No. 832,737. PATENTED OCT. 9, 1906.

F. KAEFERLE.

LOW PRESSURE STEAM HEATING APPARATUS.

APPLICATION FILED DEC. 27, 1904.

Fig. 1.

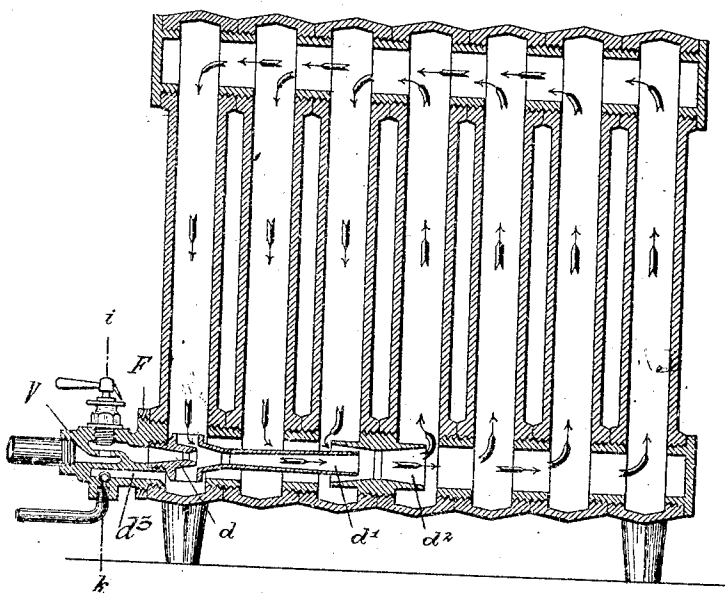


Fig. 2.

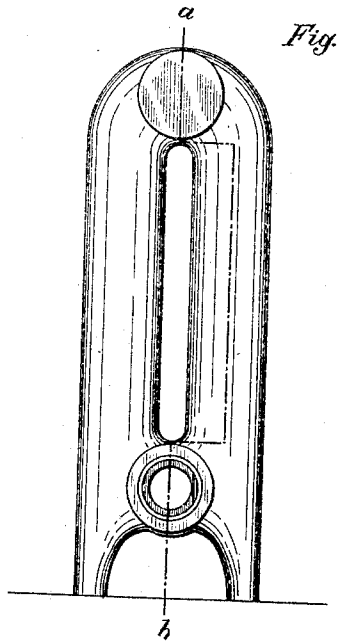
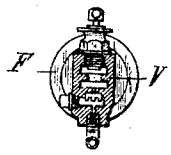


Fig. 3.



Witnesses
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UNITED STATES PATENT OFFICE.

FRITZ KAEFERLE, OF HANOVER, GERMANY.

LOW-PRESSURE STEAM-HEATING APPARATUS.

No. 832,737. Specification of Letters Patent. Patented Oct. 9, 1906.

Application filed December 27, 1904. Serial No. 238,526.

To all whom it may concern:

Be it known that I, FRITZ KAEFERLE, a subject of the German Emperor, residing at Hanover, Germany, have invented certain new and useful Improvements in Low-Pressure Steam-Heating Apparatus, of which the following is a specification.

This invention relates to improvements in low-pressure steam-heating apparatus; and its object is to provide means for enabling the steam supplied to the apparatus to drive out the air contained in such apparatus in the shortest possible time, this air having the tendency to prevent the steam from rapidly circulating in the heater, and thus reducing its pressure and temperature. By this means free expansion and distribution of the steam in all directions in the heating-space, and especially from above in a downward direction, can take place for the purpose of obtaining as far as possible a uniform and moderate temperature over the whole surface of the heater.

The above results are obtained by the use of pressure and suction nozzles or injectors suitably arranged in the lower part of the heater and through which the heating-steam must first pass before entering the heating-space of the apparatus.

In the accompanying drawings, Figure 1 is a longitudinal section on the line *a b* of Fig. 2 through a heating apparatus provided with such nozzles. Fig. 2 is a side view of said apparatus; and Fig. 3 is a section of the valve on the line of its axis *i k*, Fig. 1.

The nozzle *d*, provided with a union, is screwed into the inlet-valve chamber V, and connected to said union is the suction and pressure pipe or nozzle *d'* in such a manner that both the nozzles *d* and *d'* are practically integral with the inlet-valve and form an injector or "nozzle-valve."

As shown in Fig. 1, one or more of the tubular parts serving as screw connections between the different elements of the heater near their lower ends are in the form of pipes or nozzles d^2 or serve as such for conducting the steam from the end of pipe *d'* into the last element or chamber. The number of specially-shaped pipes or nozzles d^2 and their dimensions must be separately determined for each heater.

