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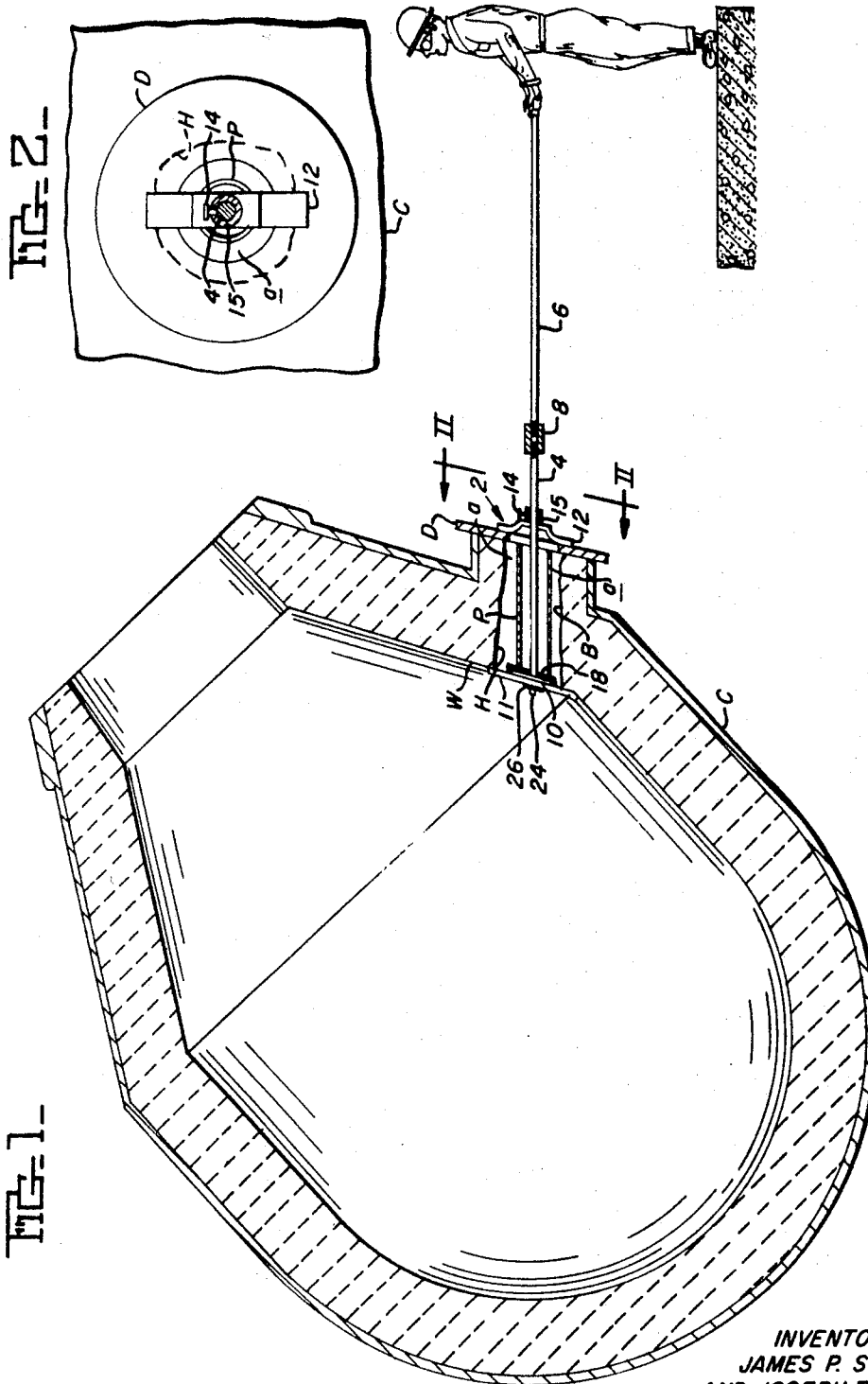
J. P. SULLIVAN ET AL

