

United States Patent

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[54] APPARATUS AND PROCESS FOR SLAG DEPOSIT REMOVAL

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[73] Assignee: Foster Wheeler Corporation, Livingston, N.J.

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Related U.S. Application Data

[63] Continuation of Ser. No. 851,875, Aug. 21, 1969, abandoned.

[52] U.S. Cl. 122/392, 15/317

[51] Int. Cl. F22b 37/52

[58] Field of Search 15/316, 317, 318; 122/390, 122/392

[56] References Cited

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[57] ABSTRACT

An apparatus and process for slag deposit removal wherein water is injected under pressure towards the heat absorption surface in the furnace section of a vapor generator to create a thermal shock and a mechanical force which causes the slag deposits on the surface to separate therefrom. A nozzle is provided which has a plurality of orifice units extending at different acute angles with respect to a plane perpendicular to the longitudinal axis of the body portion of the nozzle, so that when the nozzle is rotated, a plurality of spiral streams of cleaning fluid are injected.

7 Claims, 5 Drawing Figures

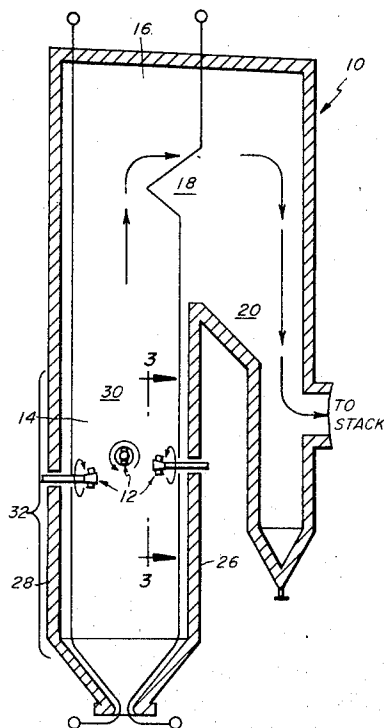


FIG. 1

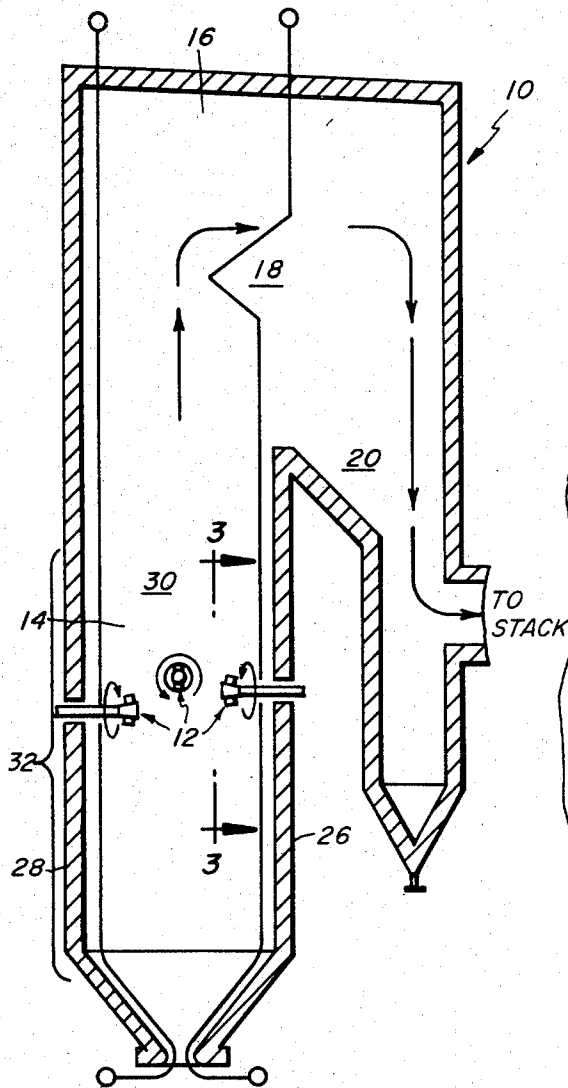
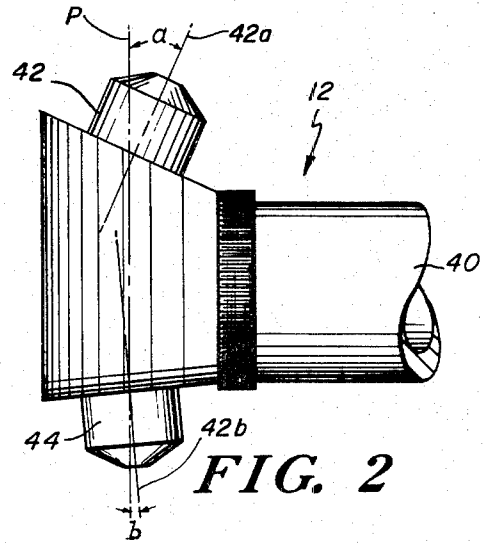


