H. W. HIXON.

ELECTRIC FURNACE.

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957,337. Patented May 10, 1910.

Fig. 1.

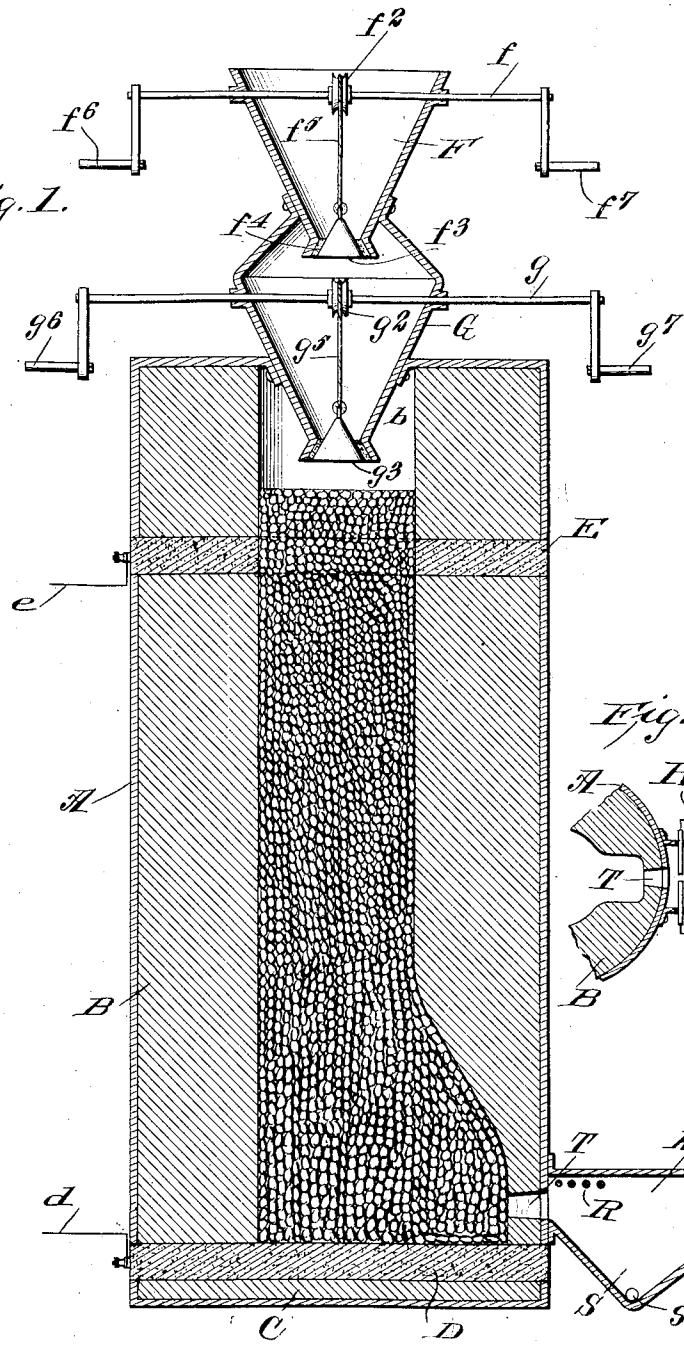
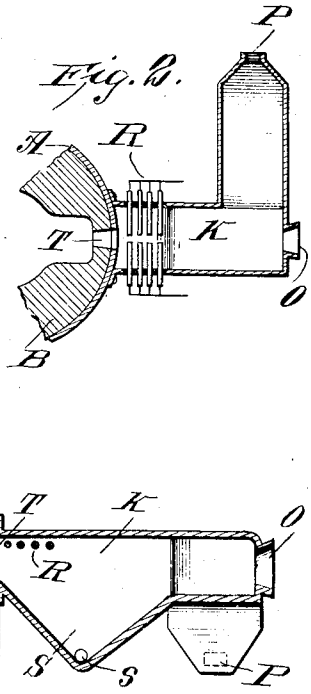


Fig. 2.



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ELECTRIC FURNACE.

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To all whom it may concern:

Be it known that I, HIRAM WEISS HIXON, a citizen of the United States, residing at Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented an Improvement in Electric Furnaces, of which the following is a specification.