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METHOD AND APPARATUS FOR REPAIRING TAP HOLES IN FURNACE WALLS

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2 Sheets-Sheet 1



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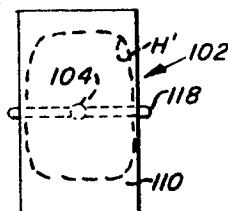
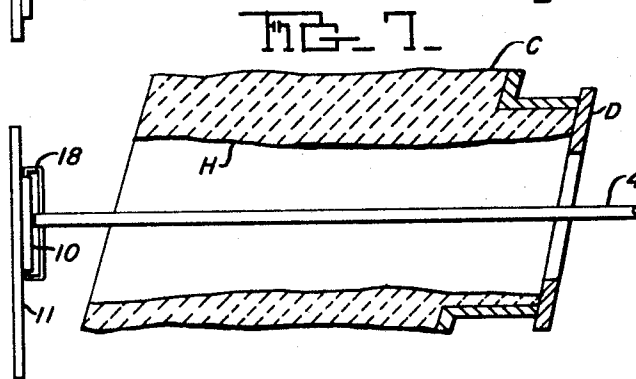
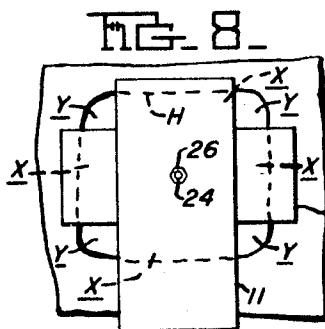
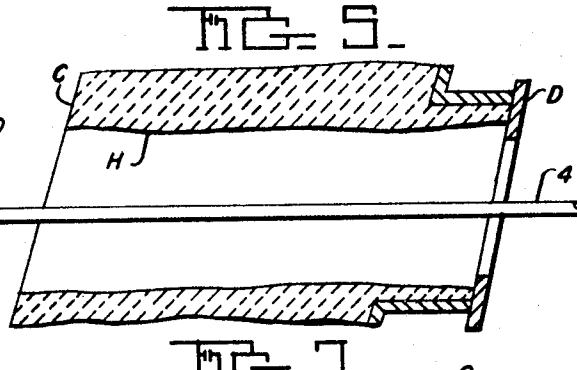
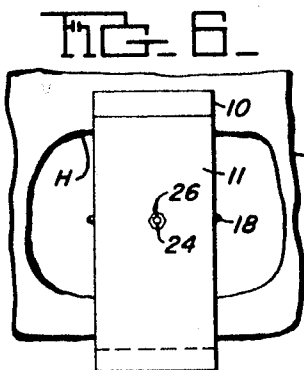
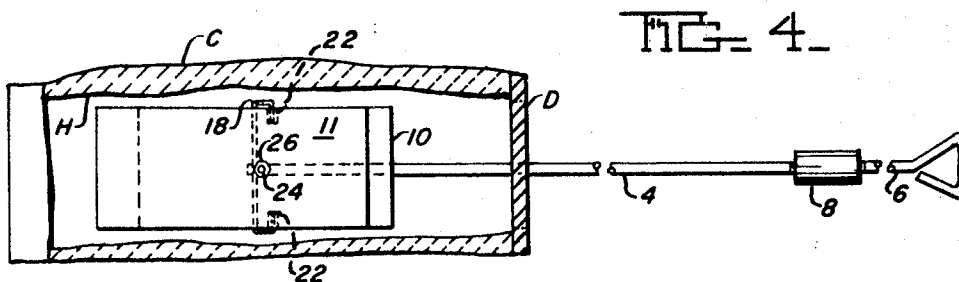
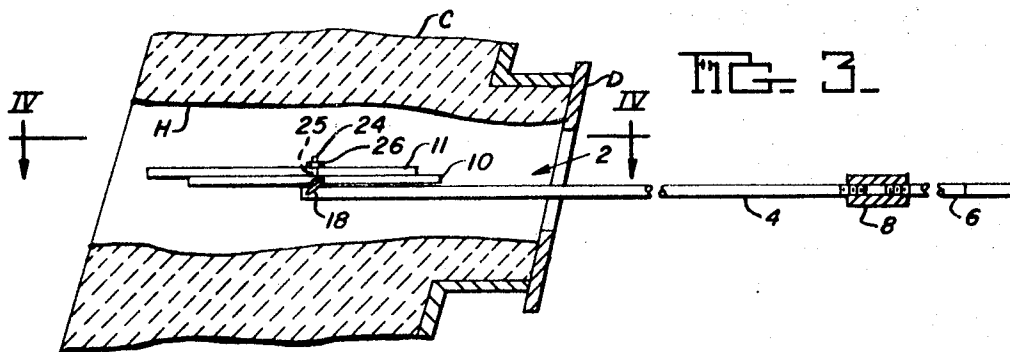
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METHOD AND APPARATUS FOR REPAIRING TAP HOLES IN FURNACE WALLS

