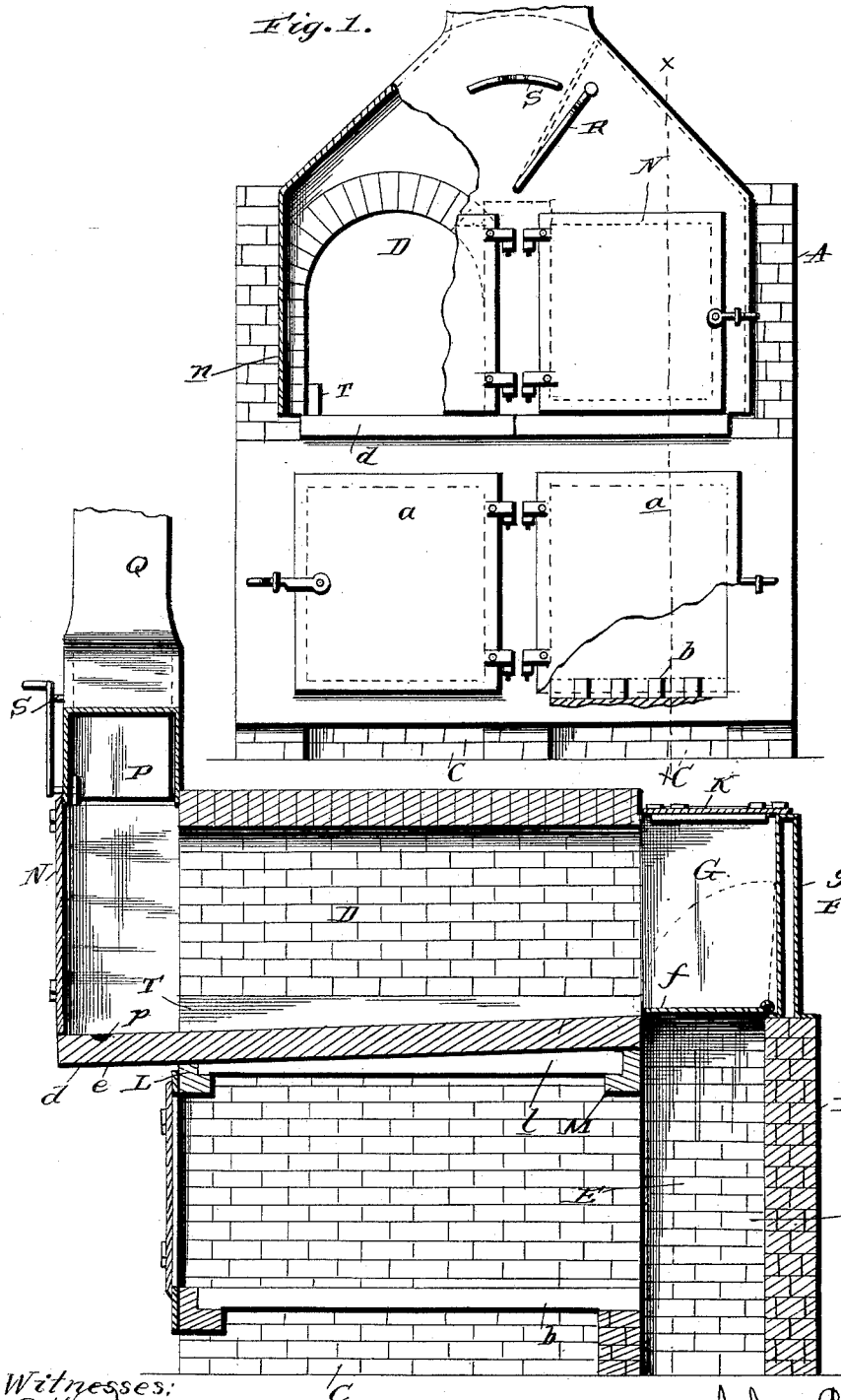
(No Model.) 2 Sheets—Sheet 1.

J. L. HOPPER.

ROASTER, SMELTER, AND SEPARATOR.

No. 462,767. Patented Nov. 10, 1891.

Fig. 1.



Witnesses:
C. H. Kaeder
P. E. Turpin

Inventor
John L. Hopper
by James J. Shuebruk
Attorney

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

(No Model.) 2 Sheets—Sheet 2.

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Fig. 3.

