

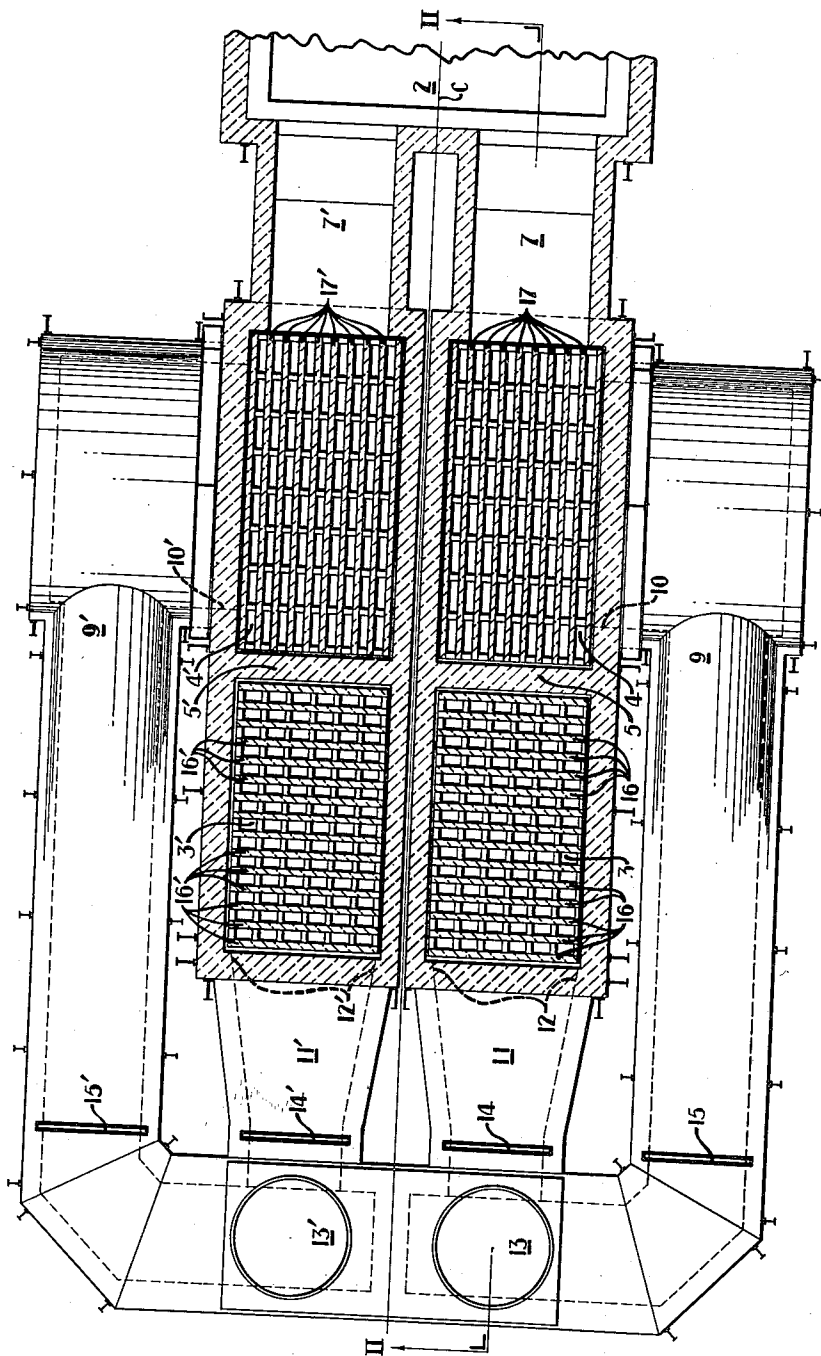
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S. A. FORTER
REGENERATOR STRUCTURE

