(No Model.)

T. FAIRBANKS.

FEED WATER HEATER.

No. 381,618. Patented Apr. 24, 1888.

Fig. 1.

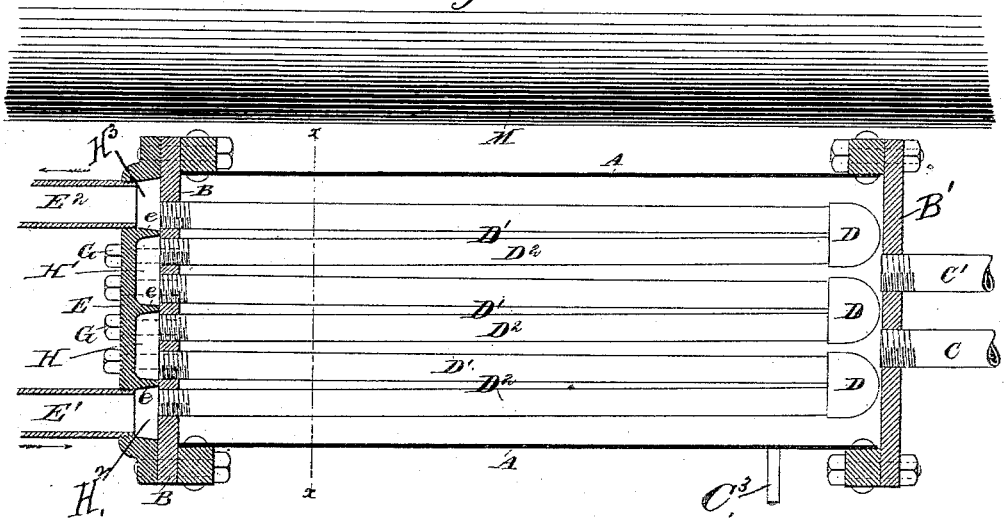


Fig. 2.

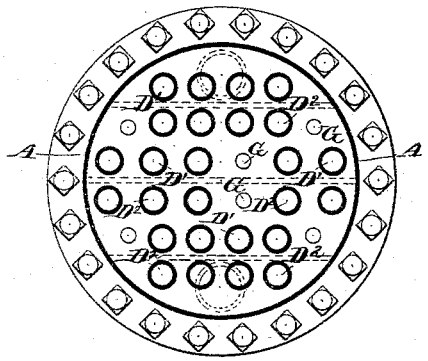


Fig. 3.

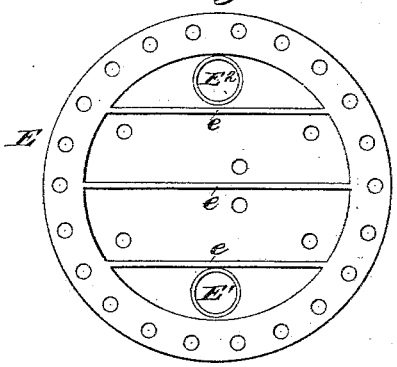
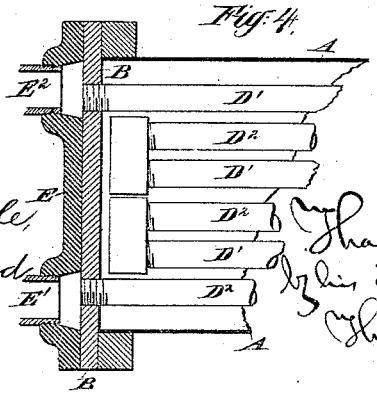


Fig. 4.



Witnesses:
Charles R. Searle,
F. A. Richmond.

Inventor:
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by his attorneys
Thomas Drew Stetson.

UNITED STATES PATENT OFFICE.

THADDEUS FAIRBANKS, OF ST. JOHNSBURY, VERMONT, ASSIGNOR TO THE FEED WATER HEATER COMPANY, OF SAME PLACE.

FEED-WATER HEATER.

SPECIFICATION forming part of Letters Patent No. 381,618, dated April 24, 1888.

Application filed March 11, 1886. Serial No. 194,759. (No model.)

