

Jan. 19, 1960

P. S. HEPP

2,921,777

VAPOR-LIQUID CONTACT ASSEMBLIES

Filed June 1, 1956

4 Sheets-Sheet 1

Fig. 1

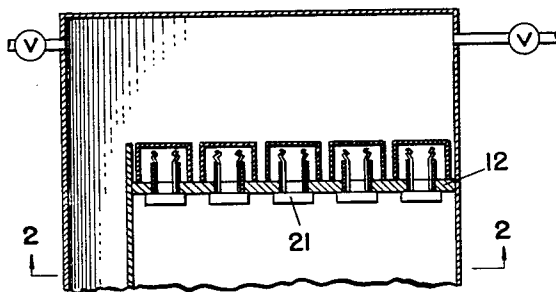


Fig. 2

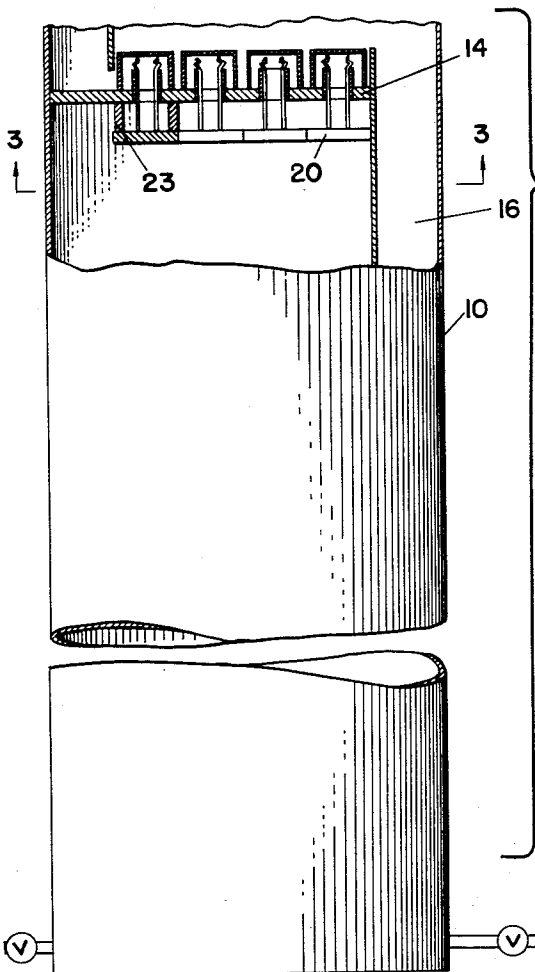
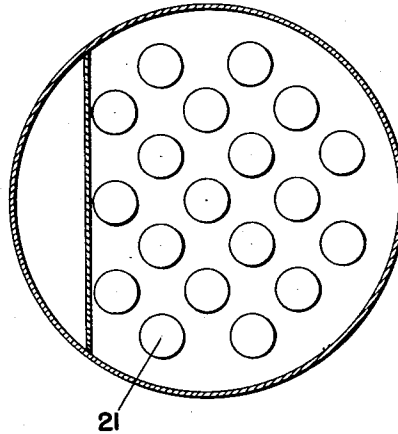
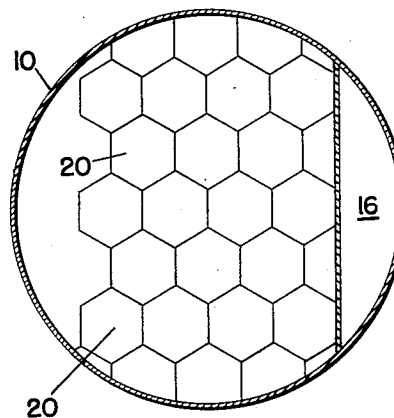


