

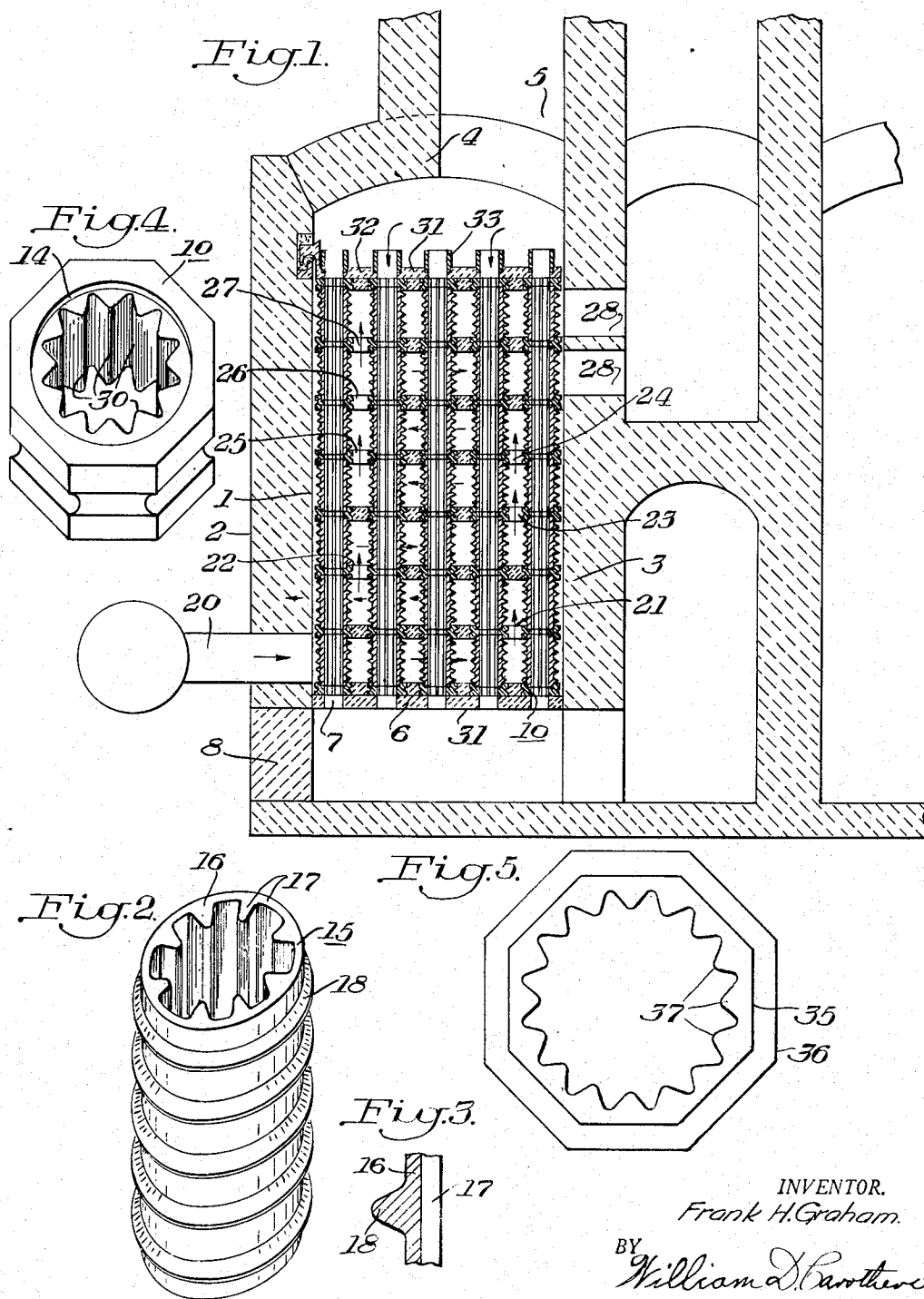
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RECUPERATOR TUBE TILE STRUCTURE

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1

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RECUPERATOR TUBE TILE STRUCTURE

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This invention relates generally to industrial heat exchangers, known as recuperators, and more particularly to a recuperator tube tile structure that conducts the hot gases from the furnace chamber through a recuperator to the stack to effect a heat exchange.

