2 Sheets--Sheet 1.

# D. F. MOSMAN.

## Apparatus for Heating Feed-Water.

No. 162,940. Patented May 4, 1875.

*Fig. 1.*

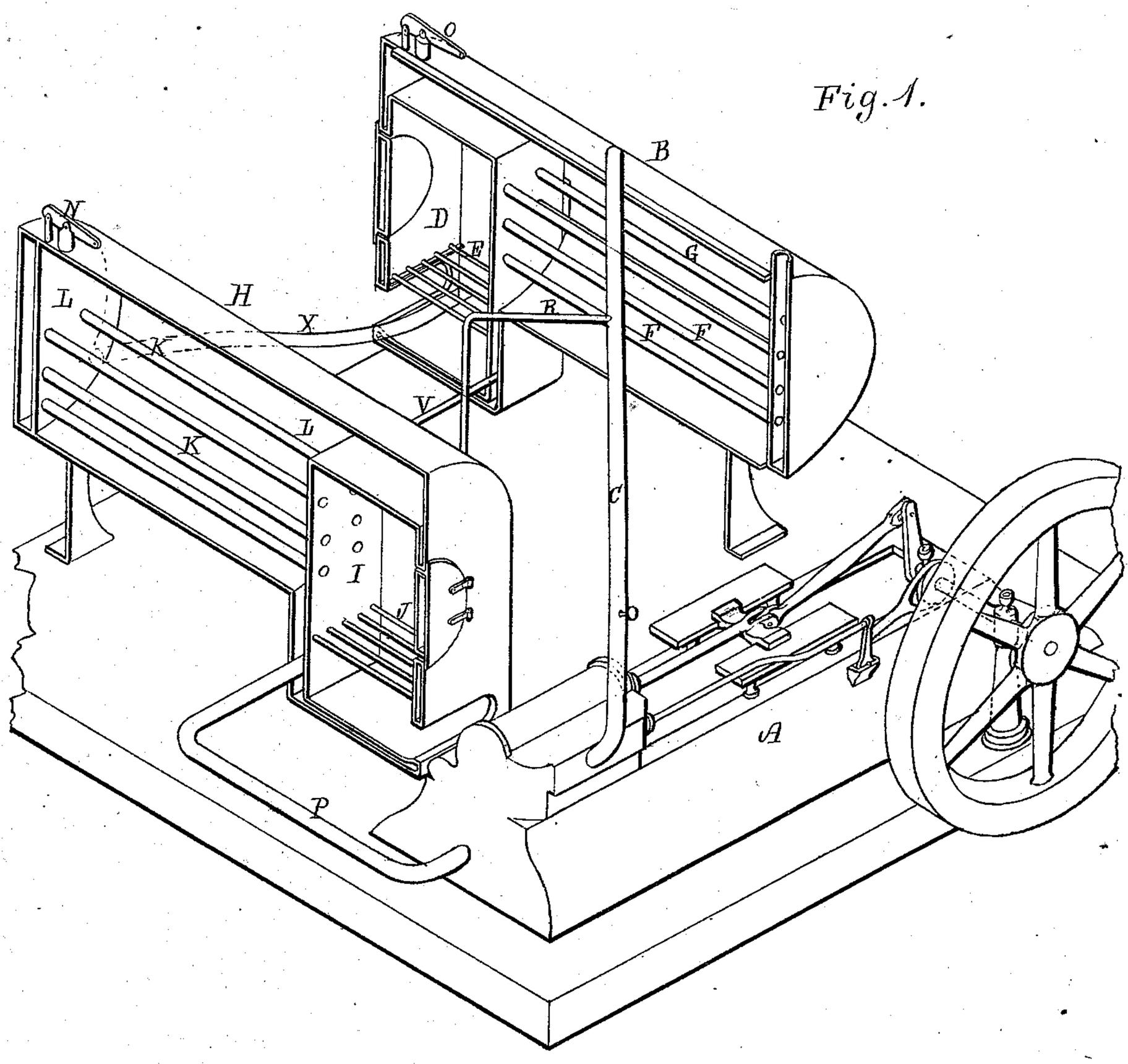
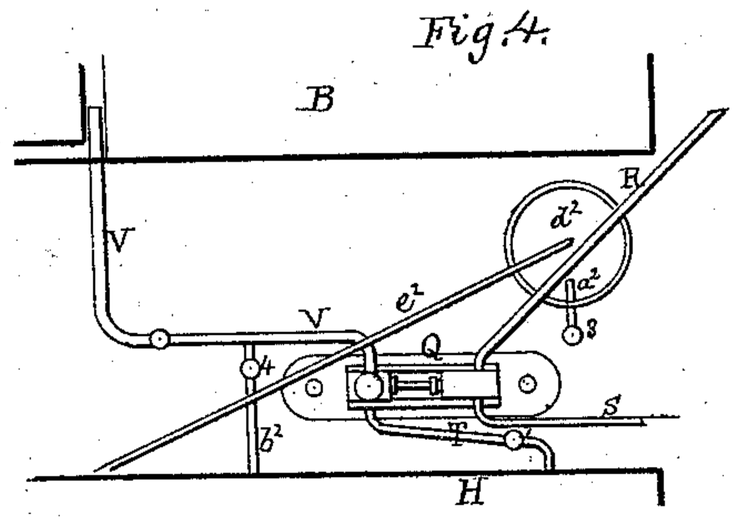