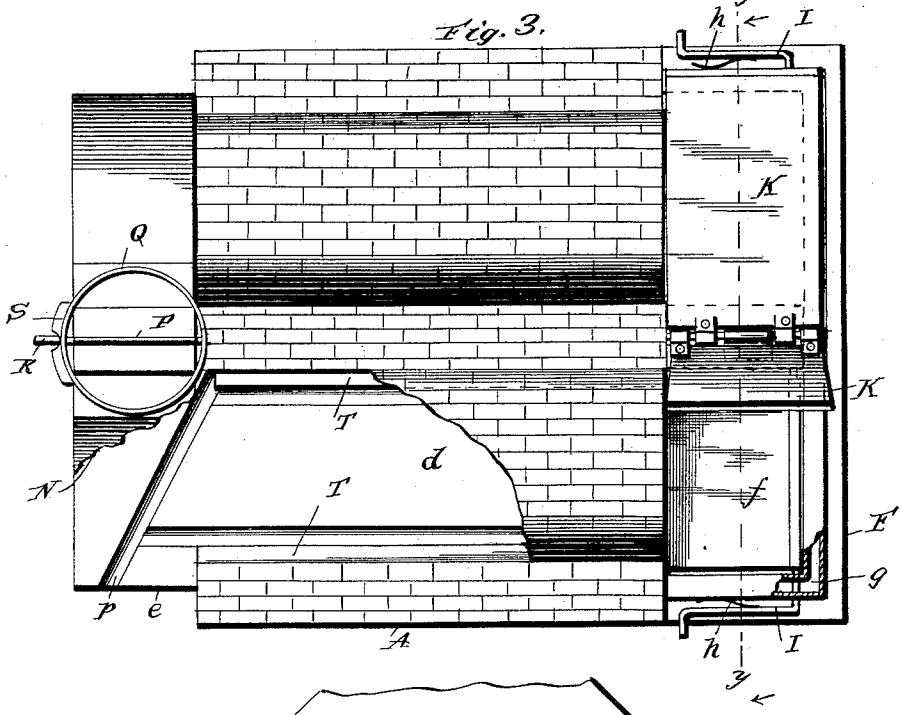
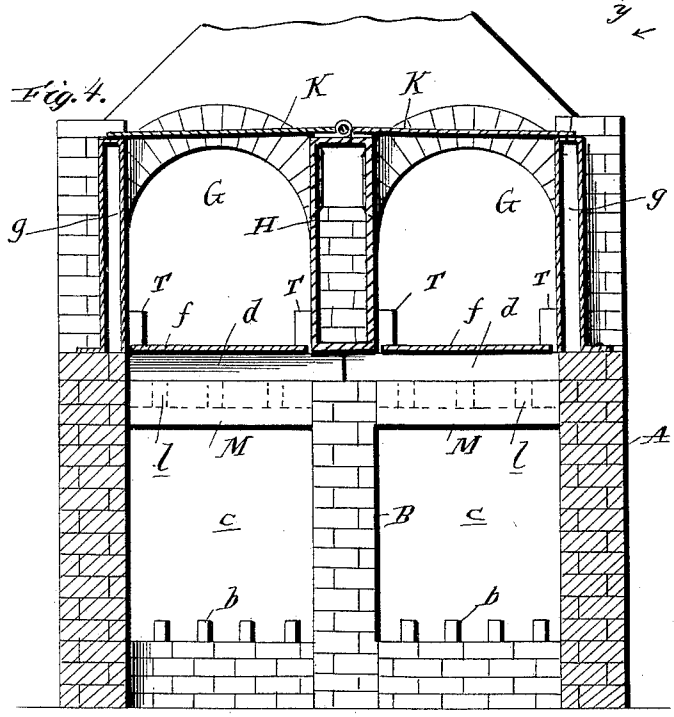


Fig. 4.



Witnesses:
C. H. Raeder
T. E. Durpin

Inventor
John L. Hopper
by James Shelby
Attorney

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

JOHN L. HOPPER, OF SARCOXIE, MISSOURI.

ROASTER, SMELTER, AND SEPARATOR.

SPECIFICATION forming part of Letters Patent No. 462,767, dated November 10, 1891.

Application filed January 30, 1891. Serial No. 379,728. (No model.)

To all whom it may concern:

Be it known that I, JOHN L. HOPPER, a citizen of the United States, residing at Sarcoxie, in the county of Jasper and State of Missouri, have invented certain new and useful Improvements in Roasters, Smelters, and Separators; and I do declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention has relation to improvements in furnaces for roasting, smelting, and separating refractory and other ores; and the novelty will be fully understood from the following description and claims, when taken in connection with the accompanying drawings, in which—

Figure 1 is a front elevation of my improved furnace, showing parts in section and parts broken away. Fig. 2 is a vertical longitudinal sectional view taken in the plane indicated by the dotted line *x x* on Fig. 1. Fig. 3 is a plan view with one of the arches or roofs of the smelting-ovens broken away and one of the doors partly raised; and Fig. 4 is a vertical transverse sectional view taken through the hot-air chamber and flue-chamber above the same, at the point indicated by dotted line *y y* on Fig. 3.

