(No Model.)

2 Sheets—Sheet 1.

H. KENNEDY.

BLAST FURNACE.

No. 457,202. Patented Aug. 4, 1891.

FIG. 1.

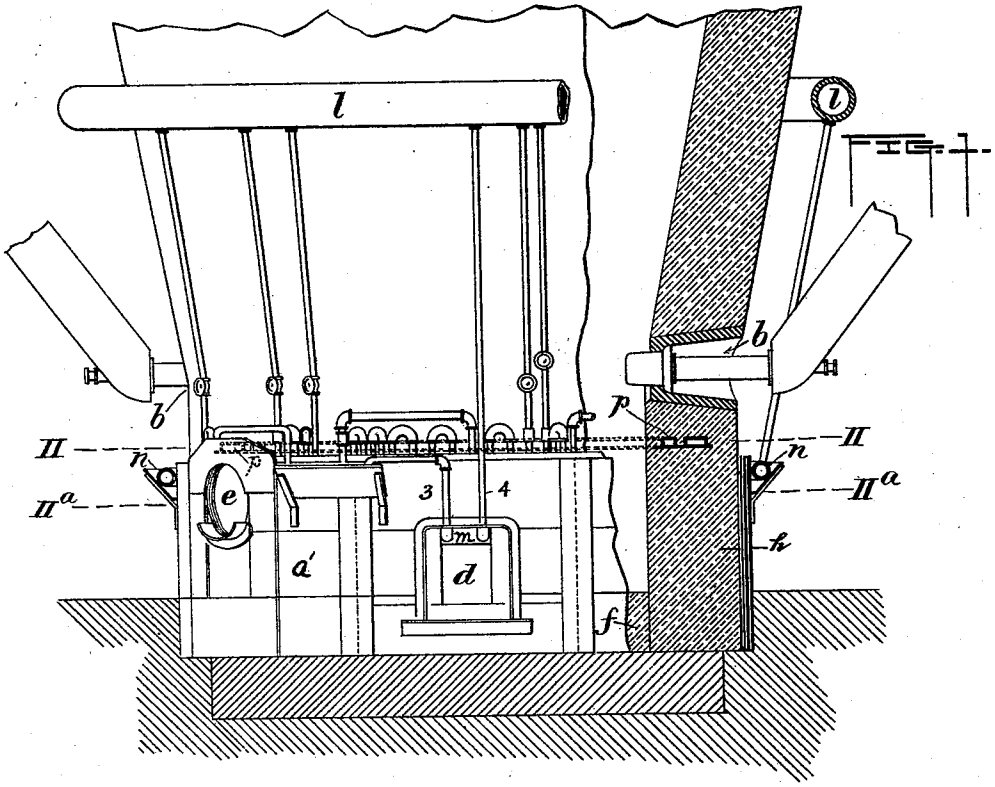
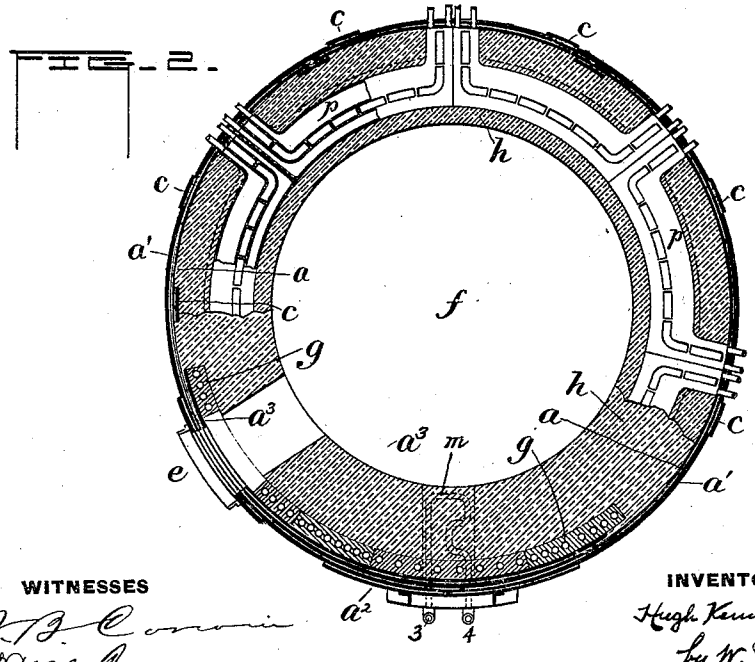


FIG. 2.



