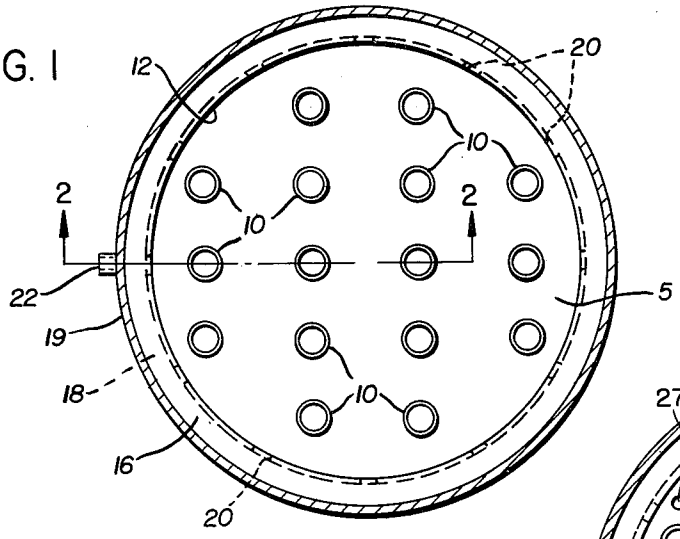
Feb. 1, 1966 J. S. ECKERT 3,232,590

TREATING TOWER HAVING A PLATE FOR COLLECTING, MIXING AND DISTRIBUTING LIQUID

Filed July 8, 1964 5 Sheets-Sheet 1

FIG. 1



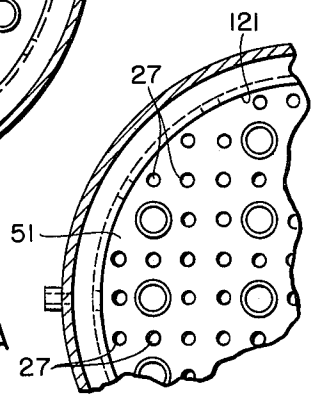


FIG. 1A

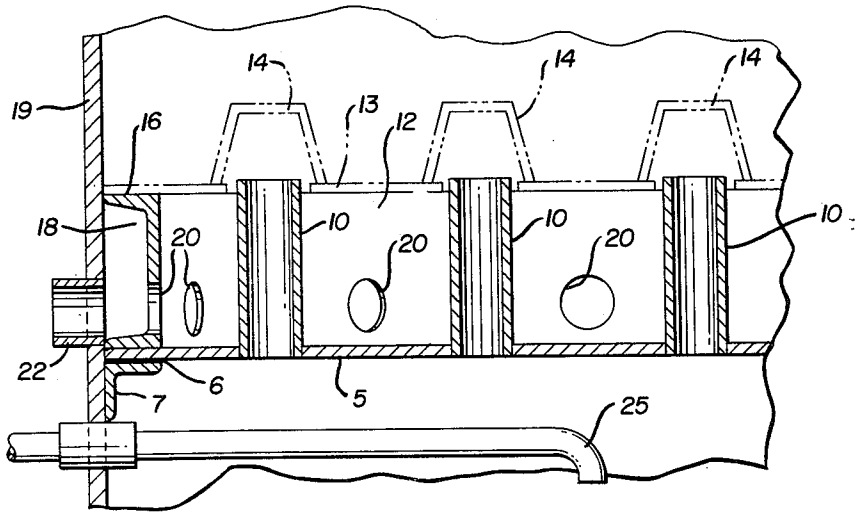


FIG. 2

INVENTOR.
JOHN S. ECKERT

