United States Patent

Jones et al.

[15] **3,679,194**

[45] **July 25, 1972**

[54] COOLERS

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[21] Appl. No.: **65,427**

[30] **Foreign Application Priority Data**

Aug. 20, 1969 Great Britain 41,613/69

[52] **U.S. Cl.** ..... **266/32**, 122/6 R, 263/44

[51] **Int. Cl.** **C21b 7/10**

[58] **Field of Search** ..... 122/6 B; 263/44; 266/32

[56] **References Cited**

UNITED STATES PATENTS

2,311,819	2/1943	Dobscha	122/6 B
572,143	12/1896	Witherow	122/6 B

FOREIGN PATENTS OR APPLICATIONS

782,954	3/1935	France	122/6 B

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Assistant Examiner—Theophil W. Streule
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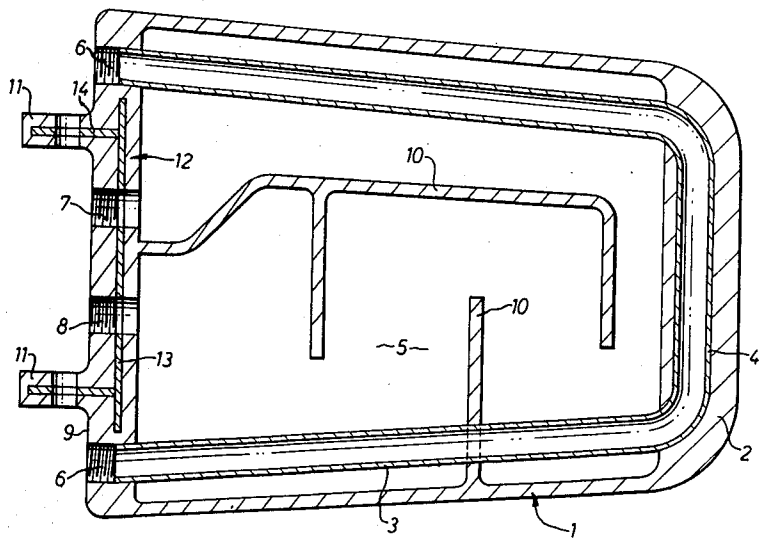
[57] **ABSTRACT**

The invention provides a cooler for insertion in the lining of a furnace, for example for bosh or stack cooling in a blast furnace, and which mitigates against the effects of cooler failure by having nose and body portions with mutually isolated cooling water cavities, so that in the event of failure of the nose portion of the cooler, which is the portion most likely to fail in practice, the cooler can be kept in operation by the cooling water passing through the body portion alone. The nose portion cavity is fed with water through water passageways which extend through the body portion. Preferably the body portion cavity is provided with baffles which ensure that water passing therethrough travels into the vicinity of the nose portion.

