(No Model.)

W. E. PEARSON.

HEATING FEED WATER BY EXHAUST STEAM.

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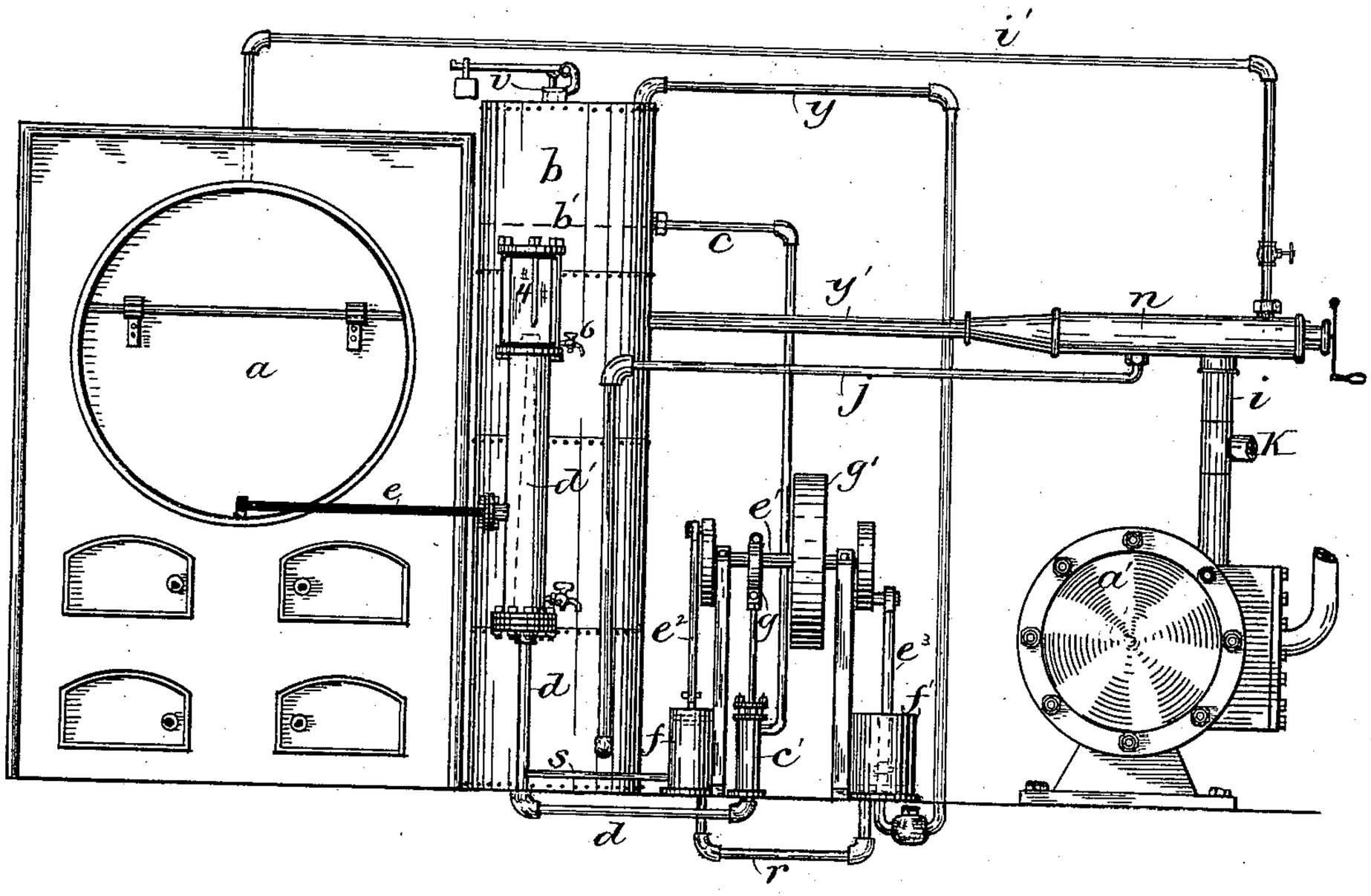

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HEATING FEED-WATER BY EXHAUST-STEAM.

SPECIFICATION forming part of Letters Patent No. 332,555, dated December 15, 1885.

Application filed April 25, 1885. Serial No. 163,432. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM E. PEARSON, of Saugus, in the county of Essex and State of Massachusetts, have invented certain new and useful Improvements in Heating Feed-Water by Exhaust-Steam, of which the following is a specification.

This invention has for its object to provide an apparatus for utilizing the exhaust-steam of a steam-engine for heating and augmenting the feed-water for the boiler which supplies the engine without creating the back-pressure on the piston of the engine usually caused by the use of the exhaust-steam for feed-water heating.

To this end the invention consists in the combination of a steam-engine, an ejector connected with the exhaust-pipe of the engine, so as to receive steam therefrom, a feed-water tank connected at its lower portion with the water-inlet of the injector and a higher point with the discharge-passage of the injector, so that the passage of the exhaust-steam through the injector will cause continual circulation of water from the tank through the injector and back to the tank, the water being thus heated and augmented or increased in volume by the exhaust-steam which is absorbed by the water, and means for preventing an increase of pressure in the tank by the formation of vapor therein, so that there will be no back-pressure on the piston in the steam-cylinder of the engine.