The principal object of this invention is the provision of particular style of tubular tile structure that provides increased surface area for producing a more efficient transfer of heat and also provides additional physical strength to the tube tile itself.

The principal object of this invention is to improve the thermo efficiency in the heat transference from the hot gases flowing down these flue pipes to the air flowing past the outside thereof into the furnace. The particular structures as disclosed in this application increases the efficiency of heat transference by reason of the fact that they are provided with longitudinally disposed fins or ribs on the inside of the tube and annular ribs on the outside. A structure of this character permits the cylindrical cross-section of the tube to be reduced in size which increases the frequency of heat transference. Again, the ribs in the bore of the tubes are longitudinally and in the same direction as the flow of the gases through the tubes, and they have a tendency to direct and strengthen this flow. The annular ribs on the outside of the flue tubes are likewise in the same direction as the path of air as it continues back and forth upon rising through the recuperator. The annular ribs on the outside of the tube also provide an increased surface area together with a reduced cylindrical section of the tube which also increases the heat exchange from the inside to the outside of the tube.

The flue tubes may be constructed with the cross-section substantially cylindrical or octagonal or any other suitable form. In the past, octagonal flue tubes have been employed and they are equally adapted to contain the longitudinally extending ribs in the bore and the annular external ribs in the same manner as that of the flue tube with cylindrical cross-section.

Owing to the fact that the actual cross-sectional area of the cylindrical portion of the tube may be reduced in thickness, in view of the increased area supplied by the ribs, and a greater heat transference is provided in each tube with substantially the same amount of material and the same space employed with the recuperator, which is a material advancement over that of the previous structures.

Other objects and advantages appear hereinafter in the following description and claims.

The accompanying drawings show for the purpose of exemplification, without limiting the invention and claims thereto, certain practical embodiments of the invention wherein:

Fig. 1 is a view in vertical section of the recuperator tile structure assembled in a refractory chamber embodying the principals of this invention.

Fig. 2 is a large perspective view of a flue tube comprising this invention.

2

Fig. 3 is a detailed sectional view, showing the disposition of the inner and outer ribs of the flue tube.

Fig. 4 is a large detailed view of the flue block which is employed in the horizontal course of the recuperator employing a ribbed tube structure.

Fig. 5 is a plan view of an octagonal form of a flue tube, comprising this invention.

Referring to the drawings, each of the tile structures making up the recuperator is made of a material capable of withstanding a very high waste gas heat and also capable of withstanding a high degree of thermo shock and still maintain its shape and is capable of supporting the recuperator structure thereabove.

The recuperator tile structure is layed within the recuperator refractory chamber 1 closed by refractory side walls 2 and 3. In the arched roof 4 contains the passage 5, through which the waste gases are withdrawn from the furnace chamber.

The bottom of the recuperator is provided with a bridge wall 6, designed to support the recuperator tile structure within the chamber 1. The bridge wall 6 is provided with a series of vertical openings 7, that are aligned with the vertical flues of the recuperator tile structure for the purpose of conducting the waste gases from the recuperator to the passage 8, to an additional heat exchangers, or to a stack as the case may be.

The horizontal courses of the recuperator tile structure may be constructed on a plurality of different types of tile members such as illustrated in U. S. Letters Patent 2,093,402, and 2,574,738. A flue block 10, such as illustrated in Fig. 4, is octagonal in shape and may be provided with an upper recess 14, for the first and last horizontal courses containing the air. These recesses are shaped in a manner to receive the vertical tubular section of the flue pass such as illustrated at 15, and shown specifically in Fig. 2. The intermediate blocks have a recess in both sides and the ribs should match the ribs of the tubular flue tile.

The tubular flue tile 15 is provided with a substantially cylindrical section as indicated at 16 and which has on its inner face or bore a series of inwardly extending ribs 17 and that extend longitudinally of the tube and which may be straight or follow a spiral path as desired. However, the ribs 17 are in the direction of the flow of the hot gases down through the flue tubes 15.

