J. REESE.

Furnace.

No. 31,327. Patented Feb. 5, 1861.

Fig. 3

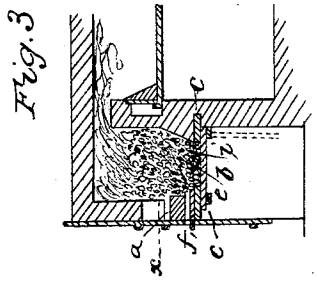


Fig. 2

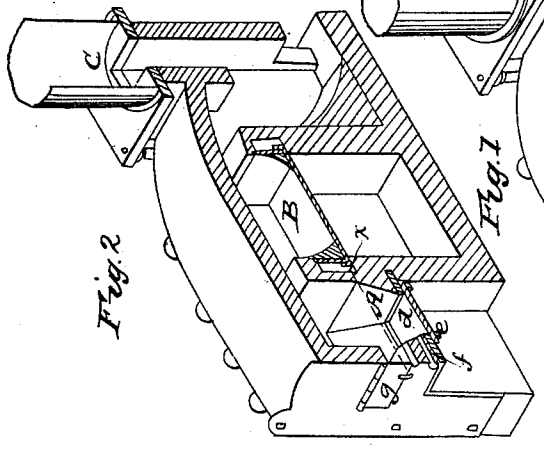
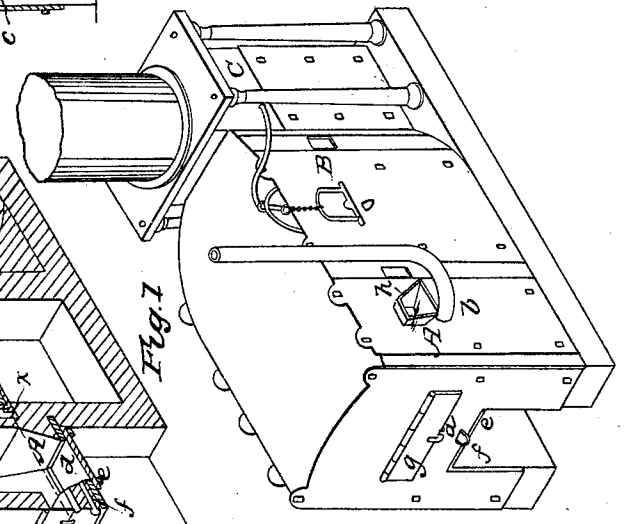


Fig. 1



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JACOB REESE, OF PITTSBURG, PENNSYLVANIA.

IMPROVEMENT IN THE CONSTRUCTION OF THE FIRE-CHAMBERS AND IN OPERATING THE FIRE OF REVERBERATORY FURNACES.

Specification forming part of Letters Patent No. **31,327**, dated February 5, 1861.

To all whom it may concern:

Be it known that I, JACOB REESE, of the city of Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in the Fire-Chambers of Furnaces for Puddling, Boiling, or Reheating Iron, in which Coal is used as a Fuel; and I do hereby declare the following to be a full, clear, and exact description thereof, reference being had to the annexed drawings, forming part of this specificalion, which represent the application of my improvement to the ordinary puddling-furnaces for the manufacture of iron.

