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WATER WALL FOR STEAM BOILERS

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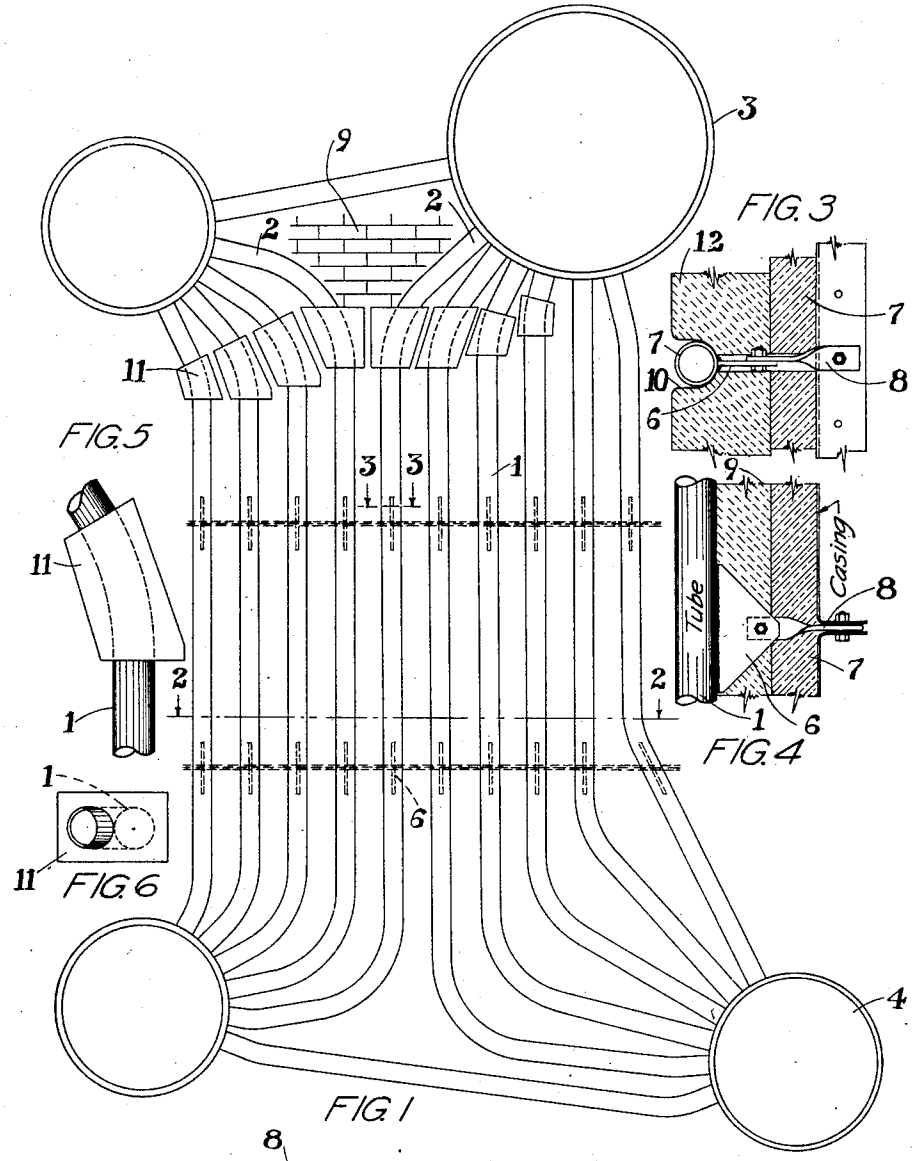



FIG. 1

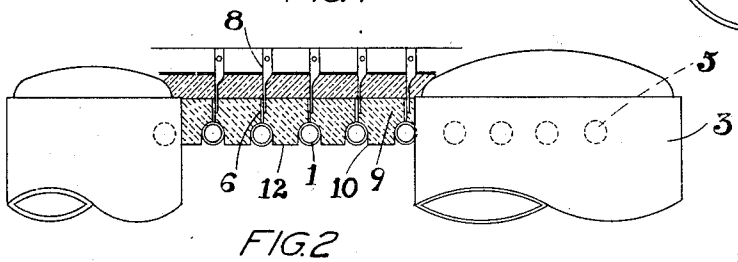



FIG. 2




FIG. 3




FIG. 4




FIG. 5




FIG. 6

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## WATER WALL FOR STEAM BOILERS.

Application filed June 2, 1927. Serial No. 195,929.

This invention relates to water walls for steam boilers and is especially adapted to walls for furnaces employing oil or powdered fuel, or other finely divided fuel that requires a furnace of large volume and extensive wall surface.

