(No Model.) 2 Sheets—Sheet 1.

W. L. DENIO.

NOZZLE FOR INJECTING STEAM INTO FURNACES.

No. 564,873. Patented July 28, 1896.

Fig. 1.

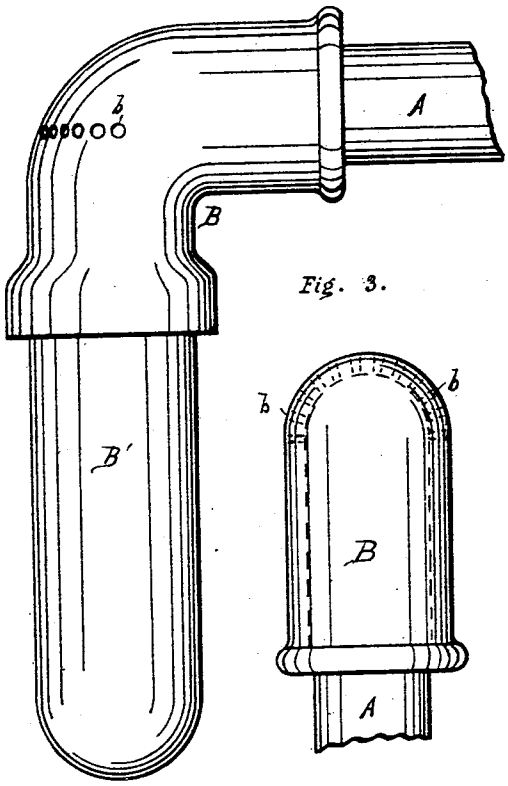


Fig. 3.

Fig. 2.

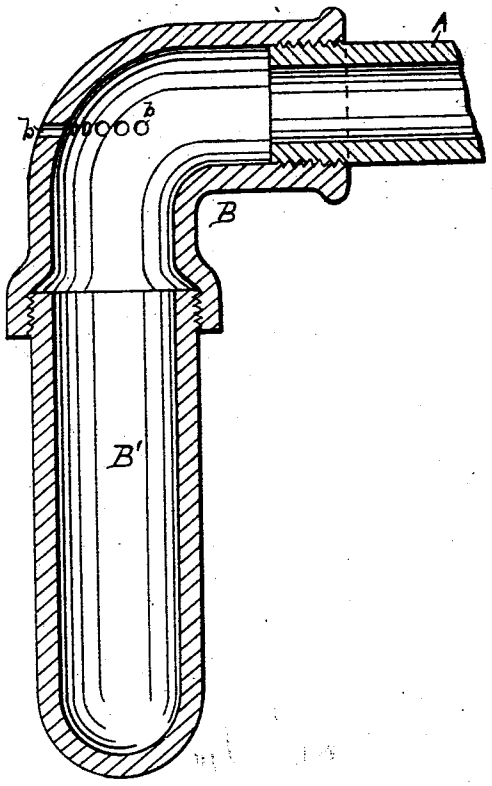
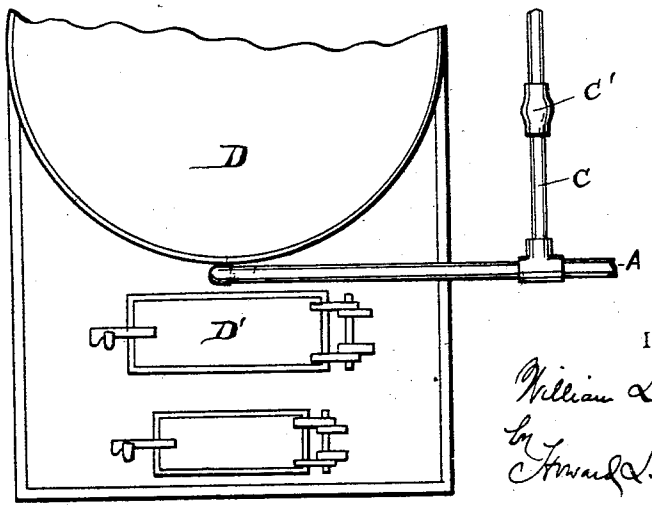


Fig. 4.



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(No Model.) 2 Sheets—Sheet 2.