It is well-known that coal ordinarily used for fuel contains, besides its combustible constituents, some that are incombustible, at least at the degree of heat employed in most furnaces—such as silica, alumina, and sulphate of iron. These, not being removed in the process of combustion of the coal, form into hard cakes or lumps, which are called "clinkers," which choke up the fire, settle about the grate-bars, closing up the passage of the air into the fire, thus impeding the draft and causing a great loss of heat. To obviate this difficulty it is necessary to stir the fire repeatedly in order to free the air-passages between the grate-bars, and to remove the clinker, which fills up the grate without adding to the heat of the furnace. This stirring of the fire in puddling and other furnaces is done with long iron rods, which are pushed from beneath up between the bars of the grate, the effect of which is to bend and wear out the grate-bars very rapidly, and to cause a great loss of fuel by the escape between the bars of a large quantity of partially-burned coal, which falls down with the ashes and clinker and is lost. Oftentimes the clinker accumulates so rapidly that it is necessary to remove one or more of the grate-bars from the furnace in order to get rid of it, and this increases the loss of fuel. This loss in puddling-furnaces amounts usually to at least twenty per cent. of the fuel used, and in other descriptions of furnaces to over fifteen per cent. This accumulation of clinker is owing to the fact that the incombustible but fusible portions of the coal being melted in the hottest part of the fire run down toward the openings between the grate-bars, where, being met by the current of cold air passing upward into the fire, the melted cinder is cooled and forms the clinker. The use of grate-bars or perforated plates for the bed of a furnace and the admission of the blast or draft of air through these grate-bars from below is the cause of the formation and accumulation of clinker. It is also in a great measure owing to the use of open grate-bars and the admission of the cold air through them into the furnace that so large a quantity of smoke is evolved from these furnaces. My invention is designed to remedy both these defects in puddling, boiling, and reheating furnaces where coal is consumed as fuel, by causing the cinder, instead of forming clinker, to run out of the furnace in a melted state; and also by the mode of introducing the blast or current of air to cause it to become heated before it reaches the bituminous matter on the top of the fire sufficiently to cause the combustion of the smoke. These important results I accomplish by constructing the fire-chamber of furnaces in such a manner as to prevent the entrance of the air for the support of combustion from beneath the furnace-bottom, either by dispensing with grate-bars entirely and using a closed bottom, or by closing up the space under the grate-bars; and in either case introducing the blast or current of air in any convenient way only at a point or points in the fire-chamber sufficiently above the level of the furnace-bottom or grate-bars, and constructing a hopper-shaped or contracted receptacle, of greater or less depth, below the point of entrance of the blast for the collection of the cinder in a fused state, which is allowed to run off spontaneously as it is formed and rises to the level of its exit. By this means the cinder is collected in a vitreous melted mass on the bed or bottom of the fire-chamber and forms a good protection to it, as the lower part of the cinder is comparatively cool. The coal is floated on top of the melted cinder. The blast of air entering about the level of the surface of the melted cinder is heated as it passes over this surface, and thence through the hottest and clearest part of the fire to the top of the burning mass of coal, where it is sufficiently hot to consume the smoke.

To enable others skilled in the art to construct and use my improvement, I will pro-

ceed to describe it more fully in its practical application to a puddling-furnace, referring to the accompanying drawings, in which—

Figure 1 is a perspective representation of a puddling-furnace constructed with my improvement. Fig. 2 is a longitudinal sectional perspective representation of the puddling-furnace shown in Fig. 1. Fig. 3 is a longitudinal vertical section of the fire-chamber of the puddling-furnace, showing the relative position of the sand, cinder, and fuel when the furnace is in operation.

In the several figures like letters of reference denote similar parts of the furnace.

The puddling-furnace represented in the drawings is of the ordinary construction of such furnaces as used in Western Pennsylvania, so far as relates to the hearth B, in which the iron is puddled, and the stack or chimney C. The fire-chamber A is, however, differently constructed from what is usual. As ordinarily made, it is a rectangular chamber, with parallel vertical sides and open grate-bars at bottom, which are placed a little only below the bottom of the hearth in the puddling-chamber. These grate-bars, forming the bottom of the fire-chamber, are usually about two inches wide, thirty-six inches long, and placed parallel to each other, about two or three inches apart.

My fire-chamber (see Figs. 2 and 3) is constructed, in the usual manner, above the line *x x*, (which is the usual level of the grate-bars.) Below the line *x x*, I continue the fire-chamber down of fire-brick, but gradually contracting it by sloping its sides, as seen in Figs. 2 and 3, to a convenient depth—say about fifteen inches below the line *x x*. Just below the line *x x* is a small opening, *a*, through the side or front wall of the fire-chamber, designed to allow of the outflow of the melted cinder as it forms and rises above that level. Just above the opening *a* is the aperture *b* for the blast-pipe, on either or both sides of the fire-chamber, for the admission of air to the fire. It will be better to incline this opening for the blast downward, and insert a tuyere to direct the current of air against the surface of the hot cinder, and to prevent the choking up of the blast-hole by the influx of the melted cinder. The fire-chamber may be built upon an iron plate, *c*, to which is attached a hinged iron door, *d*, which shuts up against the opening in the bottom of the fire-chamber, which opening may be about twenty-four inches square. This opening is of the full size of the bottom of the fire-chamber. The hinged door *d* is kept closed in any convenient way, as by a bar, *e*. (Seen in Figs. 2 and 3.) A few inches above the bottom plate or hinged door, *d*, is another small opening, *f*, similar to *a*, which is designed for running out the melted cinder when it is desired to clean out the fire-chamber. The hinged door *d* at bottom of the fire-chamber affords an opportunity for cleaning out the entire contents of the fire-chamber, and the door *g* in the side is for the purpose of obtaining admission when any repairs are necessary. The square opening *h* is the "stock-hole," through which the fuel is supplied to the furnace, and is kept closed by the coal.