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(No Model.) 2 Sheets—Sheet 2.

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FIG. 7. -Hearth-wall Plate-

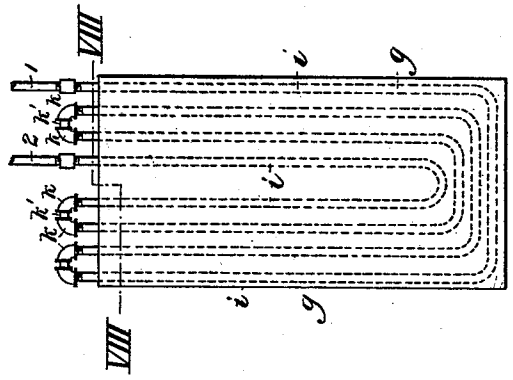


FIG. 8.

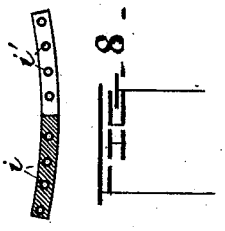


FIG. 5. -Tap-hole Plate-

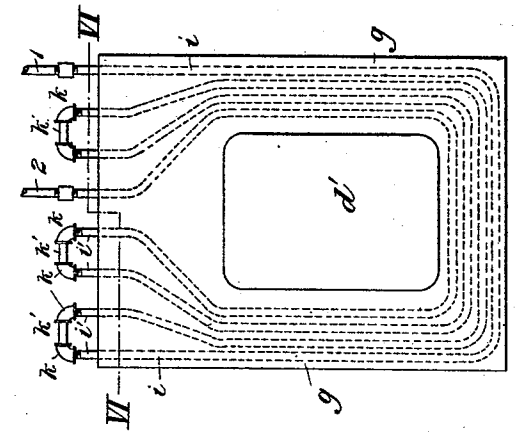


FIG. 6.

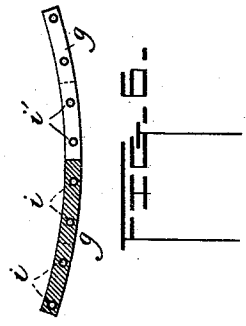


FIG. 3. -Cinder Notch Plate-

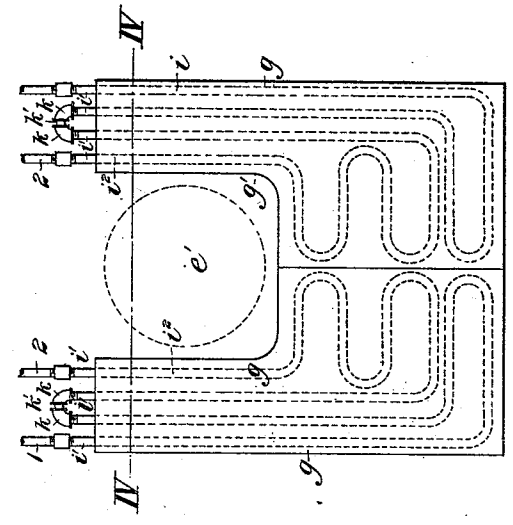
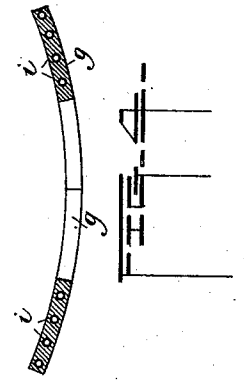


FIG. 4.



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UNITED STATES PATENT OFFICE.

HUGH KENNEDY, OF SHARPSBURG, PENNSYLVANIA.

BLAST-FURNACE.

SPECIFICATION forming part of Letters Patent No. 457,202, dated August 4, 1891.

Application filed October 10, 1890. Serial No. 367,706. (No model.)

To all whom it may concern:

Be it known that I, HUGH KENNEDY, of Sharpsburg, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in the Construction of Blast-Furnaces, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, forming part of this specification, in which—

Figure 1 is a front view, partly in section, of the lower part, boshes, and hearth of a blast-furnace constructed with my improvement. Fig. 2 is a horizontal section, partly on the line II II of Fig. 1 and partly on the line II^a II^a of the same figure. Fig. 3 is a front view, and Fig. 4 a section on the line IV IV of Fig. 3, of my improved water-cooled plates for the cinder-notch. Fig. 5 is a front view, and Fig. 6 a section on line VI VI of Fig. 5, of my water-cooled plate for the tap-hole. Fig. 7 is a front view, and Fig. 8 a section on the line VIII VIII of Fig. 7, of my water-cooled plate for the walls of the hearth.

