(No Model.)

H. L. BRIDGMAN.

PROCESS OF REDUCING ORES.

No. 578,912. Patented Mar. 16, 1897.

Fig. 1.

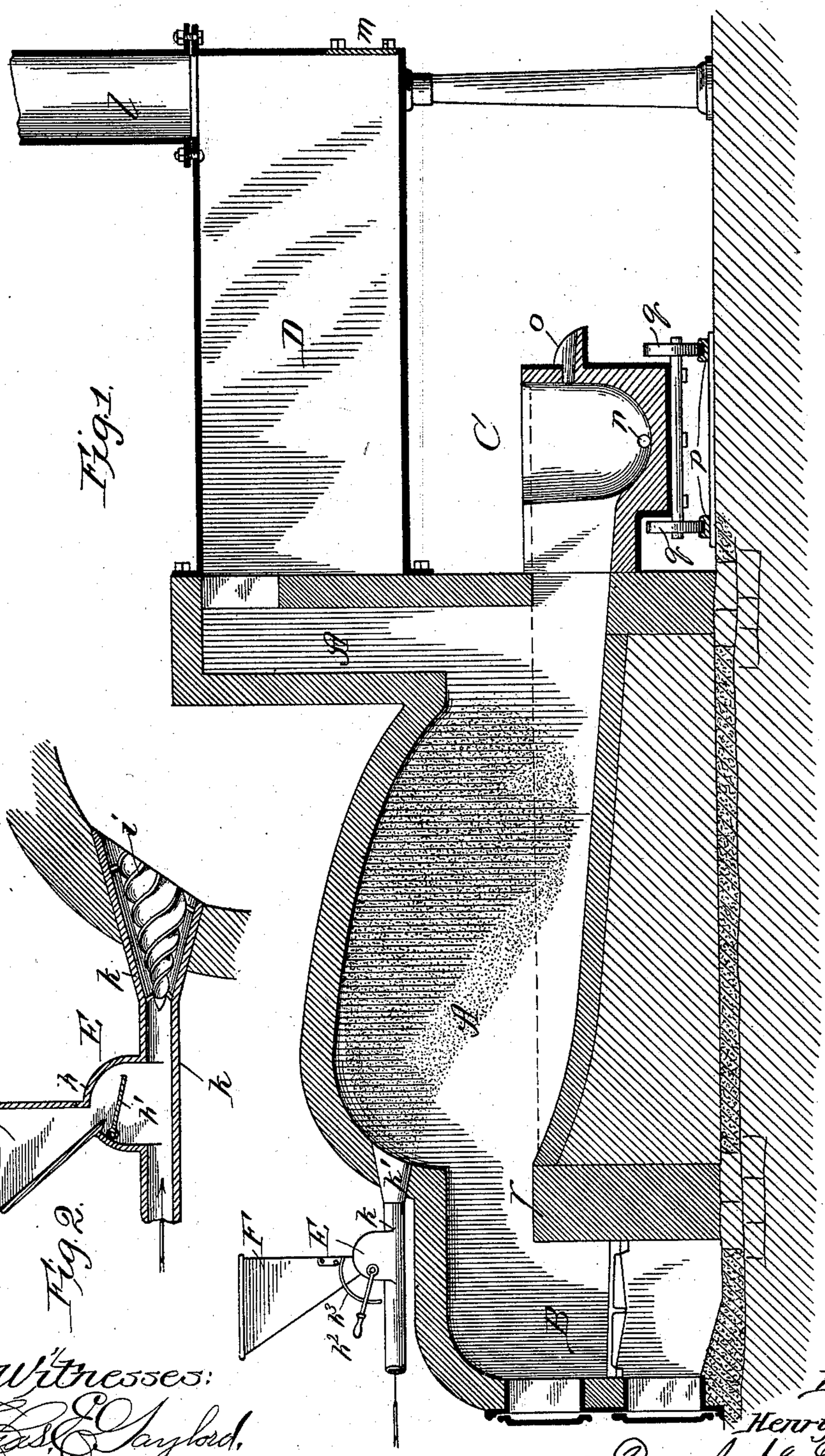

Fig. 2.

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HENRY L. BRIDGMAN, OF CHICAGO, ILLINOIS.

PROCESS OF REDUCING ORES.

SPECIFICATION forming part of Letters Patent No. 578,912, dated March 16, 1897.

Application filed May 22, 1895. Serial No. 550,243. (No specimens.)

To all whom it may concern:

Be it known that I, HENRY L. BRIDGMAN, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a new and useful Improvement in Processes of Reducing Ores, of which the following is a specification.

The primary object of my invention is to effect practically simultaneously or in frequently-recurring alternations the roasting and smelting of sulfur-bearing ores and products in a single apparatus either solely by means of the heat generated by their own combustion (oxidation) or by such heat aided, to a greater or less extent, by independent firing.

I am aware of two methods at present mainly employed for reducing such materials as are hereinbefore specified. One consists in first roasting them either in coarse condition in heaps, stalls, or kilns or in a finely-divided condition in various styles of furnaces under subjection to a greater or less extent to the heat from their own combustion, but always employing more or less extraneous fuel, and, secondly, in smelting the roasted product in a shaft or reverberatory furnace always with the use of large quantities of fuel. As the result of these two separate operations it is seldom practically possible to produce a matte of more than fifty-five per cent. to sixty per cent. in copper, and the fuel consumed to obtain this result is a very considerable item. Besides, there is a large expenditure in time required for roasting the material in a coarse condition, and there are other disadvantages which I overcome by my improvement.