FIG. 2

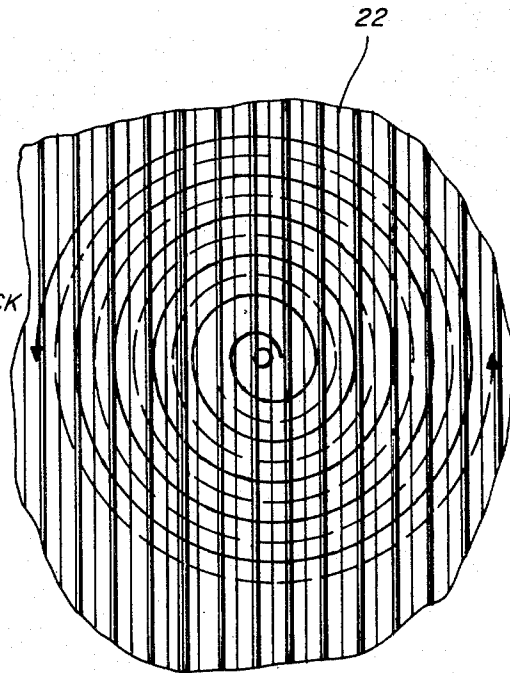


FIG. 3

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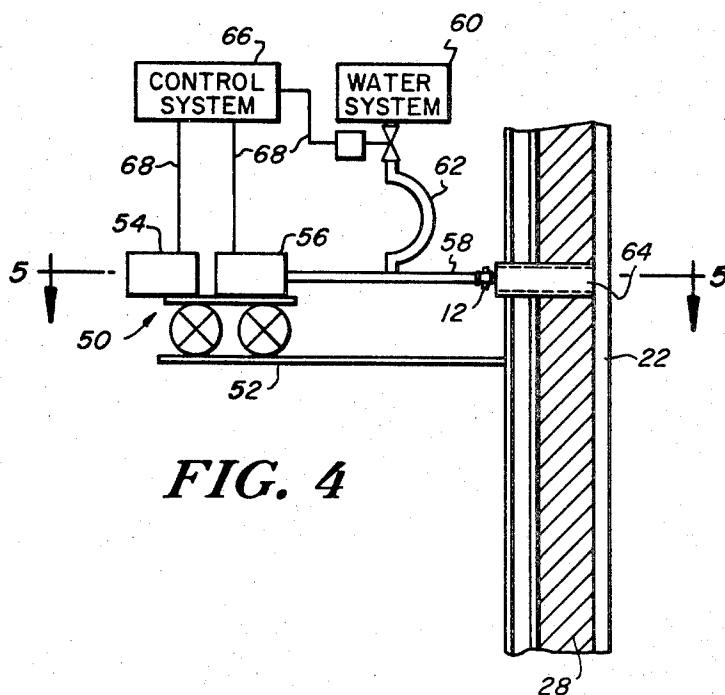


