3 Sheets—Sheet 1.

W. VON F. Du FAUR.

Blast Furnace.

No. 2,558.

Patented Apr. 16, 1842.

Fig. 1 Vertical Section through a Blast Furnace

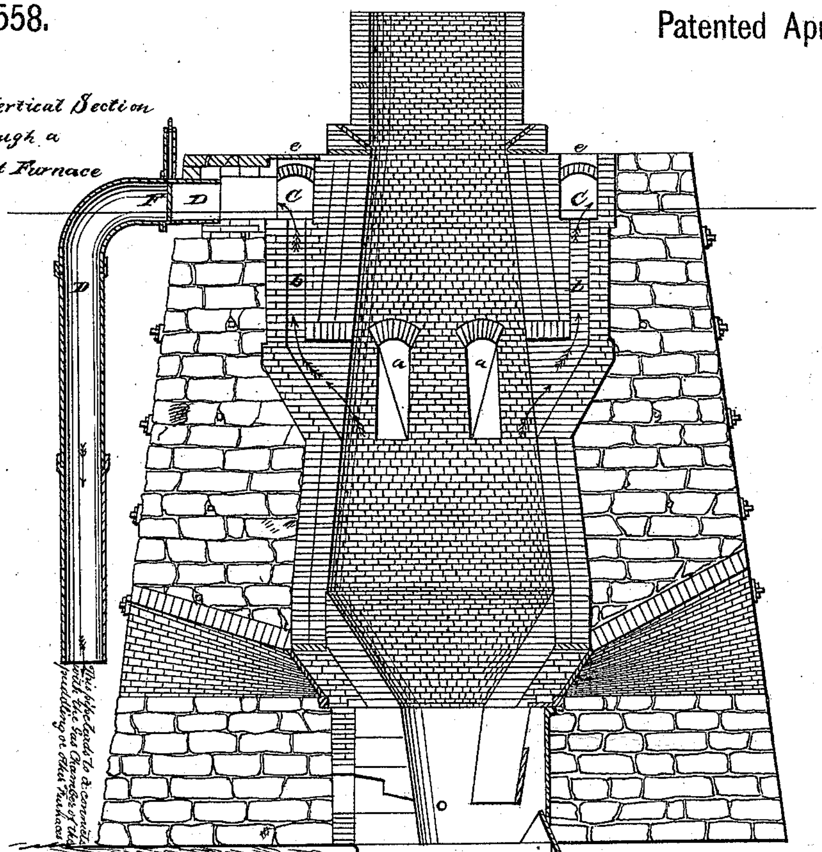
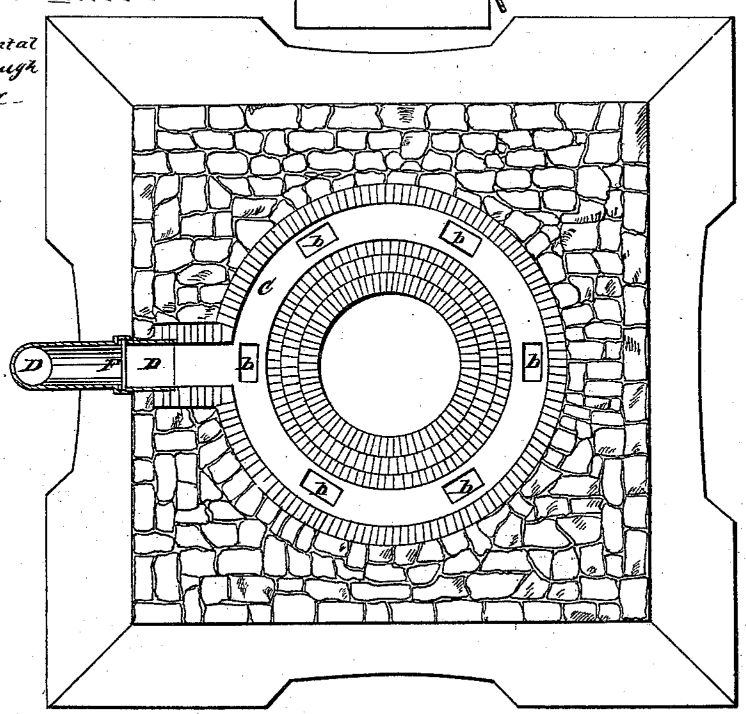


