Oct. 10, 1944. T. NAGEL 2,360,260

WATER CIRCUIT STEAM GENERATOR

Filed Feb. 29, 1944 2 Sheets-Sheet 1

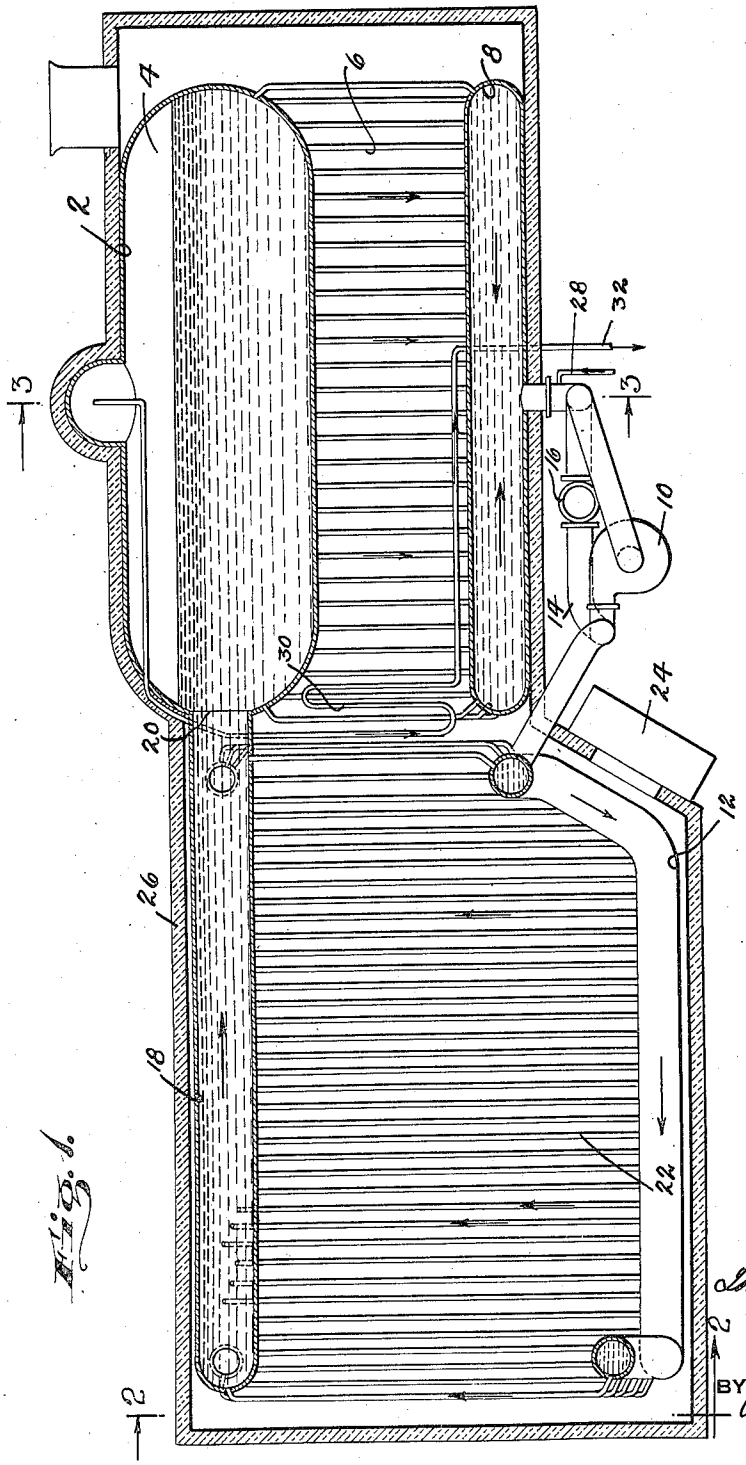



Fig. 1.

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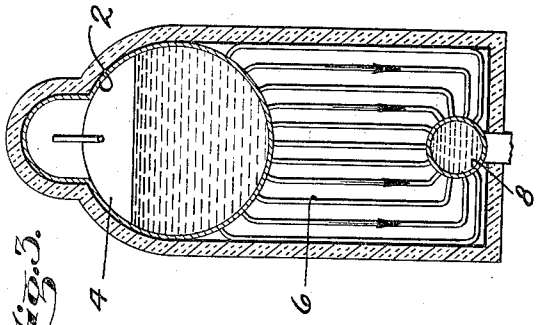



Fig. 3.