FIG. 4

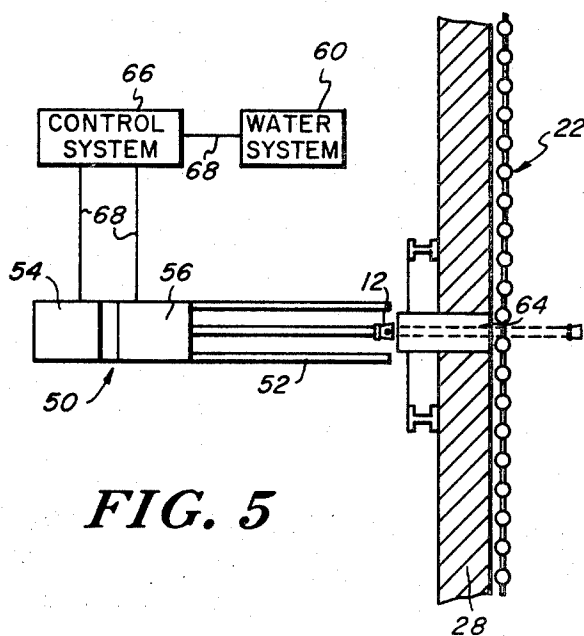


FIG. 5

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APPARATUS AND PROCESS FOR SLAG DEPOSIT REMOVAL

CROSS-REFERENCE TO RELATED APPLICATION

This application is a continuation of U.S. patent application Ser. No. 851,875, filed Aug. 21, 1969, now abandoned.

BACKGROUND OF THE INVENTION

In the generation of power from fossil fuels, there has been a great deal of interest in building the vapor generators close to the source of fuel. This type of installation has resulted in the availability of many types of fossil fuels, such as various types of lignite, which heretofore have not been practical.

There is a major problem attendant in the firing of fuels such as lignite, which have a high alkali metal content, and this relates to the severe slag deposits that are formed on the heat absorption surface in the furnace section during the operation of the vapor generator. For example, severe slagging of the furnace wall heat transfer surface has been found to occur when the combined content of sodium and potassium in the fuel exceeds 2 percent of the ash. The presence of calcium in the fuel can also further aggravate the problem.

In the past, the fouling of boiler surfaces by heavy slag deposits has been avoided primarily by restricting and blending the lignite fuel and using additives such as kaolin. Even with this restricted use of lignite, the problem of fouling furnace heat transfer surfaces has still persisted to a great degree, rendering it necessary to use a large number of steam soot blowers.

In U.S. Pat. application Ser. No. 759, filed Sept. 11, 1968, and assigned to the assignee of the present invention, a plurality of nozzles, each having a single orifice unit, were directed on the heat absorption surface in the furnace section in order to exert a combined thermal shock and mechanical force to continuously clean the deposits formed thereon. Although this effectively removed the slag to an extent whereby the vapor generator could be operated continuously near rated capacity, even when fired with a fuel such as lignite having a high alkali metal content, this design necessitated a traversing and rotation action of each spray nozzle in one direction, indexing at the end of the forward transversing cycle, reverse rotation and retracting, and returning to the start of the cycle. This procedure required a minimum of 4 minutes per deslagger, and a total time of several hours to complete total deslagging of all boiler walls on a single boiler. It can be appreciated that this increased time is expensive both from a time and economical point of view.

SUMMARY OF THE INVENTION

It is therefore an object of the present invention to provide an apparatus and method for the removal of slag deposits from the heat absorption surface in the furnace section of a vapor generator, which will substantially decrease the amount of time required to complete total deslagging of all boiler walls on a single boiler, without reducing the thermal shock and mechanical force which cause the deposits of slag to be separated from the heat absorption surface.

To the fulfillment of this object, the present invention features the use of the simultaneous spraying of at

least two streams of cleaning fluid towards the furnace section of a vapor generator by means of a blast nozzle having at least two orifice units carried on its body portion and registering therewith, said orifice units extending at different acute angles with respect to a plane perpendicular to the longitudinal axis of said body portion. In accordance with a preferred embodiment, there are two orifice units spaced approximately 180° apart.

BRIEF DESCRIPTION OF THE DRAWINGS

The above brief description as well as further objects, features, and advantages, of the present invention will be more fully appreciated by reference to the following detailed description of presently preferred but nonetheless illustrative embodiments in accordance with the present invention when taken in connection with the accompanying drawings wherein:

FIG. 1 is a sectional view taken through the front and rear walls of a typical vapor generator, to more clearly show the location of the blast nozzle of the present invention;

FIG. 2 is a side elevational view of the blast nozzle according to the present invention;

FIG. 3 is a fragmentary enlarged sectional view through the line 3—3 of FIG. 2, depicting a portion of the heat absorption surface of the rear wall, with the concentric circle showing the spray patterns achieved by the blast nozzle during slag removal;

