J. A. MILLER.

Steam-Generator.

No. 161,258. Patented March 23, 1875.

Fig I.

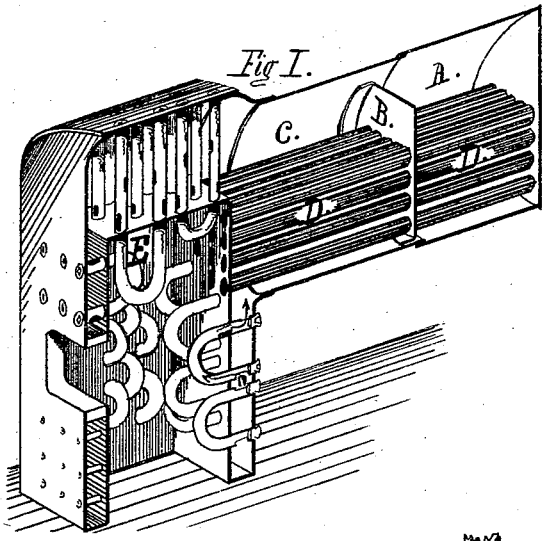


Fig II.

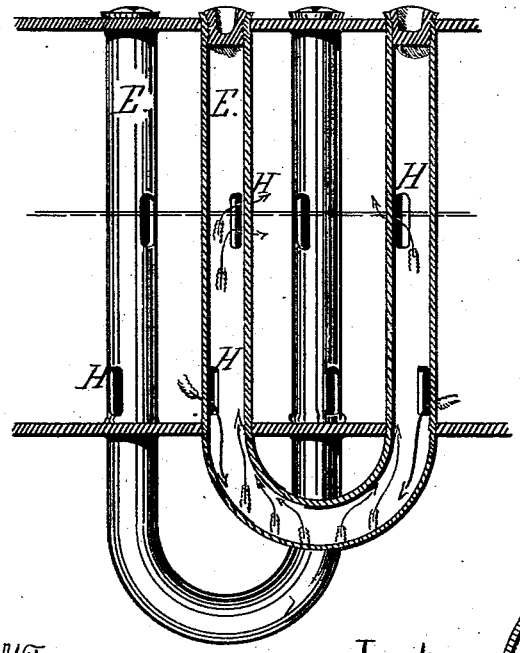
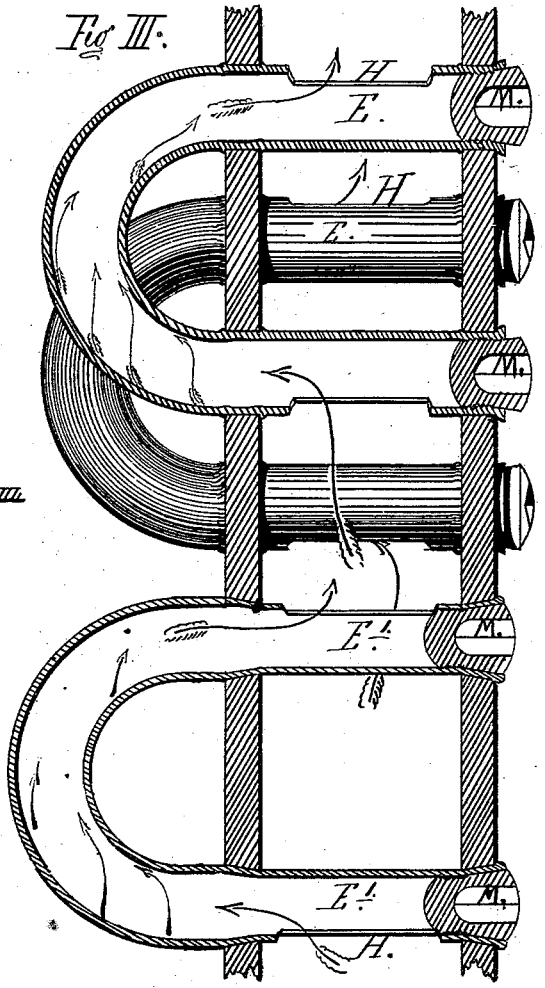


Fig III.



Witnesses

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UNITED STATES PATENT OFFICE.

JOSEPH A. MILLER, OF PROVIDENCE, RHODE ISLAND.

