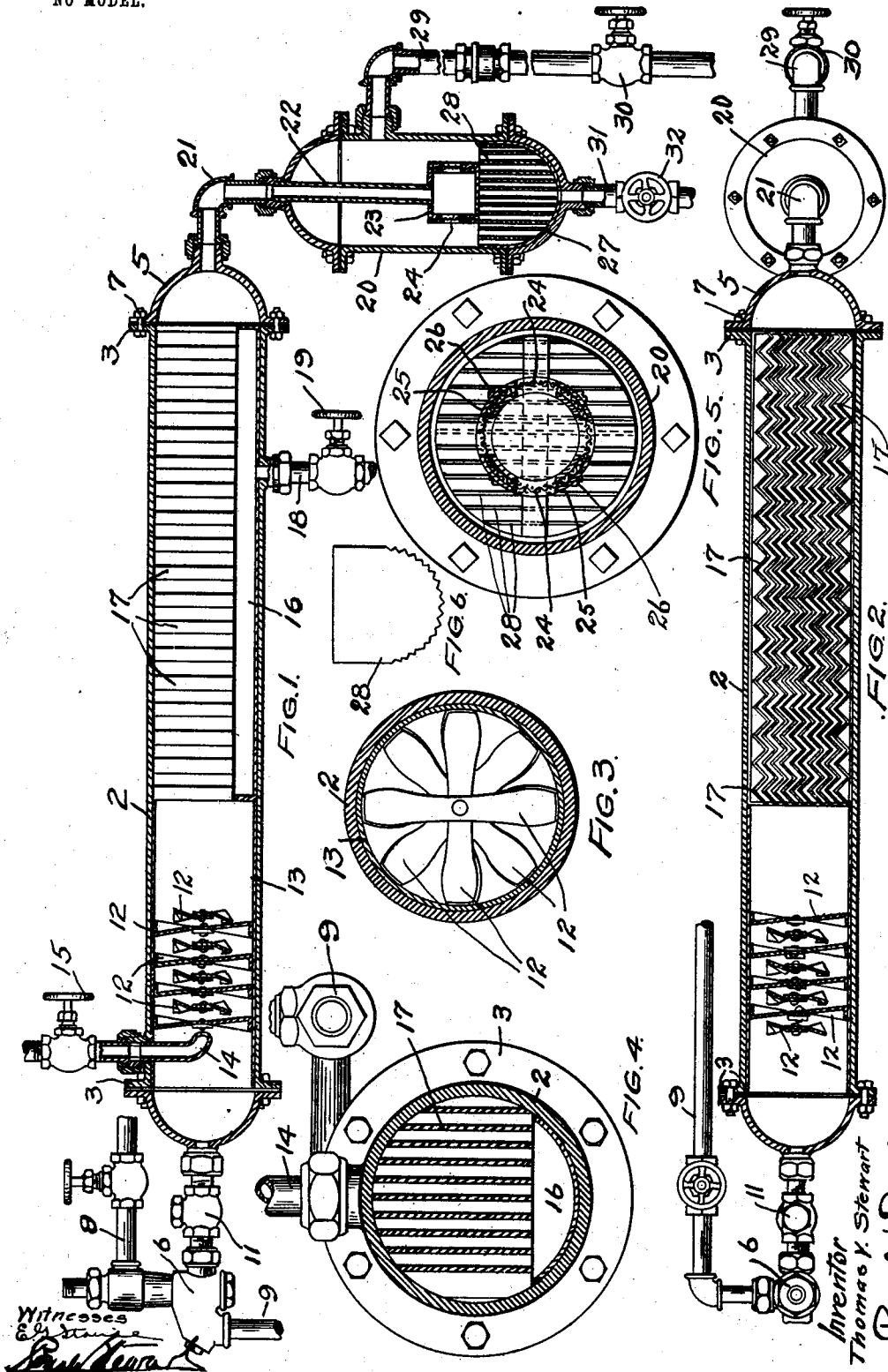


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PATENTED APR. 26, 1904.