My invention relates to electric furnaces, more particularly to those furnaces used in the smelting of zinc ores and it consists in the combinations, constructions and arrangements of parts herein described and claimed.

Hitherto the efforts to reduce zinc by electric smelting have been unsatisfactory owing to the production of a blue powder instead of spelter. One reason for the failure is that the zinc vapor is obliged to rise against the cold charge of ore which is fed in at the top of the furnace.

An object of my invention is to provide a device in which the zinc is fed into the furnace, the top of which is kept closed so that the zinc vapor is forced to escape at a lower point, preferably the tap hole. To this end I provide a furnace with a top of double construction so that an upper door may be opened and a charge fed in while the lower door is shut thereby keeping the zinc vapors within the furnace.

A further object of my invention is to provide a device in which there is a great increase in the amount of ore handled per man employed, owing to the fact that the electric furnace can be built to handle a much larger tonnage than the ordinary retorts.

A further object of my invention is to thoroughly volatilize the zinc from the fused material and also to heat the condenser above the boiling point of the zinc. This I obtain by means of carbon electrodes inserted in the side of the condenser adjacent to the top of the tap hole.

Other objects and advantages will appear in the following specification and the novel features of the device will be particularly pointed out in the appended claims.

My invention is illustrated in the accompanying drawing in which—

Figure 1 shows a central vertical section through an electric zinc furnace constructed according to my invention, and Fig. 2 shows a horizontal section on a reduced scale through a portion of the furnace.

As heretofore stated one objection to the use of the ordinary electric furnace in zinc smelting is that the vapors of zinc arising from the smelting operation meet the cold charge coming in at the top of the furnace which results in the formation of refractory compounds of zinc to the detriment of the smelting operation. In order to overcome these obstacles, I have designed the form of furnace shown in Fig. 1. This consists of a steel shell A preferably of a cylindrical shape and forming the inclosing casing of the furnace. Within the steel shell A is a non-conducting refractory lining B which may be of any appropriate dimensions and is preferably two or three feet thick. At the lower end of the furnace is a layer C of the refractory lining upon which is a base or plate D of carbon which is connected to a source of electricity by means of a conductor *d*. Toward the top of the furnace is a similar plate of carbon E of an annular shape which is connected to the source of electricity by means of the conductor *e*. The interior of the furnace may be filled with zinc ore to a point above the upper carbon electrode E, the bottom of the charge resting directly upon the lower electrode D.

In order to prevent the escape of any of the vapors I have arranged the double feeding hopper shown in Fig. 1. This consists of an upper funnel like receptacle F having a transverse shaft *f* extending therethrough upon which a central wheel f^2 is located. At the bottom of the receptacle F is a closure f^3, of a cone shaped form, arranged to fit snugly against the asbestos gaskets f^4 disposed on the interior of the lower opening of the receptacle F. The closure f^3 is attached to the wheel f^2 by means of the cable f^5. The shaft *f* is provided with the crank handles f^6, f^7 respectively.

The upper hopper F projects down into and is supported by a lower hopper G having a similar shaft *g*, carrying the wheels g^2 arranged to operate a closure g^3 at the lower end of the receptacle G in a similar manner to the upper hopper. The lower hopper extends down into the interior *b* of the furnace.

At the lower end of the furnace is the tap hole T which leads to the condenser K. This tap hole is smaller at the inside than at the outside as shown in Fig. 1. Just above the tap hole I propose to locate a number of arcs R which are preferably connected in parallel as shown in Fig. 2. Immediately opposite the tap hole is an

observation hole O through which the progress of the smelting operation may be observed. At the end of the condenser is the outlet P for the melted zinc.

From the foregoing description of the various parts of the device the operation thereof may be readily understood.

