No. 45,343. PATENTED DEC. 6. 1864.

J. REESE.

APPLICATION OF HOT BLAST TO PUDDLING FURNACES.

2 SHEETS—SHEET 1.

*Fig. 2.*

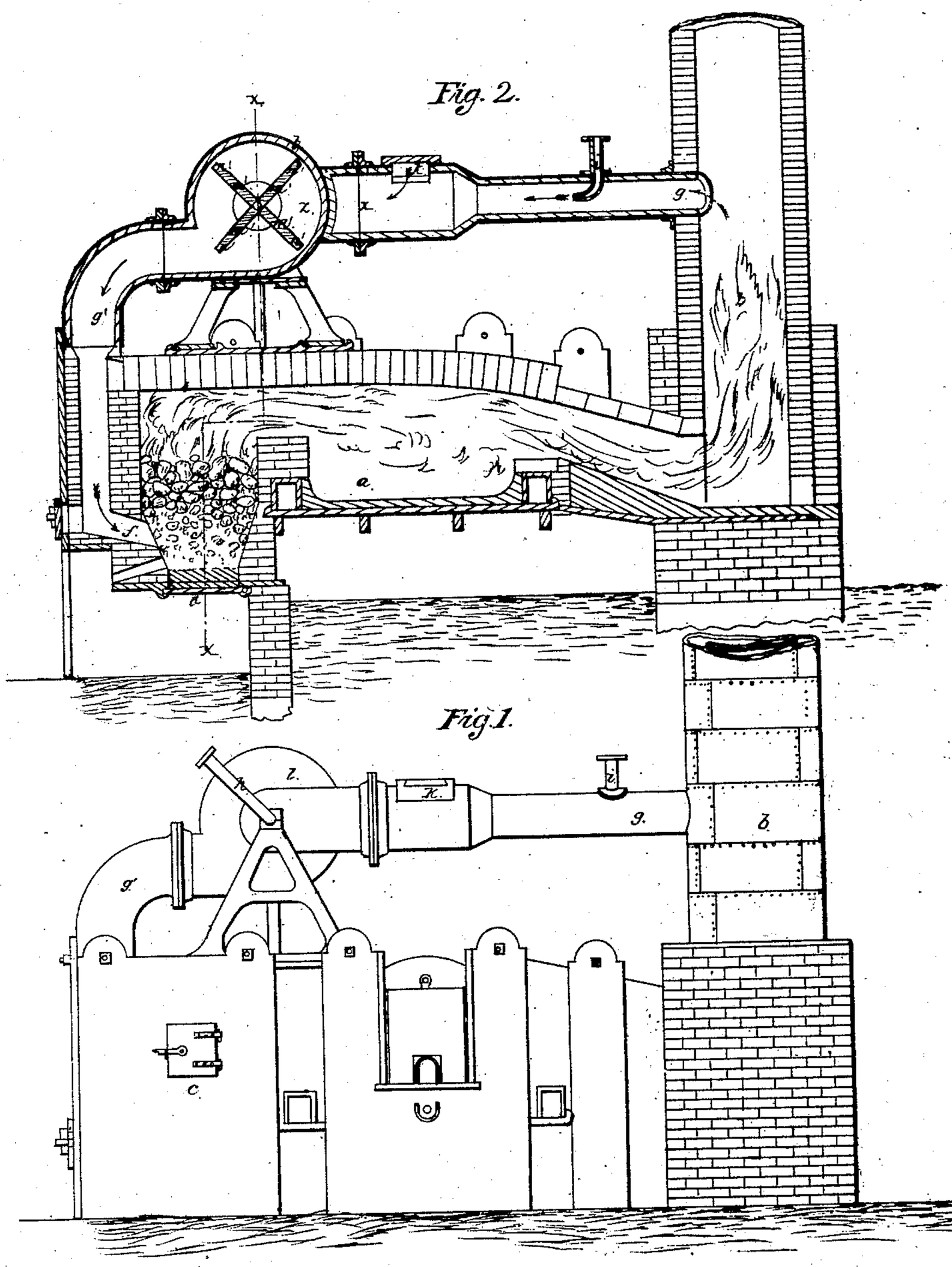



*Fig. 1.*

Witnesses:

W. Bakewell

W. B. Cushing

Inventor:

Jacob Reese

No. 45,343. PATENTED DEC. 6, 1864.