IMPROVEMENT IN STEAM-GENERATORS.

Specification forming part of Letters Patent No. **161,258**, dated March 23, 1875; application filed March 26, 1874.

To all whom it may concern:

Be it known that I, JOSEPH A. MILLER, of Providence, in the State of Rhode Island, have invented a new and useful Improvement in Steam-Generators; and I do hereby declare that the following is a full, clear, and exact description thereof, which will enable others skilled in the art to make and use the same, reference being had to the accompanying drawings, forming part of this specification.

Figure I represents a sectional perspective view of my improved steam-generator. Fig. II is an enlarged section, showing the U-shaped tubes connected to the crown-sheet and the outer shell. Fig. III is an enlarged view, representing the U-shaped tubes used as stays for the sides of a locomotive fire-box.

Similar letters of reference indicate corresponding parts.

The object of this invention is to increase the heating-surface of a locomotive-boiler in the fire-box without enlarging the same, and also to provide a large space for the precipitation of impurities contained in the water before the same reaches the active surface near the fire.

My invention consists chiefly in substituting for the present solid stays, by which the flat surfaces of a locomotive-boiler are secured so as to resist the pressure of the steam, tubular U-shaped or bent tubes, which, being firmly expanded into both sheets of a fire-box, act as stays, and which, having the bent ends extending into the fire-space, and the other ends closed by plugs, and the interior of which tubes communicates, by suitable openings, with the interior or water space, so that, while acting as stays and being protected by the water, these tubes supply an additional and most efficient heating-surface. The crown-sheet, also, instead of the cumbrous crown-bars and stay-bolts, I secure by similar bent tubes, which, while acting as stays, also add to the heating-surface. To prevent impurities contained in the water from lodging within these tubes an extra tube-sheet is placed about midway into the barrel of the boiler, and the feed-water is made to enter the boiler near the end farthest from the fire.

The power of a locomotive is limited to its capacity to generate steam, and this depends on the area of grate and heating surface, while the value of heating-surface primarily depends on the temperature surrounding the same, which being the highest in the fire-box, it is obvious that here, as much as possible, should be exposed to the action of the fire.

In my improved steam-generator, the U-shaped tubes E and E′, as shown in Figs. III, are firmly secured, by expanding, to the sheets of the fire-box, in place of the usual stay-bolts. They may be made of copper, brass, iron, or, as I prefer, of homogeneous or Bessemer steel lap-welded. In bending the tubes pains should be taken to compress the metal on the inner side of the bent tubes, rather than stretch the outer side. When the tubes are so bent a slit, H, is cut into each limb of the tube, so as to give the largest possible area without decreasing too much the cross-section of the tube. The slit is, therefore, made preferably narrow and long—about half an inch wide by about two inches long.

The holes for these tubes being carefully drilled of such diameter that the tubes will require some little force to enter the same, and the tubes entered, so that the two ends project about one-fourth of an inch from the outside sheet, the expanding-tool is inserted and the tube firmly expanded into both the sheets, so as to make a perfect and reliable joint. A screw-tap having fine and shallow threads is now inserted, and a thread is cut in the inside of each end of the tubes, when the screw-plug M, having a tapering shoulder, is firmly screwed into the tube, so that the tapering shoulder will rest firmly against the sides of the tube and make a good joint, metal to metal, and also give additional strength to the expanded joint and prevent all possibility of the sheets spreading under pressure.

By practical tests I find such a stay to be stronger than the ordinary riveted stay. When firmly expanded the tube will sustain a greater pressure than the solid stay, as usually made. To give still greater strength, I use a tube in which the bent portion is of larger diameter than the portion which enters the sheets, and by this means the sheets may have tapering holes drilled into them, as shown in

Fig. III, by the water-tube stay E′. When such a tube is properly expanded, and the plug M is properly inserted, the tensile strength of the tube only limits its power to hold the sheets in place. These U-shaped tubes I call water-tube stays, they being at all times filled with water from the fire-box, and when the boiler is in use the water freely enters through the slit H in the lower limb of the tube and passes out of the slit H in the upper limb, partly converted into steam, thus forming an efficient steam-generator, having good circulation of water, and also increasing the circulation in the fire-box.

