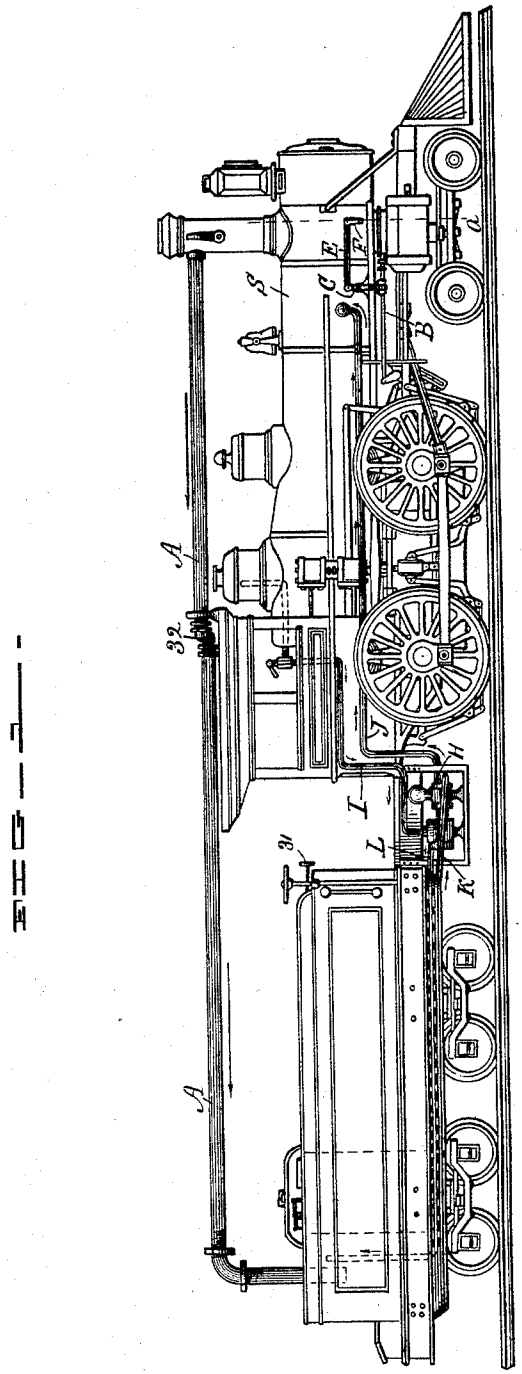
(No Model.) 3 Sheets—Sheet 1.

F. L. McGAHAN.

LOCOMOTIVE FEED WATER HEATER.

No. 456,676. Patented July 28, 1891.



Witnesses

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Inventor

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By his Attorney

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FIG. 3.

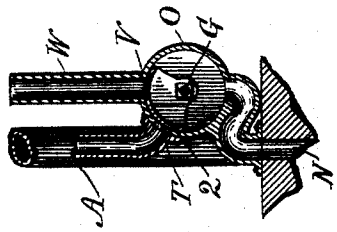


FIG. 4.

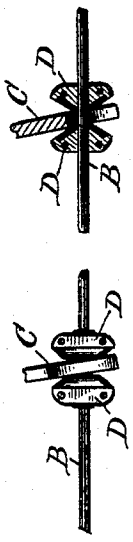


FIG. 5.

