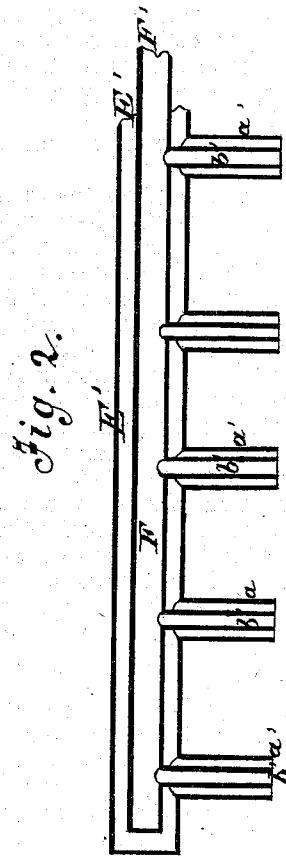
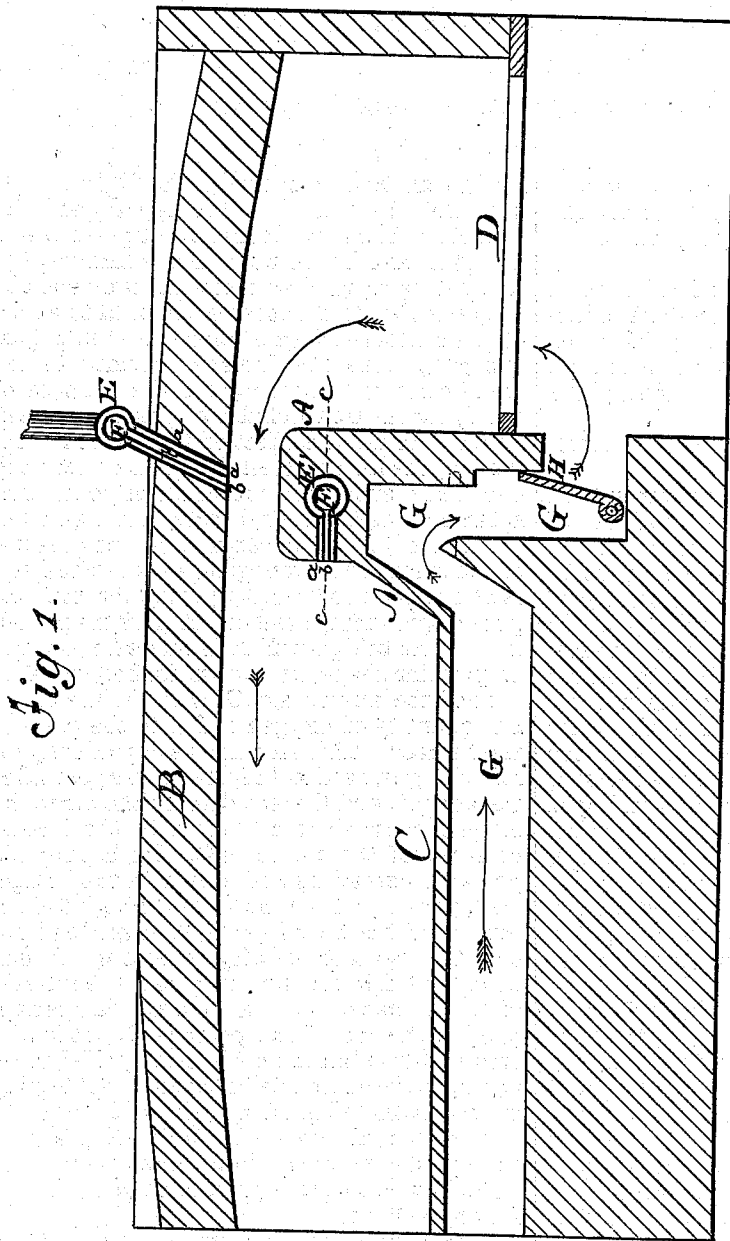


G. E. HARDING.

Improvement in Puddling-Furnaces.

No. 130,044.

Patented July 30, 1872.



Witnesses:

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GEORGE EDWARD HARDING, OF NEW YORK, N. Y.

IMPROVEMENT IN PUDDLING-FURNACES.

Specification forming part of Letters Patent No. 130,044, dated July 30, 1872.

Specification describing a new and Improved Puddling-Furnace, invented by GEORGE EDWARD HARDING, of the city, county, and State of New York.