4 Claims, 13 Drawing Figures



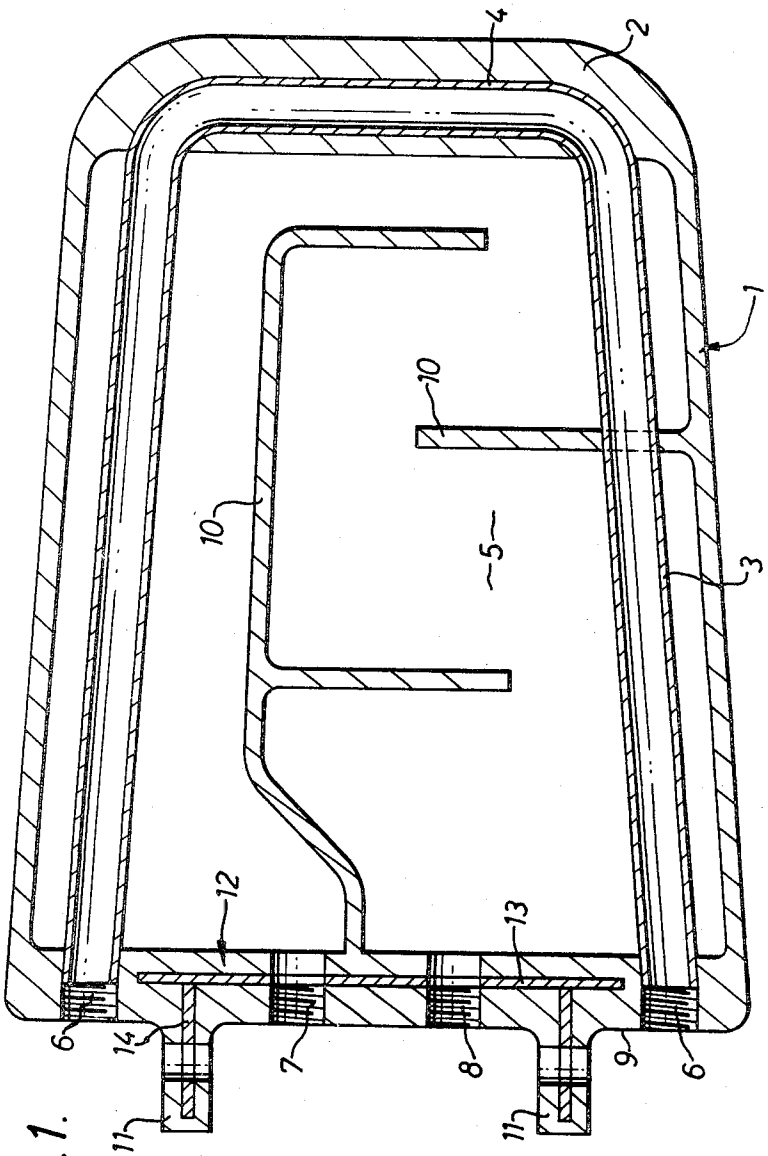


FIG. 1.

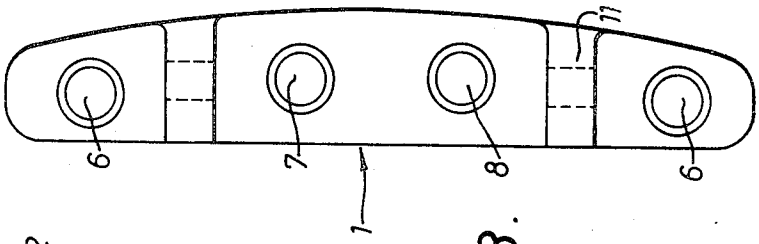


FIG. 3.

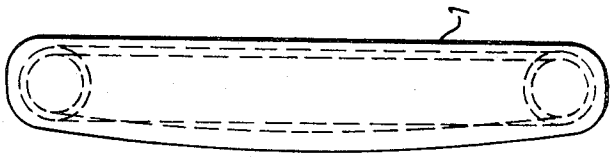


FIG. 4.

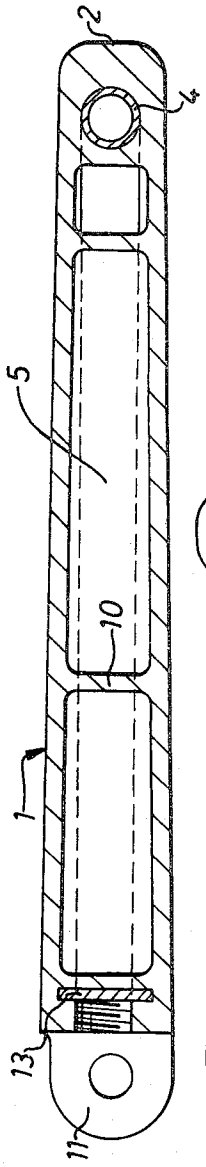


FIG. 2.

