W. HELBIG & R. HASENCLEVER.

Ore-Furnace.

No. 218,673. **Patented Aug. 19, 1879.**

Fig 2.

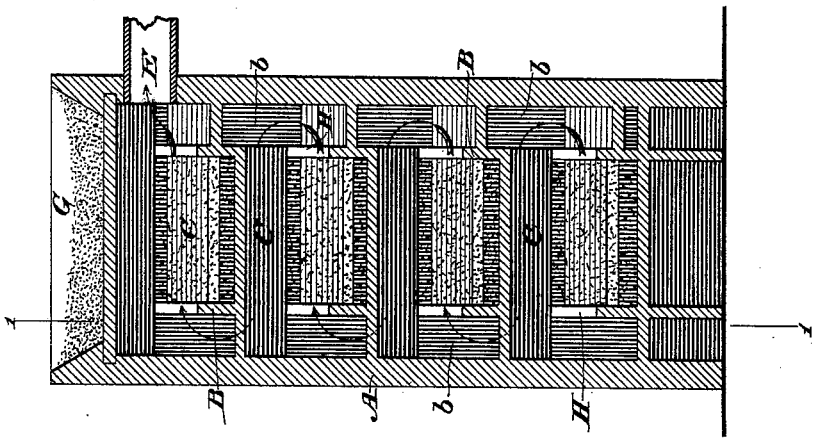


Fig 3

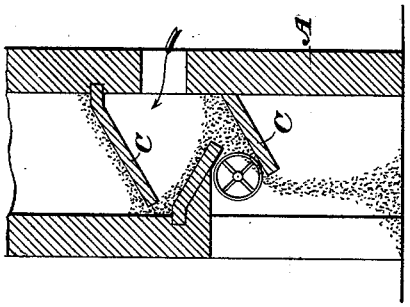
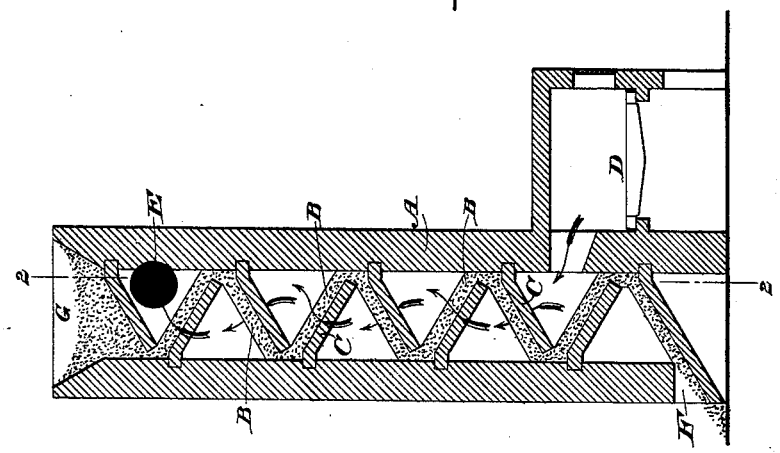


Fig 1.



WITNESSES

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UNITED STATES PATENT OFFICE.

WILLIAM HELBIG, OF AUSSIG, AUSTRIA, AND ROBERT HASENCLEVER, OF AACHEN, PRUSSIA, GERMANY, ASSIGNORS OF ONE-FOURTH THEIR RIGHT TO MARCUS S. HOPKINS, OF WASHINGTON, DISTRICT OF COLUMBIA.

IMPROVEMENT IN ORE-FURNACES.

Specification forming part of Letters Patent No. **218,673**, dated August 19, 1879; application filed May 22, 1879; patented in England, December 30, 1869.

To all whom it may concern:

Be it known that we, WILLIAM HELBIG, of Aussig, in the Empire of Austria, and ROBERT HASENCLEVER, of Aachen, in the Kingdom of Prussia and Empire of Germany, have invented a certain new and Improved Furnace for Roasting and Reducing Pulverized Ores, of which the following is a specification.

In the roasting and reduction of coarse ore in vertical-shaft furnaces it is practicable to dispense with plates, shelves, or obstructions for breaking up or subdividing the mass, because the products of combustion will readily pass into and fill the comparatively large interstices between the lumps of ore, and thus come in intimate contact with all portions of it; but in attempting to roast and reduce pulverized ores, particularly if they are very fine, it is found that if they are placed in an undivided mass in a vertical stack, in the manner of coarse ores, the products of combustion will not permeate them effectively; hence plates or shelves are provided to break up the mass, as it were, into separate parts and spread it out, and provide numerous passages for the free access of the products of combustion to the ore thus distributed into thin streams or layers, which descend in an irregular course from top to bottom with constantly shifting particles and changing surfaces. In this manner the products of combustion or reducing gases are brought in the most perfect manner in intimate contact with the fine particles of ore, and the draft and circulation are rendered even more complete than in coarse-ore furnaces, all of which is well understood by those skilled in the art.

The purpose of our improved furnace, for which we have heretofore secured English Letters Patent No. 3,769 of 1869, is to roast and reduce fine ores of all descriptions, such as pulverized pyrites, pulverized zinc ores, mercury ores, &c.

