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ROTARY REGENERATIVE HEAT EXCHANGERS

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Fig.1

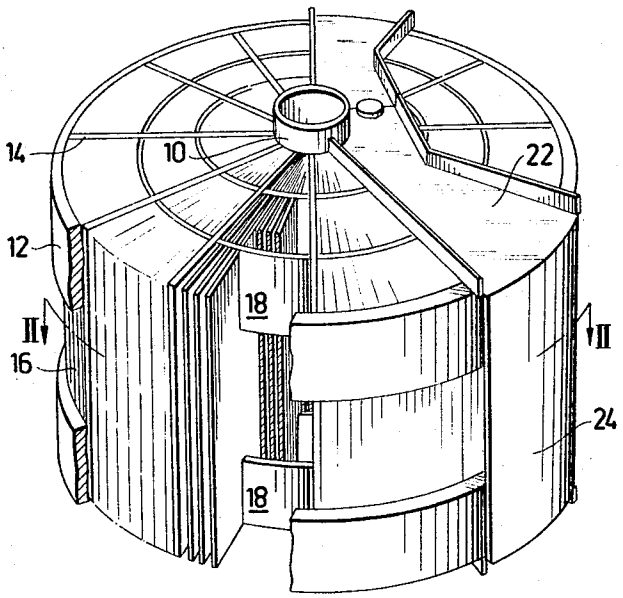
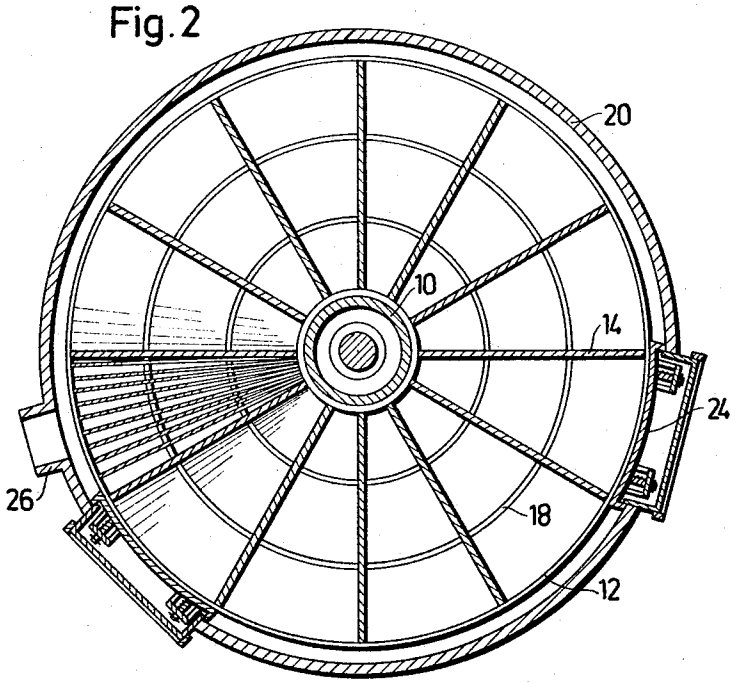


Fig.2



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ROTARY REGENERATIVE HEAT EXCHANGERS

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1 Claim. (Cl. 165—4)

This invention relates to rotary regenerative heat exchangers, viz. to such heat exchangers in which the regenerator body rotates and the ducts are stationary or in which the regenerator body is stationary and the ducts rotate. Such heat exchangers are used particularly after furnaces for heating the combustion air by means of the hot flue gases.

This utilization of the flue gas heat is of vital importance to the economy of the total plant and must be accomplished at so low costs as possible, small space requirements and at a high efficiency. The heat of the hot flue gases discharged from the furnace is usually utilized in feed water heaters and air preheaters.

The technical development in the boiler field, the change from grate furnaces to pulverized fuel, the introduction of slack tap furnaces and the further evolution of the oil heating plants as well as the demand of high feed water temperature are based on high air temperatures. On the other hand there is also a requirement that the heat contents of the fluid gases shall be utilized as far as possible which means that the flue gas temperature shall be so low as possible.