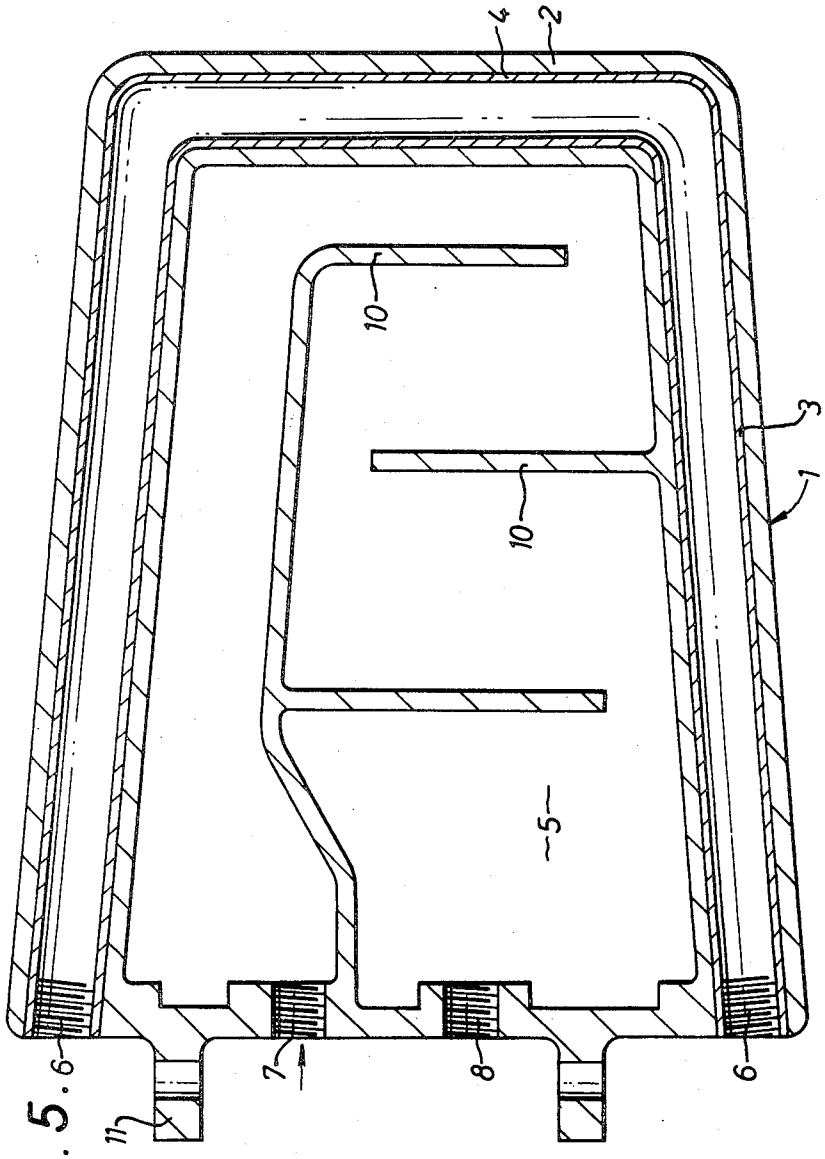
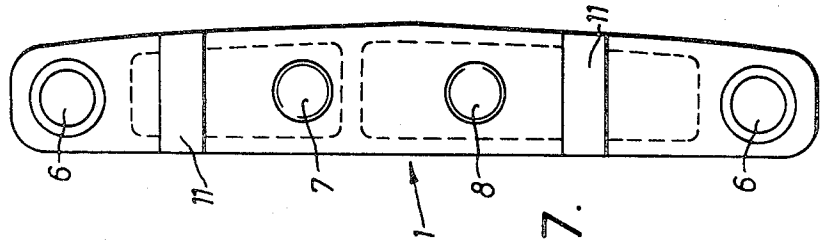


FIG. 5.



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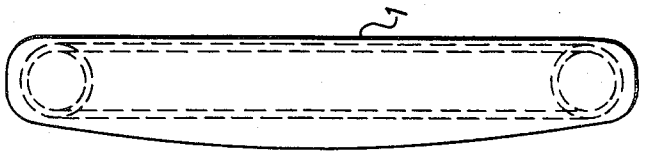


FIG. 8.