W. L. DENIO.

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Fig. 5

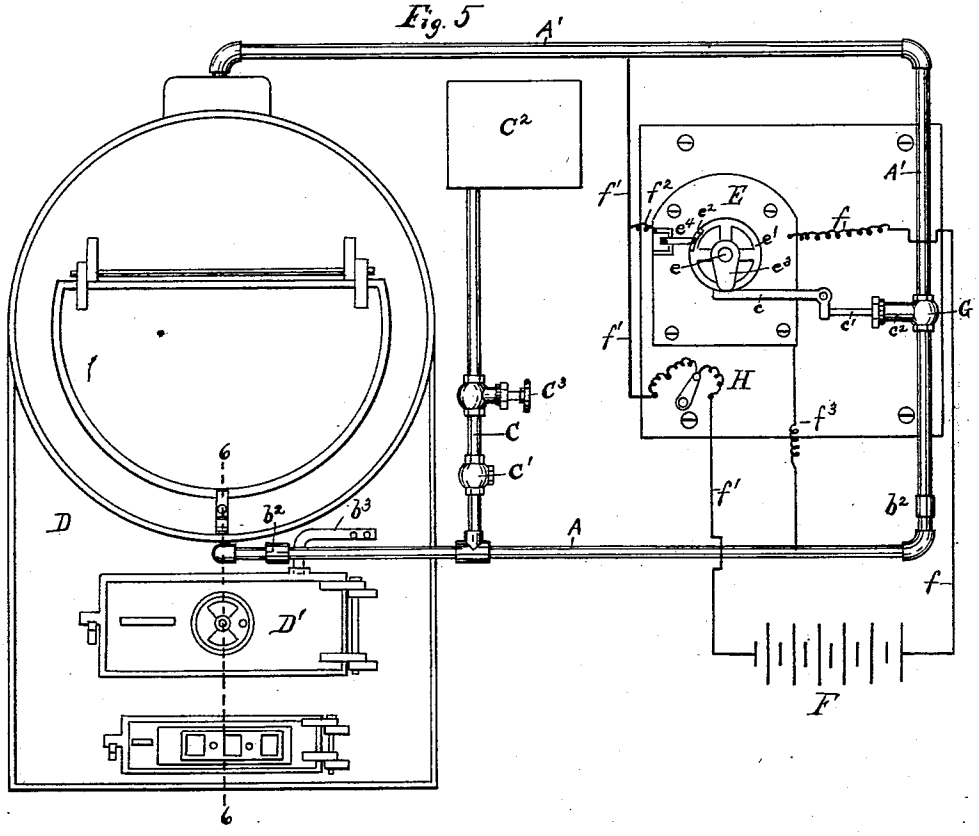
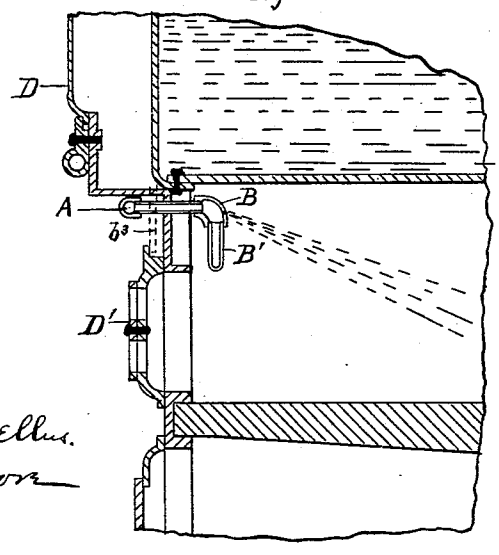


Fig. 6



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UNITED STATES PATENT OFFICE.

WILLIAM L. DENIO, OF ROCHESTER, NEW YORK, ASSIGNOR TO THE DENIO SMOKE CONSUMER COMPANY.

NOZZLE FOR INJECTING STEAM INTO FURNACES.

SPECIFICATION forming part of Letters Patent No. 564,873, dated July 28, 1896.

Application filed January 13, 1896. Serial No. 575,401. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM L. DENIO, a citizen of the United States, and a resident of the city of Rochester, in the county of Monroe and State of New York, have invented a certain new and useful Nozzle for Injecting Steam or Air into Furnaces, of which the following is a specification, reference being had to the accompanying drawings, in which—

Figure 1 is a side elevation of one of my nozzles. Fig. 2 is a vertical section thereof. Fig. 3 is a top plan view. Fig. 4 is a front elevation of a furnace, showing the pipe devices which I use in connection with my nozzle. Fig. 5 shows a view of a mechanism for controlling the supply of vapor or gas, and Fig. 6 is an enlarged vertical section on the line 6 6 of Fig. 5.

