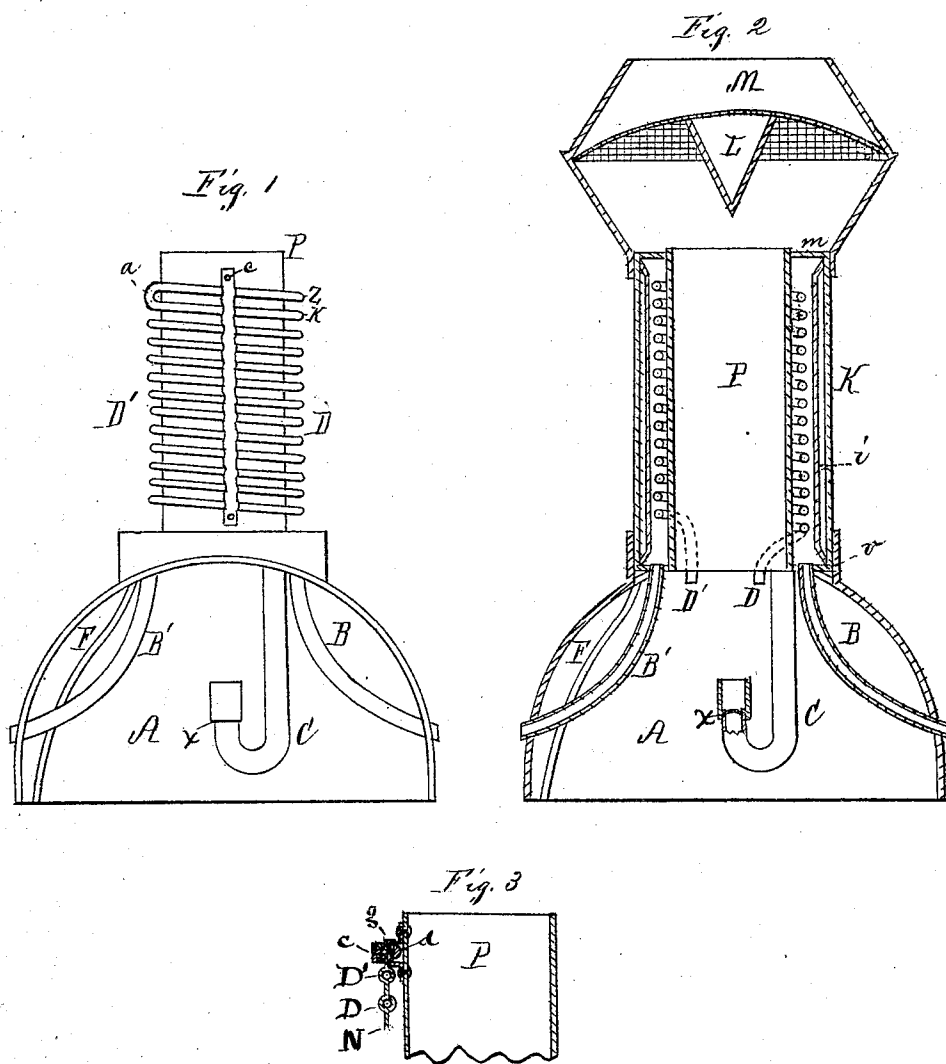


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Feed-Water Heaters for Locomotives.

No. 147,013.

Patented Feb. 3, 1874.



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UNITED STATES PATENT OFFICE.

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IMPROVEMENT IN FEED-WATER HEATERS FOR LOCOMOTIVES.

Specification forming part of Letters Patent No. 147,013, dated February 3, 1874; application filed December 18, 1873.

To all whom it may concern:

Be it known that I, ISRAEL P. MAGOON, of St. Johnsbury, in the county of Caledonia, State of Vermont, have invented a certain new and useful Improvement in Feed-Water Heaters for Locomotive Steam-Engines, of which the following is a description sufficiently full, clear, and exact to enable any person skilled in the art or science to which my invention appertains to make and use the same, reference being had to the accompanying drawing forming a part of this specification, in which—

Figure 1 is a sectional view, showing the manner in which the feed-water pipe is coiled and the arrangement of the exhaust and drip pipes. Fig. 2 is a vertical section taken through the stack, smoke-pipe, and exhaust-pipes. Fig. 3 is a sectional view, showing the stays and manner of supporting the pipe in the steam-chamber.

Like letters refer to like parts in the different figures of the drawing.

My improvement relates to that class of locomotive steam-engines in which the feed-water is heated by means of the exhaust steam before being passed into the boiler; and consists in an insulator or steam-chamber constructed and arranged in a novel manner within the smoke-stack, and in means by which the entire exhaust steam is utilized by passing it through such insulator before it is applied to promote the draft of the engine, all as hereinafter more fully set forth, the object being to simplify the heating apparatus, and, by rendering the same more effective, increase the saving of fuel.