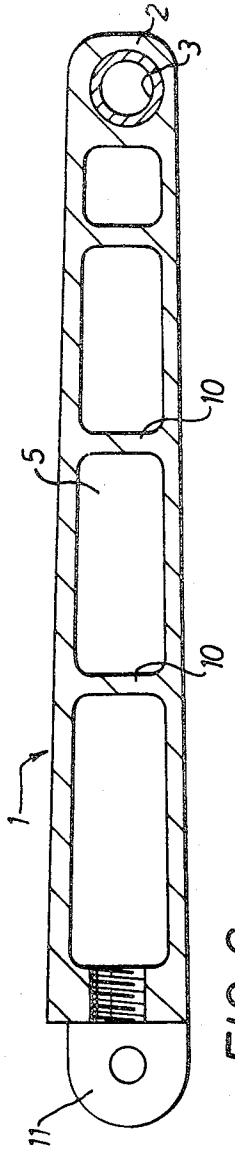


FIG. 6.

FIG. 9.

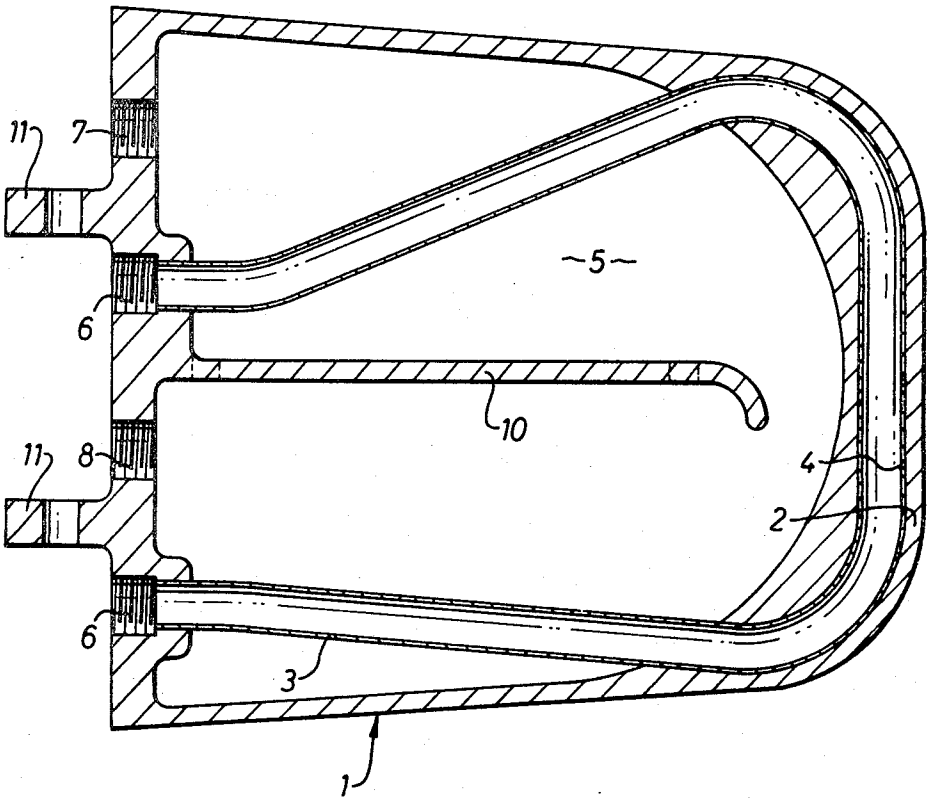
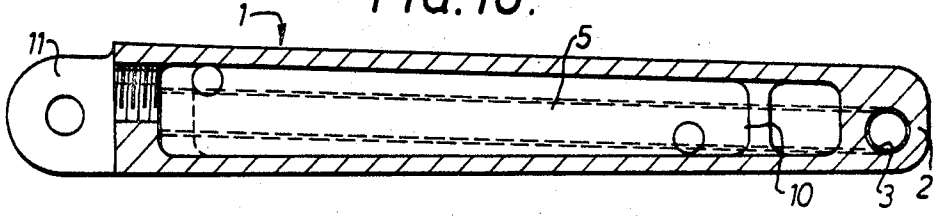


FIG. 10.