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Filed Jan. 18, 1954

2 Sheets-Sheet 1



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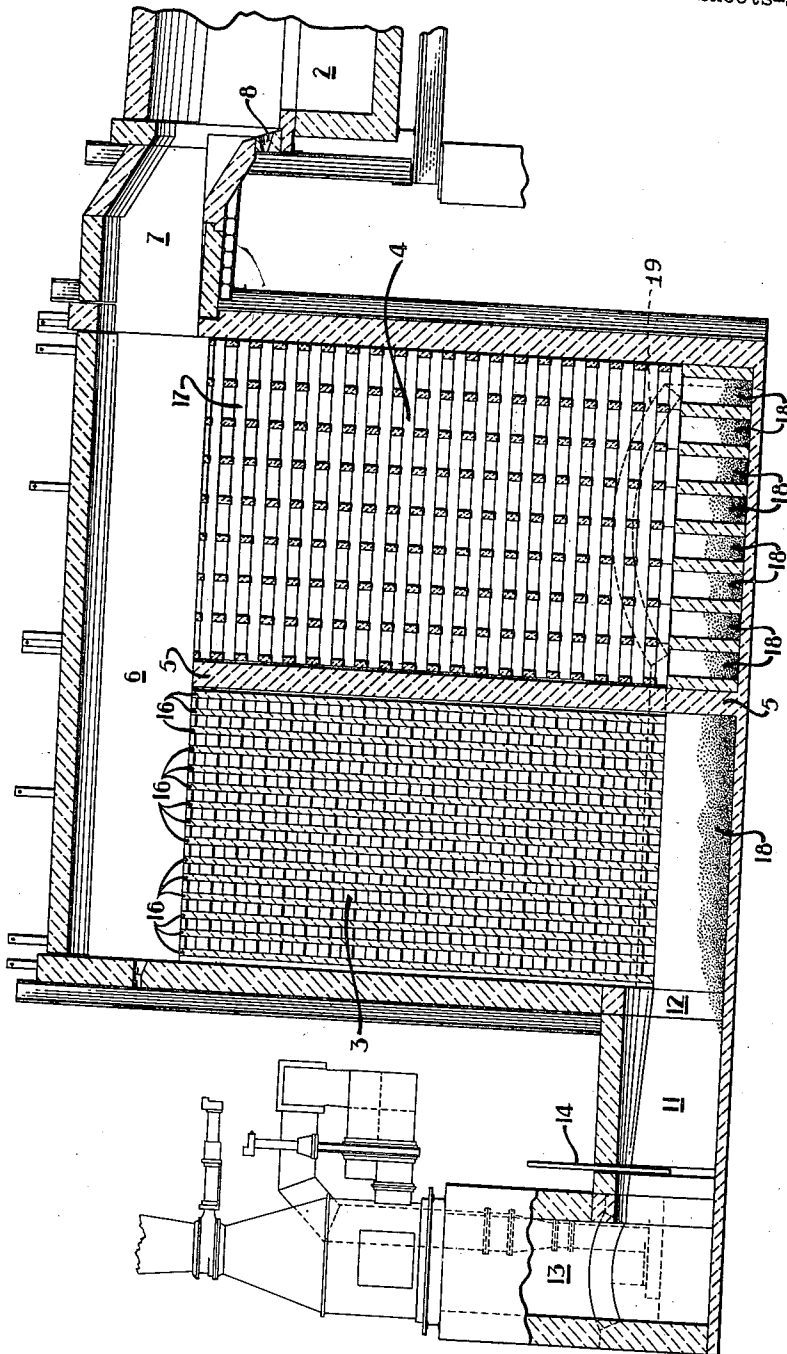
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Fig. 2.



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REGENERATOR STRUCTURE

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9 Claims. (Cl. 263—15)

This invention relates to regenerator structure for use in connection with a furnace and particularly to regenerator structure having advantages in economy and efficiency and which makes possible material increase in the length of the periods of operation between shutdowns of the furnace for cleaning out the regenerator.

