FIELD OF DISCLOSURE

The present disclosure relates to a hybrid boiler system.

More particularly, the present disclosure relates to a packaged hybrid boiler system which provides flexibility of fuel and multiple combustors.

BACKGROUND

In an integral furnace boiler system, the furnace is placed inside the boiler shell. The boiler typically works on fuels like coal, wood logs and biomass briquettes. Due to the placement of the furnace within the boiler shell, this type of boiler system offers inherent limitations to the furnace dimensions. As the furnace dimensions cannot be increased beyond certain limits, the combustion performance of such boiler system is low. Other disadvantages of the integral furnace boiler system are poor volatile combustion and poor residence time of solid /biomass fuels in furnaces having smaller volumes, thereby giving poor efficiency and high emissions. Further, the type of combustor that can be used in the integral furnace boiler system is limited to a stationary grate, bubbling bed or chain grate combustor. Other combustors such as reciprocating grate, moving grate and fluidized bed cannot be placed inside the integral furnace boiler system. This results in limited flexibility of fuel.

To overcome the above-noted limitations of the integral furnace boiler system, a hybrid boiler system can be used. In the hybrid boiler system, the furnace is placed outside the boiler shell, surrounded by water walls (membrane panel). The boiler shell is placed at the top end of the membrane panel. The boiler system comprises both water tubes and fire tubes, thus it is called a hybrid boiler system. As the furnace is placed outside the boiler, different types of combustors can be placed below the furnace. A major drawback of the hybrid boiler system is that such boiler systems cannot be packaged because of the bulky components such as membrane panel, boiler shell, combustors and supporting structure, and all these components are to be assembled at the site. Also, the overall footprint for the hybrid boiler system is high.

Further, to accommodate different types of combustors, the design of the membrane panel needs to be adapted.

There is therefore felt a need for a hybrid boiler system which will overcome the above-cited shortcomings of the known hybrid boiler systems.

OBJECTS

Some of the objects of the present disclosure, which at least one embodiment herein satisfies, are as follows:

It is an object of the present disclosure to provide a packaged hybrid boiler system which provides flexibility of fuel and multiple combustors.

Another object of the present disclosure is to provide a packaged hybrid boiler system which has a smaller footprint.

Still another object of the present disclosure is to provide a packaged hybrid boiler system which gives a higher overall efficiency.

These and other objects of the present disclosure will be more apparent from the following description.

BRIEF DESCRIPTION OF ACCOMPANYING DRAWINGS

The disclosure will now be described with the help of the accompanying drawings, in which,

FIGURE 1 illustrates a schematic of a typical integral furnace boiler system;

FIGURE 2 illustrates a schematic of a typical hybrid boiler system;

FIGURE 3 illustrates a schematic of the side-view of a preferred embodiment of the hybrid boiler system in accordance with the present invention;

FIGURE 4 illustrates a schematic of the front-view of the preferred embodiment of the hybrid boiler system in accordance with the present invention;

FIGURE 5 illustrates a schematic of the sectional-view of the preferred embodiment of the hybrid boiler system in accordance with the present invention;

FIGURE 6 illustrates a schematic of another preferred embodiment of the hybrid boiler system in accordance with the present invention; and

FIGURE 7 illustrates a schematic of still another preferred embodiment of the hybrid boiler system in accordance with the present invention.

DESCRIPTION OF THE ACCOMPANYING DRAWINGS

The embodiments herein and the various features and advantageous details thereof are explained with reference to the non-limiting embodiments in the following *description. Descriptions of well-known components and techniques are omitted so as* to not unnecessarily obscure the embodiments herein. The examples used herein are intended merely to facilitate an understanding of the ways in which the embodiments herein may be practiced and to further enable those of skill in the art to practice the embodiments herein. Accordingly, the examples should not be construed as limiting the scope of the embodiments herein.

