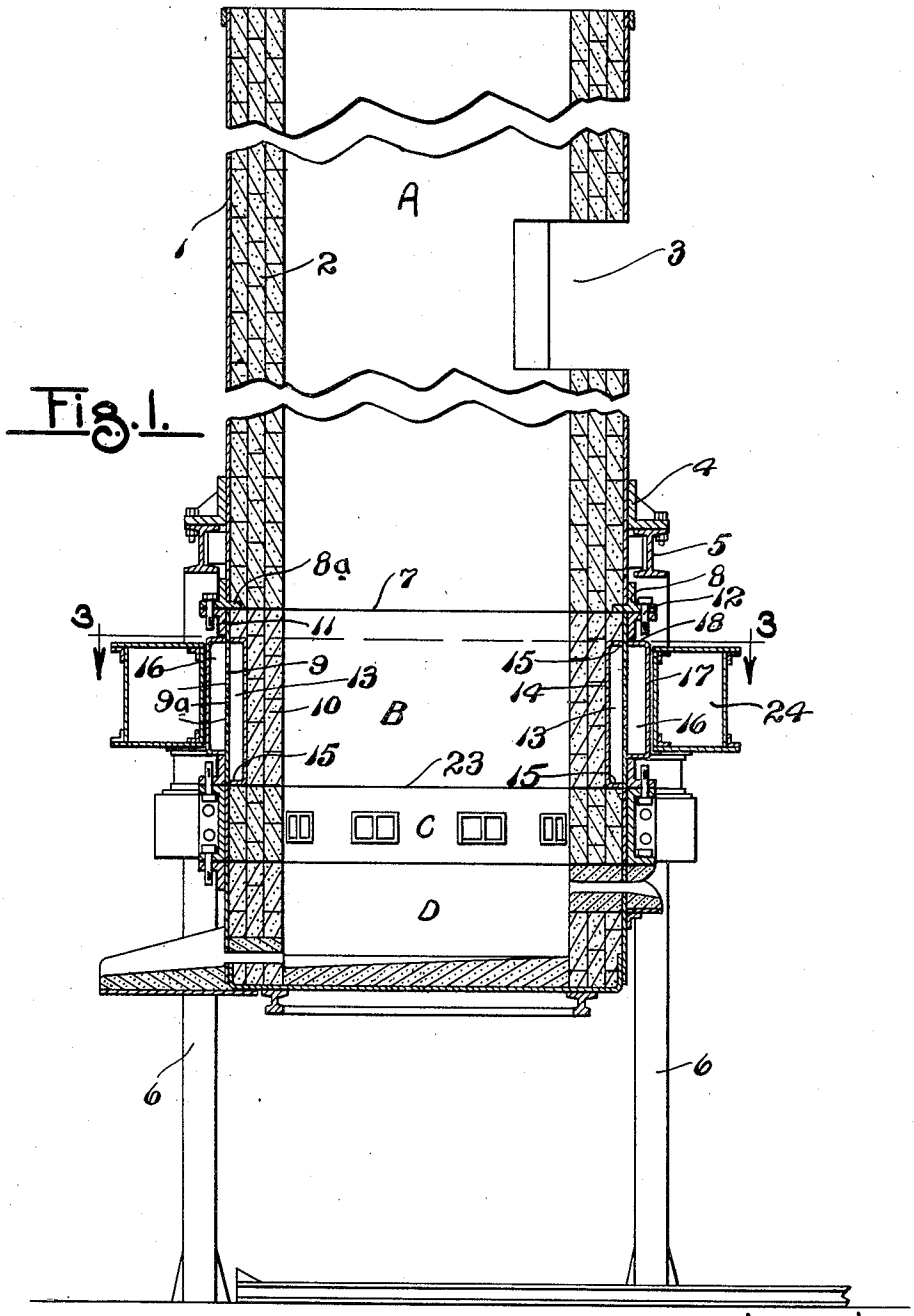
Oct. 17, 1939. L. A. GROTEWOHL 2,176,336

CUPOLA FURNACE

Original Filed Feb. 3, 1936 2 Sheets-Sheet 1

Fig. 1.