Like symbols of reference indicate like parts in each.

The plate-iron casing for the hearth of the furnace is illustrated in Figs. 1 and 2. A cylinder of plate metal is formed of curved sheets of steel *a a'*—such, for example, as boiler-plate—of a height extending from the hearth-stone up to within a short distance of the boshes and below the tuyere-openings *b b*. These plates are preferably made in two layers or courses, excepting where the furnace-openings are situate, where they may be reenforced, as at a^2 a^3 in Fig. 2, by the use of three or four layers. The joints of the plates run in a vertical direction, and instead of being lapped one edge over the edge of the adjoining plate, the edges are brought together, and vertical strips *c* are placed over the joints, to which strips the plates are firmly riveted. The plates are made of such width as to break joint, as shown in Fig. 2. Suitable openings are made in the plates for the tap-hole *d* and the cinder-notch *e*. The casing-cylinder being thus formed is placed over or upon a hearth-stone *f*, and on each side of the openings for the tap-hole and cinder-notch, inside of the casing-cylinder and resting against its inner surface, I place vertical cast-iron cooling-plates *g*, (the construction of which I will presently describe,) the height of which is preferably the same as that of the casing-cylinder and the width such as may be found convenient. These plates are of arc shape in cross-section, as shown in Figs. 2, 4, 6, and 8, and of the same degree of curvature as the inside of the cylindrical casing, as shown in Fig. 2. When these cooling-plates *g* are in place, the wall *h* of the furnace-hearth is laid of stone, brick, or other suitable refractory material within and close up against the cylindrical casing *a a'*, as shown in Fig. 2, but not extending so as to cover the upper edges of the plates, which would interfere with the connecting water-pipes.

By my plan of forming the casing first and then building the wall inside of and close up to the casing, instead of placing a single layer of iron around the wall of the hearth after it is built, as is usual, the thickness of masonry composing the wall *h* of the hearth may be reduced, and the structure is rendered stronger, and the cracking of the wall by expansion and contraction is in a great measure prevented.

A water-pipe *n*, supplied from a pipe *l*, extends around the furnace, and is adapted to discharge a stream of water upon the plates *a a'*. The masonry is built within the plates as closely to the interior thereof as possible, and as the plates are riveted securely in place around the furnace the effect of the heat of the hearth is to expand the masonry into very close contact with the plates and to cause the cooling influence of the water which flows over the plate to be exerted on the masonry in the most effective manner. In addition to the water-cooling afforded by this device, I employ a circle of horizontally-arranged water-cooled plates *p p*, constructed in the manner of bosh-plates, which are built in the furnace-wall at the hearth below the level of the tuyeres and as near as possible to the level at which the molten iron rises in the hearth. Heretofore very great difficulty has been experienced from the liability of furnace-walls to burn out at the hearth in curved lines extending down from the tuyeres until the wall becomes so thin as to cause the metal-incas-

ing jacket to stretch and thus to weaken the hearth-wall, so as to permit the escape of the molten metal, which attacks the incasing-jacket and cracks it, thus necessitating frequent repairs, and by enlargement of the furnace requiring the use of more fuel. I have discovered, however, that by using the water-cooled bosh-plates in the walls below the tuyeres and using the tightly-fitted externally-cooled incasing-jacket, this is prevented, the furnace-walls are preserved, and may be used intact for a long period of time.

In the use of furnaces as heretofore built the action of the blast and the wearing of the stock cause the walls to be eaten away in a curve extending from the tuyeres to the hearth. By placing the circle of water-cooled plates below the tuyeres and as low as possible, so that they shall not touch the iron line, the brick-work between the tuyeres and plates is preserved and the curve of cutting in the short distance between the plates and the hearth is very much shortened, so that it is quite possible to hold the hearth intact for an indefinite time by means of the incasing-jacket. This has not been possible in prior furnaces, in which the curve of cutting at the hearth soon becomes so deep as to endanger the breaking out of the molten iron and to cause a great waste of heat and fuel in operating the furnace. The advantages of these water-cooling devices for preserving the walls will be appreciated by those skilled in the art. They will be found to be the means of saving of labor and time and diminish in a great measure the dangers attending the operation of a blast-furnace.