BY Gordon C. Clark

ATTORNEY

Feb. 1, 1966 J. S. ECKERT 3,232,590

TREATING TOWER HAVING A PLATE FOR COLLECTING, MIXING AND DISTRIBUTING LIQUID

Filed July 8, 1964 5 Sheets-Sheet 2

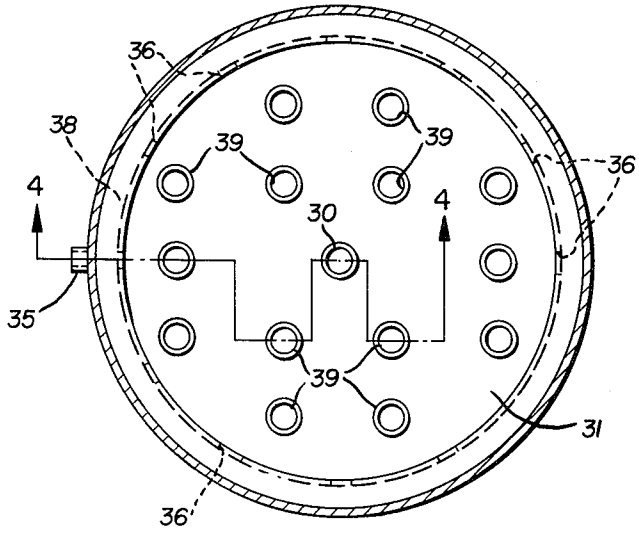


FIG. 3

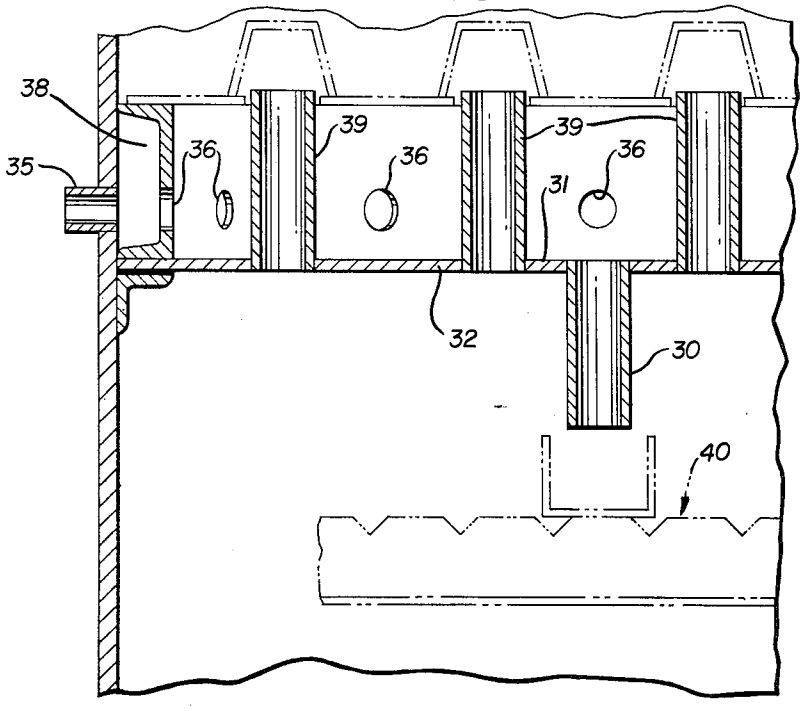


FIG. 4

INVENTOR.
JOHN S. ECKERT
BY Gordon C. Clark