Referring by letter to said drawings, A indicates the masonry of a twin furnace. This furnace is provided with doors *a* in its front, as shown, and suitable grate-bars *b*, forming a fire-box, which may be of the ordinary or any approved construction, and these fire boxes or chambers *c* are divided by a vertical central partition-wall B, which extends from the front of the furnace to a sufficient distance rearwardly, as shown.

C indicates a cold air or draft passage formed beneath the fire-grate.

Arranged above each fire-chamber or fire-box is a roasting-oven D, provided with an arched top, as shown, and the floor of these ovens are formed with roasting-plates *d*. These plates are made of pure fire-clay and are arranged above the fire-chambers of the furnaces and pitched or inclined toward their outer ends, as better shown in Fig. 2 of the drawings. These roasting-plates, which form the roof of a furnace fire-chamber, are extended beyond the front wall of the furnaces, as shown at *e*, for a purpose which will be presently explained.

E indicates a hot-air chamber, designed to receive the smoke and particles of combustion from the furnaces. This chamber is arranged in rear of the fire-boxes and bridge-wall of the furnaces and connects both of said furnaces with the roasting-oven above. This hot-air chamber, which opens from the respective furnaces into the roasting or smelting ovens, is provided with damper plates or gates *f*. These gates or dampers are hinged or pivoted in the top of the hot-air chamber E, so that communication may be established between the furnace below and the oven above or closed, as desired.

It will be observed that the masonry in the rear of the furnace is of a less height than the side walls in front, and I arrange upon this rear wall F a chamber G, which I shall denominate a "smoke-chamber." This smoke-chamber is divided into two compartments, one for each of the roasting-ovens, which compartments are arranged, respectively, in rear of said ovens and in communication therewith. This smoke-chamber is preferably constructed of metal and has double walls, as shown at *g*, a double wall being also formed between the compartments of said chamber, as shown at H.

The dampers or gates *f* are journaled in one of the side walls of each compartment of the smoke-chamber and one of the division-walls H, and each gate or damper is provided with a handle I, which extends on the outside of the casing, so that said dampers may be opened or closed by an attendant, and these handles I are preferably provided with a flat spring *h*, designed to press against the wall of the casing, so as to hold the dampers or gates in the desired position placed by the attendant. These smoke-chambers are each covered by a door K, which are hinged to the double-walled partition H, separating said chambers, and are designed to normally close the chambers, and, consequently, the roasting-ovens, from the open atmosphere. These fall-doors K are preferably formed of a double thickness, as shown, so as to resist the action of intense heat with which they come in contact.

In operation it will be seen that the smoke

and products of combustion as they leave the fire-box of the furnace and enter the hot-air chamber E will pass to the compartments G above and are thence directed into the oven.

L indicates a cross-beam arranged in the front of the furnaces, as shown, and M indicates the bridge-wall of the furnaces, upon which bars *l* are placed and arranged longitudinally to support the roasting-plates of the smelting or roasting ovens. These roasting-plates, which are made of fire-clay, extend forwardly over the front wall of the furnaces a sufficient distance to receive beneath them suitable cars or receptacles for the metal which has been smelted, and these projected plates serve the additional function of a support for the breeching, which is built thereon. This breeching N communicates with the ovens at one end and is divided by a wall *m*, upon the top of which is a damper P, so arranged as to open and close the branched stack or smoke-pipe Q or either passage thereof, as desired. The wall separating the passages of this stack between the ovens is preferably a double wall, and the damper is provided with a handle R, which extends upon the outer side of the breeching within convenient reach of an attendant, and a ratchet plate or rack S is also provided on the outer side of the breeching, so as to hold the arm or handle of the damper in the desired position.

By reference to Fig. 1 of the drawings it will be seen that the lateral vertical walls *n* of the breeching extend slightly beyond the lateral edges of the roasting-plates, so that the metal, as it is melted, may be conducted beneath said walls and into any suitable receptacle placed or brought beneath the projected ends of said plates. These roaster-plates, which pitch toward one end, have a groove or channel with a rounded base extending along the edges of their upper sides, and these grooves or channels communicate with a transverse channel or flume *p*, leading to the side edges of said plates at the points where the walls *n* of the breeching overlap them.

T indicates ribs or flanges arranged on the upper sides of the roasting-plates and along the side walls of the ovens. These flanges or ribs are fixed to the plates by being molded thereon and burned therein, and the ribs and plates are highly glazed before burning, so as to give them a perfectly smooth surface, and thereby allow any matter which has been smelted to run freely as fast as melted and be received into clay pans or other suitable receptacles from the flumes *p*.