FIG. 4 is a sectional view showing a portion of the wall of a vapor generator with the blast nozzle shown in a retracted position outside of the furnace section; and

FIG. 5 is a sectional view through line 5—5 of FIG. 4, with the broken line views showing the blast nozzle in two different extended positions within the furnace section during the slag removal operation.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring specifically to the drawings, there is shown schematically in FIG. 1 a vapor generator 10 provided with an injection system for water, or other cleaning fluid, including a blast nozzle generally designated by the reference numeral 12. The vapor generator 10 includes a furnace section 14 capable of being fired with high alkali metal content fossil fuels, and forming combustion gases which are passed through an upward vertical gas pass 16, to a horizontal gas pass 18, and through a downward vertical gas pass 20 to the stack, as indicated by the directional arrows.

The vapor generator 10 is formed from a plurality of fin-tube walls shown in general by the reference numeral 22 in FIG. 3, which define a heat absorption surface in the furnace section 14. The latter section 14 includes a front wall 26, a rear wall 28, and a pair of side walls 30, only one of the latter being shown in FIG. 1. A heavy slag zone 32 extends from the bottom of the height of the furnace section 14, up to approximately 75 percent of the height of the furnace section 14, as shown by the bracket in FIG. 1. It has been found that, when firing the furnace section 14 with high alkali metal content fuels, the slag deposits are concentrated on the walls in the zone 32. (It should be understood that, for the purpose of the application, references made to slag deposits is contemplated to mean the build-up of material on the heat absorption surface of

the fin-tubes 22 of the walls when the furnace section is fired with high alkali metal-content fuels such as lignite, which have a content of sodium and/or potassium in excess of 2 percent of the ash. These deposits form a coating on the heat absorption surface which results from the ash fusing at relatively high thermal conditions.)

Each wall in the furnace section 14 is provided with a plurality of blast nozzles 12. Although only one nozzle is shown extending through each wall in FIG. 1 of the drawings for convenience of presentation, it is understood that a plurality of nozzles will extend through each wall.

Referring specifically to FIG. 2, each nozzle 12 is made up of a cylindrical body portion 40 which registers with a pipe lance (not shown) which will be described in detail later. The free end portion of the body portion 40 is enlarged and is adapted to accommodate a pair of radially extending orifice units 42 and 44. These orifice units are disposed at a 180° angle with respect to each other along the enlarged end portion of the body portion 40, and each extends at different acute angles with respect to a plane perpendicular to the longitudinal axis of the body portion 40. The latter plane is referred to by the reference letter P in FIG. 2, and the longitudinal axis 42a of the orifice unit 42 extends at an angle a with respect to the plane P and the longitudinal axis 44a of the orifice unit 44 extends at an angle b with respect to the plane P. The disposition of the orifice units 42 and 44 on the body portion 40 are such that angles a and b are acute, with angle a being slightly larger than angle b .

In this manner, when water under pressure is applied to the body portion 40, and the latter is rotated and translated in a manner that will be described in detail later, two different continuously increasing spiral spray patterns will be trained rearwardly toward, and impinge upon, the wall through which the nozzles are mounted. The spray pattern from the orifice unit 42 is shown by the solid lines in FIG. 3 and the spray pattern from the orifice unit 44 is shown by the broken lines.

As an example of the number and location of the nozzles, nine nozzles may be located with respect to the front wall 26, with the rear wall 28 and each of the side walls 30 being respectively provided with two nozzles. The reason for the relatively large amount of nozzles on the front wall is due to the fact that the largest amount of slag deposits will be formed on this wall since, in normal practice, a plurality of burners (not shown) will be located on the rear wall 28 and thus direct their heat towards the front wall 26.

Since the slag deposits are continuously formed on the heat absorption surfaces of the walls 26, 28, and 30, it is necessary to periodically and sequentially actuate the nozzles 12 in order to maintain full capacity performance of the vapor generator 10.