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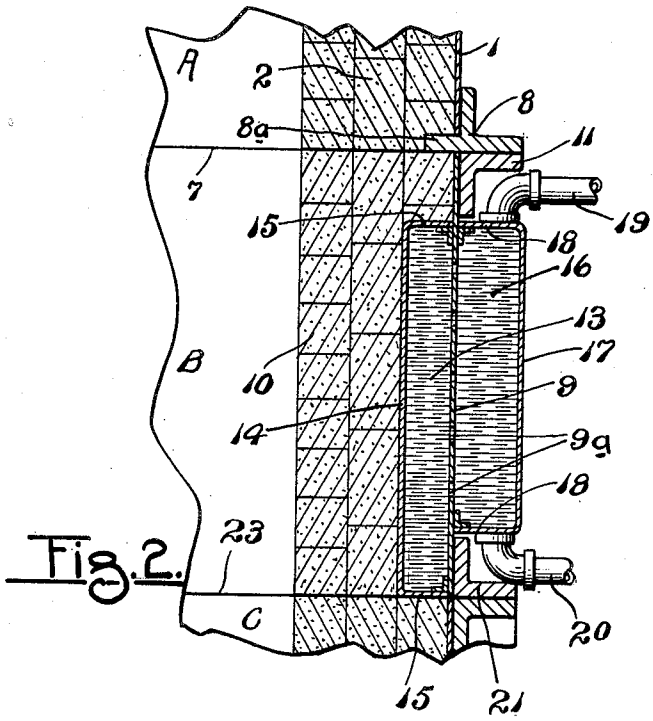


Fig. 2.

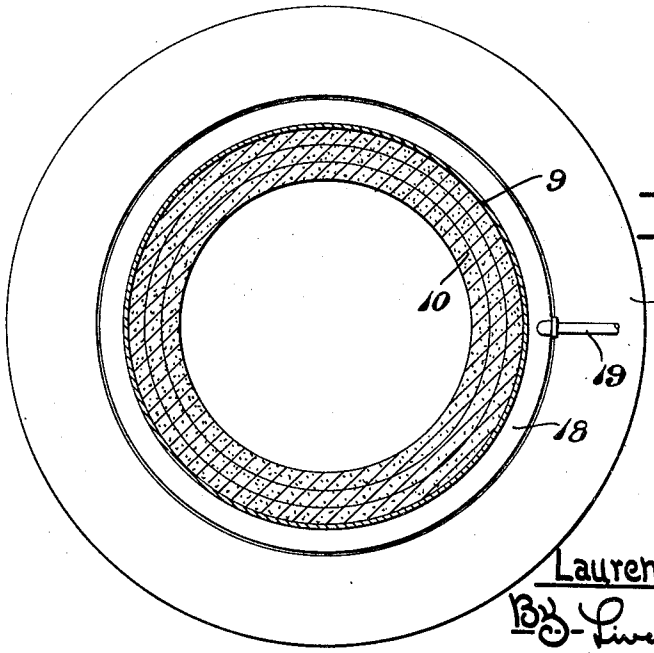


Fig. 3.

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UNITED STATES PATENT OFFICE

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CUPOLA FURNACE

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Original application February 3, 1936, Serial No. 62,066. Divided and this application June 21, 1937, Serial No. 149,406

7 Claims. (Cl. 122—6)

This invention relates to a method for cooling cupola furnaces. Such method and the structure of the furnace wherein the method is employed is disclosed in my application, Ser. No. 62,066, filed February 3, 1936, of which this application is a division.

In a cupola furnace which is used in the process of molding to melt and refine pig iron and to alloy it with other ingredients to produce a molten iron suitable for casting, in the construction there is an outer shell, usually of steel, which is lined with fire clay or equivalent high temperature resistant material. The upper part of the cupola furnace is not subjected to the action of the heat and temperature to nearly the same extent as an intermediate portion of the furnace, particularly that part where the melting of the pig iron takes place. The lining within such intermediate part of the furnace is subjected to very high temperature which injures the lining to such an extent that periodically the lining of the furnace has to be repaired, this requiring shutting down and cooling of the furnace and then the repair of the fire clay lining with consequent loss of time during which the furnace equipment cannot be profitably used.

The present invention is directed to a cooling of the lining in that portion of the furnace where the lining is most seriously affected by the high temperature so as to eliminate to considerable extent the damaging effect of the high temperature and thus make the periods of shutting down the furnace and repairing the lining thereof farther apart than is normally the case. In the application of which the present application is a division, a construction of furnace is disclosed and claimed whereby the economic loss previously necessary on repairing the furnace has been greatly reduced by making it possible to remove sections of the furnace where the greatest damage has occurred, replace them with other sections, and the removed section which is to be repaired can then be left to cool and eventually required without stopping the work of the furnace nearly as long as had been previously necessary. However, it is evident that it is very desirable to have the repair of the furnace take place at as far apart intervals as can be done, and this is even more true of those furnaces not of sectional structure.

