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[54] **FABRICATED BLAST FURNACE COOLING PLATE**
 6 Claims, 5 Drawing Figs.

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 [50] Field of Search..... 122/6, 6 B,
 6.5, 6.6

ABSTRACT: A blast furnace cooling plate is constructed by bending a steel pipe into a U-shape to form a first fluid conduit, and welding to it a top, bottom and end plate to form an enclosed chamber, which serves as a second fluid conduit. This second conduit permits the plate to function even if failure of the first conduit occurs.

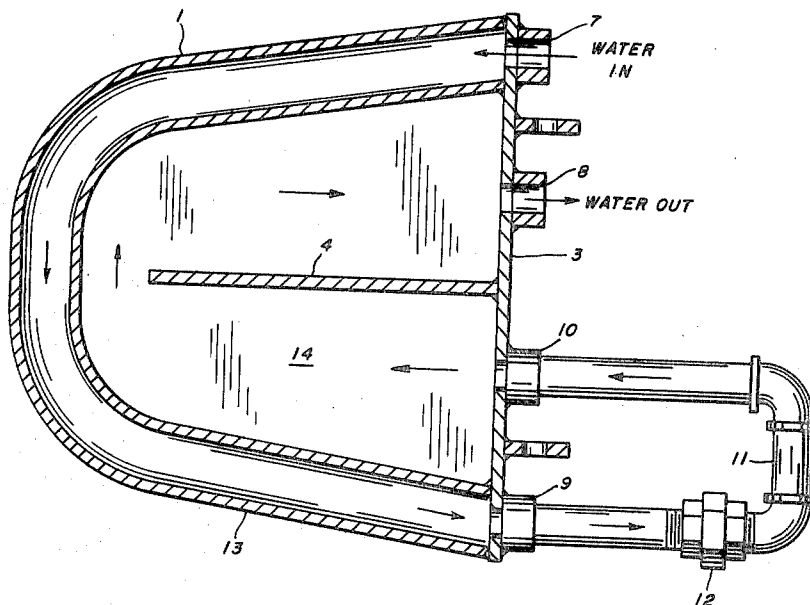
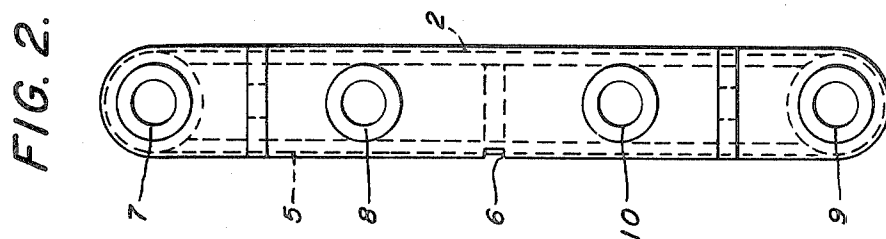
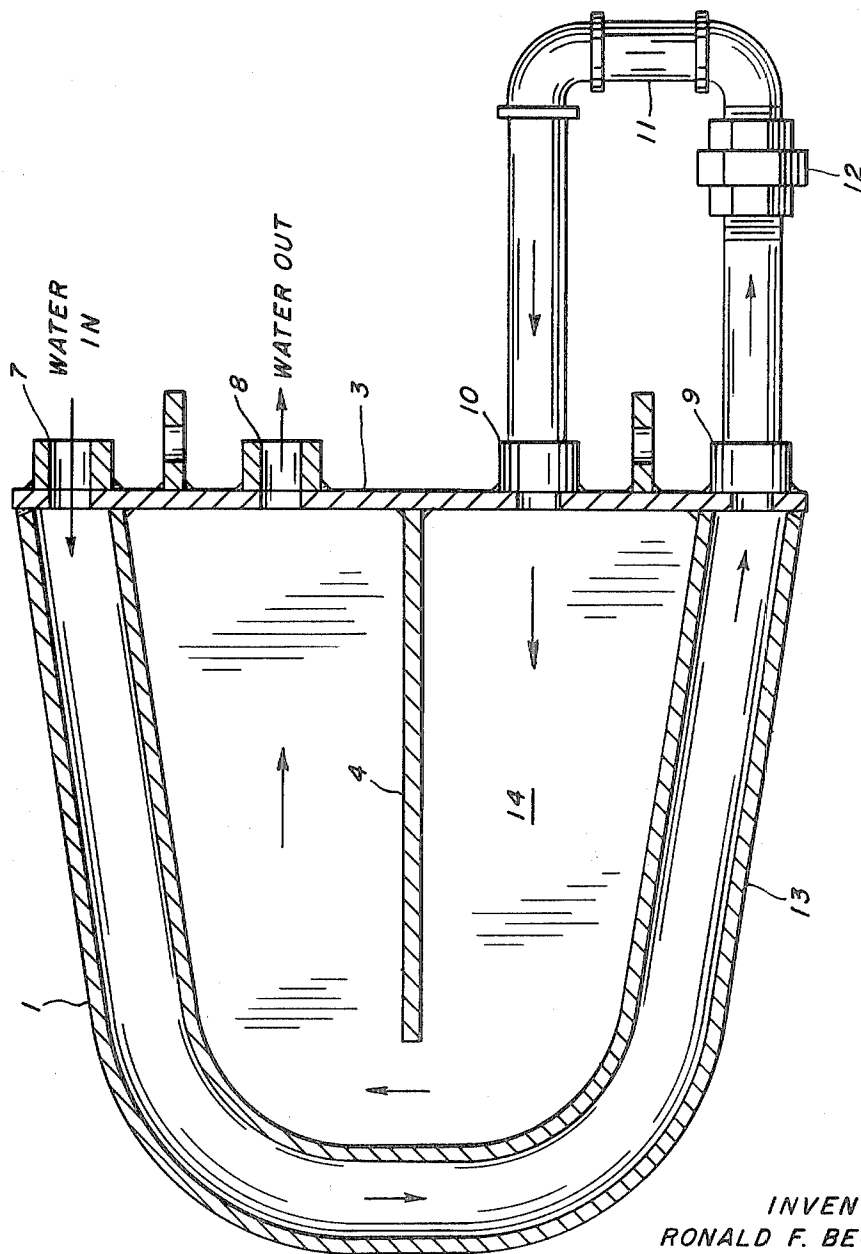