However, the possibilities to use regenerative air preheaters for attaining high air temperatures are limited because the heat quantity which can be absorbed by the air is not sufficient to cool the flue gases from their high initial temperature necessary for reaching the desired high air temperature down to such a low final temperature which must be obtained from the point of view of economy.

In order to meet the two conflicting requirements, that is the high air temperature and as low a flue gas temperature as possible, it has already for some time past become customary to heat the air in two steps by means of a rotary regenerative heat exchanger the regenerator body of which is divided into two heating stages spaced from each other as seen in the direction of flow. Hereby a feed water heater can be connected in parallel with the first stage at the flue gas side. The space between the regenerator body stages which can be called the intermediate stage and through which the radial walls of the sector shaped body compartments pass, constitutes the region within which a partial flow discharged from the feed water heater is again mixed with the other partial flow which has passed the first regenerator body stage lying in parallel with the feed water heater. On the other hand, it is also possible to withdraw a flue gas of a mean temperature from this intermediate stage. It is also known to withdraw air from this intermediate stage which air has already been preheated to a mean temperature lying between the inlet and outlet temperatures. Inversely it is also known to introduce air of mean temperature in this intermediate stage and to further heat this air to the high final temperature together with the main air flow already preheated.

Such heat exchangers in which the two regenerator body stages are located at a distance from each other and are separated by the intermediate stage, are impaired by a drawback consisting in that the space of this intermediate stage is not utilized for the heat exchange. This unutilized space is still larger in heat exchangers having a plurality of heating stages and a corresponding number of intermediate stages. Such an increase of the

need of space caused by one or more intermediate stages does not only affect the height of the heat exchanger but also the height of the total boiler plant and the building therefor.

The invention has for its object to obviate this drawback and relates to a rotary regenerative heat exchanger having conduits for the introduction and withdrawal of partial flows of the heat exchanging media connected between the inlet end and the outlet end. These conduits are called "partial flow conduits." The essential feature by which the heat exchanger according to the invention differs from the known heat exchangers of this type consist in that at least in that region of the body which is located in front of the partial flow conduit connections the heat exchanging mass is such that it permits axial as well as radial flue.

Heat exchanging masses of the last mentioned kind need only be provided in that region between the inlet end and the outlet end which is intended for the connection of the conduits for the introduction or withdrawal of media. If the regenerator body as a whole is filled with such heat exchanging masses which permit axial as well as radial flow there are no restriction as regards the location of the conduits. On the contrary, it is possible to connect these conduits at any desired point, that is at any desired temperature level.

In the accompanying drawing there is shown an embodiment of the invention.

FIG. 1 is a perspective view of a regenerator body according to the invention and

FIG. 2 is a cross-section of a regenerator body taken along line II—II in FIG. 1. and further illustrating the casing surrounding the body.

The regenerator body shown is of the type which comprises a central hub **10** and a cylindrical shell **12** interconnected by radial partitions **14**. These partitions **14** divide the regenerator body into a plurality of sector-shaped compartments which are filled with a heat exchanging mass. The shell **12** is split so that there is formed an annular opening **16** along a middle zone of the regenerator body.

In the embodiment shown the regenerator body is filled with a heat exchanging mass of one and the same type over its whole height. The mass consists of plates which are arranged radially in the sector-shaped compartments such as to provide between them channels for the flows of heat exchanging media permitting axial flow from one end to the other of the regenerator body. Above and below the opening **16** the sector-shaped compartments are subdivided by transverse walls **18** while the space radially inside the opening **16** is not so subdivided.

