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CHECKERWORK FOR OPEN HEARTH AND BLAST FURNACES

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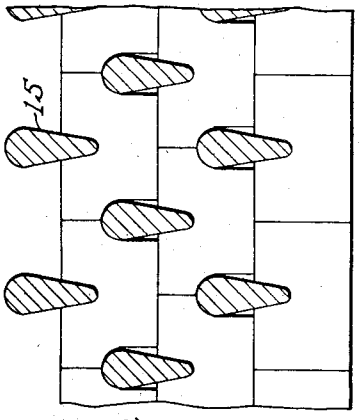


Fig. 4

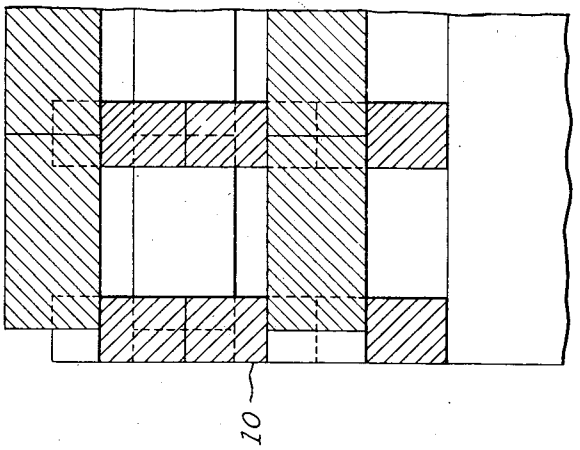


Fig. 3

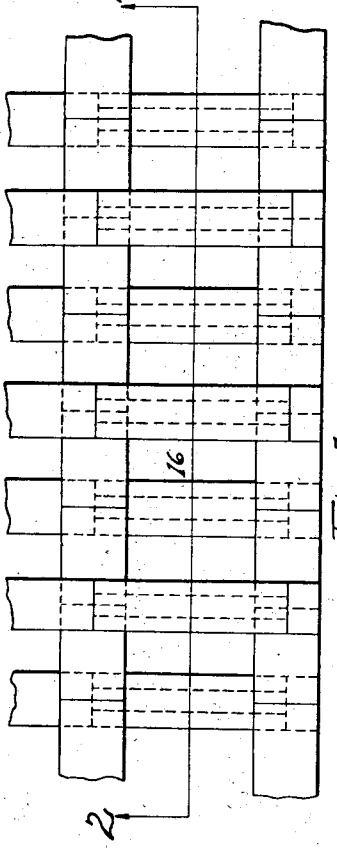


Fig. 1

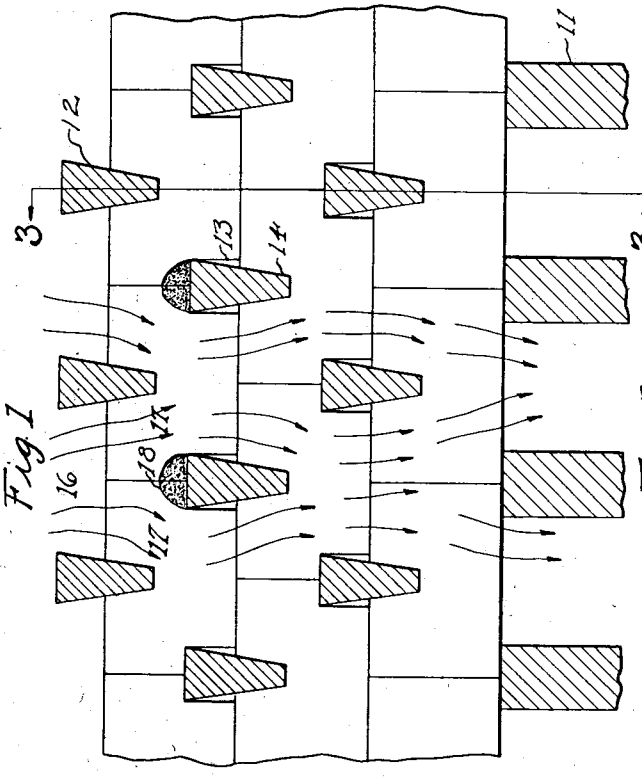


Fig. 2

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UNITED STATES PATENT OFFICE.