ATTORNEY

Feb. 1, 1966 J. S. ECKERT 3,232,590

TREATING TOWER HAVING A PLATE FOR COLLECTING, MIXING AND DISTRIBUTING LIQUID

Filed July 8, 1964

5 Sheets-Sheet 3

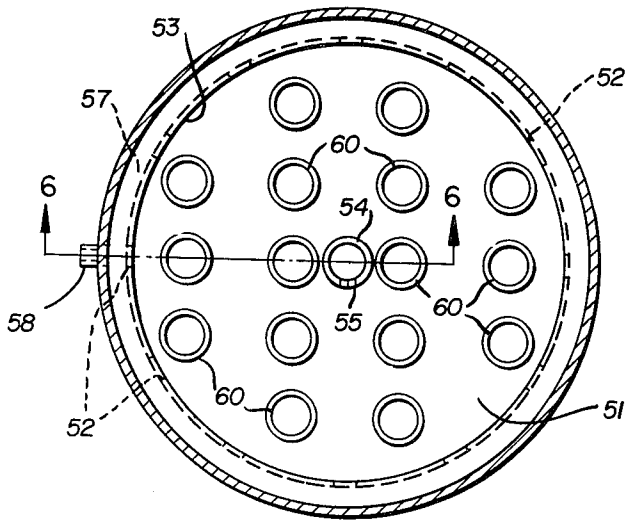


FIG. 5

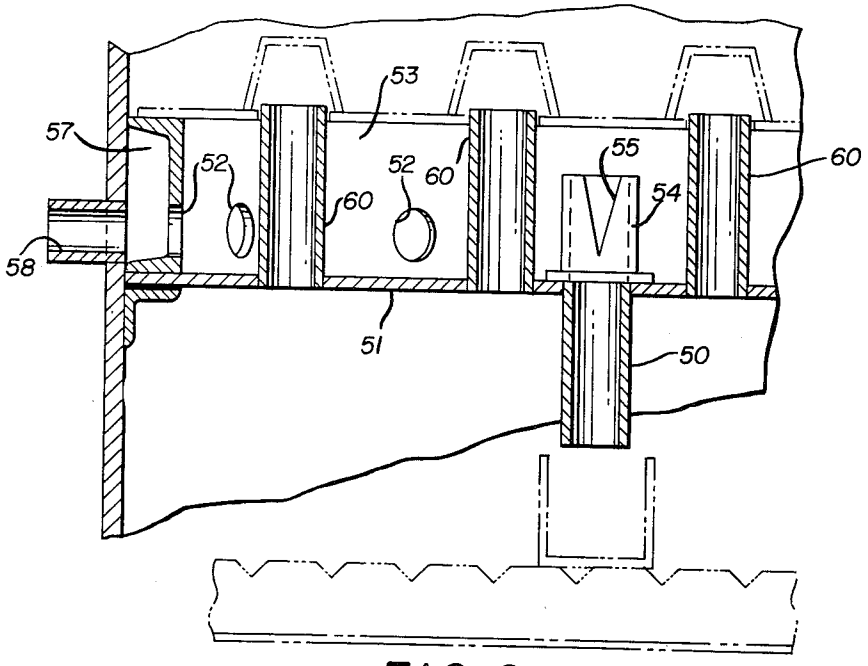


FIG. 6

INVENTOR.
JOHN S. ECKERT
BY Gordon C. Cleark
ATTORNEY