The description herein after, of the specific embodiments will so fully reveal the general nature of the embodiments herein that others can, by applying current knowledge, readily modify and/or adapt for various applications such specific embodiments without departing from the generic concept, and, therefore, such adaptations and modifications should and are intended to be comprehended within the

meaning and range of equivalents of the disclosed embodiments. It is to be understood that the phraseology or terminology employed herein is for the purpose of description and not of limitation. Therefore, while the embodiments herein have been described in terms of preferred embodiments, those skilled in the art will recognize that the embodiments herein can be practiced with modification within the spirit and scope of the embodiments as described herein.

Referring to **FIGURE 1** of the accompanying drawings, therein is disclosed a schematic of a typical integral furnace boiler system. The boiler system is generally referenced in the **FIG. 1** by numeral **10**. The boiler system **10** includes a fire door **11**, an integral furnace **12**, an internal reversal chamber **13**, first set of fire tubes **14**, second set of fire tubes **15**, combustor **16**, boiler shell **17**, an external reversal chamber **18**, and a smoke chamber **19**. The furnace **12** is placed inside the boiler shell **17**. The flue gases generated at the furnace **12** are conveyed to the first set of fire tubes **14** via the internal reversal chamber **13**. The flue gases are then carried to the second set of fire tubes **15** from the first set of fire tubes **14** via the external reversal chamber **18**. The cooled flue gases are discharged through the smoke chamber **19**. The boiler system **10** has several limitations like low combustion volume, poor residence time, poor volatile combustion, poor overall efficiency, and high emissions. Also, the boiler system **10** can only be used with limited types of combustors **16**.

A hybrid boiler system is designed to overcome the above-cited drawbacks of a typical integral furnace boiler system **10**. **FIGURE 2** of the accompanying drawings illustrates a typical hybrid boiler system; where the hybrid boiler system is referenced in the **FIG. 2** by numeral **20**. The hybrid boiler system **20** includes a membrane panel **21**, boiler shell **22**, fire tubes **23**, combustor **24**, smoke chamber **25**, and supporting structure **26**. The furnace (not shown in the fig.) is placed outside the boiler shell **22**, and is surrounded by the membrane panel **21**. The boiler shell **22** is placed in line with the membrane panel 21 at the operative end of the membrane panel **21**. The boiler shell **22** is supported on the structure **26**. The membrane panel **21** is made of a

plurality of tubes through which boiler water is circulated to absorb the heat generated in the furnace. The flue gases are then conveyed through the fire tubes **23** placed inside the boiler shell **22**. The flue gases are discharged through the smoke chamber **25**. The hybrid boiler system **20** can be worked with different types of combustors. However, due to the bulky components, the hybrid boiler system **20** cannot be packaged, thereby occupying a larger footprint. Also, the design of the membrane panel **21** must be adapted according to the type of the combustor **24**.

These drawbacks of a typical hybrid boiler system **20** are overcome by the present invention. The present invention envisages a packaged hybrid boiler system in which the membrane panel and the boiler shell are selectively arranged to provide a flexibility of fuel and multiple combustors, smaller footprint, and higher overall efficiency.

FIGURES 3, 4 & 5 illustrate a schematic of a preferred embodiment of the hybrid boiler system of the present invention; where the hybrid boiler system is generally referenced in the **FIGS. 3, 4 & 5** by the numeral **100**. The hybrid boiler system **100** primarily comprises a membrane panel assembly, a furnace, a boiler shell, a combustor, supporting structure for the boiler shell, and covering sheet metal panels for the boiler packaging. The membrane panel assembly includes a first membrane panel **102** and a second membrane panel **104**, where the first membrane panel **102** comprises small membrane panels and the second membrane panel **104** comprises big membrane panels. The boiler shell **106** is placed at the operative top of the first membrane panel **102**. The first membrane panel **102** is adapted to encompass the furnace **114**. This arrangement of the membrane panel assembly and the boiler shell **106** reduces the boiler system **100** foot print. The second membrane panel **104** acts as an internal reversal chamber for carrying flue gases generated in the furnace **114** to the fire tubes placed inside the boiler shell **106**.