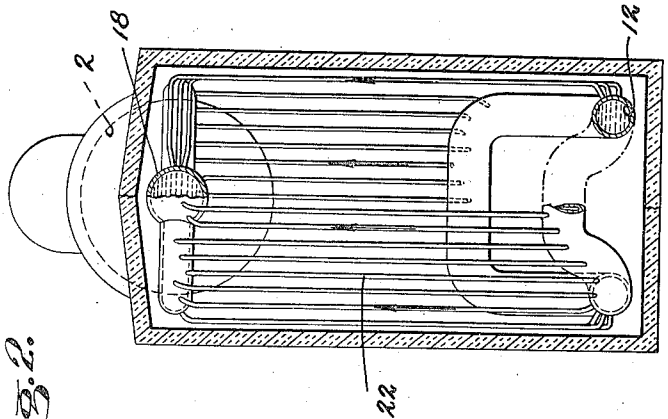



Fig. 2.

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# UNITED STATES PATENT OFFICE

2,360,260

## WATER CIRCUIT STEAM GENERATOR

Theodore Nagel, Brooklyn, N. Y.

Application February 29, 1944, Serial No. 524,359

7 Claims. (Cl. 122—235)

My invention relates to an improvement in railroad locomotive type steam generators, and has for one of its objects to provide a generator of this general type, which is of such construction as to enable working steam pressures to be increased to approximately 500 p. s. i. to improve the thermal efficiencies of conventional steam locomotives, which usually operate at working steam pressures of around only 250 p. s. i.

It is impracticable as well as hazardous to generate steam pressures substantially higher than 250 p. s. i. in the conventional horizontal fire-tube, barrel type locomotive boiler. Accordingly in order that I may go to the higher pressures above referred to, the present invention provides for generating the higher steam pressures in a water tube circuit steam generator which is of such construction as to meet the space limitations and requirements of railroad service, and produce the desired improved thermal efficiency, while practically eliminating the explosion hazards of the conventional fire-tube, barrel type boiler.

In the accompanying drawings:

Fig. 1 is a longitudinal part sectional elevational view of one embodiment of my invention;

Fig. 2 is a section taken on the line 2—2 of Fig. 1; and

Fig. 3 is a view taken on the line 3—3 of Fig. 1.

Referring to the drawings in detail: My improved locomotive type steam generator comprises an upper horizontal drum 2 providing a steam-water separating chamber 4. The lower water section of the drum 2 is connected by a bank of convective heat water tubes 6 to one or more horizontal water drums 8 located below and substantially parallel to the drum 2.

The suction side of a water pump 10 is connected to the water drum or drums 8 and the delivery side of this pump is connected to a lower horizontally inclined water drum 12.

14 designates a by-pass for by-passing the pump 10, which may be controlled by suitable valve 16.

The water drum 12 constitutes the water feed of the circuit to a water wall combustion chamber. As will appear from the drawings this combustion chamber comprises an upper horizontal water drum 18, communicating at one end as indicated at 20 with the steam-water separating chamber 4. The drum 18 preferably is below the water level in the drum 2 and constitutes the ceiling rafter for the water wall combustion chamber. The upper drum 18 and lower drum 12 are interconnected by a bank of radiant heat water tubes 22 forming the water wall sides of the combustion chamber.

Solid fuel can be burned in this combustion chamber on grates in the conventional manner or fluid fuel such as pulverized coal or oil can be injected through a burner or burners shown diagrammatically at 24.

In the operation of my improved steam generator, water from the steam-water separating drum 2 flows downward through the bank of convective heat tubes 6 and through the lower horizontal drum or drums 8. In starting up the by-pass valve 16 is preferably left open, so that the water from the drum or drums 8 by-passes the pump 10 and flows to the drum 12 and upwardly through the radiant heat tubes 22 to the upper horizontal drum 18, from which it passes by way of passage 20 to the steam-water separating drum 2. After operation has been initiated, the pump 10 is set in operation and the by-pass valve 16 closed.

The entire steam generator water circuit, except for the pump 10 and by-pass 14, is enclosed in heat insulated jacket 26.

The feed water connection is shown at 28, while the steam circuit is from the steam section of the steam-water separating drum 2 through superheater coil 30 to steam outlet 32 of the generator.

It will be appreciated that the water circuit steam generator above described provides a steam generator which will meet the space limitations and requirements of railroad service. It will be appreciated, further, that the thermal efficiency of my generator is very much improved as compared with the conventional horizontal fire-tube, barrel type locomotive boiler, and adapted, without explosion hazards, to generate steam pressures of the order of 500 p. s. i. as compared with the pressures around 250 p. s. i. at which the conventional locomotive boiler is operated.

It is to be understood that changes may be made in the construction above described without departing from the spirit and scope of my invention.