Feb. 1, 1966 J. S. ECKERT 3,232,590

TREATING TOWER HAVING A PLATE FOR COLLECTING, MIXING AND DISTRIBUTING LIQUID

Filed July 8, 1964 5 Sheets-Sheet 4

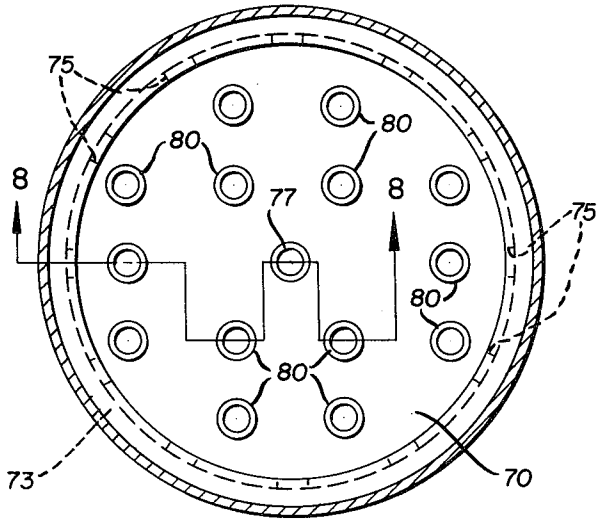


FIG. 7

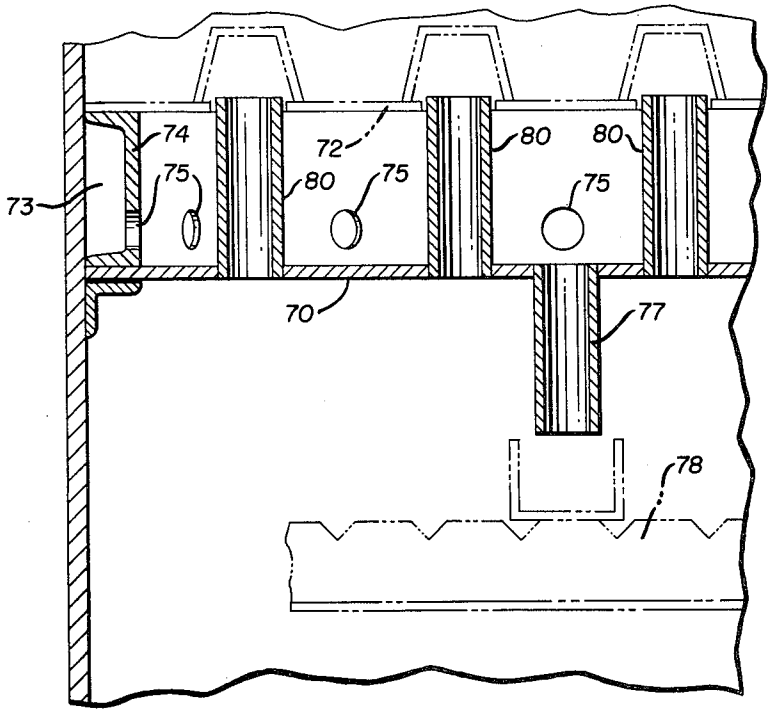


FIG. 8

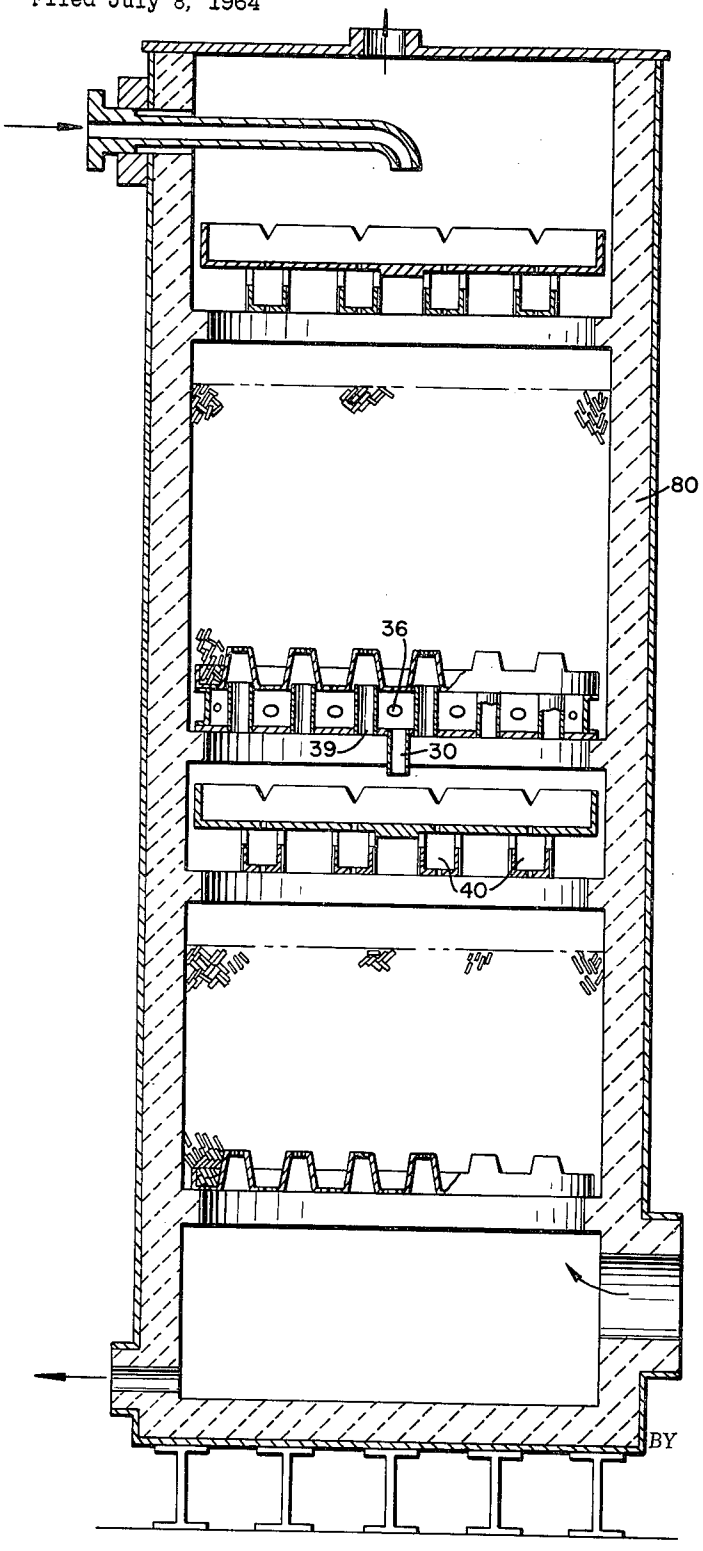
INVENTOR.
JOHN S. ECKERT
BY Gordon C. Mark
ATTORNEY

