HEAT EXCHANGE SURFACE FOR AIR PREHEATERS

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HEAT EXCHANGE SURFACE FOR AIR PREHEATERS

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1. The present invention relates to heat exchange apparatus and particularly to improvements in air preheaters of the rotary regenerative type.

In rotary regenerative air preheaters where a mass of heat transfer material in the form of metallic plates is carried first into the gas passage to absorb heat and then into the air passage to impart heat to the gas passing therethrough, deposits form on the plate surfaces at the "cold end" of the rotor. In time these deposits partially clog the passages and restrict the loads that can be carried on boilers to which the air preheaters are connected due to increased draft and pressure drops. Consequently, it has been the practice to blow off the deposit by air or steam or wash it off with water. In doing this the remaining portion of the plate surfaces below that on which the deposits form become contaminated with deposit removed from the cold end. If it were possible to remove only the surface at the cold end of the rotor and replace the same with clean surface, the deposits from the dirty surface would not be transferred in part to clean surfaces below by the cleaning devices; in fact it would not be necessary to equip the air preheater with cleaning nozzles. It has been proposed herefore to provide several layers of plates in the preheaters so that the upper layer at the cold end where the deposits form could be removed for cleaning or replacement of corroded plates without involving the wastage that would be incurred if the plates extended the full height of the rotor. These proposals, however, have not proved entirely practical because of the length of time required for removing, cleaning and replacing the plates was often greater than the time ordinarily available for such purposes without shutting a boiler down except for a weekend, and the cost of performing this work proved to be unjustified.

The present invention contemplates an arrangement of the heat transfer plates at the cold end of a rotor in such a way that they may readily be removed for cleaning or to be replaced by new elements.

In the drawings:

Figure 1 is an elevational view, partly in section, of a rotary air preheater embodying the present invention;

Figure 2 is a partial plan view of the rotor of the air preheater shown in Figure 1;

Figure 3 is a fragmentary sectional view on the line 2—2 in Figure 2;

Figure 4 is a perspective view illustrating a container for holding a number of plates constituting part of the heat transfer surface; and

Figure 5 is a partial plan view similar to Fig. 2 but showing a rotor of larger diameter.

As illustrated in the drawing, the air preheater is of the familiar Ljungstrom type as illustrated in Patent No. 1,652,025, issued December 6, 1927, comprising a housing 10 enclosing a rotor 11 containing heat transfer material brought first into contact with gases entering through the duct 12 for absorbing heat therefrom and then into contact with air entering through duct 13 to preheat it, the rotor being turned as by a motor (not shown) connected to rotor post 14. The rotor 11 comprises a cylindrical shell 16 connected by radial partitions or diaphragms 15 to the rotor post 14 and serving to subdivide the rotor into a plurality of wedge or sector-shaped compartments 17. Sector plates 18 at the ends of the casing 10 opposite the rotor 11 are formed with alined openings as at 20 for passing heating gases and air through the rotor. The radial partitions 16 carry sealing members 21 which bear against the sector plates 18 and act to prevent the cross flow of gas into the air side of the preheater and of air to the gas side of the preheater. This is because the imperforate portions 22 of each sector plate 16 that separate the gas inlet opening from the air openings are of greater circumferential extent than the angle subtended by a sector-shaped compartment 17 of the rotor. The flow of gas and air between the sides of the rotor and the housing 10 is prevented by the circumferential seals 23 carried on the edge or rim of the rotor shell 18.