Fig. 2 Horizontal Section through the line XX –



Witnesses:

Inventor:

3 Sheets—Sheet 3.

W. VON F. Du FAUR.

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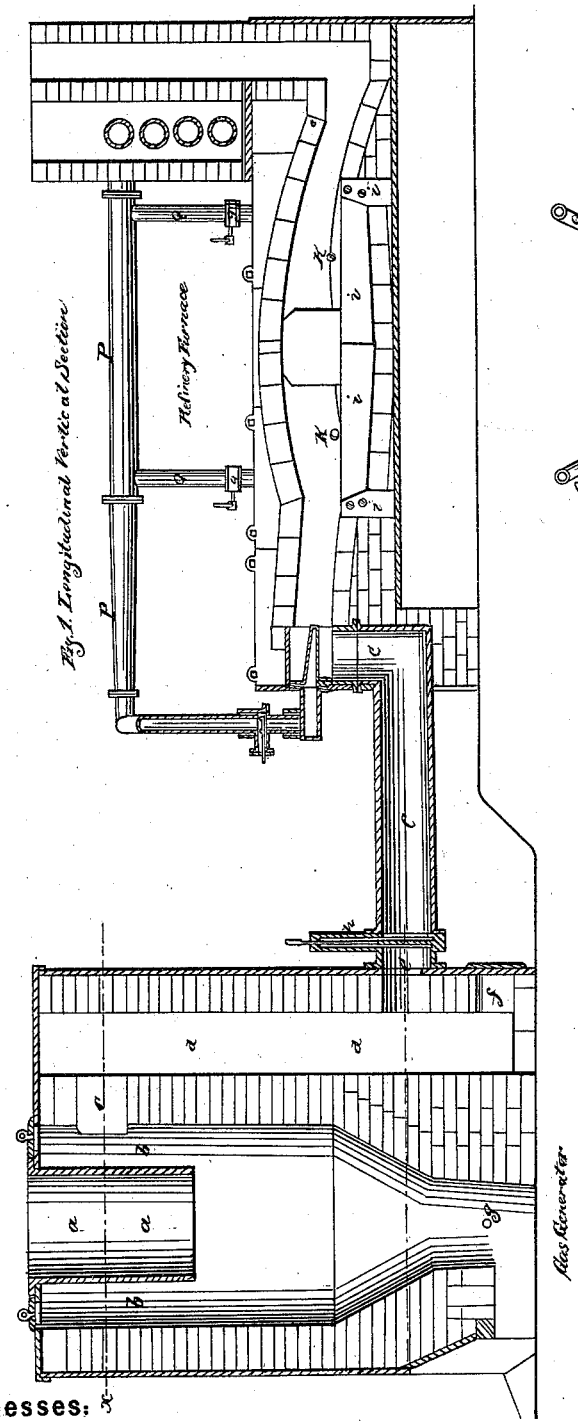

