April 10, 1962 F. C. KOCH 3,029,070

PLATE FOR CONTACT APPARATUS

Filed April 8, 1958

Fig. 1.

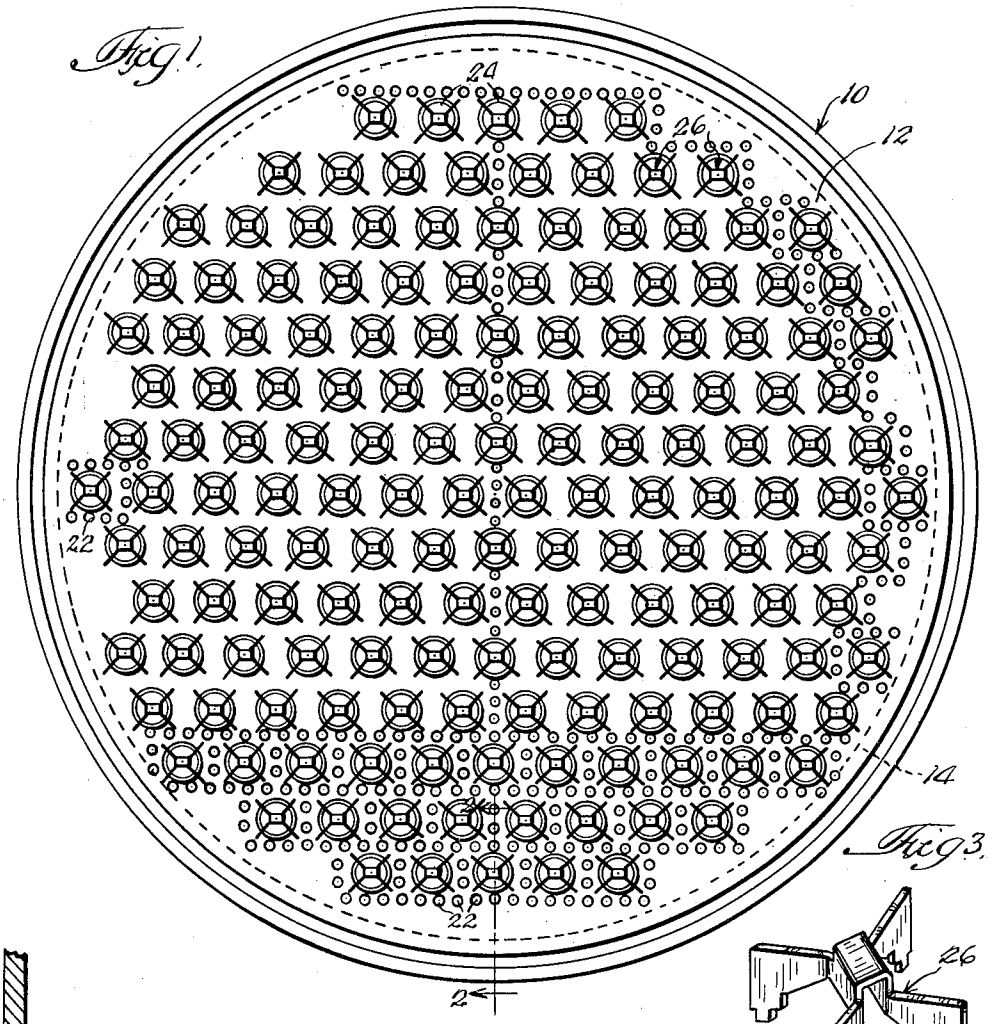


Fig. 3.

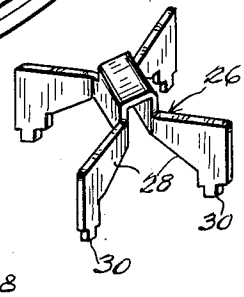


Fig. 2.

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United States Patent Office 3,029,070 Patented Apr. 10, 1962

3,029,070

PLATE FOR CONTACT APPARATUS

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Filed Apr. 8, 1958, Ser. No. 727,203
3 Claims. (Cl. 261—113)

The present invention pertains to a contact apparatus and more particularly relates to an improved tray or plate construction employed therein.

The apparatus hereinafter disclosed is particularly well adapted for the fractionation of organic liquids such as hydrocarbons, alcohols, and the like; being, however, equally well suited for the washing of gases or in fact any operation in which effective contact between gases or vapors and liquids, or liquids and liquids, or other countercurrently flowing fluid phases in general, is to be effected.

