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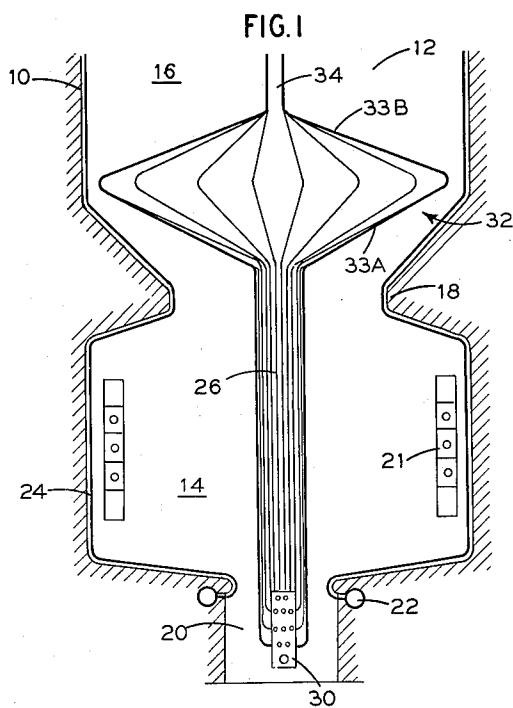
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SLAG SCREEN FOR VAPOR GENERATING UNIT

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SLAG SCREEN FOR VAPOR GENERATING UNIT

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This invention relates in general to vapor generating units of circular cross-section, and more particularly, to a slag screen for use in a vapor generating unit of circular cross-section firing a slag forming fuel in a slag tap combustion chamber.

In vapor generating units employing corner firing systems, the fuel burners are arranged so that the fuel and combustion air streams enter the combustion chamber tangential to an imaginary cylinder concentrically disposed within the chamber. Because of steadily increasing boiler capacities, units of circular cross section have been found especially advantageous in promoting the spinning, spiraling flow path associated with corner firing systems, when compared to the rectangular furnace cross sections customarily used up to this time. However, attempts to form a slag screen of the fluid heating tubes which line the cylindrical wall of the vapor generating unit result in very complicated patterns of tube bends. Further, if the slag screen is formed by providing tubes extending inwardly through the refractory walls of the unit, consequent weakening of the refractory structure will result.

The invention, however, avoids these undesirable results since the slag screen is formed of tubes which are separate and distinct from those lining the circumferential wall of the combustion and radiation zone of the vapor generating unit and they are located wholly within the unit. The slag screen tubes are arranged as a hollow cylindrical tube bundle vertically positioned about the vertical axis of the combustion zone, thereafter forming the slag screen, with spaced tubes extending from the upper end of the tube bundle radially outward toward the wall of the radiation zone where they may augment the effect of the fluid heating tubes which line the periphery of the radiation zone.

As a further advantage, the slag screen is formed of comparatively simple, symmetrically arranged tube patterns which provide the roof of the melting chamber, and thus afford an effective heat transfer relationship with respect to the combustion gases as they pass from the combustion to the radiation zone.

Accordingly, the present invention provides a vertically elongated vapor generating unit of circular cross section transversely divided into a lower combustion zone and an upper radiation zone by an inwardly projecting annular shaped restriction formed from the wall of the vapor generating unit. Burners are arranged to fire a slag forming fuel and combustion air into the combustion zone of the vapor generating unit and a molten slag discharge opening is located in the lower portion of the combustion zone. Fluid heating tubes are disposed within the combustion and radiation zones of the vapor generating unit and a portion of these tubes are arranged to form a slag screen. The fluid heating tubes which form the slag screen are arranged within the combustion zone as an annular shaped tube bundle spaced from the circumferential wall thereof and extending upwardly into the radiation zone. In the radiation zone the slag screen tubes extend out-

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wardly toward the circumferential wall and are arranged in planes projecting radially from the vertical axis of the vapor generating unit.

The various features of novelty which characterize my invention are pointed out with particularity in the claims annexed to and forming a part of this specification. For a better understanding of the invention, its operating advantages and specific objects attained by its use, reference should be had to the accompanying drawings and descriptive matter in which I have illustrated and described preferred embodiments of the invention.