Below the line *x x* in the fire-chamber is the receptacle for the melted cinder, the use of which and the mode of working the furnace I will no proceed to describe.

When the furnace is to be put in operation, the hinged door *d* is closed and fastened. A layer of sand, *i*, (about four inches deep,) is placed upon it inside the furnace, extending up to the bottom of the opening *f*. This opening *f* is kept closed while the furnace is at work. The upper opening, *a*, is left open. The sand forms a protection to the hinged door or bed-plate *d*, so that it will not burn out. On this layer of sand the fire is built, and the blast is turned on through the tuyere or opening *b*. When the fire is well lighted, some hammer-slag or oxide of iron, or other suitable flux, is thrown on the coals, which is repeated from time to time. This melts and runs down into the bosh or receptacle below the line *x x*. This oxide of iron serves as a flux to melt the substances in the coal which form the cinder—such as silica, sulphate of iron, &c.—and they also run down into the bosh. As the melted cinder thus forms in the bosh, the fuel rises (being of less specific gravity) until the bosh is full of melted cinder to the bottom of the opening *a*, when the fuel and cinder occupy their proper relative positions. The cinder, as it accumulates, runs out spontaneously through the opening *a*, and the melted cinder serves to keep the lower part of the fire fully ignited and red-hot. The blast of air entering through the tuyere at *b* strikes the surface of the melted cinder, and is heated, rises up through the hottest of the fire, and, uniting with the smoke at the top of the fuel, causes its combustion, thus effecting a great saving of fuel and increase of heat. This is manifest in practice, from the fact that while puddling-furnaces of ordinary construction emit large volumes of smoke when in operation, a furnace constructed with my improvement scarcely gives off any smoke, excepting at the moment when the stock-hole is opened to add fresh fuel, and the smoke thus caused ceases as soon as the stock-hole is again closed. Another great advantage of admitting the air in the manner described is that the oxygen, being consumed on uniting with the carbon, does not pass over into the puddling-chamber, as it usually does in puddling-furnaces of ordinary construction when it mingles with the iron ore and scrap-iron used for "fixing," and causes a great waste by the formation of oxide of iron, so that my improvement effects a saving of the cost of one-half of the fixing in a puddling-furnace.

My improvement is applicable not only to puddling and boiling furnaces, as described, but also to furnaces for reheating iron.

The use of the oxide of iron or any other flux is not essential, as the cinder will melt

down and run off in my furnace without employing it, but not so readily. Neither is it absolutely necessary to retain the melted cinder in any quantity in the bottom or bosh of the fire-chamber; but it may, if preferred, be allowed to run off as rapidly as it accumulates. This may be effected by diminishing the depth of the bosh or the distance between the bottom of the fire-chamber and the point of exit of the cinder, either by filling up the bosh with sand or building it with a very shallow bosh.

Having thus described my improvement in the fire-chamber of coal-burning furnaces for puddling, boiling, or reheating iron, what I claim as my invention, and desire to secure by Letters Patent, is—

1. Constructing the fire-chamber of reverberatory furnaces for puddling, boiling, or reheating iron, in which coal is used as fuel, so as to form at its base a contracted receptacle for the accumulation of the melted cinder below the point where the blast of air is admitted, in combination with a close air-tight fire-chamber bottom, for the purpose of freeing the fuel of its incombustible particles by keeping the cinder in a melted state so long as it remains in the fire-chamber, and thus preventing the formation of clinker, as described.

2. Fluxing the clinker in the fire-chamber of a puddling, boiling, or reheating furnace constructed as above described by means of the introduction with the fuel into the fire-chamber of oxide of iron or other suitable flux, for the purpose of keeping the clinker in a state of fusion so long as it remains in the fire-chamber bottom, so as to enable it to run off spontaneously as it accumulates, in the manner hereinbefore set forth.

3. In the fire-chamber of puddling, boiling, or reheating furnaces constructed as above described, introducing the blast near the surface of the melted cinder, so as to heat the blast before it ascends through the mass of fuel in the fire-chamber, and thus increase the intensity of combustion and consume the smoke, as set forth.

In testimony whereof I, the said JACOB REESE, have hereunto set my hand.

JACOB REESE.

Witnesses:
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