Jan. 21, 1964 J. A. RUSSELL ETAL 3,118,430

WATER HEATER

Original Filed May 8, 1959 3 Sheets-Sheet 1

Fig. 1

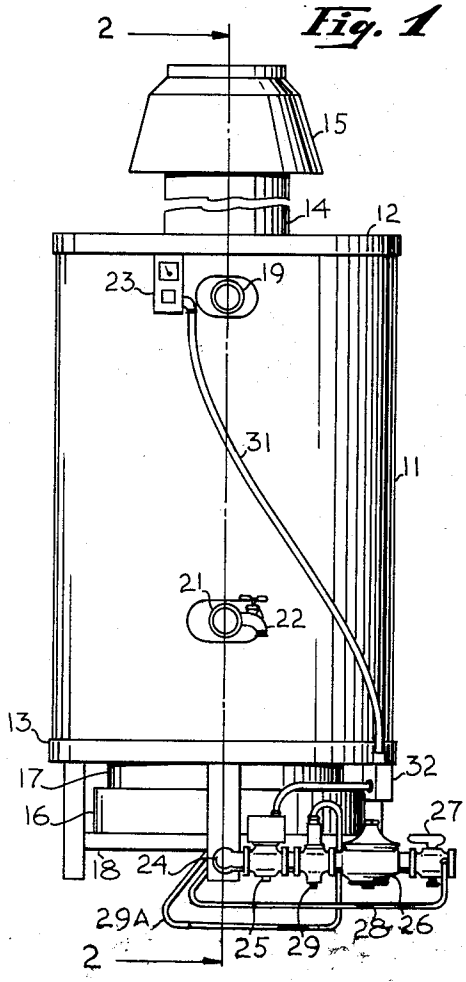


Fig. 2

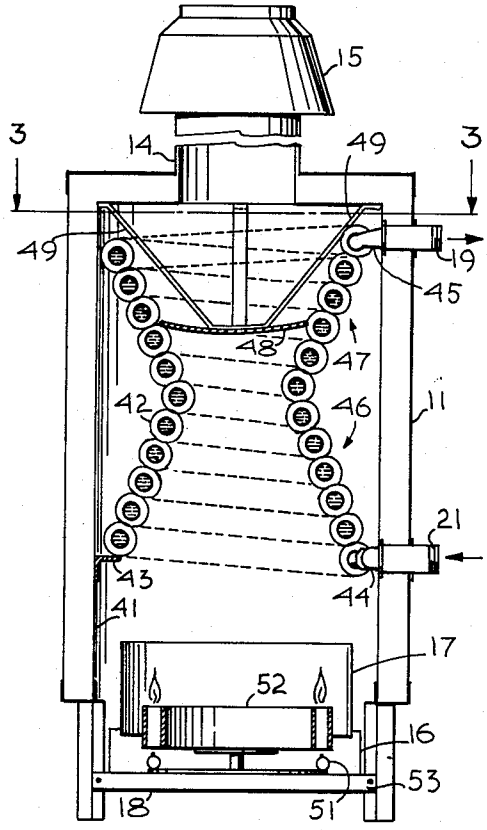
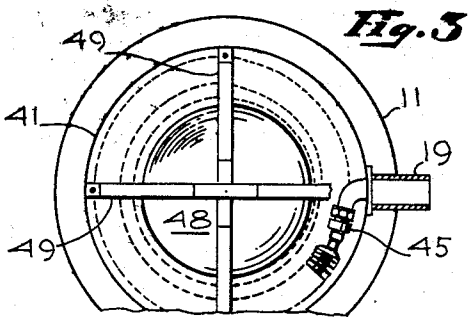


