Jan. 31, 1939. G. L. ROBINSON 2,145,555

WATER COOLED FURNACE PORT CONSTRUCTION

Filed Oct. 26, 1937

Fig. 1.

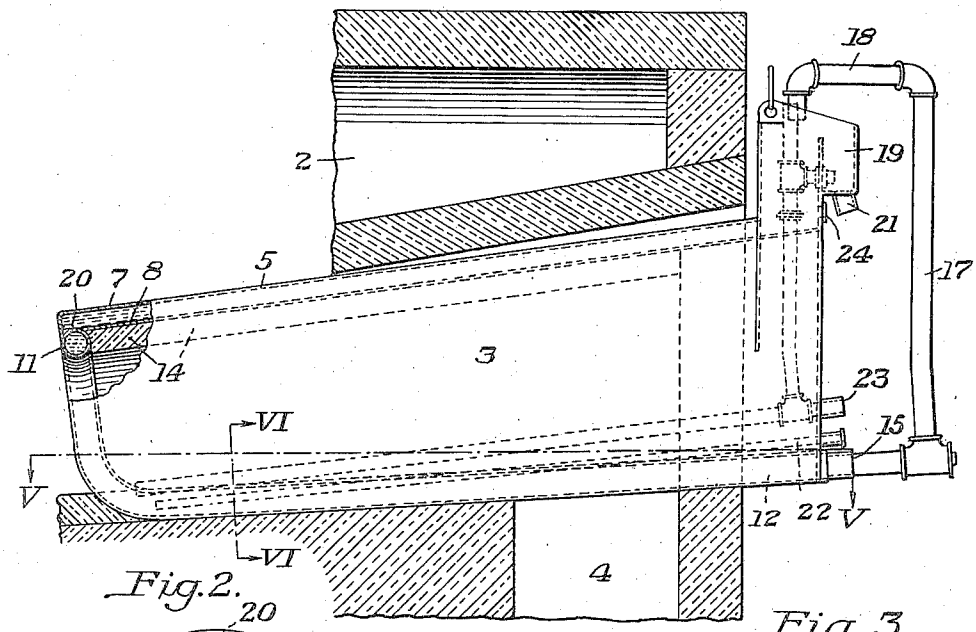


Fig. 2.

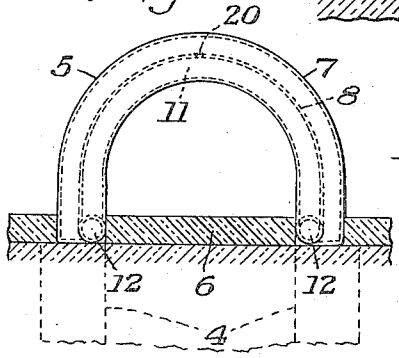


Fig. 6.

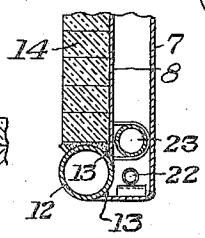


Fig. 3.

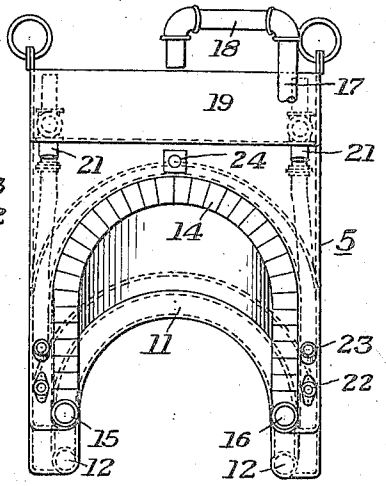


Fig. 4.

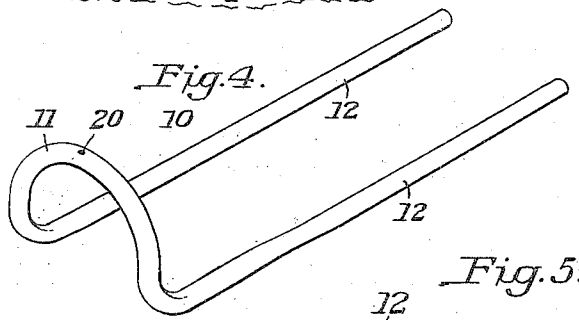
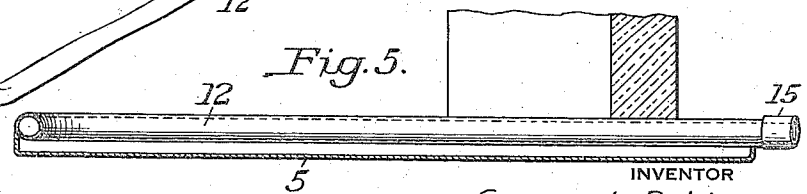


Fig. 5.



