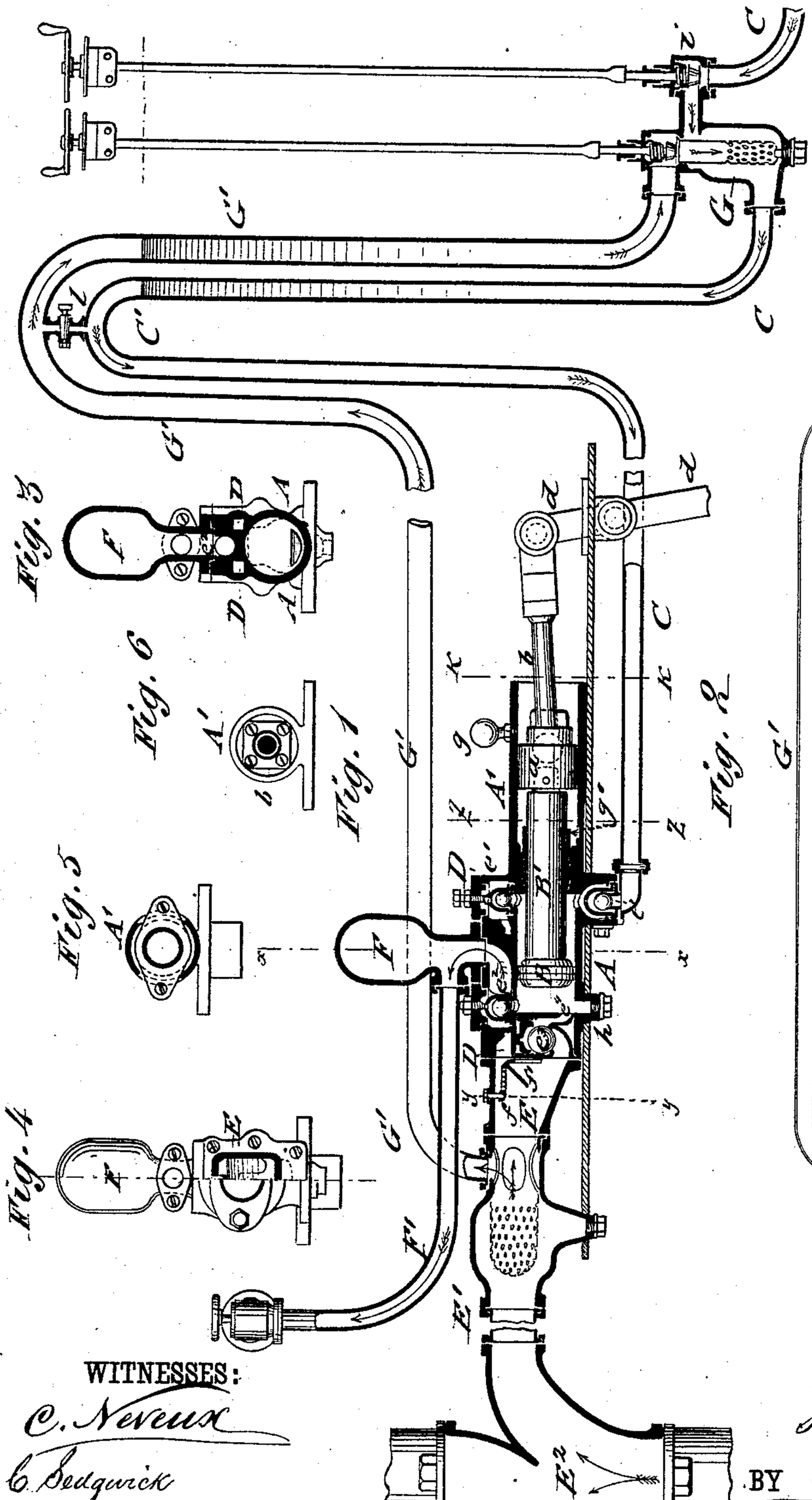
H. C. de TORRES.

Feed-Water Heaters.

No. 211,439. Patented Jan. 14, 1879.



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IMPROVEMENT IN FEED-WATER HEATERS.

Specification forming part of Letters Patent No. **211,439**, dated January 14, 1879; application filed July 18, 1878.