In accordance with the present invention the usual circumferential diaphragms 24 extend only part-way through the height of the rotor from the hot or bottom end thereof as appears in Fig. 1. The heat transfer plates 25 at the part of the rotor above the circumferential diaphragms 24 are mounted in a plurality of removable baskets 26. As shown in Figure 2, there are a number of radially and circumferentially extending rows of baskets 26 and the baskets in each circumferential row are of the same length measured radially and their aggregate circumferential width is sufficient to substantially fill the space between the adjacent radial partitions 16 without becoming wedged. Each of the circumferential rows contains a plurality of basket-like containers aggregating at least three in number although immediately adjacent the rotor post there may be a single basket, as appears in Fig. 2. Thus substantially the entire space in each sector-shaped compartment 17 is filled with the baskets 26 which have only so much clearance between
them as will permit the center basket in the outermost row to be moved radially inward to clear the circumferential seal 23 without becoming jammed against the adjacent baskets at either side thereof. The radial seams 21 and the circumferential seals 23 overlap or overhang those baskets 26 that are positioned adjacent the marginal edges or perimeter of the compartment 17. However, upon removal of the center basket 26B in the second, or 26C in the third circumferential row from the rotor post 14 the other baskets may be removed because either of these may be lifted out of the rotor without obstruction by or variety 21, 23 or other parts of the rotor. Upon removal of such a centrally located or key basket those at either side thereof in the same circumferential row may be shifted circumferentially into positions where they also clear the overhanging radial seams 21 and they may in turn be lifted out of the rotor. Thereafter, the baskets 26D in the outer circumferential row may be moved radially inward so that they clear the circumferential seal 23 whereupon they may be freely lifted out of the rotor.

Baskets in which the heat transfer plates are mounted are preferably constructed as shown in Figure 4. They consist of a strip 30 of sheet metal bent to trapezoidal form with its ends joined at 31. Across the bottom of the cage thus formed several supporting bars 32 extend between the ends 30 of the basket and constitute supports for the heat transfer plates 25 without substantially obstructing the free area for the flow of gas and air through the rotor. Near the top of the basket is a retaining bar 34 bearing against the upper edges of the plates 25. Bar 34 is pivoted at one end to a bracket 35, and at its opposite end it is formed with an aperture 36 alignable with a similar aperture with a lug 37 projecting from the opposite end plate 33 so that a cotter pin may be inserted to hold the retaining bar in place.

In addition to providing for ready removal of the heat transfer surface at the cold end of the rotor for cleaning, the present invention permits a certain amount of standardization in the construction of preheater rotors. In various sizes of air preheater rotors the basket or baskets 26A to be mounted adjacent the rotor post would not be of the same radial extent and circumferential width. For one size of air preheater a number of baskets 26B would form a single circumferential row outwardly of the standard basket 26A. Thereafter for rotors of increasing diameter another row of baskets 26C all of like size would be added. They might also be of the same radial dimensions as the baskets 26A and B so that the sizes of plates 25 could be standardized. In cases in which the required size of a rotor as to diameter was not such as to permit division into a multiple of the radial measurement of the baskets 26, one or more circumferential rows of baskets of standard sizes would be provided and the space between the outermost circumferential row and the rotor shell would then be occupied by baskets 26E especially formed to fill in the remaining space as shown in Fig. 5. Thus each larger rotor contains the equivalent of all the baskets in the next smaller size and an additional row or rows of standard sized baskets and perhaps a row of specially designed baskets of smaller or larger than standard size.

To effect this standardization the rotor posts 14 for the center of preheaters are of the same diameter. By making the angle between adjacent partitions 16 forming the compartments 17 the same regardless of rotor diameter it becomes possible to utilize bundles of elements 26A adjacent the rotor post which are alike in all preheaters. As the diameters of rotors increase each rotor size includes bundles 26B of the same radial dimensions immediately adjacent the innermost bundles 26A and additional bundles 26C beyond which likewise are of equal radial extent as the preheater diameter increases by increments.

We claim:

1. In a rotor having partitions radiating from a rotor post, to a cylindrical shell for forming a plurality of sector shaped compartments, and radial and circumferential sealing members mounted on the edges of said partitions and of said shell in overhanging relation to the area of said compartments along the radial and circumferential portions of the perimeter thereof; a plurality of generally trapezoidal bundles of heat exchange elements disposed in alignment in each compartment to form radially and circumferentially extending rows and having aggregate radial and circumferential dimensions approximating the corresponding interior dimensions of a compartment so that said seals overhang the bundles positioned adjacent the perimeter of said compartment and obstruct removal thereof, there being at least three bundles radially and in at least one circumferential row, whereby on removal of a central bundle in said one circumferential row all other bundles in said compartment may be shifted radially and/or circumferentially into a position away from the walls of said compartment and out of overhanging relation with said sealing members so as to permit removal of said containers from said compartment by movement in one direction axially of said rotor; and means engaging said element bundles to prevent movement thereof in the opposite axial direction.