Fig. 1A

Fig. 3



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Fig. 4

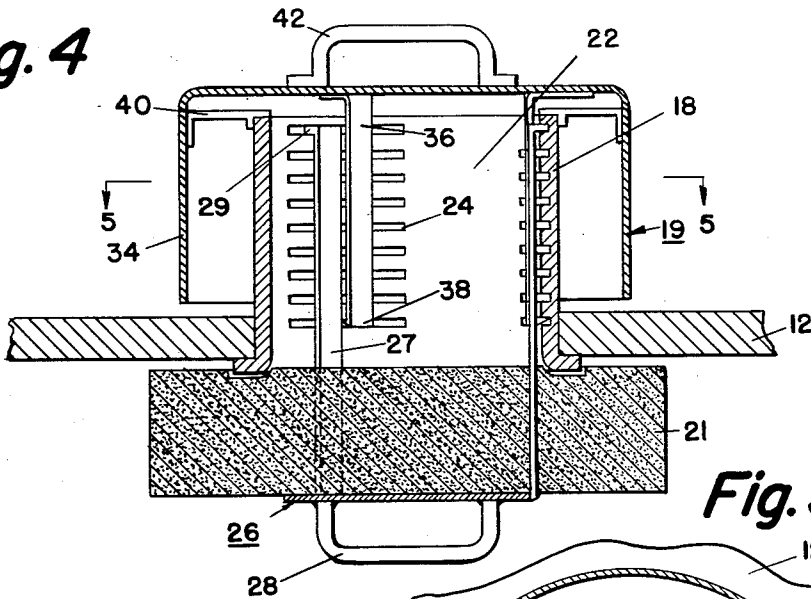


Fig. 5

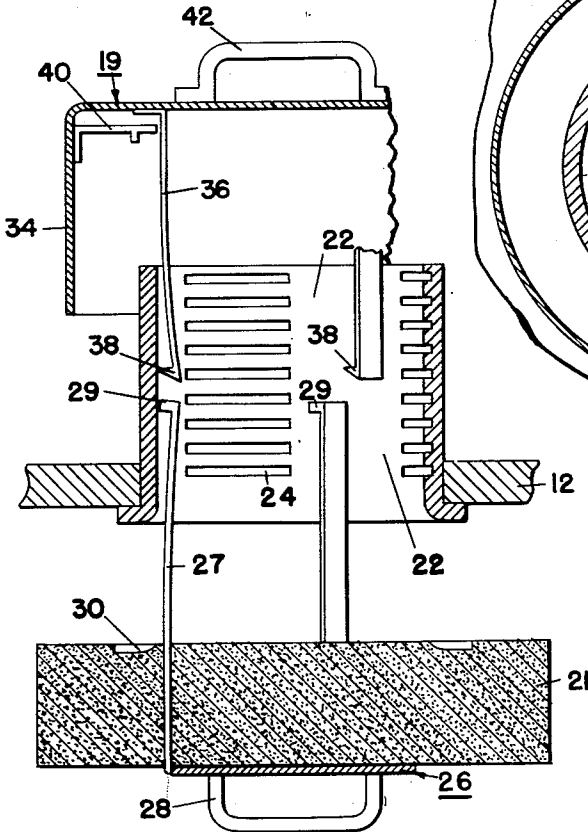
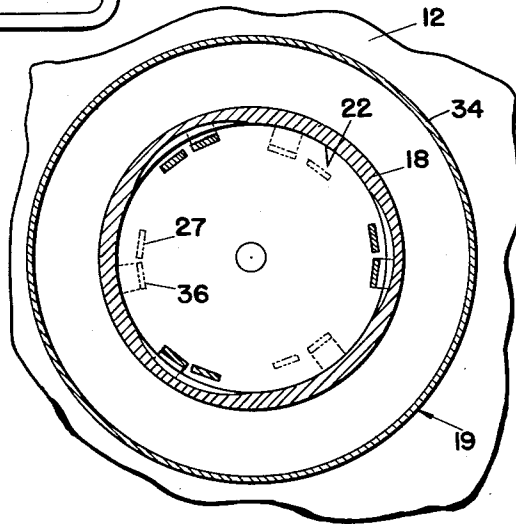