T. Y. STEWART.
FEED WATER HEATER.
APPLICATION FILED JULY 27, 1903.

NO MODEL.



UNITED STATES PATENT OFFICE.

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FEED-WATER HEATER.

SPECIFICATION forming part of Letters Patent No. 758,484, dated April 26, 1904.

Application filed July 27, 1903. Serial No. 167,156. (No model.)

To all whom it may concern:

Be it known that I, THOMAS Y. STEWART, of St. Paul, in the county of Ramsey, State of Minnesota, have invented certain new and useful Improvements in Feed-Water Heaters and Purifiers, of which the following is a specification.

This invention relates to improvements in devices designed for heating and purifying water that is to be fed to a steam-boiler; and the object that I have in view is to provide a device of this character that will be simple and inexpensive in construction, effective in operation, and take up but a small amount of space, so that it may be used upon locomotives as well as for stationary boilers.

The invention consists generally in the constructions and combinations hereinafter described, and particularly pointed out in the claims.

In the accompanying drawings, forming part of this specification, Figure 1 is a longitudinal sectional view of a feed-water heater and purifier embodying my invention. Fig. 2 is a horizontal section of the same. Fig. 3 is a transverse section, on an enlarged scale, showing the arrangement of the bafflers in the separating-chamber. Fig. 4 is a transverse section through the main separating-chamber on an enlarged scale, showing the corrugated separating-plates. Fig. 5 is a horizontal section, on an enlarged scale, of the supplemental separating-chamber. Fig. 6 is a detail.

It is well understood that most waters available for steam purposes contain more or less of impurities, which cause a deposition of sediment and of a harder incrustation on the inner surfaces of the boiler. These deposits are poor conductors of heat, and they retard the passage of heat from the fire and hot gases to the water and steam. It is commonly agreed that a deposit of one-sixteenth of an inch of scale causes a loss of about thirteen per cent. of fuel, while one-half inch of scale raises the loss to sixty per cent. The deposits not only reduce the efficiency of the boiler, but also reduce the rate of evaporation, and consequently reduce the capacity or horse-power of the boiler. Moreover, it is generally admitted that many

explosions and less serious failures of boilers are due to the incrustations, which keep the water from direct contact with the metal at the fire-surfaces. The metal sheet thus becomes overheated and blisters, and the steam sometimes pushes it out into pockets. The excessive expansion of the metal cracks the incrustated scale, causing a sudden influx of water against the intensely-heated surface, which causes a very rapid local generation of steam and possibly an explosion. Even if neither pocket nor explosion occur the strain on the metal often causes leaks, which are a source of great annoyance and which reduce the steaming capacity of the boiler. The deposits generally come from carbonates and sulfates of lime and magnesia, which are held in solution by cold water containing carbonic-acid gas. As the water becomes heated the gas is driven off and the matter held in solution is freed and deposited.

The problem of purifying water is largely solved by heating the water to a high temperature and then providing for the separation of the freed impurities before the water reaches the boiler. In some instances this may be accomplished by simply allowing the hot water to stand quiescent while the freed particles gravitate to the bottom of the containing vessel. The conditions prevailing in locomotive practice are not favorable to quiet settling of water, and so far as I am aware heretofore no satisfactory water-purifier for locomotive-boilers has been provided. My feed-water heater and purifier accomplishes the desired separation of the carbonates, sulfates, and silicates by a combined thermal and mechanical process, whereby the water is heated and at the same time is subjected to violent agitation. The heating drives off the gas, and the agitation separates the freed particles from the water.

In the drawings, 2 represents the main separating-chamber, which consists, preferably, of a piece of cylindrical pipe having flanges 3 3 at its ends and flanged heads 5, suitably secured, as by bolts 7, to the flanges 3.

6 represents a suitable injector, of any preferred construction, to which are connected the

steam-pipe 8 and water-pipe 9. A suitable check-valve 11 is preferably provided between the injector 6 and the separating-chamber 2.

