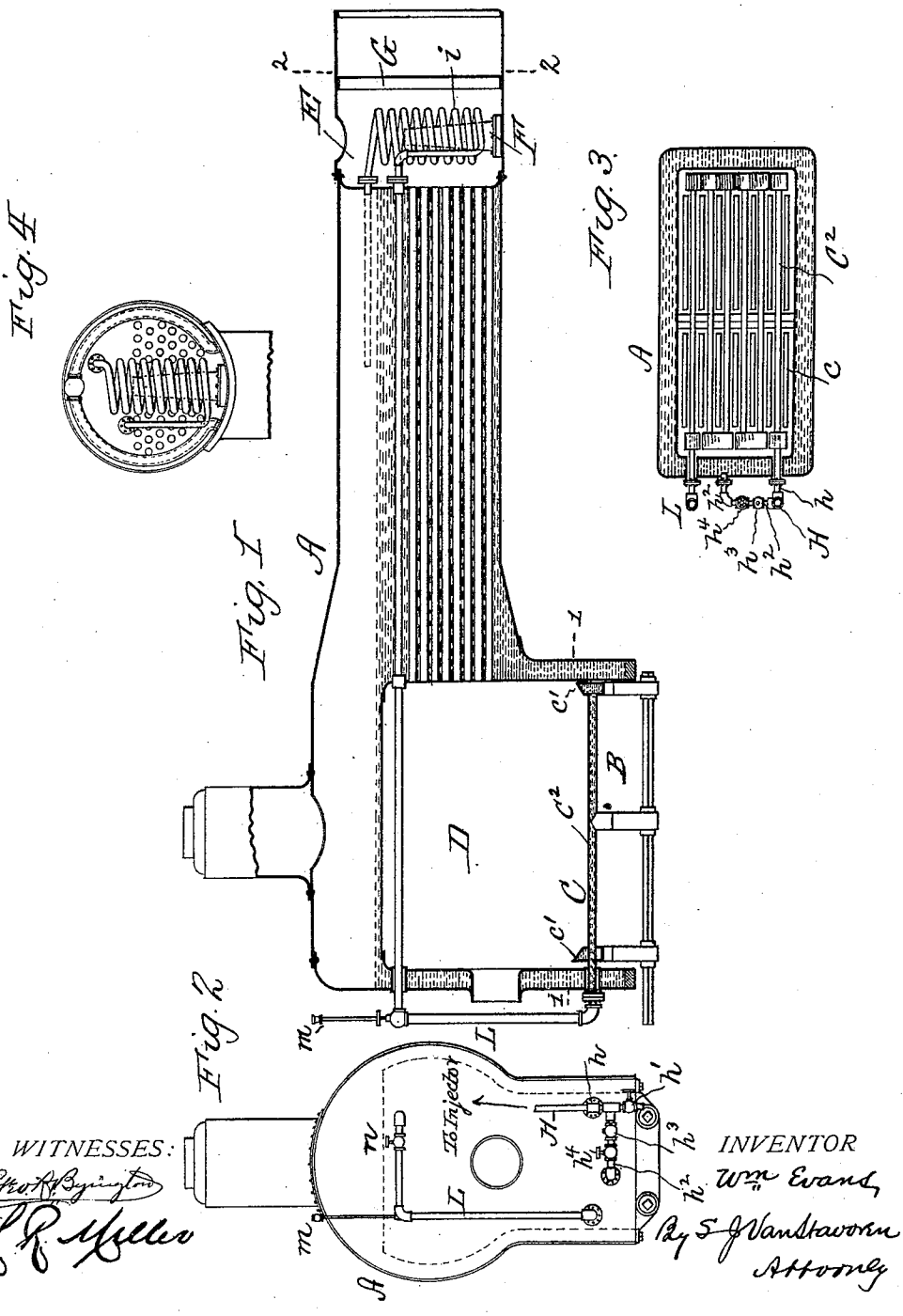
(No Model.)