*Fig. 4.*




WITNESSES.
F. Hunnewell.
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Daniel Frank Mosman.
Fred. Curtis. Atty.

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# D. F. MOSMAN.

## Apparatus for Heating Feed-Water.

No. 162,940. Patented May 4, 1875.

*Fig. 2.*

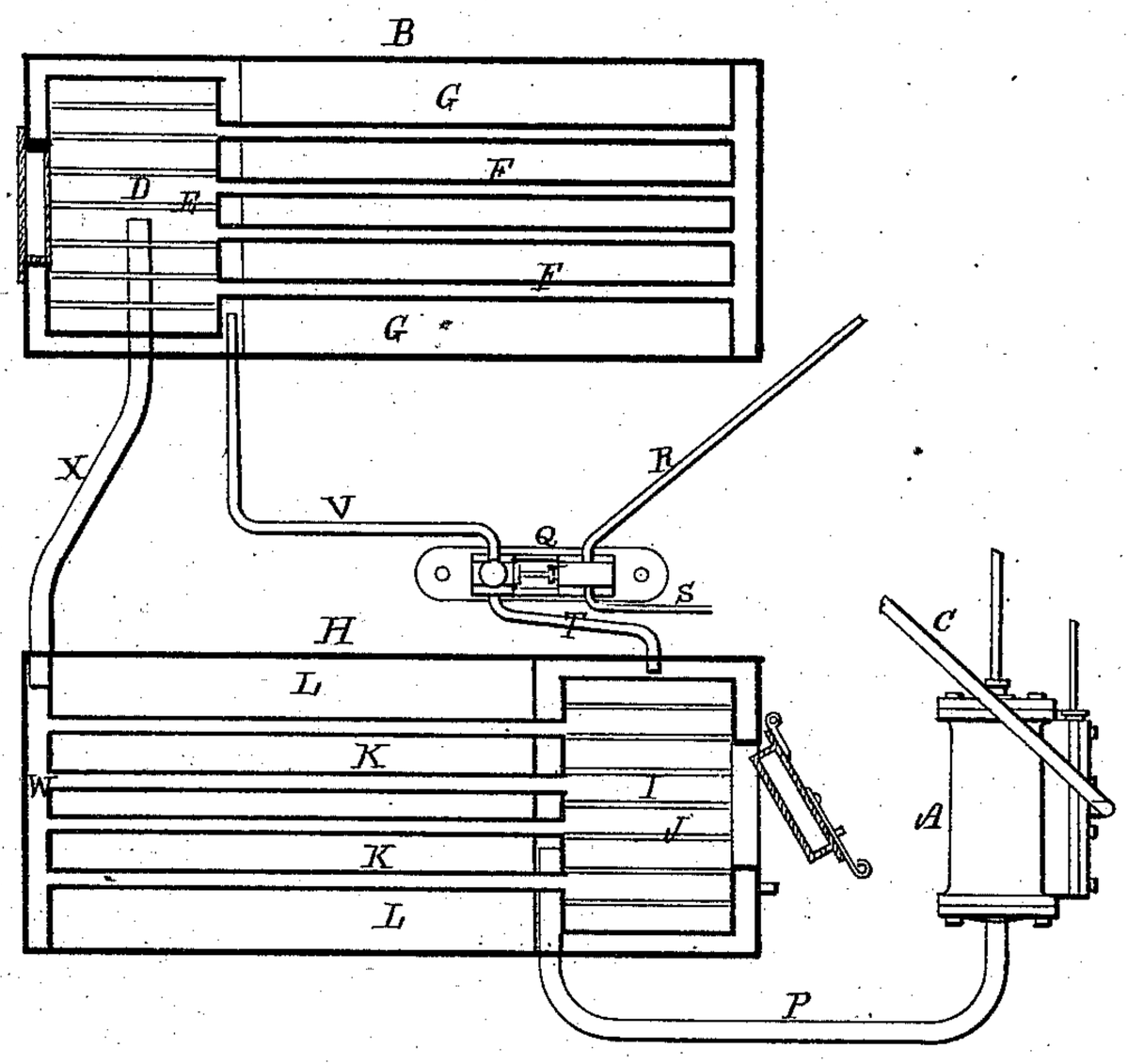
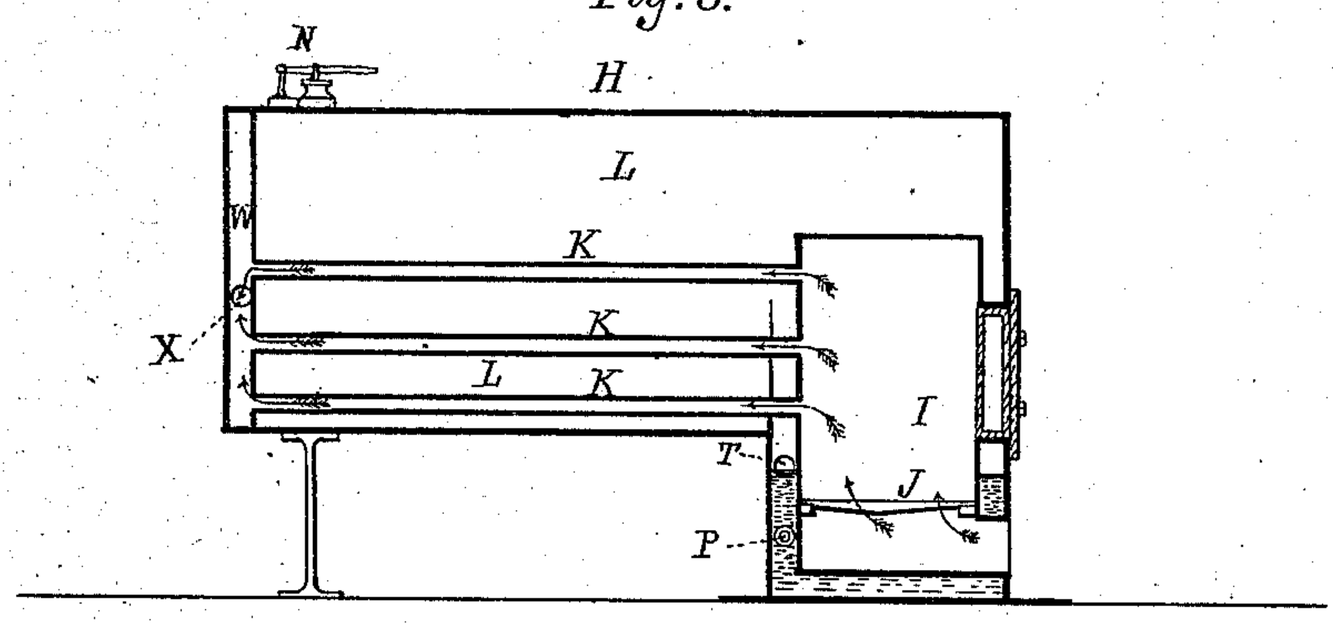



*Fig. 3.*

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# UNITED STATES PATENT OFFICE.

DANIEL F. MOSMAN, OF CHELSEA, MASSACHUSETTS.

## IMPROVEMENT IN APPARATUS FOR HEATING FEED-WATER.

Specification forming part of Letters Patent No. **162,940**, dated May 4, 1875; application filed February 17, 1875.

*To all whom it may concern:*

Be it known that I, DANIEL F. MOSMAN, of Chelsea, Suffolk county, Massachusetts, have invented certain Improvements in Method of, and Apparatus for, Heating the Feed-Water of Steam-Generators, of which the following is a specification:

The drawings accompanying this specification represent, in Figure 1, a perspective view, and in Fig. 2 a horizontal section, of my apparatus. Fig. 3 is a vertical section of the heating vessel or structure.

In the drawings, above alluded to as making part of this specification, A represents a steam-engine, and B a steam boiler or generator, the main supply-pipe for conducting steam from such boiler to the engine being shown at C.

