Sept. 10, 1935. H. J. KERR 2,013,658

HEAT EXCHANGER

Original Filed Nov. 10, 1928

Fig. 1

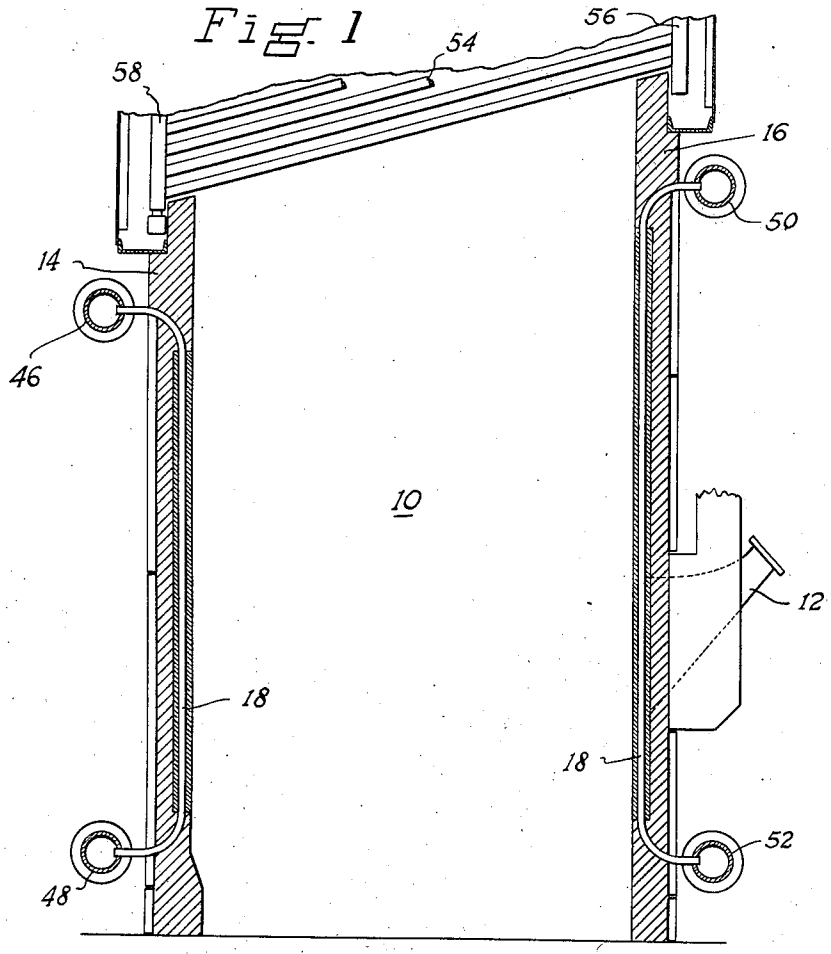



Fig. 2

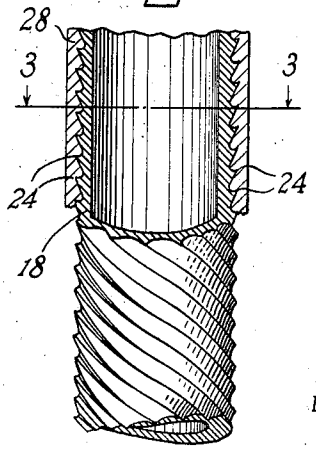
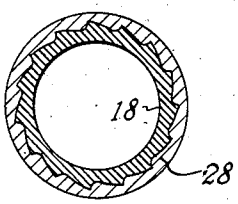



Fig. 3




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Patented Sept. 10, 1935 2,013,658

# UNITED STATES PATENT OFFICE

2,013,658

## HEAT EXCHANGER

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Original application November 10, 1928, Serial No. 318,351. Divided and this application December 8, 1930, Serial No. 500,743

2 Claims. (Cl. 122—6)

This invention relates to an improved tubular heat exchanger as a part of a heat exchange system wherein heat from burning fuel is transmitted to said exchanger which applies the heat to a fluid passing therethrough.

When tubular heat exchangers are used in the radiant heat zones of boiler furnaces their metal is subjected at times to such high temperatures that its destructive effect is too severe for any adequately long life of the device. Yet, it is highly desirable to utilize the heat radiantly transmitted from the burning fuel. It is an object of this invention to solve this problem.

It is a further object of the invention to present a practical radiant steam superheater heat exchanger of novel construction in respect to its tube protection.

Another object is to provide superheater tube protection consisting of a heat resisting shell portion applied in plastic condition to the tubes and anchored thereto.

Other objects of the invention will appear as the accompanying description proceeds.

The invention is described with reference to the accompanying drawing, in which:

Fig. 1 is a vertical section through a boiler furnace equipped with a radiantly heated steam superheater having the illustrative heat exchanger incorporated therein.

