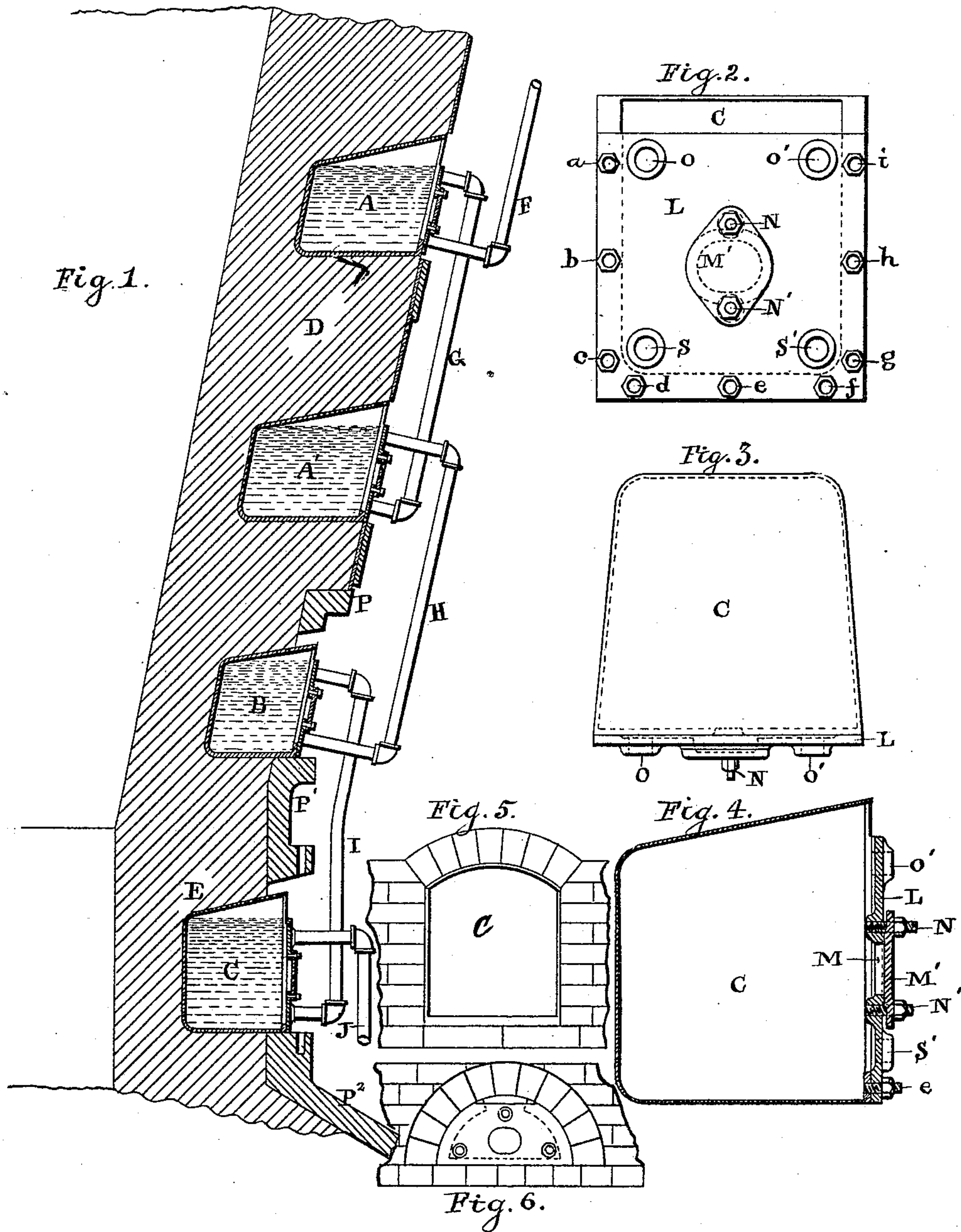


(No Model.)

J. J. FRONHEISER & S. W. VAUGHEN.
APPARATUS FOR COOLING THE WALLS OF BLAST FURNACES.
No. 460,006. Patented Sept. 22, 1891



WITNESSES.

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APPARATUS FOR COOLING THE WALLS OF BLAST-FURNACES.

SPECIFICATION forming part of Letters Patent No. 460,006, dated September 22, 1891.

Application filed November 18, 1890. Serial No. 371,784. (No model.)