Figure 1 is a vertical longitudinal section of my improved puddling-furnace for producing iron direct from the ore. Fig. 2 is a detail transverse section of the double pipe used thereon, the line *c c*, Fig. 1, indicating the plane of section.

Similar letters of reference indicate corresponding parts.

This invention relates to improvements in puddling-furnaces, whereby the puddling of iron from the ore direct is facilitated, and a better material produced at less cost than in ordinary puddling-furnaces for the same purpose. The invention consists principally in the arrangement above, and in the furnace-bridge of double pipes, for conducting heated air or cyanogen or nitrogenous gases and superheated steam to the metal or to the flame that reaches the metal, thereby aiding in the purification of the metal and in the removal or transformation of the carbonic-acid gas. The invention also consists in a new arrangement of a hollow bridge and air-passage, which furnishes a gradually-contracting air-passage throughout its length; and in improvements in the process of puddling iron made direct from the ore, as hereinafter more fully described.

A in the drawing represents the bridge; B, the crown or top of the furnace; C, the bed; D, the grate of the same. A pipe, E, having several branches, *a a*, that enter the crown of the furnace over the bridge-wall, extends transversely above the same. Within this pipe E is another pipe, F, from which branches *b b* extend into the furnace within the branches *a*. One of these pipes with its branches serves to conduct steam into the furnace, the other heated air under proper pressure. By admitting steam and air in the manner shown, they mingle with the gases which are produced in the furnace, and, adding oxygen thereto, transform the carbonic-acid gas into carbonic oxide, while the hydrogen of the steam combines with the impurities, such as sulphur, phosphorus, &c., of the iron. In place of only having the pipes E F above the bridge-wall, they are to be similarly arranged within the

bridge, as is also shown at E' F' in Fig. 1, with their branches *a' b'* leading toward the puddling-chamber. Both sets of pipes E and F and E' and F' are used on one furnace, the first set being used at first with steam and air, as stated, while the other set is used to admit steam combined with cyanogen and nitrogenous gases into the furnace previous to the iron "coming to nature," for the purpose of purifying the iron and also of producing steel. In order to aid the effect of the gases in converting the iron to steel, I put the necessary chemicals, such as ferrocyanide of potassium, sal ammoniac, or others, directly into the molten iron in the furnace, in conjunction with the use of the steam and cyanogen-gas, when the iron is at or near the "boiling-point," for the purpose of producing steel direct from the molten iron. The bridge-wall A is made hollow and of peculiar shape, as shown, its hollow being part of the air-passage G, wherein the requisite quantity of oxygen is fed to the grate of the furnace. This air-passage is gradually diminishing in section the nearer it approaches the ash-pit, and thereby detains the air in the longest convenient contact with the heated surfaces of the passages G. By having the passages extend up and down in the bridge-wall, passing all the air twice through the extension of the hearth-plate, it is made to absorb the greatest quantity of heat which can be extended in its direction from the interior of the furnace. H is a pivoted damper applied at the end of the passage G. It is pivoted so that if an index-hand is applied to its arbor, on the outer side of the furnace, to play over a graduated quadrant, the position of the damper can always be known with great accuracy. Heretofore such dampers were made to slide, and consequently apt to be moved in too far or too little.

I am aware that the application of steam alone over the bridge-wall is not new; but the introduction of steam alone cools the flame to an injurious extent; to be beneficial it must be combined with heated air or chemical gases. Use of hydrocarbonaceous gases disclaimed.

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

1. The application, in a reverberatory furnace designed to produce iron or steel direct

from the ores, of a jet of superheated steam combined with heated air driven under pressure through concentric pipes, as shown, and located directly or nearly over the bridge-wall.

2. The steam and nitrogenous-gas pipes E' F, having the concentric branches *a' b'*, and applied to the bridge-wall of a furnace, as above, in combination with the pipes E F above the bridge-wall, using steam and air, as shown and described.

3. The combination of the pipes E F and their branches *a b* with the pipes E' F' and their branches *a' b'* in one furnace, designed, as above specified, for producing steel direct from the ore.

4. The process herein described, by apply-

ing the requisite chemicals bodily and in gaseous form to the molten iron at the same time in a reverberatory furnace, as above, in order to produce steel, as set forth.

5. The air-passage G in a reverberatory furnace where all the air is forced through the bridge-wall, as shown, and made to be gradually contracting from the cold-air entrance to the ash-pit, as specified.

6. The damper H, pivoted in the air-passage G of a puddling-furnace, substantially as and for the purpose herein shown and described.

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