J. REESE.

APPLICATION OF HOT BLAST TO PUDDLING FURNACES.

2 SHEETS—SHEET 2.

*Fig. 3.*

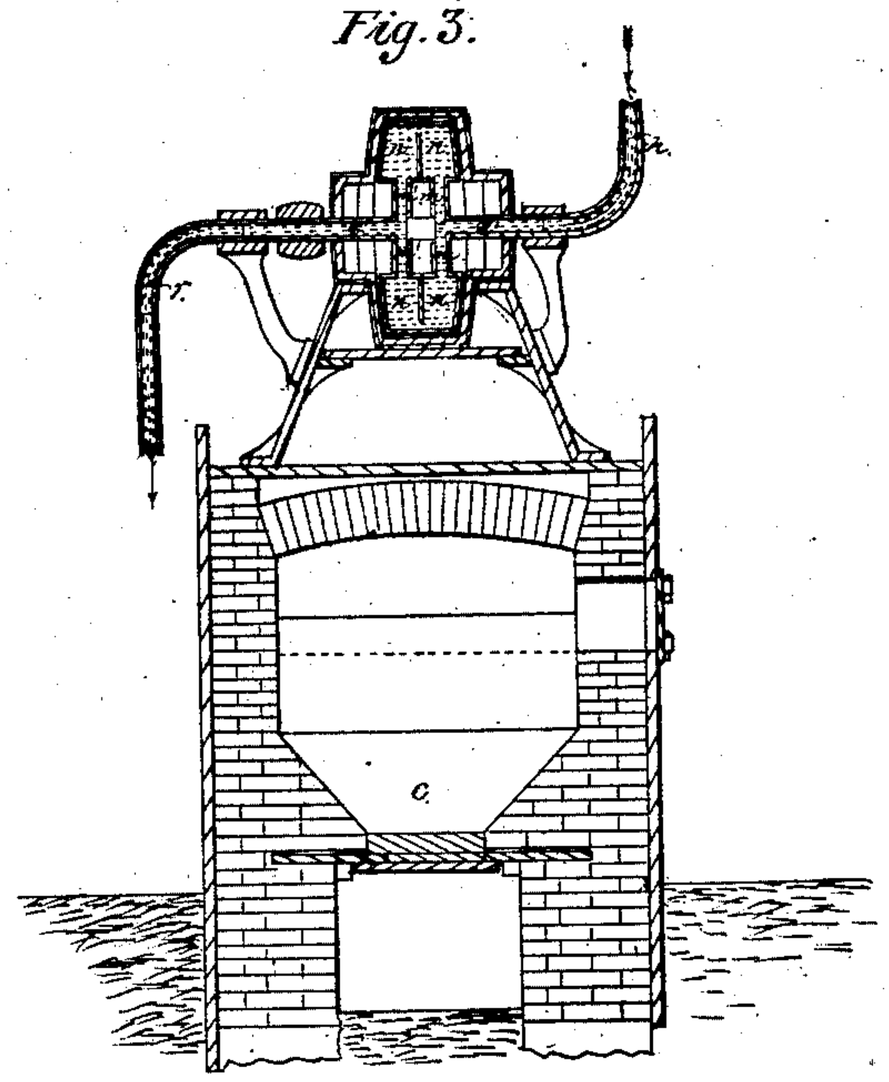
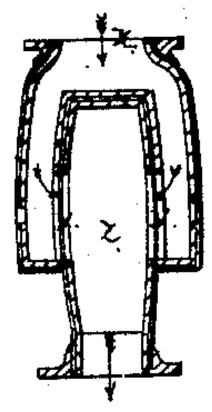



*Fig. 4.*




*Witnesses:*

W. Bakewell

M. G. Cushing

" "

*Inventor:*

Jacob Reese

# UNITED STATES PATENT OFFICE.

JACOB REESE, OF PITTSBURG, PENNSYLVANIA.

