March 30, 1971 HANS-PETER STREUBER 3,573,172

PLATE COLUMN FOR HEAT AND/OR MASS EXCHANGE

Original Filed Feb. 27, 1963 4 Sheets-Sheet 1

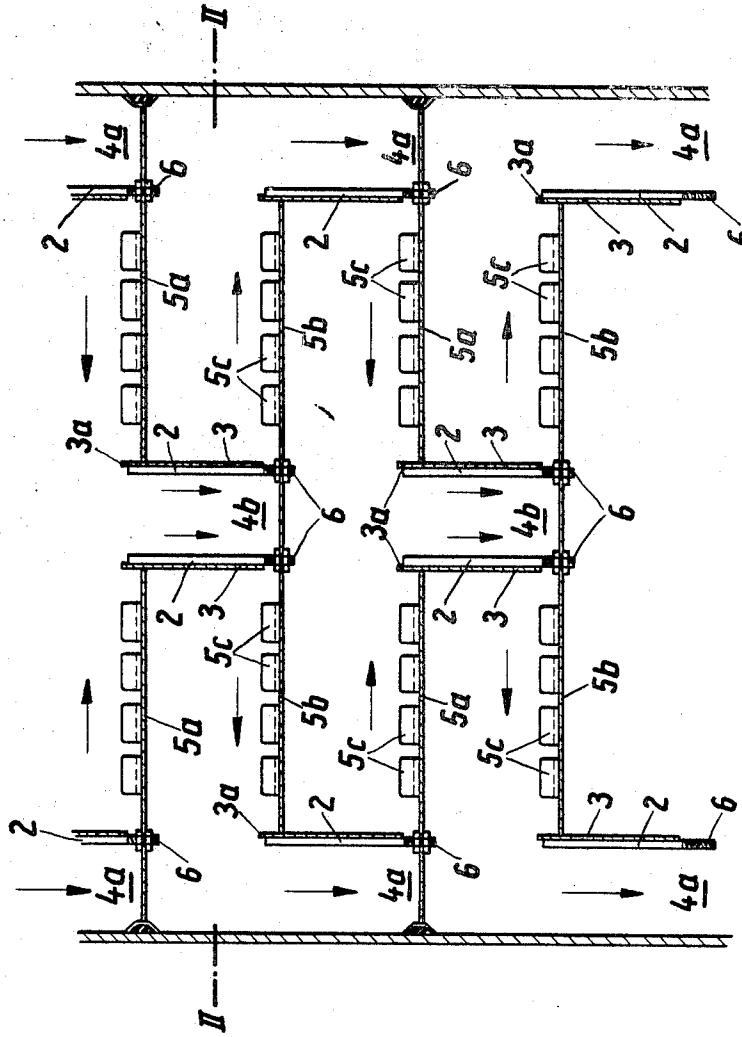


Fig. 1

PLATE COLUMN FOR HEAT AND/OR MASS EXCHANGE

Original Filed Feb. 27, 1963 4 Sheets-Sheet 2

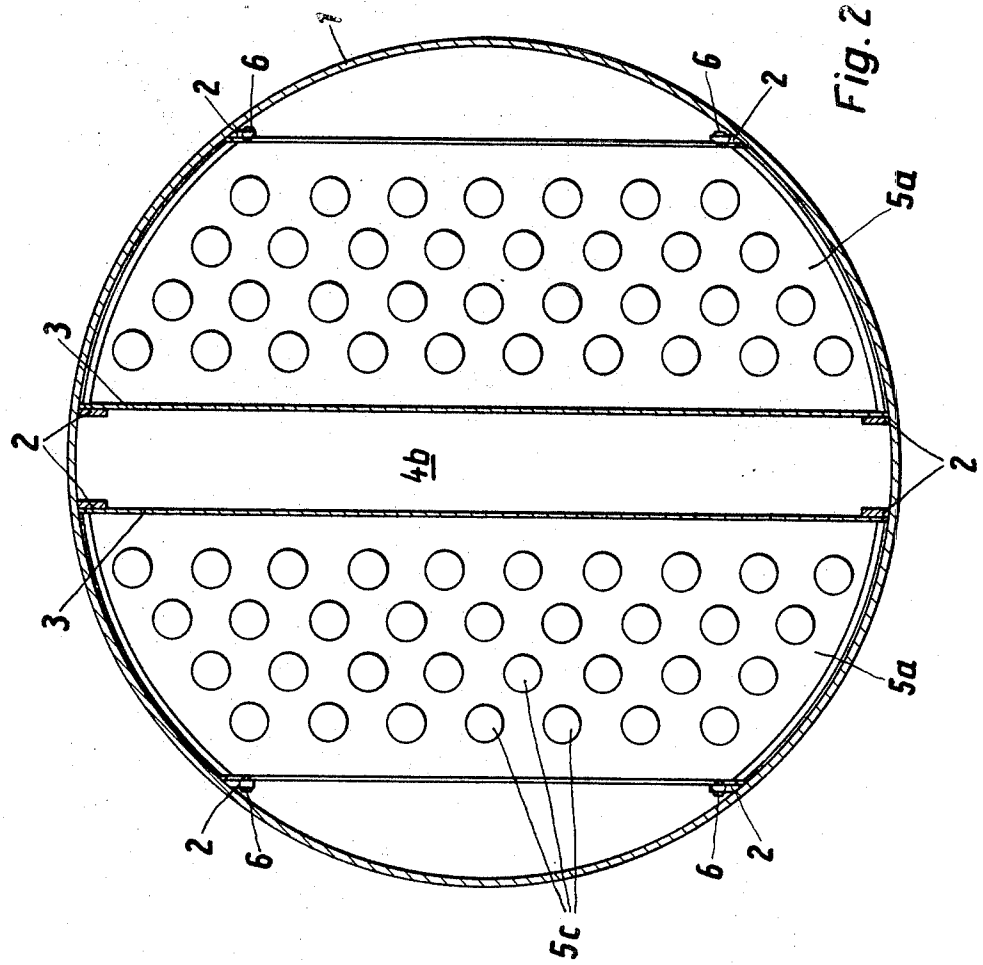


Fig. 2

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PLATE COLUMN FOR HEAT AND/OR MASS EXCHANGE

