

2 Plates-Plate I.

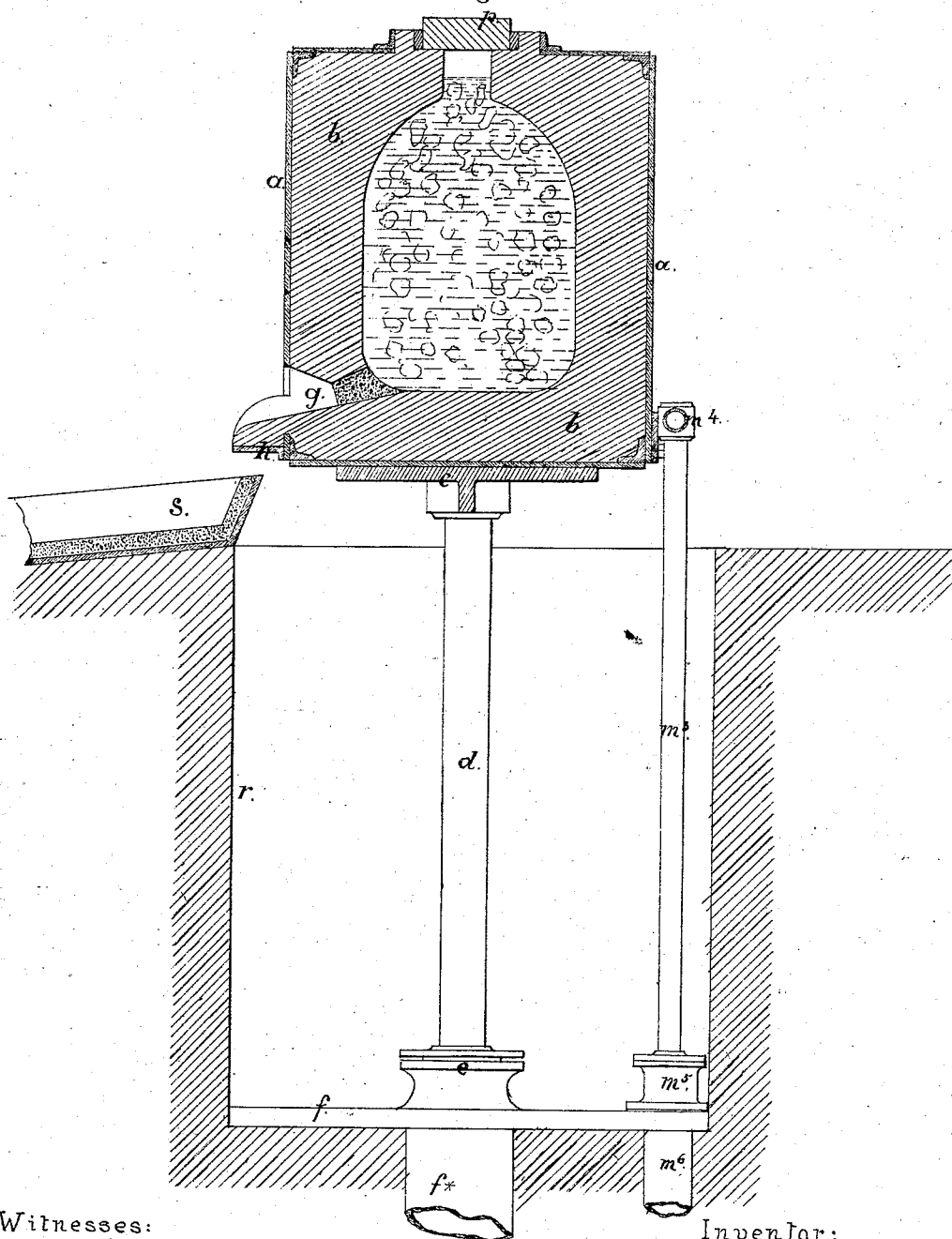
IMPROVEMENTS IN THE TREATMENT
OF CRUDE AND PIG IRON ETC.

INVENTOR: HENRY BESSEMER

117507

PATENTED AUG 1 1871

Fig. 1.



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Fig. 2.