Feb. 1, 1966 J. S. ECKERT 3,232,590

TREATING TOWER HAVING A PLATE FOR COLLECTING, MIXING AND DISTRIBUTING LIQUID

Filed July 8, 1964 5 Sheets-Sheet 5

FIG. 9



INVENTOR.
JOHN S. ECKERT

BY

ATTORNEY

United States Patent Office 3,232,590 Patented Feb. 1, 1966

3,232,590

TREATING TOWER HAVING A PLATE FOR COLLECTING, MIXING AND DISTRIBUTING LIQUID

John S. Eckert, Silver Lake, Ohio, assignor to The United States Stoneware Company, Tallmadge, Ohio, a corporation of Ohio

Filed July 8, 1964, Ser. No. 381,191
8 Claims. (Cl. 261—97)

This application is a continuation-in-part of my application Serial No. 169,491 filed January 29, 1962.

This invention relates to a plate in a packed tower designed for the counter-current flow of a gas and liquid therethrough.

The plate is located at an intermediate position in the tower, and it may take different forms. Risers extend upwardly from it and it supports a support plate, thereby providing a chamber for various functions such as collecting liquid to be drawn off from the tower, introducing fresh liquid at that level in the tower, etc.

The plate of this invention includes a wall near its edge, and if the tower is cylindrical the wall is annular and forms an annular chamber with the tower. Openings may be provided in the wall for the passage of liquid from the space inside the wall to the annular chamber, and vice versa. There is usually at least one opening in the tower itself, at or above the level of the plate for drawing liquid away from the annular chamber, or for feeding liquid to the annular chamber. However, when the plate is to be used only as a redistribution mixer no opening is required in the tower itself. The openings in the annular wall may be at various heights except that the uppermost openings will usually be at about the height of the opening in the tower; and when there is a downcomer from the plate with its upper end above the plate and it is intended that some liquid flow through the openings in the wall and some through the downcomer simultaneously, all of the openings in the wall will be at about the level of the effective top of the downcomer, and if there is a weir at the top of the downcomer, the openings in the wall will be at about the level of the bottom of the weir. Alternatively, the top of the downcomer may be level with the plate so that all of the liquid on the plate drains through the downcomer. In one type of plate there is no downcomer. If there is a downcomer, some sort of distributor is usually located below it.

The invention is further described in the accompanying drawings, in which FIGURE 1 is a plan view of the plate shown in FIGURE 2; and FIGURE 2 is a section on the line 2—2 of FIGURE 1; FIGURE 1A is a plan view of a modified plate; FIGURE 3 is a plan view of the plate shown in FIGURE 4 and FIGURE 4 is a section on the line 4—4 of FIGURE 3; FIGURE 5 is a plan view of the plate shown in FIGURE 6 and FIGURE 6 is a section on the line 6—6 of FIGURE 5; FIGURE 7 is a plan view of the plate shown in FIGURE 8; FIGURE 8 is a section on the line 8—8 of FIGURE 7; and FIGURE 9 is a section through a tower containing the plate of FIGURE 4.

In FIGURES 1 and 2 the plate 5 rests on the annular ring support 7 which encircles the inside of the tower and which may be gasketed at 6. Any liquid-tight construction can be used which prevents liquid which collects on plate 5 from draining to the lower part of the tower.

Gases collecting in the lower portion of the tower pass up through risers 10. The risers are advantageously about the same height as the annular wall 12 of the plate, and they may be somewhat higher if a support plate of the type shown in the drawings is used. Any suitable

type of support plate can be used to hold tower packing material. If a support plate of the type shown in dot-dash lines and identified by the numeral 13 is used, it rests on the wall 12, and the risers are advantageously located in rows, and made high enough to protrude through elongated openings in the plate 13 under channels 14. The walls of the channels are perforated, and the tops may also be perforated. Perforations or other openings are provided in the base of plate 13 to permit liquid which collects there to drain on to the plate 5.

The wall 12 is spaced inwardly from the edge of the plate 5. The top 16 of the wall 12 overhangs the annular chamber 18 between this wall and the cylindrical wall 19 of the tower. This provides a cover for the chamber 18 as well as a bearing area for the support plate 13. If there is no such overhang the plate 13 may seal off the top of the chamber 18, or the top of the chamber may be open. Openings 20 in the wall 12 permit interchange of liquid between the space inside the wall and the chamber 18. The nozzle or pipe 22 serves as a draw-off.