Original Filed Feb. 27, 1963 4 Sheets-Sheet 3

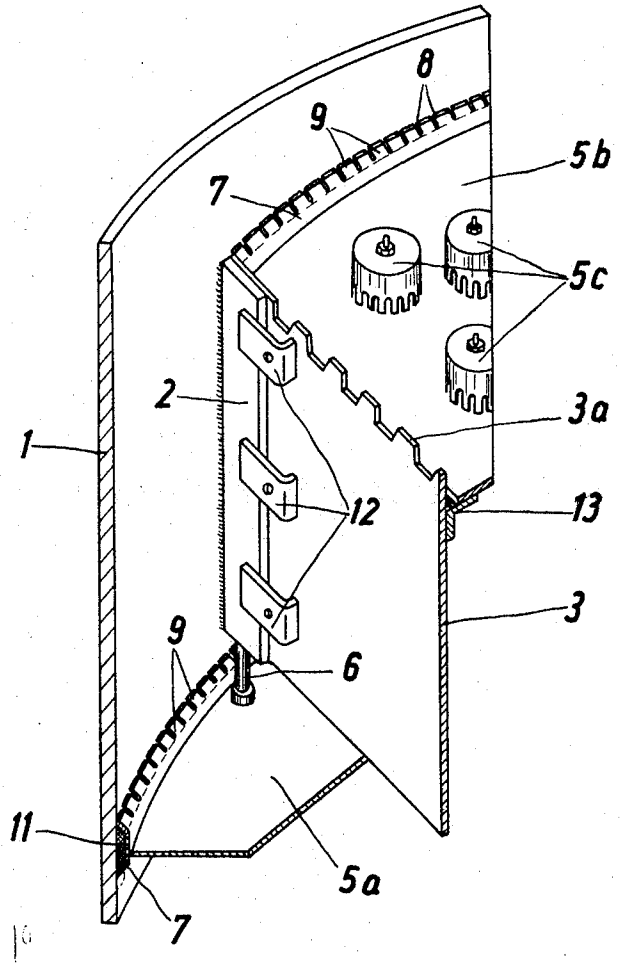


Fig. 3

PLATE COLUMN FOR HEAT AND/OR MASS EXCHANGE

Original Filed Feb. 27, 1963 4 Sheets-Sheet 4

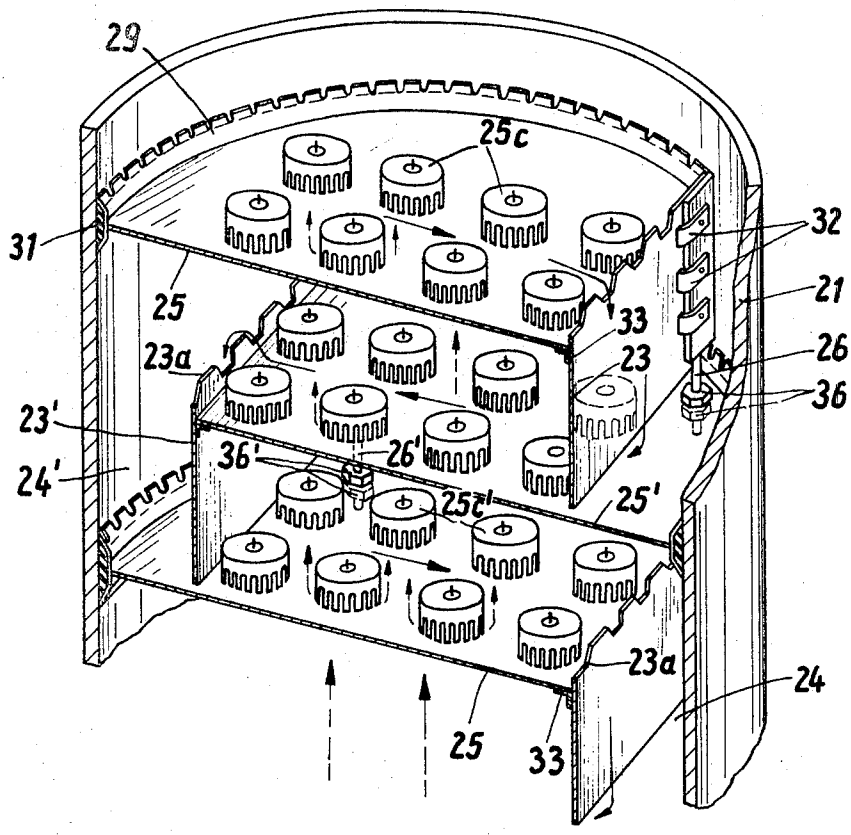


Fig. 4

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3,573,172

PLATE COLUMN FOR HEAT AND/OR MASS EXCHANGE

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Continuation of application Ser. No. 261,268, Feb. 27, 1963. This application June 30, 1967, Ser. No. 650,550
Claims priority, application Germany, Feb. 28, 1962, M 51,978
Int. Cl. B01d 3/20; B01f 3/04
U.S. Cl. 202—158 6 Claims

ABSTRACT OF THE DISCLOSURE

A fractionating column having a vertical shell in which pairs of vertical strips are fixedly attached to the internal surface of the shell and extend inwardly thereof. A plurality of vertical plates in the shell and clamping devices securing each plate at the ends thereof to a respective pair of strips to enable vertical adjustment of the plate relative to the strips. Support members extending horizontally on the plates and secured thereto. A plurality of spaced superposed tray in the shell and each having an edge secured to a respective support member on a plate whereby the tray is supported at the edge. The vertical plates extend upwardly of the trays to define weirs therefor. The vertical plates associated with two successive trays are mutually offset to cause liquid flowing over one weir to encounter the next lower tray. A bolt on each strip at the lower end thereof engaging a corresponding tray and a nut adjustably engaged with the bolt for vertically adjusting the tray at such location relative to the shell independently of the adjustment of the plate relative to the strips. The trays are constituted by alternating first and second sets, each of the trays of the first set are constituted by a pair of semicircular coplanar half-trays defining a tray of circular form with the circular side of each half-tray extending to the shell. The trays of the second set are of circular form with relieved portions on opposite sides thereof. The trays of the second set extend to the shell. The plates are arranged in first and second sets. The plates of one set are connected to the straight side of each half-tray and extend upwardly thereof to define the weir for liquid flowing from the half-tray downwardly to the next lower tray. The plates of the other set are connected to respective relieved portions and extend upwardly thereof to define the weir for liquid flowing from the trays of the second set downwardly to the next lower trays. The relieved portions are parallel to the plates of the one set and spaced from the shell a distance substantially equal to the horizontal distance between the plates of the one set which are connected to the straight sides of coplanar half-trays.

This application is a continuation of application Ser. No. 261,268, filed Feb. 27, 1963 and now abandoned.