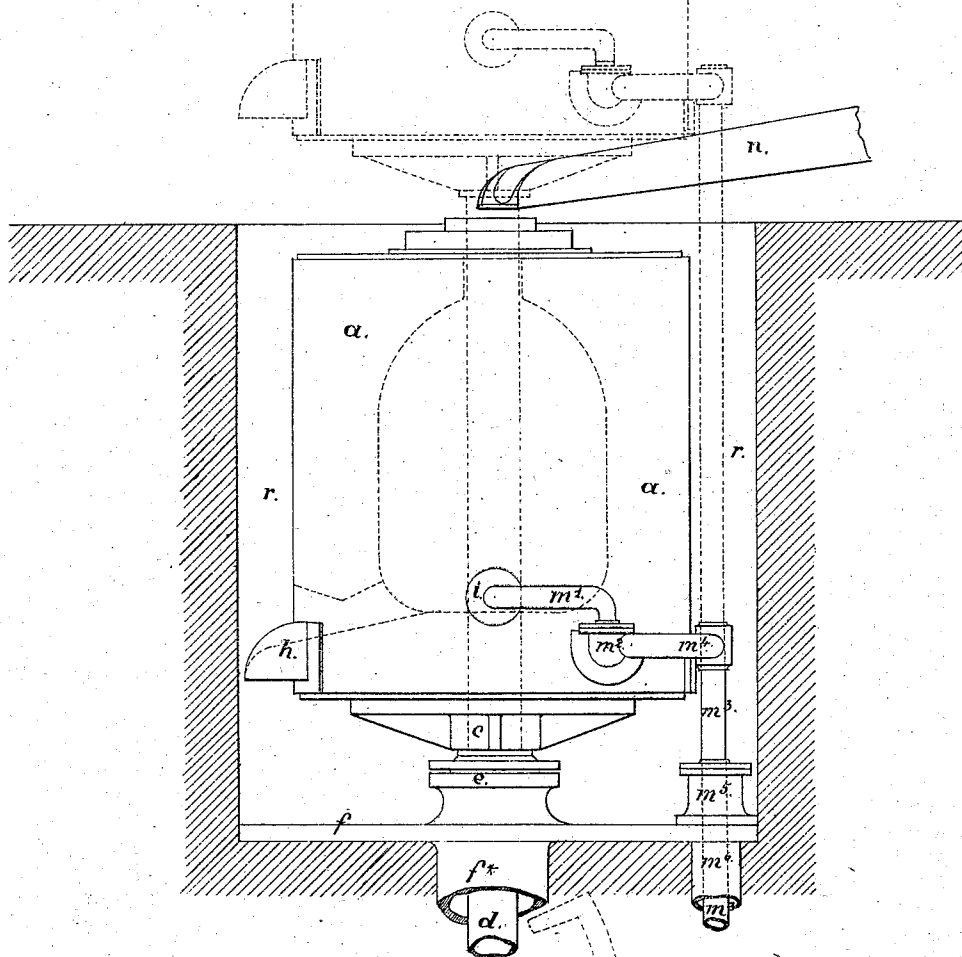
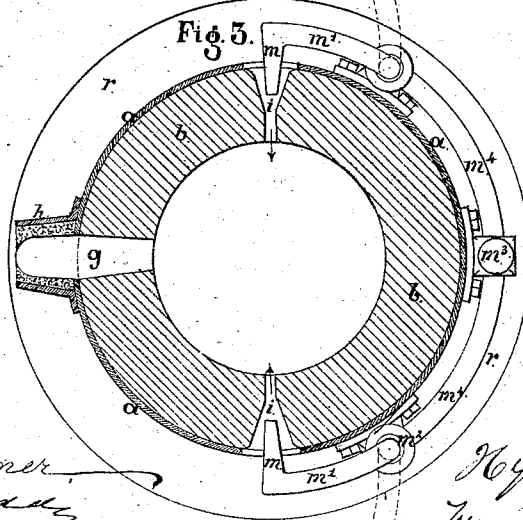


Fig. 3.



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UNITED STATES PATENT OFFICE.

HENRY BESSEMER, OF LONDON, ENGLAND.

IMPROVEMENT IN PROCESSES AND APPARATUS FOR THE TREATMENT OF CRUDE OR PIG-IRONS.

Specification forming part of Letters Patent No. 117,507, dated August 1, 1871.

To all whom it may concern:

Be it known that I, HENRY BESSEMER, of Queen Street Place, Cannon street, in the city of London, a subject of the Queen of Great Britain, have invented or discovered a new and useful improvement in the treatment of crude or pig-iron and other carburets of iron, and in the apparatus employed for such purposes; 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—that is to say:

My invention consists of a method or methods of carburizing molten pig-iron after it leaves the blast-furnace and prior to its solidification, and also the further carburization of molten scrap or other wrought or malleable or puddled iron or steel that has been fused in high-pressure furnaces, (as described in the specification of a patent granted to me in England on the 10th day of November, 1868, and numbered 3,419,) or by other means, and which treatment may also be made to, in part, purify the iron of sulphur or other deleterious matters simultaneously with the carburizing process.

