

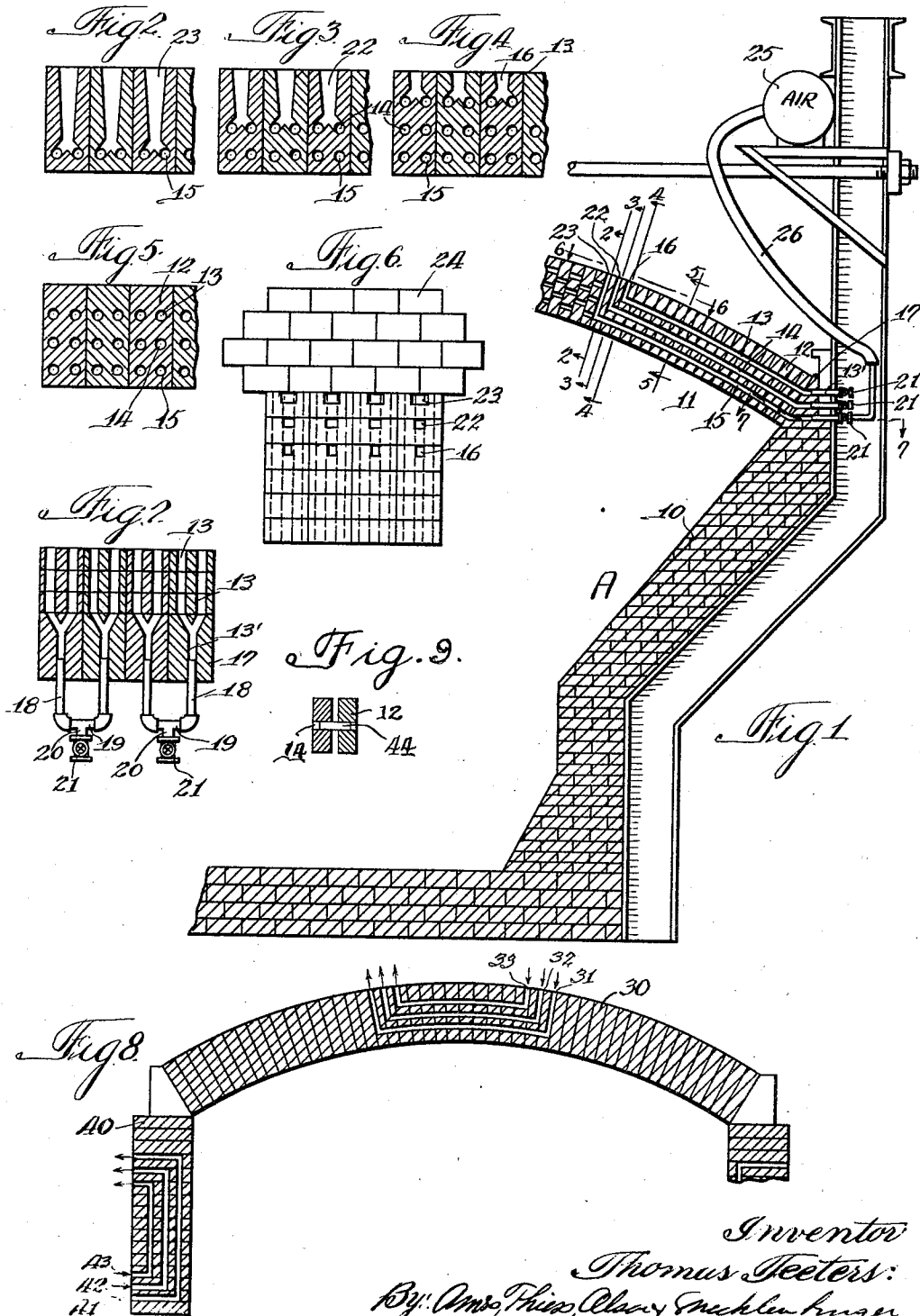
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FURNACE CONSTRUCTION

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FURNACE CONSTRUCTION

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The present invention relates to an improved type of furnace construction in which means are employed for cooling certain areas and portions of a furnace.

One of the objects of the invention is to construct a furnace—for example, a refractory or open-hearth furnace—so that certain portions of the sides or roof thereof may be cooled by a gaseous blast which is forced through internal openings in the refractories which themselves form the lining of the furnace, as contrasted with the use of separate perforated insulating bricks which have hitherto been used for such purposes.

