In apparatus for contacting liquid with vapor or gas, as in fractional distillation and other contact operations, an arrangement of the liquid in very thin vertical films with which the gasform molecules may contact in counter current flow has shown particular advantages over the usual forms of apparatus in which the liquid is arranged in pools on trays through which the gasform molecules may rise in bubble form. The mechanical difficulties in adequate support of closely enough spaced surfaces for the liquid have militated against realization of the highest efficiency theoretically possible. Very thin sheet metal has been necessary in order to provide the largest amount of liquid surface with the least bulking loss of space, but this has necessitated the interposition of spacer elements and on some constructions dents in the sheet metal to prevent misplacement of the sheet metal into contact and corresponding obliteration of the proper spaces. These spacer elements have interfered with even liquid flow in the films and have introduced disturbing eddy currents in the vapor flow, and the efficiency has been lessened. In accordance with the present invention, a construction is involved which provides a particularly free flow for liquid films and for vapor, and which may be in standardized form or units allowing application on large or small scale as desired in any instance. Other objects and advantages will appear from the description following.

To the accomplishment of the foregoing and related ends, the invention, then, comprises the features hereinafter fully described, and particularly pointed out in the claims, the following description and the annexed drawing setting forth in detail certain illustrative embodiments of the invention, these being indicative, however, of but a few of the various ways in which the principle of the invention may be employed.

In said annexed drawing—

Fig. 1 is a vertical sectional view, partly broken, showing an embodiment of the invention; Fig. 2 is a transverse sectional view taken on a plane substantially indicated by line II—II, Fig. 1; Fig. 3 is a similar view taken on a plane substantially indicated by line III—III, Fig. 1; Fig. 4 is a perspective view showing a modified form of liquid feeder; and Figs. 5 and 6 are fragmentary transverse and vertical sectional views of plate details.

The construction involves, in general, a housing 2, with an inlet connection 3 below, and an outlet connection 4 above, and having a plurality of closely spaced thin plates 5 positioned at their lateral edges and open at the top and bottom so as to allow vapor or gas to flow freely, while liquid flows downwardly in thin films on the surfaces, and at the top liquid feeder means is arranged. The plates or sheets 5 are of suitable material, usually metal, in view of the liquids, etc., to be treated, and ordinarily, as with non-corrosive liquids and gases the sheets may be a metal such as sheet steel, iron, copper, brass, zinc, etc. With liquids and gases which might cause corrosion, stainless steel, high chromium steel, nickel, monel, etc., may be employed. The sheets uniformly plain or flat throughout are assembled into a unit or co-related structure between carrier plates 6, so as to be closely spaced to allow the passage of liquid films and gases as afore-indicated. They may be joined at their edges to the carrier plates by suitable means, such as soldering, welding, etc., but we prefer to avoid such fastening in so far as possible by special forming of the sheets. For example, flanges 8 may be formed on the lateral edges of the sheets so that when apposed together the flanges provide the spacing, Fig. 5. Not all plates will then need to be fastened, as the plates may rest on narrow ledges C at the bottom of carrier plates 6. The unit assembled may be in any form of cross section desired, usually a parallelogram, and a rectangular or square cross section is most generally advantageous from a manufacturing and assembly standpoint. For a small device, one such unit with its plurality of spaced sheets 5 and edge-carrier plates 6 is sufficient. Larger devices are assembled by bringing together such number of units as desired in any case. In the illustration in Fig. 2, four such units are shown in assembly. The cross sectional shape of the housing 2 may be as desired in any given instance. A rectangular or square cross section is convenient generally. Where desired, a circular cross section may be applied, as indicated in dash lines 2' in Fig. 2, and in such case the corner edges 8 of the assembled units may be suitably anchored to the inside of the circular shell, and the escape of fluids to the space laterally of the units may be prevented by securing headers 10 to close off access at least below, or both above and below. Or, for cylindrical columns of suitable size the units may be of cross-sectional shape to make up the segments of the circular cross section.

To feed liquid such that it may film down on the surfaces of the plates or sheets 5, various feeding apparatus may be applied, but a preferable form involves pieces or strips 12 of a wicking agent or a woven mesh, such as woven wire fabric, glass
2 cloth, etc., these being superposed above the top edges of the plates 5, and extending through slits in the bottom of a liquid tray 13, and well up into the tray 13 which may be of any suitable shape, such as a reflex liquid distributor above and feeding said units and having a liquid tray and a plurality of woven wire feeder strips extending through slits in the tray bottom to the upper edges of the aforesaid thin plates and with projecting wires straddling the tops of the plates, and a liquid tray above the first-mentioned tray and having a plurality of woven wire strips extending through slits in the tray bottom to contact the top edges of the aforesaid feeder strips and at a transverse angle thereto, an inlet to the housing for liquid to the upper tray, and a vapor passway through the liquid trays allowing communication from the unit.