## IMPROVEMENT IN THE APPLICATION OF HOT-BLAST TO PUDDLING-FURNACES.

Specification forming part of Letters Patent No. **45,343,** dated December 6, 1864.

*To all whom it may concern:*

Be it known that I, JACOB REESE, of Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in the Application of Hot-Blast to Puddling, Boiling, and Heating Furnaces; and I do hereby declare the following to be a full, clear, and exact description thereof, reference being had to the annexed drawings, forming part of this specification, in which—

Figure 1 is a side elevation of the exterior of a puddling-furnace, showing the application of the apparatus which I employ in reducing my invention to practice. Fig. 2 is a longitudinal sectional elevation of the puddling-furnace and blast apparatus shown in Fig. 1. Fig. 3 is a transverse sectional elevation of the puddling-furnace through *x x*, Fig. 2. Fig. 4 is a longitudinal horizontal section of the fan-case of the fan employed for creating the draft.

In the several figures like letters of reference denote similar parts of the furnace and apparatus.

In puddling, boiling, and heating furnaces for the manufacture of iron there is an enormous waste of heat, and consequently of fuel. This is a well-known fact, and arises from the peculiar circumstances of the case. The heat generated in the fire-chamber is caused to pass rapidly over the iron in the working-chamber of a puddling-furnace, because the heated air and gases part with their caloric to the iron more freely when in rapid motion than when moving more slowly. This rapid motion of the heated air and products of combustion from the fire is ordinarily effected by raising the damper; but this admits atmospheric air into the working-chamber, which, passing over the iron, oxidizes it. If, to prevent this injurious effect, the damper is closed, the combustion of the fuel in the fire-chamber is retarded and the heat becomes too low. As the length of the working-chamber is but five feet, or thereabout, the heated air, gases, and flame pass very rapidly beyond the working-chamber into the flue or stack, and thence out into the open air, and are lost. About ten per cent. only of the heat is utilized. About fifteen per cent. is lost by radiation through the iron, brickwork, &c., of the furnace, and seventy-five per cent., at least, passes up the stack. Although the stack is about forty-seven feet in height, the heat is so great at its mouth that the gases, &c., pass out in a vivid flame, and the loss of heat cannot be checked or reduced by shutting down the damper on top of the stack, as that would lower the heat of the furnace and reduce the draft, causing the heated air and gases to pass over the iron so slowly as to impart to it less of their heat than if they traveled more rapidly. The enormous waste of heat consequent on the necessarily rapid passage of the heated air and products of combustion from the fire-chamber has prevented the use of hot-blast to the puddling and boiling of iron, which, I believe, has never been attempted before; but by the plan which I have invented, as hereinafter described, of causing the waste heat, heated air, gases, and other products of combustion which pass from the puddling-chamber to circulate through the furnace, impelled in rapid circuit by a fan-blower, I am able not only to save and utilize a very large percentage of heat previously lost, but also to apply a highly-heated blast directly to the process of puddling and boiling iron in a puddling-furnace. This circulating hot-blast, which passes first through (not merely over) the fire in the fire-chamber, and thence over the iron in the working-chamber of the puddling-furnace, if charged with oxygen, would injure (by oxidizing) the iron, and if deprived of oxygen would not keep up the heat of the furnace by supporting the combustion of the fuel; but this difficulty I overcome by supplying the requisite amount of oxygen to the circulating current after it leaves the puddling-chamber and before it enters the fire, and by passing it then through the body of incandescent fuel in the fire-chamber I deoxidize the current, or at any rate deprive it of a large portion of its oxygen, and largely increase its heat, and thus fit it for its work in the puddling-chamber. If, as I believe to be the fact, I am thus enabled continually to return to the fire-chamber of the furnace a very large proportion of the seventy-five per cent. of heat otherwise lost, and also to save the large quantity of carbon which would otherwise pass off as smoke, and to return the unconsumed gases, charged with oxygen to aid their combustion, into the fire-chamber, it is manifest that I must effect a very great saving of fuel, as well as in a cheap and simple manner supply a hot and deoxidized (instead of a cold) blast to the pud-

dling, boiling, and reheating furnaces for the manufacture of iron.