In order to produce more perfect combustion of fuel in furnaces and to prevent the production of smoke therefrom, it is well known that the injection of steam or air or any other oxidizing vapor or gas into the fire-space above the grate, at the time when a fresh charge of fuel is placed upon the grate and for a short time thereafter, is a sufficient means of effecting the desired result. The great difficulty, however, in the use of such apparatus has always been that the tip or nozzle of the injector itself quickly burns off in the high heat to which it is exposed, and, in cases where the water used in the boiler is charged with sediment, the slots or perforations through which the injection occurs become filled with sediment or incrustration, thus at times hastening the deterioration of the nozzle. In order to obviate these difficulties, and to provide a nozzle which shall have a long life in the high heat of the furnace, I have produced the device hereinafter described and claimed.

In the drawings, A is the pipe by which steam or air under pressure or a mixture of steam and air is conducted to a nozzle which is situated within the furnace and above the grate. Upon the end of the pipe A and inside the fire-space of the furnace, but preferably close inside the front wall thereof, is the nozzle B, provided with the depending water-holding tube or cup B′, and having, above the level of the top of the cup, a series of perforations b through which the injected steam or air or the mixture thereof passes into the furnace. The water-holding cup B′ is made of sufficient depth and diameter to hold a body of water, and this will vary in quantity according to the size of the furnace and the heat maintained therein. I have found in several instances that a cup of from four to six inches in depth and of a diameter of about three-fourths of an inch to one inch holds sufficient water for my purposes; but where very high heats are maintained and a large quantity of oxidizing vapor or gas is necessary these sizes may be proportionately increased.

Outside of the furnace a pipe C is connected from a suitable water supply, such as the tank C^2, Fig. 5, to the pipe A, and in said pipe C is placed a suitable check-valve C′, whereby back pressure from the pipe A will close the valve. A constant but slow feed of water is provided into the pipe C, which, in some instances of use by me, has been at the rate of from one to three drops a second. A suitable regulating device is provided in the pipe C, such as the valve C^3. This water supply flows into the pipe A and thence into the cup or pocket B′. The furnace D is provided with a regulating apparatus, such as is well known, (for instance, such as is set forth in my Patent No. 510,631,) whereby, by the opening of the furnace-door, a blast of oxidizing vapor or gas is turned on in the pipe A, and the blast is continued for a predetermined period after the door is closed.

In the circuit of pipe A A′ are interposed two connections b^2 b^2, which are electric insulators whereby that portion of the pipe A between said insulators is electrically disconnected from the remainder of the pipe-circuit. A spring b^3 is attached to the front plate of the furnace, which, when the door D′ is opened, makes an electrical contact with the pipe A between the insulators b^2 b^2, but when the door D′ closes the spring b^3 is moved away from the pipe and the contact is broken. A valve G is placed in the circuit of pipe and adjacent thereto is an electrical motor E of any suitable form. Upon the main shaft e of said motor is a wheel e', provided with an insulating spot e^2 and an insulated cam e^3. A

suitable insulated contact-spring e^4 presses upon the wheel e' and is electrically disconnected therefrom when in contact with the insulating spot e^2. A lever c, suitably pivoted to a stationary part of the aparatus, is operated by the cam e^3. The lever C operates the valve-stem c' of the valve G and serves to operate said valve. In the form of device shown, the valve-stem c' is operated in one direction by a spring within the packing-box c^2 and is actuated in the other direction by the cam e^3 through the lever c. A battery F, or other suitable source of electrical energy, drives the motor E. A rheostat H is introduced into the circuit passing through the motor, whereby the rate of revolution of the motor may be varied, if desired. The battery F has the following connections: The connection f to the motor is constant from one pole of the battery. The other pole of the battery is connected by the wire f' to the circuit of pipe A A', outside of the portion between the insulators b^2 b^2. The rheostat H may be interposed in the wire f'. From the connection f' a side connection f^2 runs to the insulated contact-spring e^4. That portion of the pipe A between the insulators b^2 b^2 is also connected to the motor E, as by the wire f^3. The whole device is at rest, as shown in Fig. 5. The contact-spring e^4 rests upon the insulating spot e^2, and the spring b^3 is out of contact with the pipe A. The furnace-door is now opened for supplying fuel to the grate and the furnace is then electrically connected with that part of the pipe A between the insulators b^2 b^2. The current passes from the battery F through the connection f, into and through the motor; thence through the wire f^3 into the insulated part of the pipe A; thence through the spring b^3 to the furnace; thence through the circuit of pipe outside of said insulated part, and thence through the wire f' to the battery. The motor E revolves and the contact-spring e^4 passes off from the insulated spot e^2 on the wheel e'. As soon as the contact-spring e^4 comes into contact with the uninsulated portion of the wheel e', a new set of connections is set up. The stoking of the furnace having been finished, the door D' may be closed, thus breaking the connection between the spring b^3 and the pipe A. The current from the battery now passes into the motor through the wire f; thence through the shaft e into the wheel e'; thence through the contact-strip e^4 and the side connection f^2 into the connection f', and thence to the battery. The revolution of the motor continues until the insulated spot e^2 breaks the connection between the wheel e' and the contact-spring e^4, whereupon the motor stops. The cam e^3 is so set upon the shaft of the motor that, when the motor is at rest with the contact-spring e^4 upon the insulated spot e^2, the valve is completely closed and the supply of steam to the nozzle is cut off. The revolution of the motor begins to open the valve G as soon as the door D' is opened, thereby admitting a jet of vapor or steam into the fire-space. When the stoking is completed, the door is closed and the valve remains open until the motor E has caused one complete revolution of the cam E'. At the end of said revolution of the cam, the valve is again closed. Thus I provide a mechanism for controlling a supply of vapor or gas by the opening and closing of the furnace-door.

