(No Model.) 2 Sheets—Sheet 1.

# B. HALL.

## REVERBERATORY SMELTING AND REFINING FURNACE.

No. 589,210. Patented Aug. 31, 1897.

*Fig. 1.*

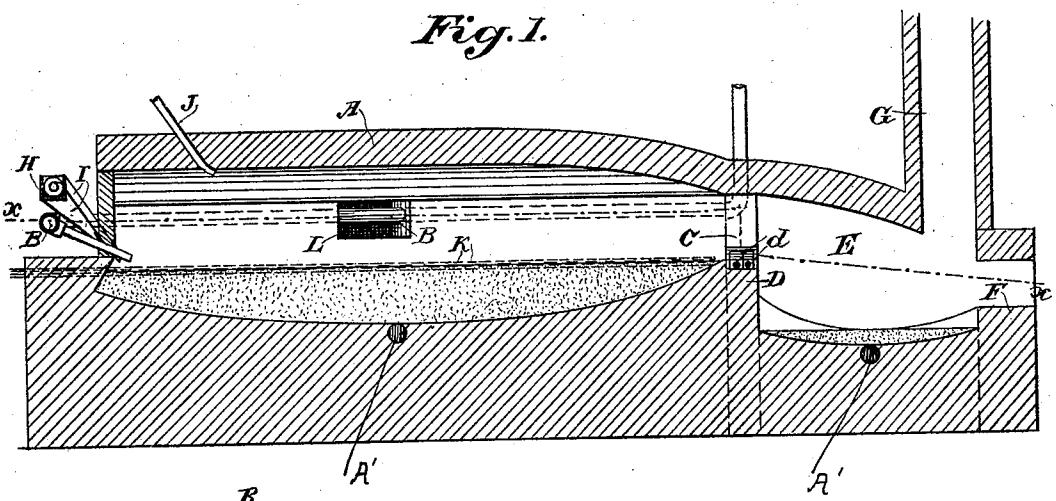
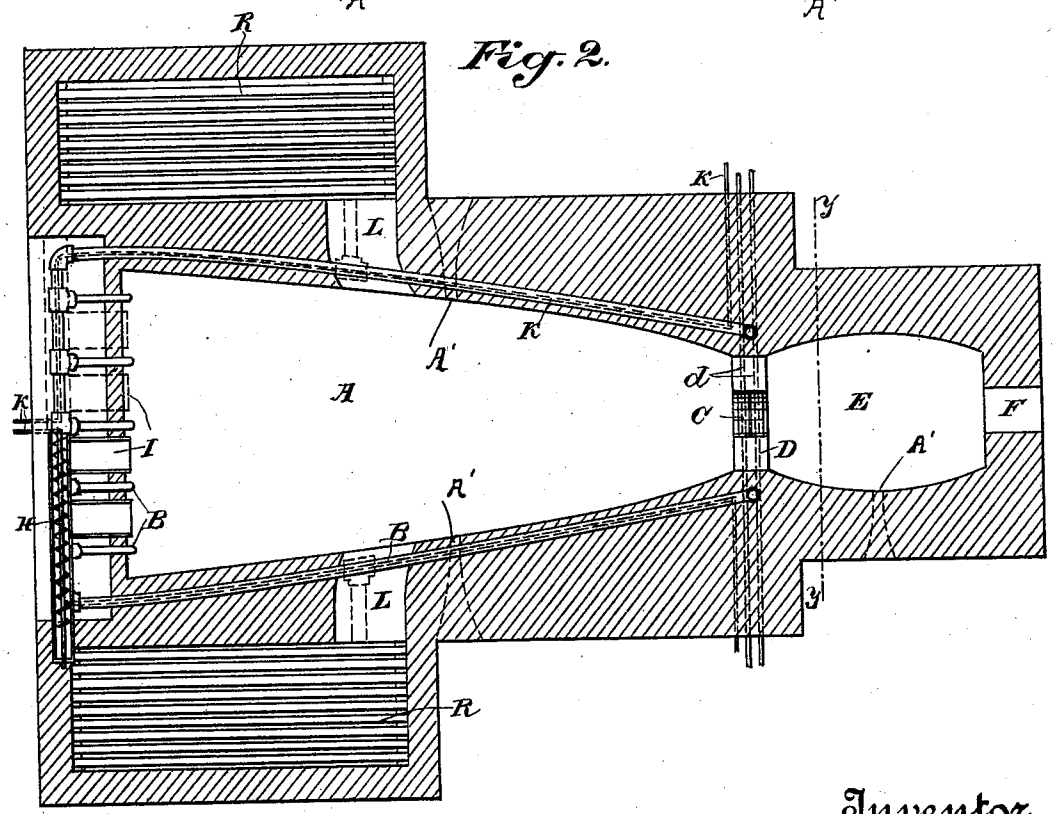



