Jan. 2, 1940. A. MOHR, JR., ET AL 2,185,559

CHECKERWORK CONSTRUCTION FOR REGENERATORS

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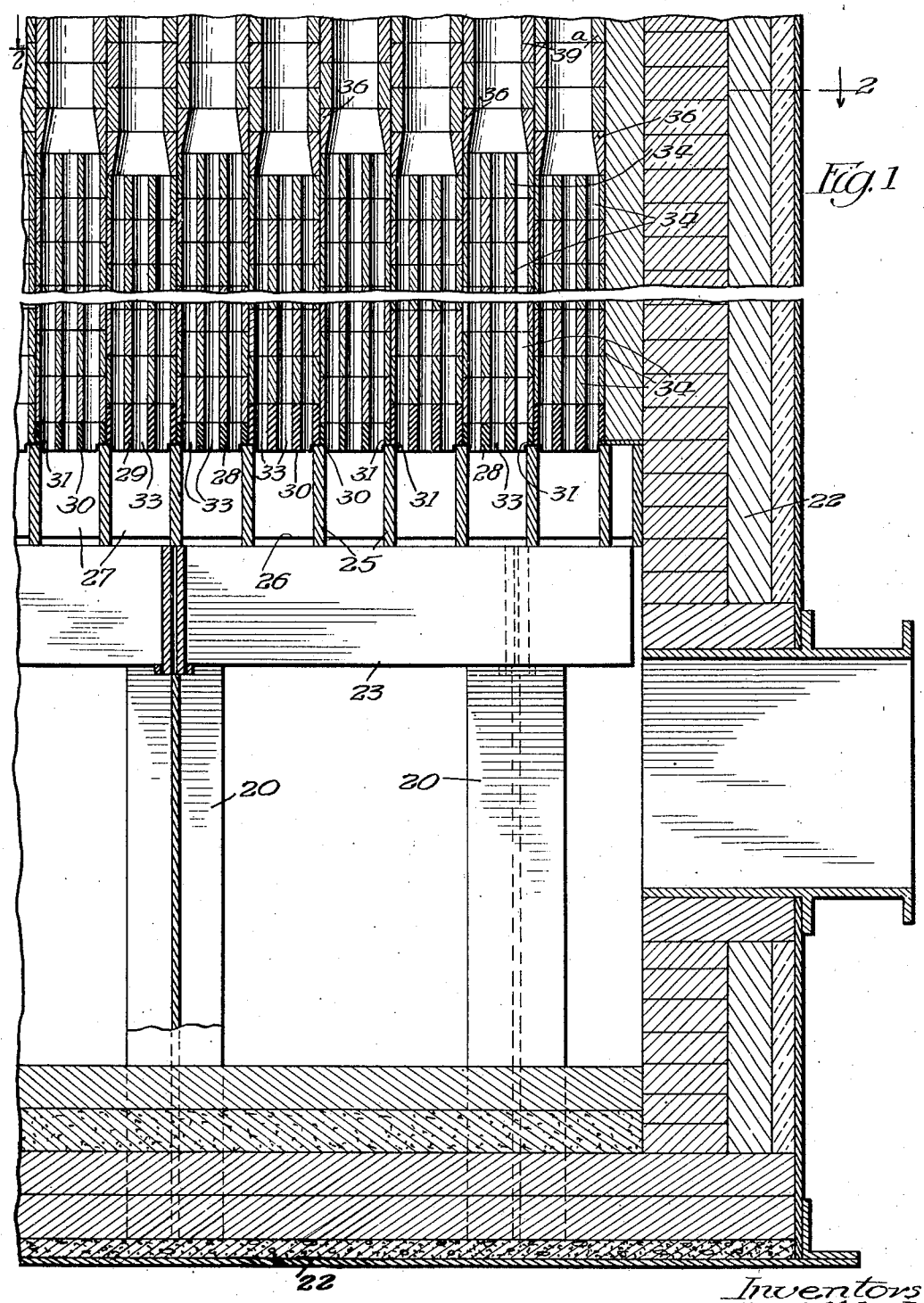


