(No Model.)

J. KENNEDY.

BOSH PLATE FOR BLAST FURNACES.

No. 378,550. Patented Feb. 28, 1888.

Fig. 1.

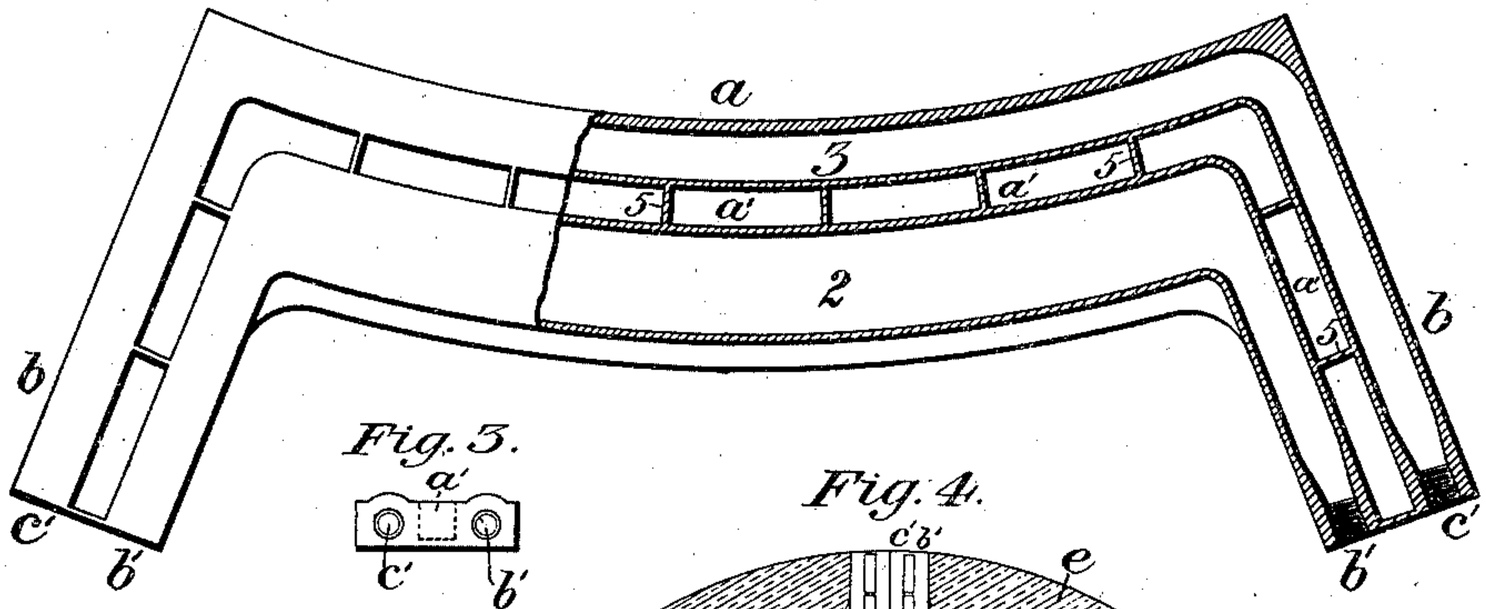


Fig. 2.

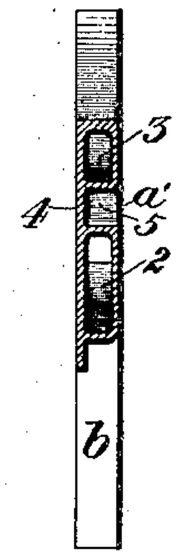


Fig. 3.

Fig. 4.

Fig. 6.

Fig. 7.