One of the greatest difficulties encountered in the operation of regenerators is the piling up of dust particles at particular locations at the bottom of the regenerator causing clogging of the regenerator and necessitating frequent shutting down of the furnace to clean out the regenerator. This is due to the fact that the draft through the regenerator tends to channel the dust-laden gases in the path of least resistance. Such channeling in turn reduces the efficiency of the regenerator as parts of the checkerwork do not participate to the optimum extent in the heat transfer cycle.

I provide regenerator structure overcoming the disadvantages above pointed out. In my regenerator structure the dust-laden gases are caused to pass relatively uniformly through all portions of the checkerwork, greatly increasing the efficiency and economy of the regenerator and enabling a regenerator of relatively small size to replace a conventional regenerator of larger size. Also the dust deposited in my regenerator is deposited more evenly throughout the regenerator so that it collects in a relatively level layer at the bottom of the regenerator resulting in much longer periods of operation between shutdowns for cleaning out the regenerator than heretofore.

My regenerator structure preferably comprises an inlet, a plurality of separate regenerator chambers receiving fluid in parallel from the inlet, an outlet, separate ducts delivering fluid from the respective generator chambers to the outlet and a fluid control device in each duct, whereby the proportion of the fluid entering at the inlet which passes through each of the regenerator chambers may be controlled. There is a passage from each regenerator chamber to the corresponding duct, and I preferably provide generally parallel baffle walls in each regenerator chamber disposed generally normal to the direction of said passage therefrom. I desirably provide fluid control means controlling the proportion of the fluid entering at the inlet which passes through each of the regenerator chambers, such fluid control means normally comprising a fluid control device in each duct as above mentioned.

I further provide regenerator structure comprising an inlet, a plurality of separate regenerator chambers each having an entrance end and an exit end disposed along the inlet and each connected with the inlet to receive fluid therefrom at the entrance end of the chamber, each chamber having therein baffle means forming passages extending from the entrance end of the chamber to the exit end of the chamber, an outlet and separate ducts delivering fluid from the respective exit ends of the regenerator chambers to the outlet. The baffle means preferably comprise generally parallel baffle walls forming passages ex-

tending from the entrance end of the chamber to the exit end of the chamber, the general planes of the baffle walls in one chamber being generally perpendicular to the general planes of the baffle walls in an adjacent chamber.

Each of the passages from the exit end of a regenerator chamber to the corresponding duct is preferably generally normal to the general planes of the baffle walls in the corresponding chamber. The regenerator structure is normally oriented so that the entrance end of each chamber is at the upper portion of the chamber and the exit end of each chamber is at the lower portion of the chamber with the chambers disposed along and beneath the inlet and each connected with the inlet to receive fluid therefrom at the upper entrance end thereof. In a preferred form of structure one of the passages from the lower end of a regenerator chamber to the corresponding duct is generally parallel to the inlet and another of such passages is generally transverse thereof.

The terms "inlet," "outlet," "entrance end," "exit end," etc., have reference to the flow through the regenerator of the hot dust-laden furnace gases whose heat is given up to the checkerwork of the regenerator in the heat storing portion of the cycle of the particular regenerator in question, it being understood that regenerators are normally provided in pairs with one regenerator of a pair operating on the heat storing portion of its cycle while the other regenerator of the pair operates on the heat supplying portion of its cycle and vice versa, the direction of flow of fluid through the regenerators being periodically reversed. When hot dust-laden furnace gases are passing through a regenerator in one direction in the heat storing portion of the cycle of that regenerator to heat up the checkerwork relatively cold fresh air for combustion is passing through the companion regenerator in the opposite direction in the heat supplying portion of the cycle of that regenerator to extract heat from the previously heated checkerwork.

Other details, objects and advantages of the invention will become apparent as the following description of a present preferred embodiment thereof proceeds.

In the accompanying drawings I have shown a present preferred embodiment of the invention in which

Figure 1 is a view partly in plan and partly in horizontal cross section of regenerator structure; and

Figure 2 is a view partly in side elevation and partly in vertical longitudinal cross section on the line II—II of Figure 1.