2. Apparatus of the character described, comprising a plurality of closely spaced parallel thin plates anchored at their lateral edges and open above and below, a liquid distributor assembly, and a liquid tray above the first-mentioned tray and having a plurality of woven mesh strips extending through slits in the tray bottom to contact the top edges of the aforesaid feeder strips and at a transverse angle thereto, and a vapor passway providing communication between the spaces between said plates and said outlet.

3. In apparatus of the character described, a liquid distributing tray having a plurality of woven mesh strips extending through slits in the tray bottom, and a liquid tray above the first-mentioned tray and having a plurality of woven mesh strips extending through slits in the tray bottom to contact the top edges of the aforesaid strips and at a transverse angle thereto, and a vapor passway providing communication with the spaces between said plates.

4. In apparatus of the character described, a liquid distributing tray having a plurality of liquid-distributing strips extending through slits in the tray bottom, and a liquid tray above the first-mentioned tray and having a plurality of liquid-distributing strips extending through slits in the tray bottom to contact the top edges of the aforesaid strips and at a transverse angle thereto, and a vapor passway allowing communication from below said plate to and said outlet.

5. Apparatus of the character described, comprising a housing, a plurality of vertical units therein each being an assembly of closely spaced parallel thin plates spaced by flanges at their lateral edges and open above and below, a feed inlet to the housing below said units, an outlet at the top of the housing, a reflex liquid distributor above and feeding said units and having a liquid tray and a plurality of woven wire feeder strips extending through slits in the tray bottom to the upper edges of the aforesaid thin plates and with projecting wires straddling the tops of the plates, and a liquid tray above the first-mentioned tray and having a plurality of woven wire strips extending through slits in the tray bottom to contact the top edges of the aforesaid feeder strips and at a transverse angle thereto, an inlet to the housing for liquid to the upper tray, and a vapor passway through the liquid trays allowing communication from the unit.

We therefore particularly point out and distinctly claim as our invention:

1. Apparatus of the character described, comprising a housing, a plurality of vertical units therein each being an assembly of closely spaced parallel thin plates spaced by flanges at their lateral edges and open above and below, a feed inlet to the housing below said units, an outlet at the top of the housing, a reflex liquid distributor above and feeding said units and having a liquid tray and a plurality of woven wire feeder strips extending through slits in the tray bottom to the upper edges of the aforesaid thin plates and with projecting wires straddling the tops of the plates, and a liquid tray above the first-mentioned tray and having a plurality of woven wire strips extending through slits in the tray bottom to contact the top edges of the aforesaid feeder strips and at a transverse angle thereto, an inlet to the housing for liquid to the upper tray, and a vapor passway through the liquid trays allowing communication from the unit.
of said plates, an inlet to the housing for supplying liquid to said liquid receiving means, a liquid outlet at the bottom of said housing, and a vapor passway through said liquid receiving means for conducting vapors to said vapor outlet from the spaces between said plates, said vapor passway having an elongated horizontal cross section extending transversely over all of said plates.

6. Apparatus of the character described, comprising a housing, an assembly of closely spaced parallel vertical thin plates therein spaced at their lateral edges and open above and below, a vapor feed inlet to said housing for admitting vapor to the space below said plates, an outlet at the top of said housing for discharging vapors, a liquid distributor above said plates for feeding liquid to said plates and having a liquid tray with a plurality of woven feeder strips passing through slits in said tray with the opposite edges of each slit contacting the opposite sides of the associated strip, the top portion of each strip being located above its slit and adapted to contact the liquid in said tray, the entire width of each feeder strip extending downwardly into contact with the tops of said thin plates, whereby the liquid flow along all portions of the length of each feeder strip is accomplished solely by the action of gravity, an inlet to the housing for supplying liquid to said tray, an outlet for liquid at the bottom of said housing, and a vapor passway through said tray and extending transversely over said plates allowing communication from the spaces between said plates to said vapor outlet, said vapor passway being spaced from said slits so as to be free of obstruction by said woven feeder strips.

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