Fig. 1

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CHECKERWORK CONSTRUCTION FOR REGENERATORS

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Fig. 2

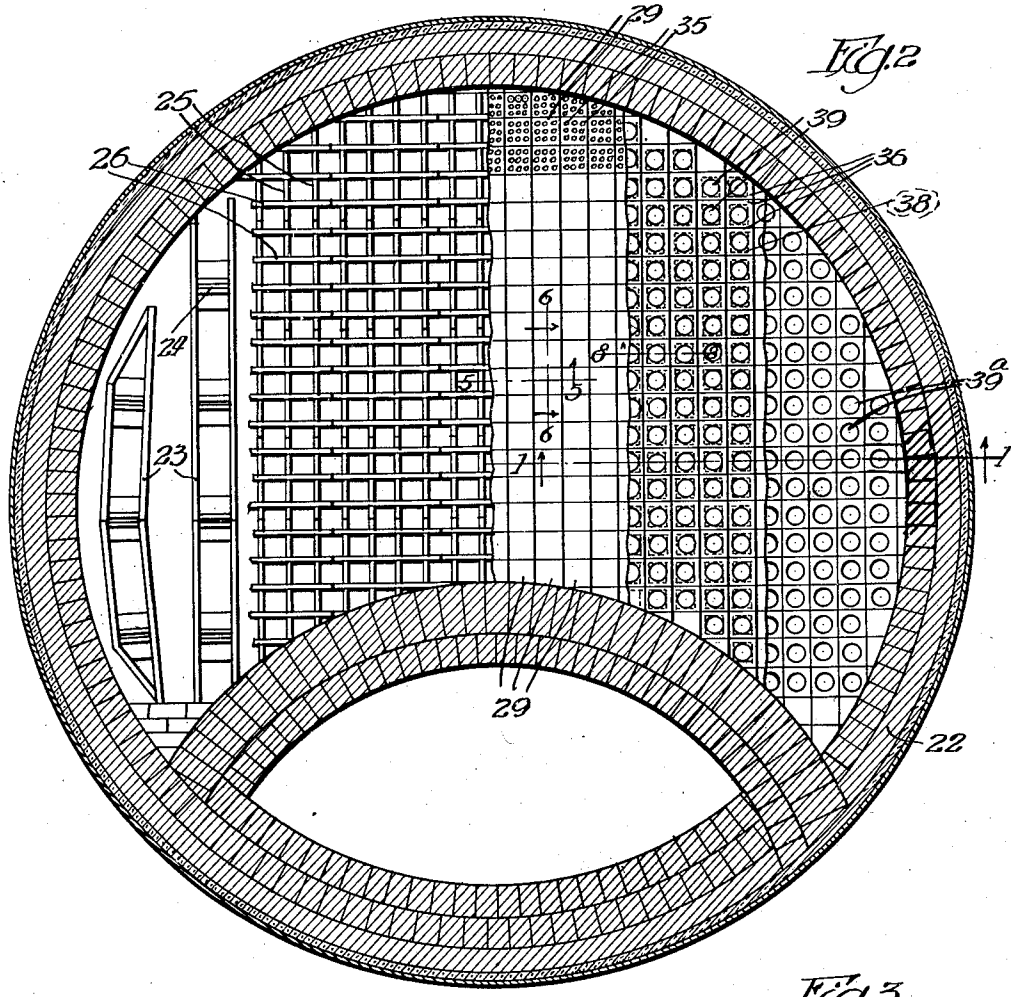
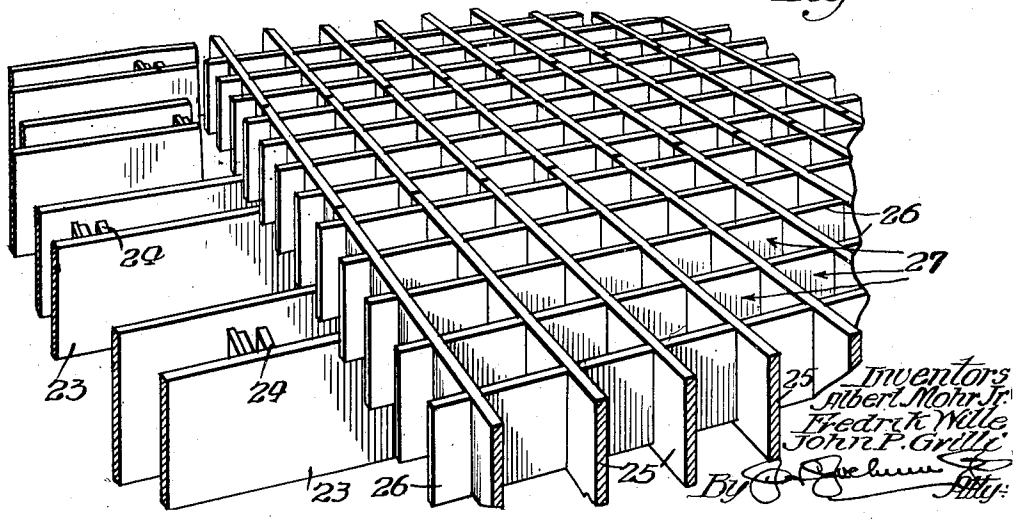


