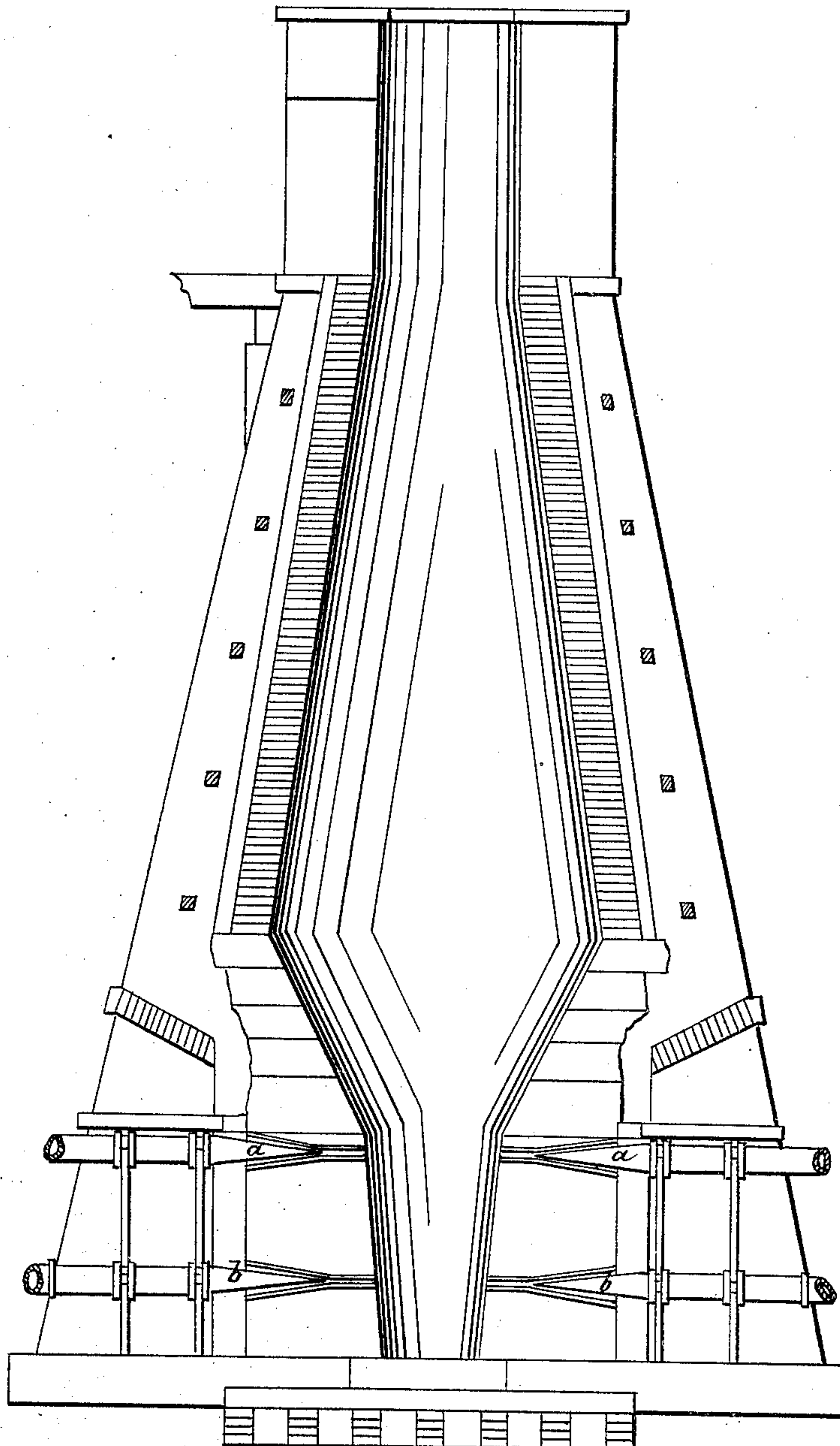


H. BESSEMER.

Blast Furnace.

No. 16,083.

Patented Nov. 18, 1856.



# UNITED STATES PATENT OFFICE.

HENRY BESSEMER, OF LONDON, ENGLAND.

## IMPROVEMENT IN SMELTING IRON ORE.

Specification forming part of Letters Patent No. 16,082, dated November 18, 1856.

*To all whom it may concern:*

Be it known that I, HENRY BESSEMER, of Queen Street Place, New Cannon Street, in the city of London, civil engineer, a subject of Her Majesty the Queen of Great Britain, have invented or discovered new and useful Improvements in the Manufacture of Iron; and I, the said HENRY BESSEMER, do hereby declare the nature of the said invention and in what manner the same is to be performed to be particularly described and ascertained in and by the following statement thereof, and the drawing accompanying the same.

My invention consists in obtaining metallic iron in a more or less pure state direct, and without carbonaceous fuel, from carbonaceous iron ores, or from mixtures of carbonaceous ores with oxides of iron, by the application to such ores and to the metal resulting therefrom of a blast or current of hot or cold air, or of steam, or of other gaseous matter containing or capable of evolving oxygen, by forcing such air or matters below the surface of and into and among the particles of the fluid metal after it has been separated from the ore, and also between and among the lumps or pieces of iron ore, and thereby causing the oxygen of the atmospheric air, or rather gaseous matter, to unite with the carbon contained in the ore and in the fluid metal, and produce combustion and the caloric on which I depend for the smelting of the said ores.