Fig. 3



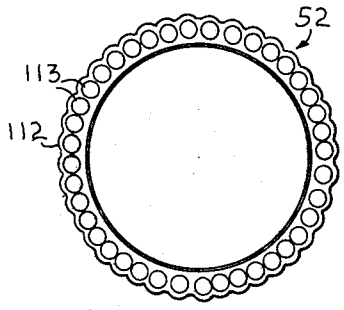


Fig. 6

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WATER HEATER

Original Filed May 8, 1959 3 Sheets-Sheet 2

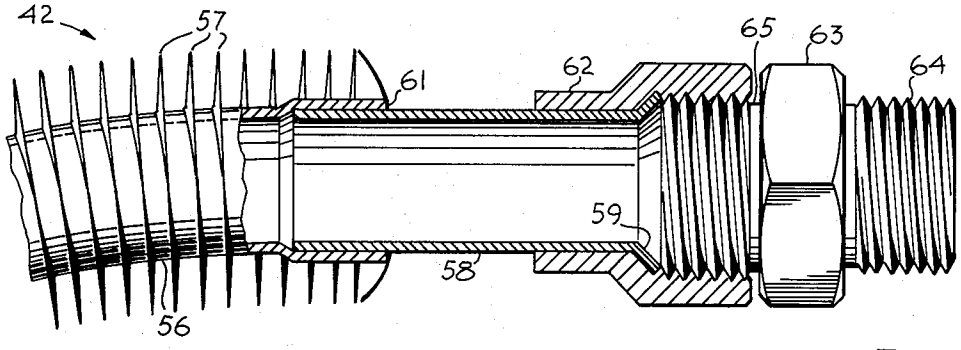


Fig. 5

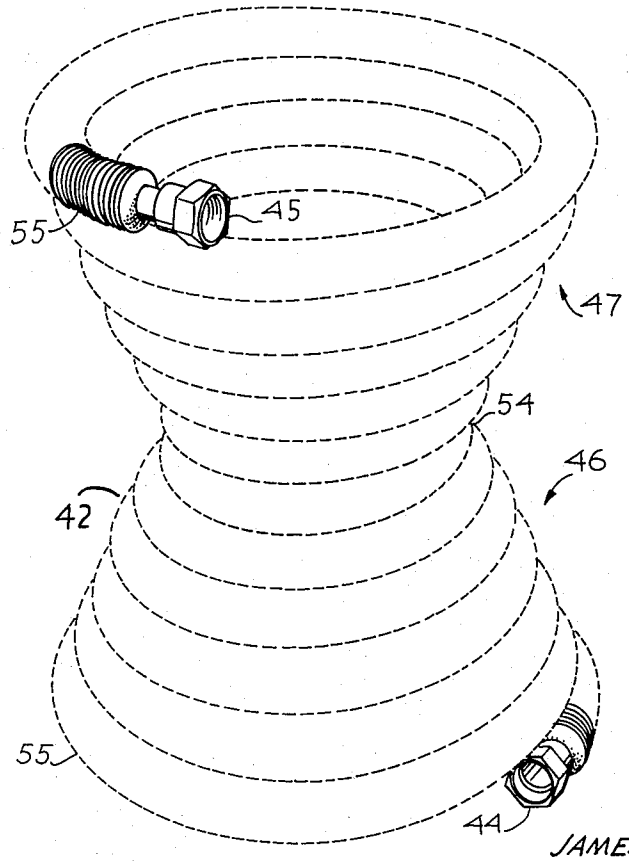


Fig. 4

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WATER HEATER

Original Filed May 8, 1959 3 Sheets-Sheet 3

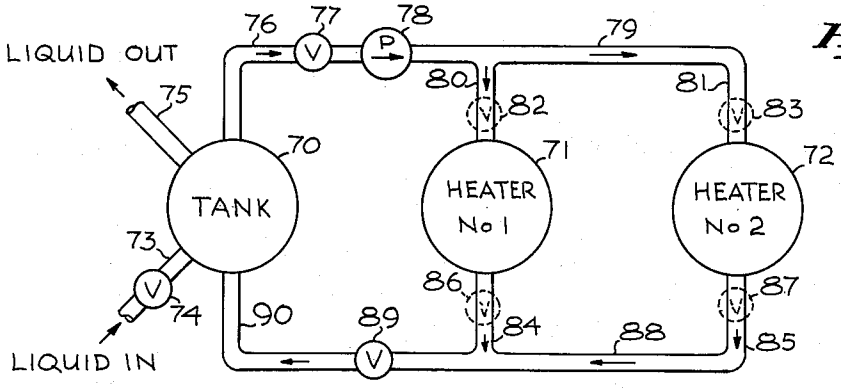


Fig. 7

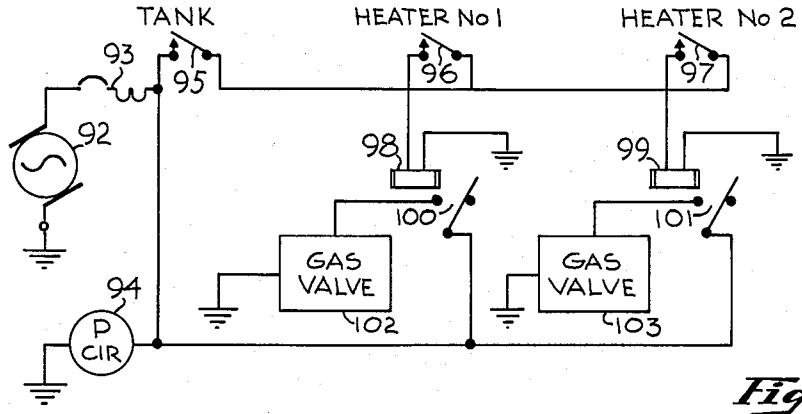


Fig. 8

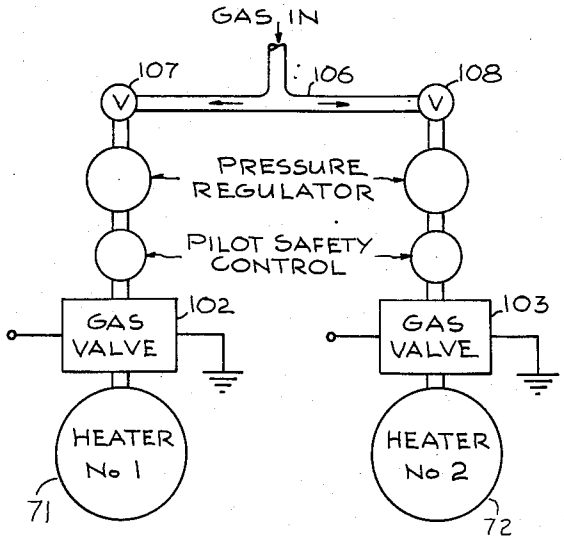


Fig. 9

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United States Patent Office 3,118,430 Patented Jan. 21, 1964

3,118,430
WATER HEATER

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Continuation of application Ser. No. 811,965, May 8, 1959. This application Nov. 25, 1960, Ser. No. 71,666
4 Claims. (Cl. 122—250)

This invention relates to liquid heating systems and more particularly to a new and improved heater for use in liquid heating systems. This application is a continuation of copending patent application Serial No. 811,965, entitled "Water Heater," of James A. Russell and Bernard E. McClanahan, now abandoned.

Where a large volume of a heated fluid is required, as for example in commercial laundries and swimming pools, it is well known to recirculate a volume of fluid between a reservoir, pool or tank and a heating apparatus within which the temperature of the fluid is raised by the transfer of heat energy from the burning of a combustible material such as gas. In general, previously known heaters have suffered from many disadvantages including small capacity and inefficient utilization of the heat energy produced by the burning gas. The result has been a high cost of installation and operation due to the necessity of using several individual heaters connected in parallel in each of which much of the valuable heat energy is lost in the exhaust gases so that the cost of fuel is relatively high.

It is accordingly an object of the present invention to provide a liquid heating system which provides a large volume of liquid at a predetermined temperature.

Another object of the present invention is to provide a liquid heating system which is more efficient than those previously known in the art.

Another object of the present invention is to provide a liquid heater in which transfer of the heat generated by the heat source is more readily accomplished than has been possible heretofore.

It is a further object of the present invention to provide a liquid heater having a more efficient coupling between the heater and the outlet therefrom.