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ABSTRACT OF THE DISCLOSURE

Apparatus for covering one end of a tap hole on one side of a furnace wall, and a method of cementing a pipe in a worn tap-hole of an oxygen steel converter. The purpose is to block one end of a hole while introducing cement or other such viscous material to the other end. The apparatus is fed through the hole from the end opposite the end to be covered, and is manipulated into its hole-covering position from the opposite end of the hole. The method simplifies the steps required for repairing worn tap-holes of oxygen steel converters.

This invention relates to apparatus for covering tap holes in furnace walls, particularly where one end of the hole is difficult to reach. The invention also relates to a method of repairing a worn tap-hole of an oxygen steel converter.

During the tapping of the converter, the refractory lining of the converter adjacent the tap-hole is gradually eroded. The usual method of repairing this tap-hole has been to rotate the converter until the axis of the tap-hole is horizontal. Then a steel pipe having a length substantially greater than the length of the tap-hole is inserted into the hole until one end is flush with the outer end of the tap-hole. The other end of the pipe protrudes a substantial distance into the interior of the converter. A workman fixes the pipe in this position with cement introduced at the outer end of the tap-hole. After the cement hardens, the converter is rotated further until the axis of the tap-hole is vertical and the mouth of the converter faces the workman. He then shovels cement into the converter and around the protruding steel pipe, thus filling the space between the refractory and the outer surface of the steel pipe. When this second application of cement has hardened, the converter is tilted back to its vertical position and is ready for refining another batch of iron. During the first tapping of metal through the repaired tap-hole, the steel pipe left in the tap-hole melts and dissolves in the hot metal flowing through it.

One disadvantage of the foregoing method is the time taken for two separate applications of cement to harden. An average of 15 to 20 minutes is required to repair a tap-hole. Another disadvantage is the inefficient, slow manner in which the second application of cement must be shovelled around the pipe inside end of the furnace by a workman standing outside. Both cement and the workman's time are wasted.

An object of our invention is to provide a method and apparatus for repairing the tap-hole of a converter that requires less time than prior methods and apparatus, and makes it easier for the operator to apply the correct amount of cement needed for repairing the refractory around the tap-hole.

Another object of our invention is to provide apparatus that can be manipulated to cover an end of a hole on one side of a wall by an operator standing on the opposite side of the wall. Such apparatus has application with the foregoing method, but has many other uses as well.

These and other objects will be more apparent in the

following detailed description of our invention and the attached drawings in which:

FIGURE 1 is a vertical sectional view of an oxygen converter undergoing repairs with our apparatus, the converter being shown smaller than scale to enable a more detailed showing of the tap-hole and repair apparatus;

FIGURE 2 is a sectional view of the tap-hole repair apparatus of FIGURE 1, taken along line II—II of FIGURE 1.