The steam passes through the nozzle *d* into the suction-space of the suction and pressure nozzle *d'* and carries with it the fluid (air or steam) in said suction-space, forcing said fluid through the narrowest part of the nozzle *d'* (which forms the pressure-cylinder) into the pressure-space of the latter. A mixture of fresh steam and air is therefore contained in the nozzle *d'* as long as air is still present, and when all the air has been driven out a mixture of fresh steam of higher pressure and temperature with steam of lower pressure and temperature is contained in the heater. The mixture referred to passes from the pressure-space of the nozzle *d'* into the suction-space of the pipe d^2 and again carries with it the fluid (air or steam) contained in said pipe d^2 and forces it through the narrow portion of this pipe into the pressure-space thereof. From said pressure-space or from that of the last similarly-shaped pipe, if more than one, the mixture thus obtained flows to the heating-space of the apparatus itself. As long as air is contained in the heater this mixture consists of steam and air; but the mixture is not such an intimate one that both the mixed fluids leaving the pressure-space of the last pipe d^2 would remain in intimate connection and continue to travel in such a condition through the heater upwardly and downwardly in all directions, since they are prevented from so doing, first, by the difference in specific gravity of the two fluids, and, secondly, by the continuous transformation of the steam into water. Owing to the speed given to it by the steam when passing through the pipe d^2, the air cannot ascend together with the steam; but, on the contrary, the steam and air separate immediately after passing from the pipe d^2 or the last of said pipes, owing to the difference in their specific gravity. The specifically lighter steam is forced upward by the heavier air, and when accumulated in sufficient quantity it exercises pressure on the air, owing to its expansion. It is therefore quite impossible for the air to pass upward or to circulate or be distributed wit' the steam. In the same manner the steam in the upper part cannot move downwardly or circulate with the air. The steam is always above the air and forces the latter from above in a downward direction, according to the volume of steam admitted, and when sufficient steam has been injected it will press said air out through an exhaust-pipe arranged at the lowest point of the heater.

By means of the present invention the air is rapidly removed from the heater, owing to the speed given to it by the steam in the noz-

zles and pipes, and the condition wherein steam only is contained in the heater is arrived at in a very short time. From this point the steam in the heater is sucked in by the fresh steam passing in and driven through the pipes, so that circulation of the steam alone is produced, the mixture of fresh steam and steam already in the heater being forced from the last pipe d^2 rapidly upward through the heating elements behind or beyond said last pipe and sucked downwardly through the elements in front of said pipe and then again through the nozzles or pipes. The relatively small quantity of steam admitted is rapidly distributed throughout the whole heater, its pressure and temperature being thereby reduced, and the following result is obtained—viz., that the whole surface of the heater is utilized for transmitting the heat of even a very small volume of steam, so that a uniformly moderate heat is produced over the whole surface of said heater.

The opening d^3 for the admission and exhaust of air and outlet of condensation-water is arranged in the nozzle-valve chamber or casing V, itself below the nozzle d or at the lowest point of the heater. It is therefore in communication with the suction-space of the pipe d', so that it is impossible that the specifically lighter steam can escape through this opening, since it is continuously sucked by the suction-pipe d' and driven again into the heater. Only the air and condensation-water can flow out through said opening, owing to their greater specific weight. By the arrangement of this outlet in the nozzle-valve itself the effect is also obtained that steam will never flow from the heater into the condensation-water conduit, this being very important in low-pressure steam-heaters.

To enable the valve-chamber V to be easily fitted and fixed with the valve in the necessary vertical position, it is not provided with a fixed flange, but with a loose collar or flange F, engaging a thread on the valve, the thread of said collar having an opposite pitch to that by which the valve-chamber is screwed into the heater. If the latter is a right-hand thread, the collar is given a left-hand one and is screwed back on the valve-chamber by turning it to the right so far that the boss on the valve can be screwed completely into the aperture provided therefor in the heater without the collar lying against the wall surrounding said aperture. The axis $i\,k$ of the valve will then probably not be vertical, so the valve is rotated back to slightly beyond the vertical position of the axis $i\,k$, and the collar F is screwed upon the valve by rotating it to the left until it bears against the wall surrounding the aperture in the heater and is then acted on by a wrench until the axis of the valve is perfectly vertical. As during the latter action of screwing the pitches of the threads of the valve and collar coöperate, it is only necessary to give a short jerk to simultaneously adjust and fix the valve-chamber.

I claim—

1. The combination in a low-pressure steam-heater comprising a plurality of elements of a steam-inlet and controlling valve, a plurality of suction and pressure nozzles communicating in series with said valve and traversing the lower part of the interior space of the heater and an outlet adjacent to said valve for outlet of air and condensed water substantially as described.

2. The combination in a low-pressure steam-heater comprising a plurality of heating elements, of a steam-inlet and controlling valve chamber and nozzle in the lower part of one of said elements having an orifice at its base for outlet of air and water and a plurality of suction and pressure nozzles alined with the aforesaid nozzle and communicating with the interior space of the elements, substantially as described.

3. The combination in a low-pressure steam-heater, of a plurality of heating elements severally communicating near their bases by a series of alined orifices, a steam-inlet and controlling valve chamber having a nozzle alined with said orifices and a plurality of suction and pressure nozzles communicating in alinement with the aforesaid nozzle and communicating with the interior space of the aforesaid elements, and adapted to form screw connections for the different elements, substantially as described.

In witness whereof I have signed this specification in the presence of two witnesses.

FRITZ KAEFERLE.

Witnesses:
LEONORE RASCH,
H. HAN HALL.