To enable others skilled in the art to make use of my improvement, I will proceed to describe it more particularly, and the method which I employ to carry it into practical effect.

In the accompanying drawings, Fig. 1 represents the exterior, and Fig. 2 the interior, construction of a furnace for puddling iron.

The working-chamber *a*, in which the iron is puddled, and the stack *b* are constructed after the method generally in use in western Pennsylvania. The fire-chamber *c* is of the peculiar construction for which I have obtained Letters Patent dated February 5, 1861. Below the level of the bed of the working-chamber the diameter of the fire-chamber is gradually reduced, the sides sloping toward each other. No grate-bars are used; but the bottom is closed by an iron door, on which, in the bottom of the fire-chamber, is laid a bed of sand. An aperture or vent, *e*, near the bottom, allows the melted clinker to run off as fast as it accumulates in the bottom of the fire-chamber. If preferred to allow the melted clinker to accumulate in the bottom of the fire-chamber, this vent *e* is closed and another is opened at the line of the lower edge of the blast-opening *f*, which communicates with the furnace a little below the level of the bottom of the working-chamber *a*. This blast-flue *f* rises upward to the top of the furnace, where it communicates with the blast-pipe *g'*. In the stack *b*, just above the velvetry, an opening is made, into which is inserted the blast-pipe *g*, which passes horizontally to the fan-blower *l*, and thence downward to communicate with the blast-flue *g'* at the front end of the furnace.

The blast-pipe *g* and the case *l* of the fan-blower, being necessarily exposed to a very high heat, are made of sheet-iron, and lined throughout internally with fire-clay. In the horizontal part of the blast-pipe *g*, not far from the stack, is a steam-injector, *i*, being a pipe inserted into the blast-pipe with its curved extremity turned toward the fan in the direction of the current. This steam-injector communicates with any steam-generator, and through it steam is let into the blast-pipe. Beyond this point, and near to the fan-blower, the blast-pipe *g* is enlarged, so as to allow for the expansion of the steam and the influx of atmospheric air through the air-valve *k* without impeding the draft through the blast-pipe *g*. From the blast-pipe *g* the air enters the fan-case *l*, the shape of which may be seen by comparing Figs. 2, 3, and 4. In Fig. 2 a longitudinal vertical section is given, the section being, as usual, circular. In Fig. 4 a longitudinal horizontal section is given; in Fig. 3, a transverse vertical section. At the point *x*, Figs. 2, 4, the hot-blast enters a passage which conducts it (as seen by arrows in Fig. 4) to the openings *y y* at the center of the fan-case.

*z*, Figs. 2 and 4, is the interior of the fan-case, in which the fan revolves rapidly, driving the hot current down the blast-pipe *g'* into the fire-chamber *c* of the furnace. The fan, being a suction-fan, draws the heated air, smoke, and gases from the stack *b*, with the steam and atmospheric air which enter the blast-pipe at *i* and *k*, into the fan-case, and thence send them in a strong blast down the pipe *g'*, as just stated.

Although the fan is made of iron, it could not resist the strong heat of the blast passing through the fan-case without some means of protection. For this purpose the arms *m m'* and wings *n n'* of the fan are made hollow, and a stream of cold water is kept continually through them. A pipe, *h*, leading water from some more elevated point, enters the bearing of the hollow axis *q* of the fan, the bearing breaking the joint at the point of connection of the pipe and hollow shaft, and preventing the escape of water. The water thence passes along the hollow axis of the fan, along the arms *m m*, through the hollow wings *n' n'*, and thence along the arms *m' m'* on the farther side of the fan to the axis *q'*, thence out at the escape-pipe *r*. The hollow axis *q q'* of the fan is obstructed between the arms *m m'*, so as to prevent the water running through without reaching the extremities of the fan-wings. The fan and its case may be placed on the top or roof of the puddling-furnace.