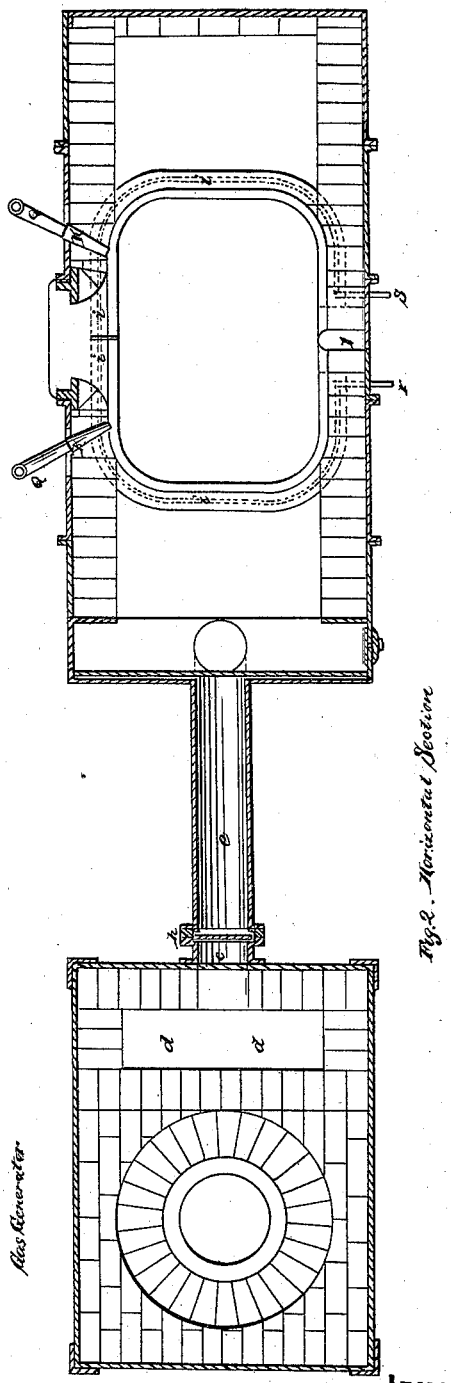

Witnesses:

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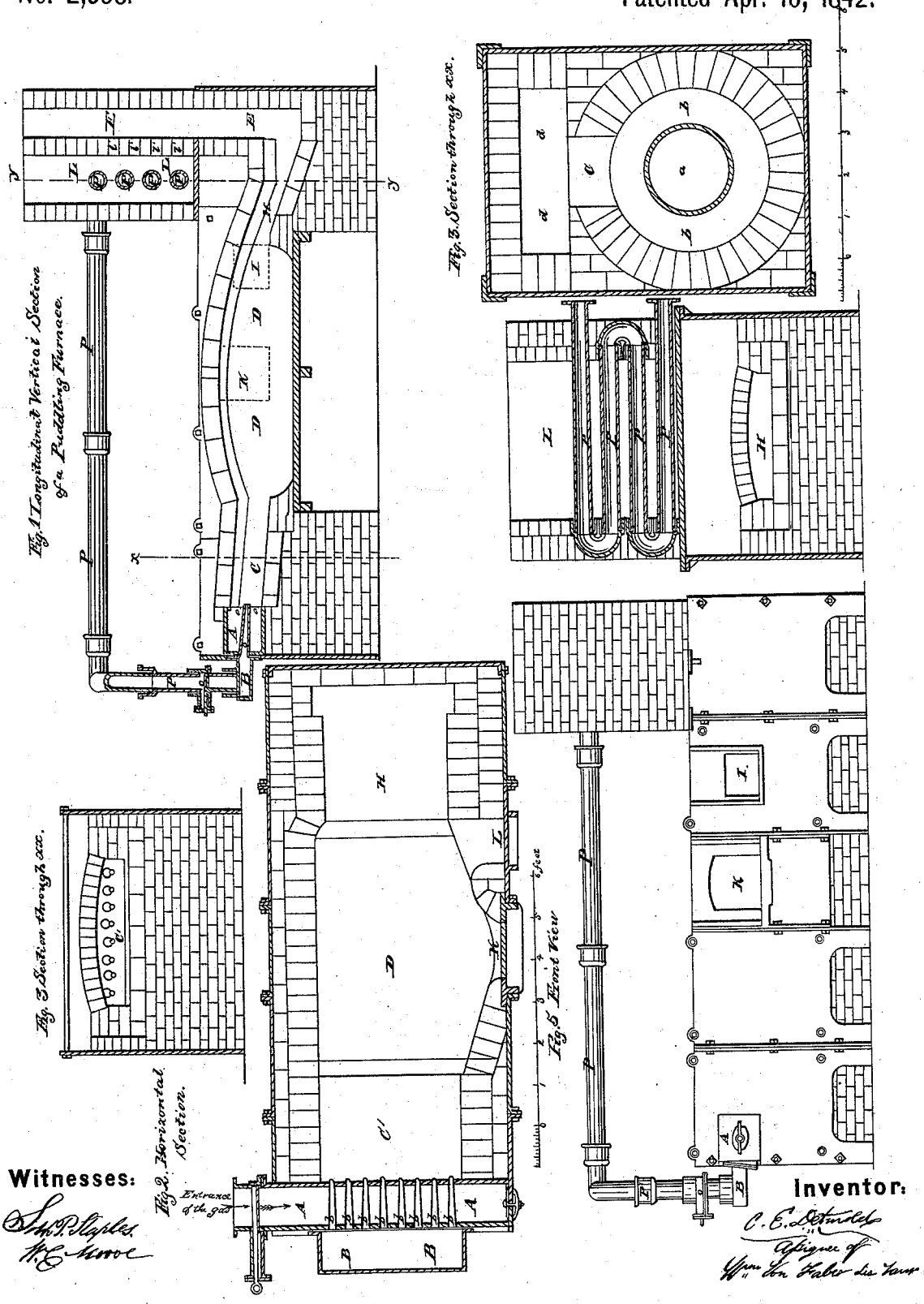
3 Sheets—Sheet 2.