Fig. 6

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Fig. 7

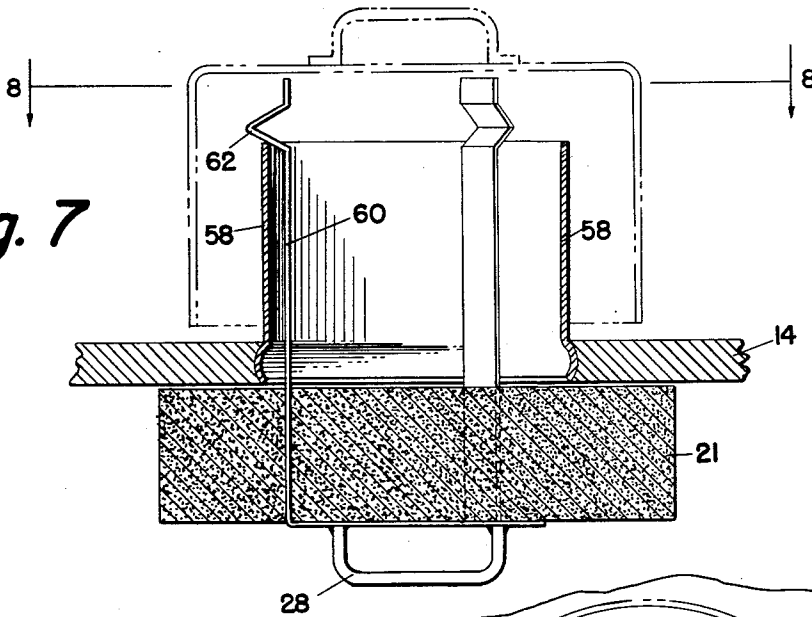


Fig. 9

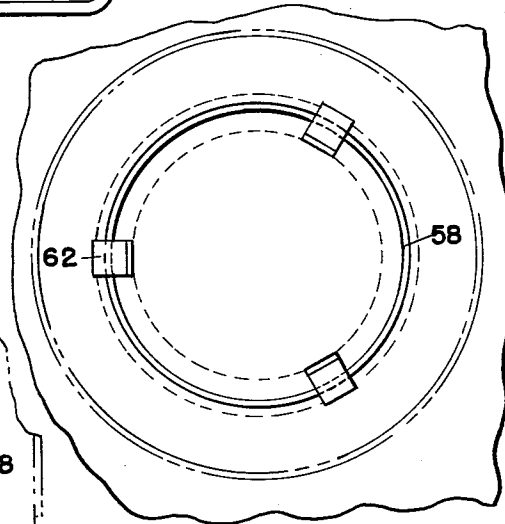
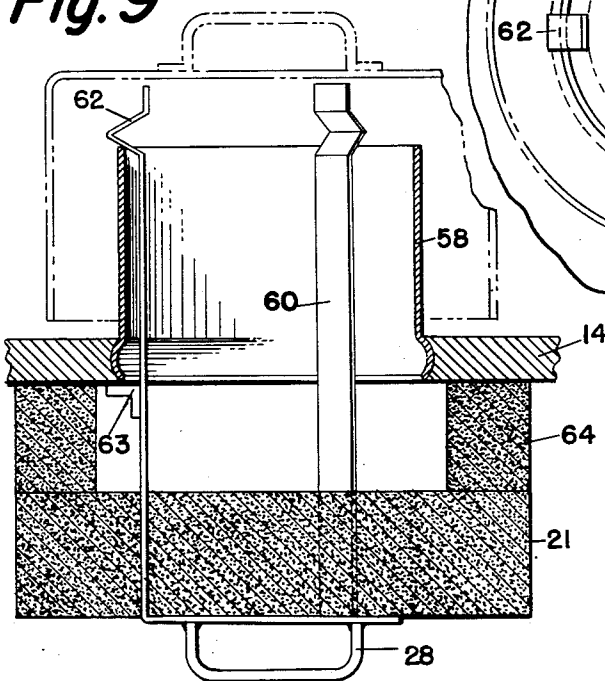