Having thus described the blast apparatus and construction of furnace which I use, I will proceed to explain more fully its operation.

The heated air, unconsumed gases, and smoke which pass off from the working-chamber up the stack or chimney are prevented by a damper at the top of the stack from escaping in that direction, but by means of the suction-fan are drawn off through the horizontal blast-pipe *g*, the fan-case *l* being so constructed, as before described, as to admit nothing within it but what comes through the blast-pipe. When the hot air, gases, and smoke enter the pipe at its orifice in the stack, they are at a temperature usually of from 1,800° to 2,000° Fahrenheit, but, although intensely hot, are not calculated in their present state to serve as a blast for a fire, for, having been almost, if not entirely, deprived of their oxygen, they would not materially aid in the combustion of the fuel in the furnace, which is not supplied with air from any other channel than the blast-pipe *g g'* and the blast-flue *f*. To supply the necessary oxygen a jet of steam is introduced through the steam-injector *i* into the blast-pipe *g*, which mixes with the hot current of gases, smoke, &c., and enters the fan-case, whence it is forced through the flue *f* into the hottest of the fire in the fire-chamber. The admixture of the steam with the gases, &c., in the blast-pipe *g* raises the temperature of the steam and lowers that of the blast until the whole is about 1,200° Fahrenheit. When this hot-blast enters the fire, the steam is decomposed, the oxygen uniting with

carbon of the fuel, and the hydrogen with the sulphur and carbon, and forming a highly-combustible gas. If steam cannot be conveniently used, cold atmospheric air may be introduced through the valve *k* into the blast-pipe *g*, which will unite with the contents of the blast-pipe, reducing their temperature, but affording the requisite supply of oxygen. If desired, both the steam-injector and air-valve may be used at the same time. The air-valve should be so regulated as to admit only about one-third as much air as the volume of gases, &c., in the blast-pipe *g*. By these means a constant circulation of heated gases, smoke, &c., is kept up, not unlike the circulation of the blood in the body, the air-valve or steam-injector serving as the lungs to oxygenize the current.

No damage can accrue to the iron in the puddling-chamber by this process, as the oxygen is consumed in the fire-chamber, and the other gases are only those which have before passed over the iron, and which are continually returned to the fire and there consumed.

I do not claim as new the use of steam for supplying oxygen to promote combustion, nor do I claim, broadly, heating a current of air before introducing it into a fire-chamber or furnace; but

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

1. Creating a hot-blast for supplying the fire-chamber of puddling, boiling, and heating furnaces, by drawing the waste hot air, gases, and smoke, after they have passed over the iron in the puddling-chamber, from the furnace-stack or chimney by means of a fan or similar device, and forcing such hot-blast, previously recharged with oxygen in the shape of atmospheric air or steam, into and through the fire, whereby it is again deprived of its oxygen and receives an accession of caloric, and is thus fitted for use in the puddling-chamber, thus keeping up a constant circulation through the furnace.

2. The application to the working-chamber of puddling, boiling, and heating furnaces of a hot-blast, consisting of the waste heated air, gases, and smoke drawn from the stack or chimney of the furnace, and, previously to entering the working-chamber, deoxidized and highly heated by passage through the body of the fire in the furnace, substantially in the manner hereinbefore described.

3. Constructing a fan for hot-blast with hollow axle, arms, and wings, or any of them, for preventing the injurious action of the intense heat by passing a current of cold water through the fan, substantially as hereinbefore described.

In testimony whereof I, the said JACOB REESE, have hereunto set my hand.

JACOB REESE.

In presence of—

M. G. CUSHING,

A. S. NICHOLSON.