In carrying my invention into practical operation I construct a vessel of plate-iron, which I line with fire-bricks or other refractory slow conductor of heat. I make the vessel, by preference, in the form of an upright cylinder. The interior of the lining may be made more or less in the shape of an inverted air-balloon; the lining may be from one and a half to two feet in thickness, and of an internal capacity, by preference, of one hundred cubic feet at the least. I mount this vessel on the table of a hydrostatic ram or plunger having a range about equal to the external height of the vessel, at the upper part of which I make an opening, say, of one foot in diameter, and at the lower part I form a tap-hole similar to the tap-holes of cupola melting-furnaces. I also provide other openings for the insertion of tuyeres, so that the vessel may be filled with coke or other fuel and the fire urged by a blast of air through the tuyeres until the whole mass of the fuel is brought into a state of vivid ignition and the massive lining of the vessel intensely heated on its interior surface and more or less throughout its entire thickness. I also make a sort of shallow pit at a convenient dis-

tance from the blast furnace, and I fit the hydrostatic apparatus into this pit in such a manner that, when the ram sinks down with the vessel, the upper part of the latter will be in such a position that a stream of fluid iron from the blast-furnace may, by means of a gutter, be run therein, the stroke of the ram being such that on the rising up of the vessel the tap-hole, situated in the lower part of the vessel, will rise high enough to allow the metal to be run from it into the "pig-bed," as usual. The blast-pipes may be made to slide telescopically so as to admit of this motion. The rising and lowering of the ram may be effected by suitable pumps arranged in a similar manner to that adopted for the rising and lowering of casting-crane used in the Bessemer process, or a single hand-pump may be employed to raise the vessel.

And in order that the construction and mode of working such apparatus for carburizing or further carburizing molten iron may be fully understood, I have hereunto annexed a drawing, on which an apparatus for this purpose is shown in vertical section at Figure 1, in elevation, and by dots in Fig. 2, and in horizontal section at Fig. 3, in each of which figures the same letters of reference are used to indicate each particular part where it is repeated.

a represents the outer metal shell of the carburizing-vessel, formed of stout riveted plate-iron lined internally with fire-bricks, ganister, or other suitable slow conductor of heat, as shown at *b*, the lining being of considerable thickness in order the better to retain the heat of the metal under operation for several hours. *c* is the table of a hydraulic ram, *d*, which passes through a stuffing-box or leather ring at *e*, for the purpose of keeping a water-tight joint, as is well understood. *f* is a large flanged plate formed at the upper part of a hydraulic cylinder, *f**, shown broken off, and into which cylinder the ram *d* works freely, rising by the pressure of water within the cylinder *f** and sinking down by its own gravity whenever the water is allowed to flow out by a valve under the control of the workmen. The flanged plate *f* is supported on masonry forming the bottom of a pit or well, *r*, into which the vessel may be lowered, as shown in Fig. 2. The vessel is provided with a tapping-hole, *g*, and spout *h*, through which the metal is drawn off at the end of the process, falling into

the gutter *s*, by which it is conveyed to the pig-bed or where else it may be required. There are also two similar openings, *i i*, (best seen in Fig. 3,) into which the nozzles *m* of the blast-pipe *m*¹ are inserted. The blast-pipes *m*¹ are movable in stuffing-boxes *m*² formed on short pieces of pipe attached by flanges to the vessel *a*. The upper end of the blast-pipe *m*³ is provided with branches *m*⁴ which communicate with the stuffing-boxes *m*² and pipes *m*¹, which are free to swing round in the stuffing-boxes *m*², as shown by dots, and be thus withdrawn from the openings *i i* in order that these openings may be closed with a plug of loam in a similar manner to the closing up of the tap-holes of ordinary cupola-furnaces. In order to admit of the motion of the vessel *a* upward and downward the pipe *m*³ is made to slide through a stuffing-box, *m*⁵, formed at the upper end of the main blast-pipe *m*⁶, which is of sufficient internal diameter and length to receive the pipe *m*³ when the vessel *a* is lowered.

