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GAS AND LIQUID CONTACT DEVICE

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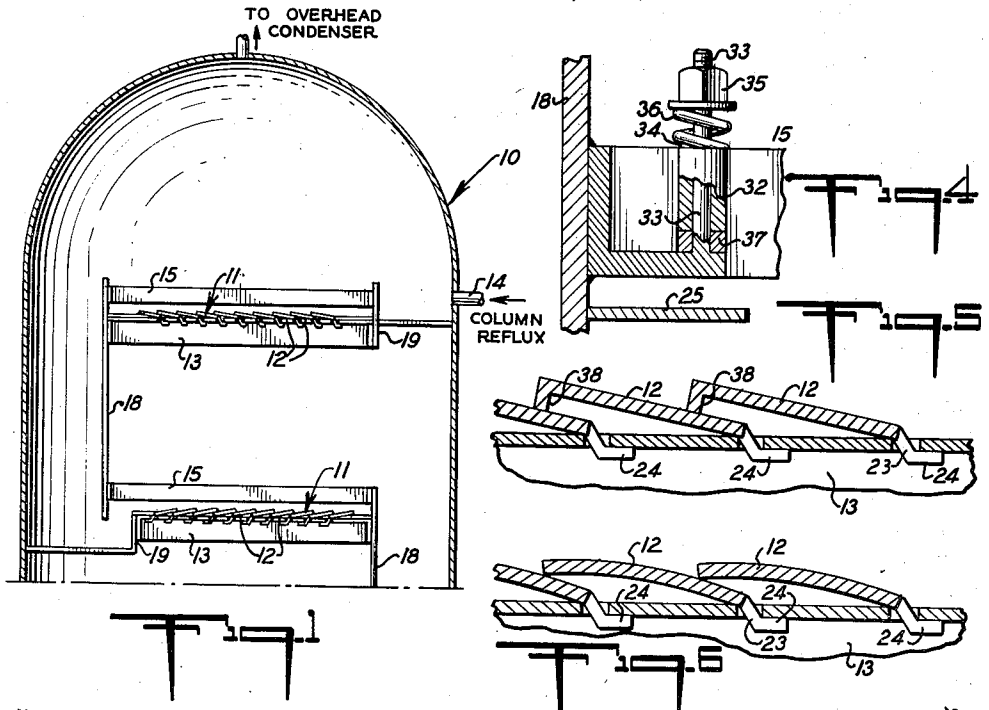


