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METHOD OF PROTECTING TUNNEL FURNACES FROM INJURIOUS GASES.

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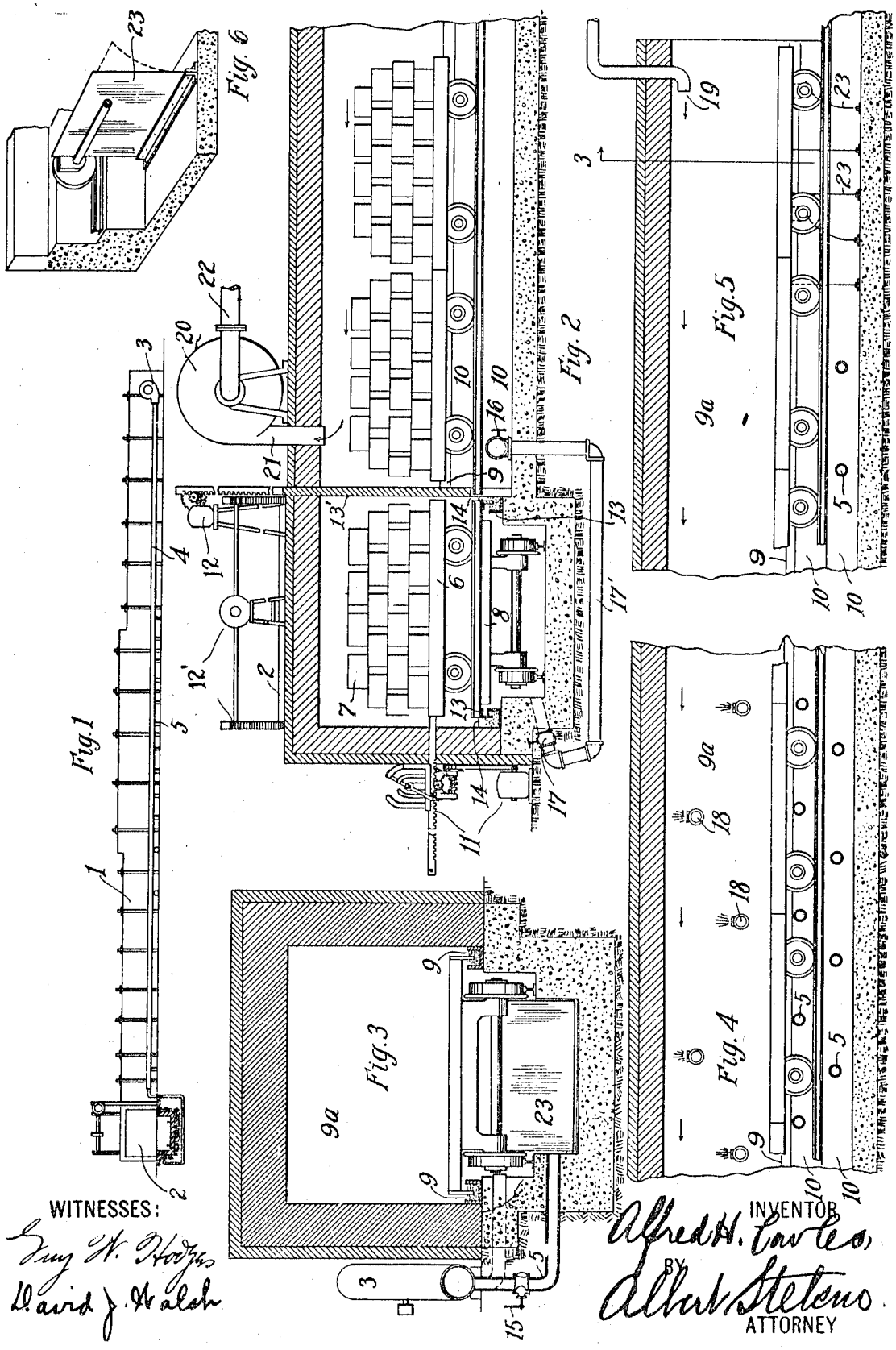

UNITED STATES PATENT OFFICE.

ALFRED H. COWLES, OF SEWAREN, NEW JERSEY, ASSIGNOR TO THE ELECTRIC SMELTING AND ALUMINUM COMPANY.