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CHECKERWORK FOR OPEN-HEARTH AND BLAST FURNACES.

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My invention relates to regenerative furnaces and blast furnace stoves, wherein it is necessary or important to preheat the air necessary for combustion and provides a construction which entirely eliminates many of the troublesome features inherent in the present constructions.

It is an object of this invention to provide a system of checker work which will increase the capacity of present regenerative chambers by obtaining more regenerative surface and a greater weight of brick for a given size of regenerative chamber.

A further object is to provide a greater weight of checker brick per unit of exposed surface which will increase the heat storage capacity of the regenerator and also give a more uniform temperature to the preheated air.

A further object of my invention is to increase the number of passages per unit of area, thereby giving a design which provides ample passages to allow the waste gases to pass away from the furnace without undue resistance.

A further object of my invention is to provide a construction in which the amount of friction for the passage of the outgoing gases through the regenerators will be greatly decreased and at the same time a construction which will, when functioning as a means for preheating the incoming air, afford sufficient resistance to the passage of the air to cause it to flow through the checkers at the proper velocity to absorb the greatest amount of heat.

A further object of my invention is to provide a checker in which the accumulation of dust and dirt renders inefficient only one-third the surface per checker brick compared to the present construction.

A further object of my invention is to provide a regenerator which will produce a greater campaign by eliminating the possibility of clogging with dirt and dust.

A further object of my invention is to provide a design in regenerators or checkers in which all surfaces of the checker block are directly in the path of the gases to and from the furnace.

A further object of my invention is to provide a regenerator or checker design which is a firm and rigid construction and can not be destroyed by explosions of the intensity common to open hearth practice.

A further object of my invention is to provide a construction which is easily installed, also a construction wherein all passages are uniform, whereas in present constructions much care must be exercised in order to even approximate the passages desired.

In the ordinary operation of a regenerative furnace or a blast furnace stove the amount of heat recovered from the waste gases is dependent upon the efficiency of the regenerators or stove. The campaign of a furnace depends upon the available draft and the checkers or regenerators are responsible for the draft. The principles and purpose of the regenerative furnace and blast furnace stoves are well known in the art and in view of this it should only be necessary to treat the disadvantages of the present regenerator and stove construction.

From an operation standpoint the regenerators, which may be termed the lungs of the furnace, are extremely vital. The operator must depend upon the ability to readily absorb heat from the waste gases and transfer it to the incoming air, all of which must be done with a minimum loss of draft through the passages of the checkers when functioning on the outgoing end. The checker work must be of rigid construction and possess sufficient weight per unit of exposed heating surface in order to properly absorb and store the heat. The checkers must contain a sufficient number of openings to properly clear the furnace of waste gases and also of such a design that they will not be easily clogged by dirt.

In the present type construction of regenerators and checkers, operators have not been able to accomplish the desired results, although they are continually trying different arrangements. The present types of checkers consists of the straight flue common to blast furnace stove practice and the combined horizontal and vertical flue com-

mon to open hearth practice. With such constructions it is impossible to get satisfactory operation when making certain grades of steel from all cold stock it is necessary, after a period of 125 to 150 heats, to remove and replace the checkers at a considerable expense in material and labor and lost furnace time. The vertical straight flue checker construction does not clog as readily as the design in which the vertical and horizontal flues are used, but the vertical flue checker does not give the proper heat transfer, thereby retarding production because of lack of flame temperature which in turn is due to the low temperature of the air used for combustion.

The combined horizontal and vertic l flue checkers are more efficient in heat transfer, but clog up very rapidly and shorten the campaign of the furnaces due entirely to the loss of draft.

