

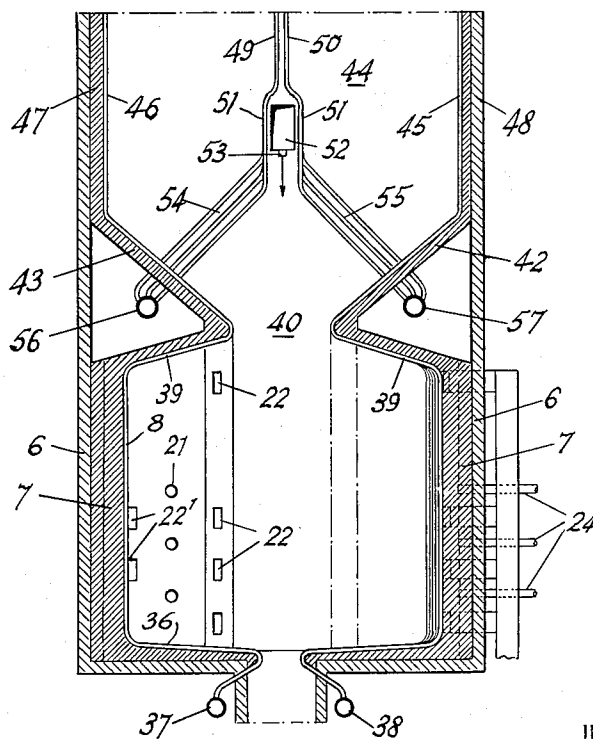
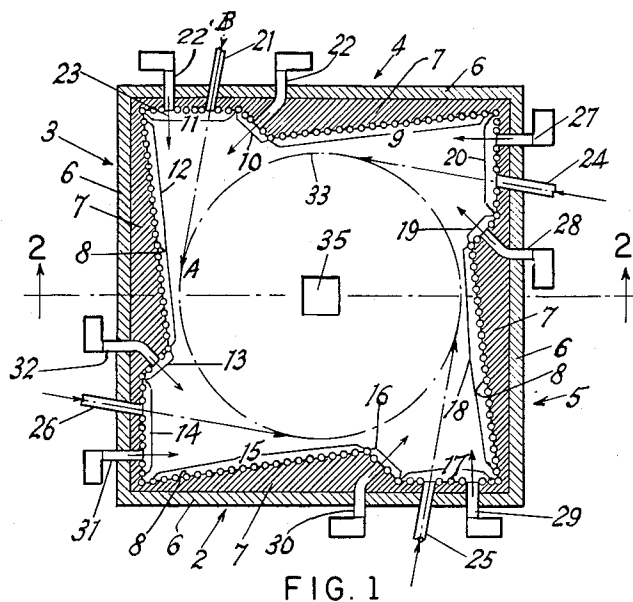
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FLUID HEAT EXCHANGE UNIT WITH A FURNACE HAVING
GAS DEFLECTING INNER WALL SURFACES

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FLUID HEAT EXCHANGE UNIT WITH A FURNACE HAVING GAS DEFLECTING INNER WALL SURFACES

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This invention relates to fluid heat exchange apparatus of the type having a furnace burning a slag forming fuel. The walls of the furnace include vapor generating wall tubes subjects to the heat of the furnace. The invention is more particularly concerned with such a unit, operating at temperatures above the fusion temperatures of the slag or non-combustible of the fuel. One of the major problems encountered in the operation of such a unit is the separation of the slag from the gaseous combustion products so that the slag will not excessively accumulate upon convection heat exchange components contacted by the combustion products at positions beyond the furnace. The invention promotes the solution of this problem by increasing impingement of the burner flames upon the furnace walls.

In a preferred exemplification of the invention a corner fired furnace has wall tube sides so angled with respect to the projection of the flames from the burners that the flames sweep the furnace walls to a high degree. The fuel and air streams are introduced at the furnace corners and are directed toward and over adjacent furnace walls disposed in converging relation to the longitudinal axes of the fuel and air jets projected by the burner means. The slag accumulates upon the walls in a molten state, flows down the furnace walls and along the furnace floor which has a central slag discharge opening through which the slag exits from the unit.