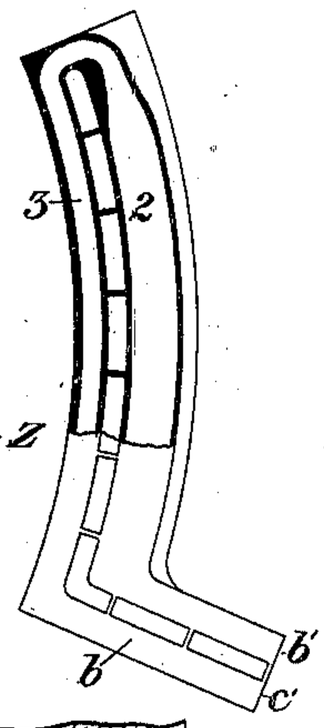
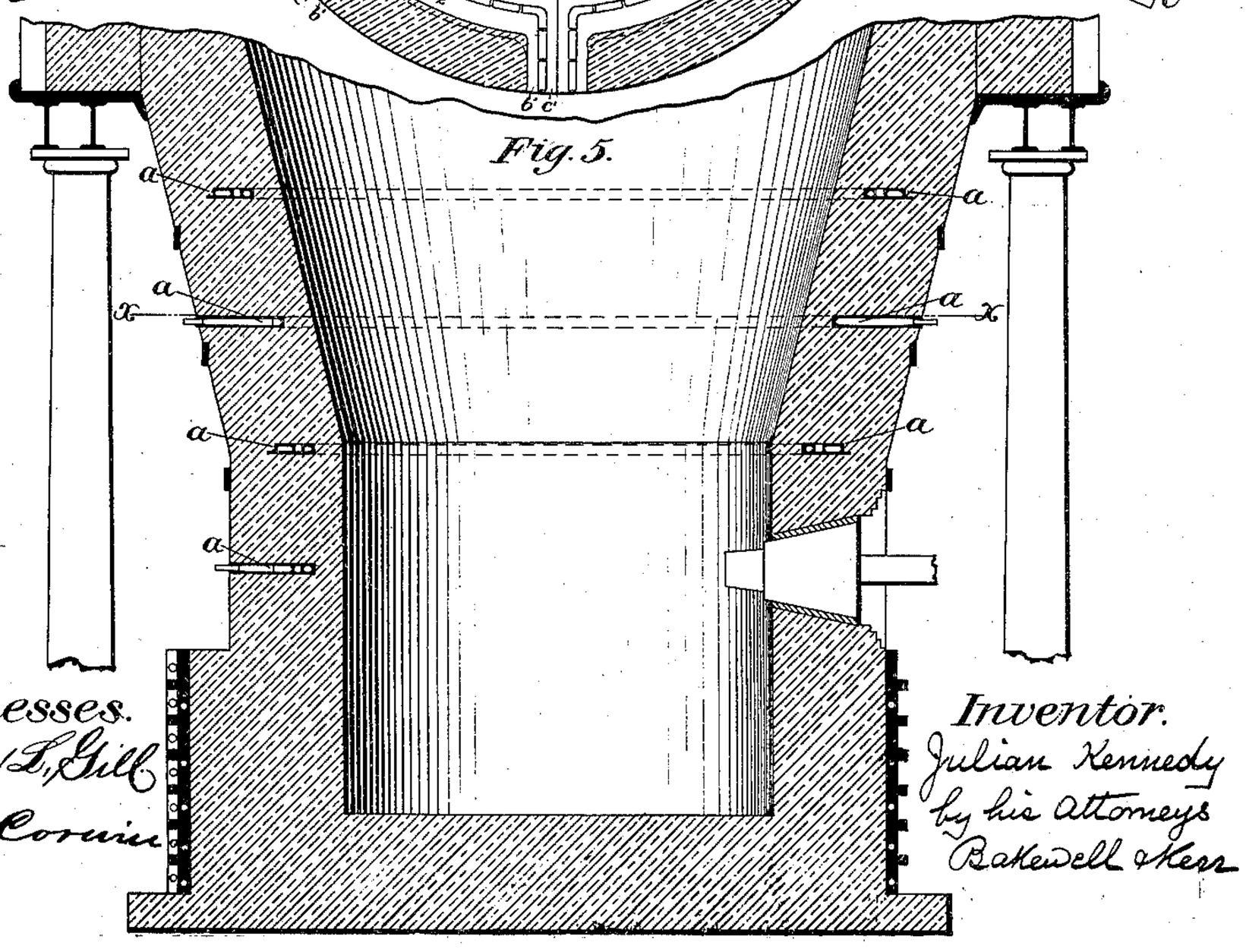


Fig. 5.