A further object of the invention relates to a furnace roof and wall construction in which perforated bricks are used to form air passages for a cooling blast of gas or other cooling medium, these passages being so arranged that they may be used either simultaneously or successively, so that when, in the course of the operation of the furnace, one of the passages becomes inactive as a result of the melting down of the bricks, there will still be available one or more reserve passages through which a cooling medium can be directed, the total result being that the furnace can be kept in operation for a much longer period than has hitherto been possible.

A further object of the invention is to produce an open-hearth furnace having a roof and side walls, a portion of which is made out of bricks having co-ordinated openings therein through which air or other gas may be passed for the purpose of cooling the bricks themselves so as to prevent their too rapid melting down or erosion during the operation of the furnace.

Other objects of the invention will be apparent from the further description hereinbelow and the hereunto appended claims.

In its broadest aspects the invention comprises a furnace—for example, an open-hearth furnace—in which the roof or arch and also the walls, if desired, are constructed of special bricks having internal openings which are so aligned with each other that it becomes possible to force a cooling medium, for example, air, through these openings or passageways in a predetermined manner. For instance, the cooling medium may first be passed only through the passage nearest the interior of the furnace, leaving the other passages for future use when the bricks have eroded sufficiently to break the continuity of the first-named passage.

For a better understanding of the invention,

a sheet of drawings is furnished herewith in which:

Fig. 1 is a vertical section through a portion of an open-hearth furnace and an elevational view of air-supply means therewith connected;

Fig. 2 is a cross section of the roof portion on the line 2—2 of Fig. 1;

Fig. 3 is a similar section along the line 3—3 of Fig. 1;

Fig. 4 is a similar section along the line 4—4 of Fig. 1;

Fig. 5 is a cross section along the line 5—5 of Fig. 1;

Fig. 6 is a plan view looking down on top of the roof from the points 6 to 6 as shown in Fig. 1;

Fig. 7 is a sectional view along the line 7—7 of Fig. 1;

Fig. 8 is a diagrammatic representation of a modification of the invention, showing a furnace in which the side walls as well as the center of the roof are provided with cooling means which are structurally the equivalent of those shown in connection with Figs. 1 through 7; and

Fig. 9 is a cross sectional view of two adjacent bricks having central passageways connected by means of a metallic nipple.

As will be seen from the figures in the drawing, there is illustrated the usual type of open-hearth furnace, broadly designated by the letter A, this having side walls 10 and a roof broadly 30 designated as 11. This roof, at least so far as those portions immediately abutting the side walls 10 are concerned, consists of an arch made up of a number of perforated bricks 12, each of which bricks is provided with a plurality of internal openings extending across the narrow dimensions of the bricks, so that in cross section these bricks will have the appearance shown in Fig. 5, being provided with a plurality—say, six—of openings 13, 14 and 15. By aligning a number of these bricks there will thus be produced a plurality of more or less parallel passageways 13, 14 and 15 which extend across the top of the arch any desired distance, as shown in Fig. 1. Provision is made for communication of these internal openings with the outside air, this being accomplished by providing special forms of bricks, as shown in Figs. 2, 3 and 4. For example, one of the uppermost passages 13 may terminate in a brick having the construction shown in Fig. 4, 50 in which there is a passage 16 along the longer dimensions of the bricks, so that the uppermost channel 13 will terminate in the channel 16 which leads to the outer air above the furnace. The other end of the passage is connected through a 55

special brick 17 (Fig. 1) in which there is a passage 13' which connects with tubes 18 (Fig. 7), of which there is a plurality, each two of which are connected with, for example, a header 19, which in turn, by means of nipple 20, connects with a control valve 21. It will be seen that the pipe 13' branches out so as to connect with two parallel passages 13 (best seen in Fig. 7).

Similarly, provisions are made for terminating the passage 14 by means of special forms of brick having the general configuration shown in Fig. 3, in which the passage 14 terminates in a transverse passage 22 which leads to the outer air, this brick, of course, also being perforated for passage 15. The passage 15 terminates in a similar manner in a special form of brick, such as shown in Fig. 2, from which the passage 15 emerges into a channel 23 which runs along the general longitudinal direction of the bricks and terminates in the open air above the furnace.

The rest of the roof of the furnace may be, for example, constructed of bricks having internal openings, which however are deliberately offset so that there will be no communicating passages at all and through which it is not desired to pass a cooling medium. These noncommunicating bricks may be of the type described in a copending application of the present inventor, Serial No. 194,110, filed March 5, 1938, now Patent No. 2,154,414, issued April 11, 1939. The present invention is not, however, dependent upon the use of this type of bricks. The construction can well be seen from Fig. 6, in which the bricks which do not have communicating passages are shown at 24 while the openings or passages 16, 22 and 23 are plainly to be seen. It will be noticed that each of these passages 16, 22 and 23 is connected with a duplicate passage. The sectional views 2, 3, 4 and 5 plainly show how these passages are connected, for in Fig. 5 it will be seen that each brick has its perforations broadly designated as 13, 14 and 15, which, by alignment, produce the correspondingly numbered passageways.