W. EVANS.

FEED WATER HEATER.

No. 460,528. Patented Sept. 29, 1891.



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UNITED STATES PATENT OFFICE.

WILLIAM EVANS, OF PHILADELPHIA, PENNSYLVANIA, ASSIGNOR TO JAMES REAGAN, OF SAME PLACE.

FEED-WATER HEATER.

SPECIFICATION forming part of Letters Patent No. 460,528, dated September 29, 1891.

Application filed October 26, 1889. Serial No. 328,241. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM EVANS, a citizen of the United States, residing at Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented certain new and useful Improvements in Feed-Water Heaters, of which the following is a specification.

My invention has relation to feed-water heaters for stationary and locomotive boilers; and it has for its object to utilize the grate, the fire-box, the boiler, and the smoke stack or box for heating the feed-water before it is finally fed to the boiler, and to this end I preferably use a water bar-grate, which is in connection at one end with the pump or injector-pipe and has thereat a check-valve and a blow-off pipe or valve and at the other end has a pipe connection provided with an air-valve and leading through the top of the fire-box to and through the boiler to the smoke stack or box, wherein it is coiled or manifolded and then conducted back again from the smoke box or stack into the boiler. Such construction and arrangement provides for a circulation of the feed-water through the grate, thence to and through the upper part of the fire-box, thence through the boiler, and thence through the smoke stack or box, from which it is delivered to the boiler in a highly heated or more or less vaporized condition. When water is not fed to the boiler, such construction and arrangement affords a circulation of water from the boiler to and through the grate back to the boiler, and, further, it admits of readily blowing off from time to time all sediment and like material in the boiler and grate, and thereby keeps the same free from scale.

My invention accordingly consists in the combinations, constructions, and arrangements of parts, as hereinafter more particularly described in the specification, and pointed out in the claims.

Reference is had to the accompanying drawings, wherein Figure 1 is a longitudinal section showing a locomotive-boiler equipped with devices embodying my invention. Fig. 2 is an elevation of fire-box end of same, showing more plainly the pipe connections for injector, grate, and fire-box. Fig. 3 is a section on line 1 1, Fig. 1; and Fig. 4 is a like view on line 2 2, Fig. 1.

A represents a boiler, which may be a stationary boiler; but in the drawings I have illustrated it as a locomotive-boiler, as my improvements are applicable to either, but more particularly to locomotive-boilers.

B represents the ash-pit, and C a water bar-grate of any suitable kind. In the drawings (see more plainly Figs. 1 and 3) I have illustrated that form of the same having throw or raking bars *c* and tubular sectional end-bearing bars *c'*, through which the water also circulates.

D represents the fire-box; E, the smoke stack or box; F, the exhaust-nozzle, and G the steam pipes or arches for the cylinders in said smoke stack or box. From the injector or pump for the boiler, which injector or pump is not shown in the drawings, leads a feed-pipe H, which has a branch *h*, connecting with one end *c'* of the water bar-grate (see more plainly Fig. 3) and a blow-off cock *h'* below said branch.

h^2 represents another branch from pipe H, having a check-valve h^3, a cut-off h^4, and leads to the lower part of the boiler. (See more plainly Figs. 1 and 2.)

The blow-off cock *h'* is normally closed, and is only opened at intervals, as hereinafter more particularly described. The check-valve h^3 closes against the pressure of the feed-water in pipe H and opens against the pressure from the boiler by way of branch h^2 when the feed is off, the cock h^4 being normally opened, and is only closed when communication to the lower part of the boiler is to be cut off.

From the front end *c'* of the grate C leads a pipe L, which passes to the upper part of and through the fire-box and through the boiler, as indicated more plainly in Fig. 1, to the smoke box or stack E, wherein it is coiled either around the exhaust-nozzle F, as indicated at *i*, or otherwise manifolded and located in said stack or box, as desired, and then leads back into and terminates in the boiler to deliver the feed-water therein.

