Aug. 23, 1949. W. J. IRWIN 2,479,933

HEAT REGENERATOR OF THE CHIMNEY TYPE

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FIG. 1

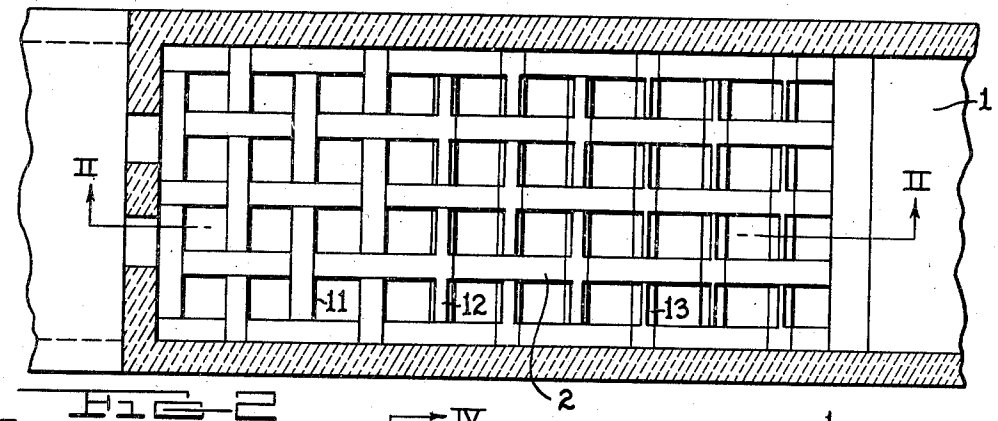
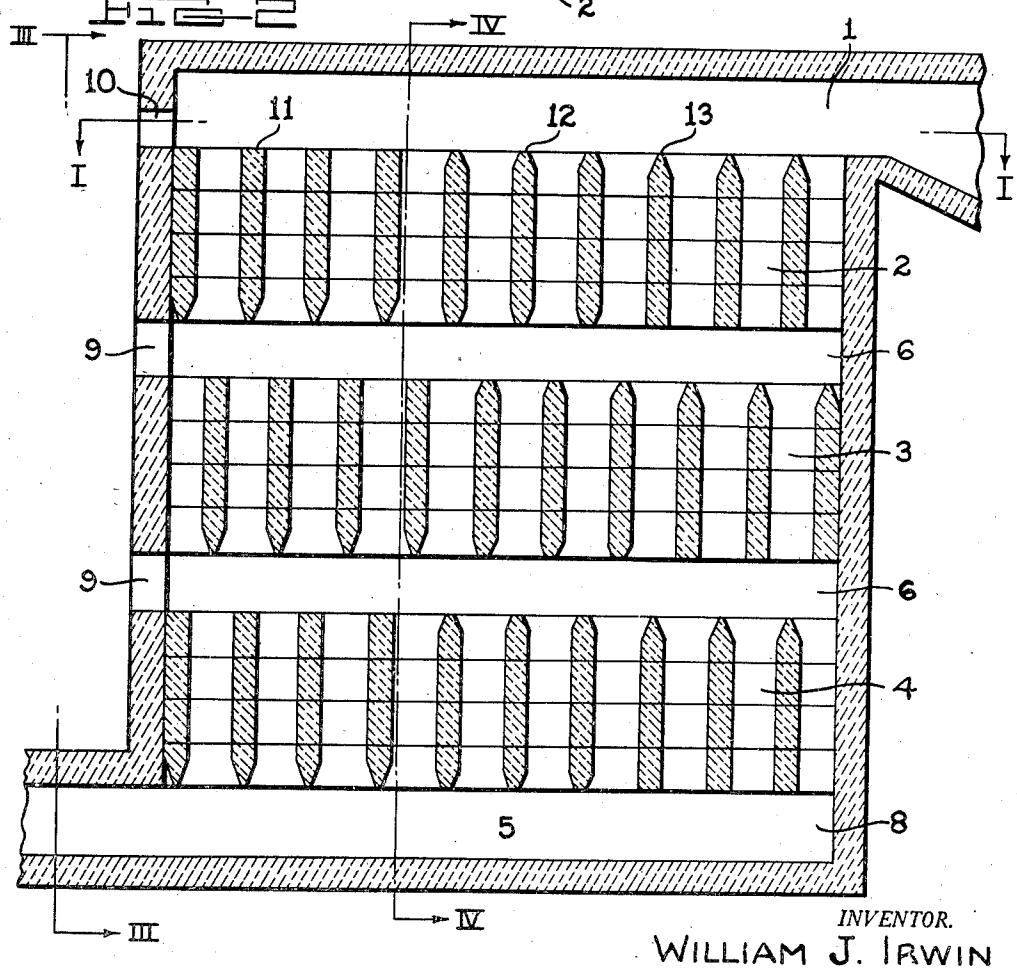