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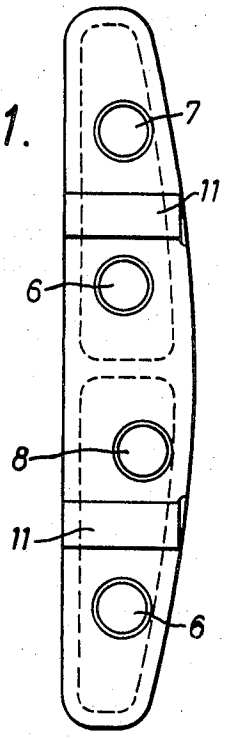

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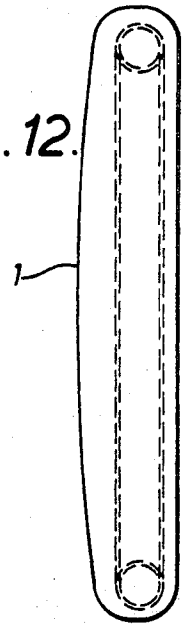

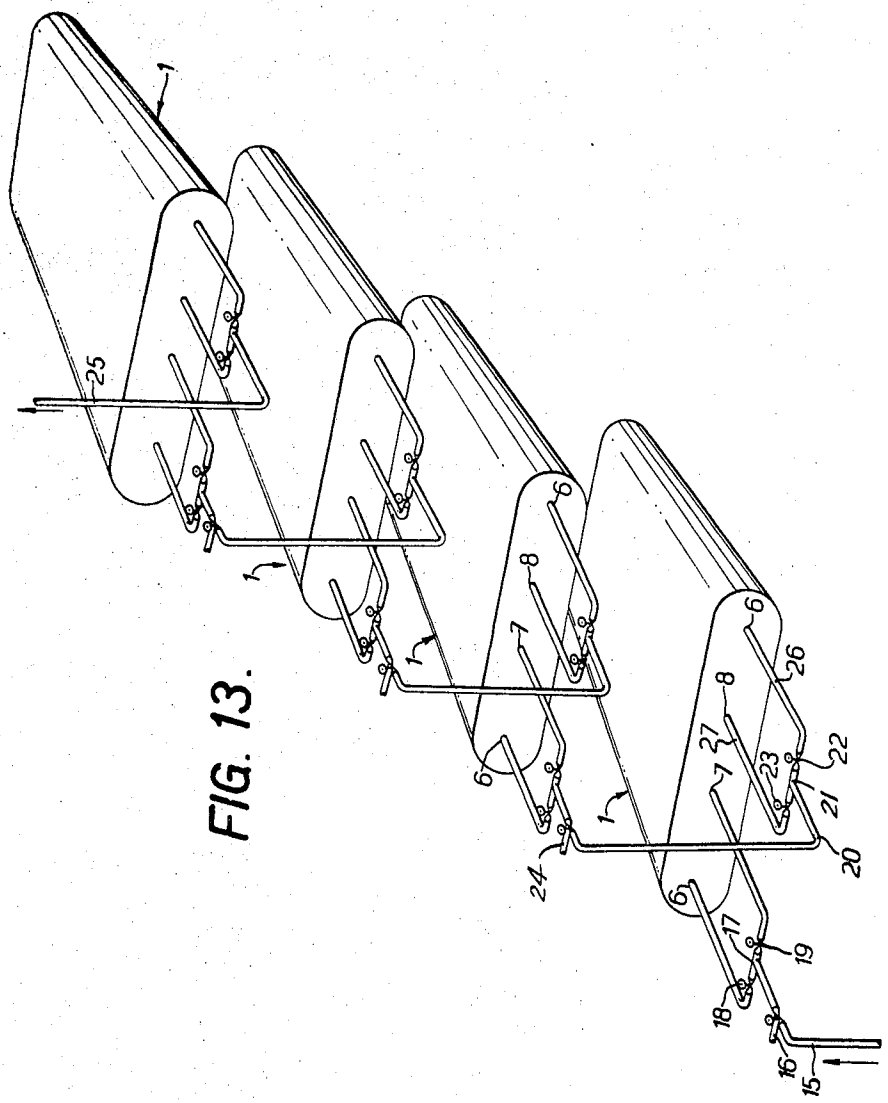

FIG. 13.