Fig. 8

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Fig. 10

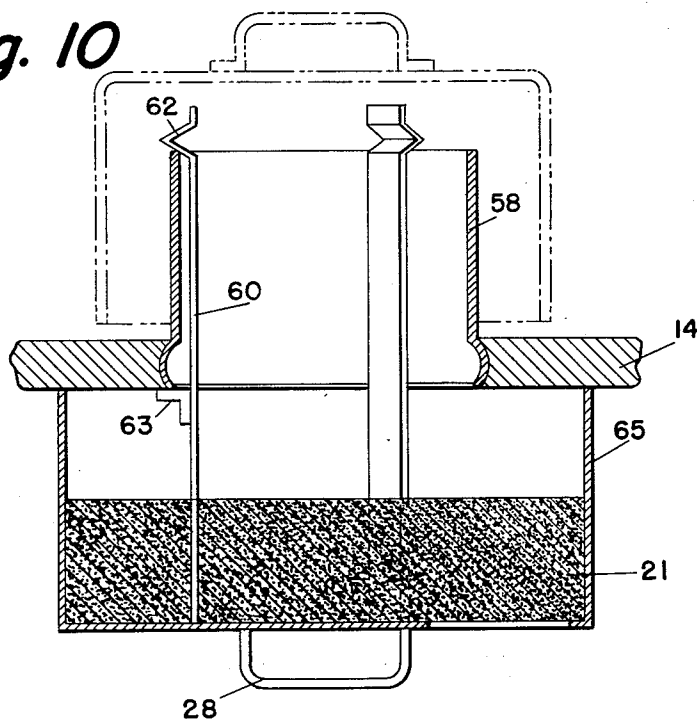
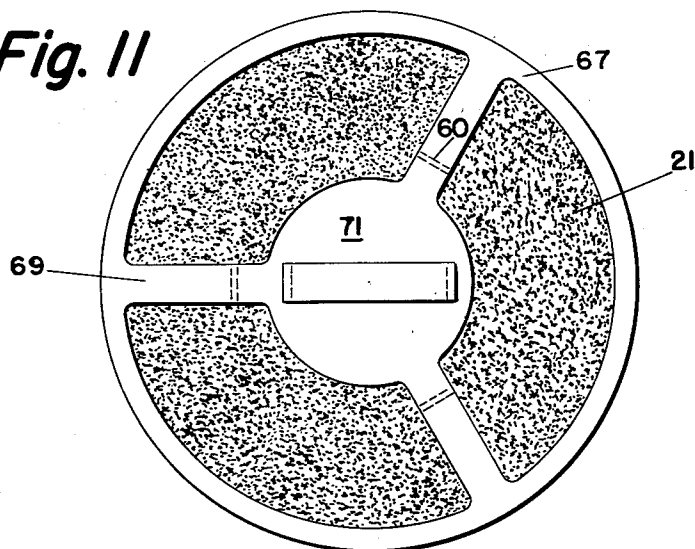


Fig. 11



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VAPOR-LIQUID CONTACT ASSEMBLIES

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Application June 1, 1956, Serial No. 588,879

3 Claims. (Cl. 261-114)

This invention relates to improvements in vapor-liquid contact assemblies, such as are used in fractionating towers and similar structures designed for the purpose of intimately contacting or separating gas and liquid.

Presently a normal arrangement for vapor-liquid contact assemblies in fractionating towers requires spacing trays of different contact devices at selected vertical levels. For example, one tray will support the well known bubble caps of acceptable design above openings as by chimneys, cooperatively engaging these openings. This special type of equipment may be repeated or may be interspersed with other contacting elements designed to assist in obtaining the desired results. In any case the flow of gas upwardly in the tower comes in contact with descending liquids and by means of the separate elements these are caused to more intimately contact or separate. Additional equipment used with bubble cap trays frequently takes the form of an element or group of elements positioned to be carried on the under side of the opening in the tray over which the bubble cap is mounted. An example is found in bubble caps combined with suspended inverted cups. Interposed layers of mist-eliminating material placed in the space between bubble cap trays is frequently used in place of such inverted cups, serving generally the same purposes. In such a case, as this last-mentioned expedient, the cost and labor required in initial installation and later maintenance of such an added device can be economically excessive. It is an object of this invention to provide a vapor-liquid contact assembly which will serve the full purpose of tray supported bubble caps interspersed with additional contact or separating elements, at greatly reduced cost and labor expense both in initial installation and maintenance.