2. In a rotor having a rotor post, a cylindrical shell interiorly divided into a plurality of sector-shaped compartments by partitions radiating from the rotor post to said shell, and radial and circumferential sealing members mounted on the edges of said partitions and of said shell and overhanging the area of said compartments along the radial and circumferential portions of the perimeter thereof; a plurality of bundles of heat exchange elements disposed in immediately contiguous relation to form radially extending rows in each compartment and having aggregate radial and circumferential dimensions approximating the corresponding interior dimensions of a compartment so that said seals overhang the bundles positioned adjacent the perimeter of said compartments and obstruct removal thereof, there being at least three radial rows and at least three bundles in at least the central one of said rows, whereby on removal of the middle bundle in said central row all other bundles in said compartment may be moved radially and/or circumferentially into a position away from the walls of said compartment and out of overhanging relation with said sealing members so as to permit removal of said bundles from said compartments by movement in one direction axially of said rotor; and means engaging said element bundles to prevent movement thereof in the opposite axial direction.

3. In a rotor having a rotor post with partitions radiating therefrom to a cylindrical shell for forming a plurality of sector shaped compartments; and radial and circumferential sealing
members mounted on the edges of said partitions and of said shell in overhanging relation to the area of said compartments along the radial and circumferential portions of the perimeter thereof; heat exchange elements mounted in a plurality of containers disposed in alignment in each compartment to form radially and circumferentially extending rows and having aggregate radial and circumferential dimensions approximating the corresponding interior dimensions of a compartment but being capable of movement in said compartment upon removal of a centrally disposed bundle, there being at least three containers radially and an odd number of containers aggregating at least three in at least two adjacent circumferential rows, whereby on removal of the central container in the central one of said circumferential rows all other containers in said compartment may be shifted radially and/or circumferentially into a position away from the walls of said compartment and out of overhung relation with said sealing members so as to permit removal of said containers from said compartments by movement of said containers from said compartments by movement in one direction axially of said rotor; and means engaging said element bundles to prevent movement thereof in the opposite axial direction.

4. In a rotor having a rotor post with partitions radiating therefrom to a cylindrical shell so as to form a plurality of sector-shaped compartments and radial and circumferential sealing members mounted on the edges of said partitions and of said shell in overhanging relation to the area of said compartments along the radial and circumferential portions of the perimeter thereof; a plurality of bundles of heat exchange elements disposed in each compartment having aggregate radial and circumferential dimensions approximating the corresponding interior dimensions of a compartment so that said seals overhang the bundles positioned adjacent the perimeter of said compartments and obstruct removal thereof in a direction axially of said rotor, there being at least one centrally located key bundle not overlapped by said seals whereby on its removal all other containers in said compartment may be shifted radially and/or circumferentially into a position away from the walls of said compartment and out of overhung relation with said sealing members so as to permit removal of said containers from said compartments by movement in one direction axially of said rotor; and means engaging said element bundles to prevent movement thereof in the opposite axial direction.

5. In a rotor having partitions radiating from a rotor post to a cylindrical shell for forming a plurality of sector-shaped compartments, and radial and circumferential sealing members mounted on the edges of said partitions and of said shell in overhanging relation to the area of said compartments along the radial and circumferential portions of the perimeter thereof; one or more bundles of heat exchange material mounted in each compartment adjacent said rotor post, at least five other bundles disposed in two circumferential rows occupying the space between said shell and the bundles adjacent said rotor post, said bundles substantially filling said compartment and all bundles having a radial dimension that is a fraction of the radial depth of said compartment and all those in each circumferential row being of equal radial depth whereby on removal of the central bundle in the inner circumferential row all other bundles may be moved radially and/or circumferentially in said compartment.

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