COOLERS

This invention is concerned with coolers of the kind inserted at intervals in the lining of a furnace, e.g., for bosh and stack cooling in a blast furnace. Such coolers are commonly made of copper and known as flat block coolers. Their purpose is to reduce the temperature in the refractory lining, thereby prolonging the life of the refractory. Hereinafter such coolers will be identified as 'coolers of the kind referred to.'

The coolers are currently designed to permit the flow of water through coolers in banks ranging from two to eight units. Water is passed through the coolers of a bank in series, the water flowing through the first cooler in the bank to the last and thence into a waste water trough. In the event of a cooler failure in a bank of coolers, it is at present necessary to discontinue or curtail the flow of water through the bank to prevent the water from entering the furnace. In consequence, all of the coolers are temporarily uncooled and are subject to excessive temperature which has a detrimental effect on the copper and the future life. Also, a cooler failure is not at first detectable as being in a particular cooler. All coolers in the bank must therefore be checked and the furnace taken off blast for this purpose.

It is an object of the present invention to provide a cooler which can be kept in operation after failure of the nose portion, which we have found is the portion most susceptible to failure.

According to the invention, a cooler of the kind referred to comprises a nose portion and a body portion having cavities for the passage of cooling water, the cavity in the nose portion being isolated from the cavity in the body portion, cooling water inlet and outlet openings for the body portion, separate cooling water inlet and outlet openings for the nose portion, and water passageways extending through the body portion to the nose portion from the inlet and outlet openings for the nose portion, the cross-sectional area of the cavity in the body part being substantially greater than that of the passageways so that the cooler can be kept in operation by passage of water through the body portion alone. Baffles may be provided in the cavity to ensure the flow of cooling water towards the nose of the cooler.

Preferably, the passageways are provided by pipes which extend through the cavity in the body portion with clearance from the walls thereof.

The rear of the cooler (i.e., the end opposite to the nose portion) may, in known manner, be provided with lugs for extraction of the cooler from its refractory surround. According to an optional feature of the present invention, the lugs, or inserts therein of stronger material, may be attached to a plate of stronger material, e.g., steel, than the material of the cooler body portion, which plate is embedded in the rear of the cooler inwardly of the rear face thereof. Preferably the plate is entirely surrounded by the material of the body portion to avoid the possibility of any electrolytic action.

The invention also provides a bank of coolers in accordance with the invention, the bank comprising a plurality of coolers, a common inlet pipe connected by branch inlet pipes to the inlet openings of the body and nose portions of each cooler, and a common outlet pipe connected by branch outlet pipes to the outlet openings of the body and nose portions of each cooler, each cooler having individual common inlet and outlet pipes and branch pipes connected thereto, the common outlet pipe of each cooler except the last in the bank being connected to the common inlet pipe of the next cooler in the bank, and the branch inlet and outlet pipes to the openings of the nose portion of each cooler being provided with valves whereby the supply of water to the nose portion can be terminated. Preferably the branch inlet and outlet pipes to the openings of the body portion of each cooler are provided with valves whereby the supply of water to the body portion can be terminated.

It will therefore be seen that if the nose portion of a cooler fails, the supply of water thereto can be terminated without preventing the flow of water through the body portion of the same cooler and through the nose and body portions of all of the other coolers. It is readily possible to detect which cooler nose portion has failed, without rendering any of the coolers inoperative, by terminating the water supply to each cooler nose portion in turn to see which cooler is responsible for the generation of steam in the furnace.

Preferably, the common inlet and outlet pipes have valved outlets and inlets. Thereby, if it is desired to isolate a failed cooler completely while keeping the other coolers in operation, the valved outlet from the cooler immediately preceding the failed cooler can be connected by a flexible hose to the valved inlet to the cooler immediately following the failed cooler, the valves of the valved outlet and inlet thus connected are opened, and the valves in the branch pipes of the failed cooler are closed.

From another aspect the invention provides a furnace comprising a cooler or a bank of coolers as defined above.