Fig. 3



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CHECKERWORK CONSTRUCTION FOR REGENERATORS

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Fig. 4

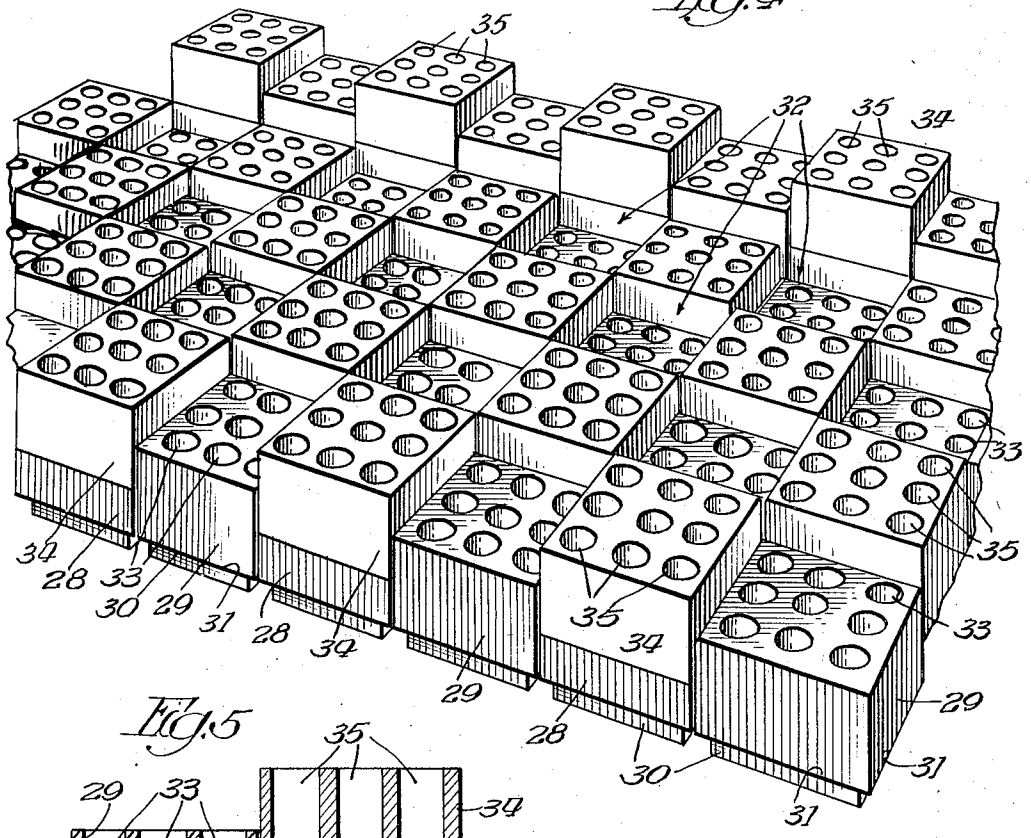


Fig. 5

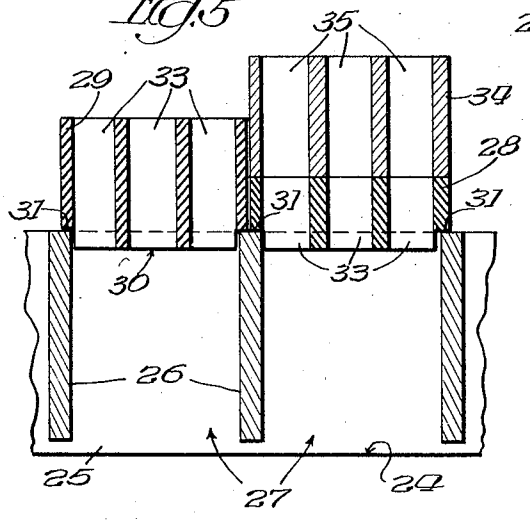
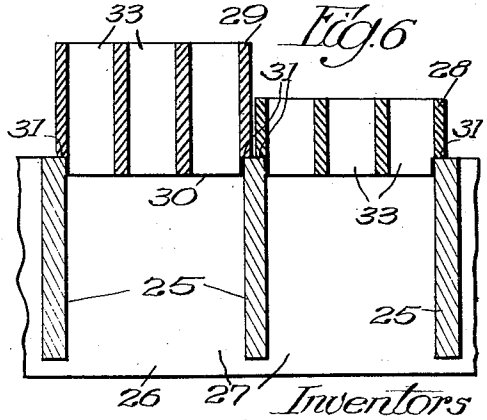


