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(54) **Tap hole construction of a metallurgical vessel, method of renewing it and brick for use with it.**

(57) A tap hole construction of a metallurgical vessel with a refractory lining has a plurality of annular bricks (4) arranged in the longitudinal direction of the tap hole and having central openings which provide the tap hole flow passage (1) and refractory casting or spraying material (6) around said bricks (4) to fix them in place. To improve the centering of the tap hole and to make its renewal easier, at least one of the annular bricks (4) has at least one projection (7) projecting radially from its peripheral outer face. After introduction of the surrounding material (6), the projection becomes embedded in the material (6).

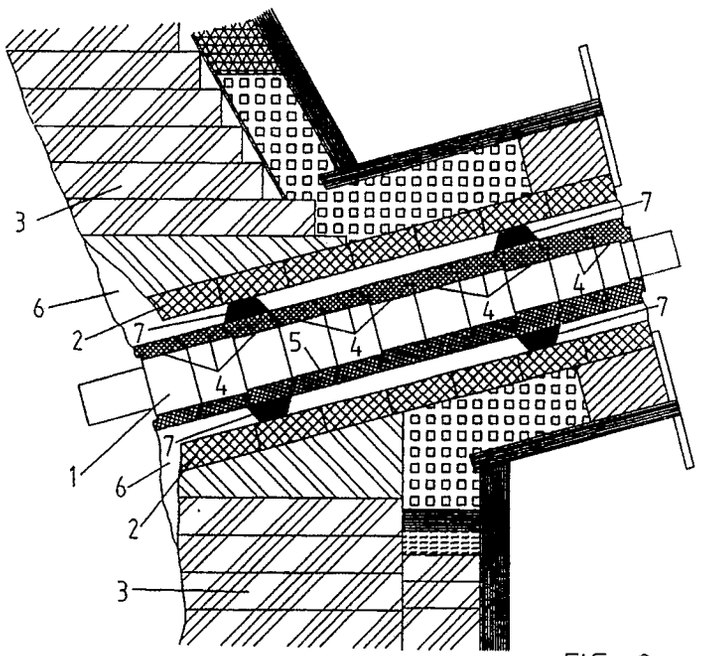

FIG. 2

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TAP HOLE CONSTRUCTION OF A METALLURGICAL VESSEL, METHOD OF RENEWING IT AND BRICK FOR USE WITH IT

The invention relates to a tap hole construction of a metallurgical vessel having a wall with a refractory lining and a tap hole in the vessel wall for discharging liquid metal out of the vessel. The invention also relates to a method of renewing such a tap hole construction and to a brick for use in such a construction and such a method.

In a known tap hole construction, the flow passage is provided by an assembly of annular bricks, which are arranged in the metallurgical vessel wall. A refractory casting or spraying mass or material is introduced between the annular bricks and the refractory lining, to fix the bricks in place. Such a metallurgical vessel is known from the practice of steel making, for example the oxygen steel process. See for example NL-A-6707057. In such a vessel a process is performed on the crude liquid metal in the vessel until a desired quality is reached, whereupon the finished steel is discharged out of the vessel through the tap hole by tilting the vessel.

In the case of a new tap hole, this tapping typically takes about ten minutes but the tap hole becomes enlarged through wear. Consequently after a number of charges have been processed in the metallurgical vessel, tapping time reduces to, for example, about four minutes. Then it is necessary to repair or renew the tap hole in order to avoid further reduction in tapping time and to prevent the refractory lining of the vessel wall from being affected.

Prior to the tap hole being repaired, the refractory casting or spraying compound still remaining is removed by being drilled out. Then an assembly of annular bricks is placed in the vessel wall where the tap hole is located. To this end the metallurgical vessel is brought into a tilted position and the assembly of annular bricks is held in the correct place using a fork lift truck for example. The annular bricks are prevented from moving laterally relative to each other by interlocking recesses and projections. Because this assembly is very heavy it is very difficult to position and maintain the annular bricks at the location of the tap hole.

After the assembly of annular bricks has been introduced and located at the tap hole position, the repair is completed by introducing a refractory casting or spraying compound between the annular bricks and the refractory lining of the vessel wall. Then the fork lift truck is driven away.

