

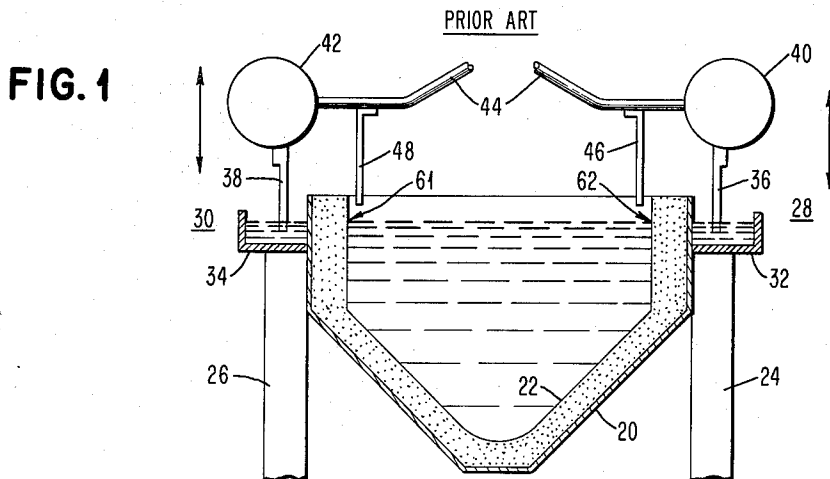
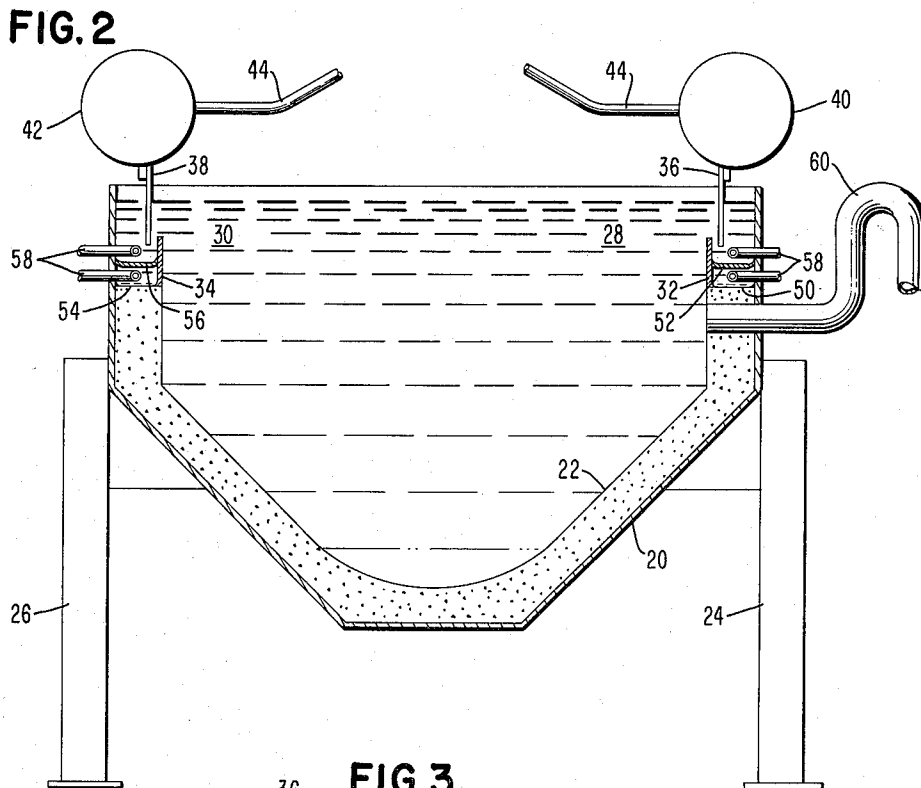
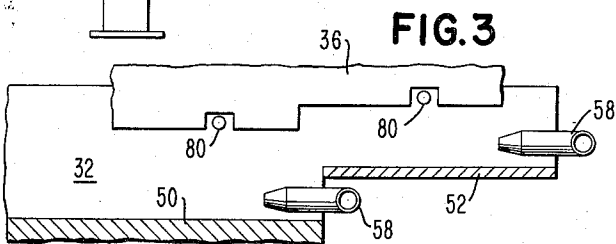
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E. S. ALEXANDER