To all whom it may concern:

Be it known that I, THADDEUS FAIRBANKS, of St. Johnsbury, Caledonia county, in the State of Vermont, have invented a certain new and useful Improvement in Feed-Water Heaters, of which the following is a specification.

The improved heater is intended more particularly for locomotives, but may be used in any situation where exhaust-steam may be commanded. I will describe it as applied to a locomotive and mounted in the center-line of the structure under the boiler. The great pressure to which the feed-water is subjected in overcoming the pressure of the boiler proper and the other resistances, including that of lifting the check-valve, involves the necessity for great strength in the parts subjected to the pressure of the water. In my construction the parts subjected to such pressure are mainly a series of thin tubes favorably conditioned to allow expansion and contraction at will. I will refer to these as U-shaped tubes. The additional parts are two nearly-plane disks or slightly-dishing plates, which may be of any desired thickness and rigidity, joined tightly together, and provided with peculiarly-arranged partitions and connections for receiving the cold and delivering the hot water. A thin casing sufficient to withstand the slight pressure of the exhaust-steam, inclosing the U-shaped tubes with suitable connections for the steam and water, is all that is necessary to complete the apparatus.

By my invention the water is caused to circulate through a number of the U-shaped tubes simultaneously, and, after mixing in one chamber common to all, the water is again led through a second series, and so on, each time becoming more thoroughly heated by the bath of steam in which the tubes are enveloped. If the water shall for any reason circulate more actively through one tube than another, but little harm results, because there is ample area in the great number of tubes for thoroughly subjecting all the water to the action of the steam. The admixture of the water from many small pipes which takes place in each chamber makes the heating of the whole uniform and efficient.

The invention constitutes a successful heater in which the water is within and the steam exterior to the tubes, and overcomes the difficulty heretofore experienced from the tendency due to the momentum of the incoming jets of water to move through the pipes unequally, and consequently flow to the boiler imperfectly heated.

The accompanying drawings form a part of this specification, and represent what I consider the best means of carrying out the invention.

Figure 1 is a vertical longitudinal section through my heater, with a portion of the boiler. Fig. 2 is a cross-section on the line x x in Fig. 1. Fig. 3 shows an inner face view of one of the parts detached. Fig. 4 is a vertical longitudinal section of a portion, showing a modification.

Similar letters of reference indicate corresponding parts in all the figures where they occur.

M is the barrel of the boiler; A, the light casing which incloses a series of U-shaped tubes, D D′ D². A connection, C, brings exhaust-steam from the cylinders. (Not represented.) C′ is a connection for leading away the uncondensed steam to the chimney. The pipes C C′ are connected to a disk, B′, as shown, said disk being connected to the casing A in any suitable manner.

C³ is a drip-tube to allow the trapping out or otherwise removing the water produced by the condensation of the steam.

B is a steel or wrought-iron tube-sheet, in which the U shaped tubes are tightly set.

The pipes C and C′ extend in the line of the tubes. This is important when the U-shaped pipes carry a dense fluid, as water. The momentum of the entering steam received through the pipe C in a line with the motion which it is to follow contributes to the active movement of the water through the heater-pipes. I also attach importance to the fact that the exhaust-connections C C′ both extend in line with the tube and are both connected through the same disk, which is removable. Their being in line facilitates the active circulation of the steam among the U-shaped pipes, and their being

in the same disk reduces the number of joints to be broken when the apparatus is taken apart.

E is a strong cap-casting providing a series of horizontal chambers for the water between itself and B. The tube-sheet B and cap E are tightly bolted together by their edges and also by bolts G, distributed over their areas.

E′ is a water-connection leading from a pump or other forcing means. (Not represented.) This admits the cold water.

E^2 is a connection leading from another point in the casting E and conveying away the hot water. This connection, through a check-valve, (not represented,) inducts the water into the boiler.

On the inner face of the slightly-dishing casting E are horizontal partitions *e*, extending continuously across. These partitions *e* are cast in one with E. Their edges are finished to make an approximately-tight contact with the adjacent surface of B, and they serve to make mixing-chambers H H. The bolts G are tapped in the plate B and tightly set up, so as to hold B and E rigidly together. These parts mechanically support each other and constitute a unit.