5 Arranged within the separating-chamber 2 is a series of baffles or baffle-plates 12. These plates each consist of a narrow strip of sheet metal bent into spiral form and provided at its ends with flanges, by means of which the
10 plate is secured within a suitable sheet-metal tube 13, that is placed within the separating-chamber 2. These baffle-plates are staggered, and I have here shown the separating-chamber provided with eight sets of such plates.
15 Any preferred number, however, may be employed. In front of the baffle-plates 12 I arrange a steam-pipe 14, that projects into the separating-chamber 2, substantially to the center thereof, and has its open end turned
20 toward said baffle-plates. This pipe is provided with a suitable valve 15. I also arrange in the separating-chamber a series of corrugated metal plates with narrow zigzag spaces between them. (See Fig. 2.) These
25 plates are supported at a short distance above the bottom of the separating-chamber. (See Fig. 4.) I prefer to provide a shallow trough 16, preferably formed of zinc and arranged in the lower part of said separating-chamber.
30 This trough has closed ends, and the corrugated plates 17 are supported upon the ends of said trough. (See Figs. 1 and 4.) This trough forms a dead-water space or settling-chamber within the separating-chamber, and
35 within this trough the solid particles removed from the water are collected. A suitable waste-pipe 18 is connected to the lower part of the chamber, and the trough 16 has an opening in its bottom communicating with
40 this waste-pipe. The pipe is also provided with a suitable valve 19, by means of which the sediment that collects in said trough may be drawn out through the pipe 18. The plates 17 are provided with a series of cor-
45 rugations, and they are preferably arranged with narrow zigzag spaces between them. I have in actual use generally placed said plates so that the spaces between them were each about one-quarter of an inch across. The
50 opposite end of the separating-chamber 2 is connected to an auxiliary separating-chamber 20 by means of a suitable pipe 21, and I prefer to connect a pipe 22 with the pipe 21, extending the pipe 22 down some distance
55 into the auxiliary chamber. Screwed upon the lower end of the pipe 22 is a cap 23, having a series of openings in its circumferential wall, and a sheet of wire-gauze or other suitable material is wrapped around the cap 23,
60 passing over and covering the openings in the wall of said cap and being secured in position by suitable metal strips 25 and screws 26. (See Fig. 5.) I also prefer to provide in the bottom of the auxiliary chamber 20 a sheet-
65 metal cup 27, preferably formed of zinc, with

a series of vertically-arranged plates 28 in said cup. These plates have serrated lower edges (see Fig. 6) and are arranged with narrow spaces between them. A feed-pipe 29 leads from the chamber 20 and has suitable connec- 70
tion with the boiler that is to be supplied with water through this device. This pipe has a suitable valve 30 and a check-valve 30'. The auxiliary chamber 20 is also provided with a waste-pipe 31 and with a suitable valve 32, 75
arranged therein.

The operation of my improved heater and purifier is as follows: The water is fed by means of the injector into the end of the separating-chamber 2. It passes between the spiral plates 80
or baffles 12 and is at the same time subjected to the action of steam entering through the pipe 14. As the water passes between the baffles it is given a spiral or helicoidal motion. The water then passes along in the separating- 85
chamber and is broken up into a number of separate streams, each passing between two of the corrugated parallel plates. Each stream of water is compelled to follow a zigzag course, and thereby the direction of each particle of 90
water is repeatedly and suddenly changed, and the heavier particles of sediment are thrown out by tangential force and find their way downward into the trough 16, where the water is comparatively quiet, and from whence they 95
may be removed through the pipe 18. After the water passes through the chamber 2 it enters the chamber 20, passing through the openings in the cap 24, and the screens over these openings divide up the water into a finespray 100
and cause it to be thrown against the side walls of the chamber 20. This agitation and division of water permits the freed particles to drop down into the lower part of the chamber 20 into the space between the plates 28. I prefer 105
to provide zigzag plates 17, alternately of copper and zinc. A galvanic action is thereby obtained which, while it is insufficient to decompose the water, gives sufficient directive force to cause any oxygen in solution in the 110
water to go to the zinc plates and corrode them instead of corroding the boiler. It is for this purpose that I provide the zinc trough 16 in the bottom of the separating-chamber. This trough is easily removable, and its use 115
in the separating-chamber reduces the corrosion of the boiler. I have found also that when zinc is used for the trough 16 and when alternate plates of zinc and copper are used in the separating-chamber the sediment taken 120
from the water is more muddy and less scaly. It is for the same purpose that I use the series of zinc plates 28 in the bottom of the auxiliary separating-chamber 20.