FIG. 1.



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FIG. 3.

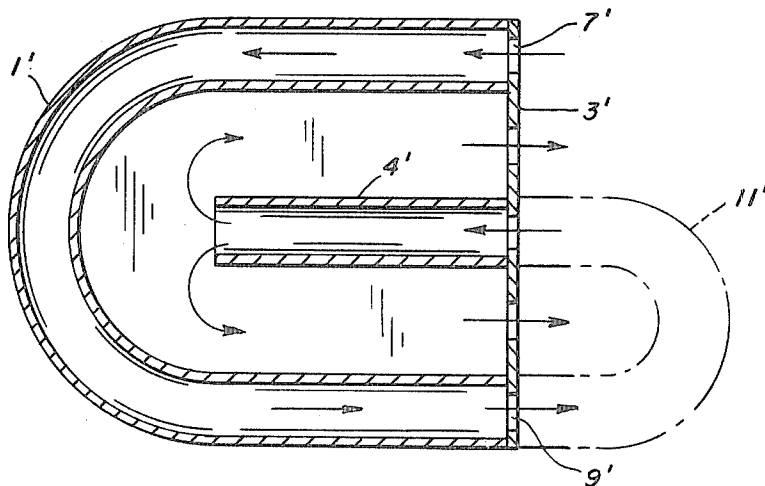


FIG. 4.

