

Jan. 4, 1944.

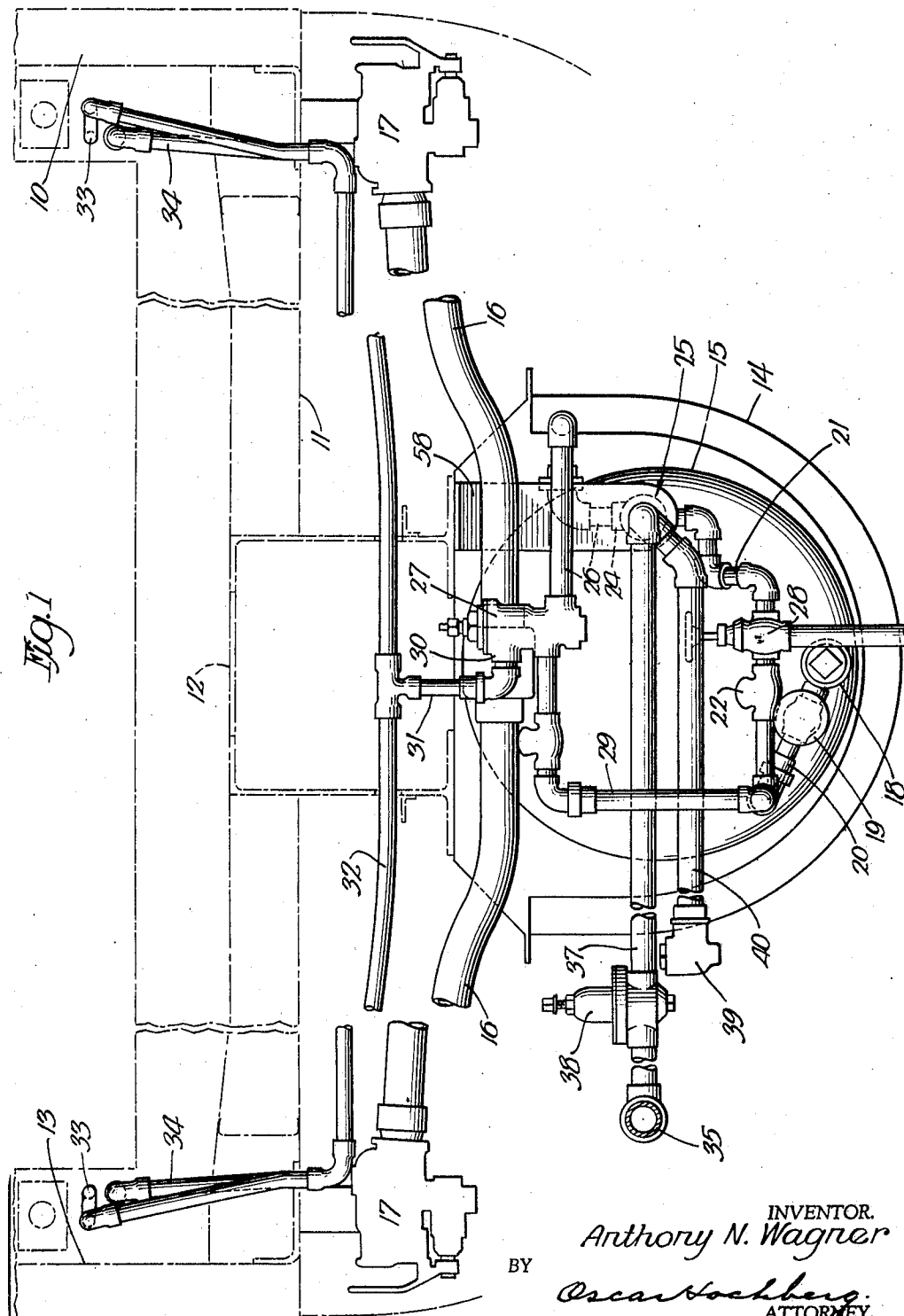
A. N. WAGNER

2,338,368

WATER HEATER

Filed Nov. 28, 1941

2 Sheets-Sheet 1



UNITED STATES PATENT OFFICE

2,338,368

WATER HEATER

Anthony N. Wagner, Chicago, Ill., assignor to
Pullman-Standard Car Manufacturing Com-
pany, Chicago, Ill., a corporation of Delaware

Application November 23, 1941, Serial No. 420,789

1 Claim. (Cl. 257—246)

The invention relates to a device for heating water utilizing steam as the heating medium and primarily intended for use in railway cars.