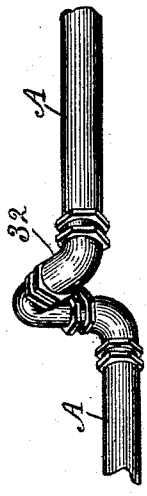
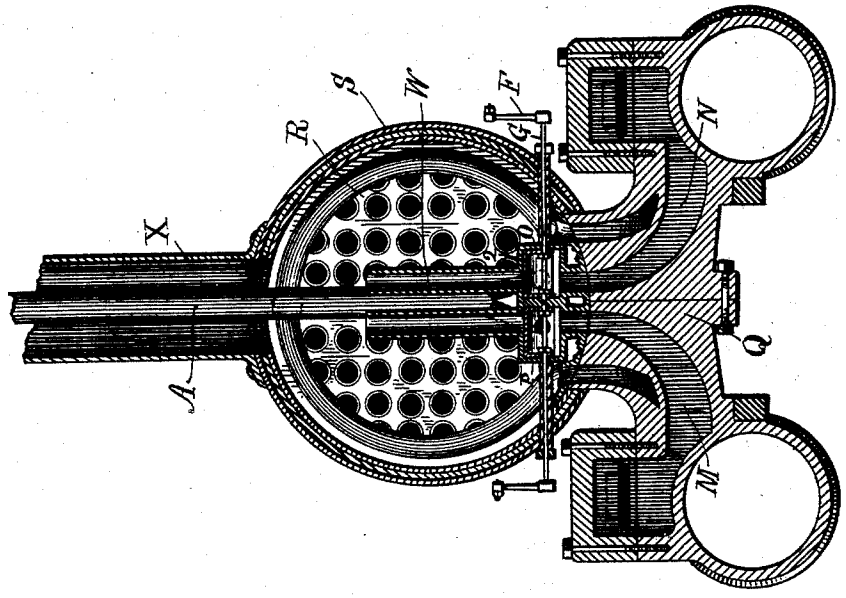


FIG. 2.



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FIG. 7.

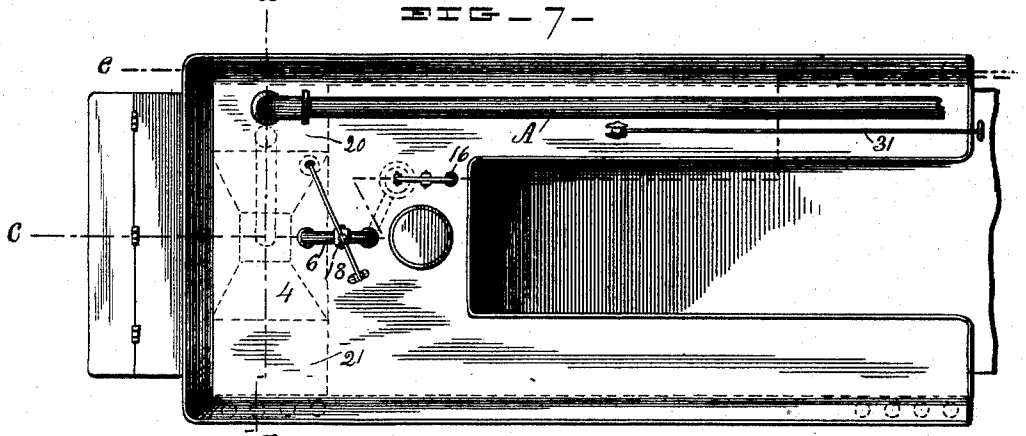


FIG. 8.