The engine-boiler and connecting-pipe are of ordinary construction, and contain, *per se*, nothing of my invention, the engine being a horizontal high-pressure one, and the generator a locomotive-boiler, the fire-place or furnace of which is shown at D, the grate at E, the flame and smoke flues at F F, &c., and the water and steam chamber at G.

In carrying out my invention, I employ a vessel for heating the water to be fed to the boiler, and I have in the present instance adopted for this purpose a locomotive-boiler, H, which is a counterpart of the first in general, but with slight changes, hereinafter stated, in order to represent the ease with which my invention may be adapted to a pair or gang of boilers already set or in use. The furnace of the second boiler or heater H is shown at I, its grate at J, its flues at K, and its water-chamber at L, it being provided with a safety-valve, N, as is also the boiler B, as shown at O, the positions of the boilers, however, being, for convenience, reversed end for end, and the second boiler or, rather, heater, being entirely closed to access from the atmosphere, except through the pressure-valve N. The exhaust-pipe of the engine is shown at P as discharging into the lower part of the water space or chamber L of the structure H, and as I condense and reconvert into water this exhaust steam I require the injection into said water-space of but little water from an outside source, and this may be provided by any suitable injector or pump, and from any suitable source, after the usual manner of operating steam-boilers.

I prefer that the water within the chamber L shall stand at the point indicated therein in the drawings, and the steam-pump for conveying this water to the generator B is shown at Q as situated between the two, the steam supply-pipe, by which such pump is driven, being shown at R as a branch of the pipe C, the exhaust-pipe of such pump being shown at S, the draft-pipe from the water-chamber L to the pump at T, and the delivery-pipe from the pump to the generator B at V. The pipe T leads preferably from a point somewhat elevated above the bottom of the water-chamber L, in order that any sediment which may collect in the bottom of such chamber shall not be carried by and with the water which flows through the pump into the generator; and by this means I gain a very important point, attaching to my invention that of entirely preventing sediment in the generator. I obtain this result from the fact that there is no ebullition in the chamber L to disturb the feed-water therein, and the influx of fresh water is very limited.

The space at the rear end of the structure H, into which the flues K discharge, is shown at W as closed, in lieu of being open, and serving as a discharge for the smoke and waste products of combustion, as is the case with the generator B; and I connect this space W by a hot-air conduit, X, with the ash-pit Y of the said generator.

The air that is admitted to the furnace D of the generator B to support combustion of its fuel after its fire is started, and water is heated to the boiling-point, is supplied through the flues K, chamber or space W, and conduit X.

Should the water in the chamber L stand at a point above the cylinder of the engine, which, in practice, will seldom take place, a check-valve opening outward should be placed in the exhaust-pipe P.

The above description embraces the mechanical construction of an apparatus which I have

employed in carrying out my experiments; but this form of apparatus is not compulsory, as I can depart from it to a considerable extent without losing sight of the principle of my invention.

The operation of the apparatus may be briefly stated, assuming that the water supplied to the boiler B and the heater H is at a temperature of 32° Fahrenheit, and the height of the water in the two being as shown in the drawings: A fire is built in the furnace D, and the water in the boiler B vaporized until desired pressure—for example, sixty pounds to the square inches generated—the air for supplying combustion within the furnace being furnished through the ash-pit until the water in the boiler is raised to the vaporizing-point, when draft through the ash-pit is shut off, and is supplied through the flues K and conduit X, before named. Steam being let onto the engine performs its office therein, and exhausts through the pipe P into the water contained within the chamber L of the structure H, parting with its heat both sensible and latent.

A portion of the heat contained in the exhaust steam thus admitted to the chamber L is given up to the water, and a portion of the steam (varying, of course, with circumstances) passes upward through the superincumbent body of water, and circulates about the flues K, but has no access to the atmosphere, except through the safety-valve N.

The back pressure upon the piston of the engine is due to the resistance which the body of water in the chamber L offers, which is very slight, and hardly worth calculating, and to the extent to which the valve N is weighted.

The exhaust steam, entering the structure H, raises the temperature of the feed-water in the latter until one pound pressure is reached, or such pressure as the valve N is weighted to produce. All excess of heat from the exhaust steam, whether from leaking of engine into exhaust-pipe or other causes, which is not taken up by the tubes K, blows off through the safety-valve N, and the heat within the structure lowers, until the pressure is reduced, when the exhaust again begins to condense, and so on, as before.

