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FURNACE WALL WITH FINNED WALL TUBES

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FURNACE WALL WITH FINNED WALL TUBES

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3. Claims. (Cl. 122—367)

1. This invention relates to combustion chambers, of boilers, for example, which may be used under pressure and more particularly to the provision of a gas-tight combustion chamber enclosed by walls made without refractory material or with very little refractory material.

2. Combustion chambers with water cooled tubes lining the walls are well known.

3. Water tubes located along the lateral walls of a combustion chamber are exposed to radiation which is not the same on all the surfaces of the tube. Thus it is that normally the front surface of a tube being directed toward the fire space is exposed to greater caloric radiation than the back surface which is directed toward the wall of the combustion chamber. However, in order to avoid distortions in the tube and assure that it functions properly in service, it is desirable that the tube be heated equally on its entire surface.

4. According to one feature of the present invention, the difference in the quantity of radiant heat received by the front face of the tube facing toward the fire space and by the rear face directed toward the wall of the combustion chamber is compensated for by providing on its rear face lateral projections or fins which have the effect of increasing the surface of the tube exposed to the radiant heat. These fins permit the accumulation on the rear face of the tube of an amount of heat equal to that which is received by the front face so that they are at the same temperature or nearly so.

5. A corollary of this feature of the invention is that the fins on the rear face of the tube are slightly curved convexly with respect to the furnace space so that these fins which are themselves subjected to a difference of caloric radiation on their dorsal face and on their ventral face may correct for the effect of the differences of expansions which result therefrom and reach the maximum level in service. The junction of the fins with the surface of the tube is thickened so that no stress due to their differences of expansion is transmitted to the normal wall thickness of the base tube which thus wholly retains its resistance to distortion: This thickness at the fin root also assures a better distribution of the heat on the whole circumference of the tube, and gives it a large moment of inertia to resist mechanical stresses.

6. According to another feature of the present invention, such finned tubes being exposed to radiation have behind the fins a wall made up of iron plates of the desired thickness and preferably corrugated. This wall may itself be made of a series of secondary lateral fins on the back of each tube, these fins abutting along their longitudinal side faces and being welded together to form a wall. In other words, the water tubes comprise in a measure, completely or partially, a framework on which there are fastened, possibly with insulation, the corrugated iron plates which form the tight envelope of the combustion chamber.

7. The advantage of this arrangement is that the finned tubes form water screens and protect the sheet metal wall from radiation. This assures maintenance of the tightness of the combustion chamber which makes it possible to enclose this chamber with less thick iron plates, and to provide only a little or no refractory material for the chamber. Furthermore, the heat absorbed by the sheet iron wall is retransmitted by conductivity to the water tubes onto which the iron plates which make up said walls are fastened.

8. Corrugations are advantageously provided on the sheet iron blades preferably extending in two directions (longitudinally and transversely) so as to absorb the expansion differences while stiffening the whole of the wall against the inner pressure and the possible deformations.

9. Figure 1 is a cross-sectional view of a portion of a gas-tight combustion chamber wall lined with water tubes according to the invention.

10. Figure 2 shows, in elevation, the partial removal of the water tubes, a fragment of said wall.

11. Figure 3 is a cross-sectional view of a tube with tapering rear fins which are thicker at their roots or junctions with the tube.

12. Figure 4 is a cross-sectional view illustrating the expansion of the concave lateral fins when heated.

13. Figure 5 shows in perspective a fragment of a water tube with a slit in the lateral fin.

14. As may be seen in the drawings, the tubes of the heat exchanger, which are for example, water tubes, are placed along the wall of a combustion chamber. The front face of the tube which is directed toward the fire space is subjected to the action of radiant heat exerted in the direction of the arrows A. The back face of the faces toward the wall and thus is subjected to radiant heat reflected from said wall in the direction of arrows B. Normally, the amount of heat radiated by reflection from the wall is less than that which is radiated directly from the fire space. Consequently, there is a temperature difference bet-
between the two faces 11, 13 which produces differences in the expansions and distortions of the tube.

To correct this disadvantage in accordance with this invention, the rear face 13 of tube 10 which faces toward the wall 12 is equipped, for example, with two lateral fins 15, 16. These fins are joined by a quite thick root 17 to the wall of the tube, and are preferably curved concavely with respect to the furnace as shown in Fig. 1. The over-all surface of tube 10 exposed to the radiation of wall 12 is thus increased, and the surface of the fins is calculated in such a way that they have a large compactness in the fins and the face of the tube onto which they are bonded or with which they are integral.