Witnesses.
Harry L. Gill
W. B. Corwin

Inventor.
Julian Kennedy
by his attorneys
Bakewell & Kerr

UNITED STATES PATENT OFFICE.

JULIAN KENNEDY, OF PITTSBURG, PENNSYLVANIA.

BOSH-PLATE FOR BLAST-FURNACES.

SPECIFICATION forming part of Letters Patent No. 378,550, dated February 28, 1888.

Application filed December 12, 1885. Serial No. 185,433. (No model.)

To all whom it may concern:

Be it known that I, JULIAN KENNEDY, of Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Blast-Furnaces; and I do hereby declare the following to be a full, clear, and exact description thereof.

In the operation of blast-furnaces one of the difficulties which engineers have been obliged to meet is the corrosive action of the intense heat and smelting reactions upon the masonry of the stack. The inside of the walls, unless protected, soon burn out and present large cavities around the boshes, where the heat is very intense. The formation of these cavities destroys the symmetry of the stack and produces an uneven or faulty distribution of the currents of reducing-gases, and also causes an irregular descent of the solid materials, which necessitates the use of a greater amount of fuel and more time to smelt the iron. To prevent this and to preserve the integrity of the furnace-walls, it has been usual to build circles of water-cooled plates in the masonry of the bosh. These are technically known as "bosh-plates," and have consisted of simple cast-iron plates, which are cast about a coil of wrought-iron pipe circular in cross-section. A series of these plates, which are of the form of a segment of a circle, is built into the stack around the bosh in the same horizontal plane, with their sides abutting against each other, so as to encircle the stack, and a stream of water is caused to circulate through the coil in each segment. A number of these horizontal series of water-plates is built in the furnace-walls, separated vertically from each other usually about three feet. The inner edges of these plates are distant from the inside of the furnace about six inches when the latter is in its normal condition, and the outer edges project to the outside of the stack, where it has been customary to unite the adjacent plates to each other by bolts and flanges for the purpose of bracing the furnace-walls. The circulation of water through these plates has the effect of retarding the corrosion of the walls very greatly; but they are subject to the following disadvantages: When in time the working of the furnace burns away the inner lining of the walls and exposes the edges of the plates, the cast-iron shell of the latter will eventually burn and will lay bare the inner part of the coil. Immediately upon the destruction of the latter the water will escape into the furnace and the usefulness of the plates as a cooling device will be spoiled. This necessitates the removal of the old plate and the substitution of a new one; but this change is apt to distort the furnace-wall, the symmetry of which cannot easily be restored. In the iron pipes which have customarily been cast inside of the bosh-plates there is an especial reason for their destruction, because the flowing water, unless exceptionally pure, soon corrodes their inner surfaces, and this causes a sediment or deposit from the water to settle in and adhere to the pipes and to choke or partially choke them, thereby lessening the cooling influence of the water and causing the exposed plate to burn away rapidly. Another bad feature of the bosh-plates which have been commonly used results from the mode of their manufacture. In casting the metal around the wrought-iron or copper coil there is apt to be an imperfect union between the two, caused either by the formation of blow-holes in the surrounding metal or from other causes. In consequence the coil has a defective cooling influence on the plate and upon the stack, and when the plate itself is exposed it soon burns.

My invention has for its object to so improve the construction of these bosh-plates and their auxiliary appliances as to obviate the evils above adverted to and to strengthen the structure of the stack.

