

Oct. 15, 1946.

E. L. HOPPING
HOPPER CONSTRUCTION

2,409,567

Filed Aug. 28, 1944

2 Sheets-Sheet 1

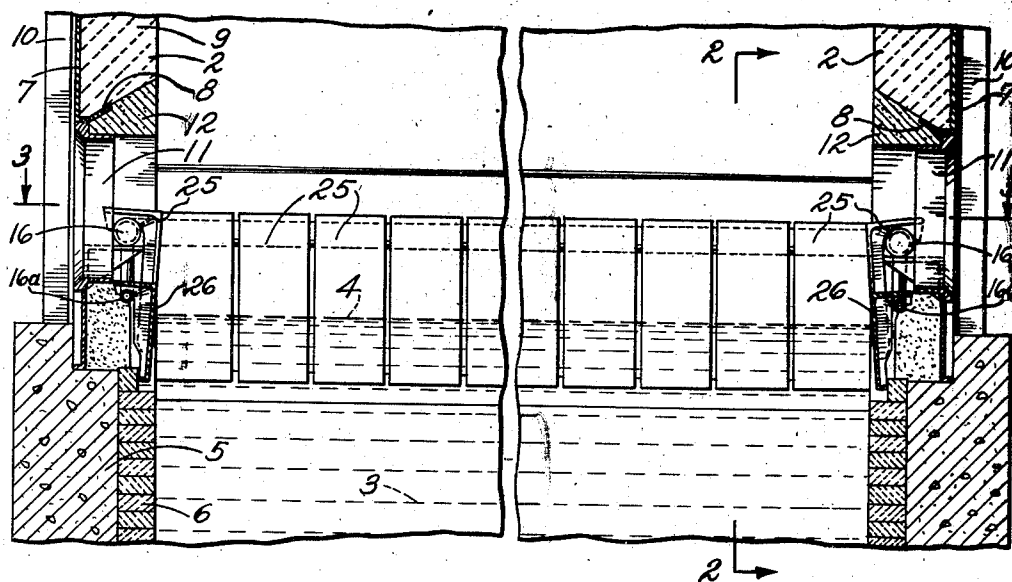


Fig. 1

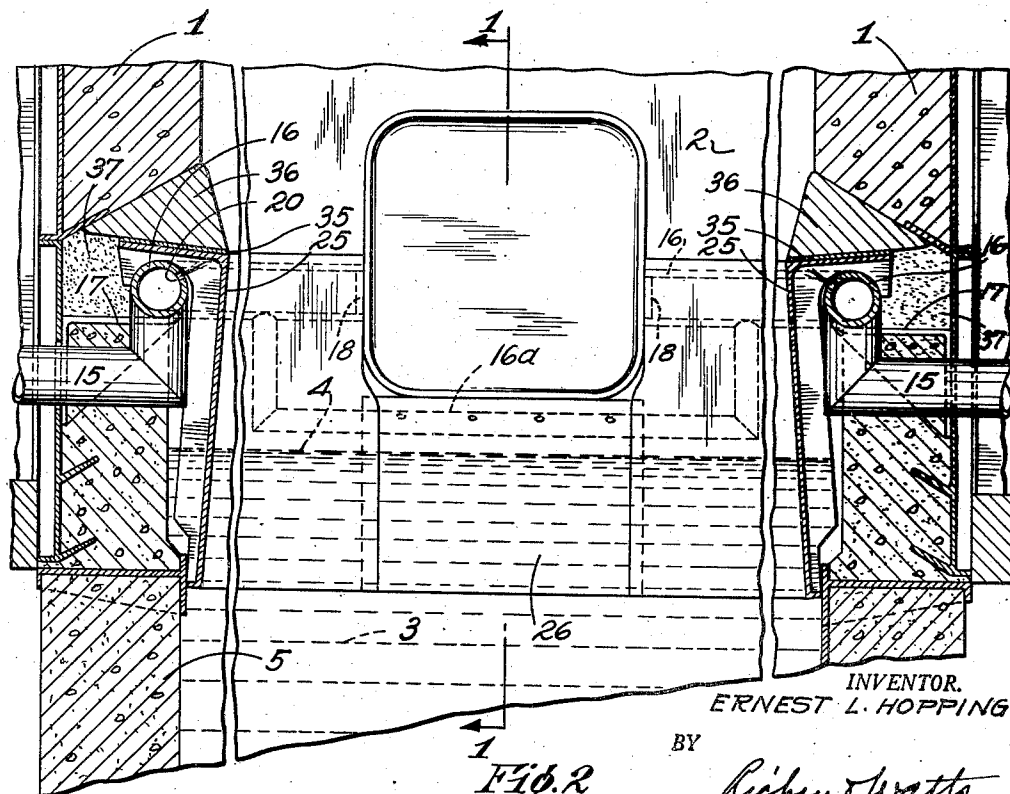


Fig. 2

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2 Sheets-Sheet 2

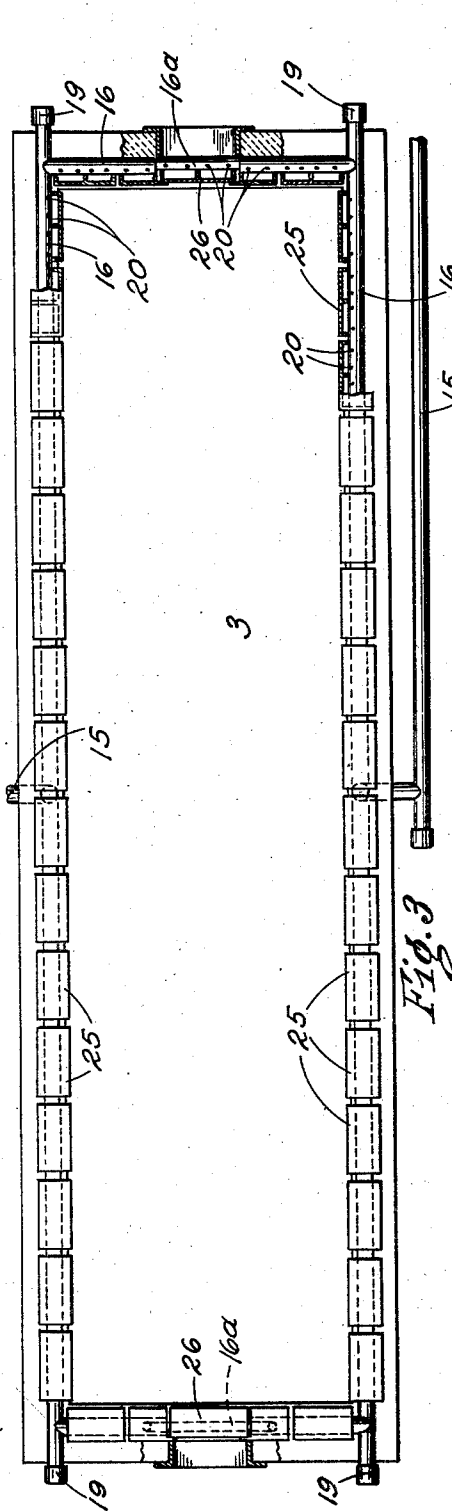


Fig. 3

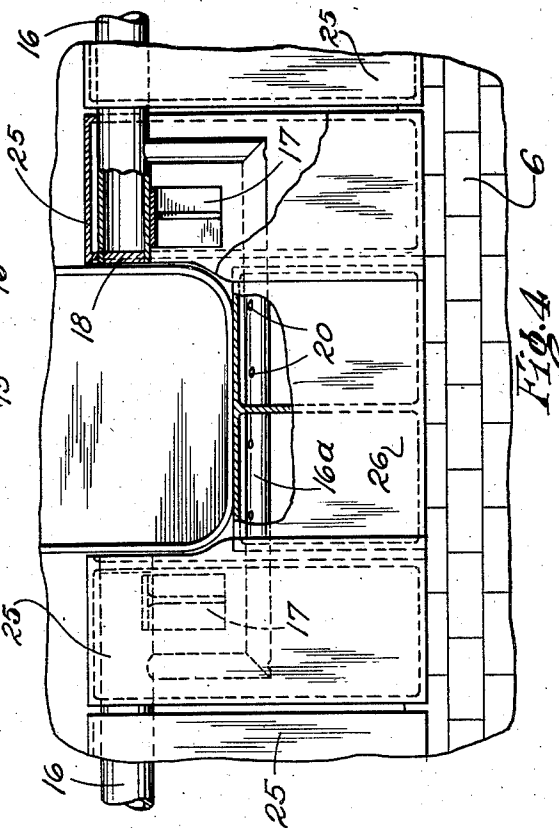


Fig. 4

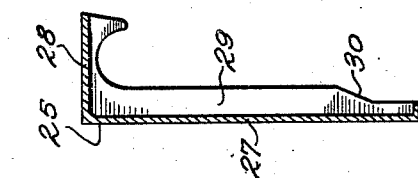


Fig. 5

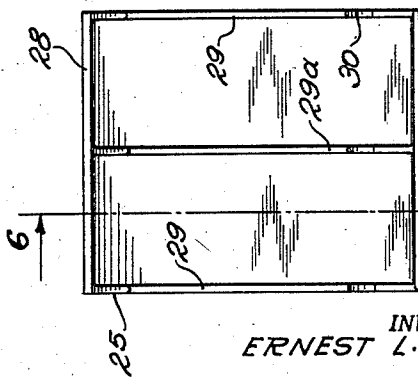


Fig. 6

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HOPPER CONSTRUCTION

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11 Claims. (Cl. 110—171)

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This invention relates generally to ash hoppers and particularly to an ash hopper of the submerged type in which the hopper walls are protected against deteriorating influences in the region which includes the normal surface level of water in the hopper.

Heretofore submerged type hoppers have been used to some extent in conjunction with steam generating power plant furnaces in which the ash produced is in a molten or very highly heated condition. The term "submerged" was applied to this type of hopper probably because the highly heated ash was submerged in a body of water retained in the hopper during the ash accumulating period of time. While submerged hoppers were quite effective in quickly cooling and disintegrating the highly heated or molten ash, they were