FIGURE 3 is a detailed sectional view of the tap-hole of the converter of FIGURE 1, showing apparatus of our invention being inserted therethrough;

FIGURE 4 is a sectional view of the converter tap-hole, taken along lines IV—IV of FIGURE 3, showing a top view of our apparatus;

FIGURE 5 is a sectional view of the converter tap-hole showing our apparatus inserted therethrough with the cover plates of the apparatus held in a first operating position;

FIGURE 6 is an interior end view of the converter tap-hole and apparatus shown in FIGURE 5;

FIGURE 7 is a sectional view of the furnace tap-hole showing our apparatus inserted therethrough with the cover plates of the apparatus held in a second operating position;

FIGURE 8 is an interior end view of the converter tap-hole and apparatus shown in FIGURE 7;

FIGURE 9 is an interior end view of the tap-hole of an oxygen steel converter, and showing a modified form of our apparatus covering the tap-hole.

FIGURE 1 shows an oxygen steel converter C which has a worn tap-hole H. Before the tap-hole H is repaired, the converter is tilted to the position shown in FIGURE 1, so that the tap-hole H extends in a substantially horizontal direction. Then a hole repair apparatus 2 is inserted through the tap-hole H in a manner to be described, and is fixed in the position shown in FIGURE 1.

The apparatus 2 includes a rod 4, to which an extension handle 6 is detachably joined by a coupling 8. At the left-hand end of rod 4, as viewed in FIGURE 1, are mounted two cover plates 10 and 11. A pipe P is passed over the rod 4 from outside the converter C and placed in the tap-hole H. To hold the plates 10 and 11 pressed against the inner wall W, a clamp 12 outside the tap-hole H engages flange D of the converter. Sleeve 15, secured to the rod 4 by set screw 14, holds the clamp 12 against the flange D.

The connection of the plates 10 and 11 to the rod 4 is seen best in FIGURES 3 and 4, in which the apparatus is shown being inserted through the tap-hole H. A fork 18, pivotally mounted at the end of rod 4, extends around the edges of plate 10 and into holes 22 that are drilled in these edges. The fork 18 thus holds the plate 10 rotatable about the axes of its edge holes 22.

The plate 11 is pivotally connected to the plate 10 by a stud 24 that is welded to the middle of plate 10 and is in lengthwise alignment with the edge holes 22. The stud 24 is passed through a hole 25 in plate 11, and a nut 26 secures the plate 11. The hole 25 is positioned off-center on the plate 11 so that plate's center of gravity is to the left of the edge holes 22 (FIGURE 3), about which both plates 10 and 11 pivot. Thus, the plate 11 is weighted so that both plates assume a vertical position, as shown in FIGURE 5, when the plates have been pushed all the way through the tap-hole H with the fork 18 in a horizontal position.

In the operation, a workman outside the converter pushes rod 4 and plates 10 and 11 through the tap-hole H. As shown in FIGURES 3 and 4, plates 10 and 11 are pivoted to lie parallel with the rod 4. As FIGURE 4

shows, the width dimension of each plate is small enough to allow clearance between the plate and the interior wall of the tap-hole.

When plates 10 and 11 are pushed all the way through tap-hole H, the offset center of gravity of plate 11 causes both plates to assume a vertical position on the interior side of the converter wall, as shown in FIGURES 5 and 6. The workman then turns the rod 4 90°, thereby turning the plate 10 to the position shown in FIGURES 7 and 8, with its lengthwise dimension extending horizontally. Due to the pivotal connection between the plates 10 and 11, and the center of gravity of plate 11 being below stud 24, the plate 11 remains in its lengthwise vertical position while the plate 10 is turned. As shown in FIGURE 8, the lengthwise dimensions of both plates 10 and 11 are large enough that the plates span the inside end of the worn tap-hole and overlap portions x of the wall surface W. As also shown in FIGURE 8, small areas y of tap-hole H remain uncovered. Such uncovered areas are tolerable due to the high viscosity of the cement mix which the cover plates 10 and 11 are designed to stop. Only minimal amounts of cement will escape through these areas before the cement hardens.

Referring back to FIGURE 1, after the workman positions the plates 10 and 11, he slides a pipe P over the rod 4 and positions the pipe inside the tap-hole H. Then, he removes the extension handle 6 and slides the clamp 12 and sleeve 15 over the rod and secures them. The plates 10 and 11 are thus held pressed against the inner wall W of the converter, and the apparatus is ready for the cement.