In order that others skilled in the art may fully understand and apply the invention, I will describe it with reference to the accompanying drawings, in which—

Figure 1 is a plan view of one of my improved bosh-plates, a part of the upper shell thereof being broken away for purpose of illustration. Fig. 2 is a vertical cross-section of the plate on the line *x x* of Fig. 1. Fig. 3 is an end view of the pipe end of the plate. Fig. 4 is a horizontal cross-section through the boshes of a blast-furnace, showing the arrangement of the bosh-plates in the furnace-walls on the line *x x* of Fig. 5. Fig. 5 is a vertical axial section on the line *x x* of Fig. 4. Figs. 6 and 7 are views of modifications.

Like figures and letters of reference indicate like parts.

As shown in Fig. 1, the general outline of the bosh-plate *a* is that of a segment of a circle, having at the ends projecting arms *b*, which extend outward in the direction of radii of the circle. The plate consists of two adjacent parallel pipes, 2 and 3, whose bases are connected by an integral web, 4, preferably coextensive with the pipes. At intermediate points along the sides of the pipes they may be further united and strengthened by connecting-ribs 5, which extend across the intervening space *a'*. The pipes 2 and 3 are thus entirely distinct in their structure, and are connected only by the web 4 and ribs 5. In cross-section the shape of the pipes is preferably oblong, as shown in Fig. 2, and at their ends they are screw-threaded, as at *b'* and *c'*, for the attachment of pipe-connections. For the latter purpose the ends of the pipes are somewhat reduced in diameter and are of cylindrical form; but instead of being reduced abruptly at the discharge end they taper gradually. This is a material feature of advantage, since when thus made there is no lodging-place for the collection of leaves or other impurities which may be in the water, and which would otherwise be apt to choke the pipe.

The plates are built into the furnace-walls, as shown in Fig. 4, being laid horizontally on the same course of bricks, with their radial ends in contact, or nearly so. The inner concave sides of the plates lie at a short distance from the inside of the stack, and the ends of the radial arms of the pipes are made flush with the outside of the wall. There is therefore a row or several rows of brick, *d*, separating the inside of the track from the plates, and there is also masonry *e* on the outer or convex side of the pipe 2 and between the radial arms of the plate. The space *a'* between the pipes is filled in with brick or mortar, or both, and this, by uniting with the layer of brick immediately above the plate, holds the latter still more firmly in position and increases the coherency of the structure. The masonry *e* between the arms forms solid and unbroken vertical columns extending from the base of the stack to the level of the mantel. The existence of these columns has a very material effect in strengthening the furnace-stack, the external brick-work being unbroken except where the arms *b* project from it. The bosh-plates heretofore in common use, which extend to the outer face of the wall, break the integrity of the masonry, and by interposing a rigid sheet of metal on which the mortar has no firm grasp very much weakens the structure, the more so on account of the unequal limits of expansion and contraction of brick and metal. This disadvantage thus stated is not apparent when the plates are applied as shown in Fig. 4, because the brick columns *e* bind the stack together and hold it in its proper shape.

The advantage of this construction of furnace will be strikingly apparent to the skilled blast-furnace engineer. It very greatly increases the solidity of the stack as compared with furnaces built with the old-style plates described above—so much so, in fact, that even if both water-pipes of my improved bosh-plate should be burned out the columns *e* would impart the stability to the furnace necessary to successful operation, while the presence of the few projecting arms of the plates would be no material detriment to the structure.

Water-supply pipes are coupled to the ends of the pipes 2 and 3 in the ordinary manner, and a constant current of water is maintained through the latter, the effect of which is to cool the masonry and to retard the burning of the stack. When in turn the boshes burn out so much as to expose the inner pipes, 3, to the stock in the furnace, and finally burn this pipe out, the construction of the bosh-plate is such that the outer pipe, 2, is left intact, and by turning off the water from the inner pipe and using the outer pipe only, the cooling influence of the water-circulation is still obtained. For this purpose the pipe 2 is preferably made of greater diameter than the inner pipe, as shown in the drawings, so that when the supply of water through the latter is checked the cooling of the other pipe may be sufficient to conserve the stack.