FIG. 1

FIG. 4

FIG. 5

FIG. 6

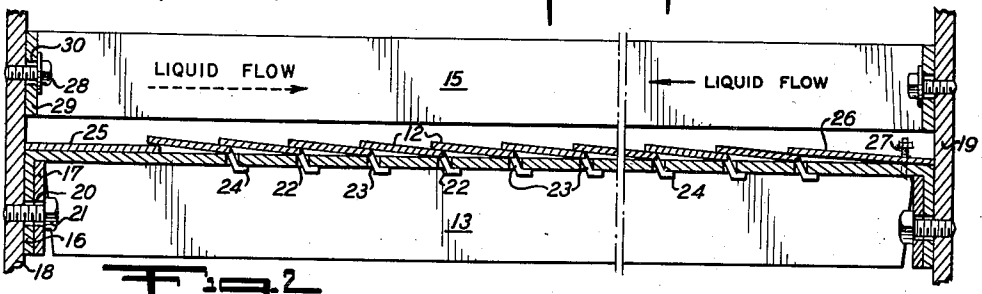


FIG. 2

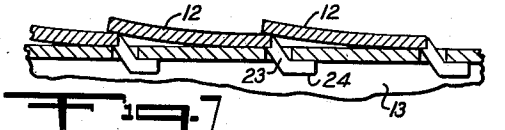


FIG. 7

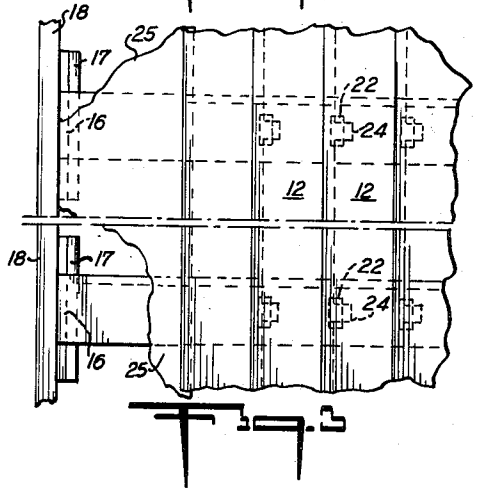


FIG. 3

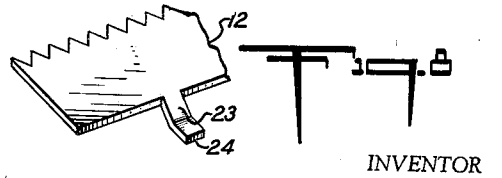


FIG. 8

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GAS AND LIQUID CONTACT DEVICE

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12 Claims. (Cl. 261—114)

This invention relates generally to gas and liquid contact apparatus such as used in gas scrubbers, absorbers, dephlegmators, fractionators and the like.

In general, apparatus of this type may include a "column" in which are mounted a series of vertically spaced trays or decks over which water or other refluxing liquid is flowed in thin sheets to contact and intimately mix with a current of ascending gas which passes successively through apertures or channels provided in the several trays or decks. The present invention has for one object the provision of tray elements which contain adjustable gas apertures or channels which will automatically adjust themselves as to size in accordance with the force or power of the ascending gas stream.

Another object of the invention is to provide an apparatus of the character described in which the gas channels through the trays will open to a maximum extent upon the occurrence of a violent upward surge of gas due, for instance, to an explosion within the base of the column.

Another object of the invention is to provide a tray structure which will insure thorough and uniform mixing of the gases and water and which may be readily altered in design to provide the desired degree of mixing to suit any composition of gases and refluxing liquid.

Another object of the invention is to provide a tray structure wherein a series of plate valves constitute the "deck" of the tray, which valves are normally closed but which open automatically in response to ascending gas currents, together with stop means for limiting the maximum degree to which the valves may open. The stop means is preferably resiliently mounted to absorb shocks incident to explosions and violent gas surges within the column.

These and other objects of the invention will become apparent from the following specification, read in connection with the accompanying drawings wherein is illustrated preferred forms of the invention and wherein

Fig. 1 is a generally diagrammatic fragmentary sectional view of the top portion of a column in which the tray structures of the present invention have been mounted;

Fig. 2 is a transverse sectional view through one of the trays;

Fig. 3 is a fragmental plan view of a tray;

Fig. 4 is a detail view showing one method of mounting the valve stop;

Figs. 5, 6, 7 and 8 are detail views, generally diagrammatic, showing modified forms of plate valves.

In the accompanying drawings wherein like reference numerals are used to designate like parts throughout the top portion of a fractionating column is indicated generally diagrammatically at **10**. Within the column is mounted a series of vertically spaced tray elements or contact devices indicated generally at **11**. Each such tray or contact device includes a series of plate valves **12**, supported in overlapping relation upon supporting

bars **13**. The plate valves **12** may be made of any suitable material such as metal, plastic or the like. Each group of plate valves **12** forms the deck of a tray over which refluxing liquid is flowed from a source indicated generally at **14**. Associated with each tray **11** is a valve stop bar **15** which extends transversely of the deck of the tray above the plate valves **12** to limit the degree of opening of the valves in a manner to be described. The supporting bars **13** which support the plate valves **12** may be mounted within the column **10** in any convenient manner. A preferred manner of mounting the bars is shown in Fig. 2 wherein the bars **13** are shown as metal channel members which at their opposite extremities are provided with down-turned hook portions **16**, formed by cutting away the side walls of the channel member and bending down the horizontal wall as shown. The bars **13** are dimensioned so that the hook portions **16** thereof may be seated within pockets formed in blocks **17** which are secured in any desired manner to downcomer plates **18** and to seal well side plates **19**. The hook portions **16** are apertured or slotted as at **20** to provide for desired vertical adjustment of the bars **13** with respect to securing bolts **21** passing through said apertures **20**, thus to position the tray elements **11** on a horizontal or on a slightly inclined plane as desired.