It consists of a vertical stack of masonry, provided within its interior with inclined shelves somewhat overlapping, and having an angle usually of about thirty-three degrees, but which angle may be varied at discretion.

The stack is furnished with a hopper or feed-opening at its top for the reception of the pulverized ore, which finds its way by gravity down over and between the inclined shelves to the bottom. It is also provided near its top, but below the hopper or charging-opening, with an exit for the fumes or vapors which pass out of the stack with the gaseous products of combustion. At its bottom it is provided with a fire-grate and with an exit for the roasted or reduced ore.

The mode of circulation of the products of combustion from the fire-grate is that they pass from the grate under the first shelf above the grate, then longitudinally along its under side through a flue-opening in an inner partition of the stack, which partition immediately supports the shelves at one end, thence up through another flue-opening on a higher level underneath the next shelf, across to the side of starting, and out through a similar flue-opening in a corresponding interior shelf-supporting wall, and thence on again to and fro in a zigzag course over and under the successive shelves, as indicated by the arrows, to the exit-opening.

While the provision is made as indicated for a clear and free passage of the reducing-gases through openings underneath the inclined plates, these gases will also naturally sufficiently penetrate the thin streams of descending pulverized ore, because their particles are loose and continually shifting, and new surfaces are constantly forming, and thus no part of the ore can escape contact with the gases in its passage to the bottom.

The shelves are heated by the direct under contact of the hot gases, and in turn by conduction heat the under surface of the ore resting upon them.

Our improvements in vertical-stack furnaces provided with inclined shelves for roasting pulverized ores involve all of the above-mentioned conditions of construction and of operation; and our improvements consist in the combination of elements organized as more exactly specified below, and then definitely expressed in our claim, it being conceded that, broadly speaking, vertical-stack furnaces provided with inclined overlapping shelves are

old, and the design of our invention being merely to improve that class of furnaces.

In the accompanying drawings illustrating our furnace, Figure 1 is a vertical sectional elevation through the line 1 1 of Fig. 2. Fig. 2 is a corresponding section through the line 2 2 of Fig. 1; and Fig. 3 is a section showing a wheel employed at the exit for the calcined ore.

Referring to the letters on the drawings, A indicates the body of the furnace, of masonry, which may be of any suitable size and character. B indicates the interior shelf-supporting flue-partitions of the flues *b*, and C the inclined plates or shelves, extending entirely across the interior of the stack in one direction and partly across it in the other direction, and somewhat overlapping each other.

D is the fire-grate, from which the products of combustion pass to and fro through the interior of the stack, and upward to the exit-opening E, as indicated by the arrows.

F indicates the outlet or exit for the roasted or calcined ore; and G is the hopper, represented as filled with pulverized ore, which is also indicated in the interior of the stack in about the position it occupies in the process of roasting. The exit F presents a free and unobstructed outlet for the fumes, and is sufficiently below the hopper and the body of fine ore in and immediately under it on the first shelf, (which fine ore closes the top of the stack,) so that there will be no injurious escape of the fumes through the hopper if it is kept well filled, as in practice it is and should be.

H indicates the apertures in the shelf-supporting flue-partitions, located between the shelves, but higher than their upper surfaces, in order that the fine ore may not fall out through them into the flues *b*.

It will be observed that the operation of our furnace is continuous, the removal of the calcined ore from beneath causing the descent of the stream from the hopper, and the supply of the ore to the hopper should be constantly kept up, according to the rapidity of discharge.

It will be observed, also, that, since the rapidity of discharge or removal of the ore from the bottom may be controlled at will, the roasting or reducing operation may be as slow or as rapid as desired.

We sometimes employ a wheel somewhat like an undershot water-wheel within the exit-passage at the bottom of the furnace for effecting the delivery mechanically, as illustrated in Fig. 1. This wheel may be driven by any suitable power, and its speed regulated at will, as will be readily understood by mechanics without particular description, or it may be operated by the weight of the descending stream of ore. In either case it serves to stop the lower exit-opening and prevent the injurious ingress of cold air.

When the pulverized ores to be operated in our furnace are of such a character that it is desirable to collect the evolved vapors, a suitable apparatus may be connected, by means of pipes or conveyers, to the exit-opening E to convey them to proper receptacles for treatment.

Having described our invention, what we claim as new, and desire to secure by Letters Patent, is—

The combination, in a vertical stack, of overlapping inclined shelves, apertured shelf-supporting interior partitions, side flues, *b*, a fire-grate and exit-opening below, and a feed-opening or hopper and a fume-exit above, all arranged and operating together, substantially in the manner set forth, to effect the continuous operation of reducing pulverized ores.

In testimony whereof we have hereunto subscribed our names.

WILLIAM HELBIG.
ROBERT HASENCLEVER.

Witnesses to signature of William Helbig:
OTTO SALLAR,
JULIUS STEINHAUSEN.

Witnesses to signature of Robert Hasenclever:
H. THICLE,
HEINR. BOECKING.