The invention is diagrammatically illustrated by way of example in the accompanying drawings in which:

FIG. 1 is a sectioned plan view of a first embodiment;

FIG. 2 is a sectional side elevation of the device shown in FIG. 1, the section being taken on the line C—C of FIG. 1;

FIG. 3 is an elevation of the rear of the device shown in FIG. 1,

FIG. 4 is an elevation of the front of the device shown in FIG. 1;

FIG. 5 is a sectioned plan view of a second embodiment;

FIG. 6 is a sectional side elevation of the device shown in FIG. 5 and taken on the line C—C of FIG. 5;

FIG. 7 is a rear elevation of the device shown in FIG. 5;

FIG. 8 is a front elevation of the device shown in FIG. 5;

FIG. 9 is a sectioned plan view of a third embodiment;

FIG. 10 is a sectional side elevation taken on the line A—A of FIG. 9;

FIG. 11 is a rear elevation of the device of FIG. 9;

FIG. 12 is a front elevation of the device of FIG. 9, and

FIG. 13 shows diagrammatically the arrangement of feed pipes to a bank of coolers.

Referring to FIGS. 1 to 4 of the drawings there is shown a flat block cooler which comprises a closed generally rectangular flat vessel 1 which is cast in copper, the vessel defining a cavity 5. The cooler tapers outwardly from its front end, or nose, 2 to its rear end 9. A generally U-shaped pipe 3 is cast into the cooler so that its free ends are disposed at the rear end 9 of the cooler while the base portion 4 of the U-shaped pipe extends along the nose 2 of the cooler. The major portion of the limbs of the pipe 3 are disposed within the cavity 5, but the portion 4 is buried in the wall of the nose portion 2. The ends 6 of the pipe form respectively an inlet and an outlet for cooling water for the nose of the cooler.

Openings 7 and 8 formed in the rear end 9 of the cooler communicate with the cavity 5 and are respectively an inlet and an outlet for cooling water. The cavity is formed with cast-in baffles 10 whereby the water entering the cavity is forced to follow a sinuous path. It will be seen however that the path between inlet 7 and the nose of the cooler is relatively direct.

The rear end of the cooler is also formed with lugs 11 whereby the cooler can be removed from its operative position. In order to strengthen these lugs, an internal steel reinforcement 12 is provided, the reinforcement consisting of a plate 13 arranged to extend along the rear end of the cooler, and a pair of rearwardly extending projections 14 which extend within the lugs 11.

Referring to FIGS. 5 to 8 of the drawings there is shown a flat block cooler generally similar to that described with reference to FIGS. 1 to 5. In this arrangement however the pipe 3 is buried in the wall of the cooler for its entire length. With such an arrangement it is possible to cast cavities in the wall of the vessel communicating with the nose portion rather than to cast a pre-formed pipe into the wall of the vessel.

The cooler of FIGS. 9 to 12 is similar to those described above and includes a single centrally disposed baffle 10.

In FIG. 13 there is shown a pipe arrangement for connecting a series of the coolers together in a bank. Water from a mains feed is fed to the bank of coolers by way of a pipe **15** which branches into two branch conduits at **17**, one branch going to the inlet **6** of the first cooler **1** in the bank and the other branch going to the inlet **7** of the first cooler. Valves **18, 19** are disposed in the respective branches and a tapping **16** is provided in the pipe **15** upstream of the valves **18, 19**.

Water leaving the first cooler **1** through outlets **6** and **8** flows through pipes **26, 27** respectively which connect at **21** with a pipe **20**. Valves **22, 23** are arranged in the pipes **26, 27** respectively, and a tapping **24** is provided in pipe **20**. The pipe **20** is connected to the second cooler in the bank in similar manner to that in which the pipe **15** is connected to the first cooler in the bank. Water leaves the bank of coolers through a pipe **25**.

The pipe arrangement is such that should the nose portion of any one of coolers fail so that cooling water leaks from the cooler, the valves, e.g., **18** and **22**, are shut so that the water circuit through the nose portion of that particular cooler is isolated, so that the bank of coolers can remain in use for a period of time. If it is desired to remove any one of the coolers from the bank, the valves **18, 19, 22,** and **23** are shut and a flexible pipe connected between tappings **16** and **24** so that the cooler is bypassed.