FIG. 2



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FIG. 3

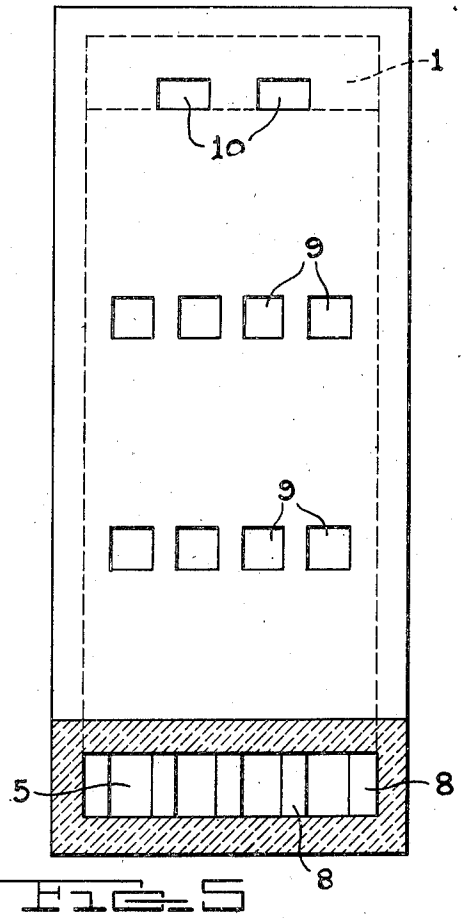


FIG. 4

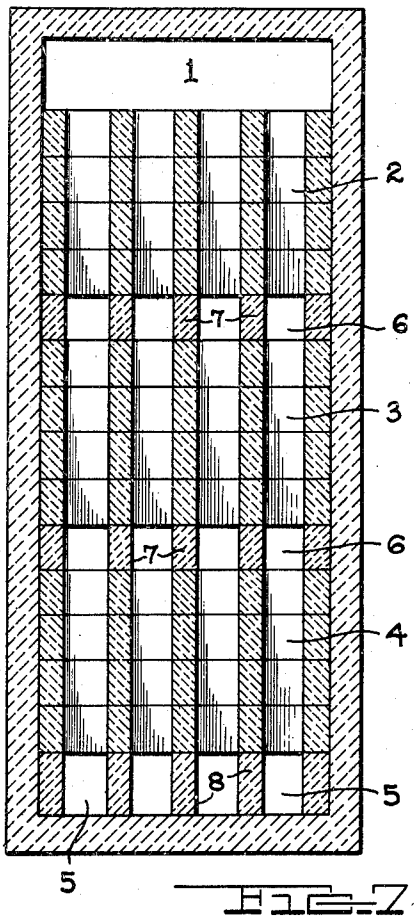


FIG. 5

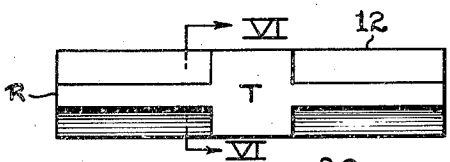


FIG. 8

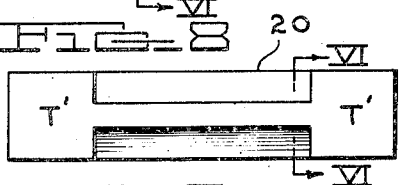


FIG. 6

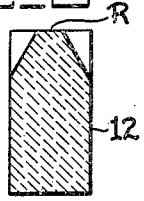
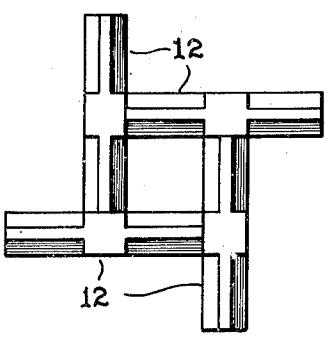


FIG. 7



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HEAT REGENERATOR OF THE CHIMNEY TYPE

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Application August 20, 1946, Serial No. 691,816

11 Claims. (Cl. 263—19)

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This invention relates to a heat regenerator, of the chimney type, particularly adapted for use in connection with a steel-making, regenerative, open-hearth furnace. The object of the invention is to get more heat returned to the furnace and a more uniform hearth temperature resulting in a greater rate of production without increase in rate of fuel supplied. At the same time, it provides a construction permitting the use of a dust blowing tool inside the regenerator.

A specific example of the invention is illustrated by the accompanying drawings in which:

Figure 1 is a horizontal section taken on the line I—I in Figure 2;

Figure 2 is a vertical section taken on the line II—II in Figure 1;

Figure 3 is a view taken on the line III—III in Figure 2 showing the wall of the regenerator chamber at its stack end;

Figure 4 is a full depth cross-section taken on the line IV—IV in Figure 2 looking toward the hearth end of the regenerator;

Figure 5 is a plan view of a special brick;

Figure 6 is a sectional view taken on the line VI—VI of Figures 5 and 8;

Figure 7 is a view showing a modified manner of applying the special bricks to the top of the regenerator;

Figure 8 is a plan view of a modification of the special brick shown in Figures 5 and 6 when the invention is applied to other forms of regenerators.