In arrangements in accordance with the present invention, a volume of liquid is maintained at a predetermined temperature level and is delivered, upon demand, to the point of use. The temperature level is maintained by applying heat to the liquid when the temperature thereof drops below a given point. In order to supply the heated liquid upon demand, the liquid is continuously circulated through a heater where the heat is applied. The application of heat is controlled by the temperature of the liquid within the circulation system at the output of the heater. When the temperature of the circulating liquid rises to a predetermined level, the heat is removed.

In accordance with one aspect of the present invention, the circulating liquid travels a circuitous path through the heater. As the liquid travels this path, heat is applied thereto. The heat applied to the circulating liquid is diverted within the heater so as to contact as much of the circulating liquid as possible. In this manner the efficiency of heat transfer is greatly increased.

In accordance with another aspect of the present invention, all obstructions are romoved from the liquid flow path within the heater. By so doing, a relatively large volume of the liquid flows through the heater and the system may supply substantial amounts of heated liquid upon demand therefor.

In accordance with one particular configuration of a liquid heater in accordance with the present invention, there is provided a heating coil in the shape of a pair

of truncated cones joined at their minor diameters surrounding which combustion gases are passed to transfer heat energy to fluid passing through the coil. The gases first contact the heating coil by entering it from inside the major diameter of one of the cones. As the gases enter the heating coil they are diverted by a baffle and caused to pass through one of the cones. Thereafter the gases are caused to pass through the other of the cones above the baffle. Thus, in accordance with the invention, the combustion gases are driven into contact with the heat-transfer surfaces of both cones of the heating coil so that an improved transfer of heat energy to the circulating liquid takes place as the fluid passes through the heater.

In accordance with another particular configuration of the present invention, the inlet and outlet portions of the heating coil are increased in diameter so that coupling units may be attached thereto while maintaining the diameter of that portion of the apparatus through which the liquid flows substantially constant.