METHOD OF PROTECTING TUNNEL-FURNACES FROM INJURIOUS GASES.

1,040,892. Specification of Letters Patent. Patented Oct. 8, 1912.

Application filed April 14, 1911. Serial No. 621,002.

To all whom it may concern:

Be it known that I, ALFRED H. COWLES, a citizen of the United States, and resident of Sewaren, in the county of Middlesex and State of New Jersey, have invented certain new and useful Improvements in Method of Protecting Tunnel-Furnaces from Injurious Gases, of which the following is a specification.

My invention relates to improvements in tunnel furnaces.

It relates particularly to a new and improved method for protecting portions of the furnace and the conveying devices from the action of injurious gases, or liquids, developed during the operation of the furnace.

The present method is particularly adapted for use in the manufacture of hydrochloric acid and sodic-silico-aluminate, from clay, or aluminous material and an alkali chlorid, in connection with the process set forth in my application Ser. No. 521,692, filed Oct. 2d, 1910.

The object of the invention is to allow the use of tunnel furnaces under conditions where the gaseous products formed in the heated zones above the cars are of an acid nature and such that upon cooling they attack the metal portions of the cars and the concrete parts of the masonry in the tunnel structure.

To carry out my invention I introduce into the portion of the furnace under the cars air, or an inert gas—that is, air or gas that does not attack the corrodible parts of the cars or furnace—under such pressure as to counterbalance any pressure of the acid fumes tending to force said acid fumes downward between and around the cars.

In the drawings accompanying and forming part of this application are shown, by way of example, means for carrying out my invention, and therein—

Figure 1 is an elevation of a furnace showing one of my attachments; Fig. 2 is a longitudinal section through the feeding end of the furnace and the vestibule; Fig. 3 is a cross-section on the line 3—3 of Fig. 5; Fig. 4 is a longitudinal section of the furnace near the central and hottest zone; Fig. 5 is a section near the outlet of the furnace, and Fig. 6 is a detail showing an air baffle.

Referring to the drawings:—1 is the furnace provided with the vestibule 2; 3 is a blower forcing air, or an inert gas, through the conduit 4 and inlets 5 into the lower part 10 of the furnace 1; 6 are the cars loaded with briquets 7, and 8 is the transfer car by which the loaded car is brought into the vestibule; 9 are sand seals for sealing the space above the cars from the space 10 below the same; 11 is the device, shown as electrically operated, for imparting to the cars 6 a gradual and forward movement through the furnace, as set forth in my application Ser. No. 614,876 filed Mar. 16, 1911; 12 shows means for operating the door 13^1 between the vestibule and the furnace, and 12^1 are means for operating the two end doors of the vestibule; 13 are sand seals for sealing two sides of the vestibule pit, the other two sides being provided with sand seals, fully shown in my application Ser. No. 814,876, filed March 16th, 1911; 15 is a pressure regulating valve inserted in the air inlet pipes 5.

16 and 17 are pressure regulating valves provided at the entrance end of the furnace and vestibule respectively, and 17^1 is a pipe connecting these two valves; 18 are the oil burner holes and 19 an inlet for steam and air.

20 is the suction fan for drawing the acid fumes from the furnace above the cars through the pipe 21 and conveying them to the acid towers, or other receptacles, through the pipe 22; 23 are air baffles for hindering the exit of air at the discharge end of the furnace.

The operation is as follows:—Assume the portion 9^a of the furnace to be filled with cars loaded with briquets of such a composition that the product to be drawn off by the suction fan 20 is to be hydrochloric acid-fumes, mixed with water vapor and products of combustion, and assume a car to be ready to enter the furnace, as shown in Fig. 2. The gas jets 18 having been lighted, steam and air are blown in at 19 over the tops of the advancing cars. The

mechanism 12 operates the door 13¹, and the car enters, urged forward by the electrical pusher 11. As soon as the car 6 has entered the furnace, the door 13 of the vestibule is closed, the vestibule door opened, and the transfer car 8 enters with a new loaded car ready to be advanced into the furnace.