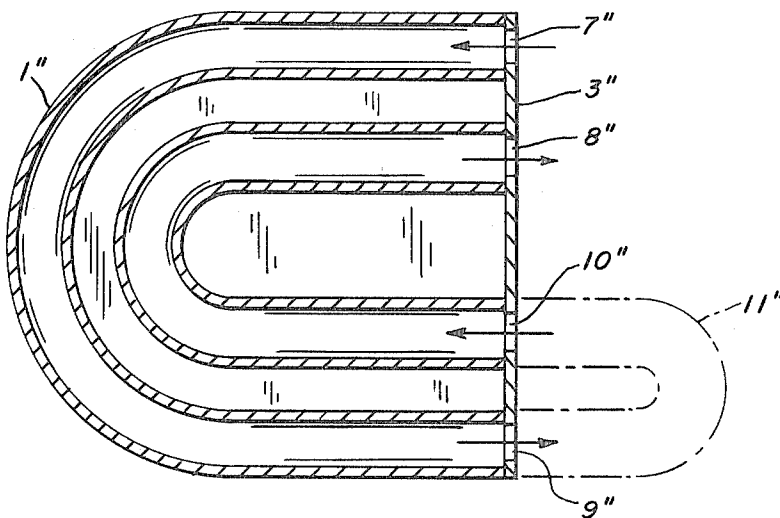
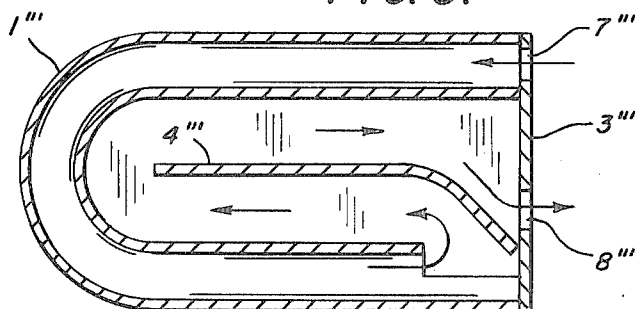


FIG. 5.



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FABRICATED BLAST FURNACE COOLING PLATE

This invention pertains to a novel blast furnace (bosh) cooling plate fabricated from steel pipe and rolled plate, and method for making same.

Wall sections of a blast furnace are generally equipped with cooling plates designed for circulation of cooling fluid therein. The function of such cooling plates is to conduct enough heat from the furnace sidewalls to prevent deterioration due to the extremely high temperatures encountered. These cooling plates (such as described in U.S. Pat. Nos. 2,333,439; 2,991,061; and 3,241,528) are primarily fabricated from copper castings which are subject to many disadvantages, a number of which are overcome by the design of the instant invention. To obtain the necessary strength, these plates must be cast relatively thick; thus any benefit which may accrue due to the high thermal conductivity of copper is offset to a large extent by this increased thickness. Since copper alloys are expensive, especially when compared to steel, this increased thickness not only results in an unduly heavy plate, but an expensive one as well. As a result of the sand core techniques which are employed in making these castings, the interior surfaces, through which the coolant must flow, are rough and therefore offer undesirable resistance to the flow of coolant fluid. The steel pipe cooling plates of this invention, do not require these expensive casting techniques; moreover, the smoother interior of the pipe offers significantly lowered resistance to the flow of coolant water. The higher strength of steel permits the use of thinner wall sections, thereby achieving heat transfer similar to that of the thicker copper, while resulting in a further reduction in the cost and weight of the plate.

Blast furnace cooling plates are subjected to severe mechanical abuse. This is especially true after prolonged use of the furnace, when the refractory wall portion in which the plate is inserted tends to wear away, exposing the nose of the plate to increased temperatures and the abrasive movement of the burden. This condition has generally resulted in severe downward warpage of the nose portion, resulting in failure of the whole plate. When failure or leaks develop, the entire plate is generally removed and scrapped. The steel pipe cooling plate of this invention is not only more resistant to such failure by reason of its higher strength and higher melting point, but is designed to provide separate flow systems, which may be operated in sequence, or individually if failure of one of the systems occurs.

It is therefore an object of this invention to provide a novel technique for the fabrication of blast furnace cooling plates, which materially reduces production costs of such plates, and provides a plate of a design more resistant to high temperatures and mechanical abuse, so that further economies may be realized due to the significantly longer plate life.

It is another object of this invention to provide additional economies and further reduce the need for replacement by providing a design which permits functional operation, subsequent to failure of a portion of the plate.

It is a further object of this invention to provide a blast furnace cooling plate, having improved heat transfer characteristics by reason of its thinner cross section and lowered resistance to coolant flow.