A further object of this invention is to provide separate mist-eliminating elements adapted to cooperate with separate bubble caps.

Another object is to provide a mist-eliminating element, chimney and bubble cap combination as a vapor-liquid contact assembly designed for installation and maintenance by a single workman working from one side of the supporting tray only and without need of a helper.

Yet another object is to provide a vapor-liquid contact assembly of the stated elements which, although firmly engaged against dislodging pressures and surges within the tower, are easily and quickly released from either side of the supporting tray without the need of special tools.

Still another object is to provide a bubble cap-chimney combination for normal use which provides an easily maintained combination, securely held in operating position but releasable from either above or below the mounting tray by a single workman.

And still another object is to provide mist-eliminating elements adapted to operatively engage existing chimneys supporting bubble caps which are releasable from either above or below the bubble cap tray by a single operator.

Other objects and advantages of the invention will be apparent from the following detailed description taken

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in connection with the accompanying drawings, in which:

Figure 1 is a side elevation of the upper part of a tower in sectional view showing the improved assembly in operating arrangement.

Figure 1A is a side elevation of the intermediate and lower portions of a tower partially broken away in which is shown an alternate arrangement of the invention.

Figure 2 is a sectional view of Figure 1 taken on line 2-2.

Figure 3 is a sectional view of Figure 1A taken on line 3-3.

Figure 4 is a vertical sectional view of the bubble cap-demister combination assembled in operating position and enlarged to show structural detail.

Figure 5 is a sectional view of Figure 4 along line 5-5 showing latched and unlatched positions.

Figure 6 is an exploded vertical view in section showing the separate elements in position for engagement or removal.

Figure 7 is an elevational view in section of a modification of one element of the combination adapted for use in existing installations, completing the combination with a phantom outline of the existing portion.

Figure 8 is a sectional view of Figure 7 taken on line 8-8.

Figure 9 is an elevational view in section of an alternate arrangement of the modification illustrated in Figure 7.

Figure 10 is an elevational view in section of another alternate arrangement of the device illustrated in Figure 9.

Figure 11 is a bottom view of the device shown in Figure 10.

Referring to the details of the drawing, there is illustrated the usual type of fractionating tower or column 10, Figures 1 and 1A, which may be provided with inlets and outlets as are required, and here indicated. A number of transverse trays 12 in Figure 1 and 14 in Figure 1A are supported on the wall of the tower casing. Liquid is permitted to pass downwardly from one tray to another through the usual overflow pipes 16, or otherwise.

The vapor passages are provided with chimneys secured to the trays 12, 14. To facilitate the assembly and disassembly of the elements associated with these chimneys, later to be described, the chimney, shown as part of this combination, assumes a special configuration also later described. Several forms of the element for use with existing chimneys as shown in Figure 1 are also described as modifications of one part of this combination.

Continuing the general description, the two trays 12 and 14 indicated in Figures 1 and 1A are included to show two arrangements of the flexible assembly possible with the vapor-liquid contact device of this combination.

Figure 2 illustrates the use of demister body 21 fitting tightly against the underside of tray 12 to cover the chimney opening. Such an arrangement as this permits easy installation of the demister body, otherwise suspended in a separate tray, and efficient replacement of defective areas where necessary. As thus assembled and operated, the chimney opening is covered by the demister body 21 which can be reduced in area to any economical proportions required by the chimney area. The term "demister body" used above and later in this specification, refers to a piece of filter body material such as is described and claimed in Patent No. 2,327,184, or the like, especially manufactured for the purpose of intercepting gas entrained liquid particles.