W. VON F. Du FAUR.

Blast Furnace.

No. 2,558. Patented Apr. 16, 1842.



Witnesses:

Inventor:

UNITED STATES PATENT OFFICE.

WILHELM VON FABER DU FAUR, OF WASSERALFINGEN, WÜRTEMBERG, ASSIGNOR TO C. E. DETMOLD.

IMPROVEMENT IN HEATING FURNACES, &c.

Specification forming part of Letters Patent No. **2,558**, dated April 16, 1842.

To all whom it may concern:

Be it known that I, WILHELM VON FABER DU FAUR, of Wasseralfingen, in the Kingdom of Würtemberg, director of mines of His Majesty the King of Würtemberg, have invented a new and useful Method of Generating and Applying Heat, of which the following is a full and exact description.

It is known that a large quantity of combustible gas called the "carbonic-oxide gas," is formed in all blast and other furnaces, most of which escapes unconsumed, and may be seen burning with a blue flame at the tops of blast and other furnaces. I have invented a method of using this gas as a fuel, and of producing thereby a most intense heat, which may with great ease and convenience be used in the manufacture of iron and other metals, of glass, and pottery, to steam-boilers, to forges, and generally wherever a high temperature is required. It may also be advantageously applied to heating the hot-air apparatus of blast-furnaces, where the hot-air blast is used. This apparatus, unless heated by separate fuel, is generally placed on top of the blast-furnace, where it is heated by the waste flame and heat escaping out of the furnace-mouth; but by the application of my invention the hot-air apparatus may be located below on a level with the hearth of the blast-furnace and close to the forms, and thus the air will enter the furnace at a much higher temperature than when the apparatus is on top and the heated air conveyed down by pipes. I collect the carbonic-oxide gas from blast, cupola, and other furnaces, or from furnaces constructed expressly for the purpose of producing it, and conduct it to the refinery, puddling, reheating, or other furnaces requiring to be heated. By means of any ordinary blowing-machine heated atmospheric air is there forced through a system of blow-pipes among the inflammable gas. Thus the oxygen of the air becomes thoroughly incorporated with the gas, so that when ignited its combustion will be completely effected and a heat produced sufficiently high for any kind of manufacture.

My invention therefore consists, first, in a new method of using carbonic-oxide gas as a fuel; secondly, in the method employed to obtain the carbonic-oxide gas, so as to have it in a pure and uninflamed state, and of conveying it to the furnaces to be heated by its combustion; thirdly, in a new method of employing the blow-pipe in furnaces, by which continuous jets of highly-heated atmospheric air are mixed with the gases that are to be burned in them, thus effecting their complete combustion.

To explain more fully my invention, and to enable those skilled in the art to use it, I proceed to describe the apparatus by which the gas is obtained and used.