In Fig. 1, A is the smoke-box of the engine; B B', the exhaust-steam pipes leading from their respective cylinders; D D', the copper feed-water pipe; F, the drip-pipe; C, the main exhaust-pipe, and P the smoke-pipe or chimney.

In Fig. 2, the same parts are shown, in section and otherwise, and in addition thereto K is the outer wall of the stack; M, the cap or bonnet; L, the cone or deflector; *i*, the auxiliary wall; and *m* and *v* the upper and lower heads of the insulator. The water with which the boiler is "fed" or "supplied" is taken, in the usual manner, from the tender or tank, and

forced, by means of the ordinary force-pump, through the pipe D D', one end of said pipe being connected with the pump, and the other end with the boiler, in such a manner that the water will be forced upward through the coil K, Fig. 1, and returned through the coil *z*, which is the method I prefer, although I do not confine myself to the same, as the water may be forced through the coil *z* first, and thence through the coil K into the boiler, by changing the ends connecting with the force-pump and check-valve or boiler accordingly. In constructing the heater, the pipe is first bent, as seen at *a*, Fig. 1, and there coiled in a double helix and placed around the pipe P, as shown, being supported in that position by the means exhibited in Fig. 3. Around the pipe, when so coiled and arranged, I construct a closed steam-chamber or insulator, as shown in Fig. 2. The inner wall of this chamber is formed by the smoke or eduction pipe P, and the outer wall by the wall K, the space between these walls being closed in by the heads *m v*. Within this chamber, and fastened at the top and bottom to the wall K, there is arranged an auxiliary wall, *i*, between which and the wall K there is an air-space, into which no steam can pass. This air space or jacket acts as a non-conductor to prevent the condensation of steam within the insulator from cold air surrounding and in contact with the wall K. The convex strainer *x* is to prevent the cinders from the smoke-box A and chimney P being drawn into the pipe C, and thence upward into the insulator, when a vacuum is created in the cylinders of the engine by shutting off steam, which shutting off also tends to create a vacuum in the insulator. The pipe F, or "drop-pipe," is used to convey the water of condensation from the insulator or steam-chamber, in which the feed-water pipe D D' is coiled.

Fig. 3 represents the method of supporting the feed-pipe in position in the chamber, and in said figure P is the chimney; D D', the feed-water pipe, and *g* a truss attached by rivets to the pipe P. Through this truss there is a screw-bolt, *e*, having a head, *d*, and provided with a nut, check-nut, and washer. N is a double yoke or clamp, bent to fit around the

pipe, and held in place on the truss by said bolt and nuts. It will be understood that a series of these trusses provided with bolts and nuts, as shown, is attached to the pipe P in a vertical line, and that there is also a corresponding series of yokes or clamps, one clamp encircling each coil of pipe within the heater, and firmly holding it in position. When the bolts which hold the yokes or clamps and sustain the weight of pipe are extended through the chimney P, I have found that the constant jar and vibration of the engine, when in use, are liable to loosen the bolts in the wall of the chimney, and thus produce a leakage of the chamber. This is obviated by means of the trusses, as no bad effects will occur should the bolts become loose therein.

I sometimes construct my apparatus with a small exit-pipe leading from the chamber to the top of the stack, and fitted with a stop-cock, so that after throwing all of the exhaust steam into the chamber to heat the feed-water, a part of it can be discharged through said exit-pipe directly into the open air, if desired.

In the drawing accompanying this specification, the feed-water pipes are represented as disconnected from the boiler and pump, it not being deemed necessary in that respect to show anything more than their arrangement and relative position to the other parts of the apparatus.

From the foregoing, all conversant with such matters will readily understand the nature and operation of my improved heating apparatus. Water being drawn from the tank of the tender, and forced by the ordinary force-pump through the coiled pipe located within the insulator or steam-chamber formed by the walls P K and heads *m v*, will be heated to a high degree of temperature on its way to the boiler by means of the exhaust steam, which, as the engine works, is thrown into said chamber, through the pipes B and B' alternately, so that when said water reaches the boiler comparatively little fuel will be required to convert it into steam. After the exhaust steam has accomplished its work in heating the feed-water, as aforesaid, it is conveyed by the pipe C, through the strainer *x*, into the eduction-pipe P, to promote or assist in maintaining the draft of the engine, as shown, all water of condensation being conveyed from the insulator or chamber by means of the pipe F.

The numerous advantages arising from the use of hot feed-water in working a locomotive steam-engine are too apparent to every practical engineer to require specifying, especially when such water is obtained or produced by utilizing the heat of steam which has already performed duty as a motive power.

One section only of the truss mechanism for supporting the pipe in the chamber is shown in the drawing, more being deemed unnecessary.

I also sometimes connect small pipes, fitted with stop-cocks, to the pipes B B', between the cylinders and the heating-chamber or in-

ulator, and extend them to the top of the stack, so that a part of the exhaust steam can be discharged through them directly into the open air, if desired; but these pipes, and the exit-pipe from the heating-chamber for discharging the steam into the open air, are very seldom used, and in most instances all of the steam is required to be thrown into the chamber to heat the feed-water, and is also all required to promote the draft of the chimney, in which case the stop-cocks in said exit-pipe, and in the pipes leading from the pipes B B', as stated, are closed.