Figures 1A and 3 show a spaced relation between the demister body 20 and the underside of tray 14. When this spaced relation is used, closely approaching present practices of suspended demister masses, close association

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between the separate demister sections is required. This is illustrated in Figure 3 where a polygonal body with contacting edges is shown for interior demister bodies. On the exposed edge of the demister mass an intercepting surface indicated as collars 23 in Figure 1A, later described in relation to Figures 9 and 10, is used. It will be recognized that the chimney spacing pattern will determine the most satisfactory polygon shape to assume to obtain a continuous demister barrier below the chimneys. As indicated, the suspended demister forms 20 contact each other and extend across the critical portion of the tower. As later to be described, the flexibility of the several disclosed elements affords variable vertical and horizontal spacing as well as ease in maintenance and installation, for better production. The suspended demister body can be used with an impervious collar or vertical spacer as it is called, which can be considered as a continuation of the chimney structure supported by the tray supplying an additional flue for gases and liquids, or the spacer may be made of demister or other porous material avoiding the requirement for matching geometrical patterns by extending the active demister area. This is disclosed and discussed in reference to figures of the drawing described later.

In any of the forms indicated, however, the vapor-liquid contact function of the disclosed combination is the same, and it retains all the necessary flexibility to meet the stated objects and above operating description. Figures 4, 5 and 6 are referred to for an understanding of the elements of this assembly each cooperating with the other to complete the combination.

In the specific combination disclosed here and illustrated in these Figures 4 to 6, inclusive, the common support for both the bubble cap 19 above the tray and the separator body (called "demister" here and numbered 20 or 21 as shown above) below the tray, is the chimney 18. For this combination, the chimney is especially designed and, as is evident from Figures 4 and 5, is cylindrical in section with smooth areas 22 spaced apart, circumferentially, on the inner wall. Cut into the inside of the chimney 18 between these smooth areas 22 are grooved areas formed of a plurality of horizontal grooves 24 arranged in parallel at predetermined elevations. These afford elevational positioning means for the separator or demister bodies 20 or 21 relative to the mounting tray and latching arrangements for the bubble caps, as will be better understood later. By spacing smooth areas in the chimney as at portions 22, between the latching segments 24, both the cap and separator body or demister can be quickly clipped in operating engagement or removed by a slight twist preliminary to the lift or drop required. It will be evident that this special chimney may be combined with the described bubble cap as a sub-combination of the complete assembly, or used to support the demister element with other forms of bubble caps. A modified form of the demister element sub-combination makes it usable also with other types of bubble caps and chimneys as later described.

A spring clip 26 extends upwardly through the demister material at substantially third points forming an operating element of this sub-combination. Structurally this corresponds to the circumferential spacing of the grooved portions 24 of the chimney 18 described above. A grip 28 attached to clip 26 assists in placing and removal.

At the upper end of the spring clip arms 27, an engaging portion 29 is shaped to move into grooves 24 with a shoulder portion designed to abut the upper and lower land portion of each groove. By so shaping this engaging portion of the clip 26, the separator body is able to resist operating pressures tending to dislodge it. As thus shaped the engaging top 29 of clip arm 27 will easily slide on the smooth areas 22 of the chimney and can be inserted to proper level then turned into locking engagement in the selected grooves 24. The demister or separator body portion 21 is grooved at 30, if necessary,

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where the chimneys are burred against the underside of the tray 12, to permit a tight fit against the tray 12 if used in that way. Where the underside of tray 12 is finished flush as shown in Figures 7, 9 and 10 later to be discussed, the chimney being fastened other than by burring the end as shown here, groove 30 can be omitted.