Moreover, even after the casting or spraying compound has been introduced but has not fully hardened, the assembly of annular bricks can sink under the weight of the bricks as soon as the fork lift truck is driven away. Repairing the tap hole in accordance with the current procedure is not only very hard, but also often suffers from the defect of poor positioning of the new tap hole in the vessel wall.

The result of this is that the maximum number of charges to be processed in the repaired metallurgical vessel is not as high as is possible in an optimally repaired vessel. Indeed this leads to higher operating costs because the next repair becomes necessary earlier.

It is mentioned that other tap hole constructions are known. US-A-3463475 shows tap hole bricks with square shapes having external projections which cooperate with recesses in the adjacent bricks of the lining.
Replacement of such bricks requires extensive rebuilding of the lining.

The object of the invention is to achieve the better and easier positioning and maintenance of the position of the assembly of annular bricks at the location of the tap hole.

The tap hole construction in accordance with the invention is set out in claim 1. The projection or projections on the brick ensure that the annular brick in question, and because the bricks are interlocked the whole assembly of the annular bricks, maintains at least a minimum distance from the refractory lining of the vessel wall, even after the casting or spraying compound has been introduced.

The tap hole construction in accordance with the invention further presents the advantage that a slag stopper as described in NL-A-8801231 of the present applicants is more effective. It is believed that, with the better location of the tap hole, the slag stopper is able to seal off the tap hole better as soon as slag is about to be tapped. Consequently, at the same time the quantity of steel tapped from a charge may be higher.

Another significant advantage of the invention is that it can improve safety. Repairing the tap hole in accordance with the current procedure necessitates the permanent presence of the fork lift truck in order to hold the assembly of annular bricks properly in position. This means that there is no room for a roof structure under which the casting or spraying compound can be introduced, giving protection to an operator from any waste which might fall from the stack above the metallurgical vessel. With the invention the fork lift truck may be driven away directly after the assembly of annular bricks has been put in position and a mobile roofing structure may then be placed in the spot where the

fork lift truck was standing so that protection is given against falling waste.

Preferably the or each annular brick provided with a projection has three such projections spaced circumferentially. Preferably each projection has the shape of a ridge extending in the axial direction of the brick. This helps achieve optimum centering of the new tap hole.

To achieve good centering over the full length (for example 2 metres) of the new tap hole it can be sufficient to provide two annular bricks with the radial projections which two annular bricks are located respectively near to the inner end and to the outer end of the tap hole. The remaining bricks then may have no such projections.

The invention further provides a method of renewing a tap hole construction of a metallurgical vessel as set out in claim 5, and a tap hole brick as set out in claim 9.

The invention will now be illustrated by way of example with reference to the accompanying drawings in which:-

Fig. 1 shows in section the tap hole portion of the wall of a known metallurgical vessel;

Fig. 2 shows in section the corresponding tap hole portion of a metallurgical vessel in accordance with the present invention; and

Fig. 3 shows an annular brick in accordance with the invention, used in the tap hole construction of Fig. 2.

Metallurgical vessels of the kind to which the invention relates are known and do not require further description here. The tap hole constructions of two metallurgical vessels are shown in Fig. 1 and Fig. 2 in accordance with the known state of the art, and in accordance with the invention respectively.

In each case, the tap hole passage 1 is provided by the central hole of an assembly of annular moulded bricks 4 located within a permanent refractory lining 2 of the vessel wall 3 of the metallurgical vessel. These moulded bricks are prevented from moving laterally relative to one another (i.e. radially with respect to the tap hole axis) by cooperating recesses and projections at their axial end faces so that the tap hole 1 is formed with an essentially smooth inner wall 5. When viewed along the length of the tap hole 1, it can been seen that the inside diameter of the tap hole 1 increased in size at selected places, in steps towards the interior of the metallurgical vessel. A refractory casting or spraying compound 6 is introduced between the annular bricks 4 and the refractory lining 2, to fix the bricks 4 in place.

The method of renewing the tap hole construction of both Figs. 1 and 2 has been described above. Briefly, the worn bricks 4 and compound 6 are removed e.g. by drilling, the new assembly of bricks 4 is put in position and new compound 6 is introduced.

Fig. 1 shows that the tap hole 1 of known construction is not centered well in the vessel wall 3. This has the result that the metallurgical vessel requires repair of the tap hole 1 earlier in order to avoid the risk of the permanent refractory lining 2 being affected.