The pipe L, before entering the fire-box, is

provided with an air-valve *m*, opening downwardly by gravity to allow the escape of air in the grate and pipes in building fresh fires, and closing with the pressure in said grate and pipes. Pipe L is also provided with a cut-off valve *n* to close said pipe to the boiler whenever desired, as valve *n* is normally open.

The operation of heating the feed-water is as follows: The water from the injector passes through pipe H and branch *h* to the front end *c'* of grate C, through the latter to pipe L, and any air in said grate and pipes is, by the pressure of the feed-water, forced ahead of the same and escapes through the automatically-acting air or check valve *m*, so as to avoid air-traps in the grate and consequent failure of circulation therein or therethrough. The feed-water passes through pipe L to the coil *i* in the stack or box, and thence to the boiler. Such feed-water, therefore, is subject successively to the heat of the fire-bed on the grate-bars or to the direct action of the fuel, and also to the heat in the ash-pit, to the heat or flames in upper part of the fire-box, to the heat of the boiler, to the heat or flames passing into the smoke stack or box, and to that radiated from the exhaust-nozzle and steam-pipes in said stack or box when the latter is a locomotive boiler, stack, or box. Such water, therefore, when delivered to the boiler, is in a highly-heated or more or less vaporized condition, and this is effected without in any manner occasioning any loss in the increments of heat in the fire-box or boiler. When the injector-pump is not in operation or is cut off, a circulation from the boiler to and through the grate and back to the boiler then occurs for the reason that the check-valve h^3 then opens against the pressure of the boiler, and this circulation is provided to assist in more quickly generating steam and also to prevent burning out of the grate. By opening the blow-off valve *h'* the sediment in the bottom of the boiler and in the grate C is blown off from time to time, so that all foaming in said parts and the deposition of scale therein is entirely avoided. When my improvements are applied to boilers already in use in which there is a deposit of scale, it has been found that the automatic circulation of water from the boiler to the grate and back to the boiler in a short time loosens and removes all the scale from the boiler, from which it is removed by opening the blow-off cock *h'*, and in this regard my improvements for securing such automatic circulation provide a quick and effectual method as well as apparatus for removing scale from boilers.

It is obvious that in different forms of boilers or in the same construction of boilers the herein-described parts constituting my improvements may be variously constructed and arranged without departing from the spirit of the invention, and hence I do not limit myself to the same, as shown and described.

What I claim is—

1. The combination with a boiler and its fire-box, of the pipes C, forming the grate-bars and connected at one end to the feed-water appliances for the boiler and having at their other end a pipe connection which passes through the fire-box, thence through the boiler to the smoke stack or box, and from the latter back again to and terminating in the boiler, substantially as set forth.

2. In combination with a boiler, a feed-water pipe leading from the feeding appliances therefor to and through the lower part of the fire-box to form the grate-bars and thence to the upper part of the fire-box, to and through the boiler to the smoke stack or box, and from the latter back to and terminating in the boiler, substantially as set forth.

3. In combination with a boiler and its feed-water appliances, a pipe leading from the latter to the fire-box to form the grate-bars and thence to and through the boiler to the smoke stack or box, wherein said pipe is coiled or manifolded, and then conducted to and terminating in the boiler, substantially as set forth.

4. In combination with a boiler and its feed-water appliances, a pipe leading from the latter and having branches, one of which is provided with a blow-off cock, a check-valve, and a cut-off valve and leads to the boiler near its bottom, and the other leads to the lower part of the fire-box, thence to the upper part of the same, thence through the boiler to the smoke stack or box, and from the latter to and terminating in the boiler, and said last-named branch being provided between the lower and the upper part of the fire-box with an air-valve, substantially as set forth.

In testimony whereof I affix my signature in presence of two witnesses.

WILLIAM EVANS.

Witnesses:
FRANK H. MASSEY,
FRANK R. JORDAN.