The bent portion of the water-tube stays may enter the furnace part of the fire-box more or less as more or less additional heating-surface is required. By only entering the bent portion or half-circle, a large amount of additional heating-surface is obtained, for by placing the tubes the same distance from center to center, as is now the case with the common stay-bolts, the water-tube surface will be three times the sheet-surface of the fire-box, adding three square feet to every square foot of heating-surface in the fire-box. When the whole fire-box of a locomotive-boiler is stayed with these water-tube stays, including the crown-sheet, the heating-surface will be four times the area of the same sized fire-box with the old stays and crown-bars, while the weight of metal is much less and the surface more favorable and efficient as a steam-generator.

A large number of the plugs M, closing the ends of the water-tube stays, can be reached at any time, and can be easily unscrewed and the condition of the tubes examined and cleaned out when required. Should any of the stays leak at any time, the same may be made safe and tight by the expanding-tool.

Fig. II represents the water-tube stays supporting the crown-sheet by being expanded into the same, and also into the shell of the boiler. For this purpose the tubes must be so arranged as to give the strain parallel with the axis of the tubes to secure the best results. The heat also acts differently on these tubes, when so suspended, than when placed on the sides of the fire-box, as is shown by arrows in the drawing, and two slits or holes, H, must be cut into each limb of the water-tube stay, viz, one on the outer side of each limb, near the crown-sheet, and one on the inner side of each limb, at the water-line. The steam arising will pass up near the inner circle of the tube, and so ascend to near the water-line, while the water freely enters the lower slit H and keeps the bent portion supplied with water in the fiercest fire.

Many locomotives built on the old plan with stay-bolts are deficient in their steam-generating capacity, and consequently wasteful in fuel and a nuisance to the traveler and the railroad company. The fire must be continually forced, and half-burned coals sent through the tubes and up the smoke-stack. The introduction of these bent water-tubes entirely prevents all the above trouble, steam is at once made without forcing, the combustion is much improved by the gases being broken up and mixed by the projecting bends, and as the boiler steams freely the exhaust is but seldom used.

When such locomotives are to be so improved, I place any number of my water-tubes that may be required and secure the same in the space between the rivets in the fire-box that is between the present stays, and make them of any length that may suit the conditions of the boiler, sometimes projecting from a space close to the fire and re-entering the fire-box near the crown sheet, at other times making two lengths and alternately projecting more or less into the fire. In all such cases I prefer to secure the bent tubes into both sheets of the fire-box; but they may be secured in any other way to the inner sheet only, and the hole in the outer sheet made to so secure the water-tube may be closed in any manner.

These water-tubes add greatly to the durability of the boiler by partially protecting the sheets from the severe action of the fire, and when the whole fire-box is so stayed no burning of sheets or stays can take place, as all the metal exposed to the fire is directly protected by water, and in no place are two thicknesses of metal exposed to the action of the fire, as is the case with riveted and upset stays and tubes.

Impure water is the great enemy to an efficient steam-generator, and particularly is this the case in locomotives. To purify the water, therefore, as much as possible, I place one or more tube-sheets, B, as shown in Fig. I, into the barrel of the boiler. Holes for the reception of the tubes are drilled into these tube-sheets B, the same as in the tube-sheets on each end of the barrel, so as to make a good fit and firmly support the tubes, which prevents them from sagging in the center and relieves all the strain from the ends of the tubes which now causes the same to leak.

The tube-sheet B is made so as to extend above the water-line in the boiler, and the feed-water is forced into the compartment A, and is made to flow over the tube-sheet B into the space C, and so to the more efficient heating-surface near the fire. Most impurities held in solution or suspension in water will be precipitated when the water is boiled under such pressure as is used in locomotives. Most of the scale-forming material will, therefore, be precipitated in the compartment A, where not sufficient heat exists to burn the same into a hard scale, and it may therefore be easily blown out or otherwise removed, while the most effective surface is kept free from scale.

Having thus described my invention, I claim as new and desire to secure by Letters Patent—

1. The tubular stay, secured in the sheets of a fire-box, and provided with openings, and with plugs on its outer ends, the inner portion projecting into the furnace, to perform the duties of a stay and generating-tube, substantially as described.

2. The tube-sheet B, in combination with the barrel of a locomotive-boiler, said sheet extending above the water-line of the boiler, substantially as and for the purpose specified.

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Witnesses:
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