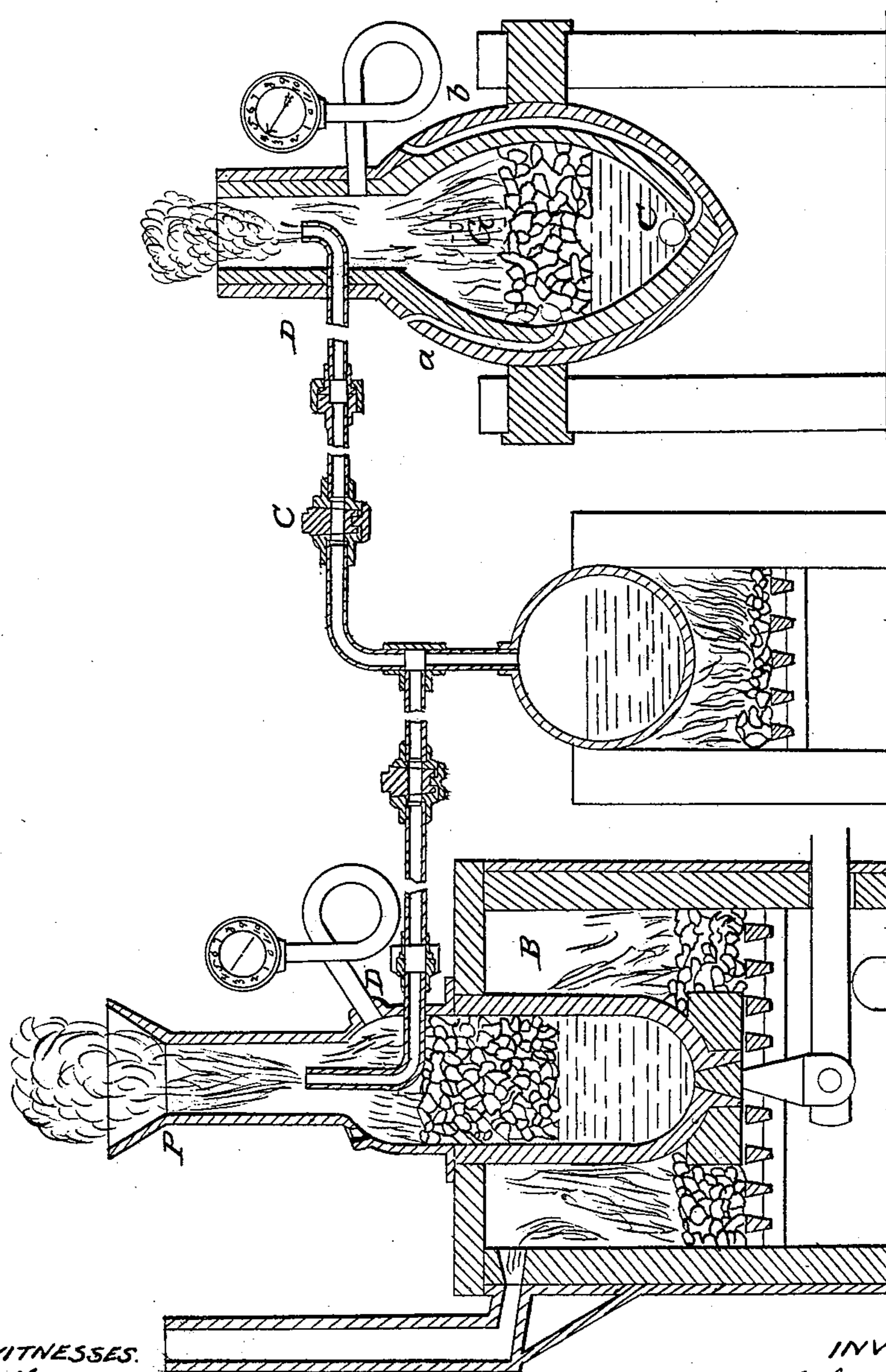


J. ABSTERDAM.
Refining Iron and Steel.

No. 52,121.

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WITNESSES.
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IMPROVED PROCESS FOR REFINING IRON AND STEEL.

Specification forming part of Letters Patent No. 52,121, dated January 23, 1866.

To all whom it may concern:

Be it known that I, JOHN ABSTERDAM, of the city, county, and State of New York, have invented certain new and useful Improvements in the Process of Refining Iron or Making Steel *in Vacuo*; and I do hereby declare the same is fully described in the following specification, viz:

The nature of my invention consists in a new process of manufacturing iron and steel *in vacuo* by creating and maintaining a vacuum within the interior of a furnace or pot containing melted iron or steel, so as to extract the impurities from the fused metal after these being dilated into a gaseous state by the heat; also, in fusing the metal with a current of air or oxygen gas produced by creating and maintaining a vacuum within the interior of the pot or furnace containing the melting metal; also, in producing a current of air through the molten metal, in creating and maintaining a vacuum within the interior of the furnace or pot containing the fused metal, so as to dilate the impurities, (such as sulphur, arsenic, phosphorus, aluminium, silicum, &c.,) and to burn away the carbon contained in the iron.

In order to explain my process, I have drawn the accompanying diagram of an apparatus in which my process can be carried out with convenience, although it must be understood that I do not wish to confine myself to any particular apparatus in carrying out my invention, but reserve the right to use the apparatus of any suitable construction.

The pot or furnace in which I refine my iron or make my steel is constructed in the ordinary manner, and in order to create the vacuum within the furnace or pot I introduce a steam-pipe, D, in the throat of said pot or furnace, so that a jet of steam, or, if preferred, condensed air, may be injected into said throat from a steam boiler or generator, the end of said steam-pipe being turned up into the throat in the direction of the mouth of the furnace or pot. In the side of the furnace I make an opening, G, near the level of the surface of the melted metal in the furnace, and in place of the ordinary tuyere I make one or more openings through the wall of the furnace near the throat, forming channels between the outer casing and the fire-lining of the furnace, as seen at *ab*.

