

March 1, 1966

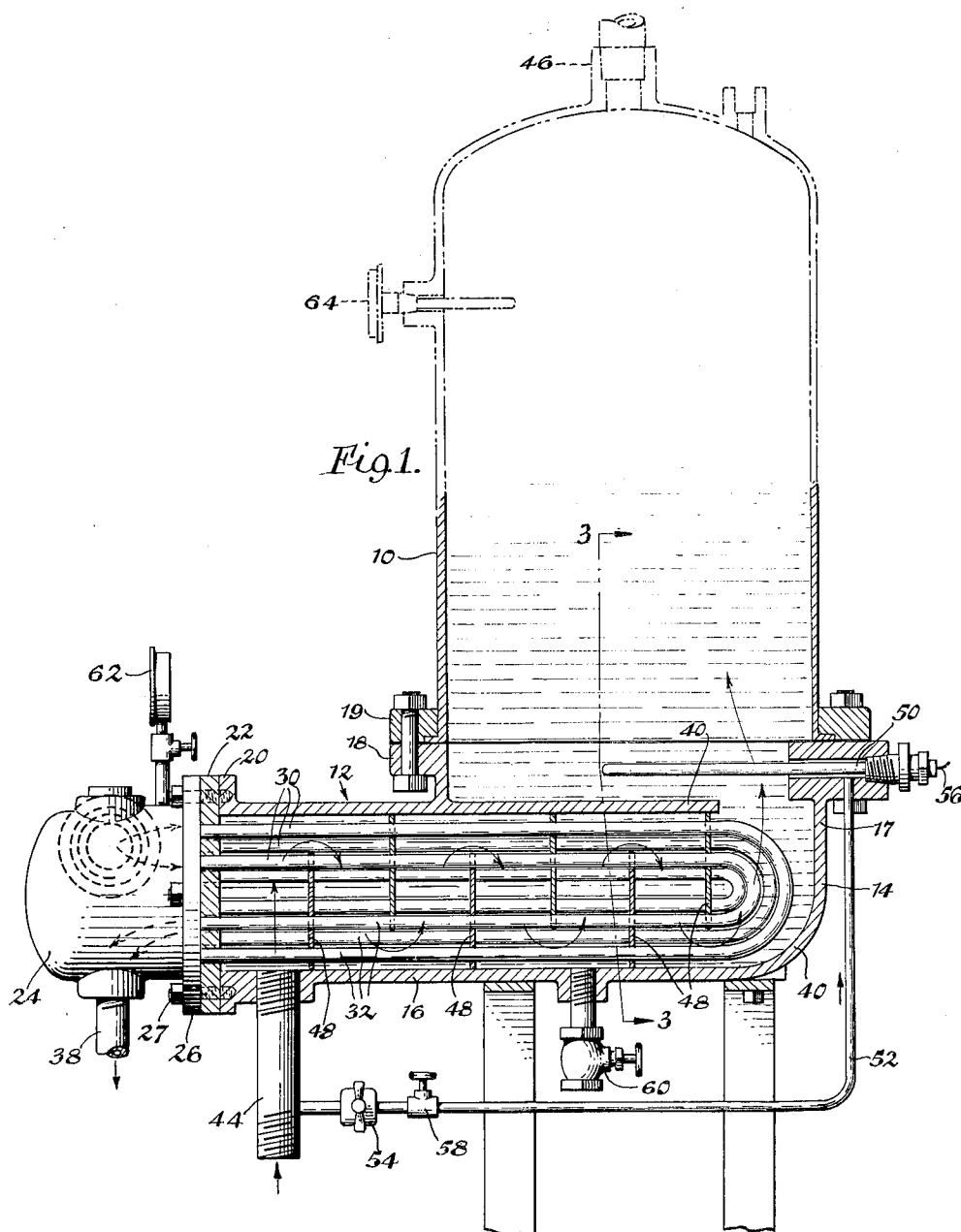
L. J. MORGAN

3,237,684

WATER HEATER

Filed Jan. 27, 1964

2 Sheets-Sheet 1



INVENTOR.
LEMUEL J. MORGAN

BY

Beau, Brooks, Buckley & Beau
ATTORNEYS

March 1, 1966

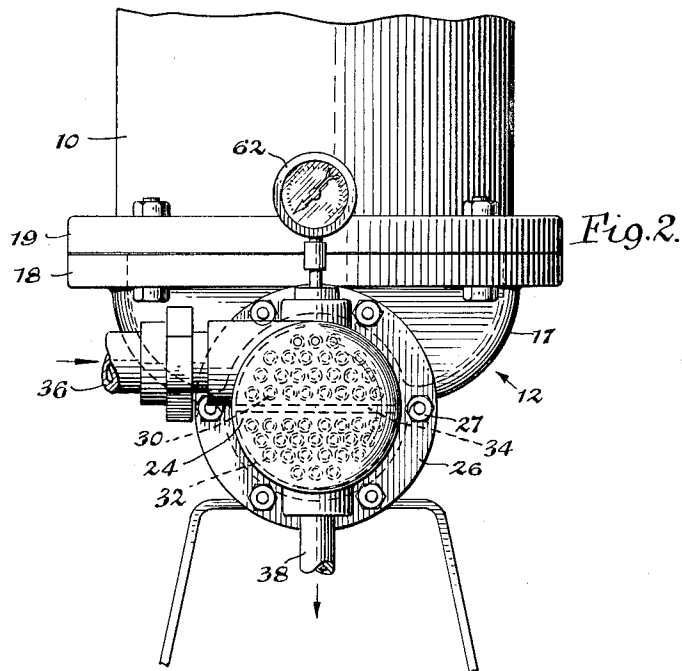
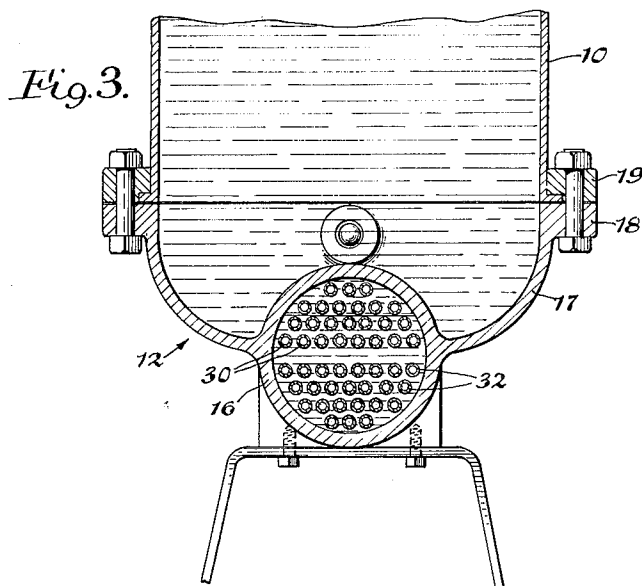
L. J. MORGAN

3,237,684

WATER HEATER

Filed Jan. 27, 1964

2 Sheets-Sheet 2



INVENTOR.
LEMUEL J. MORGAN

BY

Bean, Brooks, Buckley & Bean
ATTORNEYS

1

3,237,684

WATER HEATER

Lemuel J. Morgan, Stroudsburg, Pa., assignor to The Paterson-Kelley Co. Inc., East Stroudsburg, Pa.

Filed Jan. 27, 1964, Ser. No. 340,347

4 Claims. (Cl. 165—39)

This invention relates to industrial water heaters, and more particularly to steam-energized heaters of the type having a steam tube bundle immersed in a water tank acting as a combination water heater and temporary storage facility. Such devices of the prior art typically comprise a closed cylindrical or other shaped tank ported through a side wall portion to receive in slip-fitted relation therein the steam carrying tube bundle; along with appropriate cold water inlet and hot water outlet and accessory connections usually arranged so that the cold water enters at the bottom of the tank and hot water is drawn off at the top. However, such arrangements usually permit the cold water to immediately spread and disperse throughout the tank; and in spite of various baffle arrangements some portions of the inlet water usually find their way into the upper storage level of the tank without coming within the heat exchange range of the heating tubes. Hence cold water pockets or stratifications of relatively hot and cold water tend to occur in the storage area, in many cases to such extent as to require the use of agitation or recirculation devices with a view to delivering water at uniform temperature. Previous efforts to eliminate the difficulties and disadvantages referred to hereinabove have involved undesirably increased costs of manufacture, operation, and maintenance, while at the same time falling short of attainment of maximum heat transfer rate and heat exchange efficiency; and it is a primary object of the present invention to provide an improved water heater designed specifically to avoid the difficulties and disadvantages mentioned hereinabove.

Another object is to provide an improved heater design as aforesaid; the parts of which may be easily and inexpensively fabricated and assembled to provide an overall structurally simplified mechanism of improved performance capabilities.

Another object is to provide an improved heater design as aforesaid which in operation is productive of a substantially increased heat transfer rate.