difficult and expensive to maintain in service. The walls of the hopper below the surface of the water in the hopper were kept at temperatures below the boiling point of water, while the walls of the hopper above the water line were exposed to the intense heat radiated into the upper end of the hopper from the combustion chamber of the furnace as well as the heat radiated from the ash as it moved down thru the hopper and into the water. Since submerged hoppers were usually lined with refractory material, often in the form of blocks, and since some of that material or those blocks extended from below to above the surface of the water in the hopper, such material or blocks were subjected to temperature differentials extending over many hundred degrees. These differentials, and doubtless other factors incident to the conditions of service, resulted in short service life of the hopper liners in the region of the surface of water in the hopper and necessitated frequent and expensive repairs or replacements of the liners.

Many expedients have been proposed heretofore for lengthening the life of the hopper liners in the region of the surface of the water in submerged type hoppers but, so far as I am advised, none of these proposals has resulted in any material extension of the life of the hopper liners in that region or has minimized the expense of upkeep of the liners.

Another factor which may have tended to shorten the life of liners of submerged hoppers and which also tended to interfere with the most efficient operation of the furnace was the practice of spraying water into the hopper above the level of liquid therein for the main purpose of cooling the water which was exposed to the intense heat of the combustion chamber and thereby decreasing the rate of evaporation. However, the cooling effect of the water so sprayed into the hopper was not substantial because a large part of it was vaporized before it reached the body of water in the hopper; and the resulting vapor which was

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immediately carried into the combustion chamber tended to cool the gases produced by the combustion of fuel and thus decrease the efficiency of operation of the furnaces, and also tended to promote corrosion of tubes and other metal parts in the boiler unit.

The present invention makes it possible to avoid those disadvantages and to construct hoppers of the submerged type which will operate for much longer periods of time without repair or maintenance than prior hoppers of this type, which may be quickly and inexpensively repaired in the region of the normal surface level of water in the hopper, which has an efficient means for cooling the upper portions of the water in the hopper and thereby minimizing evaporation of the water, and which does not liberate any substantial amount of water in finely divided form above the surface of water in the hopper.