Additional objects and other features of the present invention will become apparent from a consideration of the following description taken in conjunction with the accompanying drawings, in which:

FIG. 1 is an elevational view of a heater in accordance with the present invention;

FIG. 2 is a sectional view of the heater of the present invention taken along line 2—2 of FIG. 1;

FIG. 3 is a sectional view of the heater of the present invention taken along line 3—3 of FIG. 2;

FIG. 4 is a perspective view of a heater coil utilized within a heater in accordance with the present invention;

FIG. 5 is an enlarged view of the end portion of the heating coil of FIG. 4, partially broken away to illustrate the details of the coil and the coupling utilized for providing a connection thereto;

FIG. 6 is a plan view of a burner head utilized with the heater of the present invention;

FIG. 7 is a schematic diagram illustrating the flow of liquid in a heating system in accordance with the present invention;

FIG. 8 is a schematic circuit diagram illustrating an automatic control arrangement for the heaters in a system in accordance with the present invention; and

FIG. 9 is a schematic diagram illustrating the flow of gas which is utilized as the fuel for the heaters in accordance with the present invention.

The following description of the present invention and its operation will be given, utilizing water as an example of the liquid which is to be heated and maintained at a predetermined temperature. It is to be understood, however, that any liquid may be utilized which is to be maintained at a predetermined temperature and supplied in volume upon demand.

Referring now to the drawing, and particularly to FIG. 1 thereof, there is illustrated an elevational view of a heater in accordance with the present invention. As is therein shown, the heater includes an outer jacket 11 having an outer top 12 and a base 13. Protruding from the outer top 12 is an exhaust stack 14 having an apron 15 at the upper end thereof. The exhaust stack 14 and the apron 15 provide a conduit for exhaust gas from the heater housing through the stack to a chimney or vent (not shown) in normal operation, and also provide an escape path for the exhaust gases in the event that the chimney or vent attached to the stack 14 becomes obstructed.

Located beneath the base 13 of the housing 11 is an upper floor pan 16 and a fire shield 17. Beneath the fire shield there is disposed a lower floor pan 18. Protruding from the side of the outer jacket 11 of the heater is a water outlet 19 and a water inlet 21. Disposed ad-

jacent the water inlet 21 is a drain cock 22. In the normal course of operation, water to be heated enters through the water inlet 21, passes through the heater, and is removed from the heater by way of water outlet 19. In case the water distribution system is shut down for maintenance repairs, or the like, the water may be drained from the heater by use of the drain cock 22.

Located adjacent the water outlet 19 is a heat control unit or thermostat 23. The thermostat is adapted to sense the temperature of the water which leaves the heater and serves as a high temperature limiting element to prevent overheating of the water. The thermostat 23 is interconnected by means of conduit 31 and junction box 32 to a solenoid valve 25 which is utilized to control the flow of gas to the gas burner. The solenoid 25 is disposed within a gas inlet conduit 24.

Also disposed within the gas inlet conduit 24 is a gas pressure regulator 26. The regulator is utilized to maintain the pressure of the gas entering the gas burner relatively constant, irrespective of pressure variations in the gas source connected to the conduit 24. A main gas valve 27 is also connected within the gas inlet conduit 24. A pilot light gas inlet tube 28 extends from the main gas valve 27 through and into the gas burner disposed within the fire shield 17 located beneath the base 13 of the heater. A pilot safety control valve 29 is disposed between the pressure regulator 26 and the solenoid gas valve 25. The function of the pilot safety control is to remove the supply of gas from the main burner if the pilot light should become extinguished in a manner well known to the prior art. For this purpose, a thermocouple (not shown) may be positioned adjacent the pilot light flame and connected to the valve 29 via a conduit 29A.

Referring now more particularly to FIG. 2, a heater in accordance with the present invention is illustrated in a sectional view taken along line 2—2 of FIG. 1. As is illustrated in FIG. 2, the heater includes an inner jacket 41. A layer of insulation may be provided between inner jacket 41 and outer jacket 11. Supported within the inner jacket 41 is a heater coil 42. The heater coil 42 is supported upon a bracket 43 which is attached to the inner jacket 41 and with the ends of the heater coil 42 being connected to the water inlet coupling 44 and the water outlet coupling 45.

The heater coil 42 is constructed from first and second truncated cone-shaped coils as illustrated at 46 and 47, respectively. Each of the truncated cones 46 and 47 has a major and a minor diameter. The two truncated cones are joined at their minor diameters. Mounted within the interior of the two truncated cones is a baffle 48 which is held in place and supported by hangers 49. The hangers 49 are attached to the baffle as by welding, brazing, or the like, and are also attached in any convenient desired manner to the inner jacket 41.

Disposed within the upper floor pan 16 is a burner ring 51 and a burner head 52 which are adapted to cooperate in the manner of a Bunsen burner. The burner ring 51 is supported upon burner support bracket 53.

