We claim:

1. A distillation column, comprising:

a vertically extending distillation housing; and

a plurality of tray assemblies, at least one of which includes a horizontally extending tray panel and a downcomer panel assembly that defines a downcomer having, in a downward direction, an upper region of decreasing cross-sectional area, and a lower region of substantially constant cross-sectional area.

2. The distillation column of claim 1, wherein the tray panel includes an outer edge that is adjacent to an upper edge of the downcomer panel assembly.

3. The distillation column of claim 2, wherein the outer edge of the tray panel and an opposing side of the distillation housing define the opening of the upper region of the downcomer.

4. The distillation column of claim 2, further comprising a weir disposed along the outer edge of the tray panel and extending vertically upward therefrom.

5. The distillation column of claim 2, wherein the downcomer panel assembly includes a downcomer top panel extending downwardly away from the outer edge of the tray panel toward the distillation housing at an angle.

6. The distillation column of claim 5, wherein the downcomer top panel and the distillation housing define the upper downcomer region.

7. The distillation column of claim 6, wherein the at least one tray assembly comprises a downcomer bottom panel extending substantially vertically downward from the downcomer top panel.

8. The distillation column of claim 7, wherein downcomer bottom panel and the distillation housing define the lower downcomer region.

9. The distillation column of claim 8, wherein the at least one tray assembly comprises at least one support structure extending from the distillation housing.

10. The distillation column of claim 9, wherein the at least one support structure includes an angled portion that supports the top downcomer panel at an angle with respect to a vertical axis.

11. The distillation column of claim 10, wherein the at least one support structure further includes a side portion extending between the sides of the top downcomer panel and the inner walls of the distillation housing.

12. The distillation column of claim 10, wherein the at least one tray assembly includes a second support structure having a vertical portion that supports the downcomer bottom panel and further defines the lower downcomer region.

13. The distillation column of claim 10, wherein the angled portion comprises an extension piece extending substantially vertically upward from the top of the angled portion.

14. The distillation column of claim 13, further comprising a weir connected to the extension piece and disposed along the outer edge and extending vertically upward therefrom.

15. A method of increasing the volume of an upper region of a downcomer in a distillation column, wherein the downcomer includes upper and lower regions that define a channel of substantially constant cross-sectional area along a vertical axis, the method comprising:

re-sizing the upper region of the downcomer to define a channel a channel of decreasing cross-sectional area in the downward direction while maintaining the lower region of the downcomer the same size to define a channel of substantially constant cross-sectional area along the downward direction wherein the volume of the re-sized upper downcomer region is greater than the volume of the lower downcomer region.

16. The method of claim 15, wherein the distillation column comprises a column housing and a plurality of tray assemblies, at least one of the tray assemblies comprising a horizontally extending tray panel that is substantially circular and has a first outer edge, the opening of the upper downcomer region being defined by the first outer edge and the column housing.

17. The method of claim 16, wherein the re-sizing comprises:

re-sizing the tray panel by forming a second outer edge that is closer to a center axis of the distillation column than the first outer edge; and

providing a downcomer top panel extending downwardly away from second outer edge toward the column housing at an angle in the downward direction, wherein the second outer edge, the downcomer top panel, and the column housing form the re-sized upper downcomer.

18. The method of claim 15, wherein the volume of the re-sized upper downcomer region is at least 20% greater than the volume of the initial downcomer region.

19. The method of claim 15, wherein the volume of the re-sized upper downcomer region is at least 30% greater than the volume of the initial downcomer region.

20. A method for increasing a volume of a downcomer in a distillation column containing plurality of tray assemblies, at least one of said tray assemblies including a horizontally extending tray panel having an edge, and a vertically-oriented downcomer panel assembly connected along the edge of the tray panel that defines a downcomer of substantially constant cross-sectional area in a downward direction along a vertical axis, comprising:

disconnecting the panel assembly from the edge of the tray panel;

removing a portion of the tray panel parallel to the edge to form a new edge;

moving an upper portion of the panel assembly toward the new edge of the tray panel while maintaining a lower portion of the panel assembly in a same vertical position within the distillation column, and

connecting the upper portion of the panel assembly along the new edge of the tray panel such that the panel assembly defines, in the downward direction, an upper downcomer region of decreasing cross-sectional area and a lower downcomer region of substantially constant cross-sectional area.

21. The method of claim 20, wherein a sufficient portion of the tray panel is removed to increase the cross sectional area of the top of the resulting downcomer by at least 30%.

22. The method of claim 20, wherein a sufficient portion of the tray panel is removed to increase the cross sectional area of the top of the resulting downcomer by at least 50%.

23. The method of claim 20, wherein the panel assembly includes an upper panel and a lower panel, and wherein the upper panel is pivotally moved at an angle toward the new edge of the tray panel while the lower panel is maintained in a same vertical position within the distillation column.

24. The method of claim 20, wherein a weir is mounted along the edge of the tray panel, and the method further includes the steps of removing the weir before removing a portion of the tray panel parallel to the edge to form a new edge, and re-using the weir by mounting it along the new edge.

25. The method of claim 24, wherein the at least one tray assembly includes a vertically-oriented support structure extending from the distillation housing that supports the vertically-oriented panel assembly, and wherein the method further includes mounting an angled support structure on interior walls of the distillation column to support the upper panel at an angle relative to the lower panel while maintaining the vertically oriented support structure within the distillation column to support the lower panel.

Claims

1. A distillation column, comprising:

a vertically extending distillation housing; and

a plurality of tray assemblies, at least one of which includes a horizontally extending tray panel and a downcomer panel assembly that defines a downcomer having, in a downward direction, an upper region of decreasing cross-sectional area, and a lower region of substantially constant cross-sectional area, wherein the downcomer panel assembly comprises:

a downcomer top panel extending downwardly away from the outer edge of the tray panel toward the distillation housing at an angle; and

left and right angled bolt bars attached on left and right side edges of the downcomer top panel,

wherein each of the left and right angled bolt bars comprise a triangular side portion comprising an inner edge attached to the downcomer top panel and an outer edge attached to an inner wall of the distillation housing such that the triangular side portion fills in a gap between the inner wall of the distillation housing and each of the left and right side edges of the downcomer top panel,

the inner edge of the triangular side portion is parallel to an outer edge of the downcomer top panel;

the outer edge of the triangular side portion is displaced decreasingly further from the inner edge of the triangular side portion in a downward direction; and

the distillation housing, the downcomer top panel, and the left and right angled bolt bars define the upper region of the downcomer.

2. The distillation column of claim 1, wherein the tray panel includes an outer edge that is adjacent to an upper edge of the downcomer plane assembly.

3. The distillation column of claim 2, wherein the outer edge of the tray panel and an opposing side of the distillation housing define the opening of the upper region of the downcomer.

4. The distillation column of claim 2, further comprising a weir disposed along the outer edge of the tray panel and extending vertically upward therefrom.

5. The distillation column of claim 2, wherein the downcomer panel assembly further comprises:

a downcomer bottom panel extending substantially vertically downward from the downcomer top panel; and

a support structure having a vertical portion that supports the downcomer bottom panel.

wherein the distillation housing, the downcomer bottom panel, and the support structure define the lower region of the downcomer.

6. The distillation column of claim 1, wherein each of the left and right angled bolt bars further comprise an extension piece extending substantially vertically upward from a top of the triangular side portion.

7. The distillation column of claim 6, further comprising a weir connected to the extension piece and disposed along an outer edge and extending vertically upward therefrom.