The objects of the invention are to provide a water wall that can be easily applied in combination with the usual transverse cylindrical upper steam drum and lower water drum of a water tube boiler of the so-called bent or curved tube type.

The means by which this object is attained constitutes a water wall comprising a number of water tubes all disposed in the same plane, or substantially so, and connecting said drums, the ends of the tubes being bent so as to converge in fan-like formation, each tube directed radially toward the drum, that is, toward an imaginary point lying in the central axis of the drum. The tubes are received in a circumferential row of tube holes in the drum. The middle parts, that is, the parts of the tubes that are intermediate the bent ends, are preferably arranged upright and parallel, or substantially so.

Another advantage possessed by the bent tubes which lead direct into the ring of holes in the drum near its ends is that when a man goes into one of the steam drums or water drums to clean the tubes of the usual water tube banks of a boiler he can with equal facility clean the tubes which comprise the water wall, for there are no hand-holes to be removed, as is the case where headers are used in water wall construction. By eliminating the usual headers all sharp changes in direction of flow are avoided and free water circulation is made possible. This solution of the difficulty of cleaning the tubes of a water wall is an important improvement.

Another object of the invention is to provide an improved supporting means for the upright parts of the tubes, so that their normal expansion and contraction will not be interfered with, for they will be adequately supported at suitable places throughout their length, and thereby strains on the drums that would otherwise be caused by tube distortion are avoided. The tube-supporting means is adapted to carry a considerable part of the weight of the tubes and also to keep them properly alined, that is to say, in the plane of the water wall, and to prevent their bulging when expanded by heat, yet allowing them a limited amount of movement.

The means by which this result is attained is embodied in a fin or series of fins welded to each tube, or otherwise permanently secured to it and projecting outward from the plane of the water wall, each fin being anchored to the wall of the furnace by means of a bar or link.

A still further object of the invention is to provide on the tubes themselves a suitable means for supporting a portion of the furnace lining, that is to say, the part of the lining which is located near the upper drums and includes the area of the fan-like tube formation above referred to. This embodiment of the supporting means for the furnace lining consists in laterally projecting lugs on certain of the tubes near their upper ends, or on all of them, as the case may be, the top face of each lug forming a supporting shoulder upon which the weight of the superposed lining is carried. This arrangement protects the furnace lining against cracking caused by lengthwise expansion of the bent tubes.

This part of the invention is especially well adapted to water walls in which the tubes are embedded, or partly embedded, in the face or refractory lining of the furnace wall proper, which is preferably provided with grooves to receive the respective tubes.

While the invention will be described as applied to a water wall used for steam generating purposes, and consequently as being exposed directly to the furnace heat, it will be understood that it may equally well be built entirely outside the furnace setting, or for some purposes may be completely concealed in the furnace wall. In such installations a water wall is used, not for steam generating purposes, but as downcomers.

With the foregoing and certain other objects in view, which will appear later in the specifications, my invention comprises the devices described and claimed and the equivalents thereof.

In the drawings Fig. 1 is a side elevation of a water wall consisting of two series of tubes connecting two sets of steam and water drums.

Fig. 2 is a horizontal section on line 2—2 of Fig. 1 with parts omitted.

Fig. 3 is an enlarged horizontal sectional

detail on line 3—3 of Fig. 1, showing the tube anchored to a furnace wall.

Fig. 4 is a side view of the parts shown in Fig. 3.

Fig. 5 is an enlarged side view of a brickwork-supporting lug molded integral with a water tube.

Fig. 6 is a plan view of the same.

As is clearly shown in the drawings, the water wall consists primarily in a plurality of upright, or approximately upright, water tubes 1 spaced apart and, with the exception of their ends, preferably parallel. Their upper parts are bent so as to point their ends 2 radially toward the horizontal axis of the upper or steam drum 3. Their lower ends are likewise directed toward the axis of the lower or water drum 4.

Each drum 3, 4 has a circumferential row of tube holes 5, into which the radially directed tubes are expanded in the usual way. Preferably all of the parts of the water wall are in the same plane, or substantially so, as shown in Fig. 2, namely, the intermediate and end parts 1, 2 of the tubes, the row of tube holes 5 in the upper drum and the corresponding row of tube holes in the lower drum. The tubes, as shown, are arranged in fan-like formation adjacent each drum and their intermediate parts 1 comprise upwardly directed parallel series of water circulating tubes.

The horizontal spacing, or distance apart of the upright tubes is an important consideration in furnace construction, because if the tubes are too close together they will have too much cooling effect, so that improper combustion and a smoky furnace will result, and if they are too far apart the right amount of heat absorbing surface will not be present and the water wall would not prevent the fire-brick from fusing.