In the case of the metallurgical vessel of Fig. 2 in accordance with the invention, among the moulded bricks 4 these is one centering brick near the inner end of the tap hole and another centering brick near the outer end of the tap hole. Each centering brick is provided with three circumferentially spaced projections 7 projecting from its outer face radially. These projections 7 are in this example shaped as axially extending ridges (see Figs. 2 and 3). The remaining bricks 4 have no such radial projection. The metallurgical vessel of this embodiment is able to process more charges than the vessel in accordance with Fig. 1 before repair of the tap hole 1 becomes necessary. The projections 7 extend approximately to the inner faces of the refractory bricks 2 and provide centering of the tap hole 1 in the vessel wall 3, so that excellent resistance is achieved against displacement of the assembly of moulded bricks 4, both during and after the introduction of the refractory casting or spraying compound 6. The projections 7 thus become embedded in the compound 6. Moreover, a tap hole 1 made in this manner is, taken by itself, much easier to center than the tap hole of the metallurgical vessel of Fig. 1. An optimally centered tap hole improves the action of a slag stopper used with the metallurgical vessel. This slag stopper is able to close the tap hole properly and on time, so that steel may be tapped slag-free for a maximum tapping time. This means that there is a high steel yield from a charge.

Fig. 3 shows a single annular moulded brick 4 in accordance with the invention which is provided with the three ridges 7 for centering. It can be seen that the three ridges 7 are uniformly spaced apart occupying in total less than 180° of the circumference of the brick 4, thus permitting the introduction of the compound 6 while achieving good centering of the assembly of bricks 4. Such a moulded brick is, as mentioned above, also provided with a recessed region 8 and a projection 9 for cooperation with a projection and recess respectively of an abutting moulded brick 4 to prevent bricks from moving against one another laterally. While the annular bricks 4 are here illustrated with cylindrical outer peripheries, other shaper may be used within the invention.

With metallurgical vessels provided with a tap hole 1 as in accordance with Fig. 2, the number of charges processed in this vessel per tap hole is

high even after repeated repair of the tap hole 1.

Claims

1. Tap hole construction of a metallurgical vessel having a wall with a refractory lining, said construction having a plurality of annular bricks (4) arranged in the longitudinal direction of the tap hole and having central openings which provide the tap hole flow passage (1) and refractory casting or spraying material (6) around said bricks (4) to fix them in place, characterized in that at least one of said annular bricks (4) has at least one projection (7) projecting radially from its peripheral outer face and embedded in said refractory casting or spraying material (6).

2. Tap hole construction according to claim 1 wherein the or each said annular brick (4) having at least one said projection (7) has three such projections (7) spaced circumferentially around the brick.

3. Tap hole construction according to claim 1 or claim 2 wherein the or each said projection (7) has a ridge shape extending axially of the brick.

4. Tap hole construction according to any one of claims 1 to 3 wherein two of said annular bricks each have at least one said projection (7), said two bricks being near to respectively the inner end and the outer end of the tap hole.

5. Method of renewing a tap hole construction of a metallurgical vessel having a refractory lining, which tap hole construction comprises a plurality of annular bricks (4) arranged in the longitudinal direction of the tap hole and having central openings which provide the tap hole flow passage (1) and refractory casting or spraying material (6) introduced around said bricks, said method including the steps of

(i) removing the annular bricks (4) and the refractory casting or spraying material (6) of the used tap hole construction, so as to provide a bore to receive the new tap hole construction,

(ii) locating a new plurality of said annular bricks (4) in said bore, and

(iii) introducing new casting or spraying material (6) around said new annular bricks to fix them in said bore,

characterized in that at least one of said new annular bricks has at least one projection (7) projecting radially from its peripheral outer face, for assisting location of said new bricks (4) in said bore while permitting the introduction of said casting or spraying material (6).

6. Method according to claim 5 wherein the or each said annular brick (4) having at least one said projection (7) has three such projections (7) spaced circumferentially around the brick.