This invention relates to a plate column or tower for heat and/or fractionating mass exchange between a downflowing liquid and ascending gases or vapors, in which tiered trays communicate through downflow channels for the downward passage therethrough of the liquid from tray to tray. An object of the invention is the provision of a plate column or tower of simple construction and high heat and/or mass transfer efficiency. The invention also concerns an improved means of suspending the trays in the column.

The invention constitutes an improvement of conventional heat and/or material exchanging plate columns in which the downflow channel from each tray is formed between parts of the inside wall of the shell of the column and a special plate or plates located vertically in the column. The invention contemplates in such the detachable and vertically adjustable support of opposite sides

of the tray from support means affixed to the shell of the column wherein at least one of said support means is a vertical strip section which detachably supports the plate forming a downflow channel from the said tray in vertically adjustable manner. Preferably one side of the tray is suspended on suspension bolts or the like from the support means of the vertical plates which form sides of the downflow channels between consecutive trays. The support means which have the form of vertical strip sections may each be provided with a suspension bolt extending downwards from the bottom end of the strip section for the suspension therefrom of the tray below. Alternatively, the trays may be suspended on one or both sides from the plates forming the side walls of downflow channels above and below the trays, the plates being elevationally adjustably affixed to the support means. In such a case the tray is not directly connected to the shell of the column.

The proposed arrangement of affixing the trays facilitates leveling the trays in the column by the adjusting means that are provided. Moreover effective seals between the trays and the inside walls of the shell of the column can be readily and easily provided without the necessity of using bolts, clips, clamps or like fixing elements for locating the seals and without taking up additional space. The useful surface area of the trays which is thus made available for the transfer of heat and/or material is thus considerably increased. A simple seal may be formed for instance by providing the peripheral edge of the tray adjacent the shell of the column with a cylindrical ledge or flange with parallel slit-shaped indentations at equidistant intervals forming crenelations. A sealing packing interposed between the cylindrical ledge or flange of the tray and the inside wall of the shell of the column can then be located by bending the crenelated portions of the ledge or flange angularly into contact with the shell. The space occupied by the sealing packing in such an arrangement is much smaller than that required for the seal in conventional forms of construction. Moreover, particularly in columns of major diameter, considerable quantities of sealing material are saved. The manufacturing tolerances in column diameter which in the past have caused difficulties in the location of sealing packings can be readily compensated in the proposed form of construction. A safe and reliable location of the sealing packing is always assured.

Embodiments of the invention will be more particularly described by reference to the accompanying drawings in which

FIG. 1 is a schematic axial section of a bubble plate column showing one arrangement of suspending the trays according to the invention,

FIG. 2 is a horizontal section of the arrangement shown in FIG. 1 as taken along lines II—II therein,

FIG. 3 is a fragmentary perspective view of a middle portion the arrangement shown in FIG. 1 which also illustrates the means of sealing the edges of the trays, and

FIG. 4 is a perspective view of another embodiment of the column partially broken away and in section.

With reference to FIGS. 1 to 3 therein will be seen a bubble plate column 1 which contains a plurality of plates or trays 5*a*, 5*b* spaced vertically in tiers from each of which reflux passes through downflow channels 4*a*, 4*b* to the next tray. In the particular arrangement shown in the drawings two downflow channels 4*a* are located adjacent the inside wall of the shell of the column between two trays and alternate with one downflow channels 4*b* located in the center of the column between the two next trays. The tiered trays are therefore so contrived that one tray 5*b* extends between two peripheral downflow channels 4*a*, whereas adjacent trays 5*a* above and below are divided,

each half extending from the shell **1** of the column to one side of the central downflow channel **4***b*.

The direction in which the liquid flows is indicated in FIG. 1 by arrows. A plurality of bubble caps **5***c* (FIG. 3) are distributed on the surface of every tray. The purpose and function of these caps is well known. The side walls or plates **3**, of the downflow channels project above the level of trays **5***a* and **5***b* and form the weirs **3***a* in conventional manner.