To prevent leakage around the bolts G, I apply red lead or analogous material to the outer face of B and the inner face of E adjacent to each bolt and screw up the bolts G, so as to confine these surfaces tightly together at those points.

The arrangement is such that the cold water received through E′ fills the bottom chamber of the space between E and B and causes the water to flow actively through the lowermost series of tubes, D^2, up through the return-bends D and back through the corresponding upper tube, D′. This brings the water into the chamber above the lowermost partition *e* and between it and the next partition, correspondingly marked above. The water now flows outward through another series of tubes D^2, up through the connected bends D, and back through the corresponding set of tubes, D′. This brings the water into a chamber still higher between the castings E and B. From this chamber it flows through another set of tubes D^2, up through D, and back through D′. This brings the water to the highest chamber and allows it to flow away through E^2.

When the pipes E′ E^2 are connected to the disks B E, as shown, chambers H^2 H^3 are formed between the walls and said disks, whereby the water is allowed to flow through the inlet-pipe E′ into the lower pipe, D^2, and through the series of pipes D′ D^2 to the top pipe, D′, where it passes into chamber H^3 and thence through the discharge-pipe E^2.

The mixing of the water after each traverse and return is important. The cold water entering through E′ in a strong current, as is the case when the pump or injector (not shown) is working with its fullest force, tends to distribute the water unequally into the several lower pipes.

By my construction the water which has passed through the lower series of tubes, D′ D^2, is not only thoroughly mixed in the chamber H, but after such mixing it is again sent back through the next series of pipes to absorb more heat and again is mixed in the chamber H′. I find this to be a decided advantage over the known method of passing water through similar pipes and then passing it to the boiler without thoroughly mixing and returning the mixed hot and cold again through the heating-pipes.

The construction is eminently simple and easy to be kept tight. The U-shaped tubes may expand and contract to an indefinite extent. The castings E and B may be made of any thickness to give rigidity. If they are not rigid, but spring under the great pressure to which they are subjected, no harm results.

The pipes E′ and E^2 extend in the line of the tubes D′ D^2. This is important when these parts carry a dense fluid, as water. The momentum of the entering water received through the pipe E′ in line with the motion which it is to follow contributes to the active movement of the water through the heater-pipes. When at a later stage the water is being discharged, the fact that the discharge-pipe E^2 extends in the direction of the motion which the water already possesses contributes to the ease of movement. I also attach importance to the fact that the steam-connections C C′ extend in the same direction as the tubes D′ D^2 and connect at such points as to communicate with the spaces between them, and are both connected through the same head, which is removable. Their being in line with the spaces between the tubes facilitates the active circulation of the steam among the tubes D′ D^2, and their being both set in one head reduces the number of joints to be broken when the apparatus is to be taken apart.

Modifications may be made in the forms and proportions without departing from the principle or sacrificing the advantages of the invention. The number of the U-shaped tubes may be increased or diminished. Parts of the invention may be used without the whole.

In the modification shown in Fig. 4 certain chambers are formed in boxes, which I term "manifolds," lying within the plate B. These manifolds allow the water to mix in the same manner as the corresponding chambers in the head. I prefer the construction shown in Fig. 1.

I claim as my invention—

In a feed-water heater, the combination, with the casing A, the disk B, connected thereto, the pipes D′ D^2, arranged in series one above the other and connected in pairs by bends D and secured to the disk, of the disk-cap E,

having partitions *e*, extending across the inner face thereof, the pipes E' E^2, connected to the disk and disk-cap, the chambers H H' H^2 H^3, formed by said disk and disk-cap, the disk B', having pipes C C' connected thereto and interposed between the bends D, and the drip-pipe C^3, attached to the bottom of the casing, as shown and described.

In testimony whereof I have hereunto set my hand, at St. Johnsbury, Vermont, this 3d day of March, 1886, in the presence of two subscribing witnesses.

THADDEUS FAIRBANKS.

Witnesses:

DENNIS E. MAY,

LUCY FAIRBANKS.