May 17, 1960 J. I. ARGERSINGER 2,936,740

HEAT EXCHANGER

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Fig. 1.

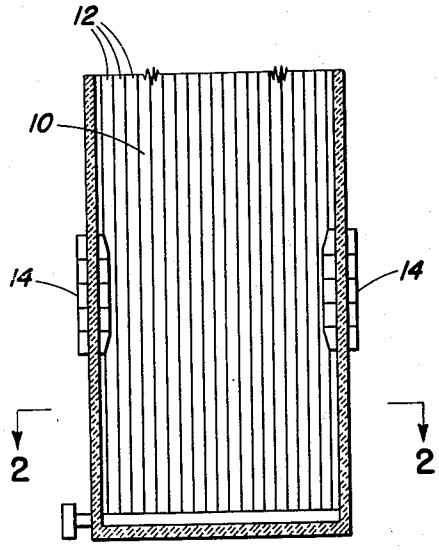


Fig. 2.

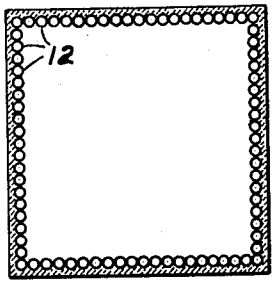
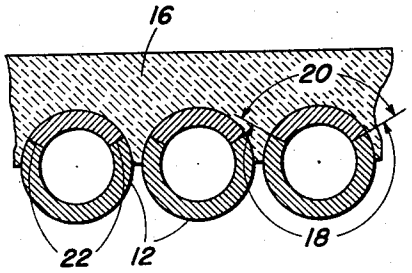


Fig. 3.



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HEAT EXCHANGER

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1 Claim. (Cl. 122—6)

This invention relates to heat exchangers and in particular to tubular heat exchangers for heating vapors and wherein a portion only of the circumference of the tubes is subjected to intense radiant heat so that the tube metal of this circumferential portion is at a higher temperature than that of the remaining portion.

In tubular heat exchangers for the heating of vapors, such as the superheater employed in steam generators, and where the vapor to be heated is conveyed through the tubes and the heat is applied exteriorly of the tubes it sometimes happens that this heat is very intense radiant heat and is not applied to the entire outer surface of the tubes but is applied only to a limited circumferential portion or sector of the tube wall. Such is the case when superheater tubes for superheating the steam generated in a steam generator are positioned next to the inner surface of one or more walls of the furnace of the steam generator. The inwardly facing half of these tubes receives intense radiant heat from the burning fuel in the furnace while the outwardly facing half of the tube wall receives substantially no heat at all direcly from the burning fuel. When this condition prevails a substantial temperature differential in the tube metal exists between the portion of the wall which receives this intense radiation and the portion which is shielded from such heat. It is of course necessary to design the tube to withstand the higher of these temperatures and with high operating temperatures and also in some instances high pressures extremely costly steel alloys must be employed to withstand the operating conditions.

In accordance with the present invention, rather than fabricating the tubes of such a heat exchanger of a single metal the tubes are bi-metallic with the circumferential portion of the tube which is subjected to intense heat being of a steel alloy which has sufficiently greater strength at high temperatures than the metal of which the remaining portion of the tube is made so as to compensate for the effect that the differential temperature between these tube portions has upon the strength quality. These bimetallic tubes are fabricated by joining together these two wall portions of different metal by welding with the juncture or weld being clearly visible and with the circumferential or arcuate length of the two portions being of sufficiently different length so they may be readily distinguished by observation so that the erector may easily and unmistakably distinguish the portion of the tube which is more heat resistant and is to be subjected to the intense radiant heat. With these tubes the amount of extremely expensive alloy which is required may be reduced to substantially one half of that of conventional heat exchange organizations.

It is an object of this invention to provide an improved tubular heat exchanger for heating vapors and in which only a portion of the circumference of the tubes are subjected to intense radiant heat.

Other and further objects of the invention will become apparent to those skilled in the art as the description proceeds.

With the aforementioned objects in view, the invention comprises an arrangement, construction and combination of the elements of the inventive organization in such a manner as to attain the results desired as hereinafter more particularly set forth in the following detailed description of an illustrative embodiment, said embodiment being shown by the accompanying drawing wherein:

Fig. 1 is a vertical sectional view of a heat exchanger in the form of a furnace which has tube portions adjacent or lining the inner surface of its walls.

Fig. 2 is a transverse sectional view taken along line 2—2 of Fig. 1.

Fig. 3 is a fragmentary transverse sectional view to enlarged scale of a wall with the tubes disclosed therein having a vapor to be heated passing therethrough.