Briefly stated, the present invention contemplates a submerged hopper having a lining of readily removable metal plates extending from above to below the normal surface level of liquid in the hopper, means to spray cooling water against the outer surfaces of the plates and means to direct the flow of such water into, but a short distance below the surface of, the body of water in the hopper.

The present invention will be better understood by those skilled in the art from the following description of one practical embodiment of the invention shown in the drawings, in which

Figure 1 is a vertical, central, longitudinal, sectional view, with parts broken away, taken on line 1—1 of Fig. 2 thru a submerged hopper embodying the present invention;

Figure 2 is a transverse vertical, sectional view, with parts broken away, taken on line 2—2 of the hopper of Fig. 1;

Figure 3 is a plan view, partly in section, taken approximately on line 3—3 of the furnace of Fig. 1 and showing the arrangement of metal wall plates and water pipes and their outlets;

Figure 4 is a fragmentary, end elevational view, partly in section, similar to Fig. 2 but showing details of the metal plates and water pipes in the vicinity of an end door of the hopper;

Figure 5 is an exterior, side elevational view of one of the larger metal wall plates; and,

Figure 6 is a sectional view taken on line 6—6 of Fig. 5.

The hopper shown in the drawings comprises side walls 1 and end walls 2 which define a chamber open at its upper end to receive ash from the combustion chamber of a furnace (not shown) and to retain water 3 in which the ash may be submerged. The normal surface level of this water is indicated at 4 in Figs. 1 and 2. The walls 1 and 2 may be of any suitable construction. As shown, the side walls 1 below the water line 4

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consist of masonry 5 while the end walls 2 below that line consist of masonry 5 and a brick lining 6. The lining 6 may be omitted from walls 2 or added to walls 1, or other types of wall construction may be used below the water line. The upper parts of walls 1 and 2, that is, above the part 5, preferably consists of a metal shell 7 having upwardly inclined inner ledges 8 projecting therefrom and supporting refractory material, for example, blocks 9. The shell 7 is exteriorly supported by vertical metal angles 10. Other types of construction may be used, if desired.

In each end wall 2 a doorway is provided. Each doorway consists of a metal frame 11 resting on wall 5 below the normal surface 4 of liquid in the hopper and refractory material 12 surrounding frame 11 and extending into contact with, or in close proximity to, the lower adjacent surface of refractory liners 9. Each doorway is provided with a removable door (not shown).

The end and side walls 1 and 2 have horizontal recesses open to the interior of the hopper. The water pipes, about to be described, are located in these recesses.

As will be better seen by reference to Fig. 3, the hopper of Figs. 1 and 2 is provided with water supply pipes 15 which communicate with horizontal pipes 16, each of which extends from one door frame to the other in the recesses in the walls. The pipes 15 extend thru the side walls of the hopper and are supported by the hopper wall. The pipes 16 are supported in the recesses in the side and end walls on brackets 17 (see Figs. 2 and 4). The pipes 16 are closed by plugs 18 (Fig. 4) adjacent to the door frames 11 and have capped extensions 19 projecting thru the end walls of the hopper for clean-out purposes. Pipes 16 on opposite sides of either door are connected by branch pipes 16a which extend vertically down from pipes 16 and horizontally across beneath the door frame. The pipes 16 and branches 16a are provided with outlet openings 20, so that water may be discharged therefrom inwardly toward the water chamber.

Walls 1 and 2 are lined with a plurality of metal plates 25 and 26 which extend from well above to well below the normal water level 4, as is clearly shown in Fig. 1.

The metal liners 25 may be alike and differ from liners 26 primarily in length only. Each of the liners 25 and 26 consists of a main body 27 and a top flange 28 extending at substantially right angles thereto. Strengthening ribs 29 extend along the edges of body 27 and flange 28 and under the flange have lower edges shaped to conform to the curvature of pipes 16 and 16a, so that the plates may be hooked onto the water lines for support. When the plates 25 or 26 are wide enough to make it desirable, an additional rib 29a (as is shown in Fig. 6) may be employed if desired. The ribs 29 are cut away near the lower edges of plates 25 and 26, as is indicated at 30 in Figs. 5 and 6, so that the plates may swing outwardly at their lower ends and bear against the inner surfaces of the hopper walls below the water level 4.