Referring now more particularly to the drawings, there is shown one end of a furnace chamber 2 which may be of any of a variety of types, the particular furnace shown being a glass melting tank. Heat is supplied to the furnace chamber 2 by burning gas therein. The air for supporting combustion of the gas is preheated in and the products of combustion are discharged through a regenerator structure shown to the left of the furnace chamber in each of Figures 1 and 2. The regenerator structure is symmetrical about the longitudinal center line C (Figure 1) of the furnace and regenerator structure. The direction of flow of the gases is periodically reversed as in any regenerator structure, the outgoing hot products of combustion heating the checkerwork on each side of the center line in the heat storing portion of the cycle at that side of the center line and the heat thus stored in the checkerwork being delivered to the incoming air for supporting combustion of the gas to be burned in the furnace chamber in the heat supplying portion of the cycle at that side of the center line.

Each side of the regenerator structure comprises two separate regenerator chambers separated by a transverse wall. At one side of the regenerator structure two separate regenerator chambers 3 and 4 are separated by a

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transverse wall 5. The chambers 3 and 4 are arranged in alignment longitudinally of the structure and beneath an inlet 6 which is connected through a passage 7 with the furnace chamber. At the other side of the regenerator structure two separate regenerator chambers 3' and 4' are separated by a transverse wall 5'. The chambers 3' and 4' are arranged in alignment longitudinally of the structure and beneath an inlet 6' which is connected through a passage 7' with the furnace chamber. The gas to be burned in the furnace chamber is introduced through burner ports 8 as is conventional. In one part of the cycle the air enters through the previously preheated checkerwork in the chambers 3 and 4, passing upwardly through those chambers 3 and 4 from bottom to top of the chambers into the inlet 6 and thence through the passage 7 into the furnace chamber 2 where it supports combustion of gas introduced through the burner ports 8. The products of combustion pass out through the passage 7' into the inlet 6' and thence downwardly through the chambers 3' and 4' and thence to the outlet.

Connected with the lower end of the chamber 4 is a duct 9. The duct 9 communicates with the chamber 4 through a passage 10 transverse of the structure. The arch 19 (Figure 2) forms the roof of the passage 10. Connected with the lower end of the chamber 3 is a duct 11. The duct 11 communicates with the chamber 3 through a passage 12 longitudinal of the structure. The ducts 9 and 11 are separate, both leading to the outlet 13. A fluid control device such as a damper 14 is provided in the duct 11 and a similar device 15 is provided in the duct 9. The checkerwork in the chamber 3 comprises generally parallel baffle walls 16 which are generally upright extending from top to bottom of the chamber 3 and also extend generally transversely of the chamber and generally perpendicular to the passage 12. The checkerwork in the chamber 4 comprises generally parallel baffle walls 17 which are generally upright extending from top to bottom of the chamber 4 and also extend generally longitudinally of the chamber and generally perpendicular to the passage 10.

The numerals 9 to 17, inclusive, have been applied to the parts at one side of the center line C of the structure, to wit, the lower side viewing Figure 1. Corresponding reference numerals, each with a prime affixed, are applied to the corresponding parts at the opposite side of the center line, to wit, the upper side viewing Figure 1. Each of the outlets 13 and 13' communicates with a stack and provision is made by means which may be conventional and hence not illustrated in detail for reversing the direction of flow of the gases. The dampers 14, 14', 15 and 15' may be regulated to control the proportion of inflowing air and outflowing products of combustion through the respective ducts 11, 11', 9 and 9' so that channeling may be inhibited and the respective chambers efficiently utilized. Moreover, the generally parallel baffle walls 16, 16', 17 and 17' are in each of the chambers arranged perpendicular to the passage connecting the chamber with the corresponding duct leading to the outlet which further inhibits channeling of outflowing products of combustion and results in depositing of a relatively even layer of dust at the bottoms of the chambers as indicated at 18 in Figure 2. This inhibits clogging and enables substantial increase of operating periods between shutdowns for cleaning out the regenerator.