Figure 1 shows the top view of the chimneys while Figure 2 shows that they are arranged in three vertically separated sections marked 2, 3 and 4. Between these regenerator sections are the separators 7 shown in Figure 4. These separators 7 run lengthwise of the regenerator and are in alignment with the walls between the chimney passages running lengthwise of the regenerator. This arrangement also gives two rows of horizontal passages 6 across the regenerator as shown in Figures 2 and 4. These horizontal passages 6 are connected to corresponding openings 9 in the stack end wall of the regenerator chamber as shown in Figures 2 and 3. Also above the regenerator top are the dust blowing holes 10 in the same stack end wall. As shown in Figures 2 and 3, the entire regenerator is supported by the supporting walls 8 which are in alignment with the chimney passage walls running lengthwise of the regenerator. Between the suporting walls 8 are the underneath passages 5 that connect to the stack and air or fuel inlet

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valves. Above the regenerator is the passage 1 connecting the regenerator with the hearth.

As seen in Figure 2 the cross-sectioned walls of the chimney passages for two adjacent regenerator sections are staggered to each other in the direction running lengthwise of the regenerator.

The cross-sectioned walls of the chimney passages decrease in bluntness on their top ends in the direction of the hearth for all three regenerator sections 2, 3 and 4. This is shown by bricks 11, 12 and 13 in both Figures 1 and 2. On the bottom ends of these walls, the bluntness decreases in the direction of the stack end. In other words the transverse areas of the top of the chimney passages is greatest at the hearth end where the flue gases enter the regenerator and the least at the stack end of the regenerator. The transverse areas of the bottom of the chimney passages is greatest at the stack end where the air or fuel gas enter the regenerator and least at the hearth end. The above is true of all three regenerator sections 2, 3 and 4.