Cement is fed into the annular area a between the pipe P and the walls of tap-hole H by an appropriate gunning means. In order to get cement between the bottom surface B (FIGURE 1) of the tap-hole H and the pipe P, it is necessary that the pipe P be initially suspended above this bottom surface. The workman may do this directly with his hands, or if the diameter of the tap-hole H is large compared to that of the pipe P, the pipe P can be suspended on the rod 4.

When the cement around the pipe P has dried, the converter is ready for use again. The apparatus 2 and pipe P are left in the tap-hole, and are expended by being melted and dissolved in the first tapping of metal through the tap-hole. The entire foregoing procedure of repairing the tap-hole requires approximately five minutes, as compared with 15 to 20 minutes for the prior-known method described above.

An end view of a modified form of our invention is shown by apparatus 102 of FIGURE 9. The tap-hole H' is of a slightly oblong shape, thus making it feasible to cover the interior end of the hole with only one cover plate 110 (FIGURE 9). The plate 110 is slid through the tap-hole H with its width oriented across the widest dimension of the tap-hole. When the plate 110 reaches the interior of the converter, the rod 104 is turned to that fork 118 holding plate 110 is horizontal. Then, due to the center of gravity of plate 110 being offset from its axis of rotation about fork 118, the plate 110 assumes a vertical position. In this position, the plate 110 covers the tap-hole H' with its width extending across the narrow dimension of the tap-hole, and its length spanning the widest dimension of the tap-hole. In all other respects, the construction and use of apparatus 102 is the same as the construction and use of apparatus 2 described above.

While several embodiments of our apparatus and method have been shown and described herein, other modifications and adaptations will be apparent within the scope of the appended claims.

We claim:

1. Apparatus for covering one end of a tap hole extending through a furnace wall, said apparatus comprising:

a rod extendable through said tap hole in said furnace wall,

a first plate pivotally mounted on said rod about a first axis perpendicular to said rod,

a second plate parallel to said first plate and pivotally connected to said first plate about a second axis perpendicular to both plates,

said plates having width dimensions that are small enough to allow passage of said plates lengthwise through said tap-hole in said furnace wall,

said plates having lengthwise dimensions large enough to span said end of said tap hole so that each of said plates overlaps portions of the furnace wall surface on opposite sides of said end of the tap hole,

said plates together being weighted to cause said plates to assume a vertical position when said first pivotal axis is horizontal, and

means for holding said plates in engagement with said furnace wall surface so as to cover said end of said tap hole.

2. Apparatus of claim 1 wherein said plates are weighted by said second plate having its center of gravity located to one side of said first pivotal axis when the lengthwise axes of said plates are parallel,

the lengthwise dimension of said first plate being large enough to span the said end of said hole so that said first plate can overlap portions of said wall surface spaced from the portions of the wall surface overlapped by said second plate.

3. Apparatus of claim 2 wherein said means for holding said plates includes a clamping arm mounted on said rod and adjustable along the length thereof, said clamping arm when said rod is centrally located in said hole having a portion engageable with the wall surface adjacent the end of said hole opposite from said end to be covered, means for securing said clamping arm in a fixed position on said rod so that said portion of said clamping arm engages its associated wall surface and pulls said plates tight against the wall surface adjacent said end of said hole to be covered.

4. A method of repairing a worn tap-hole of an oxygen steel converter, comprising:

feeding through said tap-hole from the exterior of said converter two plates that are pivotally connected together and have the axes of their longest dimensions aligned,

on the interior side of said tap-hole, rotating a rod attached to one of said plates so that the longitudinal axis of said plate pivots away from alignment with the longitudinal axis with the other plate,

extending a force from the exterior of said tap-hole on said rod to pull said plates tight against the interior wall of said converter adjacent said tap-hole,

placing from outside of said converter a pipe in said tap-hole,

feeding cement between the outer surface of said pipe and wall of said tap-hole, and

allowing said cement to dry, thereby securing said pipe in said tap-hole and forming a new tap-hole for said converter.

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