The peripheral downflow channels **4***a* (FIG. 1) in the column are formed, on the one hand, by the shell **1** of the column and, on the other hand, by the plates **3** which are secured vertically in the column. As will be seen more particularly in FIG. 3 these plates **3** are detachably and vertically adjustably affixed to vertical strip sections **2** by clamping members **12**. The strip sections **2** themselves are secured to the inside of the shell **1** of the column by welding or similar means. The trays **5***a* and **5***b* are supported by the strip sections **2**. To this end suspension bolts **6** extend from the bottom ends of the strip sections **2** and are engaged with the plates therebeneath by means of nuts to permit adjustment of the plates along the bolts. It will be seen by reference to FIG. 2 that the half trays **5***a* which extend from the peripheral shell of the column to the central downflow channel **4***b* are each suspended at four points, each half tray being connected at two points to bolts **6** extending downwards from the strip sections **2** in the next tier above, and at two points to the strip sections **2** which carry the side plates of the central downflow channel **4***b*. By adjustment of the elevational position of the trays **5***a* at these points by means of the bolts **6** and the nuts, the attitude of the trays can be varied.

Trays **5***b* which extend between two downflow shafts **4***a* on opposite sides of the column are likewise supported at four points near their edges, these trays being affixed to the strip sections which also support the side plates **3** of the peripheral downflow shafts **4***a*. They are also suspended from bolts **6** extending downwards from the bottom ends of the strip sections supporting the central downflow channel **4***b* which descends from the tray above.

Moreover, horizontal angle irons **13** may be affixed to the side plates **3** for supporting the trays **5***a* and/or **5***b* (cf. FIG. 3). In such an arrangement the central trays **5***b* are carried by the side plates **3** of the downflow channels **4***a*, whereas only one side of the half trays **5***a* is supported by one side plate **3** of downflow channel **4***b*, the other side being suspended from suspension bolts **6** of the sections **2** supporting the adjacent superposed plate **5***b*.

By appropriately adjusting the suspension bolts **6** or the position of the clamps **12** holding the vertical plates **3** which extend downwards from the trays **5***b* the trays **5***a* can be precisely leveled. The plates **5***b* will be adjusted in horizontal attitude by the bolts **6** and nuts on the strip sections **2** depending from the adjacent superposed plates **5***a*.

In the described form of construction in FIGS. 1–3 the trays **5***a* and **5***b* have not been directly secured anywhere to the shell **1** of the column. This means that the gaps between the tray edges and the shell **1** must be sealed, unless this gap between shell and trays is likewise utilized for the purposes of heat and material exchange in a manner yet to be described. The required seal may be formed by means which have in the past been conventional in the art. However, a particularly useful arrangement is to form the seal in the manner illustrated in FIG. 3. In this form of construction the edge of each of the trays **5***a* is provided with a cylindrical ledge **7** which extends above and below the plane of the tray, and which by stamping or in some other way is indented to form crenelations **8** with intervening ledge sections **9**. The tray is inserted into the column with these crenelated ledges vertical. When the tray is in position it is exactly centralized and leveled to form a uniform surrounding gap between the tray and the shell. The crenelated ledge projecting from the bottom of the edge of the tray is then peened over against

the inside of the shell **1** of the column to close the bottom of the gap **10** and to locate the tray in its adjusted position.

A packing **11** for forming the seal is then filled into gap **10**. The ledge sections **9** between the indentations prevent the packing from falling through. Since the packing gap tapers in the downward direction the packing material **11** is compressed particularly well against the inside wall of the shell **1**. When the packing **11** has thus been put into position the upper crenelations **9** are likewise peened against the shell. The joint thus formed is clearly illustrated in FIG. 3, which show the crenelations projecting above and below the edge of the tray bent over into contact with the shell **1** of the column and tightly locating the packing **11**.

In the fractionating column illustrated in FIG. 4 which has a circular cross section, there are alternate bubble plates **25** and **25'**. The bubble plates **25** and **25'** have the shape of a circular segment which is cut off at one end along a straight line and which is connected at this end by means of an angle iron **33** with a vertical wall **23** or **23'** of the associated bubble plate. The upper edge **23A** of walls **23**, **23'** is of toothed or zig zag configuration and constitutes a weir for the overflow of liquid from each bubble plate **25**, **25'**. The lower portion of walls **23**, **23'** bound a respective shaft **24**, **24'**. The lower parts of the walls **23**, **23'** constitute one boundary of the shafts **24**, **24'** whose other boundary is the shell **21**. Welded to the shell **21** are vertical strips **22** to which the walls **23**, **23'** are secured by suitable releasable securing means **32** in such a way that the vertical walls **23**, **23'** can be adjusted in a vertical direction to adjust the accurate horizontal position or attitude of the bubble plates **25**, **25'**. The strips **22** are provided at their lower ends with threaded bolts **26**, **26'** which extend through the immediate lower bubble plates underneath these strips and which are secured to these bubble plates by nuts **36**, **36'**. At the circular periphery of the bubble plates **25**, **25'** contacting the shell **21** there is a seal **31** between the plate and the shell similar to the seal **11** illustrated in FIG. 3. The bubble plates are equipped with bubble caps **25***c* through which the gas or vapor rises in known manner in the direction indicated by broken arrows. The direction of liquid is indicated by arrows in full lines.

