

GAS/LIQUID CONTACT TRAY

The present invention relates to a gas/liquid contact tray for use in a column for counter-currently contacting gas and liquid. Such a column is any column in which gas and liquid are counter-currently contacted to exchange
5 heat or matter. An example of such a column is a fractionation column and a further example is a vacuum distillation column. In such a column liquid flows, during normal operation, downwards from top to bottom, whereas gas flows upwards from bottom to top. In the
10 specification and in the claims the word 'gas' is used to refer to gas and to vapour.

Such a column is provided with a number of horizontal gas/liquid contact trays arranged one above the other. Each tray comprises a perforated panel provided with one
15 or more downcomers. The downcomer is a conduit for downward passing of liquid arranged in an opening in the perforated panel, the part of the wall of the downcomer extending above the perforated panel is called the downcomer weir, and the part of the downcomer extending
20 below the perforated panel is called the downcomer apron.

During normal operation liquid collected on a tray flows over the perforated panel where it is contacted with upwardly flowing gas passing through the perforations. Then the liquid will flow over the
25 downcomer weir into the downcomer and onto the perforated panel of the tray below, and so on. It will be understood that the downcomers of two adjacent trays are not placed directly above each other, but spaced apart in lateral direction (or staggered) in order to prevent liquid from
30 falling directly into the downcomer of the lower tray. Moreover, the downcomers are so located that the liquid

exiting the downcomers can flow evenly over the perforated panel. In this way it is achieved that the time during which gas and liquid are in contact with each other is independent from the position of a liquid element on the perforated panel.

The gas/liquid contacting tray to which the present invention relates comprises a perforated panel of which the area is divided in two or more parallel sections, wherein either the odd numbered sections or the even numbered sections are provided with a plurality of downcomers directed perpendicular to the direction of the section, and wherein the bottoms of the downcomers are provided with lateral outflow openings directed in the direction of the sections.

Such a gas/liquid contacting tray is disclosed in Belgian patent specification No. 584 426, and described in more detail with reference to Figures 8, 9 and 14 IV.

The gas/liquid contacting tray shown in Figures 8 and 9 of this publication comprises a perforated panel of which the area is divided in two parallel sections, wherein either the first section (Figure 8) or the second section (Figure 9) is provided with a plurality of downcomers directed perpendicular to the direction of the section, and wherein the bottoms of the downcomers are provided with lateral outflow openings directed in the direction of the sections. This arrangement is selected to get an even distribution of liquid flowing during normal operation over the perforated panel, so as to prevent a stagnant zone at near the edge of the perforated panel, where the liquid could reside longer than the average residence time of liquid on the tray. Applicant, however, had found that this arrangement did not fully eliminate the stagnant zone.

It is an object of the present invention to overcome this problem.

To this end the gas/liquid contact tray according to the present invention for use in a column for counter-currently contacting gas and liquid comprises a perforated panel of which the area is divided in two or more parallel sections, wherein either the odd numbered sections or the even numbered sections are provided with a plurality of downcomers directed perpendicular to the direction of the section, wherein the bottoms of the downcomers are provided with lateral outflow openings directed in the direction of the sections, and wherein the bottom of each downcomer in the section(s) neighbouring the wall of the column is also provided with a frontal outflow opening directed in the direction of the wall.

The invention will now be described by way of example in more detail with reference to the accompanying drawings, wherein

Figure 1 shows schematically a top view of a gas/liquid contacting tray according to the present invention;

Figure 2 shows schematically a top view of a gas/liquid contacting tray according to the present invention, which is arranged below the tray of Figure 1; and

Figure 3 shows a cross-sectional view along the lines III-III of Figures 1 and 2, wherein also the column wall is shown.

Reference is now made to Figures 1 and 2. The gas/liquid contact tray shown in Figure 1 is referred to with reference numeral 10, and the tray shown in Figure 2 with reference numeral 20. Each tray 10 and 20 comprises a perforated panel 11 and 21. The edge of the perforated panel is referred to by reference numeral 11a and 21a. For the sake of clarity only part of the perforated panel is hatched.