This my invention may be carried into practical operation in several forms or modifications of furnaces or apparatus with more or less advantage. It will be found that the ordinary cupola-furnace—such as is commonly used by iron-founders for the remelting of pig-iron—may be used for the purposes of this invention. I, however, prefer that the interior form of the furnace should resemble the blast-furnaces in common use; but that it should be considerably less in size. In constructing such a furnace I insert in the sides of the lower part of the hearth, and within a few inches of the lowest part of the interior of the said furnace, four or more fire-bricks, having a hole or passage running through them in a horizontal direction. Into the outer end of these passages the nozzles of the blast-pipes are inserted, so that the perforated fire-bricks serve as tuyeres through which the air

or other gaseous matters are forced into the fluid iron. The furnace is also to be provided with a tap-hole, for running out the fluid metal or any part thereof, and also with a means of escape for the cinder or liquid scoria, as is provided in the ordinary blast-furnace. There may also be two or more tuyere-pipes, as ordinarily arranged in blast-furnaces, for the introduction of blast among the lumps or pieces of ore above the surface of the fluid metal. The blast introduced by the upper tuyeres, *a a*, (see the drawing, which denotes a vertical section of the blast-furnaces,) may be used at a pressure of two or three pounds to the square inch; but it will be necessary that the blast introduced into the lower tuyeres, *b b*, should be compressed with a greater force and be sufficient to keep the fluid metal from running into the passages formed in the fire-bricks before named; and here I would observe that the perforated bricks should be so put into the side walls of the hearth as to admit readily of their removal and renewal from time to time as they become worn out. A ready way of doing this is to form in the side walls of the hearth tapering openings, smallest at the inner end. The perforated brick or tuyere can be thus readily inserted in its place, and the space round about it be well rammed with loam, which will render it sufficiently secure.

The furnace having been thus rendered suitable for the purposes of my invention, I first commence operations by lighting a coke-fire therein, so as to dry the furnace and heat the interior thereof, for which purpose I force in air through the lower tuyeres, so as to keep up a thorough combustion of the fuel, which I continue until the whole of it is consumed. I then introduce into the furnace and upon its hearth a charge of molten crude iron obtained by remelting pig-iron in a common cupola-furnace or otherwise. The blast of air or other gaseous matter will be divided into numerous globules, which will pass upward through the fluid metal and produce a vivid combustion of the carbon contained therein and of a small portion of the metal itself, and thus develop an exceedingly high temperature. The workman will then introduce into the top of the furnace some rich carbonaceous ore, which I prefer to be previously roasted, such opera-



tion not depriving the ore of its constituent carbon, and to be introduced into the blast-furnace while still in a heated state. The process of forcing in oxygen being in the meantime kept up, it will be found that the iron ore will be smelted, and will thus add to the quantity of fluid metal, which may be run off from the furnace from time to time, as desired. The heat given off by the combustion which is going on below will act upon the mass of ore accumulated in the upper part of the furnace, so that by the time it reaches the lower part or boshes it will have become highly heated and will be readily acted upon by the blast of air or other gaseous matter containing oxygen introduced by the upper set of tuyeres, and be thus brought into a state of fusion, the carbon of the ore uniting with the oxygen of the blast, and thus adding to the temperature of the furnace, the fluid metallic product sinking down into the hearth, and the cinder or slag running off at a higher level in the same manner as in ordinary blast-furnaces. Fluxes such as are commonly used in the smelting of iron-ores of the particular kind under operation may be added to the charge as it is put into the furnace; but a much smaller quantity will be required, in consequence of the fluid cinder being carried upward by the blast, and thus made to exert its solvent properties on the descending charge of ore after the furnace has once got into working order. The ore may be used raw, or it may be roasted by the waste heat of the blast-furnace, or in any other convenient way. The quality of the metal thus obtained will depend much on the quantity of air forced into it and upon the time allowed between each tapping of the furnace, from which it may be run into pigs, ingots, or other forms in suitable molds, or it may be allowed to flow from

the blast-furnace into any other form of furnace or apparatus, and be there refined, puddled, or otherwise treated; but I prefer that the fluid iron should be run into a suitable vessel or apparatus and be converted into steel or into malleable iron by streams of air, steam, or other gases capable of giving off oxygen in the manner described in the specification of my application for a patent for converting cast-iron into steel or malleable iron.

I desire it to be understood that I am aware that it has been heretofore proposed to force into blast-furnaces carbonaceous gases or solid carbonaceous substances with the blast for the purpose of adding to the effect of the fuel otherwise supplied to such furnaces, or for the purpose of assisting in the reduction of ores containing oxide of iron, and I mention this fact in order that it may be fully understood that I lay no claim thereto; nor do I confine myself to any particular form of furnace or apparatus for carrying into practical operation my said invention, provided that the peculiar features thereof be retained; but

What I do claim is—

The above-described new process of obtaining iron from a charge of ore in a furnace—viz., by means of molten iron underlying such charge, and by air, oxygen, steam, or a gas containing oxygen forced into the molten iron to such extent as to effect the reduction of the charge or the abstraction of the metal therefrom without the employment of ordinary carbonaceous fuel.

HENRY BESSEMER.

Witnesses:

JNO. ALCOCK,  
*Lincoln's Inn, London.*

THOS. BROWN,  
*2 George Yard, Lombard St., London.*