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BOILER FURNACE ASH HOPPER SEAL

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INVENTOR
EDWIN S. ALEXANDER

BY *John C. Redmond Jr.*
ATTORNEY

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BOILER FURNACE ASH HOPPER SEALEdwin S. Alexander, 26 Deerfield Drive,
Florham Park, N.J.

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4 Claims. (Cl. 110—171)

This invention relates to boiler apparatus and more particularly to apparatus for removing furnace ash from solid fuel fired boilers.

Present day solid fuel fired boilers operate at pressures in excess of 2,000 p.s.i. and temperatures of the order of 1,000° F. Boilers generating large quantities of steam at these conditions consume enormous quantities of solid fuel per hour. All of the solid fuel is not combustible and as a result large quantities of ash are deposited within the furnaces of such boilers. Ash hoppers are adapted to receive this solid, combustion-produced material and dispose of the material without interruption to boiler operation. Several types of boiler ash hoppers are available to the industry. One conventional ash hopper which is the subject of present invention removes the ash by hydraulic means. Such a hopper is generally described in literature, for example, the text "Elementary Steam Power Engineering" by E. MacNaughton, John Wiley Co., New York, New York, second edition, 1933, page 335. Hydraulic ash removal hoppers require a seal to prevent air infiltration into the boiler from atmosphere. Normally, the seal arrangement consists of a combination of drip and seal plates to form a labyrinth with the seal plate extending into a water trough to maintain a positive barrier between the boiler furnace and the atmosphere. The difficulties with this arrangement are; the drip plates deteriorate as a result of exposure to high internal boiler temperatures and contact with water in the ash hopper. As a consequence, it is periodically necessary to remove the boiler from service for replacement of the drip plates in order to maintain the ash hopper seal. Additionally, the hopper which is refractory lined experiences refractory damage due to thermal stresses produced by the differential in boiler gas temperature within the ash hopper. It is desirable therefore to provide an ash hopper seal which will reduce boiler shutdown and repair from deteriorated boiler drip plates as well as deteriorated refractory.

An object of the invention is an improved seal for boiler ash hoppers.

Another object is a boiler ash hopper without a labyrinth seal.

Another object is hydraulic ash hopper having no drip plates.

Still another object is a boiler ash hopper with substantially reduced maintenance requirements with respect to refractory surfaces.

Another object is a water seal trough having improved means for removing boiler ash products deposited therein.

These and other objects are accomplished in accordance with the present invention, one illustrative embodiment of which comprises a boiler ash hopper suitably positioned with respect to the furnace of a boiler to collect ash deposits from the firing of solid fuel supplied to the boiler. The ash hopper comprises a metallic outer shell and an inner refractory lining or member designed to resist the temperatures generated within the boiler interior. The hopper is filled with water to a level above the refractory lining so as to be in contact with the metallic outer shell. A plate member is attached to a thermally expansive section of the boiler, typically the lower drums. A trough, located within the ash hopper, is filled with water and is adapted to receive the plate member so as to form a seal between the boiler interior and the surrounding atmosphere. Water nozzle means are included

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in the trough to force water there-through to flush the seal free of any combustion by-products deposited therein. The location of the seal prevents contact between the interior boiler gases and the refractory lining thereby preventing damage to the latter. The combination of seal plate member and trough is sufficient alone without drip plates to prevent any gas passage between the boiler interior and the surrounding atmosphere when the hopper is discharged and water level is lowered.