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UNITED STATES PATENT OFFICE

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WATER-COOLED FURNACE PORT CONSTRUCTION

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Application October 26, 1937, Serial No. 171,031

9 Claims. (Cl. 122—6.5)

This invention relates generally to water-cooled furnace port constructions, and more particularly to such constructions employing a main cooler and an auxiliary cooler in which the auxiliary cooler is arranged so as to give the greatest cooling effect to the edges of the port which are most exposed to the furnace gases and also to give to the cooler as a whole, greater strength and rigidity.

In the accompanying drawing which illustrates the present preferred embodiment of my invention,

Figure 1 is a vertical longitudinal section through the fuel port of a reversible open hearth furnace, the cooler being shown in elevation with a portion broken away;

Figure 2 is an end elevation of the port cooler as viewed from the left-hand end of Figure 1;

Figure 3 is an end elevation of the port cooler shown in Figure 1 as viewed from the right-hand end of Figure 1;

Figure 4 is a perspective view of the auxiliary cooler employed in conjunction with the main cooler;

Figure 5 is a horizontal section taken on the line V—V of Figure 1, parts being omitted for clearness, illustrating a portion of the main and auxiliary coolers; and

Figure 6 is a vertical section to an enlarged scale of a portion of the main and auxiliary coolers and the refractory lining, the section being taken on the line VI—VI of Figure 1.

The water-cooled furnace port construction of the present invention is adapted for use with various types of furnace ports, but is illustrated specifically herein as applied to the gas port of a reversible open hearth furnace. In such furnaces, fuel gas is admitted through the port when the furnace is fired from one end and a portion of the gaseous products of combustion is withdrawn through the port when the furnace is fired from the opposite end. The gas which is preheated is admitted from below, near one end of the port, which end is closed by brickwork or other refractory material. The gas flowing upward at the point of entry is diverted longitudinally by the port and emerges at the other end which is smaller in cross-section, so that it becomes mingled with air which likewise may be heated and which enters from above and at the sides of the gas port.

The nozzle end of the gas port and the lower edges of that port are the portions of the port which are most exposed to furnace gases when the furnace is being fired from the opposite end, and accordingly, these portions of the port have a tendency to be burned out more quickly than other portions of the port. Briefly stated, the present invention provides an auxiliary cooler which preferably is in the form of a pipe and comprises an arch portion having two leg portions extending therefrom. The auxiliary cooler is secured to the main port cooler in such manner that the arch of the auxiliary cooler lies adjacent the nozzle end of the main cooler, and the legs of the auxiliary cooler extend along and adjacent the lower edges of the main cooler. In this way the portions of the main cooler and port which are most exposed to the hot gases of the furnace are protected by the auxiliary cooler. Water or other cooling fluid is flowed first through the auxiliary cooler and thereafter through the main cooler. Thus, the coldest cooling water is supplied to the hottest parts of the port and the water which has been somewhat heated thereby is then supplied to the main cooler, the body portion of which is not subjected to as hot gases as are the bottom edges and nozzle end of the main cooler.

Referring more particularly to the accompanying drawing, there is illustrated a portion of a reversible open hearth furnace provided with air ports, one of which is indicated by the reference numeral 2 and a gas port 3 connected with a gas uptake 4. The port cooler comprises a main cooler 5 which is preferably of metallic construction and is of substantially inverted U-shape. The main cooler tapers from its outer or uptake end towards its inner or nozzle end and is closed adjacent its nozzle end by refractory material 6 so as to form a nozzle for delivery of the furnace gas. The main cooler has an outer wall 7 and an inner wall 8 providing a space therebetween in which water or other cooling fluid circulates. The construction of the main cooler may be in accordance with prior art and is not claimed herein except in combination with the auxiliary cooler which is hereinafter described.