The present invention is directed to a method and structure for cooling the intermediate portion of the cupola furnace while it is in operation so as to remove, to a very large degree, excess heat and temperature and thus save the furnace lining to an extent such that its repair with the consequent closing down and cooling of the furnace has to take place only infrequently at farther apart intervals of time than has heretofore been necessary.

An understanding of the invention may be had from the following description, taken in connection with the accompanying drawings, in which,

Fig. 1 is a central vertical section through a furnace embodying my invention.

Fig. 2 is a fragmentary enlarged vertical section through the melting portion of the cupola, showing a structure which has been devised for cooling such portion of the furnace during operation, and

Fig. 3 is a horizontal section substantially on the plane of line 3—3 of Fig. 1 looking downwardly as indicated by the arrows.

Like reference characters refer to like parts in the different figures of the drawings.

In the disclosure, the same sectional type of furnace is shown as in my application to which reference has been made. However, the invention is not limited to a sectional furnace but is of equal or greater value in connection with the usual and regular non-sectional types of cupola furnaces. In the drawings an elongated upper or charging section A is shown, preferably of cylindrical form and having an outer steel shell 1 which is lined with heat resisting refractory material 2. Such charging section has an opening 3 at one side through which the pig iron and other ingredients are put into the cupola. A distance above the lower end of the upper section A a ring 4 of right angle shape in cross section, and preferably of cast steel, is secured the horizontal outwardly extending leg of which rests upon and is secured to I-beam frame members 5 which are carried at the upper ends of the vertical supporting posts 6, the lower ends of which are anchored to the floor of the foundry whereby the charging section is permanently supported; and while it can be removed by removing the bolts which attach the ring 4 to the frame members 5, it is seldom necessary to remove this portion of the furnace for repair as the temperature in the upper or charging part of the cupola is low compared to the very high temperatures in those parts of the furnace below it.

The succeeding lower section B is at the melting portion of the cupola furnace. It meets with the lower end of the upper section A in a horizontal plane, the meeting line being indicated at 7. A ring 8 of inverted T-shape in cross section is secured at the lower end of and around the upper

charging section A, the inwardly extending flange 8a of which comes partially under the refractory lining 2 helping to support the same. The section B has an outer steel shell 9 likewise lined with refractory material 10. Around its upper end is a ring 11 of angle cross section, the upper horizontal flange of which lies against and underneath the outwardly extending lower flange of the ring 8. Holes in conjunction in said flanges receive headed pins 12 which at their lower ends are slotted through the same to receive removable drift wedges. This structure is like that described in my earlier application and the same means of making a gas tight joint between the flanges of the rings 8 and 11, is used.

In the structure shown there are three courses of fire brick forming the lining of the upper section A. In the melting section B the outer course of fire brick is wholly or partly removed as shown, thereby providing an annular chamber 13 between the middle course of brick and the lining 9. In this chamber an annular ring of channel shape in cross section is located having a vertical web 14 and outwardly extending upper and lower flanges 15 which extend to the lining 9 and are permanently secured thereto in tight relation, being connected by angle iron rings as shown in Fig. 2 thereby enclosing the chamber 13 between the lining 9 and the sheet metal ring member 14, 15. Around the lining 9 is a front continuous channel ring member having a vertical web 17 and inwardly extending flanges 18 enclosing a continuous annular chamber 16, the flanges 18 connecting to the lining 9 by use of angle iron rings, likewise shown in Fig. 2. The chambers 13 and 16 are connected by means of a plurality of openings 9a made through the lining 9 between said chambers.

Pipes 19 and 20 are connected with the outer chamber 16, being connected to the upper and lower flanges 18 thereof, through one of which pipes water may be continuously pumped into the chamber 16, passing therefrom through the openings 9a of the chamber 13, and the overflow pass out of the other pipe. For example, cold water being pumped through the pipe 20 continuously, the water will become heated and naturally rise and the pressure of the incoming water pumped will force the heated water out through the pipe 19.