The external portion of the cylindrical flue tube 15 is provided with a series of annular ribs 18, which are spaced apart and are parallel to the flow of air as it proceeds back and forth across these several passes in traveling from the lower to the upper end of the recuperator. The air is conducted through the passageway 20 and travels horizontally to the opposite end of the first pass then upwardly through the opening such as indicated at 21 where it returns back through the second pass upwardly through the openings 22 to the third pass, from thence, the air passes upwardly through the openings 23 and 24 so that it may flow back through both, next two horizontal passes, and travel upwardly through the openings 25, 26, and 27, so that it may return through the last two horizontal passes, and being discharged through the passageway 28 and 29 at the upper end of the recuperator, from whence it flows to the furnace.

As previously stated, the recess 14 in all of the flue blocks are shaped to receive the ends of the tubular flue tile members 15 and they are likewise provided with a series of inwardly extending rib members 30, which are matched in number and size with, and made aligned with rib member 17 of the matching flue tile. Thus, the whole of the end face of the tile structure is supported from the bottom of the bridge wall 6 to the top of the recuperator structure, as shown in Fig. 1.

The underside of the intermediate flue blocks are like-

3

wise provided with a cavity for receiving the tops of the subjacent flue tile. The blocks at the top and the bottom of the recuperator, have only one recess, since they do not support a flue tile of the same structure on their opposite faces.

At the top of the tile structure an additional or extra horizontal course 31 is added by placing the same on the top of the horizontal seal course made by the upper block members 32. However, the top course 31 is not cemented to the course in a manner that all the other tile blocks are cemented together. This top course includes an additional set of short tubes 33 that are cemented to the top course 32 and extend upwardly into the chamber 1. These may be or may not be shorter than the tubes 15, however, they are placed on top of the recuperator for the purpose of gathering and collecting residue from the furnace which becomes hardened, and when it reaches the tops of the tubes 32, the top layer 32 is usually removed and replaced before the residue has an opportunity to descend through the tubes and choke the passageways.

Flue structure, such as illustrated at Fig. 5 is similar to that disclosed at 15 in Fig. 2, with the exception that the flue 35 is provided with an octagonal cross-section and the outer ribs 36, and the vertical inner ribs 37 follow the general cross-section of the octagonal tube. With structures of this character the recess seat 14 and the blocks 10 must be likewise changed to fit the structure of these vertical tubes.

Regardless of whether the shape of the tube is cylindrical or octagonal, the air, in traveling back and forth through the horizontal passes, is guided and directed by the annular ribs 18 and the gases which pass downwardly through the flue tubes are guided in their path by the ribs 17. Since the wall 16 of the tubes can be materially thinner than that of the present tubes, the heat transference is materially greater in this structure than in any other known tile structure, and at the same time, the strength of these tubular flue structures is not reduced, as the total cross-sectional area remains substantially the same when including the ribs 17, which provides strength in supporting the load of the tile structure. Again, the annular ribs 18 will provide an increased reinforcement for each

4

of the vertical tubes, thereby strengthening the structure physically.

I claim:

1. Heat transfer tile structures for the construction of recuperators comprising a refractory member having an annular wall with an opening therethrough, a plurality of spaced ribs integral with the wall of the refractory member and projecting inwardly into said opening, said ribs extending longitudinally of the wall forming said opening to aid in guiding gases passing therethrough, the cross-sectional area of the ribs providing additional load carrying support to enable reduction of the thickness of the annular wall to increase the heat exchange through the refractory member.

2. The structure of claim 1 characterized in that said refractory member has a recess surrounding said vertical opening to receive a tubular flue member with matching inwardly projecting ribs.

3. The structure of claim 1 characterized in that said refractory member has an elongated tubular wall structure, and which also includes a plurality of spaced annular reinforcing rib means encircling the exterior of said tubular refractory member and spaced from the ends thereof for guiding gases flowing therepast, increasing the heat transfer thereof.

4. The structure of claim 3 characterized in that said tubular wall structure is circular and the inwardly projecting ribs are circumferentially spaced about the inner wall thereof.

5. The structure of claim 3 characterized in that said tubular wall structure is octagonal and the inwardly projecting ribs are circumferentially spaced about the inner wall thereof.

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