Another object is to provide an improved heater as aforesaid which will operate at an increased degree of heat exchange efficiency.

Still another object is to provide a heater as aforesaid which offers an improved output water temperature control facility.

Other objects and advantages of the invention will become apparent from the following specification and the accompanying drawing wherein:

FIG. 1 is a fragmentary vertical sectional view through a water heater embodying the present invention;

FIG. 2 is a fragmentary front elevational view thereof; and

FIG. 3 is a fragmentary sectional view taken as suggested by line 3—3 of FIG. 1.

In the drawing herewith the invention is illustrated as being embodied by way of example, in an "upright" type heating and storage tank system, wherein a vertically elongate tank 10 is employed; but it will be appreciated that it may be employed with equal facility in connection with any other type tank arrangement. The invention is embodied within a novel combination tank bonnet and heating tube bundle shroud which is designated generally by the numeral 12. The device is readily fabricated as shown, by simple sand foundry casting techniques or the like, to comprise in combination, an integrally formed bowl-shaped body portion 14 closing the bottom

2

end of the tank 10, and a horizontally disposed tube shroud portion 16 extending both into the body portion 14 and through and beyond the forward wall thereof. At its upper level in the region of the tank 10 the body portion 14 is shaped as indicated at 17 to complement the sectional profile of the tank 10 and is provided with a flange 18 for bolted connection to the bottom flange portion 19 of the tank 10. As shown, the shroud portion 16 of the device is of circular section form and terminates at its outer end in a flanged face 20 against which rests a tube sheet 22 backed up by a bonnet 24 having a flange 26 clamped as by means of bolts 27 to the shroud flange; thus holding the parts in the assembled relation shown.

The shroud portion 16 of the device houses a bundle of return bent heating tubes of which the upper flights are designated 30 and the lower flights are indicated at 32. The tubes are connected at their forward ends into the tube sheet 22 in conventional manner. The bonnet 24 is horizontally partitioned as indicated at 34 (FIG. 2); and thus it will be understood that live steam entering the bonnet as at 36 will pass first through the upper portions 30 of the tubes and then return through their lower portions 32 for discharge from the bonnet as indicated at 38. Thus, the discharge of "spent" steam may go from conduit 38 to a steam trap and condensate outlet (not shown) or the like, and any suitable inlet steam control devices (also not shown) will of course be used in connection with the bonnet inlet conduit 36.

Whereas the main section of the shroud 16 is of circular cross section it is a particular feature of the present invention that the bottom thereof adjacent the return bend portions of the tubes is shaped to merge as indicated at 40 into the contour of the bowl shape of the body portion 14 and in a form closely complementing the profiles of the bent ends of the tubes. Furthermore, the top portion of the tube shroud adjacent the rear end of the device is cut short as shown at 42 (FIG. 1) of the rear body wall to thereby provide an open water passageway through the top rear end portion of the shroud device just above the return bend end portions of the tubes. The cold water inlet is disposed at the front lower portion of the tube shroud such as by means of conduit 44 (FIG. 1), and the storage tank hot water outlet connection is indicated at 46. Thus, it will be seen that withdrawal of hot water at 46 will induce inlet of raw cold water through 44 into the front lower end of the tube shroud. Partial partitions or baffles as shown at 48 are preferably provided to vertically traverse the interior of the shroud in alternately disposed relation so as to compel the water traveling from the inlet conduit through the tube bundle to follow a zig-zag course as shown by the directional arrows; and it is to be particularly noted that the innermost baffle 48 closes off the upper level of the shroud and forces the water to flow under its bottom edge and thence around and upwardly through the bent end portions of the tubes, finding final egress through the opening behind the shroud portion 40 up into the storage tank 10. Note that throughout the entire travel of the water through the shroud, until it is delivered into the storage tank it is confined in intimate contact with the heating tubes and finally with their bent end convolutions. In conventional arrangements the bent ends of the tubes are not effectively employed as heat-exchange surfaces because in the prior arrangements the water velocity over the U-bend portions of the tubes falls off drastically. It will be seen from the drawing herewith that in the case of the present invention the spaces provided between and around the bent ends of the tubes, and the curving rear end wall portion of the shroud cooperate to provide for substantially constant velocity of the water flow throughout the heat exchange zones. Thus a superior heat transfer effect is obtained

because an improved water flow pattern against the tube bent end portions is obtained.