To all whom it may concern:

Be it known that we, JAMES J. FRONHEISER and SAMUEL W. VAUGHEN, citizens of the United States, residing at Johnstown, in the county of Cambria and State of Pennsylvania, have invented certain new and useful Improvements in Apparatus for Cooling the Walls of Blast-Furnaces; and we do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

In the operation of a blast-furnace for smelting iron or other ores it is found that the life of the furnace is governed in many cases by the endurance of the fire-brick walls of the bosh or similar parts which are subjected to wear from moving stock, to corrosion from melted slag, and to fusion from heat. It was formerly the practice to provide for this wear by making the bosh-walls of great size, a thickness of five and six feet not being uncommon. This excessive use of material did not always produce the desired result, one of the reasons being that, owing to the large mass of non-conducting material in the walls, their inner portions exposed to the heat were rapidly worn away, with the effect of producing a furnace-hearth of irregular form, not conducive to best results in operation, as will be readily understood. In order to prevent the undue erosion or fluxing of furnace-walls, many cooling devices have been used, the cooling medium in most cases being water under pressure. One of the usual forms of cooling devices consists of a number of flat plates of metal built into the wall at proper intervals and forming part of it, the inner faces or edges of the plates being placed at such a distance from the inner face of the wall as is found to be the proper one for protecting the brick-work while the metal plate is not subjected to too much heat. As applied to blast-furnaces having bosh and in walls of a form circular in plan, these plates have the form of a flat annular segment. They are ordinarily made of cast-iron, which in the process of manufacture is cast around an iron or copper pipe bent in a series of loops or coils, the ends of which project from the exterior edge of the plate for the purpose

of attaching to them suitable water supply and discharge pipes. In use these plates are built into the furnace-walls in one or more rows, and their coils are connected with a supply of water under pressure, which circulates through them with the effect of keeping the furnace-walls cool, thus protecting them to a certain extent from rapid wear from any of the causes before mentioned. It is found, however, that the use of such plates is attended with certain disadvantages and inconveniences consequent upon their form, their construction, and the manner in which they have to be supplied with water. As the water-coils are of necessity inaccessible, they become clogged up at times with scale, rust, or other material, with the effect of stopping the water circulation, and the final result of such stoppage is that the brick furnace-walls being unprotected burn out and the plates themselves are destroyed by the heat. Another disadvantage attendant upon the use of such plates is that if for any reason the plates become worn, cracked, or leaky a part at least of the water supplied to them may find its way into the furnace-hearth, causing trouble in operation, as will be readily understood.

Other devices than the above have been used for cooling furnace-walls; but most of them are open to the same objections heretofore set forth, and an enumeration of them here is deemed unnecessary.

It is the object of our invention to provide devices for cooling the walls of furnaces which overcome the stated objections and which use as a cooling medium water which circulates at such a low pressure that even should a leak occur it could not force its way into the hearth of a furnace, while our cooling devices are so constructed and placed as to admit of ready access for cleaning and removing any material which would interfere with the proper circulation of water within them. Their construction and position are such that should the necessity occur they may be readily removed and replaced.

Our cooling devices consist of a number of boxes placed in rows in the wall of a furnace, each box having a narrow horizontal opening at its upper and outer edge to provide for an overflow of water should a stoppage occur in

the discharge-pipe, while the opening also serves to allow the escape of gas in case the box should become cracked, worn, or leaky in such a way as to allow the furnace-gas to pass through it. Each of these boxes is supplied with water by a pipe connected near one of its exterior bottom corners, while near one of its upper exterior corners is a discharge-pipe. The form of these boxes may be varied, as necessary, to conform to the construction of adjoining parts. As applied to the bosh-wall of the usual blast-furnace for smelting iron, each one of our boxes is made of cast-iron, bronze, or other suitable metal, with thin walls to allow of ready conduction of heat. In plan and horizontal section the boxes have the form of a trapezoid, with rounded corners at the small end, the converging sides of which are formed radially with the axis of the furnace. The top of the box is inclined from its exterior to its interior in a downward direction and may be a plane or may have the form of a cylindrical or conical segment. These latter forms have an advantage over the plane top surface in that they allow a brick arch to be turned over them, and this arch properly supports the brick-work over the box in a better manner than does the plain straight tile, which is of necessity used above the boxes having plane tops.