Referring now to the drawing, wherein like reference characters are used throughout to designate like elements, there is shown therein a furnace **10** which has the inner surface of its walls lined with heat exchange tubes **12** and which is fired by means of burners **14**. By means of these burners, fuel and air is introduced into the furnace and burned therewithin with the combustion gases rising and passing out the upper end of the furnace. The walls of the furnace may be constructed in any one of several conventional and well known ways such as by having the tubes **12**, which form the inner surface of the wall, being tangent with and secured to the outer wall structure or, as shown in Fig. 3, having these tubes received or recessed in the outer wall structure with the outer circumferential portion of the tubes being surrounded by refractory or thermal insulation **16**. At least a number of these tubes **12** are vapor heating tubes with these tubes being those shown in section in Fig. 3. It would be preferable to have one or more of the walls of the furnace lined entirely with vapor heating tubes or perhaps, as in the case of a separately fired superheater, have all of the tubes **12** be vapor heating tubes. The vapor is supplied to and collected from the tubes through any desirable means, such as headers, not shown, and upon passing through the tubes is heated to a desired temperature and pressure.

As embodied the vapor heating tubes **12** are of a bimetallic construction (Fig. 3) with the inwardly facing circumferential or arcuate portion **18**, which is subjected to intense radiant heat developed by the burning fuel within the furnace, being fabricated of a metal which has sufficiently greater strength at high temperatures to compensate for the higher operating temperature of this arcuate portion relative to the circumferential or arcuate portion designated **20** and which receives substantially no radiant heat from the furnace.

The tubes **12** are fabricated by welding together the two arcuate portions **18** and **20** along the longitudinally extending seams **22** and it is of course preferable that the metals of which these two arcuate portions are made have as near as possible coefficients of thermal expansion which will not set up high internal stresses in the tube walls at the location of seams **22**.

In operation of the heat exchanger, the arcuate portion **20** of vapor heating tubes **12** will have a temperature corresponding generally to the vapor flowing through the tubes while the arcuate portion **18** which receives intense radiant heat will have a temperature substantially greater than that of the vapor. When high temperature conditions prevail this necessitates that arcuate portion **18** be constructed of a steel alloy which will withstand this greater temperature and accordingly is much more expensive than the metal of which arcuate portion **20** is fabricated. In the case of steam superheaters when the steam temperature is about 900° F. and above, and the pressure is about 2500 p.s.i. or more, with these conditions now becoming common, the temperature of arcuate portion **18** will be about 50° F. higher than arcuate portion **20**

and a substantial economic advantage will be obtained by fabricating the tubes of dissimilar metal with only arcuate portion 18 being of the expensive alloy required to withstand this increased or higher temperature.

In order that the portion of the vapor heating tubes 12 which is of the higher temperature resistant alloy (arcuate portion 18) may be readily distinguished so that this portion may be properly oriented in the erection of the boiler to receive the intense radiant heat the arcuate portions 18 and 20 are of sufficiently different length and the welded seams 22 are readily discernible so that by mere visual inspection it may be determined which portion of the tube is to face inwardly of the furnace and receive the radiant heat. In the illustrative organization arcuate portion 18 is substantially greater than arcuate portion 20 so as to accomplish this purpose as well as to extend the alloy of which arcuate portion 18 is made to a location sufficiently removed from the radiantly heated zone so that the tube metal temperature is substantially lowered before arcuate portion 20 is reached.

Thus with the present invention a tubular heat exchanger for heating vapor and in which only a portion of the circumference of the tubes are subjected to intense radiant heat is provided which is more economical than conventional organizations and yet adequately withstands the severe conditions in which it is subjected with the tubes of the heat exchanger being constructed in a manner which permits them to be unmistakably positioned in proper orientation during erection.

While I have illustrated and described a preferred embodiment of my invention it is to be understood that such is merely illustrative and not restrictive and that modifications may be made therein without departing from the spirit and scope of the invention. I therefore do not wish to be limited to the precise details set forth but desire to avail myself of such changes as fall within the purview of my invention.

What is claimed is:

In an organization of the type described a furnace wall having its inner surface lined with side by side generally

tangent elongated tubes through which a vapor to be heated is conveyed with the tubes having a generally circular transverse section and a uniform wall thickness throughout their periphery and with the tubes being formed of two circumferential portions welded together longitudinally, the circumferential half of the tube facing inwardly of the furnace being subjected to intense heat from within the furnace while the outwardly facing circumferential half is shielded from such heat and is embedded in the furnace wall whereby said inwardly facing portion operates at a substantially higher temperature than said outwardly facing portion, the arcuate circumferential portion of the tube wall embraced in a sector somewhat greater than 180°, including the inwardly facing circumferential half that is subjected to intense radiant heat and such that the extremities of said arcuate portion lie in and form part of said outwardly facing circumferential half and are embedded in the wall, being comprised of a metal different from that of the remaining portion of the tube wall, said metal in this arcuate circumferential portion being of a steel alloy having sufficient greater strength at high temperature than the metal in the remaining portion of the tube wall to compensate, relative to strength quality, for the substantially higher temperature of the inwardly facing tube portion relative to the outwardly facing tube portion, said arcuate circumferential portion being sufficiently greater in circumferential extent than the remaining tube portion and the longitudinal welds being such that the different material portions are readily distinguishable by visual inspection.

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