In another aspect of the invention different and lateral adjacent sections of a furnace wall include edge or marginal sections having an acute angle relationship. In one of the edge sections, a fuel and air mixture enters the furnace as a jet through that section and the angularly related section is so disposed with reference to the burner section that the furnace gases are directed away from the burner port from which the fuel and air jet enters the furnace. When a plurality of such furnace walls are arranged between successive and similarly arranged burners the furnace gases have a circular or cyclonic path within the furnace, and the combustion products from a leading burner are directed away from the fuel and air jet ports of the succeeding burner. This arrangement would promote effective firing of the furnace even under conditions where one burner burns fuel such as natural gas and an adjacent burner is fired by a pulverized fuel and air mixture.

The specific subject matter of the invention is particularly set forth in the appended claims, but, for a better understanding of the invention, its characteristics and advantages, reference should be had to the accompanying drawing and description which disclose a preferred embodiment of the invention.

In the drawing:

Fig. 1 is a plan of the illustrative furnace; and

Fig. 2 is a sectional elevation showing the furnace and a part of a superposed radiation chamber.

The furnace of Fig. 1 has walls 2—5 including strata 6 and 7 of non-metallic heat resisting material. The

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strata 7 form a backing for the rows of vapor generating wall tubes 8 which line the furnace walls.

The exterior surface of the furnace is rectangular but the vapor generating wall tubes are so arranged as to form a plurality of meeting or intersecting interior wall surfaces for each of the exterior sides of the furnace. Such intersecting interior walls, or wall surfaces, are indicated at 9, 10, and 11, along the exterior furnace wall 4; 12, 13 and 14 along the wall 3; 15, 16 and 17 along the exterior wall 2; and 18, 19 and 20 along the exterior wall 5.

At each corner of the furnace the interior walls, or wall surfaces, such as 10, 11 and 12, are arranged to form a channel-like pocket, or recess opening toward the center of the furnace, and in each recess fuel burning means are arranged. For instance, in the furnace wall 4, and extending through the interior wall surface 11, there is a fuel and air (pulverized coal with carrier air) tube (or burner tube) 21 having its longitudinal axis AB so disposed as to direct a jet of pulverized fuel and air along the line of that axis, and in convergent relation to the interior wall or wall surface 12 so that the projected combustion elements sweep that interior wall. The tube 21 and its fuel and air jet are directed at an acute angle to the plane of the interior wall 12.

A second air jet is directed through the wall 10 by the duct or conduit 22 and at a greater acute angle to the wall 12, as shown, and on the other side of the fuel and air jet from the tube 21 another secondary air jet is directed from the tube 22' along the wall 12, as indicated by the arrow 23. Similar arrangements of fuel and air jets are provided by the burner tubes 24—26 at the remaining furnace corners, along with similar secondary air jets from the ducts or conduits 27—32.

With this arrangement of interior furnace walls or wall sections such as 13—17 relative to the fuel and air jets through the tubes or conduits such as 25, 26, and 29—32, the flames from the jet tubes 26, 31 and 32 are deflected away from the burner port of the jet tube 25 by reason of the inclination of the interior wall or wall section 15. Thus, stabilized flame and ignition conditions in front of the wall ports of jet tubes 25, 29 and 30 are promoted by the prevention of the transversely moving combustion products from interfering with the operation of a following burner, such as that formed by the jet tubes 25, 29 and 30. The transversely moving combustion products here referred to are those moving across the front of the burner recess and the burner formed by the tubes 25, 29 and 30.