The plate 5 is located intermediate the top and the bottom of the tower. There may, for example, be three such plates spaced at intervals in the tower. This would permit gases passing up through the tower to be washed successively by three different liquids, each of which would be separately collected. In this case, fresh, liquid is introduced into the tower through an inlet 25 below each plate.

In such a tower the wash liquid collected on the plate may be drawn off the tower, heated or cooled or otherwise treated, and then be returned to the tower through inlet 25 for further treatment of the gases.

FIGURE 1A illustrates an alternative construction in which the area of the plate 5' within the wall 12' is perforated. The perforations are so small that a shallow layer of liquid collects on the plate. Liquid collected on different areas of the plate 5' is mixed on the plate as it is collected, and it drains through the perforations 27 which are distributed over the whole plate area. Thus, the liquid collected on the perforated plate is mixed and distributed widely over the entire cross-sectional area of the packing material located directly beneath it. A plurality of such perforated plates located at different levels within a tower, between beds of packing elements, provide for repeated collection, mixing and redistribution of the liquid as it flows down through the tower without the use of a conventional distributor.

The plate of this invention may be provided with a downcomer 30 as shown in FIGURES 3 and 4. Its top is flush with the bottom 31 of the plate 32. The nozzle 35 is advantageously used for introducing liquid into the tower for intermingling with liquid which has already collected on the plate. This added liquid may be the same as that in the tower or it may react with the liquid in the tower or may merely be mixed with it. The openings 36 in the annular wall are all of the same height so that the incoming liquid collects first in the annular chamber 38 and is fed into the tower from all sides through openings 36 to be mixed with the liquid on the plate. The openings 36 are advantageously, although not necessarily located above the maximum height of the liquid collected on the plate. The risers 39 which are covered with a support plate for the tower packing (shown in dot-dash lines), keep the up-flowing gases separate from the liquid which has collected on the plate.

The downcomer 30 advantageously feeds into any suitable type of distributor. This may be a notched trough distributor such as that shown in dot-dash lines and identified by the reference numeral 40.

As shown in FIGURES 5–6, the downcomer **50** may extend up through the bottom **51** of the plate and have an effective height approximately that of the openings **52** in the annular wall **53**. The top of the downcomer may be flat or it may be provided with a weir opening. In the drawings, the downcomer is shown as provided with a cap **54** in which is the V-opening **55** through which a greater or smaller volume of liquid flows, depending upon the height of the liquid on the plate. The downcomer advantageously feeds into a distributor.

With a plate having a downcomer with such a V-opening as that shown in FIGURES 5 and 6, the volume of liquid which flows through the downcomer is relatively constant. If the amount of liquid collected on the plate reaches the height of the openings **52**, the excess flows through these openings into chamber **57**, and eventually is drawn off through the outlet **58**. If the amount of liquid diminishes, so that the level of the liquid on the plate falls below openings **52**, all of the liquid flows through the downcomer, and the V-opening keeps the flow relatively constant. Risers **60** separate the upflowing gases from the liquid on the plate. A tower provided with a plate such as that shown in FIGURES 5 and 6 is advantageously provided with a support plate and a distributor plate of suitable design.

There is no opening through the tower at the level of the plate **70** shown in FIGURES 7 and 8. Liquid drains down through the packing on the support plate **72**, and through openings in the support plate. Liquid also runs down the wall of the tower. Some may collect in the annular chamber **73**. If there are openings in the wall **74**, such as openings **75**, liquid that collects in the chamber **73** will flow through the wall on to the plate **70**, and eventually down through the downcomer **77** on to the distributor **78**. The openings through the wall need not be located as shown, but may be mere arches or the like in the bottom of the wall. There need be no openings in the wall, and then liquid may collect in the annular chamber **73** until it is full and remain there. The gases pass up through the risers **80**. The plate **70** serves as a redistributor to collect liquid that may have been channeled through one section of the tower and concentrated in greater volume there than elsewhere. All of the liquid is collected on plate **70** and redistributed by means of a distributor **78**. Channeling of liquid, such as just mentioned, is objectionable because it does not provide uniform treatment of the gases, and liquid which has had more intimate contact with the gases is, as a result, of different composition from liquid that has washed the gases less efficiently. The plate **70** collects all of the liquid and blends it together. Collection and redistribution of the liquid is most efficiently done by keeping the packing on the support plate away from the plate **70**. This is a characteristic of each of the various embodiments of the invention illustrated herein.

FIGURE 9 shows the plate of FIGURE 4 in tower **80** with the lower pans of distributor **40** resting on a ledge below the ledge which supports the plate.