The regenerator is of the basket weave construction as plainly shown in the vicinity of the stack end of the regenerator in Figures 1 and 2 and is mostly made up of common flat bricks 11 also shown in Figures 1 and 2. The special bricks 12 which are used at the top and bottom of each regenerator section are shown in Figures 5 and 6. The brick 12 has a flat central part T on the tapered edge which bears on the tops and bottoms of the separators 7 as well as the tops of supporting walls 8 as shown in Figure 4. The special bricks 13 are the same as bricks 12 except that they are of a longer taper and the dimension R in Figures 5 and 6 is less. The special bricks 12 and 13 are of a form that is adaptable to the basket weave construction when used at the top and bottom of a regenerator section.

If a more flared opening of the chimney passages at the top of the regenerator is required then the laying of the special bricks 12 and 13 would appear in Figure 1 as shown in Figure 7.

In operation the waste gases come from the hearth along the passage 1 above the regenerator, then down through the regenerator to the passages 5 and out to the stack. When the waste gas flow in the furnace is reversed, air comes in through passage 5 and up through the regenerator and out to the hearth through passage 1. When the regenerator is applied to preheating fuel gas the same cycle occurs as in air preheating.

In the ordinary straight chimney type of regenerator, the waste gas velocity carries an excess amount of waste gases to the stack end of the

passage above the regenerator, which causes more downward flow in the stack end of the regenerator than at its hearth end. Similarly the incoming air velocity causes more upward flow at the hearth end of the regenerator than at its stack end.

Looking at Figure 2 it will be seen that the downward flow of the waste gases meet the blunt tops of bricks 11 at the stack end, while this downward flow meets the tapered tops of bricks 13 at the hearth end of the regenerator for all three sections 2, 3 and 4. Since the incoming air or fuel gas flow is in the reverse direction to that of the incoming waste gas flow, the bottoms of the three regenerator sections show blunt wall ends at the hearth end and tapered wall ends at the stack end of the regenerator. The bricks 12 are intermediate in effect between bricks 11 and 13 on the fluid flow. Since bluntness obstructs flow more than tapering, it is plain that the distributions of both the downward and upward flows within the regenerator are much improved.

The tapering of the bricks on top of each regenerator section in the vicinity of the hearth end decreases the deposit of dirt from the waste gases on top of the regenerator sections and in the chimney passages since the falling dirt tends to slide down the sloping surfaces. This condition takes care of the excess fall of dirt at the hearth end of the regenerator.

The horizontal passages 6 should not be deeper than that which allows the regenerator to work properly with a moderate deposit of dirt within them. This condition makes the blunt ends of bricks 11 more effective within the regenerator because of sharper turn losses across passages 6.

Internal dust blowing is done through the holes 9 in the stack end wall and along passages 6 within the regenerator. The dust blowing tool consists of a pipe having a short right angle bend on the end within the regenerator. By using steam or air supplied to the pipe under pressure the blowing may be done up and down the chimney passages as well as on the tops of the wall ends in the passages 6.

The staggering of the chimney passages of two adjacent regenerator sections improves the heat transfer rate by causing turbulence and also by splitting of the flow to obtain a greater temperature difference between the flow and the chimney walls for both waste gases and air.

If the lower row of passages 6 are below the floor line then there will be no corresponding openings 9. The internal dust blowing for regenerator section 4 can be done from the top row of passages 6. To make the blowing fully effective it may be necessary to use only the special bricks 13 on top of regenerator section 4.