The furnace of this application may be regarded as having a plurality of similarly directed fuel burning means disposed at successive positions angularly or circumferentially spaced perimetrically of the furnace. These fuel burning means so direct fuel and air streams substantially tangentially into the furnace that the furnace gases have a substantially circular path within the furnace. The furnace may be also regarded as having interior wall portions (illustrated in the drawings at 9 to 20 inclusive) which include vapor generating tubes and form at each of the spaced positions of the fuel burning means a fuel and air mixing chamber, or fuel burning pocket, each of the pockets being disposed exteriorly of the maximum circular path of the furnace gases within the furnace. The fuel burning means may be regarded as having fuel and air jet tubes supplying fuel and air to each pocket or fuel and air mixing chamber. The jet tubes terminate within the pocket and exteriorly of the maximum circular path the movement of the furnace gases within the furnace. The above indicated wall portions may be regarded as including the deflecting walls 15, 18, 9 and 12, each preceding a pocket or fuel and air mixing chamber in the direction of rotation of

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the gases within the furnace, and angled inwardly away from its pocket so as to deflect the rotating gases from or inwardly out of the pocket. For example, the pocket in which the jet tubes 30 and 29 inject air streams may be regarded as having the furnace gases deflected away therefrom by the preceding deflecting wall portion 15.

With the pertinent arrangement of furnace components the advantages of tangential or corner firing are maintained, with the characteristic high turbulence due to the cumulative tangential relationship of the burning fuel streams to an imaginary circle (such as 33) within the combustion chamber. Additionally, when a slag forming fuel is burned, a higher degree of separation of the suspended slag particles and their suspending gases is attained by the increased sweeping and impingement of the combustion products over or against the angled interior furnace walls 9, 12, 15 and 18. The molten slag particles contact the interior furnaces, agglomerate thereon, and then flow down those walls to the furnace floor. They then flow along that floor to the central slag discharge opening 35 where they exit from the furnace.

The furnace floor has extensions 36 of the wall tubes 8 disposed therealong. These tubes extend to the lower headers 37 and 38, and other appropriate tubular elements, through which they are connected into the fluid system of the illustrative unit.

At the tops of the furnace walls the wall tubes have converging roof parts 39 extending to the furnace gas outlet 40. Thence, succeeding parts of the tubes diverge along the inclined walls 42 and 43 of the radiation chamber 44. From these walls further parts 45 and 46 of the tubes are disposed along the upright walls 47 and 48 of the radiation chamber, as shown in Fig. 2. At the top of this chamber (not shown) the tubes may be appropriately connected by suitable headers and circulators to a steam and water separating drum, the water space of which is preferably directly connected to such lower headers as 37 and 38.

The radiation chamber 44 is divided by rows of vapor generating tubes 49 and 50 having the more divergently related parts 51 presenting a downwardly opening channel for the manifold 52 from which additional secondary air is directed through the nozzles 53 downwardly toward the furnace gas exit 40. From the level of the manifold 52, the division wall tubes further converge downwardly in widely spaced relationship, to form the tubular screens 54 and 55. The screen tubes extend through the inclined walls 42 and 43 to juncture with the headers 56 and 57 which are appropriately connected into the circulatory system of the unit. They are preferably connected with the water space of the conventional steam and water separator drum by downcomer tubes.

Whereas the invention has been described with reference to the details of a preferred embodiment thereof, it is to be appreciated that the invention is not limited to all of the details described. It is rather to be taken as a scope commensurate with the scope of the subjoined claims.

What is claimed is:

1. In a vapor generating unit, a furnace, similarly directed fuel burning means disposed at successive positions angularly or circumferentially spaced perimetrically of the furnace, said fuel burning means so directing fuel and air streams substantially tangentially into the furnace that the furnace gases have a substantially circular path within the furnace, interior wall portions of the furnace including vapor generating tubes and forming a fuel and air mixing chamber or a fuel burning pocket at each of said positions disposed exteriorly of the maximum circular path of the furnace gases within the furnace, the fuel burning means including fuel and air jet tubes supplying fuel and air to each pocket, the jet tubes terminating within the pocket, said wall portions including a plurality of gas deflecting walls each preceding a pocket in

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the direction of rotation of the gases within the furnace and angled inwardly away from that pocket to deflect the rotating gases away from the pocket and toward the furnace center, tubes of each deflecting wall constituting a surface of a pocket, each of said deflecting walls angled toward the deflecting wall for the next succeeding pocket to direct the gases and suspended combustion elements toward the deflecting wall for the next succeeding pocket, at least one of said jet tubes for each pocket directed obliquely toward the deflecting wall of the same pocket.