The horizontal upper walls of the channel members **13** are provided with a series of apertures **22** as shown, these apertures providing means for hingedly or pivotally mounting the plate valves **12** thereon. Each of the plate valves may be provided on one longitudinal edge thereof with two or more hinge lugs **23** which may be integral with the plate valves or secured thereto in any convenient manner such as by welding. The lugs **23** as shown are formed to extend angularly downward out of the plane of the plate valves so that they may be passed through the apertures **22** of the supporting bars **13**. The lugs **23** at their terminal extremities are each provided with an angular foot portion **24**. The lugs **23** and the apertures **22** are dimensioned to facilitate passing the lugs through the apertures with the plate valves in a substantially vertical plane to thereby form a hinged mount for the plate valves. The foot portions **24** of the lugs **23** engage the underside of the top wall of the bars **13** in closed position of the plate valves as shown in Fig. 2. The apertures **22** are spaced along the bars **13** in accordance with the width of the plate valves so that the plate valves may be mounted in edgewise-overlapping relation as shown. At one end of the deck formed by the plate valves, a stationary closure plate **25** may be mounted on the bars **13** as shown and at the opposite end of the deck a closure plate **26** may be loosely mounted in edgewise-overlapping relation to the last plate valve at the right hand end of the deck, as viewed in Fig. 2, by bolts **27**. This arrangement insures a substantially completely closed deck for the trays when the plate valves **12** are all in normal or closed position. Two or more supporting bars **13** may be employed, as necessary, to properly support the plate valves **12** and as shown in Fig. 3, the plate valves are each provided with at least two lugs **23**, and may, if desired, have as many such lugs as there are supporting bars **13**.

The valve stop bars **15** as shown in Fig. 2 are mounted above the deck of each tray and generally transversely of the plate valves **12**. The stop bars **15** may be secured at opposite ends to the downcomer **18** and the seal well side plates **19** by cap screws **28**. Conveniently, the ends of the stop bars **15** may be bent to provide lugs **29** which are apertured or slotted as at **30** to provide means, in connection with the attaching screws **28**, by which they may be disposed either horizontally or at a desired slight angle with respect to the deck of the adjacent

tray. Thus, the plate valves at opposite ends of the deck may be limited in opening movement by the same or by different amounts as may be desired.

Preferably the valve stop bars **15** are resiliently mounted and a convenient manner of accomplishing this is shown in Fig. 4 where the stop bars are shown provided with eye members **32** at their terminal extremities through which are passed bracket bolts **33** secured to adjacent wall portions of the downcomer and seal well sides. Between the uper ends **34** of the eye members **32** and the nut **35** is disposed a coil spring member **36**. By this arrangement any violent shock transmitted to the bars **15** by the plate valves **12** as a result of an explosion or sudden surge of gas within the column is readily absorbed without damage to the apparatus. In this construction, washers or shims **37** may be interposed between the lower ends of the eye members **32** and the bracket bolts **33** as shown in order to dispose the stop bar at a desired angle with respect to the deck or tray.