As I assume that the engine is running with a pressure of sixty pounds, I require, practically, no pressure within the chamber L; but, as the safety-valve must indicate some degree of pressure in order that I may determine whether or not the heat within such chamber reaches the vaporizing-point, I weight the valve to blow off at one pound, and, consequently, the back pressure upon the engine-piston will be one pound.

The water within the chamber L is pumped therefrom, by the pump Q, into the generator B, to be therein again vaporized, and returned as exhaust from the engine, and the air, passing through the flues K, space W, and conduit X, enters the furnace I, both water and air increasing in temperature until the former reaches one thousand one hundred and forty-six units.

As the advantage I gain by the introduction of hot air to the furnace of the boiler, as stated, is decided, it is nevertheless small, and I shall not refer to it as a very important feature in my improvements. Suffice it to say, that it is enough to supply a sufficient amount of hot air to support the most perfect degree of combustion of the fuel in the furnace now attainable; and, by reducing the temperature of feed-water, economize a portion of it which would otherwise blow off through the safety-valve. The important gain I effect in economy of consumption of fuel is that due to the difference in temperature between the boiling-point of water (212° Fahrenheit) and the point at which such water is actually converted into steam, one thousand one hundred and forty-eight units of heat being required to raise the water to the latter point.

In feed-water heaters hitherto used much, if not all, of this heat has gone to waste. But this heat, under my method, I believe to be, to a great extent, utilized by being returned to the feed-water, inasmuch as to bring my feed-water to the condition of steam requires much less fuel than is required for feed-water water heated by ordinary heaters—say, to 200° or 212°. Practical and continued tests have demonstrated that, by the use of my method, a saving of from sixty to seventy per cent. of coal is made over and above that effected by the use of the common heater that delivers water at about 200°.

It may become desirable in many localities to economize strictly the water used in generating steam; and, to effect this, I employ a cistern, $d^2$, located at a point near the pump Q, and connected, by a pipe, $e^2$, with the blow-off or outlet of the safety-valve of the heater H. The vapor issuing from the said safety-valve flows into the pipe $e^2$, and discharges its condense-water into the cistern $d^2$, where it accumulates until the latter is partially or entirely full. To return this condense-water to the heater H I connect the cistern $d^2$ with the pump-pipe T by a draft-pipe, $a^2$, and I connect the discharge-pipe V of the pump with the interior of the heater, H, by a pump, $b^2$. I place a cock, 3, in the pipe $a^2$, a cock, 1, in the draft-pipe T, a cock, 4, in the pipe $b^2$, and a cock, 2, in the pipe V between the pipe $b^2$ and the boiler B.

When the tank $d^2$ is to be emptied the cocks 1 and 2 are to be closed, and cocks 3 and 4 opened. The pump is now closed against drawing water from the vessel H and discharging it into the boiler, and draws water from the cistern $d^2$ through the pipe $a^2$, and discharges it into the vessel H through the pipe $b^2$. When the operation of emptying the cistern $d^2$ is completed, which may, perhaps, occur once a

day, or may be much less often, according to the capacity of the cistern, the cocks 3 and 4 are to be closed and cocks 1 and 2 opened, when the primary functions of the pump are resumed, and water is delivered from the heater H to the boiler, as at first.

The arrangement of the cistern $d^2$ and pipes $a^2$ and $b^2$ with respect to the pump Q, heater H, and boiler B, are shown in Fig. 4 of the drawings.

I claim—

1. The method herein described of heating feed-water by steam-generators by exhausting steam into the feed-water in a vessel closed to the atmosphere except through the medium of a pressure or relief valve, substantially as set forth.

2. A feed-water heater, operating to heat the feed-water by direct contact of exhaust steam therewith, and closed to the atmosphere except through the intermediary of a pressure-valve, substantially as and for the purpose set forth.

3. In combination with the feed-water heater adapted to receive the exhaust steam, and closed to the atmosphere except through the medium of a pressure-valve, as described, flues or passages whose exterior surfaces are heated from the feed-water, or the heat of the exhaust steam, or both, and whose interior areas constitute air-flues, through which air is supplied to the boiler-furnace, and which air becomes heated in passing through such flues or spaces, substantially as and for the purposes stated.

4. The combination of the engine A, boiler B, heating-structure H, having a relief or pressure valve, N, as specified, and pump Q, substantially as and for purposes stated.

DANIEL FRANK MOSMAN.

Witnesses:
F. CURTIS,
W. E. BOARDMAN.