Shortly after starting the operation acid fumes begin to fill the portion 9ª above the tops of the cars, and these are sucked out by means of the fan 20. These acid fumes (here assumed to be hydrochloric acid fumes) in the state of vapor do not attack the iron, but if cooled below the temperature at which they condense with water (say at about 220 degrees F.) they readily attack and destroy the iron work of the cars and the furnace, and the portion of the masonry containing cement or mortar. It is particularly to prevent this injurious action that I have devised the method and apparatus set forth in this application. In order that the seal between the furnace portion above the cars and that below them may be as perfect as possible, the abutting ends of the cars are machined off to make an almost gas and air tight joint. The essential thing is to prevent any leakage of the acid fumes downward, and to cause whatever leakage there is to be directed upward from below the points where the temperature is lower than the condensation point of the fumes, and I create a pressure of air, or inert gas, upward from beneath the cars equal, or exceeding that of the gases downward. The pressure may be produced, in one way, by a blower 3, delivering air through a pipe 4, arranged on one or both sides of the furnace, through the holes 5, and into the furnace below the cars, the position and number of the holes depending upon the heat and pressure in the different parts of the furnace. Hot air may, under certain circumstances, be introduced, and thus assist in preventing the lower portion of the furnace from becoming cold and the acid fumes from being deposited. Moreover, each of the air inlet pipes may be provided with regulating valves 15, so that any desired pressure may be maintained. There must be means of control, because otherwise too much air might be forced upward through the crevices between and around the cars from below, and the heating gases be unduly cooled or their proper composition interfered with. The ideal to be sought is a balance, or a slight upward pressure of the air. It is evident, in the specific illustration shown, that the downward pressure will be greatest at the point where the burning gases are hottest and where the gas jets are most closely grouped, and it is for this that I have shown the air inlets 5 most closely grouped in Fig. 4, which indicates the middle of the furnace, or the part where the gas jets are most numerous and hottest. The suction fan for drawing off the acid fumes is shown as located at the entering end, and as the leakage at that end would naturally be upward, I have shown no air inlets at this point. At the outlet end the blowing in of steam through the pipe 19 creates, at that particular spot, a tendency to an upward pressure, on account of the partial vacuum created, but farther on in the furnace, this entering steam might produce a downward pressure. On account of this partial vacuum at the outlet end I have shown few air inlets at that part of the furnace. Of course, as there are regulating valves attached to each of the air inlets, they may be scattered as thickly from end to end as desired along the funnel, the pressure thus being under absolute control. Great pressure is not needed, especially at the ends. As the furnace is open at the outlet end and cars are passing out continually, there would be a tendency for considerable air to escape from under the cars at that end. I have therefore devised and herein shown, one simple manner of preventing too great escape of air from under the cars. I place crosswise in the pit of the car track a flexible metal sheet, which fills the opening close up to the bottom of the car. The elastic limit of the metal is so chosen that when the advancing car axle meets and bends it over, as shown in dotted lines in Fig. 6, it resumes its original shape as soon as the axle has passed. Each axle in passing operates the sheet metal baffle, and by placing several of them grouped closely, as shown in Fig. 5, the pressure of the air is reduced to practically that of the atmosphere outside the furnace, and no great rush of air to or out of that end takes place. Another way in which the escape of air could be prevented to a very large extent, would be to blow air in under the cars against the air rushing into the outlet end and by the valves shown producing the balance of the two currents. There could also be attached to the sides of the cars or of the furnace means for filling up the space between the sides of the car and furnace and the space around the wheels, if that were thought desirable to produce a more perfect control of the air at the outlet end. To control the pressure in the vestibule and in the furnace, I have arranged the pressure regulating valves 16 and 17 and the pipe 17¹ connecting the lower part of the furnace and the lower part of the vestibule. When the vestibule door 13¹ is to be lowered so that a new loaded car may be brought in by the transfer car 8, the valve 17 is closed and thereby the pit is sealed against the escape of air. The vestibule being opened, the

pressure therein becomes, of course, that of the atmosphere. When the vestibule is ready, for the door 13[1] to be lifted and a car to be admitted to the furnace, through 3, or some other convenient source, the air pressure is raised to that of the furnace. The valve 17 is then closed and the door between the furnace and vestibule opened.

I do not herein claim the apparatus shown and described in the present application, that forming the subject of my divisional application, Ser. No. 645,868 filed Aug. 24th 1911.

Having thus fully illustrated and described my invention, what I claim, is:—

1. The method of protecting against the injurious gases formed in the top of tunnel furnaces the corrodible portions of the cars and of the furnace lying below the car tops, consisting in maintaining below the car tops such a pressure of non-corrodible gas as to prevent any downward leakage of the injurious gases.