Objects achieved by the arrangement described above are:

a. To improve the cooling properties of the cooler unit.

b. To design the pipework so as to alleviate the embarrassment of too much additional external pipework.

c. To enable the coolers to be independent of each other, thereby ensuring continuous cooling even in the event of the failure of any one cooler within a bank of coolers throughout the campaign.

d. To save the operator down time in the event of a cooler failure, particularly during a crucial period in the production cycle of the furnace.

e. To enable the cooler to be extracted expeditiously during normal "Off Blast" periods.

f. To enable a failure to be easily located.

Our investigations have shown that 98 percent cooler failures are at the nose portion. With the incorporation of the pipework shown in FIG. **13** it is possible to stop the water feed to the nose and to continue the flow of water to 95 percent of the cooler area. This, together with the high conductivity of the casting, will cool the area now deprived of water.

When the water feed has been stopped to the nose portion, the body is so constructed that the baffle plates (which can be inserted either vertically or horizontally during casting) assist in guiding the water, coursing through the body of the cooler, to the vital nose area of the body portion.

The pipework takes into consideration the minimum area of external pipework required and therefore proves no embarrassment to the overall construction of the pipework complex surrounding the furnace.

In the event of failure, the cooler may be safely allowed to continue in operation as, having discontinued the water to the nose portion of any one cooler, the water flow into the body portion of the cooler or to the remaining coolers in the bank is unaffected and the damaged cooler is therefore capable of carrying out its function until it is convenient for the operator to change it. The damaged cooler can be replaced during normal 'Off Blast' period. There is ample warning and time for the exchange procedure. It will be noted, that, with the use of this system the water flows continuously through the bank of coolers at all times. There is no discontinuation of the flow of water, even when the cooler is to be replaced. Neither is there any discontinuation during the insertion of the flexible bypass pipe.

This pipework can be applied to any cooler irrespective of shape, provided the cooler is constructed in accordance with the invention.

Several methods are used to withdraw coolers after failure. Some furnaces are fitted with clamps to the shell of the furnace and, with the aid of hydraulic or ratchet equipment, the coolers are eased out of the furnace and exchanged. However, the lugs incorporated in the coolers for this purpose are often insufficiently strengthened to withstand the strain and are therefore torn from the casting. In this case the cooler is abandoned in the furnace, filled with refractory cement and the cooling water bypassed to the next cooler. This deprives the refractory lining in this area of any coolant and will possibly lead to a deterioration of the lining at this point.

The cooler described with reference to FIGS. **1** to **4** is designed to incorporate strengthened withdrawal lugs at the rear of the cooler which will help to obviate the parting of the lugs from the parent casting. The full pulling strain is exerted evenly over the back end of the cooler, thereby making it extremely difficult to pull the lugs away from the casting without disintegrating the complete casting. The pull is spread throughout the whole unit. The lugs are torn due to lack of water in the cooler for a period, which allows the cooler to distort, thereby making it difficult to remove from within the furnace wall.

The bank of four coolers shown in FIG. **13** will enable the furnace operator to pipe up either vertically or horizontally and still ensure a complete flow of water with direct control over both the nose portion and body portion at any given time. It will be noted that the additional pipework is limited and confined to the cooler area.

We claim:

1. A flat plate cooler for cooling the lining of a furnace, said cooler comprising a body which is cast in one piece and has an interior cavity for the passage of cooling water extending over substantially the whole length and width of the cooler, said body having front and rear walls defining opposite ends of said body and said interior cavity, a pipe cast into said front wall to provide a nose cavity therein for the passage of cooling water, a cooling water inlet and a cooling water outlet connected through said body in communication with said interior cavity, and a separate cooling water inlet and a separate cooling water outlet connected in communication with said pipe.

2. A cooler as set forth in claim **1** in which said pipe cast into said front wall has opposite end portions, said opposite end portions extending from said front wall back through said interior cavity of said body and respectively terminating in said separate cooling water inlet and said separate water cooling outlet.

3. A cooler as set forth in claim **2**, in which said opposite end portions of said pipe have terminal ends cast into said rear wall, and said terminal ends respectively included in said separate cooling water inlet and said separate cooling water outlet.

4. A cooler as set forth in claim **1** in which said cooling water inlet and said cooling water outlet connected in communication with said interior cavity are connected in said rear wall.

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