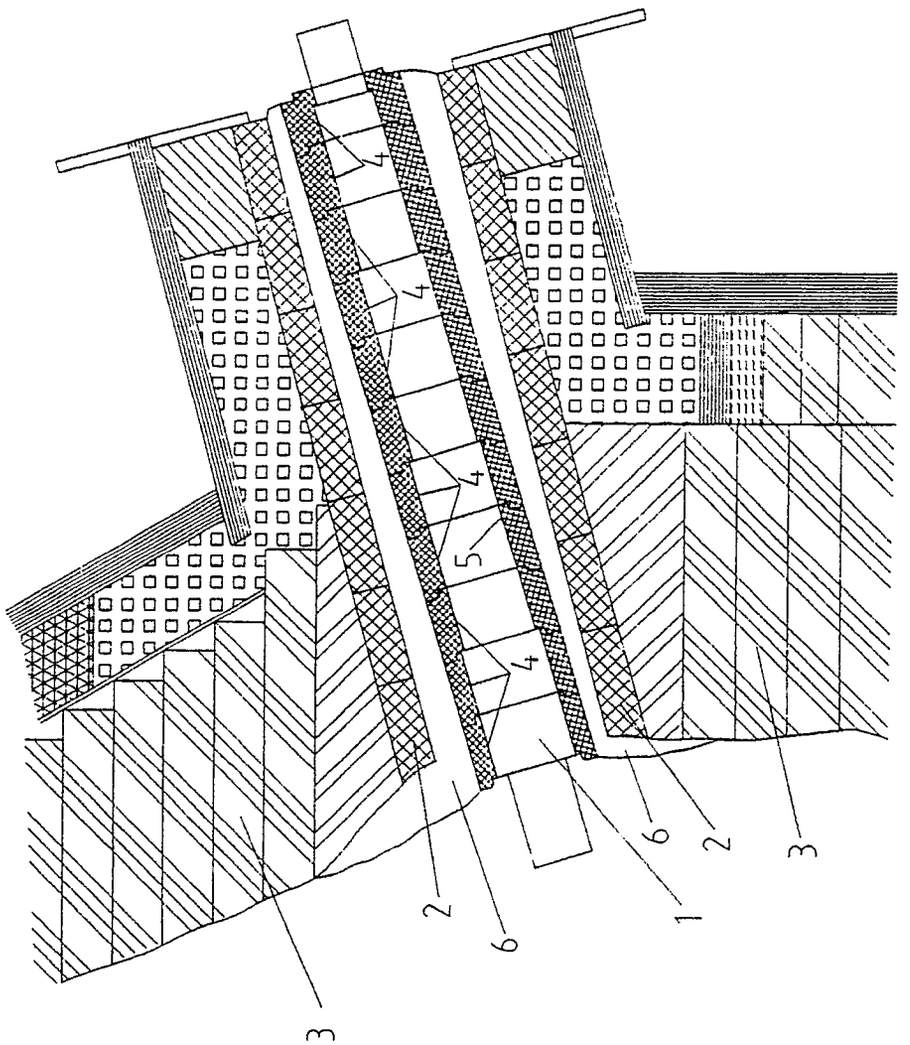
7. Method according to claim 5 or claim 6 wherein the or each said projection (7) has a ridge shape extending axially of the brick.

8. Method according to any one of claims 5 to 7 wherein two of said bricks among said new bricks (4) each have at least one said projection (7), said two bricks being near to respectively the inner end and the outer end of the tap hole.

9. An annular tap hole brick (4) for use in a tap hole construction according to claim 1 or a method according to claim 5, having a generally cylindrical peripheral outer face and at least one projection (7) projecting outwardly from said outer face, said projection or projections having a circumferential extent around said brick of less than 360°.