2. The method of preventing the injurious gases formed in tunnel furnaces above the tops of the cars from attacking the metal portions of the cars and the masonry below the car tops, which consists in creating beneath the car tops such a pressure of air as to prevent any downward leakage of the injurious gases.

3. The method of preventing the injurious gases formed in tunnel furnaces above the tops of the cars from attacking the metal portions of the cars and the masonry below the car tops, which consists in creating beneath the car tops a pressure of air upward exceeding the downward pressure of the injurious gases downward.

4. The method of protecting from the injurious action of gases formed in tunnel furnaces above the tops of the cars the corrodible portions of the cars and of the furnace lying below the car tops, which consists in introducing into the furnace under the cars an upward air pressure equal to the downward pressure of the injurious gases.

5. The method of protecting from the injurious action of gases formed in tunnel furnaces above the tops of the cars the corrodible portions of the cars and of the furnace lying below the car tops, which consists in introducing into the furnace, beneath the cars an inert gas under an upward pressure sufficient to counteract the tendency of the injurious gases to leak downward, said inert gas pressure being unequally distributed throughout the length of the furnace, to correspond with the pressure of the injurious gases in the various portions of the furnace.

6. The method of protecting from the injurious action of gases formed in tunnel furnaces above the tops of the cars, the corrodible portions of the cars and of the furnace lying below the car tops, which consists in introducing into the furnace beneath the cars an inert gas under pressure, and so regulating said pressure in the various parts of the furnace as to counterbalance the pressure of the injurious gases in corresponding portions of the furnace above the cars.

7. The method of preventing the escape of gas from the car pit of tunnel furnaces open at the exit end, which consists in dividing the exit end of the pit into a series of automatically operated gas obstructing chambers.

8. The method of protecting from the injurious action of gases formed in tunnel furnaces above the tops of the cars, the corrodible portions of the cars and of the furnace lying below the car tops, which consists in introducing into the furnace beneath the cars an inert gas, so regulating the pressure of said inert gas in the various parts of the furnace as to counterbalance the downward pressure of the injurious gases in corresponding portions of the furnace above the cars, and obstructing the passage of the air from and into the exit end of the car pit, while allowing free passage for the cars.

9. The method of controlling the gas pressure below the cars in tunnel furnaces open at the exit end, which consists in obstructing the passage of the air from and into the car pit, and controlling the obstruction by the movement of the cars out of the exit end of the furnace, substantially as set forth.

10. The method of preventing injurious gases circulating above the tops of cars in tunnel furnaces from attacking the corrodible portions of the cars and of the furnace lying beneath the cars, which consists in producing in the part below the cars an inert gas pressure upward sufficient to counterbalance the downward leakage of the injurious gases, and so regulating said upward pressure that it decreases from the center of the furnace toward either end.

11. The method of protecting from the injurious gases formed above the tops of the cars in tunnel furnaces the corrodible portions of the cars and of the furnace lying below the car tops, which consists in drawing off the gases in the upper furnace portion, supplying to the part of the furnace below the cars at predetermined space intervals inert gas and so adjusting the inert gas supply as to produce throughout the lower portion of the furnace a pressure counterbalancing that of the injurious gases in the corresponding upper portion of the furnace, and preventing said injurious gases from penetrating the lower portion of the furnace.

12. The method of preventing gas escape

from the car pit of tunnel furnaces, which consists in arranging at the exit end of the pit gas obstructors automatically operated by the moving cars.

13. The method of making hydrochloric acid from clay and an alkali chlorid, consisting in preventing the gases carrying hydrochloric acid and watery vapors circulating above the cars from passing downward beneath the cars by creating a regulated upward gaseous pressure from below the cars sufficient to overbalance the downward pressure of the injurious gases.

14. The method of protecting against the injurious gases formed in the top of tunnel furnaces the corrodible portions of the cars and of the furnace lying below the car tops, which consists in maintaining below the car tops an upward pressure of heated inert gas sufficient to counterbalance the downward pressure of the injurious gases.

Signed at New York in the county of New York and State of New York this sixth day of April A. D. 1911.

ALFRED H. COWLES.

Witnesses:
ALBERT STETSON,
M. BUTLER.