Another feature of the device of the invention is that it facilitates disposition of a temperature sensing device such as bulb 50 (FIG. 1) just above the exit of heated water from the shroud device. Thus, the sensor is adapted to provide an improved temperature control function, because the heated water rising from below and through the constricted exit immediately below the bulb 50 is permitted no substantial lateral dispersion before contacting the bulb. As also shown in FIG. 1, a device to "anticipate" the need for heat supply to the tube bundle may be provided in the form of a bypass "bleed" conduit 52 leading from the cold water supply conduit 44 directly into the housing of the control bulb 50. Thus, whenever water is withdrawn at 46 the static pressure balance inside the tank is disrupted and a compensatory charge of cold water automatically flows through conduit 44. The major portion flows into the tube bundle shroud but a minor portion flows also through bypass 52 into direct contact with the bulb 50, thereby energizing the latter to call for a supply of steam (or other heating device) into the heat exchange tube bundle. This avoids the time delay in heat control response that would otherwise be experienced if the bulb 50 waited for cooler water to reach it after flowing through the tube shroud system. The conduit 52 may of course be equipped with a metering valve 54 (manually adjustable) and the bulb 50 will of course be connected to control the steam inlet as through means of electrical conductors as indicated at 56. A shut-off valve as shown at 58 may also be provided to permit disablement of the bypass system if preferred. A drain-off valve may be provided as indicated at 60 for periodic clearing of the heater shroud of accumulated sediments; and the customary steam pressure and storage water temperature gauges are provided as shown at 62, 64, respectively.

It will be appreciated that in addition to providing a more efficient system, because of the water flow pattern through the shroud only a uniformly heated stream of water will pass through the shroud exit into the storage tank, thereby insuring against stratification or "cold water pockets" in the storage water; and that although only one form of the invention has been illustrated and described in detail herein, various changes may be made therein without departing from the spirit of the invention or the scope of the following claims.

I claim:

1. A water storage and heater device comprising, in combination,

- a tank having an elongate tubular side wall closed at one end and open at its other end,
- a hot water withdrawal outlet at said one end of the tank for connection to a variable-demand hot water system,
- a heater bonnet detachably secured to said other end of said tank, said heater bonnet including a tubular side wall forming a continuation of said tank and an end wall closing said other end of the tank, said heater bonnet also including an opening at one point in its side wall and a shroud having an external shroud portion projecting laterally outwardly from said opening and an arcuate internal shroud portion projecting inwardly from said opening, said end wall

of the bonnet having an arcuate portion opposite said arcuate internal shroud portion cooperating therewith to form an internal cylindrical continuation of said external shroud portion, said internal shroud portion terminating in closely spaced relation to that portion of said side wall of the bonnet opposite said opening to define a mouth for said shroud directed toward and communicating with the interior of said tank,

a cold water inlet connected to said external shroud portion adjacent that end thereof remote from the tank,

and heater means disposed within and extending throughout the length of said shroud.

2. The water storage and heater device according to claim 1 including

temperature-sensitive means within said bonnet adjacent said mouth of the shroud for controlling said heater means,

and a cold water bleed conduit for discharging cold water directly into the region of said mouth when hot water is withdrawn from said tank.

3. A water storage and heater device comprising, in combination,

an elongate tank having a hot water outlet at one end and a heater bonnet at its other end,

said bonnet having a tubular side wall provided with an opening therein for introducing cold water into the tank whenever hot water is withdrawn therefrom, said bonnet including an arcuate end wall portion and an arcuate shroud portion cooperating to define a cylindrical shroud extending inwardly from said opening toward the side wall portion of said bonnet opposite said opening, said arcuate shroud portion terminating in spaced relation to said opposite side wall portion of the bonnet to define therewith a discharge mouth for said shroud which is directed laterally with respect to the axis of said shroud and toward said one end of the tank whereat the hot water outlet is located,

and heater means within said shroud.

4. The water storage and heater device as defined in claim 3 including

temperature-sensitive means within said bonnet adjacent said mouth of the shroud for controlling said heater means,

and a cold water bleed conduit for discharging cold water directly into the region of said mouth when hot water is withdrawn from said tank.

References Cited by the Examiner

UNITED STATES PATENTS

2,065,147	12/1936	Munson et al.	165—159 X
2,279,552	4/1942	Bowman	165—161 X
2,429,408	10/1947	Earley et al.	165—132 X
2,460,660	2/1949	Tinker	165—161
2,879,749	3/1959	Lewy	165—159 X
2,954,965	10/1960	Sebald	165—72 X
3,133,590	5/1964	Lowe	165—132 X

FREDERICK L. MATTESON, JR., *Primary Examiner*.

KENNETH W. SPRAGUE, *Examiner*.