An important object of the invention is the provision of a water heater for railway cars which may be used vertically, horizontally, or at any angle for application to any type of car.

A further object of the invention is to provide a water heater having the highest efficiency in the transfer of heat from the heating medium to the water to be heated.

A still further object of the invention is the provision of a water heater wherein the heating element is so disposed that the water to be heated completely surrounds such element to prevent the loss of heat from the element to surrounding atmosphere and insure full heat transfer between the heating element and the water.

Another object of the invention is the provision of a water heater of light weight adapted to be fabricated from light weight materials and integrated by welding.

The foregoing and other objects are attained by the arrangement more fully hereinafter to be described and illustrated in the accompanying drawings, in which

Fig. 1 is a diagrammatic illustration of a cross sectional view of a railway car showing the water heater and piping arrangement of this invention as applied therebeneath in end elevation;

Fig. 2 is a plan view of the water heater and piping arrangement showing the relation of the various elements including the water supply tank;

Fig. 3 is a longitudinal sectional view through the water heater illustrating the details of construction thereof and showing the relation of the ports of entry and exit for the heating medium and those for the water to be heated; and

Fig. 4 is a cross sectional view through the water heater showing the relation of the finned inner heating element with the outer water casing.

The water heater of this invention is so designed that it may be connected directly to the main steam line of a railway car, which normally operates at a pressure of approximately thirty-five (35) lbs., as a source of steam for the heating element of the heater, but which is adapted also to function and preferably is connected to a source of steam at a pressure less than that of the main train line in order to have the steam trap for the heater operate at a pressure low enough to reduce the noise of operation thereof. The water heater may be connected to operate

from the car heating system, which operates at reduced pressure (approximately 20 lbs.) or it may be connected to the train line through a pressure reducing valve set to provide the desired reduction. It is entirely possible, however, to operate the heater without benefit of either a pressure reducing valve or a steam trap by merely providing a choked or reduced passage between the main train-line and the heater and a slow bleeding passage from the heater to atmosphere affording a constant drain for the disposition of condensation.

In the drawings, 10 represents diagrammatically a railway car having an underframe 11 and including a center sill 12 and having a side frame 13. An underneath equipment housing 14 is disposed beneath the car and supported from the center sill 12, and in which, in actual practice, the invention is adapted to be disposed. A water supply tank 15 is located under the car in which air pressure is maintained to raise the water in sufficient volume to the car interior and which is filled with water by means of lead-in pipes 16 from opposite sides of the car and filling valves 17, and all of which form no part of the invention herein specifically claimed.

Water from the air pressure supply tank is drawn off by means of connection 18 through a shut-off valve 19 and piping 20 and 21, including a check valve 22 permitting the water to flow in only one direction to the water heater 25 through an inlet connection 23 disposed on the under side of the heater and after being heated, flows from the heater through an outlet connection 24 on top of the heater and thence through piping 26 to an adjustable mixing valve 27. A drain valve 28 is disposed between the piping 20 and 21. From the piping 20, the cold water also branches through piping 29, including a one way check valve 30, to the mixing valve 27, whereby the hot water entering the mixing valve may be tempered to the desired degree before flowing therefrom through outlet 30 into vertical pipe 31 and transverse pipe 32 for distribution to the various washstands and fixtures throughout the car interior by means of pipes 33 disposed within the opposite side walls. Cold water is supplied to the washstands and fixtures by means of pipes 34 also disposed within the opposite side walls.