It has also been the growing tendency of the steel industry to increase the tonnage or capacity of their furnaces per individual heat, but owing to building limitations they have been unable to enlarge their regenerators with the result that an abnormal percentage of waste heat is passed through the regenerators to the stack.

The undersize regenerators cause frequent reversals and loss of preheating to the incoming air. In the present construction only about 50% of the exposed surface of each brick can be considered efficient heating surface due to the fact that the bricks are superimposed and the waste gases and incoming air are not forced to scrub the surface. In the present construction the air is permitted to pass through the checkers in large columns, the result being that only the perimeter of the column of air absorbs the heat to any high degree. Tests have shown checker brick to have a temperature of 2200 degrees Fahrenheit, while the air passing from the checkers to be as low as 1600 degrees Fahrenheit. With the present design of checkers it is impossible to obtain the proper transfer of heat and under such operation checker brick are rapidly burnt away. With the present checker construction there is sufficient waste heat passing up the stack to develop 600 horsepower, all of which is lost unless large investments are made to equip the furnace with a waste heat boiler.

The above and other features of novelty, advantages and capabilities will become apparent from the detailed description of the accompanying drawings. in which I have illustrated a checker work embodying a preferred and modified form of my invention. but the construction there shown will be understood as illustrative and not as defining the limits of my invention.

Figure 1 is a top plan view of a checker work (with a portion broken away) showing one form of my invention.

Fig. 2 is a vertical sectional view on the line 2—2 of Fig. 1, looking in a direction indicated by the arrows.

Fig. 3 is a transverse vertical sectional view taken on the line 3—3 of Fig. 2, looking in the direction indicated by the arrows, and

Fig. 4 shows my preferred form in which I have illustrated the stream line checker blocks.

Referring to the drawings, in detail, my checker work is designed for use in the checker chamber of a regenerative or blast furnace, which chamber is well understood in the art. As shown in the drawings, the checker work illustrated consists of a plurality of vertical walls 10, spaced apart and supported on rider tiles 11, which tiles are in turn supported on the usual rider walls, not shown.

Referring to walls 10, they consist of a plurality of tiers, one imposed upon the other. These tiers are formed from blocks 12 of suitable refractory material. The blocks 10 are preferably in actual practice 9 inches by 6 inches by 3 inches, but various other sizes can be used with satisfactory results. The contiguous edges of the blocks 10 are staggered with respect to the meeting edges of the next adjacent tier, as best shown in Figs. 2 and 4. These blocks at the contiguous ends are provided in the lower portion with a recess 13, and the block immediately below is provided intermediate its ends with an opposed recess 14. In my preferred form, as shown in Fig. 4, these recesses are arc-like in shape.

Extending from one vertical wall to the other end at right angles thereto, are a plurality of stream line checker blocks 15, the ends of said blocks being supported and securely held in said recesses. These blocks in my preferred form, as shown in Fig. 4, are cone shaped in cross section, with curved or rounded upper and lower longitudinal edges, so as to present a stream line path for the travel of the gas or air in either direction.

Preferably in practice, the uppermost checker blocks 15 are positioned so as to present an opening 16 of thirty-six square inches at the intake, which passage is by the next staggered lower checker block divided into two discharge openings 17. In other words, each series of checker blocks are uniformly staggered with respect to the next lower checker block from top to bottom of the checker work, that is, each checker block in the next lower adjacent tier is in a plane mid-way between the adjacent upper pair of said blocks.

By my stream line checker blocks, the re-

sistance through the checker work for the outgoing gases is reduced to a minimum, while the same arrangement when used for preheating air sets up sufficient resistance to cause the air to scrub the entire exposed surface of each block, thereby obtaining a very high degree of preheating.

The stream line checker block shown in Fig. 4 may be replaced by the standard No. 3 arch brick, shown in Figs. 1 and 2, which approximates the stream line surface. After the arch brick, shown in Figs. 2 and 3, have been in operation a short time, dirt and dust deposits on top of the brick such as shown, for example, at 18 in Fig. 2, and, when in such condition, they will more nearly approach a stream line surface and the efficiency obtained will be almost the same as when in the exact stream line shape. By utilizing the No. 3 standard arch brick in place of the true stream line shape, shown in Fig. 4, the cost is reduced to one-third of the cost of the exact stream line, shown in Fig. 4.