The auxiliary cooler 10 is shown in Figure 4. It is made of pipe which is bent to form an arch 11 and two legs 12 extending from the arch. This auxiliary cooler is secured to the main cooler in such manner as to reinforce the latter and also to protect those parts of the main cooler which are most subjected to the hot furnace gases. The legs 12 of the auxiliary cooler are secured to the outer and inner walls 7 and 8 of the main cooler adjacent the bottom edge of the main cooler, as illustrated in Figure 6. The auxiliary cooler is preferably secured to the main

cooler by welding, as indicated by the reference numeral 13. The auxiliary cooler supports the inner refractory lining 14 for the main cooler, this lining being illustrated as made up of refractory brick. It will be noted from Figure 6 that the refractory lining 14 terminates short of the bottom edge of the main cooler and that the legs 12 of the auxiliary cooler are located in such position as to protect the lower edges of the refractory lining. As shown in Figure 1, the refractory lining at the nozzle end of the cooler does not extend to the end of the main cooler, but terminates short of it. The arch portion 11 of the auxiliary cooler fits in this space so as to protect the nozzle end of the refractory lining.

The auxiliary cooler 10 is provided with a water inlet 15 connected to one of the legs 12 and an outlet 16 connected to the other leg. Cooling water is supplied under pressure by means of a pump (not shown) to the inlet 15. It flows along the leg 12 of the auxiliary cooler to the nozzle end of the port, and then flows through the arch portion 11 of the cooler and thereafter out through the other leg 12. It then flows through a vertical pipe 17 connected to the outlet 16 and then through a horizontal pipe 18 which delivers it to a trough 19 which surmounts the port at the end which projects beyond the furnace wall and communicates freely with the main cooler. The water flowing through the auxiliary cooler does not communicate directly with the main cooler at any point intermediate the ends of the auxiliary cooler except for a very small vent hole 20 in the crown of the arch 11 which permits the escape of any gases that might otherwise become trapped at this point. Of course, a small amount of water may flow through this vent hole, but the hole is so small that the water so escaping from the auxiliary cooler is negligibly small in comparison with the total amount of water circulated through the auxiliary cooler from end to end thereof. By the construction described, the lower edges of the port and the nozzle end of the port which are most exposed to the hottest waste gases are cooled by the relatively cold water which flows through the auxiliary cooler 10. The interior or body portion of the port which does not become heated to as great an extent as the lower edges or nozzle end of the port is cooled by the relatively warmer water which has become somewhat heated in passing through the auxiliary cooler.

The main cooler is provided with outlets 21 for the water which has passed through the auxiliary cooler and the main cooler. No means is provided in the main cooler for positively circulating the water through it as it has been found that there is sufficient circulation of the water in the main cooler due to the heat imparted to the cooler from the refractory lining of the port. The main cooler is provided with a set of flushing pipes 22 and a set of washout pipes 23 and a cleanout opening 24 which may be utilized to facilitate the removal of sediment which may collect within the main cooler.

The auxiliary cooler 10 should be of such size that the water necessary to circulate through the system in order to do the requisite amount of cooling without generating steam will have sufficient velocity to prevent sedimentation within the auxiliary cooler. The main cooler 5 is reinforced and strengthened by the auxiliary pipe cooler 10 extending around the inner edge of the main cooler at both the nozzle end and the bottom edges. The auxiliary cooler increases the width of the bottom edges and of the nozzle end and greatly increases the stiffness of the port construction as a whole. The auxiliary cooler is preferably manufactured as a unit. The inner and outer walls of the main cooler are then welded to the pipe, so that the whole forms an integral rigid structure which, however, can expand and contract sufficiently under the influence of the temperature variations to which it is subjected without the opening of joints and consequent leakage. The most exposed part of the cooling system, that is, the auxiliary cooler 10, keeps itself clean because of the high velocity of the circulating water, and burning of its outer surface, owing to poor heat conduction which would result from accumulation of sediment, is avoided.

A refractory lining, such as that indicated by the reference numeral 14, is preferably employed for the main cooler, but the cooler may be employed without a lining.

Although I have illustrated and described the present preferred embodiment of the invention, it is to be understood that it may be otherwise embodied or practiced within the scope of the following claims.

I claim:

1. A water cooled furnace port construction, comprising an elongated hollow main cooler adapted to extend from a point above the uptake of the furnace to a port thereof, and an auxiliary cooler integral with the main cooler, said auxiliary cooler contacting with and lying along the lower edges and the nozzle end of the main cooler and exposed to the furnace gases passing through the port.

2. A water cooled furnace port construction, comprising an elongated hollow main cooler adapted to extend from a point above the uptake of the furnace to a port thereof, and an auxiliary cooler integral with the main cooler, said auxiliary cooler contacting with and lying along the lower edges and the nozzle end of the main cooler and exposed to the furnace gases passing through the port, and connections for flowing cooling water first through said auxiliary cooler and then through said main cooler.