The feed-water heater and purifier herein 125
shown may be placed directly upon a locomotive, and the water after passing through this heater and purifier may be passed directly into the boiler. I have found by actual trial that a very large proportion of the carbonates, sul- 130

fates, and silicates are removed from the water by its passage through this purifier without interfering in any way with the rapidity of the feed.

I do not limit myself to the details of the construction herein shown and described, as the same may be varied in many particulars without departing from my invention.

I claim as my invention--

1. In a feed-water heater and purifier, the combination, with a separating-chamber, of a series of upright corrugated plates arranged in said chamber and providing zigzag passages in which the water passing through said chamber is deflected from one plate to another, substantially as described.

2. In a feed-water heater and purifier, the combination, with a separating-chamber, of a series of upright corrugated plates arranged in said chamber and providing zigzag passages in which the water passing through said chamber is deflected from one plate to another, and a space below said plates for the collection of sediment.

3. In a feed-water heater and purifier, the combination, with a separating-chamber, of a series of upright corrugated plates arranged in said chamber and providing zigzag passages in which the water passing through said chamber is deflected from one plate to another, and a removable trough arranged in said chamber below said plates, substantially as described.

4. In a feed-water heater and purifier, the combination, with a separating-chamber, of a series of upright corrugated plates arranged in said chamber and providing zigzag passages in which the water passing through said chamber is deflected from one plate to another, of a dead-water-settlings chamber below said plates and a suitable waste-pipe connected with said settlings-chamber.

5. In a feed-water heater and purifier, the combination, in a separating-chamber, of a series of corrugated copper plates and a series of corrugated zinc plates alternately arranged in said chamber and providing zigzag passages for the water passing through said chamber, substantially as described.

6. In a feed-water heater and purifier, the combination, with a separating-chamber, of a

series of corrugated plates arranged in said chamber and providing zigzag passages for the water passing through said chamber, and a series of spiral baffle-plates arranged in said chamber between the inlet-pipe and said corrugated plates, substantially as described.

7. In a feed-water heater and purifier, the combination, with a separating-chamber, of a series of upright corrugated plates arranged in said chamber and providing zigzag passages in which the water passing through said chamber is deflected from one plate to another, and a suitable steam-pipe connected with said chamber between the inlet-opening and said corrugated plates.

8. In a feed-water heater and purifier, the combination, with a separating-chamber, of a series of corrugated plates arranged in said chamber and providing zigzag passages for the water passing through said chamber, a series of spiral baffle-plates, and a steam-pipe connected with said chamber, substantially as described.

9. In a feed-water heater and purifier, the combination, with the separating-chamber provided with the zigzag separating-plates, of the auxiliary chamber, the pipe extending into said auxiliary chamber, the head secured upon said pipe and provided with a series of openings, and the screens arranged over said openings.

10. In a feed-water heater and purifier, the combination, with a suitable chamber, of a series of zinc plates having serrated lower edges arranged in the bottom of said chamber with narrow spaces between them, for the purpose set forth.

11. In a feed-water heater and purifier, the combination, with the auxiliary chamber provided with a series of zinc plates having serrated lower edges and arranged in the bottom of said chamber with narrow spaces between them, and a waste-pipe and valve, substantially as described.

In witness whereof I have hereunto set my hand this 23d day of July, 1903.

THOMAS Y. STEWART.

In presence of--

SAMUEL STEWART,
A. C. PAUL.