The form of the invention as shown in Figs. 1 to 3 illustrates the basic features which characterize the present invention, namely, the plate valves **12** constituting the decks of the tray elements rather than being attached to the deck plate of a tray, and the pivoted mounting of the plate valves which permits the plate valves to open readily in response to gas flow from beneath. The distribution of gases flowing through the passages between the plate valves may be increased or decreased by decreasing or increasing the amount of overlap between the edges of adjacent plate valves. Also, the arrangement as described insures a low flow gradient of refluxing liquid across the plate valves but this flow rate may be increased if desired by employing a greater degree of overlap between the plate valves so that the gas flow therebetween tends to accelerate the liquid flow across the deck. The amount of overlap between the plate valves may be determined by the spacing of the holes **22** in the bars **13**, or by the width of the plate valves, or by both of these expedients.

The degree of gas and liquid contact and mixing can be regulated by adjusting the spacing between the deck and the stop bar **15** to thereby vary the permissible degree of opening of the plate valves.

The actual size of the plate valves may be varied, if desired, and while they may be made of a length corresponding to the width of the column in which they are employed, it is, of course, possible to employ two or more plate valves placed end to end, if necessary, to reach across the column. In width the valve plates may vary between ⅜" when extensive and intimate mixing is desired, to about 3" or 4" when only rough fractionation is required. An average width of plate valve may be about one inch. The degree of overlap between the edges of adjacent plate valves may vary as desired but in general may be about ⅛".

It will be understood that the invention is not limited to the use of flat plate valves as shown in Figs. 1 to 3, inclusive, but these plates may be made in different cross-sectional contours, if desired. Thus, in Fig. 5, the forward edge of the plate is shown turned down to provide a depending lip **38**. This construction reduces the area of contact between adjacent plate valves and precludes sticking of the valves in instances where heavy or viscous refluxing liquids are used. A similar result may be accomplished by giving the plate a slight transverse curvature either concave or convex, as shown in Figs. 6 or 7. In addition, the plate valves in any of the proposed forms may be made with the forward edge serrated as shown in Fig. 8. By this means the gases are projected or jetted through the serrated edge and form bubbles in the refluxing liquid, which enhances the mixing action and increases the contact areas between the gas and liquid.

While the plate valves **12** in the form of the invention shown in the drawings are mounted to open in a manner to discharge gases in the direction of liquid flow across the deck, as shown by the full arrow in Figure 2, it is obvious that this arrangement may be reversed, if desired, by changing the inclination of the deck and thus have the gas flow considerably impede the flow of refluxing liquid as indicated by the dotted arrow and legend of Figure 2. Also, instead of positioning the plate valves at substantially right angles to the flow of liquid across the deck, they may conveniently be arranged at any desired angle to the flow of liquid. It should also be noted that while the column shown in Fig. 1 has only a single tray flow stream, it will be appreciated that an arrangement in which two or more flow sections may be arranged in a column having both side and center downcomers could be used if desired.

In most instances, one valve stop bar such as **15** is sufficient for each tray but where the decks and plate valves are of unusual length, two or more valve stop bars may be employed, if desired.

It will be understood that although reference is made herein to the plate valves at times being in "closed" position or are biased to "closed" position, there is no need that this condition insure complete stoppage of all fluid flow through the deck and that, due to the overlapped edges of the plate valves, some flow of fluid, either liquid or gas, or both, may occur at the end of the valves without interfering with the efficient operation of the apparatus as described.

In conclusion, it will be understood that the preferred forms of the invention described herein and shown in the drawings are but for the purpose of example only and various changes may be made in the arrangement, size and proportions of parts thereof, if desired, without departing from the spirit of the invention which is set forth more fully in the appended claims.

I claim:

1. A vapor-liquid contacting tray assembly comprising a plurality of spaced-apart substantially horizontal support members, a plurality of elongated plate valve members pivotally attached at one longitudinal edge to at least a pair of said spaced-apart support members, said plate valve members being disposed with the respective longitudinal edge portions thereof opposite said attached edge portions normally resting on and overlapping the attached edge portion of an adjacent plate valve member to form a deck across which liquid may flow, said plate valve members being adapted for upward pivotal movement about spaced-apart axes substantially parallel to said pivotally attached edges to provide openings in the deck between said plate valve members through which vapors can flow to contact liquid which may be flowing across said deck.