The area of the perforated panel 11 and 21 is divided in three parallel sections 12, 13, 14 and 22, 23 and 24. The dashed lines 15 and 25 indicate the boundaries between adjacent sections.

5 The odd numbered sections 12 and 14 of the tray shown in Figure 1 are provided with a plurality of elongated downcomers 16a, 16b and 16c and 17a, 17b and 17c. The elongated downcomers 16a, 16b and 16c and 17a, 17b and 17c are directed perpendicular to the direction of the sections 12 and 14, in other words their longitudinal axes (not shown) are directed perpendicular to the longitudinal axis (not shown) of the sections.

10 The even numbered section 23 of the tray shown in Figure 2 is provided with three elongated downcomers 28a, 28b and 28c directed perpendicular to the direction of the section 23. The projections of the downcomers 16a-c and 17a-c of tray 10 on tray 20 are shown by means of dashed lines.

15 The bottom of each of the elongated downcomers 16a-c, 17a-c and 28a-c is provided with lateral outflow openings directed in the direction of the sections 12, 14 and 23.

20 These lateral outflow openings are shown more clearly in Figure 3, which Figure shows the trays 10 and 20 arranged in a column of which the wall is referred to by reference numeral 30. The supports of the trays 10 and 20 are not shown. In this Figure the reference numeral 31 is used to refer to the downcomer weirs and the reference numeral 32 is used to refer to the downcomer apron. The lateral outflow openings are referred to by reference numerals 36, 37 and 38.

25 Furthermore, the bottoms of the downcomers 16a-c in the section 12 neighbouring the wall 30 of the column are also provided with frontal outflow openings 40 directed in the direction of the wall 30. The section neighbouring the wall will be an odd numbered section.

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During normal operation liquid exiting the downcomers of the tray (not shown) above the tray 10 is collected on this tray 10 and it is contacted with upwardly flowing gas passing through the perforations of the perforated panel 11. The liquid flows to the downcomers 16a-c and 17a-c. The liquid flows over the weirs 31 (see arrows 41 in Figure 3), and it exits the downcomers 16a-c and 17a-c through the lateral outlet openings 36 and 37 (arrows 42) and through the frontal outlet openings 40 (arrows 43). The arrows 42 and 43 are also shown in Figure 2.

The liquid is collected on tray 30 and it is contacted with upwardly flowing gas passing through the perforations of the perforated panel 21. The liquid flows over the perforated panel 21 to the downcomers 28a-c. The liquid flows over the weirs 31 (see arrows 45 in Figure 3), and it exits the downcomers 28a-c through the lateral outlet openings 38 (arrow 47).

The liquid flowing out of the frontal openings 40 causes turbulence in the liquid on the tray 20 near the wall 30 of the column, and in this way stagnant zones near the wall 30 are effectively prevented.

In order to increase the flow path length l (see Figure 3), the side of a downcomer apron that is directed to the downcomer weir pertaining to the below tray can be tilted. This is shown for the downcomer 17b in Figure 3. A downcomer apron tapered in that way can also be applied to the downcomers 28a-c of the tray 20.

In the embodiment of the invention shown in the Figures, both the lateral outlets 36, 37 and 38 and the frontal outlets 40 are in the form of slits. In an alternative embodiment, the bottom of the downcomer is closed and the outlets are formed by openings near the closed bottom.

In the embodiment as shown in the Figures, the trays 10 and 20 are divided in three sections, wherein

the number of downcomers of the tray 10 (six) is twice the number of downcomers (three) of the tray 20. Suitably the number of sections is even, two, four, six or eight, so that each tray can have the same number of downcomers.

5 The number of downcomers per section is suitably in the range of from three to five.

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1. Gas/liquid contact tray for use in a column for counter-currently contacting gas and liquid, which tray comprises a perforated panel of which the area is divided in two or more parallel sections, wherein either the odd
5 numbered sections or the even numbered sections are provided with a plurality of downcomers directed perpendicular to the direction of the section, wherein the bottoms of the downcomers are provided with lateral outflow openings directed in the direction of the
10 sections, and wherein the bottom of each downcomers in the section(s) neighbouring the wall of the column is also provided with a frontal outflow opening directed in the direction of the wall.