In operation, when gas is supplied to the burner ring 51 and is ignited by the pilot light, the flame therefrom extends through the burner head 52 and up into the interior of the heater unit. The flames as they extend upward are drawn toward the exhaust stack 14 so that the flames and hot exhaust gases first contact the lower truncated cone portion 46 of the heater coil 42. As the flames and gases contact the heater coil, heat is transmitted through the heater coil and to the water which is flowing therethrough. The baffle 48 which is suspended within the coil 42 diverts the flames and gases and causes them to pass through openings which are provided between adjacent turns of the coil 42 below the baffle 48 and into the space between the outer surface of the coil 42 and the inner surface of the inner jacket 41. The diverted combustion gases are then constrained

to pass through the spaces between adjacent turns of the upper truncated cone portion 47 of the coil 42 above the baffle 48 and are removed through the exhaust stack 14.

By thus causing the flames which project from the burner to pass through the spaces provided between adjacent turns of the truncated cone 46 below the baffle 48 and then back through the spaces provided between the turns of the truncated cone 47 above the baffle 48, very efficient heat transfer is effected. As the hot gases flow back through the truncated cone 47 and into the space above the baffle, they tend to move in a downward direction toward the upper portion of the baffle 48. This motion causes the flame to contact the inner surface portions of the turns of the truncated cone portion 47 of the coil 42. After this has occurred, the exhaust gases are drawn through the exhaust stack 14 into a chimney or vent (not shown) through which they are passed to the atmosphere.

It has been found that by using the above configuration of the heater coil 42 and the baffle 48, increased efficiency results. This increased efficiency results because the combustion gases from the gas burner 51 and the burner head 52 are caused to traverse the coils which contain the water at least twice. Since water is continuously passing through the coils during the time that the gases are traversing the coils, the water absorbs the heat produced by the burning gas and is therefore raised in temperature.

The particular configuration of the heater coil 42 may also be viewed as a helical coil in which each turn is reduced in diameter at a predetermined rate from a major diameter to a minor diameter and thereafter is increased toward another major diameter which is substantially the same as the original major diameter. The heater coil 42 may be produced as one integral unit in the configuration similar to that shown in FIG. 2 or, in the alternative, may be constructed by first forming the truncated cone portions 46 and 47 and then joining the two at their mutual minor diameter, such as by brazing, welding, or the like.

A better understanding of the placement of the baffle 48 may be obtained by referring to FIG. 3 which is a sectional view of the heater of FIG. 1 taken along line 3—3. As illustrated in FIG. 3, each of the respective coils of the upper truncated portion 47 of the heater coil 42 are reduced in diameter toward a minor diameter. At a turn near this minor diameter the baffle plate 48 is inserted. The baffle plate 48 may rest upon the outer surface portions of the coil 42. It is, however, supported by the baffle hanger 49 which is attached thereto and as above described, also attached to the inner surface portions of the inner jacket 41.

A better understanding of the actual construction of the heater coil 42 may be obtained by referring to FIG. 4 which is a perspective view thereof. As is illustrated in FIG. 4, the two truncated cone portions 46 and 47 of the heater coil 42 are joined together at their common minor diameter 54. As is also shown, a series of fins 55 are disposed upon the exterior surface of the tubular portion of the coil 42. The fins 55 permit a ready transfer of the heat from the burning gas through the heater coil and into the water which is flowing through the coil from the inlet portion 44 thereof and to the outlet portion 45 thereof and also define the spacing betwen adjacent turns of the coil 42.

A better and more complete understanding of the construction of the heater coil 42 which is utilized in accordance with the present invention may be obtained by referring to FIG. 5. As is therein illustrated, the heater coil 42 is constructed of a tubular member 56 having fins 57 thereon. As is shown, the fins 57 may be in the form of one continuous thin metallic member which is helically arranged about and affixed to the outer surface of the tube 56. The fins 57 as herein described are utilized to pass the heat of the gases surrounding the heater coil 42 into

the tube 56 and to the liquid which is being conducted thereby.

In order to connect the heater coil 42 to the exterior conduits which are utilized to circulate the water, a flared tubular nipple 58 is attached to the tube 56. In order to couple the nipple 58 and tube 56 to the exterior conduits, flare fitting adapters 62 and 63 are utilized. The outer end portion of the nipple 58 is flared as illustrated at 59 in order to retain the adapter 62 thereon. The outer portion 64 of the adapter unit 63 has male threads thereon which may be connected to an albow or other fitting (not shown) by means of which an exterior conduit may be connected to the heating coil. In order to fit the nipple 58 into the tube 56, the outer portion 61 of the tube 56 is swaged so that it is approximately one-eighth inch larger in diameter than the remaining portion of the tube 56. In this manner, the nipple 58 may be inserted within the tube 56 as illustrated so that the inside diameter of the extension member 58 and the inside diameter of the tube 56 are substantially identical. By so doing, the liquid which is flowing through the heater coil and through the nipple 58 affixed thereto will meet no obstruction or constriction. In this manner, the volume of liquid which a heater coil in accordance with the present invention can handle is increased substantially over that of prior art devices.