*Fig. 2.*




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(No Model.) 2 Sheets—Sheet 2.

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## REVERBERATORY SMELTING AND REFINING FURNACE.

No. 589,210. Patented Aug. 31, 1897.

*Fig. 3.*

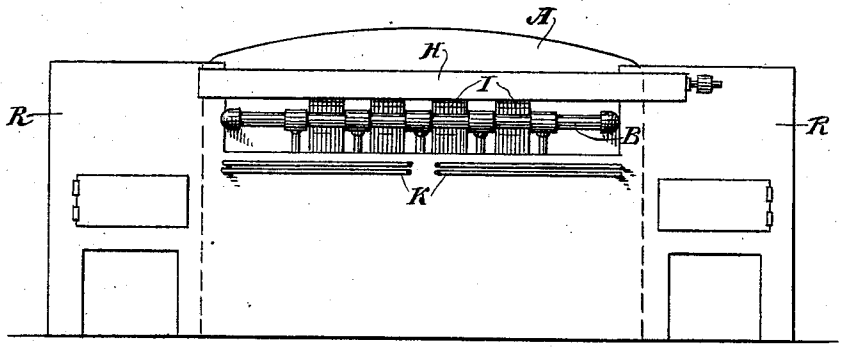



*Fig. 4.*

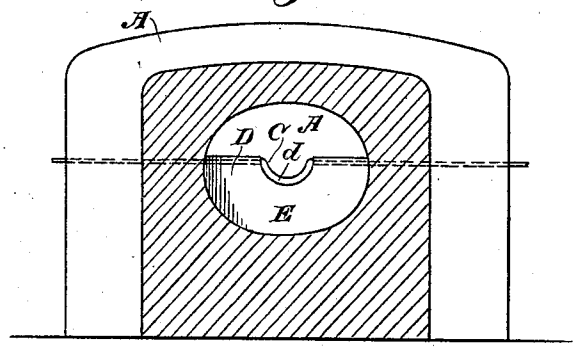
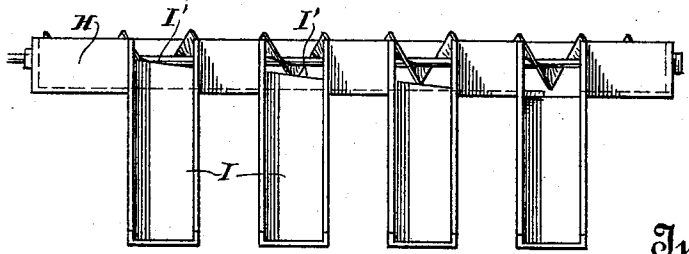



*Fig. 5.*




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# UNITED STATES PATENT OFFICE.

BENJAMIN HALL, OF NEVADA CITY, CALIFORNIA.

## REVERBERATORY SMELTING AND REFINING FURNACE.

SPECIFICATION forming part of Letters Patent No. 589,210, dated August 31, 1897.