Brick 20 shown in Figures 6 and 8 is a modification of brick 12. In this embodiment the bearing surfaces T' and T' replace the single bearing surface T for the purpose of applying the invention to the form of regenerator that is made by placing bricks end to end so as to form rows alternately lengthwise and crosswise of the regenerator and give straight vertical passages. This regenerator can also be divided vertically into sections by horizontal passages between them and the vertical passages staggered as shown in Figure 2.

The invention may be applied to other forms of construction other than the basket weave. The main features are variable flaring on at least one end of the upright passages and also staggering of regenerator sections as shown in Figure 2.

The invention is applicable to regenerator sections that have their vertical gas passages or chimneys either long or short.

In the following claims the word "side" means either top side or bottom side.

I claim:

1. A heat regenerator having a plurality of sections arranged vertically one above the other, each of said sections having substantially vertical gas passages therein arranged in substantially longitudinal rows, the gas passages of a first section being off-set with respect to the gas passages of an adjacent second section so that the walls of the second section split the flow of gas from the first section to the second section, each of the gas passages of the first section being of substantially uniform transverse area for the greatest part of its length, the ends of the last named gas passages adjacent the second section increasing in transverse area from end to end of said longitudinal rows.

2. A heat regenerator according to claim 1 in which the variation in transverse area is provided by flaring the ends of the passages to make them wider in the dimension parallel to the longitudinal rows.

3. A heat regenerator of the chimney type having a plurality of sections arranged vertically one above the other, each of said sections having substantially vertical chimneys therein for the passage of gas, said chimneys being arranged in substantially parallel longitudinal rows, the exits of a first section being off-set from the inlets of an adjacent second section so that the walls between the chimney passages in each of the said rows split the gaseous flow from one to the other of the said two sections, the chimney passages being of substantially uniform transverse area for the greatest part of their length, the ends of the chimney passages at said exits increasing in transverse area and the ends of the chimney passages at said inlets decreasing in transverse area from one end of said longitudinal rows.

4. A heat regenerator according to claim 3 having rows of horizontal longitudinal passages between the two sections, the walls of said horizontal passages being in the same plane as the walls of the longitudinal rows of chimney passages.

5. A heat regenerator according to the claim 4 in which the ends of the chimney passages on the entrance side of the regenerator decrease in transverse area from the gas entry port.

6. A heat regenerator according to claim 5 in which the variation in cross-section of the chimney passages on the said side of the regenerator is provided by special bricks each having a rectangular transverse section extending a distance on each side of the center line thereof, thereby providing a central flat upper surface, a flat portion on each side of the central flat surface extending to the ends of the brick, and a downwardly tapering portion on each side of each flat portion extending for the full length thereof to the adjacent longitudinal side of the brick.

7. A heat regenerator having upright chimney gas passages of substantially uniform transverse area for the greatest part of their length, the ends of the chimney passages on at least one side of the regenerator having different transverse areas, the transverse area of said ends being greatest at the gas entry port and decreasing in the passages further removed from the said gas entry port.

8. A heat regenerator according to claim 7 in

which the variation in transverse area is provided by flaring the ends of the passages.

9. A heat regenerator having upright chimney passages, the intermediate portions of said passages having uniform transverse areas, said passages being arranged in longitudinal rows, gas passages at the top and bottom of said chimney flues, the ends of the chimney passages at the top of said regenerator decreasing in transverse area from the top gas port and the ends of the chimney passages at the bottom of said regenerator decreasing in transverse area from the bottom gas port.

10. A heat regenerator according to claim 9 in which the variation in transverse area is provided by flaring the passages.

11. A heat regenerator according to claim 3 having rows of horizontal longitudinal passages between the two sections, the walls of said horizontal passages being in the same plane as the walls of the longitudinal rows of chimney passages, the ends of the chimney passages on the

entrance side of the regenerator decreasing in transverse area from the gas entry port, the variation in transverse area of the chimney passages on the entrance side of the regenerator being provided by special bricks each having a wedge shaped portion with the narrow part thereof being adjacent the said side of the regenerator.

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