Previously contact apparatus has been employed which utilize flat plates or trays which have series of slots or apertures formed therein. Such trays work on the principle that increasing vapor velocity through the slots or apertures enables a liquid level to build up on the plate until it counterbalances the pressure drop through the tray. The liquid then surges down through the plate openings intermittently while the vapor passes upward through the tray intermittently in the apparatus.

Trays of this type, however, although possessing a very large capacity, have limited flexibility. At low vapor velocities the trays tend to dump themselves in the absence of a sufficient pressure to force the build-up of liquid on the tray surface.

It is an object, therefore, of the present invention to provide a novel contact apparatus employing plates which enable such apparatus to have the advantage of the high capacity of the perforated tray-type apparatus in addition to the flexibility of other type contact apparatus well-known in the art and more particularly the flexibility inherent in the gas liquid contact apparatus disclosed in the Huggins et al. Patent No. 2,772,080 which issued on November 27, 1956.

It is another object of this invention to provide an improved plate construction for use in a contact apparatus which is simple in details of construction and which may be readily fabricated with a minimum expenditure of time and labor.

The above and other objects of this invention will become more apparent from the following detailed disclosure when read in the light of the accompanying drawing.

In one embodiment of the provided apparatus a contact apparatus shell is provided in which is disposed a plurality of superposed contact trays or plates of substantially planar surface configuration. The planar configuration of each plate is interrupted by openings for enabling a rising fluid phase to pass therethrough in the normal course of apparatus operation. Each of the openings is defined by a raised lip portion defining the periphery thereof. Loose cover members are arranged on each of the raised peripheries and function as valve members, preventing passage of the rising gas or other fluid phase through the plate openings until sufficient pressure has built up to remove the cover members from the raised peripheries or valve seats.

Valve retaining means are secured to the plate and limit the upward movement of the valves from the plate surface and assure return of the valves to their proper seated positions atop the raised seats in the normal course of operation. The valves and valve-retaining means hereinafter described in greater detail are the same as those described in Patent No. 2,819,050, which issued to C. A. Huggins and Griffin C. Thrift on January 7, 1958. The

specific valve construction and retaining means described herein, however, are only illustrative of forms which are workable for purposes of carrying out the inventive concepts herein disclosed.

Interspersed between the raised lip portions or valve seats of the provided plates are small apertures which are adapted to permit passage of the countercurrently flowing fluid phases present in the tower in the normal course of tower operation. The apertures permit the tower to operate efficiently at low capacities, after which the plate valves will open as will hereinafter be described in greater detail.

For a more complete understanding of this invention reference will now be made to the drawing, wherein:

FIGURE 1 is a top plan view of a plate or tray for use in a contact apparatus made in accordance with the teachings of this invention;

FIG. 2 is a fragmentary enlarged sectional view taken on line 2—2 of FIG. 1; and

FIG. 3 is a perspective view of the valve retaining means illustrated in FIGS. 1 and 2.

Referring now to the drawing and more particularly to FIG. 1, a top plan view is illustrated of a plate or tray member utilized in a contact apparatus in which a rising light fluid phase, such as a vapor, countercurrently engages a descending heavier fluid phase, such as a liquid, for purposes of providing intimate contact therebetween and as a result effecting desired rectification or a similar type operation.

The numeral **10** in FIG. 1 designates a shell in which a plurality of plates, such as plate **12**, are arranged in spaced superposed relationship. As will be seen more clearly from FIG. 2, each plate **12** may be supported in shell **10** by means of an annular ring member **14** which is welded as at **16** or otherwise suitably affixed to an inner peripheral portion of the shell **10**. The plate **12** may rest on the latter ring **14** and be secured thereto by spot welding or by means of nut and bolt assemblies or other equivalent securing means.

It will be noted from FIG. 2 that each plate **12** has a substantially even or planar surface configuration which is interrupted by projecting lip portions **18** which define the peripheries of openings **20** formed in the plate **12**.

Interspersed between openings **20** (see FIG. 1) are a plurality of apertures **22** formed in the plate **12**. As seen in FIG. 2 the cross-sectional area of each aperture **22** is much smaller than the cross-sectional area of each opening **20**.