Fig. 2 is a longitudinal view of a heat exchanger having helical projections extending into a non-metallic protector of great thickness.

Fig. 3 is a transverse sectional view taken on line 3—3 of Fig. 2.

This application is a division of my application Ser. No. 318,351, filed Nov. 10, 1928.

Fig. 1 shows a boiler furnace having a combustion chamber 10 in which burning fuel is supplied through a burner 12. Along the inner face of the furnace walls 14 and 16 are the illustrative heat exchangers. Heat from the burning fuel is transmitted directly to them and through them to a fluid passing through their inner metallic tubes. Coal, used as fuel, results in the deposition of refractory slag in plastic condition, the deposition being governed by the fusion characteristics of the refractory, and the relative temperatures, of tubes and furnace.

When the tubular structure is sufficiently low in temperature, the plastic refractory, or slag carried by the burning fuel will deposit and collect until it covers the heat exchanger. Projections and cooler portions of the exchanger start such collections.

The construction shown in Figs. 2 and 3 of the drawing presents an inner metallic tube 18 having outwardly extending projections spaced apart. Between these projections are bodies of heat resisting material, or refractory material, placed on the metallic tube, either while in plastic condition, or previously formed. The metal projections serve as bonding or holding means to keep the refractory in place. These metal projections also serve as heat conductors, while the refractory is relatively a heat insulator. By varying the average thickness of the refractory shell, or by varying the superficial area of the metal covered by the refractory shell, the heat conducting capacity of the tube is varied, and the temperature of the metal kept within safe limits. In proportion as the heat conducting capacity of the tube is reduced by this means, or the metal temperature, so will the external surface have a higher average temperature whether such surface is wholly refractory or partly refractory and partly metal, and the furnace temperature will be higher.

Extension of the apices of the projections upwardly and the extended metal surface in Fig. 2 and Fig. 3 structure promotes adequate anchoring of the non-metallic shells to the metal tube, and where necessary, the grooves between projections may be formed undercut or dovetail shaped to further increase the anchorage of the refractory.

In Fig. 2, the projections 24 are continuously helical, leaving corresponding helical grooves 22 between. The metal projection is screw-thread in type, and may have any sectional shape, square, triangular or rounded, and may be undercut on one or both sides.

In Fig. 1 the metal tubes have their intermediate sections presented to the heat from the burning fuel in the combustion chamber 10. Their ends extend through the wall 14 on one side of the furnace where they are expanded into inlet and outlet headers 46 and 48 respectively. At the other side of the furnace is a similar construction including headers 50 and 52. Above the combustion chamber is shown a section 54 of a water tube steam boiler of standard construction having uptake headers 56 and downcomers 58. Steam generated in this boiler (shown only in part) may be led to one set of headers by connections not shown, and be superheated in the tubes as it passes to the other set of headers.

Such an arrangement constitutes a radiantly heated superheater for the steam boiler, the furnace of which is the source of heat for superheating. Such radiant heat is received by the

tubes at a very high rate, and is absorbed by the steam at a rate increasing with the flow of steam through the superheater, and so varies with the boiler load. There is a normal tendency for a state of unbalance to occur when load changes and when starting or stopping a boiler, and when the steam flow inside the tubes is relatively deficient with reference to radiant heat received, the metal temperature tends to rise and if some protection is not afforded, the metal may become so hot as to be injured. By my protective shells wholly or partly covering the metal of the tube, the heat flow through the tube is retarded and rise of metal temperature restricted to safe values.

The invention has been described with reference to specific structures, but it is to be appreciated that it is not limited to all of their details. It is of a scope commensurate with the scope of the sub-joined claims.

What I claim is:

1. In power steam apparatus; a combustion chamber; means for burning fuel within the combustion chamber; and radiantly heated wall structures comprising an inner part of a wall of the combustion chamber receiving radiant heat from the burning fuel for transfer to a fluid passing through the structure; said structure comprising tubular elements through which the fluid is passing; helically disposed extensions of the tubular elements extending radially outwardly thereof to afford anchors; and non-metallic heat resisting material of greater thermal resistance than the material of the tube held in place by said anchors and placed around the tube while it is in plastic condition.

2. In power steam apparatus; a combustion chamber; means for burning fuel within the combustion chamber; and radiantly heated wall structures comprising an inner part of a wall of the combustion chamber receiving radiant heat from the burning fuel for transfer to a fluid passing through the structure; said structure comprising tubular elements through which the fluid is passing; helically disposed extensions of the tubular elements extending radially outwardly thereof to afford anchors; and non-metallic heat resisting material of greater thermal resistance than the material of the tube held in place by said anchors and placed around the tube while it is in plastic condition, said extensions substantially constituting threads formed on the tubular elements.

HOWARD J. KERR.