Fig. 6



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CHECKERWORK CONSTRUCTION FOR REGENERATORS

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Fig. 7

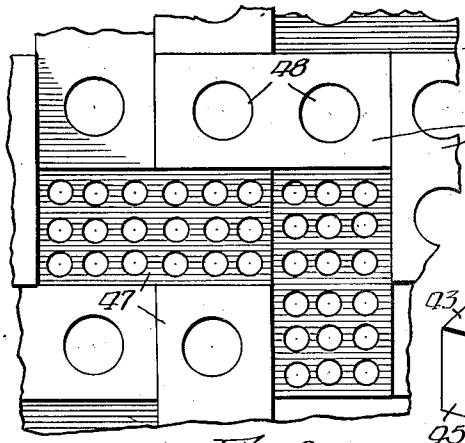


Fig. 10

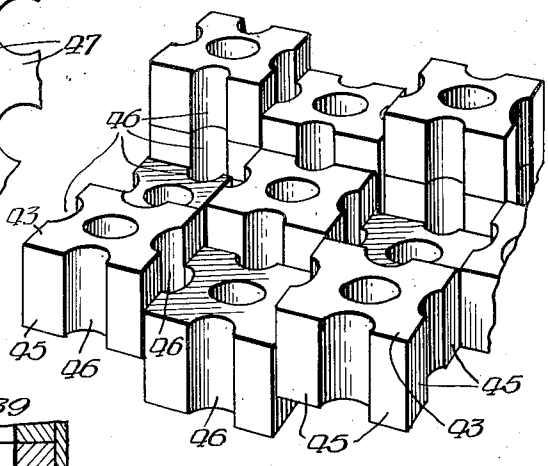


Fig. 8

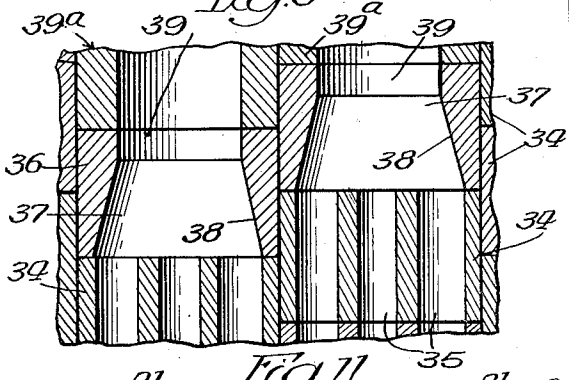


Fig. 9

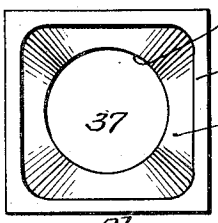


Fig. 11

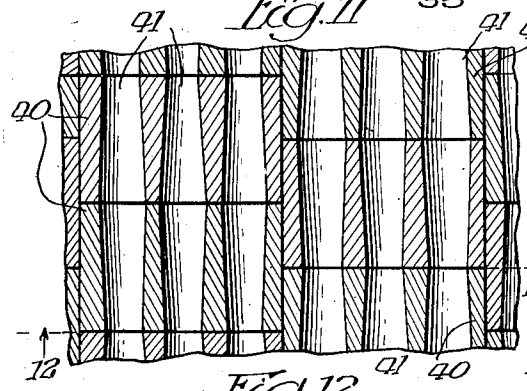


Fig. 13

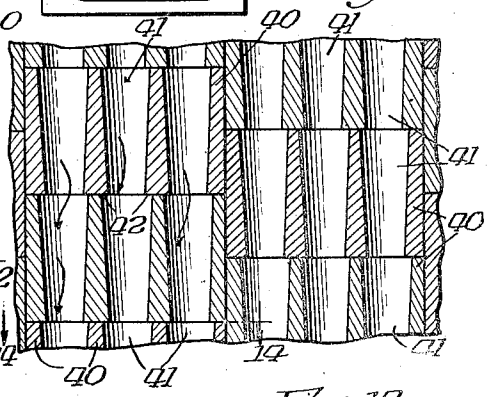


Fig. 12

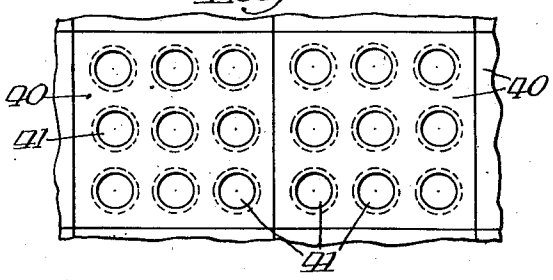
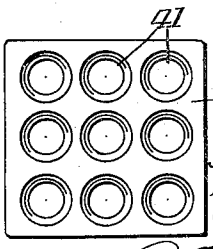


Fig. 14



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UNITED STATES PATENT OFFICE

2,185,559

CHECKERWORK CONSTRUCTION FOR REGENERATORS

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Application March 24, 1938, Serial No. 197,874

7 Claims. (Cl. 263—51)

This invention relates to a new and improved design of checker work construction for regenerators, and more particularly to checker work especially adapted for use in connection with hot blast stoves of the type used with blast furnaces in the production of pig iron, and one of the objects of the invention is to increase the heating surface of a given regenerator or stove.

Hot blast stoves or the like consist of shells which are filled with brick checker work, the function of the brick being to absorb the heat from the products of combustion, of from twenty to forty percent of the top gases from the furnace in the hot blast stoves, and to give up heat to the air to be used in running the furnace.