10. A brick according to claim 9 having three of said projections (7), in the form of axially extending ridges.

FIG. 1



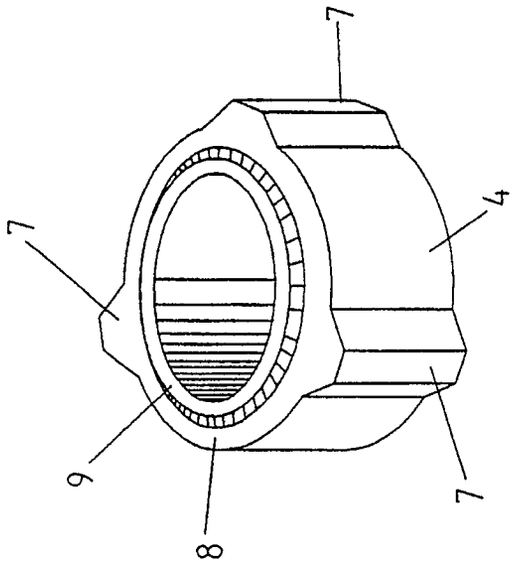


FIG. 3

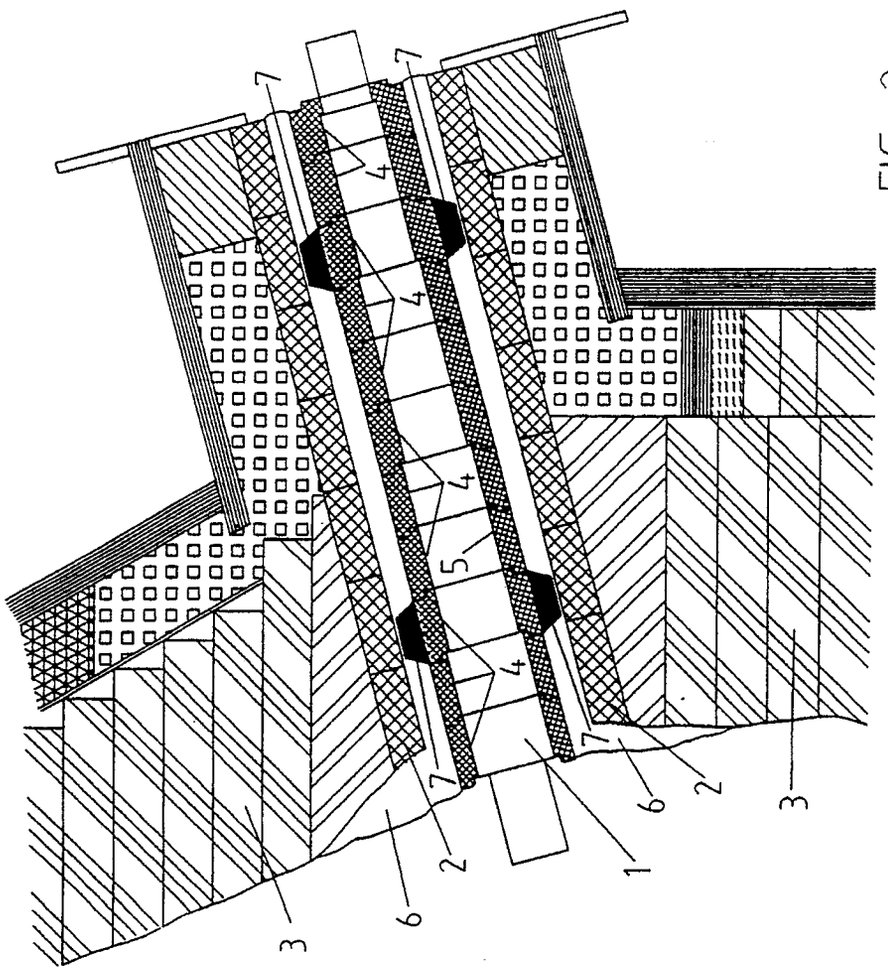


FIG. 2

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EUROPEAN SEARCH REPORT

Application Number

EP 90 20 2216

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X	US-A-3 463 475 (R.A. BUCHHOLZ) * Figures 1,2; column 3, lines 14-45 *	1,5	C 21 C 5/46 F 27 D 3/15 C 21 C 5/44
Y		2	
Y	US-A-3 554 523 (E.B. MILLER) * Figures 3,5; column 2, line 67 - column 4, line 7 *	2	
A	NL-A-6 707 057 (VEITSCHER MAGNESIT) * Figure; page 2, line 33 - page 4, line 27 *	1	
A	EP-A-0 249 647 (RADEX)		

TECHNICAL FIELDS SEARCHED (Int. Cl.5)
C 21 C F 27 D

The present search report has been drawn up for all claims

Place of search	Date of completion of search	Examiner
The Hague	31 October 90	OBERWALLENEY R.P.L.I

CATEGORY OF CITED DOCUMENTS

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