There is also shown, in Fig. 1, a general supply line 25 for air or other cooling medium, connecting by means of the hose or tube 26 with the control valves 21. In Fig. 1 it is the lowermost valve 21 which is shown as actually being connected at the time, serving to blow air or other cooling medium through the lowermost passage 15 which terminates in the transverse passage 23; thus, when the furnace is operating under the conditions shown in Fig. 1, air or other cooling medium will be forced from the duct 25 through the line 26, the valve 21 and the nipple 20 into the header 19, and from thence through the tube 18 and the passage 13' into the innermost air passage 15. Inasmuch as this passage is very close to the hottest part of the bricks, it will be most effective to cool the bricks at the very point where cooling is essential. However, inasmuch as in actual operation no amount of cooling will completely protect the bricks from erosion, the time will eventually come when the bricks will be completely eroded or broken away through to the passage 15, so that at that point air will pass through the passage and escape to the furnace from port 23. When that takes place, connection is disestablished from the lowermost valve 21 and connection established with the intermediate valve 21, which thus directs the air into the intermediate passage 14 which terminates in the duct 22, so that no interruption of the furnace operation is necessary until by further erosion the bricks are worn through and passage 14 becomes

leaky. In that case the air is connected with the uppermost valve 21 and air is forced through the passage 13 which terminates in the port 16. It is advisable, when shifting to the use of the second passage, 14, to plug the opening 23.

It is, of course, quite obvious that it would be possible to force air through all three passages 13, 14 and 15 simultaneously, interrupting the entry of air into the lowermost passage 15 only when it becomes inoperative due to erosion of the bricks. Equally obvious is the employment of more than three successively useable passageways, or only two may be employed.

Applicant is aware of the fact that air-cooling of furnace walls and roofs is not broadly a new principle, but, as heretofore directed, the air has always been passed beyond the bricks themselves and through passages which have been made either of special bricks or shapes or by merely leaving a space between courses of bricks; and, so far as he is aware, no one has used passages in the refractory bricks themselves in order to enable cooling to be effected at the points of highest heat exchange, that is to say, at the point where the bricks are most rapidly absorbing heat.

Referring now to Fig. 8, a similar arrangement is here shown, except that in this case the center of the arch 30 is provided with, for instance, three passages 31, 32 and 33, which are connected with a suitable supply pipe (not illustrated) which is on exactly the same principle as illustrated in connection with Fig. 1 and hence needs no particular description or illustration. Similarly, the side wall 40 is provided with passages 41, 42 and 43 which are supplied with air or other cooling medium in exactly the same manner as is shown in connection with Fig. 1, the same principle being employed—of feeding the cooling medium primarily to the innermost passage until the necessity arises for discontinuing the use of that passage as a result of the erosion of the bricks, whereupon the other passage, 42, and eventually passage 43, is placed in service, not excluding, however, the expedients of passing the cooling medium through two or all of the passages at the same time.

It is not deemed necessary to show cross sections of the construction shown in Fig. 8, as the types of bricks there employed are the same, the only difference being in the point of application of the bricks to the furnace itself.

It will be self-evident that by adopting a construction such as the side walls shown in Fig. 8, the invention could with equal facility be applied to vertical or shaft furnaces, cupolas, or the like, without departing from the principle of the invention and without the necessity of illustrating these types of furnaces in detail. The particular type of furnace to which the present invention is applied is of no moment.

In addition to furnishing means for abstracting heat from the refractory at the point of greatest heat absorption, the fact that the products are considerably lighter because of the passages contributes to the success of the invention, for the less gravitational effect there is on the roof of the furnace, the less likely it is to fall when it becomes eroded, and therefore the life of the furnace is prolonged not only because of this greater lightness but because of the particular arrangement of the cooling passages and the manner of their use.

By providing the passages 16, 22 and 23 (Fig. 1), none of the air or other cooling medium used enters the furnace, and therefore it does not in 71

any way interfere with the predetermined combustion conditions therein.