I prefer to cast the bosh-plates as a homogeneous casting in a single piece, using as the material of their structure phosphor-bronze or other material not liable to be corroded by impure water or heat. Pipes made of this material are therefore much more durable than either cast or wrought iron pipes. It is difficult to cast these hollow pipes unless their bore be of considerable diameter; but if they be of circular section the proper diameter for this purpose would unduly increase their bulk and thickness for use in bosh-plates. The desired result is, however, attained by making the pipes of oblong cross-section. They are then easily cast, and present a maximum area of cooling-suface without being subject to the disadvantage of improper thickness.

The principal object to be gained by making the pipes separate from each other by the space *a* is for the purpose of enabling any defect in casting the shells of the pipes to be readily discovered. If cast with one side in common, the formation of a blow-hole or other defect not easily detected in testing might open a communicating channel between them, which, in case of the burning of the inner pipe, would destroy the whole plate, because the outer pipe would then leak directly into the furnace.

I do not desire to limit the scope of all of the following claims by the casting of the pipes 2 and 3 in a single piece. They may be cast separately, as shown in Fig. 6, and be built into the furnace by seating one of them upon the laterally-projecting flange or web of the other. Nor do I desire to limit myself to the bosh-plate having radially-projecting arms at

both ends. If desired, only one of these arms may be employed, and the pipes 2 and 3, instead of being made distinct, may together constitute a single and continuous pipe, which, entering the plate through the single projecting arm, is reflexed at the other end of the plate and returns in the reverse direction through the body of the plate and through the arm at the end of which it has its discharge. This construction is shown in Fig. 7, and while on some accounts it may be convenient, it is subject to the objection that it affords but a single water-pipe, so that the destruction of one of its arms would ruin the whole plate.

I am aware that Patent No. 79,866, granted to Shea and Harvey on July 14, 1868, shows a circle of vertically-arranged bosh-plates built in the furnace-wall with water-connections extending to the outside; but such construction differs from mine, in that it cuts the wall vertically, forming practically outer and inner shells of masonry, the temperature of which, owing to the interposed cooling metallic shell, is so different as to cause a difference in the expansion and contraction of the two parts, which will tend to disrupt the stack.

I am also aware of Strobel's Patent, No. 326,804, dated September 22, 1885, having a circle of horizontally-arranged bosh-plates built in the furnace; but such construction differs from mine, in that the plates extend to the surface of the wall and cut it horizontally, differing in this respect in no way from the old form and arrangement of bosh-plates hereinbefore referred to, while my construction and arrangement secures a practically-unbroken exterior of masonry. My stack is not cut by the bosh-plates either horizontally or vertically, but is bound together by practically-unbroken masonry, in which the bosh-plates are embedded without injury to the strength and endurance of the stack.

By the words "unbroken exterior," as used in this specification and the claims, I mean an exterior shell of masonry which is unbroken by the iron bosh-plates that are built into the interior part of the wall, said exterior shell being continuous, solid, and unbroken except where the water pipes or connections *b c* extend through it to the outside, said connections, however, not being of sufficient size to injuriously affect the strength and durability of the stack.

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

1. A blast-furnace having water-cooled horizontal bosh-plates, constructed substantially as described, embedded in the walls of the bosh, and a practically-unbroken exterior wall of masonry, substantially as and for the purposes described.

2. A bosh-plate for furnaces having two separate water pipes or channels extending through it, with a supporting-flange extending between the pipes or channels, and an open space between the adjacent sides of the two pipes or channels, substantially as and for the purposes described.

In testimony whereof I have hereunto set my hand this 4th day of December, A. D. 1885.

JULIAN KENNEDY.

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