The charge, which is a mixture of roasted zinc ore and sufficient fine coal to reduce it, is fed into the top of the furnace until the furnace is full, both closures f^3 and g^3 being lowered to permit the free entrance of the charge. Owing to the presence of the coal an electrical connection is established between the top electrode E and the bottom electrode D. The current is now turned on and the heat developed in the charge by the resistance and the arcing of the current from piece to piece of the carbon in the charge roasts the charge. The tap hole is kept open to relieve the pressure of the accumulating gases and when the temperature has risen high enough to cause the reduction and volatilization of the zinc, the zinc vapor will begin to discharge into the condenser, and when it has reached a sufficient density, it will condense to metallic zinc. The starting up of the ordinary zinc furnace always produces blue powder, until the vapor density of the zinc has reached a certain point, after which the zinc continues to condense until by a reduction of zinc in the charge, the vapor density is reduced below the point required for the production of zinc, and from that point on, until the residues are discharged, blue powder forms again.

After the electric smelting furnace is once started there should be no let up in the vapor density as the furnace is fed continuously at the top and the hot zinc vapors are forced to discharge at the bottom by keeping the top of the furnace tightly closed. This is accomplished by means of the double charging hoppers already described. The hopper F is filled with a charge which by means of the handles f^6 and f^7 is delivered to the lower hopper G. The upper hopper F is then tightly closed by means of the closure f^3. The charge is thus being heated in the lower hopper and when of the required temperature it is permitted to fall into the main portion of the furnace to take the place of the smelted product which is being drawn off from below. Thus it will be seen that there is no sudden change by a cold charge but that the vapor density of the zinc will practically remain the same throughout the operation.

In Fig. 1, I have shown a pocket or settler which forms part of the condenser and is adjacent the tap hole T. This is for the purpose of separating and collecting the slag, residues and lead in the ore and this is provided with a constant discharge or tap hole *s* for discharging the slag and residues and lead, separated from the zinc. In order to keep the zinc in a volatilized state so that it will be thoroughly separated from the fused material drawn out through the tap hole *s*, I provide a series of arcs preferably in the form of carbon electrodes which project through the sides of the condenser, being immediately above the tap hole. The zinc vapor passes into the condenser and is then condensed in the usual manner and passes out through the outlet P. The progress of the operation may be observed through the observation hole O.

With the furnace thus described it is possible to maintain the density of the zinc vapor at an approximately fixed point. This prevents the formation of the blue powder and results in the continuous production of the metallic zinc.

While I have shown the electrodes as being in the form of carbon plates, it is obvious that other forms might be used such as electrodes of graphite built into the walls of the furnace. The lining of the furnace might be of various non-conducting material such as lime, carborundum, magnesite or a combination of the three in different layers from the shell toward the interior.

I claim:

1. In an electric furnace for smelting zinc, a casing provided with a non-conducting refractory lining for receiving the charge, upper and lower electrodes arranged to contact with the charge and adapted to connect with a source of current, charging means arranged to operate so as to maintain the vapor density of the zinc in the furnace during the charging operation, means for separating the slag and means for condensing the zinc vapor.

2. In an electric furnace for smelting zinc, a hollow casing provided with a non-conducting lining arranged to receive a charge of ore, electrodes carried by said lining and arranged to contact with the charge, means for passing the current of electricity through the charge, a two compartment hopper carried by said casing for receiving and preheating the charge, independent means for opening and closing each compartment of the hopper, and means for drawing off and condensing the zinc vapor.

3. In an electric furnace for smelting zinc, a hollow casing provided with a non-conducting lining arranged to receive a charge of ore, electrodes carried by said lining and arranged to contact with the charge, means for passing a current of electricity through the charge, a two compartment hopper carried by said casing for receiving the charge, independent means for opening and closing each compartment of the hopper, said means comprising a shaft, a wheel upon said shaft, and a cone shaped closure arranged to be drawn up into engagement with the mouth

of the compartment, a condenser, a passage leading from the lower part of said furnace to said condenser, said condenser comprising a pocket for collecting the slag and a compartment for condensing the zinc vapors and means for keeping the zinc in a volatilized state for passing over said pocket.

4. In an electric furnace for smelting zinc, a main casing provided with electrodes for smelting the charge, preheating means arranged to deliver a heated charge to said furnace, a tap hole at the bottom of said furnace, an exterior condenser communicating with said tap hole, and means for producing a series of electric arcs immediately above the tap hole for maintaining the zinc vapor in a gaseous condition while passing into the condenser.

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