The invention also consists in certain other combinations, all of which I will now proceed to describe and claim.

The accompanying drawing, forming a part of this specification, represents an elevation of my improved apparatus.

In the drawing, *a* represents a steam-boiler, and *a'* the cylinder of a steam-engine and steam-chest, with a portion of the steam-supplying pipe.

b represents a tank or receiver situated at a convenient distance from the boiler. Said tank, when the apparatus is supplying water to the boiler, is filled with water to the dotted line *b'*, which I call the "working-level." A pipe, *c*, leads from the tank at this point or working-level to a feed-pump, *c'*, and from said feed-pump another pipe, *d*, leads to a "separator," *d'*, which is adapted to separate from the water the grease or oil used in lubricating the steam-cylinder, and carried by the exhaust-steam into the feed-water in the supply-tank. Said separator, which will form the subject of a separate application for Letters Patent, is composed of a vertical cylinder or stand-pipe, through the lower end of which the pipe *d* from the feed-pump passes, said pipe extending nearly to the top of the stand-pipe. The water entering the stand-pipe through the pipe *d* fills the annular space surrounding the pipe *d*, and flows to the boiler through the pipe *e*, communicating with the lower portion of said annular space. The oil in the water accumulates in a glass reservoir, 4, forming a continuation of the upper end of the stand-pipe, and may be withdrawn from said reservoir from time to time by means of a cock, 6. The reservoir 4 is considerably higher than the pipe *e*, so that the oil accumulating in the reservoir cannot pass into the boiler, suitable care being taken to prevent too great an accumulation of oil.

e represents a shaft journaled on suitable supports and having at each end a disk provided with wrist-pins, to which are connected rods e^2 e^3, adapted to reciprocate pistons in the cylinders *f f'*. Said cylinders and pistons constitute a vapor-pump, hereinafter described, and are operated by power applied to the pulley *g'* on the shaft *e'*. To the shaft *e'* is also affixed an eccentric, *g*, adapted to operate the feed-pump *c*.

h' represents an injector connected with the exhaust-pipe *i* of the steam-cylinder, and adapted to receive and be operated by the exhaust-steam from the engine *a'*, in a manner hereinafter specified. A pipe, *i'*, leading from the boiler and connected with the injector, enables steam to be supplied from the boiler to operate the injector before the exhaust-steam is sufficient in quantity to operate it.

j represents a pipe connected to the water-inlet of the injector and leading to the lower portion of the tank *b*. Said pipe supplies the water to the injector when it is in operation.

y' represents a pipe connecting the discharge or combining cone of the injector with the tank at a point above the point of connection of the pipe *j*, but below the working-level line *b'*.

y represents a pipe leading from the upper

portion of the tank *b* and connected to the bottom of the vapor-pump cylinder *f'*. Said pipe is adapted to conduct away the vapor that may be formed in the tank when the water therein becomes heated sufficiently to cause accumulation of pressure in said tank, as would be the case were not means provided for the disposal of the vapor. Said vapor passes down the pipe to the vapor-pump cylinder *f'*, which forces it to the cylinder *f*, from which it passes into the boiler, as explained hereinafter.

Operation: The boiler is first filled with water to a point slightly above its working-level, and the tank is filled to a point below its working-level. Steam is then generated to the required pressure. The injector is then put in operation by "live steam" from the boiler through the pipe *i'*, the object being to heat and circulate the water contained in the tank. The engine being started, the exhaust-steam passes into and operates the injector through the exhaust-pipe of the steam-cylinder. The operation of the injector draws water from the lower portion of the tank into the injector. Said water mingles with and absorbs the exhaust-steam, and is forced in a heated condition and augmented by the condensation or the absorption of the exhaust-steam into the upper portion of the tank *b*, where it rises in consequence of such augmentation to the working-level of the tank. When the water reaches this level, it is highly heated, and is forced to the boiler by the action of the feed-pump. The original filling of the tank to a point below its working-level prevents the feed-water from passing to the boiler until it has been heated and augmented by the steam. The supply of cold water to the boiler is thus prevented. This operation continues indefinitely, the water being taken from the tank through the pipe *y'* and discharged again into the tank through the injector and the pipe *y*, the operation causing a continuous circulation of the water in the tank *b*. The absorption of the exhaust-steam keeps the water in the tank at a high degree of temperature. The steam from the boiler may be shut off from the injector when the apparatus is well in operation, the force of the exhaust being sufficient to do the work. The separation of the oil from the feed-water by the separator causes the water to pass to the boiler in a cleansed condition, so that it will not cause incrustation and priming in the boiler, thus overcoming a serious obstacle to the use of exhaust-steam for feed-water. The water-line of the tank is always maintained at the working-level *b'* when the apparatus is in operation, and in case the water becomes heated sufficiently to cause a vapor in the space above the working-level, (so as to create a pressure in the tank,) said vapor will pass off through the pipe *i'* into the cylinder f^3 of the vapor-pump, and following the piston thereof in its upward stroke will be forced into the cylinder *f* by the return or downward stroke of the piston in the cylinder *f'*, and from the cylinder *f* it will be forced by the piston of that cylinder into the pipe *s*, and into the pipe *d*, leading to the boiler. This operation keeps the tank from accumulating pressure and avoids back-pressure on the steam piston or exhaust of the engine.