Closing the chimney 18 from above, bubble cap 19 includes within the body portion 34 three spring clip elements 36 fastened to the cap as by welding. These clips are spaced circumferentially, at third points for example, like those of clip 26 described as forming part of the separator unit, thus permitting cooperative use with the same chimney which thus forms the connecting element of the complete combination. The unsupported end 38 of element 36 is bent to engage the upper side of a groove 24, shown here as that one lowest in the chimney but could be any one of the group. As shown in Figure 4 the supporting spring clip arms of both the bubble cap and the separator element can use the same groove without interference. In this figure the engaging ends 38 of spring clips 36 are bevelled on the under side and flat on the upper side. This shape locks the cap in place resisting lifting pressures yet permits easy and rapid placement on the chimney. By bevelling the bottom of end 38, direct insertion of the cap over the grooved surfaces is permitted avoiding the steps of passage over the smooth area 22 and rotation to engagement as required for the separator element described above. Inside the bubble cap 19, positioning brackets 40 space the cap horizontally and vertically from the chimney 18 and relative to tray 12. A ring or handle 42 is centered outside the cap to permit a turning action and lifting movement for insertion and removal relative to the chimney.

Rotation of the bubble cap 19 through a third turn will remove the engaging ends 38 of clips 36 from grooves 24 to smooth areas 22 of the chimney as shown in Figure 5 phantom lines, and in Figure 6. The bubble cap is then easily removed. A simple tool similar to a spanner member can be used to rotate the clips of the separator combination in like fashion to drop them while working above the tray. Or these separators may be removed by rotating the sub-combination by grasping grip 28 and rotating as described for removing the bubble cap. Thus the bubble caps and separators in each tier can be removed without assistance above or below. Replacement is made by reversing the operation described with the additional facility of being able to clip the bubble cap without rotation as previously described.

The exploded illustration in Figure 6 illustrates the initial steps of assembly or disassembly which, when taken together with Figure 5 and the above description, shows one of the advantages of this combination. This view of the device compared with Figures 7 to 11, inclusive, will illustrate the combination in contrast with the separate use of the demister element with other types of chimneys and bubble caps. A workman in between the trays will have access, on the tray below him, to bubble caps, and above him to the separator bodies. Discussion of the operation of these elements as shown in these figures will emphasize the placement and removal of these items without additional help above or below.

The above description and discussion is directed to a combination of elements forming an illustrative embodiment of the invention. Without materially changing the demister elements, and entirely within the scope of the letter and spirit of the invention, this portion of the combination can be adapted for use, to excellent advantage, with existing equipment. Figures 7 through 11 show such a modification of the demister bodies 20 and 21 with the supporting spring clip adapted for use with existing chimneys in bubble cap assemblies generally. These figures show the demister element and support engaging a typical chimney 58 in which there are no grooves nor spaced smooth portions described above for the combination. No particular form of bubble cap is

shown as it does not enter into the support of the demister body as does the chimney. For clarity of understanding, a bubble cap of no particular kind is indicated in phantom line where necessary to complete these figures.

As is evident from the illustrations the spring clip 60 varies in length as required, being sufficiently long to engage an upset portion 62 thereof with the top of the chimney in all instances, positioning the demister body 21 either in contact with the underside of the tray 12 (Fig. 7) or spaced therefrom (Figure 9). In these figures the circular demister element 21 is shown as the element used. With the exception of Figure 1A where the polygonal form of demister 20 is shown with spacers mounted on the peripheral assemblies, the circular form 21 in Figure 1 is otherwise suggested as easier to use. The demister element 20, described as of geometrical section capable of abutting like shapes as previously described, is used in specific instances. When so used the structure would parallel Figure 9 omitting spacer 64 except as in Figure 1A, and to be described later. The positions of the separator elements either adjacent the underside of the tray or spaced therebelow except for the spacer combination of Figures 9, 10 and 11 parallel those previously described relative to Figures 1, 1A, 2 and 3 and need not be repeated here. The spacer can be made of either pervious material such as demister material as in Figure 9, or of impervious material such as metal as shown in Figures 10 and 11. When demister material is used, it is evident that the separator area would be extended, as would the travel path of the gases, and any shape demister element 21 which extends beyond the tray opening as shown in Figure 9 and spacer 64 could be used.