The front of our box-casting is left open and is made with an interior flange on two sides and bottom, to which flange is bolted a front cover of metal, which cover extends nearly to the top of the box, leaving there a narrow horizontal opening. In this cover-plate is a hand-hole near its middle provided with a cover which is held in place by bolts and which may readily be removed to allow of access to the interior of the box in order to clean it or for other purposes. At the corners of the large cover-plate of the box are four bosses or hubs bored out and threaded for pipe connections. The upper ones are intended for connection of discharge-pipes and the lower ones for the supply-pipes. In operation only one of these connections need be in active use, although the other ones may be fitted up complete in case they might be needed, if the set in use becomes clogged up or inefficient from any cause. As applied to the bosh and hearth walls of a blast-furnace for smelting iron ore these boxes are placed in several horizontal rows, the boxes in each row being preferably but a small distance apart, and the spaces unoccupied by boxes in one row have immediately over them the boxes of the row next above them, or, in other words, the boxes are preferably staggered vertically. The object of so placing the boxes is to provide a better protection for the furnace-wall, as such a position would tend to keep the wear of the same more uniform and prevent the formation of grooves or pits in the wall. The connection of water-supply pipes is made at the bottom of the boxes, while the discharge-

pipes are connected near the top of the same. In order to save water and to simplify the pipe system the discharge-water from each row is supplied to the row below, the supply being so adjusted that the water finally discharged from the lower row is at the maximum temperature consistent with proper operation of the cooling device. This system of pipes may be supplemented by another system, in which each box can be supplied independently for use in case any of the boxes become temporarily disarranged.

Having given this general description of our devices, we will now, to make our invention more clear, refer to the annexed sheet of drawings, which form part of this specification, and in which like letters refer to like parts.

Figure 1 is a vertical section through the center of a blast-furnace, showing part of the bosh and hearth walls containing our cooling-boxes, the pipe connections of which are shown in elevation. Fig. 2 is a front elevation of the lower box shown in Fig. 1 with the pipes removed. Fig. 3 is a plan of box shown in Fig. 2, while Fig. 4 is a vertical section through the center of the same. Figs. 5 and 6 are front elevations showing different forms of boxes with curved tops to allow brick arches to be turned over them.

Referring now to Fig. 1, D is a section of the bosh-wall of a blast-furnace. E is a section of the hearth-wall of the same. P, P', and P² are sections of the cast-iron binding-plates of these walls. A A' and B and C are vertical sections through the centers of four cooling-boxes built into the walls D and E and which form part of horizontal rows of similar boxes. F is a supply-pipe, which, as shown on the drawings, furnishes water to the box A, whence it is discharged by the pipe G into the box A', thence by the pipe H into the box B, thence by the pipe I into the box C, from which latter the water is discharged by the pipe J into a drain or tank, as may be necessary.

Referring now to Figs. 2, 3, and 4, C is one of our cooling-boxes, L is the front cover-plate of same, O and O' are holes bored and tapped to receive discharge-pipes, and S and S' are similar holes for supply-pipes. M is a hand-hole in plate L, and M' is a cover for hand-hole held in place by bolts N N', and a, b, c, d, e, f, g, h, and i are bolts which hold the cover-plate L in place on the box C.

Figs. 5 and 6 are front elevations of different forms of boxes having curved tops to allow brick arches to be built over them, thus preventing an undue amount of weight on the boxes and facilitating their removal when necessary. In operation water is supplied to the upper row of boxes, one of which is shown at A, by a number of pipes similar to the one shown at F. The water from each row of boxes is discharged into the row below, while the water from the lower row is discharged into a tank or sewer.

Having thus described our devices and the

mode of their operation, what we claim as of our invention, and desire to secure by Letters Patent, is—

5 1. A cooling device for the walls of furnaces, consisting of a metallic box provided with a narrow horizontal front opening near its top external edge and having openings in its front wall, one near its bottom and another near its top, these openings being connected with suitable supply and discharge
10 pipes, substantially as set forth.

2. In a cooling-box for furnace-walls, the combination, with the box having an open front side, of a cover-plate removably fastened thereto, a narrow horizontal opening
15 near the top exterior edge of said box, and holes in said cover, one near the bottom for supply of water to and another near the top for discharge of same from said box, substantially as set forth.
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3. In a cooling-box for furnace-walls, the combination, with the box having an open front side, of a cover-plate removably fastened thereto, a narrow horizontal opening
25 near the top exterior edge of said box, holes

in said cover, one near the bottom for supply of water to and another near the top for discharge of same from said box, a hand-hole in said cover, and a hand-hole plate removably fastened to said cover over said hand-hole, 30 substantially as set forth.

4. In apparatus for cooling the walls of furnaces, the combination of horizontal rows of cooling-boxes having narrow openings in front near their tops, with a system of water-pipes 35 connecting with the upper row near the top of their front walls, leading thence to the bottom of the front walls of the lower rows in succession, and discharge water-pipes leading from a point near the top of the front 40 walls of the lower boxes to a suitable tank or drain, substantially as set forth.

In testimony whereof we affix our signatures in presence of two witnesses.

JAMES J. FRONHEISER.
SAMUEL W. VAUGHEN.

Witnesses:

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CORA P. SCOPY.