To this end, an injection system for one nozzle is shown cooperating with a rear wall 28 in FIGS. 4 and 5, it being understood that the arrangement and operation of the other walls is identical. Specifically, the injection system includes a carriage 50 which is adapted to travel on a pair of rails 52 in a direction which is lateral with respect to the longitudinal axis of the furnace section 14. Mounted on the carriage 50 is a carriage drive 54 for imparting lateral directional movement to the car-

riage, and a nozzle drive 56 for imparting rotational movement to the nozzle 12 via a pipe lance 58 which operatively connects the drive to the nozzle. A source of water, or other cleaning fluid, is shown by the reference numeral 60, and is placed in flow communication with the nozzle 12 by means of a flexible hose unit 62 which is connected to pipe lance 58. The pipe lance 58 travels into the furnace section 14 through an opening 64 which is formed in the wall 28.

A control system 66 is operatively connected to the carriage drive 54 and to the nozzle drive 56 in order to periodically effect lateral and rotational movement of the lance 58, as disclosed in the above-mentioned U.S. patent application. The connections between the control system 66 and the carriage drive 54, the nozzle drive 56, and the water source 60 are shown schematically by the reference numeral 68. Of course the water is placed under a predetermined pressure by any known means, and a valve or the like can be associated with each nozzle to control the flow of water therethrough, in a known manner.

In accordance with the operation of the injection system of FIGS. 4 and 5, the control system 66 is programmed to periodically and sequentially actuate the carriage drive 54, the nozzle drive 56, and a continuous flow circuit also disclosed in the above-mentioned application. In this manner the carriage 50 is moved in a forward and rearward direction with respect to the through opening 62, and the pipe lance 58 is thus moved from a retracted position as shown by the solid lines, to a series of extended positions as shown by the broken lines, with the nozzle 12 continuously rotating in one direction as shown by the directional arrows in FIG. 1. As a result, the two water sprays from the orifice units 42 and 44 of the nozzle form two different continuously increasing spirals and create a combined thermal shock and mechanical force against the walls of the furnace to cause the separation of the slag deposits from the heat absorption surface defined by the fin-tubes 22.

It should be understood that the embodiment of the injection system shown in FIGS. 4 and 5 is disclosed only as an example of one mode of advancing the nozzles 12 into and out of the furnace section 14. Accordingly, it would be possible to employ a variety of mechanical means to advance and retract the nozzles, such as a combined motor and solenoid, etc.

From the foregoing it can be appreciated that an apparatus and method has been provided for removing slag deposits from the heat absorption surface at an increased rate and with increased efficiency. In fact, it has been ascertained that the total deslagging time for the furnace described herein is reduced by approximately one-half when compared to systems utilizing single orifice nozzles.

A latitude of modification, change and substitution is intended in the foregoing disclosure and in some instances some features of the invention will be employed without a corresponding use of other features. Accordingly, it is appropriate that the appended claims be construed broadly and in a manner consistent with the spirit and scope of the invention herein.

I claim:

1. A slag deposit removal apparatus for cleaning the heat absorption surface of an inner wall in the furnace

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section of a vapor generator, said apparatus comprising a plurality of blast nozzles, each comprising a body portion and at least two orifice units directed towards said wall and extending from said body portion at two different angles with respect to a plane perpendicular to the longitudinal axis of said body portion; means to supply a fluid to said nozzles; means to translate said nozzles inside said furnace; and means to rotate said nozzles during their translation inside said furnace to create two continuously increasing spirals of fluid of varying patterns which impinge against said wall to direct a combined thermal shock and mechanical force against said heat absorption surface and cause the separation of the slag deposit from said heat absorption surface.

2. The apparatus of claim 1 wherein said translating means is adapted to automatically translate said nozzles between an operative position inside said furnace and an inoperative position outside said furnace according to a predetermined sequence.

3. The apparatus of claim 1 wherein said body portion is cylindrical and wherein said orifice units extend

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radially with respect thereto.

4. The apparatus of claim 3 wherein there are two orifice units spaced approximately 180° apart.

5. A process for the removal of deposits of slag from the heat absorption surface of the furnace section of a vapor generator, comprising the steps of simultaneously spraying at least two streams of cleaning fluid towards said surface at different angles thereto from at least one nozzle, rotating said nozzle, and translating said nozzle relative to said surface, to form two different continuously increasing spiral spray patterns.

6. The process of claim 5 in which the spraying of said fluid is controlled so that the spraying is periodically and sequentially activated in accordance with the build-up of slag.

7. The process of claim 5 wherein said step of translating is done automatically between an operative position inside said furnace and an inoperative position outside said furnace according to a predetermined sequence.

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