A cycle of operation of the structure will now be described. Incoming air passes from left to right viewing Figure 1 past the dampers 14' and 15', through the respective ducts 11' and 9' and through the respective passages 12' and 10' into the respective chambers 3' and 4' at the bottoms thereof. The air passes upwardly through the chambers 3' and 4' in the generally vertical passages between the baffle walls 16' in the chamber 3' and the generally vertical passages between the baffle walls 17' in the chamber 4' and thence to the inlet 6'

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(the reference numeral 6' does not appear in the drawings because the inlet 6' is not shown, but it is identical and parallel to the inlet 6 shown in Figure 2). In its passage through the chambers 3' and 4' the air absorbs heat from the checkerwork in those chambers. The preheated air passes to the right through the passage 7' into the furnace chamber 2 where it supports combustion of gas introduced into the furnace chamber through burner ports 8. The heat of combustion in the furnace chamber is largely absorbed by the work to be heated such as the glass melt in the tank and the products of combustion pass to the left viewing the drawings through the passage 7 into the inlet 6 and thence downwardly through the chambers 3 and 4 and out through the respective passages 12 and 10 and the respective ducts 11 and 9 and past the respective dampers 14 and 15 to the outlet 13. The fact that in each of the chambers 3 and 4 the baffle walls are generally perpendicular to the passage leading to the outlet duct reduces channeling and causes flow of the products of combustion relatively evenly throughout the chamber. The dampers 14 and 15 may be adjusted so that substantially equal or desired volumes of gas will pass through the respective chambers 3 and 4. Thus I obtain high thermal efficiency and due to the fact that the dust collects relatively evenly at the bottom of the regenerator my structure can operate for longer periods than heretofore between shutdowns for cleaning out the regenerator. When the direction of flow is reversed exactly the same advantages are obtained since the structure is symmetrical on both sides of the center line C.

While I have shown and described a present preferred embodiment of the invention it is to be distinctly understood that the invention is not limited thereto but may be otherwise variously embodied within the scope of the following claims.

I claim:

1. Regenerator structure comprising means defining an inlet, a plurality of separate regenerator chambers receiving fluid in parallel from the inlet, means defining an outlet, separate ducts delivering fluid from the respective regenerator chambers to the outlet, a passage from each regenerator chamber to the corresponding duct, generally parallel substantially continuous baffle walls in each regenerator chamber disposed generally normal to the direction of said passage therefrom and fluid control means controlling the proportion of the fluid entering at the inlet which passes through each of the regenerator chambers.

2. Regenerator structure comprising means defining an inlet, a plurality of separate regenerator chambers, each having an entrance end and an exit end, disposed along the inlet and each connected with the inlet to receive fluid therefrom at the entrance end of the chamber, each chamber having therein substantially continuous baffle means forming passages extending from the entrance end of the chamber to the exit end of the chamber, means defining an outlet and separate ducts delivering fluid from the respective exit ends of the regenerator chambers to the outlet.

3. Regenerator structure comprising means defining an inlet, a plurality of separate regenerator chambers, each having an entrance end and an exit end, disposed along the inlet and each connected with the inlet to receive fluid therefrom at the entrance end of the chamber, each chamber having therein generally parallel substantially continuous baffle walls forming passages extending from the entrance end of the chamber to the exit end of the chamber, the baffle walls in one chamber being generally perpendicular to the baffle walls in an adjacent chamber, means defining an outlet and separate ducts delivering fluid from the respective exit ends of the regenerator chambers to the outlet.