One feature of the invention is the location of the seal beneath the normal water level of a water filled ash hopper thereby preventing contact between the boiler gases and the refractory lining of the ash hopper.

Another feature is the position of a trough above the refractory member of an ash hopper, the trough cooperating with the seal plate to form a seal without drip plates and which is not interrupted when the ash hopper normal water level is lowered.

Still another feature is a step trough positioned above the refractory of a boiler ash hopper with the step trough including nozzles for supplying water to flush any combustion by-products from the trough to a disposal point or points.

These and other objects and features of the present invention will be more fully appended from the following detailed specifications taken in conjunction with the appended drawing wherein:

FIG. 1 is a cross-sectional view of a boiler ash hopper employing the conventional seal found in the prior art;

FIG. 2 is a cross-sectional view of a boiler ash hopper employing the principles of the present invention;

FIG. 3 is a side view of the boiler ash hopper shown in FIG. 2.

Referring to FIG. 1, it is believed in order to describe in detail the state of the present art in order to more fully appreciate the contribution of the present invention. FIG. 1 discloses a cross-sectional view of a boiler ash hopper commonly employed with high pressures-high temperature steam boilers utilizing solid fuel for combustion. Such an ash hopper is well-known in the art appearing, for example, in July 1961 publication of "Mechanical Engineering" The American Society of Mechanical Engineers, page 10. The hopper has an outer metallic shell 20, and an inner refractory lining 22, the combination being suitably supported upon pedestals 24 and 26. The shell is filled with water by means (not shown) which are provided to fill the shell with water and drain the water so that any ash occurring from boiler combustion will be removed from the hopper. The hopper, as indicated in the previous publication, is positioned with respect to the boiler furnace so as to collect solid fuel ash resulting from combustion. To seal the interior of the boiler from the external atmosphere, seal means 28 and 30 are included. The seals shown are only those occurring on two sides of the hopper. There are, of course, seals running at each end of the hopper, but these have not been shown for reasons of convenience in explanation. Such seals, however, perform in the same manner as seals 28 and 30 which will next be described.

Each seal, 28 or 30, includes a trough 32 and 34 respectively, which is filled with water by suitable means. Cooperating with the troughs are seal plates 36 and 38, each being secured to lower boiler drums 40 and 42 respectively, attached to steam generating tubes 44 included in the boiler. The combination of tubes and drums are suitably secured at the upper end of the boiler so that as temperatures rise and fall within the boiler interior, the drums raise and lower as indicated in the drawings. The seal plates extend into the water of the trough so as to seal the interior of the boiler from the external atmosphere. Drip plates 46 and 48 are attached to the

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water tubes and slide along the internal side of the refractory 22 to form a labyrinth seal between the interior of the boiler and the water seal trough. The drip plates are subject to severe deterioration from the water and high temperature and periodically require replacement. This necessitates shutdown of the boiler which is costly in revenue and maintenance costs. Additionally, the normal water level of the hopper does not cover the entire refractory lining so that the latter is subject to severe temperature change stresses at the water line areas, 61 and 62, which damage the refractory lining requiring replacement. These problems necessitated the present invention which eliminates drip plates as well as the refractory deterioration at areas 61 and 62.