Figures 10 and 11 show a form the combined demister element 21 can take when used with an impervious spacer 65. A metallic cup is used here as spacer 65, adapted to form a supporting lip 67 and spider connection 69 across the bottom (Fig. 11). Such construction apertures the cup bottom for passage of vapors through the supported demister material. A central support 71 provides an area to which a handle or grip 28 is fastened. Upwardly projecting spring clips 60 with upset top portions 62 form the connecting elements as previously described and are connected as shown in Figure 11 to spider 69. The depth of the metallic cup form of spacer 65 is coordinated with the length of clips 60 forming a tight seal with the underside of tray 14. An insert shaped to fit the cup 65 and allow for passage of clips 60 forms the demister body noted as number 21. By means of handle or grip 28 the device is readily inserted or removed in chimney 53. Bracket 63 helps position the demister body 21 and cup 65 and lends rigidity to clips 60.

From the above it will be evident to those versed in the art that the vapor-liquid contact assembly described may be considered as separated into a bubble cap assembly including bubble cap and chimney elements for use on a perforated tray and a mist barrier element usable either as part of the combination with the special bubble cap sub-combination described, or generally with like equipment. As described, the assembly uses all the included features. When divided into sub-combinations and separate elements, not all the features are employed. This is especially true of the internal structure of the chimney element. The horizontally grooved portions with separating smooth areas spaced peripherally of the interior of the chimney are used by the spring clips of both the bubble cap and the suspended demister in the combination. The horizontal grooves spaced in the special chimney of this application can be used to regulate the depth of suspension of the mist barrier element and also to vertically position the bubble cap if desired. For securing the bubble cap against pressures and surges

in the tower, however, the centering-elevating bracket 40 of the bubble cap should be fastened at proper elevation in the cap to engage the chimney as shown, thus cooperating with the spring clip arrangement. In all cases the bubbles cap rests firmly on the chimney secured by the spring clips engaging the chimney grooves. However, the coordinated operation of the complete assembly of elements, and their separated functions considered as sub-combinations and elements, emphasizes the versatility of the mechanism and the almost universal application of which it is capable.

The adaptation of a demister body to either the combination or separate use described has many advantages immediately evident to those versed in the art. Installation of demister trays presently used, requires fixed support facilities and once installed cannot be changed without great labor and expense. Maintenance requires complete removal and replacement of the demister layer when any defective area appears. The device here described affords inexpensive installation. Maintaining the towers using these elements is reduced to a one-man job for easy replacement of defective parts. Further, the device described can be adjusted with a minimum of labor and expense to meet operational requirements involving demister spacing, addition or removal, and provides a wide variety of arrangements for operational success, not possible with known structures.

I claim:

1. Mist-eliminating means for use with a bubble cap tray in a vapor-liquid contact apparatus in combination with the chimneys mounted in the apertures of said tray and in which each chimney has a plurality of arcuately spaced grooves vertically arranged to form alternating grooved and ungrooved areas inside said chimneys, comprising a spring clip with a plurality of arms adapted to extend upwardly into the chimney and circumferentially spaced to contact the grooved and ungrooved areas for engaging and disengaging cooperation, a body of demister material adapted to intercept the passage of vapors upwardly through the bubble cap tray supported by said clip below the chimney, and a grip engaging the arms of the clip below the demister body for rotatably connecting and disconnecting said clip and chimney.

2. The mist-eliminating means of claim 1 further characterized by the body of demister material adapted to intercept the passage of vapors being shaped to peripherally contact like bodies in a plane below the bubble cap tray forming an unbroken vapor barrier beneath the bubble cap tray.

3. The mist-eliminating means of claim 1 further characterized by the body of demister material adapted to intercept the passage of vapors including a demister body of selected peripheral shape spaced below the bubble cap tray, and extensions of demister material supported on said demister body and extending the periphery thereof upwardly to operably engage the underside of the tray.

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