In Figs. 3 to 8 the water-cooled plates *g* are shown in front view and section on a larger scale than in Figs. 1 and 2. They are formed of cast-iron of any desired shape and size by casting in a mold, in the cavity of which are placed and supported U-shaped water-pipes *i*, the metal being cast around the pipes in a manner well known in the art of casting, and which needs not to be here described. By the expression "U-shaped pipes" I mean to designate sections of pipe placed vertically in the cooling-plates with the two extremities extending above the top edges of the plate at the same end, as at *i' i'* in Figs. 3, 5, and 7, each section of pipe between its two extremities being curved in such way as may be necessary or desirable to distribute the water-space throughout the body of the plates *g*. Thus, in Fig. 7, where the plate *g* is designed to be used in a part of the hearth of a furnace where there are no openings from the outside, each section of pipe I is simply bent in U form, so as to bring both ends of the pipe to the top of the plate. In Fig. 5, where the plate is intended to surround the tap-hole, an opening *d'* of suitable size and shape being made in the plate for that purpose, each section of pipe *i* is bent so as to pass around the tap-hole, as shown in the figure, and in Fig. 3, which represents two plates surrounding the cinder-notch, the pipes *i* are curved, so as to traverse the wider as well as the narrower portions. If a single plate were used for the cinder-notch instead of two, the pipes might pass from one side to the other of the opening, as in Fig. 5. Each adjacent pair of pipes (excepting the inlet-pipe 1 and outlet-pipe 2) is connected together by elbow-joints and connecting-pieces *k k'*, so as to form a continuous water-pipe connection. For example, in Fig. 5 cold water, entering at the projecting end 1 of pipe *i*, traverses the whole series of pipes, as indicated by dotted lines, until it passes out at the projecting end 2. These projecting ends 1 and 2 are the inlet and outlet pipes for the cold water, which is introduced from a circular water-pipe *l*, surrounding the furnace at any suitable point, (see Fig. 1,) the inlet-pipes 1 being connected with the cold-water supply *l* and the outlet-pipes 2 being carried to or connected with any convenient escape pipe or trough. The special advantage of the arrangement of the pipes *i* in the cooling-plates, as just shown and described, is that if any of the pipes should become stopped or choked they may be cleared out by connecting the inlet-pipes 1 with a steam-boiler and passing steam through the series of pipes, or, in case any of the pipes should be rendered useless by the burning of the plates—as, for example, pipes i^2 i^2—nearest to the cylinder-notch or tap-hole, these pipes may be cut out of the series by removing the elbow-joints *k* and coupling-pieces *k'* and making a new arrangement which shall cut out the section of pipe which has become destroyed by burning or otherwise.

In addition to the vertical cooling-plates just described, I place a cast-iron cooling-cap-plate *m*, constructed as before described, in a horizontal, or preferably in a somewhat inclined, position over the tap-hole *d* of the furnace, as shown in Figs. 1 and 2. The dotted lines in Fig. 2 indicate the course and position of the internal water-pipes. If the plate *m* is inclined, it should incline downward toward the outside of the furnace. The pipes 3 and 4, connecting with the interior pipes of the cap-plate *m*, are the inlet-pipes from the water-supply pipe *l* and the outlet-pipe for the heated water.

I claim—

1. In blast-furnaces, the combination, with the masonry hearth-wall and tuyeres, of water-cooled plates arranged in a circle horizontally within the furnace-wall below the tuyere-level, pipes for conducting water to said plates, and a water-cooled external casing extending from substantially the level of the water-cooled plates to the base of the furnace, substantially as and for the purposes described.

2. In the construction of blast-furnaces, the combination, with the hearth-wall and

tuyeres, of the cylindrical casing with cooling-plates set in contact with the inner surface of said casing below the tuyere-level at the points exposed to great heat, pipes for conducting water to said plates, and masonry or brick-work built within said casing, substantially as and for the purposes described.

In testimony whereof I have hereunto set my hand this 6th day of October, A. D. 1890.

HUGH KENNEDY.

Witnesses:
W. B. CORWIN,
THOMAS W. BAKEWELL.