It will be noted, by reference to Figs. 2, 3 and 4, that the outlets 20 from pipes 16 and 16a are so located with reference to the plates 25 and 26 that water issuing thru those outlets will strike against the outer surfaces of the plates and will not pass directly thru the small vertical spaces between two adjacent plates and into chamber 2 above water level 4. It will also be noted that outlets 20 extend upwardly so that they direct the

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water against the plates in the angle between bodies 27 and flanges 28. Water so discharged against the plates 25 and 26 will flow down over their exterior surfaces and thence into the body of water in the hopper below the surface 4 thereof. In this manner the portions of the plates above water level 4 are maintained at a fairly low temperature despite the fact that the inner surfaces are exposed to the intense heat of the combustion chamber of the furnace and the hot ash moving therefrom into the hopper.

This cooling water cools the plates constantly and quite efficiently, enters the surface portions of the body of water outside of the plates without causing any substantial turbulence of even that part of the body of water, and in flowing between the plates does not disturb the quiescent surface of the main body of water in the hopper. As a result of maintaining quiescence and avoiding turbulence in the surface portion of the main body of water in the hopper substantially no water of that portion is broken up into small globules or spray which could be carried into the combustion chamber or boiler unit.

The plates 25 and 26 may be readily removed for replacement or repair. Thin pieces of sheet metal 35 cover the top of flange 28 of plates 26 and refractory material 36 fills the space between this sheet metal and the lower edge of the refractory wall thereabove. Loose, granular material 37 is packed in the space outside of the pipes 16. This material should be of such nature that it will not cake during use and thereby interfere with ready removal of the plates 25. When any of the plates 25 is to be removed the refractory material 36 is broken away and then the plate may be lifted off the pipe 16 and replaced by another plate whereupon new refractory material 36 may be placed in position. Plates 26 may be removed simply by lifting them off the pipes 16a.

The smooth, inclined, inner surfaces of bodies 27 of plates 25 and 26 afford no opportunity for the ash to adhere thereto, and also, due to their inclination, are less exposed to the radiant heat of the combustion chamber of the furnace. Furthermore, refractory material 36 tends to protect the plates against such radiant heat. These factors, combined with the effective cooling of the outer surfaces of the plates make for prolonged life of the plates in actual service.

Having thus described my invention so that others skilled in the art, may be able to understand and practice the same, I state that what I desire to secure by Letters Patent is defined in what is claimed.

What is claimed is:

1. A hopper of the submerged type comprising walls defining an open-topped, water-retaining chamber, water pipes disposed along said walls above the normal surface level of water in the chamber and having a plurality of outlets to discharge water toward said chamber and metal plates constituting a lining for said walls and extending from above said pipes to below the normal surface level of water in the chamber, said plates being arranged side by side with small vertical spaces therebetween and so positioned relative to the discharge outlets in said pipes that water passing thru said outlets will impinge against the exterior surfaces of said plates near their upper ends.

2. A hopper of the submerged type comprising walls defining an open-topped, water-retaining chamber, water pipes disposed along said walls

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above the normal surface level of water in the chamber and having a plurality of outlets to discharge water toward said chamber and metal plates arranged side by side on said water pipes and extending to below the normal surface level of water in the chamber, said plates being so positioned relative to the discharge outlets in said pipes that water passing thru said outlets will impinge against the exterior surfaces of said plates near their upper ends.

3. A hopper of the submerged type comprising walls defining an open-topped, water-retaining chamber, water pipes disposed along said walls above the normal surface level of water in the chamber and having a plurality of outlets to discharge water toward said chamber and metal plates having outwardly projecting portions resting on said water pipes and body portions extending to below the normal surface level of water in the chamber, the body portions of said plates extending downwardly and outwardly and bearing at their lower ends against the inner surface of the hopper walls, said plates being positioned to intercept with their outer surfaces water passing thru said discharge outlets and to permit water to flow horizontally between said plates.