When used in an air preheater the regenerator body is rotatably mounted in a stationary casing **20** which in known manner includes sector plates **22** and ducts (not shown) for supplying and carrying off flue gases and air passing axially through the regenerator body from one end to the other thereof. The sector plates **22** at opposite ends of the regenerator body are interconnected by axial sealing means **24**. As shown in FIG. 2 the casing **20** is provided with a conduit connection **26** at the flue gas side of the air preheater. This connection **26** is located radially outside the opening **16** and can be used for supplying or withdrawing partial flows of flue gas. Although not shown a similar conduit connection can be provided at the air side permitting supplying or withdrawing a partial flow of air.

As pointed out above, the regions of the regenerator body above and below the opening **16** need not be filled with a regenerative mass which permits also radial flow.

In the regenerator body according to the invention the partitions **14** between the sector-shaped compartments

pass uninterrupted from one end to the other and prevent peripheral flow in the same manner as in known multistage heat exchangers while the transverse walls **18** subdividing the sector-shaped compartments are left out in the intermediate zone. As regards the heat exchanging masses there are several types available. Preferably such plates are used which are approved in practice and are arranged radially such that there are sufficiently large flow areas between them in axial as well as in radial direction of the regenerator body. Thus, for instance, corrugated plates can be assembled such that the corrugations of adjacent plates cross each other. It is also possible to use plates which are provided with stamped or punched projections, nibs, tabs or the like spread over the surface. On the other hand there are other suitable surface-shaped heat exchanging elements which may be used instead of the usual plates and permit flow through their surfaces, for instance perforated plates, expanded metal or wire-netting. Heat exchanging elements of this type can be arranged tangentially in the regenerator body. In order to hold the elements spaced from each other they may be provided with profiled portions. Finally it can be mentioned that also rods can be used as heat exchanging elements which rods can be arranged in layers with the rods in one layer crossing the rods in adjacent layers.

The heat exchanger according to the invention permits affecting of the temperature as well as the quantity of the working media within very wide limits as flue gases or air can be withdrawn or supplied as required. For instance, air of relatively low temperature can be drawn off for a section of the furnace while obviating such drawbacks which are associated with hitherto usual constructions. Above all it is important that the space which in known multistage heat exchangers is formed by the intermediate stages and is free from heat exchanging masses, is now utilized for the heat exchange. This results in a corresponding reduction of the total height of the heat exchanger.

If imperforate plates are inserted as heat exchanging elements in those zones at which a partial flow is supplied or withdrawn transversely there is obtained a further advantage consisting in that the expensive means for trapped air recirculation (German Patent 1,042,168) used in multistage air preheaters can be dispensed with. In lieu of such means it is possible to use simpler recirculation means known from single stage embodiments.

By appropriate selection and arrangement of the heat

exchanging masses within the combined axial and radial flow region and particularly by selecting a different pitch it is possible to promote the mixing of the partial flows.

A further advantage offered by the heat exchanger according to the invention over against the known multistage heat exchangers consists in that in the first mentioned exchanger there are no abrupt temperature changes in the radial partitions within the region of the media supply and withdrawal zone. Such an abrupt temperature change is a disadvantage in known multistage heat exchangers because it leads to rupture of the radial partitions. In the embodiment according to the invention the temperature drop in the radial partitions results in a uniform deformation.

By a reduction of the height of the air preheater by about 14–15% as compared with a corresponding multistage embodiment of known type it is possible to obtain a cost reduction of about 6% of the total costs of the heat exchanger. The reduction of the height of the heat exchanger also leads to further savings with respect to the total plant and to the boiler building.

What is claimed is:

A regenerator body for a rotary regenerative heat exchanger of the type which comprises a casing, a substantially cylindrical regenerator body in said casing, ducts for supplying heat exchanging media axially to said regenerator body and for carrying off said media axially from said body and at least one conduit connection located radially outside said regenerator body and communicating with the interior of said body at a level between the ends thereof, said ducts and said regenerator body being rotatable relatively to each other, said regenerator body being filled with a heat exchanging mass permitting axial flow from one end to the other of said regenerator body and at least within a region between said ends also permitting radial flow, means being provided to prevent peripheral flow within said regenerator body.

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