In the water wall of this invention the distance between tubes can be established at will without involving any change in the construction or arrangement of the steam drum and water drum. Therefore, standard drums can be made to suit furnaces of different sizes, or the spacing of the water wall heating surfaces can be adapted to suit different kinds of fuel without necessity of redesigning the drum.

By bending the ends of the tubes while keeping them all in the same plane and thereby providing the fan-like spread or formation the following advantages are attained:

No undue strain is brought upon the drums because of expansion of the straight parts of the tubes, since the bent tube expands freely like any ordinary bent tube in a water tube boiler. The tube holes in the drum need not be made special, but are made to the same standard as the holes for regular heating surface tubes.

One or more fins 6 is secured to each tube by welding or otherwise, and is anchored to the furnace wall 7 by means of a bar link 8, as shown in Figs. 2, 3, 4.

Preferably the furnace lining 9 of refractory material, such as fire-brick, is formed with grooves 10 when the water wall is to be used for steam generating purposes.

The fin 6 holds the tube in its groove and also serves as a supporting means to carry the weight of the tube. Furthermore, the tube and its supporting fins serves to carry the weight of a portion of the fire-brick lining 9, being that part of the lining located at and above the upper tube bends.

A lug 11, preferably of cast iron, is molded around the tube and partly embedded in the lining 9. The lugs 11 provide a good support for the lining above the bends of the tubes and prevent the lining from sliding out of place. They also make it unnecessary to provide specially curved fire-brick shapes. They anchor the lining to the tubes 1 and the tubes carry a portion of the weight of the refractory material, and they in turn are supported through the tubes by the fins 6.

When burning powdered fuel or oil the furnace temperature is apt to be higher than the fusing point of fire-brick, but with this arrangement of tubes the intermediate rib 12 of refractory material gives off part of its heat to the tubes 1 and is itself kept at a temperature low enough to prevent fusing or softening to a dangerous point. Likewise the grooved brickwork keeps the tube from becoming over-heated, for a part only of the tube surface is exposed to the direct action of the fire.

The supporting fins 6 and their connections prevent the tube from bulging outward to any great extent when it becomes heated, yet the fin permits a slight relative movement between the tubes and the brickwork ribs 12. Such slight movement keeps the tubes free from slag. Slag comes from a deposit of soot that collects on the furnace walls and ultimately fuses and runs down, but because of the slight movement that occurs between the tube and the brickwork the slag flakes off and keeps the heating surfaces of the water wall clean.

Erosion of the brickwork is prevented, for the slag flakes off as fast as it is formed and destructive erosion is prevented, because that usually happens only when a large chunk of slag collects on the brick and then breaks off, taking some of the brick with it.

The possibility of air infiltration through the setting is greatly reduced by the water wall construction herein described, because the tubes of the water wall do not pass through the brickwork of the setting in order to connect with an outside header, as has heretofore been common in water walls.

In the drawings two banks of tubes have

been shown, connected to two sets of steam and water drums and also interconnected between the two sets of drums, but obviously one of the banks of tubes, as for example the left-hand bank in Fig. 1, can be eliminated, without departing from the invention as set forth in the claims.

Having thus described my invention, what I claim and desire to secure by Letters Patent is:

1. A furnace wall structure comprising a brick-work furnace lining, water tubes having their middle parts parallel and disposed in the same plane and received for a portion of their length in grooves formed in the furnace lining, their upper ends bent to fan-like formation, a fin welded to each tube and projecting outward from the plane of said tubes into said lining to restrain said tube from movement sidewise, a pivotally attached link anchoring said fin to the furnace wall, and laterally projecting lugs on said tubes near their bent upper ends, for carrying the upper part of said brickwork furnace lining.

2. A furnace wall structure comprising a brick-work furnace lining, a water wall comprising water tubes disposed in the same plane, parts of said tubes intermediate the ends received in grooves formed in the furnace lining, a fin fixed to each tube and projecting from the plane of said water wall, a pivoted link securing said fin to the furnace wall, and lugs fixed to said tubes near their upper ends and constituting means for carrying a portion of said furnace lining.

3. Water tubes substantially parallel and spaced apart in the same plane, their ends bent and joined to a drum in a circumferential row of holes, a refractory wall formed with grooves to receive said tubes, refractory ribs between the tubes, a fin on each tube for anchoring to a fixed support to prevent the middle of the tube from bulging, and lugs fixed to the upper parts of said tubes for supporting the upper part of the refractory wall thereon, for the purposes set forth.

In testimony whereof, I affix my signature.

JOHN F. L. BAKER.