Application filed February 17, 1897. Serial No. 623,812. (No model.)

*To all whom it may concern:*

Be it known that I, BENJAMIN HALL, a citizen of the United States, residing at Nevada City, Nevada county, State of California, have invented an Improvement in Reverberatory Smelting and Refining Furnaces; and I hereby declare the following to be a full, clear, and exact description of the same.

My invention relates to improvements in reverberatory smelting and refining furnaces which are especially useful in the treatment of pyritic ores.

It consists in the parts and the constructions and combinations of parts hereinafter described and claimed.

Figure 1 is a vertical longitudinal section of my apparatus. Fig. 2 is a horizontal section on line *x x* of Fig. 1. Fig. 3 is a view of the feed end. Fig. 4 is a section on line *y y* of Fig. 2. Fig. 5 is a view of the feed-trough.

In the working of reverberatory furnaces the ore is usually fed in charges, smelted, the slag skimmed off, another charge put in until a sufficient amount of metal or matte has accumulated, when it is tapped and drawn off. The disadvantage of this method is that the matte or metal is covered with a layer of ore or slag that cannot be penetrated by the air-blast. Therefore it is not oxidized and concentrated, and the fuel qualities of such oxidation are not utilized.

In my invention the furnace proper, A, is made in the usual or any suitable form for this class of furnace, having at the receiving end blast-pipes B and a feed device, which will be hereinafter described, and at the opposite end the furnace is contracted to a narrow discharge-opening C, having a bridge-wall D, over which the slag is constantly discharged by natural flow and by the action of the blast and is delivered into a smaller supplemental furnace-chamber E, from which the slag is finally discharged over a bridge F. The furnace may also have the usual tap-holes A′, as shown in Figs. 1 and 2.

The escape-flue or chimney G is situated at the end of the supplemental chamber E, so that the heat and products of combustion after leaving the main chamber A will pass into and through the supplemental chamber E, where the accumulated matte and slag from the main chamber are still exposed to the heat and prevented from too rapid cooling.

By means of the two successive chambers, arranged as shown, the matte which results from the smelting of the ore first sinks to the bottom of the main smelting-chamber and follows this chamber up to a level with the top of the discharge top of the wall D and the discharge-opening C. Thereafter the slag will constantly flow over into the chamber E.

The uniform level of the matte may be varied by the insertion of water-pipes *d* transversely within the wall D, and an increase or decrease of the flow of water through these pipes raises or lowers the level of the matte. The slag which is formed upon the top of the matte being in a fluid condition will flow over the wall D and constantly maintain an even level surface of the matte without being covered or buried too deeply in the slag, and the blast which was admitted through the pipes assists to carry the light slag along and discharge it and leave the matte constantly exposed to the air-blast.

The matte is drawn off from time to time from the supplemental chamber E, while the slag is allowed to pass off through the opening F. By this continued double operation, if used upon ore which might run, for instance, five per cent. of copper, the concentration would be such that the matte drawn off from either chamber A or E would run as high as fifty per cent. of copper, and from this it would be easy to convey it into a second similar furnace or refining apparatus, such apparatus having a tilting ladle or furnace in place of the feeding device herein described.

The feeding device of my furnace consists of an approximately horizontal trough H, having a rotary screw journaled to turn in it, so that the ore which is delivered to the trough at one end will be gradually advanced by this screw. This trough H extends across the end of the furnace at a sufficient height, so that the branch troughs or chutes I, leading from it, at intervals will receive the ore from the screw which is carrying it along behind the troughs, and each chute will thus be supplied with a portion of the ore which slides down into the receiving end of the fur-

nace. These chutes I are made with receiving-openings I′ from the many troughs inclining from one side to the other. This construction is better suited to distribute the ore evenly from the transverse main trough H into these chutes from one side to the other, so that it will flow down over the full width of the bottoms of the chutes. These inclined edges incline in line with each other, as shown, until the last but one terminates at the floor-level of the trough H.