The waste gases come in contact with the entire surface of each brick. Each stream of gas passing through the checker work is divided into two streams at every course of checker block. By so doing the column of waste gas or air is caused to flow over the entire surface of each checker block, thereby absorbing or preheating the maximum. Due to the stream line effect the resistance to the waste gases are very low and with given stack draft this design will permit the furnace to clear the waste gases. In a given space I am able to place 45% more refractory material with 40% more area for absorbing and radiating heat together with 40% more passages for clearing the furnace of waste gases than could be done with the present type. With my checker arrangement, it is only possible to destroy 15 square inches of the heating surface of each brick, whereas the other types of construction dirt may destroy 45 square inches on each brick. With my invention a deposit of dirt on the top of the checker block does not interfere with the draft of the furnace but on the contrary reduces the resistance through the checker due to the fact that it completes the stream line effect of the checker block. It is impossible with my invention for the checkers to become clogged. I am also able to obtain a greater weight of checker brick for a given amount of exposed surface. The blocks of my checker work are thin and will permit the heat to penetrate them the entire thickness of the block, thereby obtaining greater efficiency from a given weight of checker blocks.

In present furnaces where tonnage output per heat has been increased, I am, with my invention, able to increase the regenerator capacity of the furnace, thereby saving a large percentage of the waste heat which is now passing up the stack and transfer this heat to the incoming air which is used for combustion, thereby obtaining a much higher temperature in the incoming air which will greatly improve the combustion and produce a saving of fuel.

It will be further seen, with my invention, the vertical walls and checker blocks are securely held together and in place. From the foregoing, it will appear that my invention possesses to the fullest extent the advantages heretofore set forth, as well as many other inherent features.

Having described my invention, what I claim is:—

1. In a checker chamber for reverberatory furnaces, a plurality of parallel spaced vertical walls reaching across the chamber and extending from the top to the bottom thereof to form a plurality of narrow elongated wells separated one from another, and a plurality of spaced rows of super-imposed fixed heat exchangers rigidly mounted in said walls and extending across said wells, the exchangers in one row being in staggered relation to the next adjacent row forming a plurality of fixed uniform intake and discharge passages throughout said wells and adapted to afford a fixed predetermined minor resistance to the passage of the gas through the wells in one direction and upon reversal of the furnace a fixed predetermined major resistance in the opposite direction.

2. In a checker chamber for reverberatory furnaces, a plurality of solid spaced parallel vertical walls reaching across the chamber and extending from the top to the bottom thereof to form a series of separated elongated wells, a series of fixed non-swinging heat exchangers arranged at right angles to and connecting said walls and extending across said wells and being so designed and positioned with relation to each other and said walls as to provide a plurality of fixed predetermined uniform staggered passages in said wells throughout said chamber.

3. In a checker work of the class described, a plurality of parallel spaced vertical walls formed of a plurality of courses of blocks imposed one upon the other forming narrow elongated wells from top to bottom of the checker chamber, one course of said blocks being provided at their meeting edges with opposed recesses and the adjacent blocks of the next course being provided intermediate their ends with recesses opposed to said first mentioned recesses, and heat exchangers having their ends fixed in said recesses and extending from one wall to another across said wells, the exchangers of

one course being uniformly staggered with respect to those in the next course and having the upper edge of one course positioned in a plane substantially below the lower edge of the next course above.

4. In a checker work of the class described, a plurality of parallel spaced vertical walls formed of a plurality of super-imposed courses of blocks, and a plurality of courses of heat exchangers fixed to and extended from one wall to another, said exchangers being uniformly spaced apart in staggered relation from top to bottom of said chamber and so designed and positioned as to provide a substantially greater exposed area per unit of volume than said walls.

In witness whereof, I hereunto subscribe my name to this specification.

FRED H. LOFTUS.