The efficiency of a hot blast stove, or similar regenerative apparatus, depends primarily upon the efficienecy of the heat transfer. The heat transfer rate per square foot of heating surface depends principally upon the hydraulic diameter of the flue, the mass velocity of the flues, the degree of turbulence of flow of the gases in the flues, the thickness of the brick forming the flues, the temperature differential between the brick and the gases in the flues, the chemical analysis of the gases in the flues, and the cleanliness of the heating surfaces of the flues.

There have been constructed many types of so-called high efficiency hot blast stoves checker work, but as these checker works used large blocks and were of complicated geometric design, the cost amounted to considerably more than the ordinary hot blast stove.

The prior types of checker work have many objections, among them being that the vertical faces of the refractory tile are shaped to form flues with the adjacent brick at the corners. This is objectionable because with a small relative displacement between the tile, the flue openings thus formed will be blocked, also the contacting ends will be sheared off causing greater displacement. In such a form of checker work, no flues are formed in the vertical surfaces or corners of the refractory tile.

Heretofore in the so-called high efficiency hot blast checker work, very little consideration has been given to the design and construction of the metallic supporting structure, and consideration must also be given to the fact that the coefficient of expansion of the metallic members on which the refractory tile rests is very much greater than the refractory tile. Furthermore, the refractory tile at the bottom of the stove is subjected to a load of 500 to 600 pounds per square inch where it rests on the grids, which is considerable when consideration is given to the ever changing temperatures at the bottom of the refractory tile.