The last one of the chutes I is fed by an opening in the bottom of the trough H, as shown, so that the ore will be delivered regularly from one side of the receiving end of the furnace to the other.

The angle of the blast-pipe B is such that the blast of air from these pipes does not strike the ore until it has moved a short distance away from the end of the furnace toward the center, and by the time the blast does strike it it has become heated, so that it will more readily burn, and to such an extent that it will in a way cement together and thus prevent the dissipation in the form of dust when the blast strikes it. These blast-pipes are adjustable to change the angle of any one or more of them, so that the blast strikes the ore nearer to or farther from the receiving-end, as may be desired.

A supplemental blast-pipe or oil-burner enters the upper part of the furnace, as shown at J, or above the surface of the ore and matte, and also discharges upon the mass of ore within the furnace at a point in advance of that of the blast-pipes B.

A cold blast may be employed, if preferred, or the pipes connecting with the blast-pipes B may be carried through the walls of the furnace above the level of the surface of the matte, whereby the air is heated within these pipes. A line of water-pipes K along the level of the matte keeps a certain temperature along this line which prevents the lining of the furnace from being entirely destroyed by the slag.

In some cases where a suitable hydrocarbon oil is obtainable the air-blast may be joined with oil-jets, but where this is not used I have shown a furnace K, built at one or both sides of the main furnace A and having a flue or opening at L, through which the heat and products of combustion pass into the main furnace A to assist in smelting the ore therein or to commence the work or to heat the air for the jets, the amount of sulfur in the ore being usually about sufficient for the work after it has once begun.

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

1. A horizontal reverberatory smelting-furnace having a feed mechanism at one end and a discharge at the opposite end, said feed mechanism comprising a series of chutes leading into the furnace and a feed-screw whereby the ore is delivered successively to the chutes and thence to the furnace.

2. A horizontal-hearth smelting-furnace having a series of chutes leading into one end thereof and a feed-screw whereby the ore is delivered regularly and continuously at the receiving end, a passage through which the slag is discharged at the opposite end and a blast apparatus delivering air in at the receiving end along the line of travel of the ore.

3. A horizontal-hearth reverberatory furnace having a feed-inlet and a feed-screw at one end, a discharge at the opposite end and a blast-inlet at the receiving end along the line of travel of the ore whereby the action of the draft skims the slag from the matte or metal.

4. In a horizontal-hearth reverberatory furnace, a continuous feed device comprising a series of chutes leading into the furnace and a feed-screw delivering ore successively to the chutes whereby the ore is delivered at one end of the furnace, a discharge-passage at the opposite end, the blast pipe or pipes delivering the air into the feeding end of the furnace along the line of travel of the ore, a supplemental furnace-chamber in line beyond the discharge adapted to receive the overflow of slag and matte whereby the level of the matte is approximately maintained, a chimney or stack at the outer end of the second chamber through which the products of combustion escape after acting upon the matte and slag within said chamber, and a final discharge-passage for the slag at the end of said chamber.

5. In combination with a horizontal reverberatory furnace, a mechanism for regularly feeding the ore thereto consisting of a trough extending across behind the feed end of the furnace, a screw revolving in said trough to advance the ore transversely, inclined chutes opening from the main trough and having their receiving-openings inclined from one side to the other, said chutes each receiving a supply of ore from the rotating screw and delivering it into the rear of the furnace.

6. A horizontal reverberatory furnace, a transverse trough extending across behind the receiving end of the furnace, a series of inclined chutes leading therefrom into the furnace, said chutes having partitions at the receiving ends inclined transversely so that one edge is lower than the other, and a revolving feed-screw journaled in the main transverse trough whereby the ore is carried along said trough and delivered successively to the inclined chutes and thence to the furnace.

In witness whereof I have hereunto set my hand.

BENJAMIN HALL.

Witnesses:
S. H. NOURSE,
JESSIE C. BRODIE.