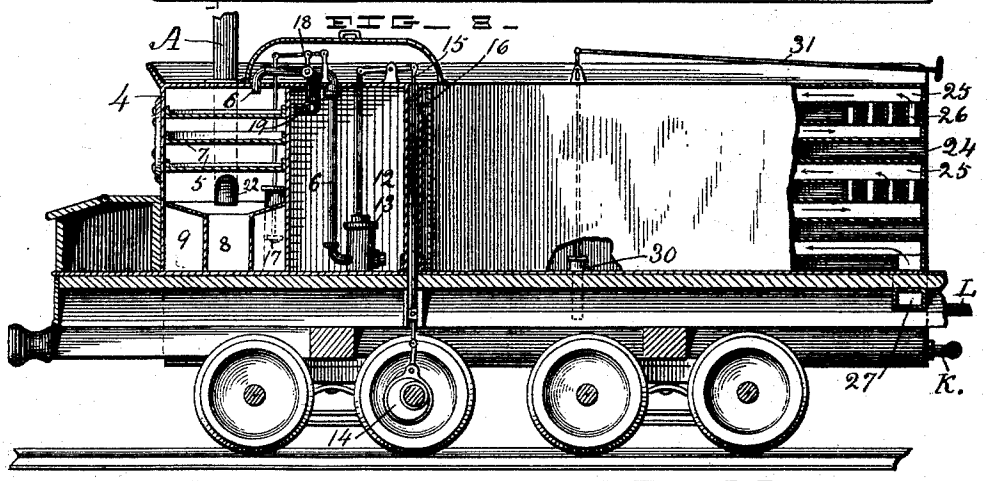


FIG. 9.

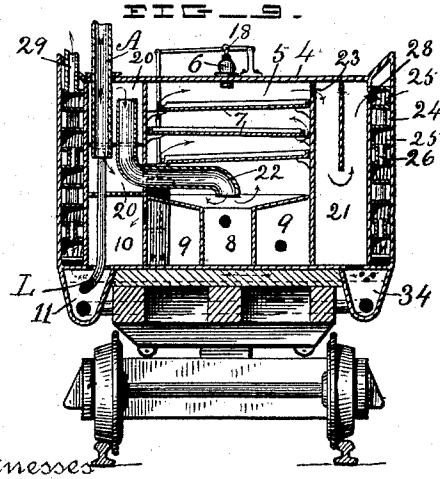
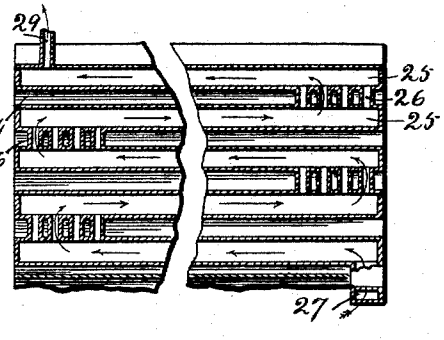


FIG. 10.



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UNITED STATES PATENT OFFICE.

FRED L. McGAHAN, OF INDIANAPOLIS, INDIANA.

LOCOMOTIVE FEED-WATER HEATER.

SPECIFICATION forming part of Letters Patent No. 456,676, dated July 28, 1891.

Application filed March 2, 1891. Serial No. 383,456. (No model.)

To all whom it may concern:

Be it known that I, FRED L. McGAHAN, a citizen of the United States, residing at Indianapolis, in the county of Marion and State of Indiana, have invented a new and useful Improvement in Locomotive Feed-Water Heaters, of which the following is a specification.

My invention relates to an improved means for heating the feed-water for locomotive-boilers.

The objects of my improvement are, first, to provide means for using a part of the exhaust-steam from the engine-cylinders to assist the draft in the smoke-stack and to use the remainder for heating the feed-water; second, to provide means for separating the lime and other solids held in solution in the feed-water before it enters the boiler, and, third, to provide means for condensing the surplus exhaust-steam and collecting the water of condensation to supplement the feed-water supply, all as hereinafter fully set forth.

The accompanying drawings illustrate my invention.

Figure 1 represents a side elevation of a locomotive having my improvement. Fig. 2 represents a transverse section on a larger scale at *a*, Fig. 1. Fig. 3 represents a partial longitudinal section at *b*, Fig. 2. Figs. 4 and 5 represent, respectively, a side elevation and a longitudinal section showing the means for connecting the valve-rod of the steam-chest and the lever which operates the exhaust-valve. Fig. 6 is a view in perspective showing the universal swivel-coupling in the exhaust-steam pipe. Fig. 7 is a plan of the locomotive-tender. Fig. 8 represents a central longitudinal section of the locomotive-tender at *c*, Fig. 7. Fig. 9 represents a transverse section of the locomotive-tender at *d*, Fig. 7. Fig. 10 represents a broken longitudinal section of the tender at *e*, Fig. 7.

