequently into the sump. This sandwich is important because as the flame is aspirated downwardly through the column 11 and that portion of the sump between the plates 51, this particular portion of the top wall is subjected to extreme heat and without such an arrangement for automatically cooling this particular portion, and incidentally for utilizing the heat which would otherwise be wasted, the sump, and consequently the heater, would, in a relatively short period of time, be damaged.

The suction fan assembly 16 is located between an exhaust stack 52 and the top of the column 12. This assembly consists of a suitable motor driven fan 53, the exhaust end of which is connected to the stack 52 and the suction end of which is connected to a column stack 54. The column stack 54 is preferably fabricated of sheet metal and fixed by welding at 55 to the top of the column 12. One face of the stack 54 is in the form of a removable cover plate 55a which permits ready access to the fan for repair purposes.

The pump 17 can be of any suitable type or construction provided it is capable of recirculating the water collected in the sump 13 back to its source. For economy reasons and for ease of operation, it is thought desirable to make this pump in the form of a jet pump which can utilize a portion of the water being directed from the source into the heat exchanger for effecting this pumping operation. More specifically, the pump 17 comprises a body housing 56 which has a pipe leg 57 fixed in a side panel 28 of the sump. A jet nozzle 58 is located in the housing 56 which discharges into a bell housing 59, the bell housing 59 in turn being suitably connected by means of piping, not disclosed, to the source of water being heated. The entry end of the housing 56 and the nozzle 58 are connected by a pipe 60 to the T-joint 30. To control the amount of water directed through pipe 60 and pipe 31, suitable control valves 61 and 62 are located in these respective pipes. As previously suggested, approximately 40% of the water is directed to the pump. The pump is formed of such a size that when approximately 40% of the water is directed through it, it will maintain the desired pre-determined level of water in the sump. It will be appreciated that the operator through the control valves 61 and 62 can adjust the amount of water being directed to the pump and thereby adjust the pre-determined level of water maintained in the sump.

In operation, the flame aspirated downwardly from the retention nozzle extends axially in the column 11 substantially as illustrated in FIG. 1. The length of the column 11, the construction of the burner assembly, and the degree of suction created by the fan are so calculated that the flame is caused to extend downwardly in the column 11 substantially the full length of the column.

The primary heat exchange is effected in the column 11, and the water, which is being directed into the column 11 by the jets 38 of the pipe ring 37 is in the form of a jacket located between the flame and the inner circumferential surface of the column 11. Since this jacket is in the form of a relatively thin film of water, the jacket of water being directed down the column is intermingled with the heat generated by the flame so that maximum heat transfer can be effected.

While the flame aspirated in the column 11 extends substantially the length of the column, it is caused to burn itself out at the discharge end of the column by reason of the jacket of water passing downwardly in the column. The hot gaseous products of combustion, however, are aspirated through the sump in that area between the water level in the sump, the bottom member of the

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sandwich and the plates 51. It will be appreciated, therefore, that secondary heat exchange takes place in the sump and particularly with reference to the upper layer of water in the sump between plates 51 and the water trapped in the bottom member of the sandwich.

A third heat exchange takes place in the column 12 by reason of the fact that the hot gaseous products of combustion are sucked upwardly by the fan through this column for ultimate discharge out the stack. The water being discharged by the nozzle in column 12 also acts as a jacket located between these hot gases and the inner circumferential surface of this column, and the amount of water being directed through this column is in proportion to the hot gases being sucked through the column. In operation the stack should be cold.

It will also be appreciated that the length of the respective columns 11 and 12, the size of the sump 13, the heat generated by the flame in column 11, and the distribution and volume of the water flowing through each of the respective columns is so calculated as to utilize to the maximum extent the heat generated by the flame.

What is claimed is:

1. A water heater comprising a U-shaped heat exchange chamber, said chamber consisting of a first column, a second column, and a sump, said sump having a top member and said first column and said second column extending into said sump through said top member and being fixed with said top member in upstanding substantially parallel relationship, means for directing a flame into the upper end of said first column, means in the upper end of said second column for creating a down-draft in said first column and an updraft in said second column for aspirating said flame downwardly in said first column, means for maintaining a pre-determined level of water in said sump and said first and second columns extending into said sump a distance sufficient to extend below the level of water maintained in said sump, each of said columns having a cut-out formed adjacent their lower ends which extends above the level of water maintained in said sump, said cut-outs being in face-to-face relation, side plates interconnecting each of said columns adjacent their lower ends for enclosing said cut-outs and for directing the gaseous products of combustion from said first column between said interconnecting side plates and into said second column, a tray member interconnecting each of said side plates adjacent the upper end thereof and between said first and second columns and spaced from said top member of said sump, means in each of said columns adjacent the upper end thereof for directing a jacket of water upon the inside surface of each of said columns, the volume of water directed through each of said columns being so calculated as to utilize to the maxi-

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mum extent the gaseous products of combustion present in each of said columns, one of said columns having an opening formed therein and a portion bent inwardly and downwardly from said opening so as to act as a trap for diverting a portion of the water flowing through said one of said columns upon said tray member, whereby the jacket of water in said first column is exposed to the heat of said flame in passing by gravity down the length of said column and into said sump, and whereby the gaseous products of combustion are directed between said side plates and upwardly through said second column, thereby exposing the water passing through said second column, the water in said sump between said side plates and said tray member to said gaseous products of combustion, the water directed upon said tray member automatically cooling said tray member while utilizing the heat of said tray member.

2. The water heater defined in claim 1 further characterized by said first column being formed of a strip of sheet material spirally arranged in overlapping relation, the overlap being on the inside of said column and downwardly extending so that the jacket of water is caused to flow over said overlap.

3. The water heater defined in claim 2 further characterized by the jacket of water being directed into said first column being caused to move in a spiral path down said first column in a direction opposite to the spiral of said sheet material.

4. The water heater defined in claim 1 further characterized by said first and second column being formed of spirally arranged sheet material which is overlapped on the inside, said overlap extending downwardly so that the jacket of water flowing downwardly in each column is caused to flow over said overlap.

5. The water heater defined in claim 1 further characterized by said tray member having side walls whereby a pre-determined level of water is maintained on said tray member at all times.

6. The water heater defined in claim 1 further characterized by said opening being formed in said second column whereby a portion of the water flowing through said second column is diverted onto said tray member.

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