According to the invention, the fins 15, 16 or 21, 22 of the tubes 10 or 20 are concavo-convex. The front concave faces of the fins, being directed toward the fire space thus receive more radiant heat and expand more than the back of the fins subjected to the heat reflected by the wall 12 in the direction of arrows B. The difference of the expansions of the two faces of the fins has the effect of rectifying the concavity of the fins, as is shown in Fig. 4, in which the fins become practically planar at maximum expansion when they are in service. This convexity of the fins also assures that the side faces of the tube not subjected to the intense direct radiation receive a contribution of indirect radiation.

It will be noted that the root of the fin, that is to say, the surface along which it is joined to the cylindrical periphery of the tube is sufficiently broad so that the expansion stresses to which the fins are subjected are not transmitted to the wall proper of the tube.

These tubes with fins can be made either by a suitable welding of the fins onto the surface of the tubes, or in the "solid-forged" ("monobloc") form, that is, the fins and the tube are produced in one single piece.

As may be seen in Fig. 1 the combustion chamber which is assumed to operate under pressure has along its wall a lining of water tubes each one having fins 15, 16 which are exposed to the radiation from the chamber, and which, by the effect of the expansions due to the temperature elevation, are thereby brought in contact, or almost so, along their longitudinal edges as shown in dotted lines in Fig. 1. In this way these fins 15, 16 protect the wall 12 located behind them from radiation.

According to a further feature of the present invention, the inner wall of the combustion chamber may be made up of corrugated iron plate 30 which is preferably fastened onto the back of the tubes 10 between fins 15, 16. This fastening can be made either by continuous welding, or by spot welding, or also by dowels or screws with the tubes 10 and penetrating the sheet iron with exterior screws, or by collars which are unitary with the sheet iron 30 and which girdle the tubes 10 with possible interposition of an insulating material. The plate 30 is preferably corrugated in both directions, longitudinally at 31 and transversely at 32 as shown in Fig. 5 so as to absorb the differences of expansion and possible deformations, while stiffening the whole of the wall against the inner pressure of the combustion chamber.

Wall 12 may be made with the aid of elements already fastened at 33 to the rear faces of tubes 10 in the manner of a secondary pair of fins 34, 35. The edges 36 of these fins on adjacent tubes are welded in continuous fashion on their entire length to form, as shown in Fig. 2, a continuous wall enclosing the combustion chamber.

The protection against radiation afforded by the fins of the tubes 10 or 20 makes it possible to make wall 12 with relatively thin iron plates, and the heat-insulating layer usually provided on the outside all around the combustion chamber may be of a relatively reduced thickness, and possibly even eliminated. The expansion differences which are produced by the effects of the temperature variations in the fins 15, 16 or 21, 22 may make it necessary to provide slits interrupting the length of these fins.

What is claimed is:

1. In a heat exchanger having parallel metallic tubes lining the wall of a combustion chamber or the like in which the tubes are exposed to radiation; a pair of longitudinally extending metallic fins on the rear face of each tube confronting the furnace wall and projecting laterally in opposite directions beyond each side of the tube, said fins each being a transverse cross-section and curving toward the front face of the tube and being thinner at their distal ends than at their root junctions with the tube so that upon exposure to heat the fins expand and their concave and convex surfaces tend to become planar while their distal edges move rearwardly so as to substantially close the gaps between the longitudinal edges of adjacent fins on adjacent tubes.

2. In a heat exchanger having parallel metallic tubes lining the wall of a combustion chamber or the like in which the tubes are exposed to radiation; a pair of longitudinally extending metallic fins projecting laterally in opposite directions from the face of each tube that confronts the furnace wall, said fins being concavo-convex in transverse cross-section and curving toward the front face of the tube and tapering from their root junctions with the tube to their distal ends so that upon exposure to heat the fins expand and tend to pivot rearwardly on the tube so as to substantially close the gaps between the longitudinal edges of adjacent fins on adjacent tubes.

3. In a heat exchanger having parallel metallic tubes lining the wall of a combustion chamber or the like in which the tubes are exposed to radiation; a pair of longitudinal metallic fins extending across the rear face of each tube that confronts the furnace wall and projecting laterally in opposite directions beyond each side of the tube, said fins being concavo-convex in transverse cross-section and curving toward the front face of the tube and tapering from their root junctions with the tube to their distal ends with the two fins merging in a reduced root section located in a plane that contains the longitudinal axis of the tube and which is normal to the furnace wall so that upon exposure under heat the
concave and convex surfaces of the fins tend to become planar so as to substantially close the gaps between the longitudinal edges of adjacent fins on adjacent tubes.

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