Turning now to FIG. 2, the present invention includes elements similar to those described in FIG. 1 and these elements will have the same reference designation for convenience in explanation. Thus, the hopper is supported on pedestals 24 and 26 and includes an outer shell 20 and a refractory lining 22. The seals 28 and 30 are located internal in the present invention as contrasted to the external seal in the prior art hopper shown in FIG. 1. The normal water level in the hopper completely covers the refractory 22 as well as the seals 28 and 30. Included in the seals 28 and 30 are one or more step-shaped base sections 50, 52 and 54, 56, respectively. At each level of the step-shaped base a combination filling and flushing nozzle 58 is employed for filling the trough and washing accumulated deposits from the seal when the hopper is being discharged. The seal plates 36 and 38 extend into the troughs 28 and 30 so that when the hopper is discharged and the normal water level is lowered, a seal is completed between the boiler interior and the external atmosphere. The water in the troughs 32 and 34 is not emptied when the hopper is discharged so that the seal plate extending into the trough water maintains the seal between the boiler interior and external atmosphere. Drip plates formerly required in the prior art (see FIG. 1) are no longer required to maintain a satisfactory labyrinth seal. Deterioration of the seal plates 36 and 38 is offset by proper choice of metal for these members, as for example, stainless steel of at least 1/4" thickness. It should be noted that filling the shell and refractory with water to the normal level above the seal trough eliminates any temperature stress on the refractory in areas 61 and 62 so that deterioration is minimized. Thus, the present invention has reduced maintenance requirements with respect to repairing refractory surfaces and maintaining a proper hopper seal without the use of drip plates.

FIG. 3 discloses a longitudinal view of one of the seals 28 or 30, showing the stepped base and nozzle arrangement for filling the water seal trough and flushing ash deposits falling therein. Experience has indicated that a quantity of water producing a velocity of four feet per second within the trough is adequate to remove such ash deposits. Maintaining the normal necessary hopper seal will require a quantity of water equal to two g.p.m. per lineal foot of seal trough. Experience has further indicated that the construction of the trough should be of a heat and acid resistant metallic member of at least 1/4" thickness, stainless steel metals being preferred for this purpose. Additionally, the trough should be suitably stiffened along its length by rods 80, and the stiffeners and seal plates being suitably arranged so that they will not engage during the lateral and vertical movement of the seal plates.

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Completing the hopper are suitable means for maintaining the water level. Normally such means is an overflow pipe or duct 60, for maintaining the normal water level in the hopper. The overflow pipe 60 is connected to a wier type reservoir, not shown.

Thus, the present invention has disclosed a boiler ash hopper having improved seal means between the boiler interior and external atmosphere. No longer are labyrinth seals necessary for such apparatus thereby eliminating the necessity for shutting down the boiler for replacing drip plates. Additionally, refractory maintenance is reduced since thermal stresses are eliminated by totally immersing the refractory in water. Flushing of the seal troughs is improved by the stepped base and nozzle arrangement which provides for cleaner trough. It is believed apparent, therefore, that the simple construction and improved seal arrangement of the present invention will contribute toward reduced maintenance and operating expenses of modern day boilers, thereby being of considerable value to the commercial boiler industry and steam generating companies.

It is to be understood that although only one embodiment has been disclosed, numerous changes may be made in the present embodiment of the present invention without departing from the spirit and scope of the present invention.

What is claimed is:

1. In a boiler furnace including a thermally expansive section and wherein the boiler is adapted to burn solid fuel and produce a gaseous flow, a water-filled vessel which serves as an ash hopper for receiving combustion by-products originating from solid fuel-fired boiler operation, said vessel comprising a metallic outer shell and an inner refractory member, said metallic shell extending vertically above the refractory member, means for maintaining a normal water level in the vessel above the refractory member and in contact with the metallic shell, a seal plate member attached to the thermally expansive section of the boiler, said seal plate member extending into the water-filled section of the vessel, and seal means located within the vessel and above the refractory, said seal means cooperating with the seal plate to prevent the escape of boiler gases inside the hopper to the surrounding atmosphere, and nozzle means for supplying water to said hopper and for filling and flushing the seal means free of any combustion by-products deposited therein.

2. In a boiler ash hopper of the type described in claim 1, wherein the seal means includes a trough member positioned above the refractory lining and cooperating with the seal plate to form a seal, said trough being of heat resistant metallic material and having a thickness of at least 1/4".

3. In a boiler ash hopper of the type described in claim 2, means for stiffening the trough to withstand thermal shock.

4. In a boiler ash hopper of the type described in claim 3, means for preventing engagement between the seal plate and the trough during lateral and vertical movement of the seal plate whereby the seal therebetween is retained.

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