In the drawings, Fig. 1, A is the exhaust-steam pipe, which extends from a point within the smoke-chamber, where it is arranged to receive the exhaust-steam from both cylinders, up and along the interior of the smoke-stack to near its top, and from thence backward over the top of the cab to the feed-water heater, hereinafter described, arranged in the rear of the tender.

B is the ordinary valve-rod which controls the slide-valve, there being one each side of the locomotive.

C is a lever pivoted to the frame of the locomotive and having one end arranged in the path of a pair of collars D D, Figs. 4 and 5, which are adjustably secured to the valve-rod B. The other end of lever C is connected by means of a connecting-rod E with a crank F, which is attached to a rock-shaft G, Fig. 2, which controls the discharge of the exhaust-steam, as hereinafter described.

H is a steam-pump, which is connected with the steam and water spaces of the boiler by pipes I and J and with the tender by the water-supply pipe K and exhaust-steam pipe L. The exhaust-ports of the cylinders M and N, Fig. 2, are arranged to discharge into a pair of cylindrical chambers O and P, which are mounted on the saddle-plate Q within the smoke-chamber R. Said chambers are arranged with their axes at right angles to the axis of the boiler S, and each is provided with a port T, Fig. 3, which enters the exhaust-steam pipe A, and a second port V, which enters a short pipe W, the open end of which is arranged immediately beneath the lower end of the smoke-stack X.

Each of the chambers is provided with a segmental valve 2, which is mounted upon and is secured to the rock-shaft G, said valve being arranged to cover either of the ports T or V. The arrangement of the collars D D, the lever C, crank F, and valve 2 is such that the exhaust-steam from one end of the steam-cylinder is discharged through the port T into the pipe A, and the steam from the opposite end of the cylinder is discharged through the port V into the smoke-stack. That portion of the exhaust which passes into the smoke-stack assists the draft therein, as heretofore. That portion of the exhaust which passes into the pipe A is conducted therein to the feed-water heater and purifier 4, which is arranged in the back part of the water-space of the tender. Said feed-water heater and purifier is similar in construction to that shown in Letters Patent No. 427,266, which were issued to me May 6, 1890. It

consists, essentially, of an inclosed chamber 5, having in its top a water-supply pipe 6, a series of communicating drip-plates 7 in its upper part, and in its lower part a central well 8, surrounded by a series of settling-chambers 9, through which the water passes in succession until it is discharged into an inclosed chamber 10, from whence it is drained into a conduit 11, extending along the bottom of the tender at one side. The feed-water is supplied to the heater and purifier from the water-space 12 in the tender by means of a pump 13, which is operated by means of an eccentric 14, mounted on an axle of the tender-truck, and a connecting-rod 15, which passes through the tender in a tube 16.

For the purpose of controlling the supply of water to the heater, I place in one of the settling-compartments 9 a float 17, which is arranged to operate a cut-off valve 18 in pipe 6, and thus causes the pump 13 to discharge through the branch 19 into the water-space 12.

On one side of the heater, between it and the wall of the tender, is formed an inclosed chamber 20, and on the opposite side a similar chamber 21 is formed. The exhaust-steam from the engines passes from pipe A into chamber 20, and from thence through pipe 22 into the chamber 5, where it is discharged directly over the central well 8. Such portion of the steam as is not condensed in chamber 5 passes through an opening 23 into chamber 21. For the purpose of condensing this remaining portion of steam I construct the sides of the tender with double walls and divide the spaces thus formed into a series of open-air passages 24, alternating with a series of steam-tubes 25, which are connected at opposite ends by short vertical tubes 26, and the tubes 25 of the two sides of the tender are connected by a transverse tube 27, thus forming a continuous steam-passage, which commences at the opening 28 in chamber 21 and ends at the open pipe 29 on the opposite side of the tender. The transverse tube 27 communicates also with a conduit 34, into which the water of condensation from tubes 25, and also from chamber 21, is drained. Conduits 11 and 34 are connected by the pipe K with pump H, and the exhaust-steam from the pump is conducted to chamber 20 by the pipe L.