3. A water-cooled furnace port construction, comprising an elongated hollow inverted substantially U-shaped main cooler adapted to extend from a point above the uptake of the furnace to a port thereof, and an auxiliary cooler integral with the main cooler, said auxiliary cooler extending along and adjacent the lower edges of the legs of the main cooler and along and adjacent the arch of the main cooler adjacent its nozzle end, and connections for flowing cooling water first through said auxiliary cooler and then through said main cooler.

4. A water-cooled furnace port construction, comprising an elongated hollow inverted substantially U-shaped main cooler adapted to extend from a point above the uptake of the furnace to a port thereof, having an inner lining of refractory material, an auxiliary cooler integral with the main cooler and supporting the refractory material, said auxiliary cooler extending along and adjacent the lower edges of the legs of the main cooler and along and adjacent the arch of the main cooler adjacent its nozzle end, and connections for flowing cooling water first through said auxiliary cooler and then through said main cooler.

5. A water-cooled furnace port construction, comprising an elongated hollow inverted substantially U-shaped main cooler adapted to ex-

tend from a point above the uptake of the furnace to a port thereof, said main cooler having an inner lining of refractory material, the refractory lining terminating short of the lower edges of the main cooler and short of the nozzle end of the main cooler, an auxiliary cooler integral with the main cooler and extending along and adjacent the lower edges of the refractory material and along and adjacent the arch of the refractory lining adjacent the nozzle end of the port, and connections for flowing cooling water first through said auxiliary cooler and then through said main cooler.

6. A water-cooled furnace port construction, comprising in combination an elongated hollow inverted substantially U-shaped metal main cooler adapted to extend from a point above the uptake of the furnace to a port thereof, and tapering toward its nozzle end, an auxiliary cooler formed of pipe and comprising an arch portion and two legs extending from the arch, the auxiliary cooler being secured to the main cooler to form a unitary structure and reinforcing it, the arch of the auxiliary cooler lying adjacent the nozzle end of the main cooler, the legs of the auxiliary cooler lying adjacent the lower edges of the main cooler, and connections for flowing cooling water first through said auxiliary cooler and then through said main cooler.

7. A water-cooled furnace port construction, comprising in combination an elongated hollow inverted substantially U-shaped metal main cooler adapted to extend from a point above the uptake of the furnace to a port thereof, and tapering toward its nozzle end, an auxiliary cooler formed of pipe and comprising an arch portion and two legs connected to the arch, the auxiliary cooler being secured to the main cooler to form a unitary structure and reinforcing it, the auxiliary cooler extending around the inner edge of the main cooler at both the nozzle end and the bottom edges of the main cooler, the main cooler having an inner refractory lining supported by the auxiliary cooler, and connections for flowing cooling water first through said auxiliary cooler and then through said main cooler.

8. A water cooled furnace port construction, comprising an elongated hollow metallic inverted substantially U-shaped main cooler having outer and inner walls and providing space therebetween for cooling fluid and adapted to extend from a point above the uptake of the furnace to a port thereof, an auxiliary cooler formed of a single piece of pipe and comprising an arch portion and two legs extending from the arch, said auxiliary cooler and main cooler being welded together to form a unitary structure, the legs of the auxiliary cooler being welded to the outer and inner walls of the main cooler adjacent the bottom edges of the main cooler and forming a part of the wall of the main cooler, the arch of the auxiliary cooler being welded to the outer and inner walls of the main cooler adjacent the nozzle end of the main cooler and forming a part of the wall of the main cooler, and connections for flowing cooling water first through said auxiliary cooler and then through said main cooler.

9. A water cooled furnace port construction, comprising an elongated hollow metallic inverted substantially U-shaped main cooler having outer and inner walls and providing space therebetween for cooling fluid and adapted to extend from a point above the uptake of the furnace to a port thereof, an inner lining of refractory material for the main cooler, the refractory lining teminating short of the bottom edge of the main cooler and short of the nozzle end of the main cooler, so as to form pockets between the main cooler and refractory lining adjacent the lower edges and nozzle end of the main cooler, an auxiliary cooler formed of a single piece of pipe and comprising an arch portion and two legs extending from the arch, said auxiliary cooler and main cooler being welded together to form a unitary structure, the legs of the auxiliary cooler lying in said pockets and being welded to the outer and inner walls of the main cooler adjacent the bottom edge of the main cooler and forming a part of the wall of the main cooler, the arch of the auxiliary cooler lying in said pocket and being welded to the outer and inner walls of the main cooler adjacent the nozzle end of the main cooler and forming a part of the wall of the main cooler, and connections for flowing cooling water first through said auxiliary cooler and then through said main cooler.

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