A side-view of the preferred embodiment is illustrated in the **FIG. 3** showing the arrangement of the boiler shell **106** and the membrane panel assembly, where the

boiler shell **106** is arranged at the operative top of the first membrane panel **102**. A front-view of the preferred embodiment is illustrated in the **FIG. 4** showing the arrangement of the fire tubes inside the boiler shell **106**. The supporting structure for the boiler shell **106** is seen in the **FIG. 4**. This type of arrangement does not need to be assembled on-site and can be packaged at the manufacturer's premise. As the furnace **114** is placed outside the boiler shell **106**, the boiler system **100** does not require a particular type of combustor **116**. Combustors like stationary grate, bubbling bed and chain grate can be placed inside the first membrane panel **102**. Other combustors such as moving grate, reciprocating grate and fluidized bed can be placed below the first membrane panel **102**. Therefore, the membrane panel assembly does not need to be adapted according to the type of the combustor **116**. Further, the external furnace **114** *gives a higher combustion volume.*

A sectional-view of the preferred embodiment is illustrated in the **FIG. 5**, showing the arrangement of the boiler shell **106**, the furnace **114**, and the combustor **116**. The combustor **116** can be selected from a stationary grate, bubbling bed, chain grate, moving grate, reciprocating grate, underfeed stoker and fluidized bed. The combustion air is received through an air inlet **108**. The fuel is fed in the combustor **116** through a fire door **110**. Multiple passes for flue gases can be provided inside the membrane panel assembly by using refractory walls or baffle membrane panels **118**. This arrangement offers higher residence time for the combustion of solid/biomass fuels. The turning of flue gases inside the membrane panel assembly due to the baffles **118**, results in better emission level & efficiency. The flue gases are received in the fire tubes placed inside the boiler shell **106** through the reversal chamber **120** defined by the second membrane panel **104**. The cooled flue gases are discharged through a smoke chamber **112**.

Sheet metal covering panels can be provided to improve the aesthetics of the boiler packaging. **FIG. 6** of the accompanying drawings illustrates another preferred embodiment of the hybrid boiler system of the present invention. The hybrid boiler

system **200** illustrated in the **FIG. 6** comprises a stationary grate combustor and a fire door **204** for manual fuel feeding with a round paneling **202**. **FIG. 7** of the accompanying drawings illustrates yet another preferred embodiment of the hybrid boiler system of the present invention. The hybrid boiler system **300** illustrated in the **FIG. 7** comprises a chain grate combustor **304** with a square paneling **302**.

ECONOMIC SIGNIFICANCE AND TECHNICAL ADVANCEMENT

The hybrid boiler system, as described in the present disclosure, has several technical advantages including, but not limited to, the realization of: a packaged hybrid boiler system in which the membrane panel and the boiler shell are selectively arranged to provide a flexibility of fuel and multiple combustors, smaller footprint, and higher overall efficiency.

Throughout this specification the word "comprise", or variations such as "comprises" or "comprising", will be understood to imply the inclusion of a stated element, integer or step, or group of elements, integers or steps, but not the exclusion of any other element, integer or step, or group of elements, integers or steps.

The use of the expression "at least" or "at least one" suggests the use of one or more elements or ingredients or quantities, as the use may be in the embodiment of the invention to achieve one or more of the desired objects or results.

Any discussion of documents, acts, materials, devices, articles or the like that has been included in this specification is solely for the purpose of providing a context for the invention. It is not to be taken as an admission that any or all of these matters form part of the prior art base or were common general knowledge in the field relevant to the invention as it existed anywhere before the priority date of this application.

The numerical values mentioned for the various physical parameters, dimensions or quantities are only approximations and it is envisaged that the values higher/lower

than the numerical values assigned to the parameters, dimensions or quantities fall within the scope of the invention, unless there is a statement in the specification specific to the contrary.

In view of the wide variety of embodiments to which the principles of the present invention can be applied, it should be understood that the illustrated embodiments are exemplary only. While considerable emphasis has been placed herein on the particular features of this invention, it will be appreciated that various modifications can be made, and that many changes can be made in the preferred embodiments without departing from the principle of the invention. These and other modifications in the nature of the invention or the preferred embodiments will be apparent to those skilled in the art from the disclosure herein, whereby it is to be distinctly understood that the foregoing descriptive matter is to be interpreted merely as illustrative of the invention and not as a limitation.

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