To all whom it may concern:

Be it known that I, HORACE CHIAZZARI DE TORRES, of Turin, Italy, have invented a new and Improved Automatic Feed-Water Heater and Regulator, of which the following is a specification:

In the accompanying drawings, Figure 1 represents a vertical longitudinal section of my improved feed-water heater and regulator; Fig. 2, a top view; and Figs. 3, 4, 5, and 6 are vertical transverse sections of the same, respectively on lines *x x*, *y y*, Z Z, and K K, Fig. 1.

Similar letters of reference indicate corresponding parts.

This invention has for its object to furnish for the steam-boilers of locomotives, stationary and portable engines, an improved automatic feed-water heater and regulator, in which the exhaust-steam is utilized for heating up the feed-water, and thereby a considerable saving in fuel and in the wear and tear of the boiler obtained, as well as an increase of power of the engine produced, as the temperature and pressure in the boiler is kept uniform without undergoing any great change, owing to the feed-water being supplied at a certain temperature.

The invention will first be described in connection with the drawings, and then pointed out in the claims.

Referring to the drawings, A A′ represent a pump-cylinder that is closed at one side, and extended beyond the stuffing-box of the piston-rod B′ of its piston B at the opposite side, so as to form a guide-tube, A′, for the cross-head *a* of the connecting-rod *b* of the actuating crank-lever *d*.

The piston-rod B is made of considerable size, being but little smaller in diameter than the piston, so as to form an annular space around the same that is smaller than that formed by the cylinder in front of the piston.

The piston-rod is secured to the cross-head outside of the stuffing-box, and the connecting-rod *b* coupled to the cross-head by a ball-and-socket joint, and to the link of the crank-lever *d* by a screw-connection, so that the connecting-rod may be turned and adjusted to greater or less length, according to the stroke desired to be given to the piston.

The annular space of the pump-cylinder A, back of the piston, is connected at the bottom by a valve, *e*, with the suction-pipe C, that forms the communication of the pump-cylinder with the feed-water reservoir, and at the top by a valve, e^1, with a branched channel, D, that extends around a central exit-valve, e^2, in front of the piston, and communicates, by a perforated plate, *f*, and inclined plate *f′*, with a condenser, E, arranged in front of the closed end of the pump-cylinder, and connected by a pipe, E^1, with the exhaust-pipe E^2 of the cylinder of the engine.

The condenser E is connected, by a valve, e^3, and inlet-duct e^4, with the space of the cylinder in front of the piston, said space being also connected, by the top valve, e^2, with a regulating-chamber, F, and by the supply-pipe F′ with the boiler.

The stuffing-box and cross-head of the connecting-rod are lubricated by a cup, *g*, of the extension A′ of the cylinder, the oil being distributed in suitable manner, first around the cross-head, and by a bottom groove or channel, *g′*, to the stuffing-box. The packing of the piston may be of any approved kind. Any impurities that settle in the pump-cylinder are collected and drawn off by means of a bottom aperture and plug, *h*.

The operation of this automatic feed-water heater and regulator is as follows: During the forward stroke of the piston a vacuum is formed in the small annular space around the piston-rod, which causes, by the pressure of the atmospheric air, the opening of the bottom valve, *e*, and the filling of the space by water from the reservoir. The return motion of the piston forces the water through the top valve, e^1, and branch channel D, then through the perforated plate into the condenser, and from the same, by opening the valve e^3, into the larger space formed by receding piston in the pump-cylinder; but as the quantity of water is too small to fill that space a partial vacuum is formed in the interior of the pump-cylinder, which draws in the exhaust-steam, and causes the same to pass with great velocity into the pump-cylinder. On its way the steam meets the small quantity of water that is minutely divided by passing through the perforated plate *f*, so as to condense itself and heat up the water. The sudden mingling of the exhaust-steam and

water imparts a certain momentum to the heated-up water, by which it is thrown with considerable force into the larger space of the pump-cylinder, whatever be its temperature, in about the same manner and on the principle of the ordinary injectors. The partial vacuum of the front space of the cylinder draws in a sufficient quantity of exhaust-steam to be condensed and mingled with the water from the reservoir, so that the large space of the cylinder is filled. This quantity of water is finally forced by the forward stroke through the top valve, e^2, air-chamber, and supply-pipe, in boiling, or nearly boiling, state, into the boiler, while the annular space back of the piston is simultaneously filled with cold water again, which is thrown forward, heated by mingling with the exhaust-steam, and then again forced into the boiler, and so on. A regulating-valve, *i*, of the suction-pipe is operated by the engineer, and supplies the required quantity of water to the pump.