Disposed atop the periphery of each raised lip portion **18** is a loose cover member **24** which is adapted to reciprocally move in a vertical plane. In the position of rest illustrated, the valve **24** will be disposed on the upper edge of the lip **18** in the normal course of contact apparatus operation. When the vapor pressure rising from below the illustrated plate is sufficiently great, as will hereinafter be explained, the valve or cover **24** will be removed from its position of rest atop lip **18** and be forced to assume a raised position. A retaining means **26**, which is more clearly seen in perspective in FIG. 3, retains each cover **24** to its respective seat and limits the distance each cover may be removed therefrom.

As will be noted from FIG. 3, each retaining means **26** comprises a spider-like member consisting of four post-like portions **28** having terminal foot portions **30** which may traverse apertures formed in each plate **12** and be readily secured to such plate by means of a simple upsetting operation. The illustrated valve **24** and retaining means **26** are the same as those disclosed in the Huggins and Thrift Patent No. 2,819,050, which issued January 7, 1958. However, it will be appreciated that the specific configuration of the loose cover member and the retaining means therefor is not of primary importance, and a large

number of valve and retaining means structures will work to advantage in the provided contact apparatus. It is apparent that the valve member should be loose and readily removable in an upward direction from its valve seat, and it is equally apparent that the retaining means should enable the valve to rise to a desired height in addition to functioning as a means for returning the valve member to its proper seated position.

In the normal course of operation a rising fluid phase which may comprise a gas or vapor passes through the plate apertures **22**. As the vapor velocity increases, the liquid level, which liquid may, for example, be formed from condensed vapors descending from trays above, is forced to build up on the tray since the vapor velocity exceeds the force of the liquid head created as the liquid builds up on the tray. However, after the liquid level is built up to the extent that it counterbalances and exceeds the pressure drop through the tray, the liquid which has built up on the tray surges down through the apertures **22**. Such is the normal course of operation when the illustrated contact apparatus functions at low vapor velocity.

As the vapor velocity continues to increase, the liquid level on the illustrated plate **12** never attains a height sufficient to counterbalance or exceed the pressure drop through the tray. Accordingly a point is reached whereat the pressure of the rising fluid phase in the apparatus is sufficient to raise the lifters or covers **24** from their respective valve seats. Therefore, with increasing vapor velocities the valve members **24** will begin to rise, allowing the vapor passing through each plate to become dispersed in the liquid head which has formed on each plate. As a result of the valve members rising from their seats, the apertures **22** may then function exclusively for allowing the downflowing fluid phase or condensed liquid to pass through the plate. Consequently, at high vapor velocities when the covers or valves **24** are removed from their seats **18**, the apertures **22** formed in the plate **12** function as downflows, while the vapor or light fluid phase passing upwardly in the contact apparatus traverses each plate by means of the opening **20** formed therein.

To enable the illustrated contact apparatus elements to efficiently function in the manner described, each cover or valve **24** must be of a weight greater than that volume of condensed liquid defined by the cross-sectional area of the opening **20** and the height of the raised seat or lip portion **18**. As a result of this latter weight relationship, each valve **24** will be unable to be raised from its respective seat **18** until the liquid level on the plate exceeds the height of the lip or seat **18**. As a result it is apparent that when the valve members **24** are removed from their seats, the rising vapors passing through the openings **20** will pass through liquid disposed on the plates.

It is seen, therefore, that the contact apparatus provided, and more particularly the tray construction above described, comprising an apertured plate and a plurality of lifter valves interposed between such apertures, enables efficient operation to be effected at both low and high vapor loads and in addition enables the provided apparatus in which disposed to have an extremely large capacity. The provided tray, therefore, is possessed by the seemingly incongruous desirable qualities of large capacity and flexibility.

The cross-sectional area of each opening and aperture, the spacing of the same, and the ratio of aperture area to valve opening area may obviously be varied tremendously depending upon the degree of flexibility desired. In the illustrated embodiment the ratio of valved opening area to aperture area is approximately 1.4:1, and the ratio of tray area to valved opening area is approximately 7.5:1. However, it is apparent, for instance, that the number of apertures illustrated may be reduced considerably with the size of the same enlarged. The diameters and cross-sectional configuration of the valved openings may be varied.

It has been found for all practical purposes that the height of the valve seat **18** above the level of the plate **12** from which formed should range between ⅛ inch and ⅜ inch. However, these dimensions may be altered to suit the needs of the particular fluid phases being processed.