The unit as illustrated in FIG. 5 may be assembled in the following manner. The outer end portion 59 of the nipple 58 is first flared as illustrated in FIG. 5. The female portion of the adapter 62 is fitted over the nipple 58 and retained in place by the flared end portion 59. The nipple 58 is then fitted within the swaged end portion 61 of the tube 56 in the manner as illustrated in FIG. 5. The nipple 58 is then finally attached to the end portion 61 of the tube 56 as by welding, sweating, brazing or the like. Thereafter, the adapter part 63 which has a male threaded end portion 65 thereon, is engaged with the female threaded portion of the adapter part 62.

At the opposite end of the adapter part 63 is another male threaded end portion 64 to which may be attached any suitable coupling for connecting the heater coil to an outlet or inlet through which liquid to be heated is passed.

Referring now more particularly to FIG. 6, there is illustrated a burner head 52 for use in a heater in accordance with the present invention. The burner head 52 includes annular member 112 which defines a series of openings 113 therethrough. Each of the openings is disposed over a gas outlet on the burner ring which is placed beneath the burner head as illustrated in FIG. 2. In operation, when the gas leaving the burner ring is lighted, the flame is drawn through the openings in the burner heads and extends into the interior of the housing.

In operation, the combustion gases produced by the flame formed by the burner head 52 flow upwardly through the spaces between the fins of the lower conical portion of the heater coil 46, through the spaces between the fins in the upper conical portion of the heater coil 47, and out the exhaust stack 14, thereby efficiently transferring heat energy to the liquid flowing through the heater coil 42.

The flow of liquid through a heating system in accordance with the invention is illustrated in FIG. 7. In FIG. 7, the system includes a storage tank 70, a first heater 71 and a second heater 72. The storage tank 70 has an input conduit 73 in which is disposed a control valve 74. The water which flows into the system enters the tank through the conduit 73 when the valve 74 is in its open position. The tank also includes an output conduit 75. The apparatus which is to be utilized in conjunction with the system as illustrated in FIG. 7 is affixed to the output conduit 75. An example of apparatus which may be utilized in conjunction with the system as illustrated in FIG. 7 would be a series of automatic washing machines for utilization by the general public. Other examples include commercial laundries and swimming pools.

The storage tank 70 also includes an output circulating conduit 76. Disposed within the conduit is a control valve 77 and a pump 78. The pump is utilized to continuously circulate water from the tank through the heaters and back to the tank during the time that the system is in operation. A common outlet conduit 79 from the pump 78 leads to the heaters 71 and 72. A conduit 80 extends from conduit 79 and into the first heater 71 while a conduit 81 extends from the conduit 79 and into the heater 72. As illustrated by the dashed portions 82 and 83, the conduits 80 and 81, respectively, may have valves disposed therein. As water is circulated through the heaters 71 and 72, it is heated and thereafter leaves the heaters and flows back to the tank. Water leaves the first heater 71 by way of conduit 84 while water leaves the second heater 72 by way of conduit 85. Conduits 84 and 85 may have valves disposed therein as illustrated by the dashed circles 86 and 87, respectively. Conduit 88 is commonly connected to conduits 84 and 85 for returning water by way of conduit 90 to the storage tank 70. A control valve 89 is disposed in conduit 90 as illustrated in FIG. 7.

From the illustration as shown in FIG. 7, it is seen that the cold water from a water source (not shown) enters the tank 70 while the hot water from the tank goes to the utilization apparatus (not shown) which is connected thereto during normal operation. The water leaving by way of conduit 75 is maintained at a predetermined temperature by the heaters 71 and 72. Water flows from the tank in the direction illustrated by the arrows disposed within the conduits 76 and 79 by virtue of the pressure maintained by the circulating pump 78. Water then leaves the heaters 71 and 72 as illustrated by the arrows disposed within conduits 88 and 90 and reenters the tank. By this circulation through the heaters, and through the operation of certain control apparatus to be described below, the water within the tank is maintained at the desired temperature.

The electrical controls for maintaining the water temperature within the storage tank 70, as illustrated in FIG. 7, are shown in FIG. 8 by way of a schematic diagram.