For the purpose of enabling the pump H to draw water direct from the water-space of the tender in an emergency, I provide a valve 30, which is controlled by means of the rod 31, within convenient reach of the engineer, and which when open allows the water from the space 12 to flow into conduit 11.

For the purpose of preventing undue strain on the exhaust-pipe A by reason of the movement of the tender and the engine relatively to each other, I provide in the pipe a universal swivel-joint 32. This joint also permits the folding of the rear portion of the pipe forward in case the tender is disconnected.

In operation at each stroke of the piston in each of the steam-cylinders a portion of the exhaust-steam passes into the smoke-stack and keeps up the draft therein. The remaining steam is conducted to the feed-water heater in the tender and operates, first, to heat the water to that temperature at which it will deposit its mineral and solid matter in the settling-chambers of the heater, and is then, as it passes through the tubes 25, rapidly condensed by the current of air flowing through the open passages 24. The feed-water stored in the water-space of the tender is by the movement of the tender automatically pumped into the heater, is there heated and purified, and is then, together with the water of condensation from the exhaust-steam, pumped into the boiler. The boiler is thus supplied with pure warm water and kept free from scale, and a considerable saving in fuel is effected.

I claim as my invention—

1. The combination, with the water-tank and the exhaust-port of the steam-engine of a locomotive, of a pipe arranged to connect said exhaust-port and water-tank, a valve arranged between said exhaust-port and pipe, and intermediate connecting mechanism connecting said valve and a regularly-moving part of the engine, as the valve-rod, whereby a portion of the exhaust-steam from the engine is automatically discharged at each stroke thereof into said pipe, substantially as and for the purpose set forth.

2. The combination, with the water-tank, the smoke-stack, and the exhaust-port of a steam-engine of a locomotive, of a chamber arranged to receive the steam from said exhaust-port, said chamber being provided with two discharge-ports, one of which communicates with a pipe leading to the water-tank and the other of which communicates with the smoke-stack, a valve mounted within said chamber and arranged to cover either of said discharge-ports, and intermediate connecting mechanism connecting said valve and a moving part of the engine, whereby said ports are alternately opened at each stroke of the engine and a part of the exhaust-steam is discharged into the smoke-stack and the remainder is discharged into the water-tank, substantially as set forth.

3. In a locomotive-tender, the combination of the feed-water heater, the steam-pipe arranged to enter said heater, the series of connected steam-passages formed in the walls of the tender and arranged to receive the exhaust-steam from said heater, and the conduit arranged to receive the water of condensation from said steam-passages, all arranged to co-operate substantially as set forth.

4. In a locomotive-tender, the combination of the feed-water heater, the steam-pipe arranged to enter said heater, the series of connected steam-passages formed in the walls of the tender and arranged to receive the exhaust-steam from said heater, the open air-passages also formed in the walls of the tender and arranged alternately with said steam-pas-

sages, and the conduit arranged to receive the water of condensation from the steam-passages, all arranged to co-operate substantially as set forth.

5. In a locomotive-tender, the combination of the water-space of said tender, the feed-water heater arranged adjacent thereto, the pump arranged in said water-space, the pipe connecting said pump with the heater, and intermediate connecting mechanism connecting a moving part of the tender, as the axle of one of the trucks, and said pump, whereby water from the water-space is automatically delivered into the heater by the movement of the tender, substantially as set forth.

6. In a locomotive-tender, the combination of the water-space of said tender, the feed-water space arranged adjacent thereto, the pump arranged in said water-space, the pipe connecting said pump with the heater and having a branch which discharges into the water-space, the valve arranged to cut off the discharge into the heater, and the float arranged in the heater and connected with said valve, whereby the amount of water delivered to the heater is controlled, all substantially as set forth.

FRED L. McGAHAN.

Witnesses:
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V. M. HOOD.