2. In a vapor generating unit, a furnace, separate and similarly directed coal burning means disposed at successive positions angularly or circumferentially spaced perimetrically of the furnace, said fuel burning means so directing fuel and air streams substantially tangentially into the furnace that the furnace gases have a substantially circular path within the furnace, and interior wall portions of the furnace including vapor generating tubes and forming a fuel and air mixing chamber or a fuel burning pocket at each of said positions disposed exteriorly of the maximum circular path of the furnace gases within the furnace, the fuel burning means including fuel and air jet tubes supplying fuel and air to each pocket, said wall portions including a plurality of gas deflecting walls each preceding a pocket in the direction of rotation of the gases within the furnace and angled inwardly away from its pocket to deflect the rotating gases away from the pocket and toward the furnace center, the tubes of each deflecting wall constituting a surface of a pocket, the air and fuel jet tubes of each fuel burning means being angled obliquely of and toward the gas deflecting wall of the same pocket and directing the burning fuel stream sweepingly over that gas deflecting wall each of said deflecting walls angled toward the corresponding deflecting wall of the next succeeding pocket to direct gases and suspended combustion elements toward the corresponding deflecting wall of the next succeeding pocket.

3. In a vapor generating unit, a furnace, separate and similarly directed coal burning means disposed at successive positions angularly or circumferentially spaced perimetrically of the furnace, said fuel burning means so directing fuel and air streams substantially tangentially into the furnace that the furnace gases have a substantially circular path within the furnace, and interior wall portions of the furnace including vapor generating tubes and forming a fuel and air mixing chamber or a fuel burning pocket at each of said positions disposed exteriorly of the maximum circular path of the furnace gases within the furnace, the fuel burning means including fuel and air jet tubes supplying fuel and air to each pocket, said wall portions including a plurality of gas deflecting walls each preceding a pocket in the direction of rotation of the gases within the furnace and angled inwardly away from its pocket to deflect the rotating gases away from or inwardly of the pocket, the air and fuel jet tubes of each fuel burning means being angled toward the gas deflecting wall of the next succeeding pocket and directing the burning fuel stream toward and sweepingly over that gas deflecting wall, one air jet tube for each pocket directing a stratum of air along and immediately adjacent the first part of the deflecting wall of that pocket and a second air jet for each pocket directed toward said deflecting wall and toward said stratum and thereby increasing the fuel and air sweeping action of the deflecting wall and preventing action which otherwise would effect air insulation of the deflecting wall.

4. In a vapor generating unit, a furnace having a plurality of similar series of meeting upright wall segments including vapor generating wall tubes, the adjacent series of wall segments meeting at a plurality of corner positions so as to form pockets opening toward the interior of the furnace and disposed exteriorly of the maximum of circular gas movement within the furnace, means within each pocket for corner firing the furnace with pulverized coal by the direction of streams of combustion

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elements out of the pockets and generally tangentially to an imaginary circle indicating the general movement of combustion elements within the furnace, each series of wall segments including one major segment or deflecting wall segment presenting a wall surface at a small acute angle to the direction of firing from the pertinent pocket and facing that firing, the surfaces of said major wall segments extending generally in planes generally tangentially to said circle at points in advance of the points of tangency of the directions of firing from successive pockets, the volume of the pockets outside of said circle constituting a large fraction of the volume of total furnace space, the fuel exit ports of the firing means being disposed radially outwardly of the circle to an extent equal to a major part of the radius of the circle, a furnace floor constructed to provide a slag discharge opening, and walls providing a radiation chamber disposed beyond the fur-

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nace with respect to gas flow, said last named walls being further constructed to provide a constricted furnace gas outlet leading to the radiation chamber and disposed centrally with respect to said circle, the pulverized coal burning means including an air jet in each pocket directing an air stream immediately adjacent and parallel to each major wall segment (or deflecting wall segment) and another air jet directed against said major segment and said air stream to increase the fuel and air sweeping action of the deflecting wall segment.

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