2. The apparatus described in claim 1 wherein the spaced-apart support members are generally parallel to each other and transversely disposed with respect to the attached plate valve members and wherein the plate valve members are pivotally connected to the spaced-apart support members for pivotal movement about substantially parallel axes adjacent to the respective attached edges of the plate valve members.

3. The apparatus described in claim 1 wherein the spaced-apart support members are provided with a series of longitudinally-spaced apertures, spaced lugs carried by each plate valve member adjacent to one longitudinal edge thereof, said lugs being entered into corresponding apertures of at least a pair of said spaced-apart support members and dimensioned for pivotal movement therein.

4. The apparatus described in claim 1 wherein the plate valve members are transversely contoured to provide substantial line contact between overlapping portions of adjacent plate valve members, when in closed position, thereby to preclude sticking of the plate valve members in the presence of viscous refluxing liquids.

5. The apparatus described in claim 1 wherein the

longitudinal edges of the respective plate valve members which in closed position thereof lie on top of adjacent plate valve members, are serrated.

6. A vapor-liquid contacting tray assembly comprising a plurality of generally parallel, spaced-apart, substantially horizontal support members, a plurality of elongated plate valve members pivotally attached at one longitudinal edge to at least a pair of said spaced-apart support members, said plate valve members being transversely disposed with respect to said spaced-apart support members and disposed with the respective longitudinal edge portions thereof opposite said attached edges normally resting on and overlapping the attached edge portion of an adjacent plate valve member to form a deck across which liquid may flow, said plate valve members being adapted for upward pivotal movement about spaced-apart axes substantially parallel to the pivotally attached edges to provide openings in the deck between said plate valve members through which vapors can flow; and a valve stop bar member positioned above and transversely of said plate valve members so as to engage and limit the extent of upward movement of said plate valve members.

7. The apparatus described in claim 6 wherein means are provided for mounting the spaced-apart support members for vertical adjustment within the tray including means for independently vertically adjusting opposite ends of said support members thereby to dispose the deck at a desired inclined position within the tray.

8. The apparatus described in claim 6 wherein means are provided for mounting said stop bar member for vertical adjustment with respect to the deck to thereby vary the extent of permissible upward movement of the plate valve members.

9. The apparatus described in claim 6 wherein means are provided for mounting said stop bar member for vertical adjustment with respect to the deck to thereby vary the extent of permissible upward movement of the plate valve members, said last-mentioned means including means for vertically adjusting opposite ends of said stop bar member independently to dispose said stop bar member in an inclined position with respect to the plane of the deck whereby to limit upward movement of the plate valve members at one end of the tray to a greater extent than the plate valve members at the opposite end of the tray.

10. The apparatus described in claim 6 wherein means

is provided for mounting the stop bar including resilient means positioned to resist upward movement of the stop bar in response to impact thereon of said plate valve members in response to a sudden and violent upward surge of gas within the column.

11. The apparatus described in claim 1 wherein the plate valve members are mounted within the tray for upward movement in a direction to discharge gases which may be rising within the column across the deck in a direction counter to the direction in which refluxing liquid is adapted to flow over the deck.

12. A vapor-liquid contacting tray assembly comprising a plurality of generally parallel, spaced-apart, substantially horizontal support members, a plurality of elongated plate valve members pivotally attached at one longitudinal edge to at least a pair of said spaced-apart support members, said plate valve members being transversely disposed with respect to said support members and disposed with respect to each other with the longitudinal edge of each opposite said attached edge normally resting on and overlapping the attached edge portion of an adjacent valve plate member to form a deck across which liquid may flow, said plate valve members being adapted for upward pivotal movement about spaced-apart axes substantially parallel to the said pivotally attached edges to provide openings in the deck between said plate valve members through which vapors can flow, and a valve stop bar member positioned above and transversely of said plate valve members to engage and limit the extent of upward movement of the plate valve members.

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