Letters Patent of the United States, numbered 117,308, were granted to me on the 25th day of July, 1871, for an improvement in locomotive steam-engines, in which patent a feed-water-heating apparatus is described, similar in many respects to my present invention, but varying in several essential features. In said patent a closed insulator or steam-chamber is shown and described, constructed and arranged around the eduction or smoke pipe of the stack, and principally supported thereby; but the outer wall of said insulator is not formed by the outer wall of the smoke-stack, and there is no auxiliary wall within the insulator, or so arranged as to produce a closed air-space on the outer side of the insulator, into which no steam or smoke can pass. The main exhaust-pipe described in said patent is provided with a branch pipe, through which a part only of the exhaust steam is passed into the insulator, being conveyed through another pipe from the insulator into the smoke-box, to assist in maintaining the draft of the engine. A coiled feed-water pipe is arranged within the steam-chamber or insulator, substantially the same as in my present invention, through which the feed-water passes, and in which it is heated by the steam in said chamber on its way to the boiler. The insulator described in said patented invention being disconnected with the outer wall of the smoke-stack, and arranged around and mainly supported by the eduction or smoke pipe in the center of the stack, it has been found difficult in actual use, in some forms of locomotives, to support it in that position with sufficient stability to prevent leakage. The arrangement of the insulator in the center of the stack also necessitates the use of shorter coils of feed-water pipe, and consequently there is less heating-surface presented to the steam within the chamber than is obtained by my improved method of constructing the heater, as herein described. I have also found that the use of all the exhaust steam is, in many instances, desirable, and the improved means by which the coils of pipe are heated, by taking the entire exhaust steam directly from the cylinders into the insulating or steam chamber, and afterward using it to produce a draft, possesses many advantages for certain classes of engines, especially the larger, over the method described in said patent.

On the 29th day of March, 1870, Letters Patent of the United States, numbered 101,287, were also granted to me for an improvement in locomotive steam-engines, in which last-named patent a feed-water-heating mechanism is described, consisting in part of a pipe, through which the feed-water passes on its way to the boiler, arranged in the smoke-stack, in connection with a kind of jacket or screen; but said pipe, not being placed in a closed steam-chamber, or insulated from the smoke and cinders, soon becomes so clogged or coated with cinders and carbonaceous deposits from the smoke as to prevent the water passing through the pipe from being properly heated, or heated to that degree which it otherwise would be.

I am also aware that a patent was granted to one Ebbert, May 5, 1857, numbered 17,208, for an improvement in feed-water heaters, which patent has expired. But the apparatus of said Ebbert was different in many respects from mine, and lacked the essential features which make mine successful, and reduce its cost of construction, the netting and bonnet in said Ebbert's engine being disconnected from the top of the heating-chamber, or nearly so, and arranged in and supported by the outer or conical casing of the stack, whereas, in mine, the netting, or bonnet in which the netting is disposed, is mounted upon or attached directly to the top of the closed steam-chamber, by which the stack is greatly simplified and lightened, and its cost of manufacture reduced.

I therefore do not herein claim anything whatsoever, when in and of itself considered, which is already secured to me by said patent of 1870 or 1871, or shown and described therein and not so secured. Neither do I herein claim the strainer *x*, except when used with the pipe *C* and other parts, arranged as herein described, having made said strainer, in combination with an exhaust-pipe and closed steam-

chamber, the subject of a claim in another application for Letters Patent, filed December 10, 1873. Neither do I claim herein anything whatsoever shown or described in the patent of said Ebbert, when in and of itself considered; but

What I do claim is—

1. In the feed-water-heating apparatus of a locomotive steam-engine, a closed chamber or insulator, the outer walls of which consist of the pipe *P* and the wall *K* of the stack, connected by the heads *m v*, and on which the netting, or bonnet in which the netting is disposed, is mounted, substantially in the manner set forth and described.

2. In combination with the closed chamber, the auxiliary wall *i*, arranged and used substantially as and for the purpose set forth and specified.

3. In the feed-water-heating apparatus of a locomotive steam-engine, the pipes *B B'*, pipe *C*, and pipe *F*, in combination with a closed chamber, through which the feed-water pipe passes, the same being arranged and used substantially as shown, so that the whole exhaust steam, unmixed with smoke, can be thrown into said chamber for heating the feed-water prior to being used to promote the draft of the chimney, for the purpose specified.

4. In combination with the closed steam-chamber and the pipe *C*, the pipes *B B'*, the pipe *D D'*, and the pipe *F*, the strainer *x*, substantially as and for the purpose specified.

5. The combination of the truss *g*, bolt *e*, and yoke *N* with the pipe *P*, for supporting the feed-water pipe in the closed steam-chamber, substantially as specified.

Subscribed December 15, 1873.

ISRAEL P. MAGOON.

Witnesses:

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