The second of the two methods referred to is the so-called "pyritic" smelting, which is now being developed and promises many advantages over the first-named and older method. According to it the material is fed into the blast-furnace in lump form, being of necessity coarse, either in lumps or bricked, and by means of a heavy blast the sulfur contained in the material is used practically as the only fuel. This method is theoretically quite perfect, but it is not applicable to finely-divided or unbricked ore, presents various drawbacks to practical operation, and yields at best, so far as now known, only a relatively low-grade matte as its product.

By my improved process the material to be treated, pulverized, say, to the fineness of forty to sixty mesh, is fed as a spray of dust into the highly-heated and strongly-oxidizing atmosphere of a furnace-chamber. In its finely-divided condition it is rapidly and thoroughly oxidized in passing through this heated atmosphere on the hearth; and the heat also melts the more or less oxidized ore as it falls, giving the well-known reaction of the sulfid on the oxid.

To practice my improved process, I may employ any of various constructions of apparatus, but prefer that which is illustrated in the accompanying drawing by a view in longitudinal sectional elevation.

A is a furnace of the general reverberatory construction having its base or hearth inclined from the bridge *r*, adjacent to the fuel-chamber B, to a forehearth C, into which the furnace A discharges and which is shown to be removably supported on wheels *q*, running on a track *p*, and as provided with an overflow-spout *o* for slag and a normally-plugged base-opening *n*, through which to withdraw the molten matte.

At the discharge end of the furnace A is an upright flue A′, opening into a settling-chamber D, provided at its farther end with a door *m*, through which to remove from time to time the deposits, and with a stack *l* for the escape of gases.

The fuel-chamber B is surmounted by a spraying-feed E, which may involve any suitable construction for the pulverized material to be roasted and smelted, and which, as shown, comprises a pipe *k*, having a flaring extremity *k′* passing through the rear wall of the furnace A and containing a stationary distributer, (represented in the form of a tapering worm *i*.) At its outer end the pipe *k* communicates with a blower, (not shown,) and between its ends on its upper side near the point of entrance into the furnace it is provided with an enlargement *h*, into which a hopper F opens, the discharge from the hopper being controlled by a hinged valve *h′* in the enlargement *h*, adjustable to increase or decrease the discharge from the hopper

through the medium of a handle h^2 on a projecting end of the valve-pivot and adapted to engage with a segmental rack h^3 to sustain it in any position of its adjustment.

To start the operation, fuel is burned in the chamber B, but after the operation is well under way the heat generated from the burning sulfur in the ore may alone be depended on for the further continuance of the process. That is to say, the combustible part of the ore may furnish all the fuel needed after the furnace has been fairly started and will of course always furnish some of the fuel; but instances are possible where about ninety-five per cent. of the heat may have to be furnished from extraneous fuel. The finely-divided ore fed through the hopper F enters the pipe *k* and is blown by the air-blast through the pipe into the furnace A, wherein it is sprayed by the action of the distributer. In the furnace the ore passes through the intensely-heated atmosphere therein and is projected through the space in the furnace, which is sufficiently prolonged to allow adequate time for roasting the pulverized ore while it remains in suspension in the hot atmosphere. It is evident that in the presence of suitable fluxes, which may be supplied in the pulverized ore or in any convenient manner, a properly-fused slag will result, in which the matte (or metal) will sink to the bottom and flow into the forehearth C, from which the slag is skimmed off at the spout *o*, and the matte (or metal) may be withdrawn by removing the plug from the opening *n*. Any particles which are carried by the current with the gases into the chamber D will settle therein and may be saved. Generally with low-grade ores the slag will clear itself with sufficient rapidity to permit of continuous work. With richer material, however, it may be necessary to interrupt the feed for a short time before tapping, maintaining the heat, if necessary, by firing in the chamber B. It is further evident that dry and non-sulfurous ores may be added to such an extent as to completely utilize the heat of combustion from the iron, sulfur, &c.; also, that the rapidity of the feed will govern the quality of the product—that is to say, a very rapid feed will give a less perfect oxidation and consequently a lower grade matte, while a slow and careful feed may very easily give metallic copper from a very low-grade ore.

By my improved process I am enabled to attain by a single continuous operation at a minimum expense for apparatus, labor, and fuel results usually attainable only in three or four operations, and it is very rapid, and I believe it to present fewer difficulties than any other process now in use.

What I claim as new, and desire to secure by Letters Patent, is—

The combined process of roasting and smelting sulfur-bearing ores, which consists in finely subdividing the ore, spraying it into the upper part of the heated chamber by means of and in contact with air, whereby the sulfur is oxidized, allowing the desulfurized particles to subside upon the hearth of said chamber and effecting their reduction on said hearth, the two operations being carried on simultaneously and continuously, substantially as described.

HENRY L. BRIDGMAN.

In presence of—
M. J. FROST,
J. N. HANSON.