First. The mode of obtaining the gas, in the description of which reference is made to Plate No. 1 of the annexed drawings, making part of this specification, in all the figures on which the same letters refer to the same parts throughout.

Figure 1 is a vertical section through the middle of a blast-furnace. Fig. 2 is a horizontal section of the same through the line *x x*.

a a a a a a are six recesses in the interior wall of the furnace, by which the passages *b b b b b b* open into the fire-room of the furnace at or a little above the highest point where the fuel is in a state of full combustion, which is generally from eight to ten feet below the mouth of the furnace. The passages *b b b b b b* open into the annular reservoir *c c*, which surrounds the whole of the inner wall of the furnace and opens into the iron pipe or duct *e e*. The gas ascends through the passages *b b b b b b* into the reservoir *c c*, whence it is led by the pipe *e e* into the furnaces which require to be heated. The gas may be conducted any distance; but if carried more than one hundred feet from the blast-furnace, it may be found necessary to reheat it, as it will only burn advantageously at a high temperature. The annular reservoir *c c* is arched over with fire-brick, but has six openings, *d d*, immediately over the passages *b b b b b b*, which are closed by iron plates. These plates may be removed for the purpose of enabling workmen to examine and clean the annular reservoir *c c* and the passages *b b b b b b*. The recesses *a a a a a a* are cut in about twelve inches deep at top, and extend down three feet six inches, so as to permit the charges in the furnace to spread out, and thus to enable the gas more freely to ascend into the passages *b b b b b b*. The passages *b b b b b b* are one foot six inches wide and eight inches high.

The reservoir *c c* is one foot six inches wide and one foot six inches high to the crown of the arch.

This invention may also be applied to a blast-furnace while in operation, without stopping or blowing it out, by inserting one or more iron pipes lined with fire-proof material into the furnace at about the same height as the recesses *a a a a a a* in Fig. 1. By means of such pipe or pipes the gas will be drawn off, and may be conducted to the furnaces where it is to be used. I have used also other methods for collecting and drawing off this combustible gas from the blast-furnaces—as, for instance, by inserting an iron cylinder into the furnace-mouth, so as to bring its bottom about eight or ten feet below the mouth, thus forming a concentric or annular chamber between the outside of the cylinder and the interior of the wall of the furnace, which chamber must be closed on top. The furnace is charged through the cylinder, and the gas will ascend into the annular chamber, whence it may be conducted in a similar manner, as above described. An iron tube may also be inserted into the mouth of the furnace and allowed to descend about eight or ten feet. A large portion of the combustible gas will ascend into this pipe, and may thence be carried to the furnaces requiring to be heated; but the method first above described, and illustrated by Figs. 1 and 2, Plate I, I find the best in practice.

In cases where there is no blast or other furnace from which the gas may be collected, a separate furnace may be built for the purpose of generating the gas. This furnace may be constructed like a small blast-furnace, with a blowing apparatus sufficient to produce a slow combustion. This will produce the requisite quantity of carbonic-oxide gas, which, by an arrangement like that described above, may be conducted to the furnace which is to be heated.

Secondly. I proceed to explain the manner of burning the gas, in the description of which reference is made to Plates Nos. 3, 4, 5, and 6, hereto annexed, making part of this specification, in all the figures of which the same letters refer throughout to the same parts.

The furnaces heated by the combustion of the carbonic-oxide gas differ from those heated in the methods now practiced, principally in these points: They have neither fire-grate nor chimney, but are constructed with a very long fire-bridge, and the combustion of the carbonic-oxide gas is effected by the forcing into it atmospheric air, that has been previously heated in the furnace itself to about 600° Fahrenheit.

I proceed to describe the application of my invention to a puddling-furnace for the sake of clearness and precision, it being understood that it is equally applicable to refinery, reheating, or mill furnaces, or to any other furnaces, ovens, or boilers in which a high temperature is required.