If desired, as shown in Fig. 9, the individual perforated bricks 12 may be connected with each other by short inserted nipples 44 of a suitable metal such as copper piping or calorized iron piping, in order to insure tightness of the connections, although this is by no means essential if the bricks are properly placed and the furnace is well constructed. Or, the construction may involve a substantially monolithic structure using specially shaped ceramic ware for the purpose.

It is also to be understood that instead of blowing air through the passages, air may be sucked therethrough by a suitable suction means; or a suitable chimney may be built, with which these pipes are connected, so as to produce an artificial draft of air through the passages. In other words, the method employed for actually forcing the air through these openings is a matter of expediency and is not a part of the present invention, the main feature of the invention being the provision of the passages permitting air to be passed through the bricks at the point of greatest heat absorption and where cooling is most needed. The precise shape of the openings is also immaterial, and they may be tapered or otherwise shaped to conform to the shape of the furnace or furnace part where they are located.

The material from which the bricks are made is not of particular importance, but usually the invention finds its best exemplification in connection with highly refractory silica bricks, although it is not to be limited to such bricks, as it may be applied to basic bricks, magnesia blocks, or any type of refractory which can be made up in advance in special shapes so that a plurality of passages may be provided, as illustrated in the drawing accompanying the present specification.

Saving for himself such known equivalents as will readily occur to those skilled in the art to which this application applies, applicant claims:

1. In a furnace having air-passages in the refractory bricks forming the lining of the interior of the furnace, said passages being connected with each other to form continuous passages through which the cooling-air may be passed, the improvement which comprises a roof or wall structure built up at least in part from individual refractory bricks having a plurality of perforations therein so aligned as to produce a plurality of passageways located progressively inwardly from that end of the bricks directed toward the interior of the furnace, said passageways being noncommunicating with each other so as to be capable of independent use, some of the bricks being provided with transverse passageways into which the first mentioned passageways terminate and by means of which connection with the atmosphere outside of the furnace is established.

2. A furnace roof built up from perforated refractory bricks, the greater part of the perforations in the individual bricks being out of register with each other so as to leave noncommunicating voids in the furnace roof, certain portions of the roof however being so constructed that the perforations in the bricks will be so aligned as to produce a plurality of continuous passageways for the passage of a cooling medium, said individual passageways being noncommunicating with each other and located progressively inwardly from the hottest end of the bricks when

in service, each passageway being in communication with a source of cooling medium, some of the last mentioned bricks also being provided with longitudinal internal passageways into which the other passageways terminate and through which connection with the atmosphere outside the furnace is established.

3. A furnace roof as in claim 2, in which the passageways are in those portions of the furnace roof nearest the side walls.

4. A furnace roof as in claim 2 in which the passageways are in the central portion of the roof.

5. A furnace roof in which the side portions of the roof nearest the side walls of the furnace are constructed of individual perforated highly refractory silica bricks so aligned that the perforations produce a plurality of continuous passageways located progressively inwardly from the end of the bricks forming the inside of the furnace, each of the passageways being independent of each other but capable of connection with a source of cooling medium, some of the bricks also having longitudinal passageways therein into which the other passageways terminate and through which the cooling medium is discharged to the outside atmosphere.

6. A furnace roof having at least a portion thereof constructed with perforated refractory bricks having their perforations so aligned as to produce two or more rows of substantially parallel sets of passageways for the passage of a cooling medium, the row nearest the inside of the furnace being connected with a source of cooling medium and the other rows being adapted to be so connected when, by erosion of the bricks in use, the first row becomes punctured, so that further continued use of the roof becomes possible.

7. A special brick for the construction of furnace roofs, having a central longitudinal passageway communicating with one or more transverse passageways leading to but one side of the brick, so as to produce a substantially L-shaped passageway in the brick, and also provided with transverse perforations not in communication with the longitudinal passageway.

8. The method of retarding the destruction of the arch of an open-hearth furnace so constructed that a portion of the arch consists of internally perforated bricks so aligned as to form two or more rows of substantially parallel passageways noncommunicating with each other but capable of receiving a flow of a cooling fluid, which comprises passing cooling fluid through that passageway nearest to the hottest part of the arch until by erosion the bricks have failed to a point where said passageway is no longer airtight, thereafter passing the cooling fluid through the next succeeding passageway until that also fails, and thereafter employing the remaining passageways in a similar manner until total failure of the bricks occurs.

9. A construction as claimed in claim 1, in which the perforations between the bricks are connected by short heat-resistant tubes.

10. A construction as claimed in claim 1, in which the perforations between the bricks are connected by short heat-resistant metallic tubes.

11. A construction as claimed in claim 1, in which the perforations between the bricks are connected by short copper tubes.

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