The mechanism described is applicable to any engine. For locomotives, however, it is advisable to prevent the entrance of water into the pump-cylinder each time when the engine is stopped, so as not to inject cold water into the boiler on starting the engine. For this purpose a kind of primary condenser and heater is arranged in the suction-pipe, which is operated jointly with the pump in perfectly automatic manner. This condenser G is arranged near the point where the water leaves the tender, the suction-pipe being then bent so as to assume the shape of a siphon, C′, that connects at its downward descending portion with the horizontal part leading to the pump-cylinder A, as shown in Fig. 1. A second siphon-shaped pipe, G′, leads from the condenser above or sidewise of the first siphon to the pipe E^1, that forms the communication with the steam-exhaust pipe of the engine. The two siphon-shaped pipes are connected at their highest points by a short pipe and stop-cock, *l*, so as to be placed in communication with each other or not, as desired. When the locomotive is at rest, the water rises in the ascending parts of the siphon-shaped pipe up to a level with the water in the tender, as indicated by a dotted line in Fig. 1; but as soon as the engine is set in motion the vacuum caused in the annular space of the pump-piston begins to work, and is filled by exhaust-steam that is drawn in through the pipe G′, the connecting-pipe *l*, and the suction-pipe C. The steam drawn in is of such a small quantity that it condenses partly before getting to the pump-cylinder. The atmospheric pressure forces then the water from the tender into the pump through the siphon of the suction-pipe, while the exhaust-steam enters from the other side into the ascending branch of the siphon G′, and mingles with the water therein, so as to heat it more or less, according to the degree to which the regulating-valves are opened.

The water in the primary condenser may, by the continuous working of the pump, reach a temperature of from 75° to 80° centigrade. This may be readily ascertained by the engineer by touching the siphon of the suction-pipe, so that by properly regulating the valves the water may be supplied to the pump in a highly-heated state. As long as there is steam in the pipe G′ the pump continues to work without interruption. As soon as the steam is shut off from the engine air is drawn into said pipe, and into the pump-cylinder, so that the same works empty. As soon, however, as the stop-cock of the connecting-pipe *l* of the siphon is closed, the pump injects cold water into the boiler, which may be of some advantage in certain cases. By the double heating action which is exerted on the feed-water by the primary and secondary condensation of the exhaust-steam, the temperature of the feed-water is raised to such a degree that when it is fed to the boiler the varying temperatures and pressures at the interior of the same are dispensed with, and a uniform temperature maintained, as no cold water is ever fed to the boiler.

The primary heating apparatus at the outside of the pump-cylinder may be used in connection with ordinary pumps by keeping up the automatic working of the pumps placed on the locomotives; or the double siphons may be dispensed with, and the exhaust-steam used solely for heating the water, as first described. Ordinary pumps of stationary or portable engines may also be worked by a primary condenser without the use of the siphons. The different mechanical features of the feed-water heating and regulating apparatus may be varied according to the different applications of the same, the principles of heating up the feed-water by exhaust-steam and supplying it by spaces of different size to the pump and to the boiler remaining the same, and forming, together with the primary condenser, the essential parts of the invention.

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

1. The combination of the double-acting pump-cylinder A A′ and piston B B′ with the valved suction-pipe C, valved branch channel D, valved inlet of condenser E, and exhaust-pipe E^2, and with valved passage of regulating air-chamber F, and supply-pipe F, substantially as specified.

2. The combination of a double-acting pump, having interior spaces of different size in front and back of piston, with a valved branch channel, connecting with a smaller space in pump, and with a condenser communicating with exhaust-pipe, and with a larger space of pump, the connecting-orifice between branch channel and condenser having a perforated plate and a deflecting-plate, for exposing the water in mechanically-divided state to heating action of the exhaust-steam, substantially as specified.

3. The combination of a boiler-feed pump

with a primary condenser, connected by siphon-shaped pipes to the exhaust-pipe of engine and to pump, so as to heat up water before passing to pump, substantially as specified.

4. The combination, in a primary condenser of a feed-water heater and regulator, of the siphon, connecting exhaust-pipe and condenser, with the siphon of the suction-pipe by a steam-channel and stop-cock, at the highest points of the siphons, substantially as specified.

5. The combination of a pump-cylinder, A, having guide-extension A′ and stuffing-box, with a piston, B, and piston-rod B′, guiding cross-head and connecting-rod, that is coupled by a ball-and-socket joint to cross-head, and by screw-connection to actuating-lever, substantially as specified.

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Witnesses:

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