Figs. 3, 4, 5, 6, and 7, Plates 3, 4, 5, and 6, show different sections of a gas puddling-furnace. Its general dimensions, including the iron plating which incloses the masonry, are thirteen feet two inches long, four feet, five inches high, and four feet nine inches wide. The mode of binding the walls together and the cast-iron plating or armature are much the same as in the ordinary puddling-furnaces. The side walls are one foot thick, of fire-brick. The fire-bridge C C, the throat M, and the arches *n n′ n″* are also constructed of fire-brick. The other parts of the masonry are of ordinary brick. Fig. 3 is a front view of the furnace. Fig. 4 is a vertical section lengthwise through the furnace. Fig. 5 is a horizontal section through the air-chamber B B and the blow-pipes *b b b b b b b*, showing the plan of the furnace. Fig. 6 is a vertical cross-section through the bridge C C, showing the position of the blow-pipes.

A A is the gas-chamber, into which the gas is conducted from the blast or other furnaces, where it is generated through the pipe *e e*. (*Vide* Plate 1, Fig. 1.) This gas-chamber is made of cast-iron and extends entirely across the end of the furnace, and communicates directly with the pipe *e e*, Plate 1, Fig. 1. It is one foot two inches wide in the clear, and ten inches high. In the front or side toward the hearth of the furnace there is an oblong horizontal opening, *a a a*, extending in length the whole width of the fire-bridge C C, or two feet six inches, and six inches high. Through this opening the gas streams into the furnace.

B B is a semicircular cast-iron air-chamber two feet four and one-half inches in diameter, and two and one-half inches high, into which the hot air is brought through the pipe *p p*. The hot-air chamber or wind-box is provided with a flange, by means of which it is fastened to the back of the gas-chamber A A, which has an opening in the back corresponding exactly to the opening of the air-chamber B B. From the hot-air chamber issue a series of blow-pipes, *b b b b b b b*, made of wrought-iron or other metal, of one and one-half inch in diameter at the largest and one inch at the smallest end or mouth, and one foot six inches long. These blow-pipes pass through the gas-chamber A A toward the fire-bridge, and project about one-half inch through the opening *a a a*. They incline slightly downward toward the hearth of the furnace.

C C is the fire-bridge. It is two feet five and one-half inches long, two feet six inches wide, and seven and one-half inches high. It is arched over with fire-brick, and, like the blow-pipes, slightly inclines to the hearth of the furnace.

D D is the main chamber of the furnace. It is five feet eight inches long, and, measuring from the plate which supports the hearth, it is one foot two and a half inches high at the termination of the bridge C C, one foot four inches in the center, and ten inches at the end or beginning of the throat H. The main chamber D D is arched over with fire-brick.

G G is the hearth of the furnace. It is formed as in ordinary puddling-furnaces of scoria and fire-proof material, about three inches thick. The hearth is supported by a large cast-iron plate, E E E E, which is shown by red dotted lines in Fig. 5, Plate V. The middle part is formed by a separate plate F F, as shown by red dotted lines in Fig. 5, Plate V, and which may be replaced by a new one whenever required. The hearth is surrounded by heavy pieces of cast-iron, *o o′ o″ o‴*. The back of the hearth and chamber D D is formed of three cast-iron pieces, *o′ o′ o′*, laid on top of each other, as shown in Fig. 7, Plate VI. To protect the pieces *o* and *o″* from the injurious effects of the intense heat in the main chamber D D, they are cast hollow, and a stream of cold water is made to circulate through them, which passes out in front of the furnace at *x*, and, entering again at *y*, through the leaden pipe *z z*, is finally discharged in the rear of the furnace.

H is the throat of the furnace. It is one foot and seven inches long, three inches high, and two feet and six inches wide, and is arched over with fire-brick.

K is the forewarming-chamber, where the iron is heated to a cherry-red by the waste heat and flame before it is placed on the hearth G G to be puddled. The opening L serves as a door to the forewarming-chamber K. It is kept closed by the plate M, which may be removed as required.

P P P P is a system of air-pipes, into which the air is forced by the blowing-machine through the pipe *p′*. The waste heat and flame circulate around the pipes P P P P, thus heating the air in them to a very high temperature, which is thence led by the pipe *p* into the hot-air chamber or wind-box B B.