In the present invention metallic checker work is employed with the refractory tile and the refractory tile or brick has full bearing on the metallic checker, the latter being interlocked into the grid. The metallic checkers are of unequal height with the result that the refractory tile will be caused to be interlocked between them. Such a construction results in a bearing pressure of less than 100 pounds per square inch, and the absolute interlocking of the metallic supporting structure with the refractory tile.

Heretofore in the so-called high efficiency hot blast checker work, turbulence is obtained by the placing of lugs, staggering inserts, and horizontal flues in the refractory tile. These are costly to provide for in the refractory tile, and result in no increase of the heat transfer rate, because even with so-called fine cleaned gas their surfaces and passages are covered with a fine light powder which has a great thermal resistance, thereby rendering them useless as heat transfer surfaces.

Another objection experienced with such prior structure is that the use of such means to increase turbulence, results in a much greater pressure drop across the stove. The objections and difficulties have been overcome in the present construction as the checker work may be provided with flues within the refractory tile which are of cross-sectional diameter greater at one end than at the other end; with the present invention the refractory tile may be placed so that the flues will form a series of ventura from top to bottom of the superposed series, or may be placed so that the dirty products of combustion or foreign matter will enter the flue at the end of the refractory tile where the flues are of greatest cross-sectional diameter, and leave at the end of the flue which is of a smaller diameter in cross-section, thereby eliminating all edges or ledges which would form obstructions where the dust can settle. This will result in a heat transfer surface much more difficult to foul; at the same time the highest degree of turbulence will be obtained with an absolute minimum of pressure drop.

A further object of the invention is to provide an improved checker brick and construction of this character which will be simple in design and construction and adapted for commercial manufacture and installation.

To the attainment of these ends and the accomplishment of other new and useful objects as will appear, the invention consists in the features of novelty in substantially the construction and in the combination and arrangement of the several parts hereinafter more fully described and claimed, and shown in the accompanying drawings in which latter certain preferred embodiments of the invention are shown.

Figure 1 is a vertical sectional view taken on line 1—1 Figure 2, of a stove or regenerator of

this character constructed in accordance with the principles of this invention.

Figure 2 is a horizontal sectional view taken on line 2—2 Figure 1, with parts omitted.

Figure 3 is a detail perspective view of a portion of the tile supporting grid and a portion of the supporting structure for the grid.

Figure 4 is a detail perspective view of a portion of the metallic tile for supporting the refactory tile, on an enlarged scale.

Figure 5 is a detail sectional view taken on line 5—5 Figure 2, on an enlarged scale.

Figure 6 is a detail perspective view taken on line 6—6 Figure 2, on an enlarged scale.

Figure 7 is a detail top plan view, showing the arrangement of one form of refractory tile.

Figure 8 is a detail sectional view, on an enlarged scale, taken on line 8—8 Figure 2.

Figure 9 is a top plan view of one of the upper refractory tiles shown in section in Figure 8.

Figure 10 is a view similar to Figure 7 of another form of refractory tile.

Figure 11 is a vertical sectional view showing an arrangement of refractory tiles which have a tapering flue opening therethrough.

Figure 12 is an irregular sectional view taken on line 12—12 Figure 11.

Figure 13 is a view similar to Figure 11 showing another arrangement of the tiles shown in section in Figure 11.

Figure 14 is a view taken on line 14—14 Figure 13.

Referring more particularly to the drawings, the numeral 20 designates generally supporting columns arranged in the bottom or the stove with their bases resting upon the bottom 21 of the stove or regenerator 22. These columns may be of any desired or suitable construction and supported thereby are suitable girders or beams 23 which may be secured thereto in any suitable manner and held spaced by suitable spacers 24.

The girders 23 are arranged on edge and resting thereupon is a grid consisting of upright members 25—26 secured together in any suitable manner to form recesses or chambers 27 opening therethrough.

These recesses may be of any desired size and configuration in cross-section, the walls of which are preferably substantially flush at the upper edges thereof and into which recesses portions of metallic blocks 28—29 project.

The metallic blocks 29 are of a greater height than the blocks 28, and the base of each of them is reduced in diameter as at 30 to form a circumferential shoulder or ledge 31 so that when the reduced base portions 30 are inserted into the recesses 27 in the grids the shoulder 31 will engage and rest upon the upper edges of the portions of the grid which form the walls of the recesses 27.