It will be observed that the diameter of the vapor-pump cylinder *f'* is of double the area of the cylinder *f*. I prefer to construct the cylinders in this manner in order to compress the vapor from atmospheric to boiler pressure on small areas.

It will be seen that by the use of the above-described apparatus the introduction of feed-water to a boiler at a temperature of 210° Fahrenheit becomes a simple matter, involving no complicated mechanism, and makes the use of exhaust-steam for heating and boiler-feeding combined perfectly feasible.

I have placed a branch pipe, *k*, in the exhaust-pipe, for use in emergencies, so that in case of derangement of the described apparatus the steam can be exhausted into the atmosphere. A safety-valve, *v*, can also be placed in the top of the tank, to relieve it of any pressure that might accumulate by the accidental derangement of the vapor-pumps.

I do not limit myself to the employment of the vapor-pump *f f'* as a means for relieving the pressure in the tank, for such result may be afforded wholly by the safety-valve *v*, or by other suitable means; or a pump otherwise constructed may be used for the same purpose without departing from the spirit of my invention.

I claim—

1. The combination of a steam-engine, an injector connected with the exhaust-pipe of the engine, and a feed-water tank which is connected, as described, with the inlet and discharge passages of the injector, so that the passage of the exhaust-steam through the injector will heat and circulate the water in the tank, and means, substantially as described, for relieving pressure in the tank, and thereby preventing back-pressure on the exhaust, as set forth.

2. The combination of a steam-boiler, an engine supplied with steam thereby, a feed-water tank, an injector having a steam-inlet connected with the exhaust-pipe of the engine, its water-inlet connected with the lower portion of the feed-water tank, and its delivery-passage connected with a higher portion of said tank below its working-level, whereby the feed-water is continuously circulated and heated by the exhaust-steam, and a connection, substantially as described, between the tank and boiler, whereby the heated feed-water is supplied to the boiler, as set forth.

3. The combination of a steam-boiler, an engine supplied with steam thereby, a feed-water tank connected with the boiler, an injector provided with connections, as described, so as to receive the exhaust-steam from the engine and to draw water from the lower portion and deliver it to the upper portion of

the tank, and means, substantially as described, for relieving the tank from pressure caused by the formation of vapor above the working-level of the water therein, as set forth.

4. The combination of the feed-water tank, the injector connected, as described, with the tank, so as to draw water from its lower portion and force it into its upper portion, a discharge-pipe leading from the tank above the point where water from the injector enters, said discharge-pipe being below the top of the tank, so as to maintain a vapor-chamber above the water in the tank, and a pump connected with said chamber, whereby the vapor is withdrawn from said chamber, as set forth.

5. The combination of the feed-water tank, the injector, connected, as described, with the tank, so as to maintain circulation of water therein, a discharge-pipe leading from the tank above the point where water from the injector enters, a feed-pump connected with said discharge-pipe, whereby the heated feed-water is forced to the boiler, and a vapor-pump having a connection with the vapor-chamber above the working-level of the tank and another connection with the boiler whereby the vapor forming in the tank is forced to the boiler, as set forth.

6. The combination of the boiler, the feed-water tank connected, as described, with the boiler, the injector connected, as described, with the tank, so as to heat and circulate the water therein, and means for supplying the injector either with live steam from the boiler or exhaust-steam from the engine, as set forth.

7. The combination of the boiler, the feed-water tank connected, as described, with the boiler, the injector connected, as described, with the tank, so as to heat and circulate the water therein, an engine having its exhaust connected with the injector, and a connection between the boiler and injector, whereby live steam may be supplied to the injector, as set forth.

8. A feed-water circulating and heating injector having steam inlet or inlets, a water-inlet, and a discharge-pipe without an overflow, combined with a tank connected at its lower portion with the water-inlet and at a higher point with the discharge-pipe of the injector, and means, substantially as described, for relieving said tank from pressure, whereby the continuous operation of the injector is permitted and back-pressure avoided, as set forth.

9. The combination, with the feed-water tank, of the vapor-pump composed of the larger and smaller cylinders and their pistons and operating mechanism, and means for connecting said pump with the upper portion of the tank above its working-level and with the boiler, as set forth.

10. The combination of the boiler, the engine supplied with steam by the boiler, the feed-water tank connected with the boiler, the injector connected, as described, with the exhaust of the engine and the feed-water tank, so as to circulate and heat the water therein by the exhaust-steam, and a separator whereby the oil mingled with the water by the exhaust-steam is separated from the water before it reaches the boiler, as set forth.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, this 23d day of April, 1885.

WILLIAM E. PEARSON.

Witnesses:
C. F. BROWN,
A. L. WHITE.