When such an apparatus is employed to further carburize the molten iron from the blast-furnace, or to carburize remelted pig-iron from a cupola or other melting-furnace, a fire is first made in the interior of the vessel for several hours, a powerful blast of air through the nozzles being employed to bring the whole body of coke or other fuel into a state of intense combustion, the vessel being filled as completely with fuel as possible, excepting the spaces necessarily left between the lumps or pieces. The nozzles are then withdrawn and the holes *i i* closed with loam. The tap-hole, which during the heating up of the vessel serves as an escape for any slags that are formed, is also securely closed; a gutter, *n*, is then moved over the mouth of the vessel, as shown in Fig. 2, and as much fluid iron is run in as will fill up all the interstices left between the lumps of fuel; a fire-tile, *p*, is then covered over the mouth of the vessel, and some sand thrown around the joint to prevent as far as possible the escape of heat. When a full cast from the blast-furnace, of about twelve to sixteen tons, is so inclosed within the highly-heated vessel it will retain its fluidity for eight or ten hours, and may then be discharged from the vessel by simply raising the ram *d* and vessel *a* into the position shown in Fig. 1, and opening the tap-hole *g*, which will allow the carburized metal to flow into the gutter *s*, and from thence into the pig-bed or into the Bessemer converter, if intended for direct conversion into iron or steel. It will be understood that the exclusion of atmospheric air during this process of fluid cementation prevents the loss or destruction of the fuel, except so much thereof as is absorbed or taken up by the iron, so that the renewal of a small quantity of coke or other fuel, and a few minutes, use of the blast, will restore the conditions necessary for a repetition of the process, which by preference should follow at a short period after the discharge of the carburized metal. The iron, having been thus brought in close contact with a large surface of incandescent carbon, will have absorbed a further quantity, (unless previously saturated,) depending on the temperature of the metal and fuel on

its previous state of carburization and on the length of time to which the molten iron is subjected to the action of the incandescent fuel. Two such carburizing-vessels may be employed near each other, so as to admit of one being under repair while the other is employed. Where the level of the ground admits of it, the vessel need not be made movable, the pig-bed being, in that case, at a level low enough to allow the carburized iron to be run into it; and although I have described a means by which this vessel may be lowered and raised by hydrostatic pressure on the ram to which it is attached, I in some cases use in lieu thereof a screw or rack, and thus raise or lower the vessel by means of engine-power transmitted through gearing of the usual kind. When it is desired to highly carburize pig-iron containing only a small quantity of carbon, or when refined or finery iron is to be recarburized, or when molten, wrought, or other malleable or scrap-iron and steel, or other carburets of iron, require to be further carburized, I prefer to heat the carburizing-vessel to an extremely high degree of temperature by nearly closing the mouth of the carburizing-vessel during the time of forcing in the blast, whereby I am enabled to retain the products of combustion under pressure, as in the furnaces described in the patent granted to me in England, and bearing date the 10th day of November, 1868, and numbered 3,419. The interior of the vessel and the carbon it contains will be thus highly heated; the metal will, in consequence absorb, or take up carbon more rapidly, and may then be run off and used for conversion into malleable iron or steel, or be used for either of the several purposes for which it is thus rendered especially suitable. The hematite pig-iron of the higher numbers, such as numbers 2, 3, and 4, usually made with a pure and expensive coke, may be thus further carburized and rendered more suitable for conversion into steel by the Bessemer process. A less quantity of coke may be used in the blast-furnace when this after process of carburization is employed, and at the same time a more uniform quality of metal will be obtained by the treatment of a whole cast or charge from the blast-furnace, by which all the metal will be of one number or quality. Coke, anthracite coal, charcoal, partially-charred wood, or other pure fuels may be employed, and before running the metal into the carburizing-vessel carbonate of soda, chloride of sodium, chloride of calcium, lime, or other matters known to act as purifiers of molten iron may be put into the vessel along with the fuel or prior to the running in of the fluid iron, and in such quantities as may be in practice found advantageous, according to the quality and quantity of metal treated, for the purpose of in part purifying the metal during the carburizing process, and with the same object the coke may, if desired, be specially prepared by the abstraction of sulphur therefrom by any known means.

Having thus described my invention, and the manner in which the same may be carried into practical operation, what I claim is—

1. The carburization or further carburization of

molten pig-iron after it leaves the blast-furnace and prior to its solidification, by subjecting such iron in close vessels or chambers to the action of incandescent carbon or carbonaceous matters, the combustion of which is not kept up by a supply of oxygen.

2. The carburization or further carburization of remelted pig-iron, and of molten malleable iron and steel, and of refined or finery iron, by subjecting such iron in close vessels or chambers to the action of incandescent carbon or carbonaceous matters, the combustion of which is not kept up by a supply of oxygen.

3. The combined process of further carburating molten carburets of iron, by subjecting such iron in close vessels or chambers to the action of

incandescent carbon or carbonaceous matters, the combustion of which is not kept up by a supply of oxygen, and the conversion of such carburized iron into malleable iron or into steel by the action thereon of atmospheric air, as in the Bessemer process.

4. The simultaneous carburization and partial purification of molten iron, by the means and in the manner substantially as herein described.

5. The general form and arrangement of apparatus for carburizing or further carburizing molten iron, substantially as herein described.

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