Q is a narrow opening of one foot and six inches by four inches, out of which the flame finally escapes.

R in Fig. 3, Plate 3, is the main door of the furnace. It is suspended by a chain from a lever. It is made of cast-iron, and is lined on the inner side with fire-brick to prevent its being burned. *r* is a small opening in the door R, which is kept closed by an iron plate, except when the puddler is operating.

The pipes *e e*, Fig. 1, Plate 1, through which the gas enters the gas-chamber A A in the furnace, and the pipe *p p*, through which the heated air is forced into the hot-air chamber B B, are provided with cocks or slide-valves, by which the quantity of gas and air to be admitted into the chamber D D may be regulated. The current or draft created by the air being forced through the blow-pipes assists greatly in withdrawing the gas from the blast-furnace. The air that is forced into the gas-furnace should be heated to about 500° to 600° Fahrenheit.

When a gas-furnace is to be put in operation, the valves in the gas and hot-air pipes are opened a little to enable the gas and air to stream in. The gas is then ignited and allowed to burn for about ten or twelve hours with a gentle flame, so as gradually and thoroughly to dry the masonry of the furnace, and to warm the furnace through. After this the valves are gradually opened more until the whole chamber of the furnace is heated equally to a white heat. The iron is then forewarmed to a cherry-red in the chamber K, and then placed in pieces of about twelve inches square upright on the hearth, fronting the fire-bridge, so as to make a charge of about three and one-half hundred-weight.

The operation of puddling in a gas-furnace is much the same as in any ordinary puddling-furnace, with this chief difference, that the iron is subjected to the full heat during the whole operation, instead of increasing or diminishing the heat according to the different stages in the process of puddling, as now practiced.

It is important, in order to avoid the loss of metal as much as possible during the process of puddling, to admit only so much air into the chamber of the furnace that the gas shall always slightly predominate in quantity. This is indicated by the color of the flame that escapes out of the opening Q, which in this case is slightly blue; but when this is not the case the escape flame is nearly white, and playing slightly into red. The same precaution is necessary in all the other gas-furnaces employed in the manufacture of bar-iron.

The refinery and reheating or mill furnaces are built on the same principle and very much in the same manner as the gas puddling-furnace, varying but slightly in their dimensions, and making any further description of them unnecessary, as the above description of the gas puddling-furnace fully elucidates the nature and application of my invention.

The advantages resulting from this invention are, first, a more intense and equal heat than can be obtained from any other fuel now in use; secondly, greater facility of converting cast into bar-iron; thirdly, diminished loss of metal in the operations of refining, puddling, and reheating the iron; fourthly, complete and effective combustion of the fuel used in the furnaces, and consequently the entire avoiding of all smoke and a most important economy of fuel.

What I claim as my invention, and wish to secure by Letters Patent, are the following points:

1. The employing carbonic oxide gas as a fuel, in combination with a proper proportion of highly-heated atmospheric air, in all furnaces for metallurgic operations and in the heating of all other ovens, boilers, or furnaces.

2. The above-described modes of collecting and drawing the carbonic-oxide gas in a pure and uninflamed state from blast and other furnaces, whence it generally escapes in large quantities unconsumed.

3. The application of the blow-pipe to furnaces, substantially in the manner above described, by which continuous jets of highly-

heated atmospheric air are forced among the gases in the furnace, thus enabling the oxygen of the atmospheric air to become thoroughly incorporated with the inflammable gas in the furnace, and thereby effecting its complete combustion, and consequently a most intense temperature.

I do not claim the discovery of the existence of the carbonic-oxide gas or of its combustibility; nor do I claim the mode of constructing the blast and other furnaces above described, excepting only so far as such construction embraces the apparatus for collecting and conveying the gas, and the combination of the gas-chamber, air-chamber, blow-pipes, and the long fire-bridge.

W. v. FABER DU FAUR.

Witnesses:

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B. M. ZAULIKOFER.