What I claim is:

1. A water circuit steam generator of the locomotive type, said generator comprising in combination a steam-water separating drum, a lower water drum, a bank of convective heat water tubes connecting said drums, a water wall combustion chamber comprising an upper drum communicating with said steam-water separating drum, a second water drum, said second water drum being below said upper drum and connected thereto by

a bank of radiant heat water tubes, said last mentioned water drum being in communication with said lower water drum thereby to provide a circuit from the water drum below the convective heat water tubes to the drum below the radiant heat water tubes, through said radiant heat water tubes to the drum at the upper end of the radiant heat tubes, and from thence to the steam-water separating chamber, and a pump having its suction side connected to said lower water drum and its discharge side connected to said second water drum.

2. A water circuit steam generator of the locomotive type, said generator comprising in combination a steam-water separating drum, a lower water drum, a bank of convective heat water tubes connecting said drums, a water wall combustion chamber comprising an upper drum communicating with said steam-water separating drum and below the water level therein, a water drum below said upper drum and connected thereto by a bank of radiant heat water tubes, said last mentioned water drum being in communication with said lower water drum thereby to provide a circuit from the water drum below the convective heat water tubes to the drum below the radiant heat water tubes, through said radiant heat water tubes to the drum at the upper end of the radiant heat tubes, and from thence to the steam-water separating chamber.

3. A water circuit steam generator of the locomotive type, said generator comprising in combination a steam-water separating drum, a water drum below the same, convective heat water tubes connecting the drums, a water wall combustion chamber comprising an upper drum communicating with the steam-water separating drum, a second water drum below the level of the first mentioned water drum and in communication therewith, radiant heat water tubes connecting said upper drum and the said second water drum to provide water walls for the combustion chamber, whereby a circuit is provided from the steam-water separating drum, through the convective heat water tubes to the first mentioned water drum, thence to the second mentioned water drum, and through the radiant heat water tubes to said upper drum and from the latter to the steam-water separating drum, a pump having its suction side connected to the first mentioned water drum and its discharge side connected to said second water drum, and a valve-controlled by-pass for said pump.

4. A water circuit steam generator of the locomotive type, said generator comprising in combination a steam-water separating drum, a water drum below the same, convective heat water tubes connecting the drums, a water wall combustion chamber comprising an upper drum communicating with the steam-water separating drum and positioned below the water level therein, a second water drum below the level of the first mentioned water drum and in communication therewith, radiant heat water tubes connecting said upper drum and the said second water drum to provide water walls for the combustion chamber, whereby a circuit is provided from the steam-water separating drum, through the convective heat water tubes to the first mentioned water drum, thence to the second mentioned water drum, and through the radiant heat water tubes to said upper drum and from the latter to the steam-water separating drum.

5. A water circuit steam generator of the locomotive type, said generator comprising in combination a steam-water separating drum, a water drum below the same, convective heat water tubes connecting the drums, a water wall combustion chamber comprising an upper drum communicating with the steam-water separating drum, a second water drum below the level of the first mentioned water drum, radiant heat water tubes connecting said upper drum and the said second water drum to provide water walls for the combustion chamber, a pump having its suction side connected to the water drum below the bank of convective heat water tubes, and its discharge side to the water drum below the bank of said radiant heat water tubes, to provide a circuit from the steam-water separating chamber through said bank of convective heat water tubes and said first mentioned water drum, through said pump to the second mentioned water drum, through the radiant heat water tubes to the drum at the top of the combustion chamber and from thence to the steam-water separating drum.

6. A water circuit steam generator of the locomotive type, said generator comprising in combination a steam-water separating drum, a water drum below the same, convective heat water tubes connecting said drums, a water wall combustion chamber comprising an upper drum communicating with said steam-water separating drum, a second water drum below the level of the first mentioned water drum, radiant heat water tubes connecting said upper drum and the said second water drum, and a pump and a by-pass for the pump connecting the first and second mentioned water drums, thereby to establish a circuit from the steam-water separating drum through the convective heat water tubes and radiant heat water tubes back to the steam-water separating drum.

7. A water circuit steam generator of the locomotive type, said generator comprising in combination a steam-water separating drum, a water drum below the same, convective heat water tubes connecting said drums, a water wall combustion chamber comprising an upper drum communicating with said steam-water separating drum and below the level of the water therein, a second water drum below the level of the first mentioned water drum, radiant heat water tubes connecting said upper drum and the said second water drum, and a pump and a by-pass for the pump connecting the first and second mentioned water drums, thereby to establish a circuit from the steam-water separating drum through the convective heat water tubes and radiant heat water tubes back to the steam-water separating drum.

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