The walls 25—26 are of a width greater than the width of the shoulder 31, so that when the metallic tiles are assembled with respect to the grid, the proximate faces of adjacent tiles will abut, and the adjacent shoulders will rest upon the same wall of the grid.

The metallic blocks 28—29 being of different heights will, when assembled, form pockets 32, as shown more clearly in Figure 4, for a purpose to be described, and the blocks 28—29 will themselves be locked against lateral movement or displacement with respect to the grid by means of the portions thereof which project into the grid.

These metallic tiles are provided with passages or flues 33 therethrough, any number of which may be provided, and may be of any desired or suitable but uniform diameter, and may be of any desired configuration.

The checker brick is constructed of refractory material and in the form of tile 34 shown in Figures 4 and 5 are of rectangular configuration in cross-section and are provided with passages or flues 35 therethrough which are unobstructed and are of uniform diameter throughout their length. When the refractory tile is placed upon the metallic block 28 or 29, the passages or flues in both will register and unobstructed openings will be formed therethrough.

The refractory tiles 34 are preferably all of a uniform height and certain of them will fit into the pockets 32 formed by the blocks 28—29, and will thereby be interlocked therewith; at the same time the refractory tiles in all of the other and superposed layers will themselves form pockets or recesses therebetween as shown more clearly in Figure 1.

When the first layer or course of refractory tiles are thus assembled they will co-operate with each other to form pockets or recesses for the next layer or course of refractory tiles, and so the checker work may be built up to any desired height.

Any number of refractory tiles may be employed according to the height of checkers it is desired to obtain, and when assembled it will be manifest they will all be interlocked and unobstructed flue openings or passages will be provided therethrough. At the same time the metallic tiles will have a supporting surface equal to the brick or refractory area at the base of the refractory tile.

At the top of the refractory checkers or tiles may be arranged additional refractory tiles 36 which are provided with unobstructed flues or openings 37 therethrough which taper from one face towards the opposite face as at 38, the tapering portion preferably terminating a substantial distance from the said opposite face to form an opening 39 which is of a uniform diameter equal to the diameter of the portion of the tapered opening adjacent thereto.

This tapered passage or flue tends to increase the turbulence of the gases flowing through the flues in the checker elements. Any suitable number of additional refractory checkers 39a may, if desired, be arranged above the checkers 36.

Thus it will be seen that unobstructed flues or passages through the checker work will be provided and no shoulders or projections will be presented to the gases flowing therethrough, with the result that heat transfer surfaces will be provided which will be more difficult to foul and at the same time the highest degree of turbulence will be obtained with an absolute minimum of pressure drop across the stove or regenerator.

In the form of the invention shown in Figures 11 and 13, the refractory tiles or checkers 40 are provided with openings or flues 41 therethrough which are unobstructed and decrease in cross-sectional diameter from one face to the opposite face producing a tapered opening. These tiles or checkers may be arranged so that the openings or flues form a double venturi, as shown in Figure 11, or they may be arranged so that the smaller open end in one layer may be disposed adjacent the larger open end of the flue or passage in the next adjacent checker tile, as shown in Figure 13. In this event the shoulder 42 formed at the abutting ends of the tile will not be objectionable as the gases flow through the

checker tiles in the direction indicated by the arrows in Figure 13 and no shoulder or projection will be presented that would tend to collect deposits or become foul, at the same time the turbulence of the gases will be increased.

In Figure 10 there is shown another form of refractory checker or tile 43 having a single opening or flue 44 therethrough of uniform diameter. This tile is provided with plain vertical peripheral surfaces 45 and is angular in cross-section. Grooves 46, preferably semi-circular in cross-section, extend vertically across the peripheral surfaces and are spaced from the corners of the checker tile, with the result that when the checker tiles are assembled, in a manner as already set forth, the proximate faces of adjacent tiles will abut and the semi-circular grooves will be placed in register, thereby forming additional flues or passages between the checker tiles and on the outside thereof.

At the same time these checker tiles will be interlocked with respect to each other.

In Figure 7 there is shown a form of checker tile 47 that is oblong in configuration, the tiles being provided with a pair of openings 48 therethrough, or with a plurality of openings 49 as may be desired.