The water heater 25, as shown, is direct-connected to the main train line 35 as a source of steam for the heating element thereof, by means of piping 37, but with a pressure reducing valve 38 interposed between the trainline and the

heater in order to bring the pressure down to a point where the steam trap 39 at the discharge end of the heater will function quietly without disturbing occupants of the car. The main trainline 35 is located outside of the equipment housing 14, while the heater 25 is located therein with piping 37 affording a connection therebetween and piping 40 connects the discharge end of the heater with the trap 39 which is also located outside of the housing 14. Thus it will be seen that the extreme heat from the trainline and the moisture of condensation from the steam trap is avoided in the equipment housing, and, further, as more fully hereinafter to be described, the heater 25 is so designed and constructed as to reduce the heat loss therefrom to the interior of the housing.

The details of construction revealing the operation of the water heater 25 are best illustrated in Figs. 3 and 4 from which it will be noted that the heater comprises an outer cylindrical casing 41 having an end closure member 42 secured at one end of the casing by welding and having an outer radially disposed flange 43 secured by welding at the opposite end of the casing for attachment to a flange plate 44 on header 45 by means of bolts 46. The flange plate 44 is secured to the header 45 by welding, and, when bolted to the casing 41 with a gasket 47 between the flange 43 and the flange plate, provides a water-tight receptacle for the water to be heated. The header provides inlet and outlet openings for the steam from the heat transfer action with which the water entering the heater 25 is raised to the desired temperature as the water and the steam circulate through the heater in heat exchange relation.

The heating element, as constructed, forms a part of the header 45 and is adapted to be mounted in the heater casing 41 with the header at the time of assembly. The header is provided with an opening 48 having a sleeve 49 secured therein and extending therebeyond for attachment of a finned tube heating element 50, the adjacent end of which is disposed about and secured to the sleeve 49 and which extends axially from the header 45 within the casing 41 approximately to the end closure plate 42 of the heater 25, where it is sealed by an end closure plate 51 welded therein so that water entering the heater through connection 23, which is disposed adjacent one extremity of casing 41, must flow over the full length of the finned heating element 50 to reach the outlet connection 24, which is disposed adjacent the opposite end of the casing 41, thereby obtaining the full heat exchange value of the element. The fins 52 on the tube 50, as shown are integral therewith and comprise a series of integral prongs turned from the body metal of the tube and whereby the utmost radiation and transfer of heat from the element 50 to the water flowing thereabout is obtained, but any other form of heating element, either plain or finned, having the necessary radiating surface may be utilized if desired.

The header 45 is provided with an opening 53 directly opposite the opening 48 and through which steam is admitted from pipe 37. The opening 53 is threaded to receive a fitting 54 screwed into the opening and into which the steam pipe 37 is threaded. The fitting 54 has a lead-in pipe 55 extending therefrom into the tube 50 to emit the steam entering from pipe 37 at or near the far end of the finned tube 50

so that the steam has to travel the full length of the heating chamber and thereby insure the utmost efficiency in the heat exchange action with the water in casing 41. The free end of pipe 55 is braced in the tube 50 by means of a Z-shaped supporting clip 56 extending between the walls of tube 50 through the slotted end of the pipe 55. After passing the full length of the heating element, the steam from pipe 55 is exhausted through a third opening 57 disposed at the side of header 45 and into which pipe 40 is threaded and leads to the trap 39 where accumulated condensate is drained.

By the disposition of the heating element 50 at the center of the casing 41 and completely surrounded by the water circulating through the heater, it will readily be seen that the greatest efficiency in the heat exchange action between the steam in the finned tube 50 and the water thereabout in casing 41 will be obtained with the smallest possible loss to the surrounding atmosphere, since the steam heating element is not exposed to the atmosphere at any point but gives up its heat directly to the water to be heated, which insulates the heating element from the atmosphere. By reason of the fact that the surface temperature of the heater 25 is so much lower than a heater where the source of heat might be disposed at the perimeter and gives off so little heat to the atmosphere, this heater may be disposed in the relatively confined space of the equipment housing 14 without unduly raising the temperature of that space.