There may be several plates of any one or more of the various types disclosed herein at different levels in a single tower.

In each of the constructions shown, the plate is removably supported within the tower, and this is the preferred construction. The plate may be of metal, ceramic or plastic composition.

The invention is covered in the claims which follow.

What I claim is:

1. A gas-and-liquid treating tower for countercurrent flow of gas and liquid therethrough, means for flowing gas upwardly and liquid downwardly in said tower, the tower having an upwardly extending peripheral wall, and in the tower a liquid-mixing chamber which is transversely disposed across said tower and open above whereby it collects throughout the entire extent of said chamber, liquids of different properties flowing downwardly in a plurality of paths spaced laterally from one another across said tower, said chamber comprising

(a) a plate which forms the bottom of said chamber and is positioned horizontally in said treating tower and in liquid-sealing contact at its peripheral edge with respect to the upwardly extending wall of said tower,

(b) said plate being provided with a plurality of riser openings extending therethrough,

(c) a riser mounted on said plate at each of said riser openings therein,

(d) each riser having an upwardly extending, encircling side wall in gas-tight contact with the edge of the riser opening in said plate associated therewith to provide a passageway through said mixing chamber into a region thereabove for gas flowing upwardly in said tower,

(e) said plate having a flat upper surface bounded at the edge thereof by an upwardly extending continuous wall mounted on said plate and surrounding said risers and spaced inwardly from the peripheral edge of said plate, and providing an inner liquid-collecting chamber and an outer liquid-collecting chamber, said chambers being in side-by-side relation at substantially a common level in said tower,

(f) the bottom of at least one of said inner and outer chambers being imperforate,

(g) said continuous wall being provided with a plurality of spaced openings to permit the flow of liquid therethrough between said inner and outer liquid-collecting chambers of liquids of different properties collected in said chambers,

(h) said risers being spaced from one another and being spaced inwardly from said continuous wall, and being located away from the edge of the plate and being so distributed that in the various directions in which liquid reaching various locations on the plate in said inner liquid-collecting chamber is adapted to flow, there is at least one of said risers which diverts the liquid flow across the plate and liquid flowing in various directions on the plate is mixed,

whereby liquids of different properties collected in said inner and outer liquid-collecting chambers are thoroughly mixed by the flow of liquid through said openings in said upwardly extending continuous wall and by diversion of the liquid flowing across said inner chamber by said risers.

2. A tower of claim **1** in which the upwardly extending peripheral tower wall is cylindrical and said horizontally positioned plate and said upwardly extending continuous wall of said chamber are circular and provide an annular outer liquid-collecting chamber adjacent said cylindrical tower wall.

3. A tower of claim **1** in which a separable cover plate overlies said inner chamber and said outer chamber, and said cover plate has a peripheral edge spaced from the tower wall and is supported on said continuous wall, said cover plate being provided with covered openings above said risers which prevent the liquids of different properties descending in said treating tower from entering the risers.

4. A tower of claim **1** in which the plate is perforated in the area within the said continuous wall, and liquid collected on the plate drains therethrough.

5. A tower of claim **1** in which there is a draw-off opening through the peripheral tower wall, and the chamber is in substantially the plane of the draw-off opening and the draw-off opening is in communication with the outer of said liquid-collecting chambers.

6. A tower of claim **1** in which said plate is provided with an opening extending therethrough, which opening is located in the portion thereof surrounded by said continuous wall, and there is a downcomer at said opening which withdraws liquid from said mixing chamber.

7. A tower of claim 6 in which a cap is mounted on the plate at said opening associated with said downcomer.

8. A tower of claim 7 in which said cap is provided with a sidewall having a downwardly converging V-shaped notch.

References Cited by the Examiner

UNITED STATES PATENTS

1,728,440	9/1929	Otto	261—114 X
2,815,532	12/1957	Braunlich	259—4 X
3,016,234	1/1962	Huppmeier	261—98

FOREIGN PATENTS

290,553 5/1928 Great Britain.

OTHER REFERENCES

"Support Plates, Distributors, and Holddown Plates for Packed Towers," U.S. Stoneware Co., Akron 9, Ohio, Design Manual TA–40 R, copyright 1960, pages 1 to 31.

ROBERT F. BURNETT, *Primary Examiner.*

HARRY B. THORNTON, RONALD R. WEAVER, *Examiners.*