While I have shown and described my apparatus as having two fire-chambers or furnaces and two roasting-ovens above them, yet I do not wish to be confined to that number, as any suitable number might be employed and arranged side by side in pairs.

In operation the ore to be smelted is fed into the oven through the smoke-chambers G, the gates or dampers *f* having been previously shut down. Fuel is fed into the furnaces in the ordinary manner, and as fire is started the dampers *f* are raised, when the smoke and products of combustion leaving the furnaces will pass into the hot-air chambers E, and the heated gas from the furnaces, which is directed against the under side of the roasting-plates which form the roof of the furnaces, is also directed into the hot-air chamber, and thence through the smoke-chambers G above into the roasting-ovens. As the ore has been smelted and drawn from the ovens, the fall-doors may be raised and more ore fed in, and in order that the operation may be continuous I close but one of the dampers *f* at a time. For instance, by closing one of the dampers the smoke and particles of combustion will be directed from both furnaces into the hot-air chamber, and thence into but one of the ovens, the other having been shut off from communication with the furnace below by the closing of the damper, when by manipulating the lever or handle R in the breeching the damper P will close off the stack from communication with the oven which is being filled with ore. In this way the operation may be continued indefinitely, and while the heat from the fuel in the furnace will act upon the roasting-plates, yet the flame and particles of combustion will not be allowed to pass into the oven being filled with ore.

As the ore is smelted and the melted metal runs out in the flumes *p*, I design providing a track beneath the projected smelting-plates, so that cars may be drawn in beneath the plates containing a suitable liquid bath, so that the metal may pour into the bath directly from the ovens, and as a bath for softening and subduing refractory ore I design using the composition of salt, saltpetre, and water, as set forth and claimed in my Letters Patent No. 437,990, although with some ores clear water alone or water and salt might be used as a bath for immersing the ore which has been brought to a red heat.

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

1. A roasting, smelting, and separating furnace having two fire-chambers, in combination with a hot-air chamber connecting said fire-chambers at one end, ovens arranged above said fire-chambers and smoke-chambers separated from each other and communicating with the ovens and hot-air chamber beneath, and dampers for closing communication between the hot-air chambers and ovens, the stack, and the flues leading thereto, substantially as specified.

2. A roasting, smelting, and separating furnace having two fire-chambers, in combination with two roasting-ovens arranged above said fire-chambers, a hot-air chamber connecting the fire-chambers at one end, dampers for opening and closing communication between the fire-chambers and ovens at one end, and

a breeching arranged at the opposite ends of the ovens, a stack on the breeching, flues connecting the stack to the ovens, and a damper in the stack for closing from one of the ovens, substantially as specified.

3. A roasting, smelting, and separating furnace having two fire-chambers, in combination with a hot-air chamber arranged in the rear thereof and in communication therewith, a smoke-chamber arranged above the hot-air chamber and divided into two compartments, roasting-ovens arranged above the fire-chambers and communicating, respectively, with the compartments of the smoke-chambers, dampers arranged in the top of the hot-air chamber, so as to open and close communication between one or both of the ovens and one or both of the fire-chambers, fall-doors arranged at the tops of the respective smoke-chambers for closing the same, and a breeching arranged upon the projected ends of the smelting-plates and carrying a damper to open and close communication with one or both of the ovens, substantially as specified.

4. A roasting, smelting, and separating furnace having a smelting-plate projected at one end beyond the furnace, so as to receive beneath said plate a suitable receptacle, and the roasting-plate having a flume arranged transversely, as shown, and on the projected parts of the plates for conducting the melted metal and arranged on a pitch or incline, substantially as specified.

5. The combination, with the furnace having the two fire-chambers, of the hot-air chamber arranged at one end thereof and in communication with the fire-chambers, the smoke-chamber arranged upon the hot-air chambers and divided into two compartments by the double-walled partition and the double wall surrounding said smoke-chamber, the dampers arranged on the top of the hot-air chamber, the fall-doors arranged on the top of the smoke-chamber, the roasting-ovens communicating with the smoke-chamber and having smelting-plates arranged on a pitch or incline and projected beyond one end of the furnace, and also having flumes, and the breeching arranged on the projected portion of the roasting-plates, with its side walls projecting over the lateral edges of said plates, and a damper arranged in the breeching, substantially as specified.

6. A roasting, smelting, and separating furnace having its roasting-plates projected beyond the furnace and arranged on a pitch, and also having a flume in their upper sides, in combination with a breeching arranged on the projected portions of said plates and having its lateral walls overlapping the side edges of said roasting-plates, substantially as specified.

In testimony whereof I affix my signature in presence of two witnesses.

JOHN L. HOPPER.

Witnesses:
S. W. HOPKINS,
J. B. HOPPER.