I claim:

1. A fractionating column comprising a vertical shell, pairs of vertical strips fixedly attached to the internal surface of the shell and extending inwardly thereof, a plurality of vertical plates in said shell, clamping means securing each plate at the ends thereof to a respective pair of strips to enable vertical adjustment of the plate relative to the strips, support members extending horizontally on said plates and secured thereto, a plurality of spaced superposed trays in the shell, each tray having an edge secured to a respective support member on a plate whereby the tray is supported at said edge, said vertical plates extending upwardly of the trays to define weirs therefor, said vertical plates associated with two successive trays being mutually offset to cause liquid flowing over one weir to encounter the next lower tray, and means supported from the internal surface of the shell and supporting each tray at a location spaced from its associated support member, for vertical adjustment of the tray at such location, relative to the shell, independently of the adjustment of the plate relative to the strips.

2. A column as claimed in claim **1**, wherein the means for supporting each tray for vertical adjustment relative to the shell comprises a bolt on each strip at the lower end thereof engaging a corresponding tray and a nut adjustably engaged with said bolt.

3. A column as claimed in claim **1** wherein said trays are constituted by alternating first and second sets, each of the trays of the first set being constituted by a pair of semi-circular coplanar half-trays defining a tray of substantially circular form with the circular side of each half-

tray extending to the shell, the trays of the second set being of circular form with relieved portions on opposite sides thereof, the trays of the second set extending to the shell, said plates being arranged in first and second sets, the plates of one set being connected to the straight side of each half-tray and extending upwardly thereof to define the weir for liquid flowing from the half-tray downwardly to the next lower tray, the plates of the other set being connected to respective relieved portions and extending upwardly thereof to define the weir for liquid flowing from the trays of the second set downwardly to the next lower trays.

4. A column as claimed in claim 3 wherein the relieved portions are parallel to the plates of said one set and spaced from the shell a distance substantially equal to the horizontal distance between the plates of said one set which are connected to the straight sides of coplanar half-trays.

5. A fractionating column comprising an outer shell, a plurality of horizontal superimposed trays in said shell, vertical plates connected to said trays and having respective upper and lower edges defining for each tray a downflow path for the liquid, each tray being disposed in spaced relation beneath the lower edge of the plate connected to the adjacent higher trays and below the level of the upper edge of the plate connected thereto, pairs of vertical strip elements secured to said shell at the interior thereof, clamping means securing each plate at the ends thereof to a respective pair of strips to enable vertical adjustment of the plate relative to the strips, support members extending horizontally on said plates and secured thereto, each tray having an edge secured to a respective support member on a plate whereby the tray is supported at said edge, and means supported from the internal surface of the shell and supporting each tray at a location spaced from its

associated support member for vertical adjustment of the tray at such location, relative to the shell, independently of the adjustment of the plate relative to the strips.

6. A column as claimed in claim 5 wherein said trays alternate and are successively constituted by semi-circular trays defining a diametral gap therebetween, and circular trays concentric with said half-trays and with a periphery in spaced relation with the shell, the vertical plates extending from the peripheral edges of the circular trays to a spaced position above the half-trays of the next lower trays and from the edges of the half-trays bounding said gap to a spaced position above the next lower circular tray, the upper edge of each plate lying above the level of the associated tray.

References Cited

UNITED STATES PATENTS

2,241,114	5/1941	Brunjes	202—158UX
2,540,781	2/1951	Glitsch	261—114X
2,646,977	7/1953	Kraft	261—114
3,262,684	7/1966	Smith	261—114
2,274,041	2/1942	Cook et al.	261—114
2,807,451	9/1957	Kuhni	261—114

FOREIGN PATENTS

891,411	12/1943	France	261—114
862,049	3/1961	Great Britain	261—114

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U.S. Cl. X.R.

52—246; 261—114