4. A hopper of the submerged type comprising walls defining an open-topped, water-retaining chamber, water pipes disposed along said walls above the normal surface level of water in the chamber, and metal plates lining the chamber from above to below the normal surface level of water in the chamber, said plates being inclined downwardly and outwardly and bearing at their lower ends against the inner surface of the hopper walls, said pipes having outlet openings to discharge water against the outer surfaces of said plates above the normal surface level of water in the chamber.

5. A hopper of the submerged type comprising walls defining an open-topped, water-retaining chamber, water pipes disposed along said walls above the normal surface level of water in the chamber and having a plurality of outlets to discharge water toward said chamber, metal plates resting side by side on said water pipes, extending to below the normal surface level of water in the chamber and constituting a lining for said walls, said plates having smooth inner surfaces and extending downwardly and outwardly and bearing at their lower ends against the inner surface of the hopper walls, said plates being so positioned relative to the discharge outlets in said pipe line that water passing thru said outlets will impinge against the exterior surfaces of said plates near their upper ends.

6. A hopper of the submerged type comprising walls defining an open-topped, water-retaining chamber and horizontal spaces open to said chamber, water pipes disposed in said spaces above the normal surface level of water in the chamber, metal plates resting side by side on said water pipes, extending to below the normal surface level of water in the chamber and constituting inner closures for said spaces, and refractory material filling said spaces above said plates.

7. A hopper of the submerged type comprising walls defining an open-topped, water-retaining chamber and horizontal spaces open to said chamber, water pipes disposed in said spaces above the normal surface level of water in the

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chamber and having a plurality of outlets to discharge water toward said chamber, metal plates extending from above said pipes to below the normal surface level of water in the chamber on the chamber side of said pipes, said plates being so positioned relative to the discharge outlets in said pipe line that water passing thru said outlets will impinge against the exterior surfaces of said plates near their upper ends, and refractory material filling spaces in said walls above said plates.

8. A hopper of the submerged type comprising walls defining an open-topped, water-retaining chamber, water pipes disposed horizontally between the inner and outer surfaces of said walls above the normal surface level of water in the chamber and having a plurality of outlets to discharge water toward said chamber, metal plates having outwardly extending top portions resting on said water pipes and body portions extending to below the normal surface level of water in the chamber, said body portions being inclined downwardly and outwardly and bearing at their lower ends against the inner surface of the hopper walls, said plates being so positioned relative to the discharge outlets in said pipes that water passing thru said outlets will impinge against the outer surfaces of plates near their upper ends, and refractory material in the spaces between the top portions of plates and the walls of the hopper thereabove.

9. A metal liner, for the side wall of a water-containing ash hopper having a substantially horizontal water pipe therein, comprising a rectangular body, a flange extending at substantially right angles from the upper part of said body, and ribs extending across the under side of said flange and at substantially right angles to said body, said ribs having substantially semi-circular edges remote from said body to engage the top of said water pipe and to permit said body to swing about said pipe and to bring its lower edge against the hopper wall.

10. A metal liner, for the side walls of a water-containing ash hopper having a substantially horizontal water pipe therein, comprising a rectangular body, a flange extending at substantially right angles from the top edge of said body and ribs extending upwardly along said body and across the under side of said flange at substantially right angles to said body and flange, the portions of said ribs beneath and extending across said flange having substantially semi-circular lower edges remote from said body to engage the top of said water pipe and to permit the lower end of said body to bear against the hopper wall.

11. A metal liner, for the side walls of a water-containing ash hopper having a substantially horizontal water pipe therein, comprising a rectangular body, a flange extending at substantially right angles from the top edge of said body, and ribs extending from the lower edge of the body to and along the under side of said flange at substantially right angles to said body and flange, said ribs being of reduced height adjacent to the lower edge of said body and having substantially semi-circular lower edges remote from said body and beneath said flange, said semi-circular edges serving to engage the top of said water pipe and to permit the lower edge of said body to bear against said wall.

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