In this form they are arranged so as to "break joint" thereby interlocking the tiles so that they will also be held against horizontal displacement with respect to each other.

It will be manifest that the metallic supporting tile for the refractory tile or brick will be interlocked with the supporting metallic grids which have substantially the same co-efficient of expansion and that the refractory tile which is supported by the metallic block which has a different co-efficient of expansion will not be injured by the heat, because they will not be locked to the metallic block in such a manner as to cause injury. The metallic blocks will form pockets between themselves for locking the lower layer or course of the refractory tile, while the different layers or courses of the refractory tile will also form recesses or pockets for locking the next adjacent layer or course.

While the preferred forms of the invention have been herein shown and described, it is to be understood that various changes may be made in the details of construction and in the combination and arrangement of the several parts, within the scope of the claims, without departing from the spirit of this invention.

What is claimed as new is:

1. A checkerwork construction embodying vertically spaced checker brick, the lower brick being provided with a greater number of flues or passages therethrough than the upper brick, and a checker tile or brick disposed between the first said brick and provided with a full unobstructed Venturi flue therethrough, extending from one end of the brick to the opposite end, said venturi connecting the flue in the upper brick with the flues in the lower brick, all of said brick having plain vertical faces and all flues therethrough being disposed within the confines of the periphery of the brick.

2. A checkerwork construction embodying a support upon which are placed refractory tiles, said refractory tiles having vertical flue openings therethrough, the tiles being laid in a series of zigzags, the major axes of adjacent tiles in the same zigzag formation being disposed at right angles to each other, and the courses of adjacent zigzag series being disposed in staggered relation.

3. A checkerwork construction embodying a support upon which are placed refractory tiles, said refractory tiles having flue openings therethrough, said tiles being laid in a series of zigzags, the major axes of adjacent tiles in the same zigzag formation being disposed at right angles to each other, and the courses of adjacent zigzag series being disposed in staggered relation, the lower faces of the tiles of one zigzag formation being disposed in different horizontal planes than the lower faces of proximate tiles in adjacent zigzag formation.

4. A checkerwork construction embodying a support upon which are placed refractory tiles, said refractory tiles having vertical flue openings therethrough, the tiles being laid in a series of zigzags, the major axes of adjacent tiles in the same zigzag formation being disposed at right angles to each other and the courses of adjacent zigzag series being disposed in staggered relation, the openings through the refractory tiles continuously decreasing in diameter from one end of the tile to the opposite end.

5. A checkerwork tile the body of which has a dimension in one direction substantially twice the length of the dimension in a transverse direction in the same horizontal plane, there being a plurality of unobstructed flue openings through said body extending from one face to the opposite face thereof, all of the said flue openings being disposed entirely within the confines of the peripheral surface of the tile, and a support upon which the tiles are placed, the tiles being laid in a series of zigzags, the major axes of adjacent tiles in the same zigzag formation being disposed at right angles to each other and the courses of adjacent zigzag series being disposed in staggered relation.

6. A checkerwork tile the body of which has a dimension in one direction substantially twice the length of the dimension in a transverse direction in the same horizontal plane, there being a plurality of unobstructed flue openings through said body extending from one face to the opposite face thereof, all of the said flue openings being disposed entirely within the confines of the peripheral surface of the tile, and a support upon which the tiles are placed, the tiles being laid in a series of zigzags, the major axes of adjacent tiles in the same zigzag formation being disposed at right angles to each other and the courses of adjacent zigzag series being disposed in staggered relation, the openings through the refractory tiles continuously decreasing in diameter from one face of the tile to the opposite face.

7. A checkerwork embodying a support, a metallic supporting block mounted upon and interlocked with said support, and refractory tile mounted upon the metallic blocks, the metallic blocks being shaped and positioned to interlock the refractory tile and the refractory tile being positioned to interlock with each other, said refractory tile being of a greater cross-sectional dimension in one direction than in another direction in the same cross-sectional plane, the refractory tile being laid in a series of zigzags wherein the major axis of each tile in the respective series of zigzags will be at right angles to each other, said tile arranged to break all vertical and horizontal joints.

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