4. Regenerator structure comprising means defining an inlet, a plurality of separate regenerator chambers, each having an entrance end and an exit end, disposed along

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the inlet and each connected with the inlet to receive fluid therefrom at the entrance end of the chamber, each chamber having therein generally parallel substantially continuous baffle walls forming passages extending from the entrance end of the chamber to the exit end of the chamber, the baffle walls in one chamber being generally perpendicular to the baffle walls in an adjacent chamber, means defining an outlet, separate ducts delivering fluid from the respective exit ends of the regenerator chambers to the outlet and a passage from the exit end of each regenerator chamber to the corresponding duct, each of the last mentioned passages extending generally normal to the baffle walls in the corresponding chamber.

5. Regenerator structure comprising means defining an inlet, a plurality of separate regenerator chambers, each having an upper entrance end and a lower exit end, disposed along and beneath the inlet and each connected with the inlet to receive fluid therefrom at the upper entrance end of the chamber, each chamber having therein generally upright substantially continuous baffle walls forming passages extending from the upper entrance end of the chamber to the lower exit end of the chamber, means defining an outlet and separate ducts delivering fluid from the respective lower exit ends of the regenerator chambers to the outlet.

6. Regenerator structure comprising means defining an inlet, a plurality of separate regenerator chambers, each having an upper entrance end and a lower exit end, disposed along and beneath the inlet and each connected with the inlet to receive fluid therefrom at the upper entrance end of the chamber, each chamber having therein generally upright substantially continuous baffle walls forming passages extending from the upper entrance end of the chamber to the lower exit end of the chamber, means defining an outlet, separate ducts delivering fluid from the respective lower exit ends of the regenerator chambers to the outlet and a passage from the lower exit end of each regenerator chamber to the corresponding duct, one of the last mentioned passages being generally parallel to the inlet and another of such passages being generally transverse thereof.

7. Regenerator structure comprising means defining an inlet, a plurality of separate regenerator chambers, each having an upper entrance end and a lower exit end, disposed along and beneath the inlet and each connected with the inlet to receive fluid therefrom at the upper entrance end of the chamber, each chamber having therein generally upright substantially continuous baffle walls forming passages extending from the upper entrance end of the chamber to the lower exit end of the chamber, means defining an outlet, separate ducts delivering fluid from the respective lower exit ends of the regenerator chambers to the outlet, a passage from the lower exit end

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of each regenerator chamber to the corresponding duct and fluid control means in the last mentioned passages controlling the proportion of the fluid entering at the inlet which passes through each of the regenerator chambers.

8. Regenerator structure comprising means defining an inlet, a plurality of separate regenerator chambers, each having an upper entrance end and a lower exit end, disposed along and beneath the inlet and each connected with the inlet to receive fluid therefrom at the upper entrance end of the chamber, each chamber having therein generally parallel generally upright substantially continuous baffle walls forming passages extending from the upper entrance end of the chamber to the lower exit end of the chamber, the baffle walls in one chamber being generally perpendicular to the baffle walls in an adjacent chamber, means defining an outlet, separate ducts delivering fluid from the respective lower exit ends of the regenerator chambers to the outlet and a passage from the lower exit end of each regenerator chamber to the corresponding duct, each of the last mentioned passages extending generally normal to the baffle walls in the corresponding chamber.

9. Regenerator structure comprising means defining an inlet, a plurality of separate regenerator chambers, each having an upper entrance end and a lower exit end, disposed along and beneath the inlet and each connected with the inlet to receive fluid therefrom at the upper entrance end of the chamber, each chamber having therein generally parallel generally upright substantially continuous baffle walls forming passages extending from the upper entrance end of the chamber to the lower exit end of the chamber, the baffle walls in one chamber being generally perpendicular to the baffle walls in an adjacent chamber, means defining an outlet, separate ducts delivering fluid from the respective lower exit ends of the regenerator chambers to the outlet, a passage from the lower exit end of each regenerator chamber to the corresponding duct, each of the last mentioned passages extending generally normal to the baffle walls in the corresponding chamber, and a fluid control device in each of the last mentioned passages, whereby the proportion of the fluid entering at the inlet which passes through each of the regenerator chambers may be controlled.

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