As illustrated in FIG. 8, the electrical control system includes a source of voltage 92 which has one output lead thereof connected to a point of fixed potential such as ground. Disposed within the other lead is a circuit breaker 93. Connected directly to the output of the circuit breaker 93 is the circulating pump 94 which has one lead thereof grounded as illustrated. Also connected directly from the output of the generator 92 by way of the circuit breaker 93 is one contact of relays 98 and 99 which will be more fully described below. Also connected to the output of the generator 92 by way of circuit breaker 93 is one contact of tank thermostat 95. The other contact of the tank thermostat 95 is connected to one contact of a thermostat 86 located within heater 71 and to one contact of a thermostat 97 located within heater 72. The other contact of the thermostat 96 in heater 71 is connected to one lead of a relay 98, the other lead of the relay being connected to ground. The second contact of the thermostat 97 located in heater 72 is connected to one lead of a relay 99 while the other lead is connected to ground. Relay 98 has a pair of contacts 100, one of which is connected to the source of voltage as above described, while the other is connected to the input lead of a gas valve 102, the other lead of the gas valve being connected to ground. Relay 99 has a pair of contacts 101, one of which is connected to the source of voltage 92 as above described and the other of which is connected to gas valve 103 which has one of its leads connected to ground.

The operation of the electrical system for controlling the temperature of the water in the tank 70 is illustrated in FIG. 7. When circuit breaker 93 is in its closed position, voltage is applied from the source of voltage 92

directly to the circulating pump 94 which begins to operate, circulating water from the tank 70 through the heaters 71 and 72 as illustrated in FIG. 7 and back through the tank 70. The thermostat 95 located on the tank 70 senses the temperature of the water contained therein. If the temperature of the water within the tank 70 is below a predetermined temperature, the contacts of the thermostat 95 will be in their closed position. When the contacts 95 are in their closed position, the voltage from the source of voltage 92 is applied through the closed contacts 95 and to the contacts 96 and 97 of the thermostats located on heaters 71 and 72, respectively, as illustrated in FIG. 7.

The thermostats 96 and 97 are located at the output conduit of the heaters 71 and 72, respectively, that is, in conduits 84 and 85 as illustrated in FIG. 7. If the water temperature at the output of the heater 71 is below a predetermined temperature, the contacts 96 of the thermostat will be in their closed condition. When they are closed, the voltage is applied through the closed contacts 96 to the relay 98, thereby energizing the relay. When the relay 98 is energized, the contacts 100 close and apply the potential from the source of voltage 92 to the gas valve 102, causing it to supply gas to the heater 71, which in turn generates heat about the heater coil 42 as illustrated in FIG. 2 and as above described. If the water leaving the heater 72 of FIG. 7 is below a predetermined temperature, the contacts 97 of the thermostat in the heater 72 are in their closed condition, thereby energizing relay 99 and in turn causing the contacts 101 thereof to be in the closed condition. This causes the gas valve 102 to supply gas to the heater 72, thereby applying heat about the coil thereof.

The gas will be continuously applied to the heaters 71 and 72, so long as the output temperature of the water leaving through conduits 84 and 85, respectively, remains below a predetermined high level.

When the water in the tank reaches a predetermined high level, the thermostat 95 contacts will open. When this occurs, the voltage will be removed from the relays 98 and 99, causing their contacts to open and the gas to be removed from the heaters 71 and 72. The water will, however, be continuously circulated by the circulating pump 94. In the alternative, even though the water in the tank may not have reached its predetermined high temperature, the water at the output of the heater 71 may reach a predetermined high temperature. If this occurs, the contacts 96 of the heater thermostat will open, thereby removing the voltage from the relay 98 and causing its contacts 100 to open. When this occurs, the gas will be removed from the heater 71 and the water flowing therethrough will no longer be heated. Heater 72 may continue to operate even though heater 71 discontinues heating at this point. Alternatively, heater 72 may cease heating in exactly the manner as previously described for heater 71.

It is therefore seen that the continuously circulating water will be heated during the time that the water in the tank is below a predetermined high temperature and the water at the output of either heater 71 or 72 is also below a predetermined high temperature. If the water in the tank is above a predetermined high temperature, the heating cycle is stopped or, in the alternative, if the water at the output of heaters 71 and 72 are both at a high predetermined temperature, the heating cycle is stopped.

Even though the heating cycle has been stopped in the manner above described, the water is still circulated by way of the circulating pump 94 from the tank, through the heaters and back to the tank. At the same time, water may be removed from the tank for use in the desired application which will cause additional water to enter the tank from the input source. When this occurs, the temperature of the water in the tank will drop below the predetermined temperature. This will, in addition, cause the heating cycle once again to start and to continue until such a time as the water in the tank reaches the predetermined high temperature level.