The lower end of the section B is equipped with an angle iron ring 21 having the lower side of its outwardly extending flange in the plane with the lower side 23 of said melting section B, to cooperate with and connect to the tuyère section C, this section in turn being above and connected in substantially the same manner to the lower or well section D. The wind box 24 through which the air is forced and thence downwardly through the several pipes of the tuyère section C surrounds the chamber 16.

It is not necessary to further specifically describe the structure of the furnace and the tuyère and well sections D. It is evident that the air under forced draft, and usually heated before it comes to the furnace, being forced into the furnace through the passages of the tuyère section C, burns the coke and melts the iron in the section B of the furnace with a resultant very high temperature, which is often in excess of 4000° F. Such very high temperature naturally has a damaging effect upon the lining of the melting section. The continuous flow of a cooling medium, such as water or its equivalent through the chambers 13 and 16, removes considerable heat with a resultant cooling and temperature lowering of the fire clay lining of the melting section, and maintains the temperature at a degree lower than it would be otherwise. This delays the burning out and damage to the lining so that the furnace can be used longer before repair is necessary.

This invention, as previously stated, is applicable to cupola furnaces whether or not of the sectional nature disclosed; and in those furnaces not of the sectional type, the invention may be of even greater value than in the sectional furnaces, in lengthening the times of use between the times of repair of the furnace lining.

Having thus fully described my invention what I claim and desire to secure by Letters Patent is:

I claim:

1. A cupola furnace having an outer metal shell and an inner lining of fire resisting material, an annular metal member of substantially channel shaped cross section secured at the inner side of said shell at a zone of the furnace where the heat is severe, a similar annular channel shaped metal member secured around the outer side of said shell, opposite the first channel member, whereby two continuous annular chambers are made, said shell between the chambers having openings therethrough, and means for continuously circulating water through said chambers.

2. A cupola furnace comprising, an outer metal shell, a lining of fire resisting material therefor, said lining immediately within the shell and at a position where the heat in the furnace in use is most severe being removed to reduce the thickness of the lining, a continuous annular metal member located within the lining and shell and attached to the shell in the space left by the removal of said portion of the lining providing a continuous annular chamber around said reduced thickness portion of the lining, a second continuous annular chamber outside of and concentric with said first named member connecting openings between said chambers, and means for circulating a cooling medium continuously through said chambers.

3. A cupola furnace including an outer metal shell and a lining of fire resisting material, said fire resisting material being reduced in thickness at its outer side in a continuous zone around the furnace where in use the heat and temperature are severe, thereby providing a chamber around the lining between the same and said shell, a second annular chamber outside of and concentric with said first named chamber connecting openings between said chambers, and means for continuously circulating a cooling medium through said chambers whereby the temperature of the lining surrounded by said chambers is reduced.

4. A cupola furnace comprising an outer metal shell and a plurality of thicknesses of fire resisting material a portion of the outermost of said thicknesses being removed to provide an annular space around said furnace, two continuous annular concentric metal members of substantially channel shape one of which is located in said space and separated from each other by said shell and a plurality of openings therethrough providing communicating passages between said members, whereby circulation of a cooling medium in and between said members is permitted.

5. The elements in combination defined in claim 4 and means in the outermost of said concentrically located members for supplying a cooling medium thereto and for removing said cooling medium therefrom after same has passed to the innermost of said members and become heated therein.

6. A cupola furnace comprising an outer metal shell and a plurality of thicknesses of fire resisting material, a portion of the outermost of said thicknesses being removed to provide an annular space around said furnace, a continuous annular metal member of substantially channel shape located in said space, a second continuous annular metal member also of substantially channel shape located adjacent said first mentioned member and outside thereof, a continuous annular metal element located between said members having a plurality of openings therein to provide communicating passages between said members, a pipe connected to the lowermost position of the outermost of said members to supply a cooling medium thereto, and a second pipe connected to the uppermost portion of said outermost member to remove said cooling medium after the same has passed to the innermost of said members and become heated therein.

7. A cupola furnace comprising, an outer shell and a lining therefor, a portion of said lining immediately within the shell being removed at a zone between the upper and lower ends of the furnace, a channel shaped ring located within the shell where said portion of the lining is removed, thereby defining a continuous annular chamber between the shell and said ring, means for circulating a cooling medium through said chamber, a second continuous channel shaped ring located against and secured to said shell at the outer side thereof thereby providing a second annular chamber between the shell and said second ring, the chambers being disposed opposite each other, said shell between the chambers having passages therethrough to make communication between said chambers.

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