The ease of fabrication, and operation of the cooling plates of this invention may be appreciated by reference to the following description and drawings which illustrate preferred embodiments of the present invention and the principles thereof, in which:

FIG. 1 is a top sectional view of one embodiment, detailing the method of construction and illustrating the operation of the cooling plate;

FIG. 2 is an end view of the plate of FIG. 1, further detailing the method of construction;

FIGS. 3 and 4 are sectional plan views of modifications which also provide the feature of individual flow system operation in the event of nose failure; and

FIG. 5 is a top sectional view showing a construction which omits this feature.

The construction and operation of the system may better be understood by reference to FIGS. 1 and 2. The plate 13 is fabricated by bending a section of steel pipe into a more or less U-shape 1 and joining it to a bottom plate 2 (FIG. 2) and an end plate 3. Baffle 4 is then joined in place and top plate 5 (FIG. 2), equipped with slot 6 (which permits joining to baffle 4), is joined to pipe 1. Coolant inlet 7 and outlet 8 are then fitted in place. Recirculating outlet 9 and inlet 10 are connected together by recirculating connecting pipe 11 which may be further joined by pipe union 12. In operation, coolant flow, represented by the arrows, enters at 7, flows through the pipe (the first conduit system), through the recirculation system and then around the baffle (the second conduit system) and exits at 8. In the event of failure of the exposed, outer wall of pipe 1, cooling plate 13 can still be functional and kept in operation (until a more appropriate time for replacement) by removing recirculating connector pipe 11, and reconnecting the coolant supply to the inlet 10. Coolant intake 7 and recirculating outlet 9 will then be capped. It will be obvious that in its simpler form, baffle 4 may be omitted so that the chamber 14 formed by the pipe and the top, bottom and end plates may likewise serve as a second conduit system, coolant entering at inlet 10, cursing through chamber 14 and exiting at outlet 8.

FIG. 3, schematically illustrates a modified cooling plate in which baffle 4 has been replaced by a straight section of pipe 4'. The direction of coolant flow is represented by arrows. In the event of failure as described above, a similar removal of the recirculating connector pipe (represented by dotted lines) accompanied with reconnection of the coolant supply to the central pipe 4' and capping of the inlet 7' and outlet 9' of the leaky section will provide functional operation until a more appropriate time for replacement.

In FIG. 4, the central baffle of FIG. 1 and the straight tube of FIG. 3 is replaced by another and smaller U-bend pipe. Disconnection of the recirculating connector pipe 11' and reconnection of the water supply at inlet 10'' will be analogous to that of the above-described embodiments.

In FIG. 5, similar fabrication techniques are employed, utilizing steel pipe bent into a U-shape and joined to a top, bottom, and end plates, but the recirculating pipe is omitted. This embodiment entails all the features as the above Figures, except that of enabling the plate to remain in operation in the event of nose failure.

We claim:

1. A blast furnace cooling element comprising

- a. top and bottom plates consisting of a pair of similarly shaped, planarly parallel, spaced-apart rolled steel plates having correspondingly disposed rear edges forming first plate peripheral portions, the remaining, correspondingly disposed edges forming second plate peripheral portions,
- b. an end plate affixed to the rear edges of the top and bottom plates and provided with a first fluid entry port and a first fluid exit port disposed adjacent the respective ends of the end plate, and a second fluid entry port and a second fluid exit port disposed inwardly of, and between the first fluid entry and exit ports,
- c. a first conduit comprising a steel tube affixed between the top and bottom plates, and extending about said second peripheral portions, the open-ended extremities of said tube interconnecting respectively with the first fluid entry and exit ports, said tube together with said top, bottom and end plates forming a second fluid chamber interconnecting with the second fluid entry and exit ports.

2. A cooling element in accord with claim 1, which includes a recirculating means for conducting cooling fluid from the first fluid exit port to the second fluid entry port.

3. A cooling element in accord with claim 2, wherein the second fluid chamber is provided with fluid-directing means for extending the length of the fluid travel path therethrough.

4. A cooling element in accord with claim 3, wherein the fluid-directing means comprises a baffle member.

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5. A cooling element in accord with claim 3, wherein the fluid-directing means comprises a second tube, one end of which communicates with the second fluid entry port, whereby the coolant fluid may be directed to impinge upon a portion of the inside surface of the second fluid chamber.

6. A cooling element in accord with claim 3, wherein the fluid-directing means comprises a second tube, the open-ended extremities of which communicate respectively with the second fluid entry and exit ports.

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