In the drawings:

Fig. 1 is a schematic vertical section of the combustion and radiation zones of a vapor generator embodying the present invention;

Fig. 2 is a view similar to Fig. 1 showing another embodiment of the present invention.

Referring to Fig. 1 there is shown wall 10 which defines a vertically elongated chamber 12 of circular horizontal cross section. The chamber 12 is divided into a lower combustion zone 14 and an upper radiation zone 16 by an inwardly projecting annular shaped restriction 18 formed from the wall 10. A molten slag discharge opening 20 is located centrally of the chamber 12 in the floor of the combustion zone 14.

Vertically disposed banks of burners 21, situated within the combustion zone 14, are arranged to introduce combustion air and a slag forming fuel into the combustion zone 14 tangential to an imaginary vertically disposed cylinder within the combustion zone 14.

An annular shaped header 22 is formed by a horizontally disposed conduit arranged exteriorly of and surrounding the slag discharge opening 20. Wall tubes 24, connected at their lower ends to header 22, line the interior of the combustion zone 14 and the radiation zone 16 to provide a portion of the fluid circulation system within the chamber 12. The portions of the wall tubes 24 in the bottom of the combustion zone 14 cooperate with the annular header 22 to provide a slag discharge opening 20, and then extend radially outward to form a fluid cooled floor in the combustion zone. From the floor of the combustion zone 14, the tubes 24 extend upwardly along the wall and following the contour of the annular shaped restriction 18, they extend first radially inward, then upward, then radially outward to the boundary wall of the radiation zone 16. From this point the tubes 24 extend vertically upward along the wall of the radiation zone 16.

In addition to the wall tubes 24 the fluid circulation system comprises an upwardly extending, symmetrically arranged, annular shaped bundle of tubes having a lower section 26, middle section 32 and an upper section 34. The middle section 32 which provides the slag screen is formed by tubes each having a lower leg 33A and an upper leg 33B. Each of the lower legs 33A extends transversely of the chamber 12 outward and upward to a point closely spaced from the wall of the radiation zone 16. At this point the tubes forming the middle section 32 reverse direction and each of the upper legs 33B extends inwardly and upwardly to a point closely spaced from the vertical axis of the chamber 12. These tubes which make up the middle portion 32 are arranged in planes extending radially from the vertical axis of the chamber 12. From the inner ends of the upper legs 33B, the upper portion 34 extends vertically upward as a spaced, ring shaped bundle of tubes.

In the modification shown in Fig. 2 the reference numerals are the same as those used in describing Fig. 1. The structures, illustrated in Figs. 1 and 2, are identical except for the variations in the slag screen arrangement. In Fig. 2 the slag screen is formed by an upwardly ex-

tending, symmetrically arranged, annular shaped bundle of tubes having a lower section 26, a middle section 36 and an upper section 42. The lower section 26 in Fig. 2 is the same as illustrated and described in Fig. 1. The middle section 36, which is the slag screen portion, is formed by tubes each having a lower leg 37, a connecting portion 38 and an upper leg 39. Each of the lower legs 37 extends from the upper end of the lower section 26 transversely of the chamber 12 outward and upward to a point closely spaced from the wall of the radiation zone 16. At this point the connecting portion 38 of the middle section 36 extends vertically upward from the outer end of the lower leg 37 to the outer end of the upper leg 38. Next the upper leg 38 extends inwardly and upwardly to a point closely spaced from the vertical axis of the chamber 12. Each of the lower legs 37 and the upper legs 39 of the middle section 36 are disposed in a plane extending radially from the vertical axis of the chamber 12. From the inner end of the upper leg 39, the upper section 42 extends vertically upward as a spaced, ring shaped bundle of tubes.

Therefore, the present invention provides a slag screen for a circular chamber without requiring expensive bends in the wall tubes or without sacrificing the structural strength of the walls of the chamber. The tube bundle forming the slag screen is arranged as a separate structural unit independent of the other fluid cooling tube structures and, hence, thermal expansion of the slag screen tube bundle is independent of the thermal expansion within the other tube structures. The arrangement, further, provides for expansion of all the tubes which form the slag screen independently from the rest of the vapor generator. The slag screen furnishes a means for cooling the combustion gases, in a furnace arranged for molten slag discharge, as they exit from the combustion zone thereby preventing the coating of the wall tubes in the radiation and convection zones with molten slag.