It will also be noted that to add to the flexibility of the provided contact apparatus, the covers or valves **24** may be arranged in predetermined groups having different weights. As a result the valve covers will open by groups; such an arrangement is of importance in insuring uniform vapor distribution through a contact apparatus plate, particularly where there is danger or chance that the plate may be installed or eventually become disposed in a nonlevel position. Despite such a condition, uniform vapor passage through the valve openings is assured if the valves are predeterminately arranged in definite groups as above described. Also the valve seats may be arranged in groups of varying height above the level of the tray planar portions for similar purposes.

The provided tray construction, although possessed of the advantages above described, is simple in details of construction. Each plate merely comprises a metal sheet (or series of sheets) which is predeterminately apertured for purposes of forming the passageways **22** and which have the flared openings **20** formed therein, the edges **18** of which function as valve seats. The illustrated covers or valves **24** may be readily formed by a simple stamping operation, and the retaining means **26** may be also formed by simple stamping and forming operations as previously mentioned. The retaining means may be fixedly secured to each plate **12** by a simple upsetting operation whereby the foot portions **30** are secured to the plate bottom.

Although the lip portions **18** are illustrated as being formed integrally with the remainder of the plate **12**, discrete means may be employed for purposes of providing a raised valve seat. For instance, ring portions may be secured to the plate about the peripheries of holes which have been formed therein. Such a construction may function to equal advantage with the arrangement shown in the drawing.

This invention is to be limited only by the scope of the appended claims.

I claim:

1. In a contact apparatus for effecting contact between a rising gaseous phase and a heavier descending liquid phase, a plate upon which the heavier liquid phase can accumulate; said plate having a plurality of unvalved perforations and having a plurality of valved openings therein, said perforations being of lesser cross-sectional area than said valved openings, each valved opening having a valve seat raised above the level of said plate perforations in the normal position of plate assembly, loose valve means reciprocally movable relative to each of said valve seats, each of said valve means being of greater weight than a volume of heavier liquid phase defined by the cross-sectional area of the opening on which said valve is disposed extending to a height equivalent to the valve seat height above said plate so as not to be liftable from the valve seat by the rising gaseous phase until said valve seat is below the level of the heavier descending liquid phase accumulated on said plate, and means for limiting the upward movement of said valve means and guiding the return of said valve means to its seat.

2. A contact apparatus for allowing contact beeween countercurrently flowing rising gaseous and descending liquid phases, comprising a housing and a plurality of substantially planar plates upon which the descending liquid phase can accumulate arranged therein, said plates being in spaced superposed relation, each plate being provided with a plurality of unvalved apertures and a plurality of valved openings, a raised lip portion defining the periphery of each of said plate openings, loose covers

for said openings liftable by a rising fluid phase in said apparatus and resting on said lip portions when in a non-elevated position, means supported by said plates for limiting the upward movement thereof, each of said covers being of greater weight than a volume of heavier liquid phase defined by the cross-sectional area of the opening on which said valve is disposed extending to the lip portion height above said plate so as not to be liftable from its lip portion by the rising gaseous phase until said lip portion is below the level of the descending liquid phase accumulated on said plate, each of the plate planar areas having apertures of smaller cross-sectional area than said openings formed in said plates interspersed between said openings for permitting passage of such rising and descending fluid phases when said loose covers are resting on said plate lip portions.

3. In a contact apparatus for enabling a rising light fluid phase to countercurrently engage a descending heavy fluid phase, the combination comprising a housing and a plurality of substantially planar plates on which said descending heavy fluid phase can accumulate arranged therein, said plates being in spaced superposed relation, each plate being provided with a plurality of unvalved perforations and a plurality of valved openings, said plate openings having peripheral portions disposed about ⅛ to ⅜ inch above the level of said substantially planar plate in which disposed, loose covers for said openings liftable by such rising fluid phase passing through said apparatus plate openings, and resting on said peripheral portions when in the non-elevated position; means operatively engaging said covers for limiting the upward movement thereof and guiding the return of the same to their respective peripheral portions, each of said covers being of greater weight than a volume of said heavy fluid phase defined by the cross-sectional area of the opening on which said cover is disposed, extending to a height equivalent to the height of said peripheral portions above the level of said plate so as not to be liftable from its peripheral portion by the rising light fluid phase until said peripheral portion is below the level of the heavy fluid phase accumulated on said plate, each of the plate planar areas having apertures of smaller cross-sectional area than said openings formed therein for permitting passage of such rising and descending fluid phases when said loose covers are resting on said plate peripheral portions.

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