Upon opening the furnace-door D', a blast of steam, or of air, or of mixed steam and air, is turned on in the pipe A, and the same is distributed over the fire-space through the perforations b of the nozzle B. A charge of fuel is placed upon the grate, the furnace-door is closed, and, after the interval for which the apparatus is set, the blast is shut off in the pipe A. During the period of injection of the oxidizing vapor or gas, the nozzle B is kept cooler than the temperature of the fire-space by reason of its containing the constantly-flowing stream of vapor or gas, but as soon as this blast or stream is turned off, the nozzle would, under ordinary circumstances, immediately become highly heated and would melt or crack, or become otherwise seriously damaged in consequence. As soon as the blast is shut off water from the water supply flows through the pipe C and through the pipe A into the cup B', and boiling therein keeps the whole of the tip or nozzle at a temperature lower than one at which the deleterious effects above mentioned are produced. The flow of water through the pipe C is stopped whenever the steam-pressure in the pipe A at the point of union of the pipe C with the pipe A is sufficient to operate as an overbalancing back pressure upon the check-valve C'. There is therefore an alternation of the blast in the pipe A and of the flow of water into the cup B'. The condensation of steam in the pipe A supplies water to the cup B' during the continuance of the blast. The cup B' is preferably made of wrought iron.

I do not limit my broad claims to any specific form of nozzle, provided the same has a water-holding cup attached thereto located inside the furnace, so that steam may be generated from the water contained in the same. It will be seen that the boiling of the water in the water-cup or pocket produces an outward blast through the perforations b, and tends to blow out sediment or incrustation which may collect therein. In fact, in actual use, the perforations b remain clean, and this cleanness I attribute, in considerable part, to the effect of the steam arising from the boiling water in the pocket B'.

What I claim is—

1. In a smoke-consuming furnace, a pipe conducting a supply of oxidizing vapor or gas into the fire-space, a nozzle on said pipe having a water-cup located inside the furnace whereby steam may be generated from the

water contained in said cup, and a water supply to said cup independent of the supply of oxidizing vapor or gas.

2. In a smoke-consuming furnace, a pipe extending into the fire-space and connected with a source of supply of oxidizing vapor or gas, a nozzle on said pipe having a water-cup located inside the furnace whereby steam may be generated from the water contained in said cup, said cup being below the orifice of said nozzle, and a water supply leading to said cup and adapted to feed water thereinto when said supply of vapor or gas is shut off.

3. In a smoke-consuming furnace, a pipe conducting oxidizing vapor or gas into the fire-space, a nozzle on said pipe having a water-cup located inside the furnace whereby steam may be generated from the water contained in said cup, means for supplying water to said cup, means for supplying oxidizing vapor or gas to said pipe and means for controlling said supply of water and said supply of vapor or gas whereby the same are alternately turned on and shut off, the said supply of vapor or gas being controllable by opening and closing the furnace-door.

4. In a smoke-consuming furnace, a pipe conducting oxidizing vapor or gas into the fire-space, a nozzle on said pipe having a water-holding cup located inside the furnace whereby steam may be generated from the water contained in said cup, means for supplying water to said cup, means for supplying oxidizing vapor or gas to said nozzle, and means for alternating said supply of water and said supply of oxidizing vapor or gas controllable by opening and closing the furnace-door.

5. In a smoke-consuming furnace, the pipe conducting oxidizing vapor or gas into the fire-space, means controllable by opening and closing the door for turning on and shutting off said supply of vapor or gas, a water supply to said pipe independent of the means for controlling said supply of vapor or gas, a nozzle on said pipe located within the furnace and having a dependent tubular water-cup whereby the water therein is generated into steam, and a check-valve in the water-supply pipe, whereby the check-valve is closed when the supply of vapor or gas is turned on and opens to admit water to said water-cup when the supply of vapor or gas is turned off.

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