From an inspection of Figs. 2, 3, and 4, it will be seen that in operation, high pressure steam from the trainline 35 passes through the pressure reducing valve 38 to be reduced to a pressure corresponding to that at which it is desired for the system to operate and such as to cause the trap 39 to function with the least amount of noise. From the valve 38, the steam passes through pipe 37 to the inlet pipe 55 into the finned tube 50 at the inner end, thence traveling the full length of the heating element tube to heat the water in casing 41, passes through the header 45 into the pipe 40 leading to the steam trap 39 where the condensate collecting in the system is discharged. While the steam passes through the heating element 50, water flows through the casing 41 to be heated by contact with the heating tube and fins 52. The water is adapted to flow over the full length of the heating element by the disposition of the inlet and outlet connections 23 and 24 at the extreme opposite ends of the casing 41, so that the full benefit of the whole length of the heating element is obtained. Water from the air pressure storage tank enters the casing 41 through connection 23 from piping 20 and 21 and flowing therethrough in heat exchange relation with the steam heated element 50 passes through pipe 26 into the mixing valve 27. The mixing valve is thermostatically controlled, and, having both hot and cold water connections, mixes the two streams of water to provide water at the temperature desired and for which the mixing valve may be adjusted. From the mixing valve, the water is distributed throughout the car interior by means of piping 31, 32, and 33.

It is desirable that the cold water entering the casing 41 should always do so from the bottom of the casing and be emitted from the top, in order to take advantage of the natural circulation of the water as it is heated and thus increase the efficiency of the water. By the disposition of the water connections 23 and 24 at op-

posite ends of the heater casing 41 and the steam inlet and outlet openings 53 and 57 together at one end of the casing, it will be seen that the heater may be disposed in practically any position and have the water piped through the casing in such manner that the cold water enters at the bottom and the hot water passes out at the top, while the accumulated condensate drains freely from the finned tube 50 from any position and so long as the heater is not actually inverted. In the embodiment illustrated, the heater is supported in a horizontal position from the center sill by means of brackets 58, which, as shown, comprise an integral part of the end closure plate 42 and the flange plate 44, but may take any form which might prove desirable for the particular position and angularity the heater is going to assume in any specific installation and may be separate from the heater or attached as the case may require.

Since the heater is of a built-up nature, it may be fabricated from materials of such gauge as to provide light weight in the completed structure and of any capacity, for the rate at which the heater will raise the temperature of the cold water to that desired will be determined by the length of the heating element 50 and casing 41, and which, therefore, may be regulated at the time of manufacture to meet individual requirements.

From the foregoing, it will be seen that there has been provided a water heater of light weight and efficient design capable of application at any angle and which may be regulated as to size for the desired capacity, and in operation is actually insulated by the water to be heated, and which permits of a simplified piping arrangement.

What is claimed is:

A water heater including a header having inlet and outlet openings, a lead-in pipe for the admission of steam removably secured in said inlet

opening in axial relation thereto and having its emission opening spaced from the inlet by the full length of the pipe, a heating element concentrically disposed about the lead-in pipe fixedly secured in said header and having a closed and adjacent the emission opening of the lead-in pipe to provide a complete enclosure therefor whereby the steam admitted travels the full length of the lead-in pipe inwardly from the inlet opening and then full length of the heating element outwardly from the steam emission opening in the header, said outlet opening being located in the header at one side of said heating element within the length of the lead-in pipe and disposed at an angle to said inlet opening, means maintaining said lead-in pipe and heating element in concentrically spaced relation, a separate water jacket enclosing said heating element and comprising a shell concentrically disposed about the heating element having one end permanently closed and a peripheral flange at the opposite end, said permanently closed end being located adjacent to but in spaced relation to the closed end of said heating element, means engaging said peripheral flange for removably securing the water jacket to said header, and inlet and outlet openings in said jacket for circulation of water over said heating element, said inlet opening for water being located in the jacket at that end of the heating element adjacent said steam emission opening and the water outlet opening being located in the jacket at that end of the heating element adjacent the steam outlet opening in the header whereby the water enters the jacket at the hottest point of the heating element and traverses the full extent of the heating element in direct heat exchange relation therewith before reaching the outlet.

ANTHONY N. WAGNER.