While the instant invention has been disclosed with reference to a particular embodiment thereof, it is to be appreciated that the invention is not to be taken as limited to all of the details thereof as modifications and variations thereof may be made without departing from the spirit or scope of the invention.

I claim:

1. In a fluid heating unit comprising, in combination, walls defining a vertically elongated chamber of circular cross section, annular shaped restricting means inwardly projecting from said walls and transversely dividing said chamber into a lower combustion zone and an upper radiation zone, said radiation zone arranged above and in axial alignment with said combustion zone, means for burning a slag-forming fuel in said combustion zone, a molten slag discharge outlet located in the lower portion of said combustion zone, fluid heating tubes disposed within said chamber, a plurality of said fluid heating tubes arranged in spaced relationship and positioned within said radiation zone transversely of its vertical axis to form a centrally disposed slag screen of circular transverse section having an upper portion spaced vertically above a lower portion, said lower portion closely spaced above said restricting means, each of the fluid heating tubes forming said upper portion having a corresponding fluid heating tube in said lower portion disposed in the same vertical plane which extends radially outward from the vertical axis of said chamber, and both said upper and lower portions having a diameter at least equal to the smallest diameter of said restricting means.

2. In a fluid heating unit comprising, in combination, walls defining a vertically elongated chamber of circular cross section, annular shaped restricting means inwardly

projecting from said walls and transversely dividing said chamber into a lower combustion zone and an upper radiation zone, said radiation zone arranged above and in axial alignment with said combustion zone, means for burning a slag-forming fuel in said combustion zone, a molten slag discharge outlet located in the lower portion of said combustion zone, fluid heating tubes disposed within said chamber, a plurality of said fluid heating tubes forming an annular shaped tube bundle spaced from the walls of said chamber and extending upwardly along the vertical axis thereof from said combustion zone into said radiation zone, the fluid heating tubes of said annular bundle arranged in spaced relationship and positioned within said radiation zone transversely of its vertical axis to form a centrally disposed slag screen of circular transverse section having an upper portion spaced vertically above a lower portion, said lower portion closely spaced above said restricting means, each of the fluid heating tubes forming said upper portion connected to a corresponding fluid heating tube in said lower portion and disposed in the same vertical plane which extends radially outward from the vertical axis of said chamber, and both said upper and lower portions having a diameter at least equal to the smallest diameter of said restricting means.

3. In a fluid heating unit comprising, in combination, walls defining a vertically elongated chamber of circular cross section, annular shaped restricting means inwardly projecting from said walls and transversely dividing said chamber into a lower combustion zone and an upper radiation zone, said radiation zone arranged above and in axial alignment with said combustion zone, means for burning a slag-forming fuel in said combustion zone, a molten slag discharge outlet located in the lower portion of said combustion zone, fluid heating tubes disposed within said chamber, a plurality of said fluid heating tubes forming an annular shaped tube bundle spaced from the walls of said chamber and extending upwardly along the vertical axis thereof from said combustion zone into said radiation zone, a centrally arranged circular slag screen positioned within said radiation zone and formed by the fluid heating tubes of said annular shaped tube bundle, said slag screen comprising an upper portion vertically spaced above a lower portion, the fluid heating tubes forming the lower portion of said slag screen closely spaced above said restricting means and extending radially outward and upward from said annular shaped tube bundle in spaced relationship to a point on a first circle whose radius is at least equal to the smallest radius of said restricting means, the upper portion of said slag screen provided by the continuation of the fluid heating tubes forming said lower section with each tube extending radially inward and upward from said first circle in a common vertical plane-with the tube in said lower portion of which it forms a continuation to a point on a second circle, said second circle concentrically arranged within said chamber and having a radius approximately equal to the radius of said annular shaped bundle in said combustion zone, and the fluid heating tubes forming the slag screen extending vertically upward from said second circle through the radiation zone.

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