The application of the gas to heaters 71 and 72 is illustrated in FIG. 9. The gas is supplied from a source thereof (not shown) through a common conduit into conduit 106 which applies the gas to the heaters 71 and 72. In one arm of the conduit 106 is disposed a valve 107 while on the other arm is disposed a valve 108. The valves 107 and 108 are the main valves for controlling the application of gas to the remainder of the apparatus. If valves 107 and 108 are in their open position, gas flows through a pressure regulator which is utilized to maintain a relatively constant pressure of gas which is applied to the heaters 71 and 72 irrespective of the variations in pressure at the source. The gas then is applied to a pilot safety control valve which automatically shuts off the supply of gas to the heater, if the pilot flame becomes extinguished. This is accomplished in the normally accepted way which is well known to the prior art. The gas is then applied to the gas valves 102 and 103 which are also illustrated in FIG. 8. When the gas valves 102 and 103 are in their open position as described in conjunction with FIG. 8, gas is applied to heaters 71 and 72 respectively, for heating the water which circulates through the heater coil as above described.

By taking the schematic diagrams as illustrated in FIGS. 7, 8 and 9 and as above described, the operation of a heating system in accordance with the present invention can be readily understood. In summary, it is seen that the water continuously circulates from the tank, through the heaters and back to the tank. When the temperature of the water in the tank drops below a predetermined point, the electrical circuits under control of the thermostats cause gas to be applied to the heaters, which causes the temperature of the water to begin to rise. When the water reaches a predetermined temperature, the gas under control of the electrical circuits which are in turn controlled by the thermostats is removed from the heaters. This cycling continues to maintain the temperature of the water stored in the tank at a predetermined level.

There has been described a liquid heating system for maintaining a volume of liquid at a predetermined temperature level and which is adapted to supply large volumes of the heated liquid upon demand. A heater for use in the system is also disclosed along with a heating coil for use in the heater. The coil provides a greater efficiency of operation than has been heretofore possible in the prior art.

Although a particular arrangement of the invention has been illustrated and described, it is intended that such be by way of example only. Accordingly, any and all variations, modifications or equivalent arrangements falling within the scope of the annexed claims should be considered to be a part of the invention.

What is claimed is:

1. A gas burning water heater for use in a water heating system in which the water is continuously circulated through the heater comprising a combustion chamber having upright cylindrical walls, a gas burner at the base of the combustion chamber, a heating coil in the form of a helically wound tubing member having a plurality of fins encircling the member along substantially its entire length, the tubing member being wound with a regularly diminishing diameter of each turn beginning at opposite ends of the coil and proceeding toward the center thereof, the fins of adjacent turns of the coil being in contact in order to define the spacing therebetween, means for diverting the combustion gases between adjacent turns of the lower portion of the coil in one direction and between adjacent turns of the upper portion of the coil in an opposite direction comprising a baffle mounted in the vicinity of the midsection of the coil in order to block the flow of gases through the coil and means positioning the upper end turn of the coil adjacent the combustion chamber walls in order to block the flow of gases along

the wall outside the coil, and means for coupling opposite ends of the tubing member of the coil to corresponding portions of the water heating system.

2. A water heater in accordance with claim 1 wherein the coupling means comprises means for providing a connection to the tubing member substantially free of restrictions to the free flow of water therethrough comprising a coupling element having an inside diameter of substantially the same diameter as the tubing member, a swaged portion at the end of the tubing member enlarged to receive one end of the coupling element, and a threaded connection at the opposite end of the coupling element for connection to standard plumbing components.

3. A gas burning water heater comprising a combustion chamber having cylindrical walls, a heating coil through which water is continuously circulated comprising a finned tubing member, the fins encircling the tubing member along substantially its entire length, the tubing member being wound in the form of a helix having turns of diminishing diameter as they proceed from the ends of the coil toward the middle thereof, the end turns being disposed adjacent the walls of the combustion chamber, a gas burner substantially centrally located below the coil, and means comprising a baffle positioned within the helix for diverting combustion gases from the gas burner out between the turns of the lower portion of the coil, the upper end turn of the helix and the combustion chamber wall being juxtaposed to provide a constriction for the combustion gases so that the gases are returned to the interior of the coil in the upper portion thereof above the baffle in order to maintain the combustion gases in heat transferring contact with the coil in two different portions of the coil.

4. A gas burning heater for a water heating system in which water is continuously circulated through the heater comprising a combustion chamber having substantially vertical walls, a gas burner centrally located at the lower end of the combustion chamber a heating coil in the form of a pair of truncated cones joined at their minor diameters, the heating coil comprising a tubing member having external encircling fins positioned substantially along the entire length of the member, the tubing member being wound so that the fins of adjacent members are in contact with one another so as to define the spacing between the adjacent turns, means for diverting combustion gases from the gas burner through the lower portion of the heating coil including a baffle mounted near the minor diameter of the coil, and means for constraining the combustion gases to pass between adjacent turns of the upper portion of the heating coil comprising means for positioning the upper end turn of the coil adjacent the wall of the combustion chamber in order to substantially prevent the passage of combustion gases between the end turn and the combustion chamber wall.

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