In order to carry out my process I commence

by laying a few chips of wood in the bottom of the furnace, and after having filled the furnace up to its throat with coke or charcoal I light the fire through the orifice *c*, and in a quarter or half an hour, when the fuel is sufficiently kindled, I open the stop-cock C in the steam-pipe and let on the steam. By the action of the steam discharging through the mouth of the furnace or pot a vacuum is created, causing the air to rush below the fuel and the flame to rush out through the mouth of the furnace; but no flame escapes through the orifice *c*, as is the case in forcing the air with the tuyeres.

A few minutes after the steam has been let on the coke or charcoal begins to settle down, and then I throw in alternate charges of coke or charcoal and crude or pig iron through the throat or mouth of the furnace, and when the iron begins to melt similar charges are thrown in every ten or fifteen minutes. Before the metal begins to melt, or when commencing to melt, I close the orifice C with a lump of moist clay, in the ordinary way. The air is supplied through the orifices and channels *a b*, and as soon as the level of the melted metal rises near the opening or large orifice G, I open said orifice and rake out the slag from the surface of the fused metal, and when this operation is completed I let on a higher pressure of steam, so as to produce a greater vacuum in the furnace, and to cause the air to pass through the melted metal with increased rapidity, causing the heat to become more intense. By these means the impurities of the iron are evaporated or dilated into gases, which are carried away by the suction of the steam. The air, in passing through the melted metal, also burns a portion of the carbon contained in the metal, thus transforming the iron into steel.

After having extracted or dilated the impurities from the metal, and having reduced the percentage of carbon to the proper standard, I stop the supply of air altogether and let on a still higher pressure of steam, producing a more perfect vacuum within the furnace or pot, for the purpose of better extracting the impurities that may still remain in the melted metal. When it is ascertained that the impurities have disappeared by testing a sample at different stages of the process, I again rake out the slag from the surface of the fused metal through the orifice G, and

after the metal has been deprived of its impurities I run it off, either by piercing the plug of the orifice C or by inclining the furnace or pot with its mouth downward by turning the same on its trunnions, and the ingots obtained by this process are drawn out and annealed in the ordinary way.

My process in making steel from crude or pig iron is the same as in refining iron, with the exception that I only leave in the iron the percentage of carbon required in making steel.

In order to make steel of a superior quality, I run the metal off the furnace in thin slabs and break it into small fragments and remelt it in the second pot or furnace and cast it again, as desired. The second pot or furnace is simply a large crucible having an orifice on its side near its bottom or in its bottom, and set stationary in a furnace, and having its mouth secured in fire-brick, with an opening through the bricks, forming a flue in line with the interior of the crucible. The upper end of this flue is contracted and joins a neck, P, with a bell-shaped mouth, and through this neck I introduce the steam-pipe, the end of which turns up parallel with the side of said neck.

From this description it will be seen that my process is accomplished by seven distinct manipulations, as follows: First, I melt the iron in a furnace or pot, where the draft is created by producing a continuous vacuum within the furnace; second, to rake the slag or dross from the surface of the melted iron, which operation is effected without stopping the supply of air for combustion; third, to let in a heavy pressure of steam in order to cause a rapid circulation of air through the molten mass of iron, so as to burn away some of the carbon of the iron and to dilate the impurities into gaseous vapors and separate them from the iron as much as possible by the vacuum; fourth, to reduce the pressure of steam and allow the melted metal to settle down, so as to again rake off the slag from the surface of the metal; fifth, to stop the supply of air entirely and to increase the pressure of steam in the throat of the furnace, so as to create and maintain a total vacuum within the furnace or pot, for the purpose of finally extracting all the gaseous impurities by the process of distillation *in vacuo*; sixth, to cast the steel obtained by the previous manipulations in ingots, or in the form of any object desired, and draw and anneal the same as required; seventh, to obtain steel of a superior quality I break up the steel

so obtained into small fragments and remelt it again in the second furnace or crucible by adding to it some oxides of manganese and other carbonic substances, in the ordinary manner. I also create and maintain a vacuum within the said crucible, so as to exclude the atmospheric air from the interior of the pot in fusing the metal, so as to prevent the oxidation of the steel, and I afterward run out the metal and cast it again as desired. During this process the means for producing the vacuum may be varied, although I use, by preference, the steam arrangement, as described.

I do not confine my process to the manufacture of iron and steel from crude or pig iron, for I also make cast-steel by melting blistered steel by the same process. By melting in the second pot or crucible (marked B) the vacuum created and maintained within the interior of the same pot also facilitates the dilation and extraction of the impurities that may be contained in the iron before cementation.

The advantages of my invention are as follows, viz:

First, by melting the iron under a vacuum maintained within the interior of the furnace I obtain a well equalized distribution and pressure of air throughout the whole mass.

Second, in producing a rapid circulation of air through the molten mass by means of the vacuum created and maintained in the interior of the pot or furnace I equalize the pressure of air and combustion of carbon throughout the molten mass.

Third, in obtaining a current of air through the molten metal entering the furnace of its own accord, without being forced, it facilitates the running out of some of the molten metal for its examination at different stages of the process.

Fourth, in continuing the vacuum after the supply of air has been stopped I extract the remaining gaseous impurities from the molten metal by distilling them *in vacuo*.

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

The above-described process for refining iron or making steel *in vacuo*, substantially as set forth.

In testimony whereof I have hereunto set my signature.

JOHN ABSTERDAM.

Witnesses:

A. SHEDLOCK,
A. NEILL.