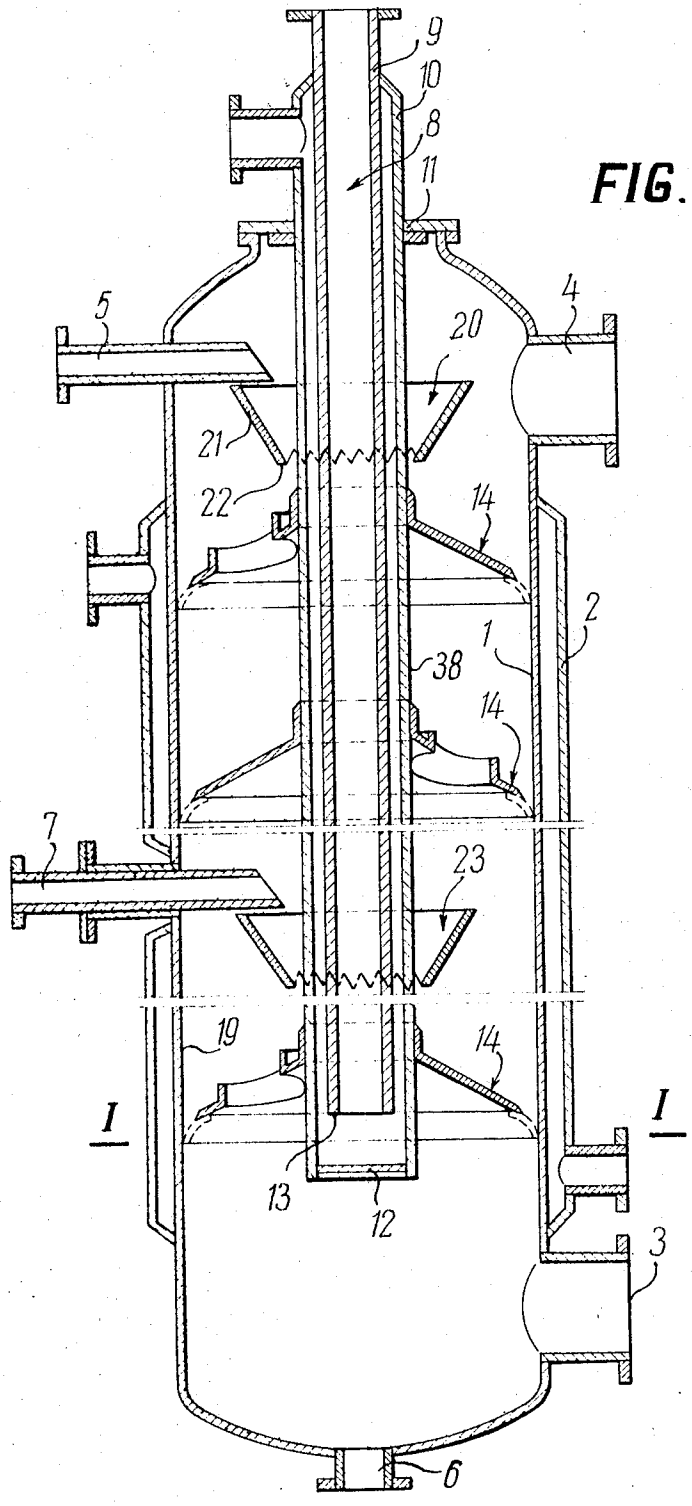
Sept. 2, 1969 I. Y. GORODETSKY 3,464,893

RECTIFIER HAVING SIEVE RIM AND TAPERED DISC DISTRIBUTING MEANS

Filed Jan. 27, 1967 2 Sheets-Sheet 1

FIG. 1



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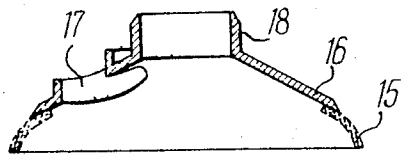


FIG. 2

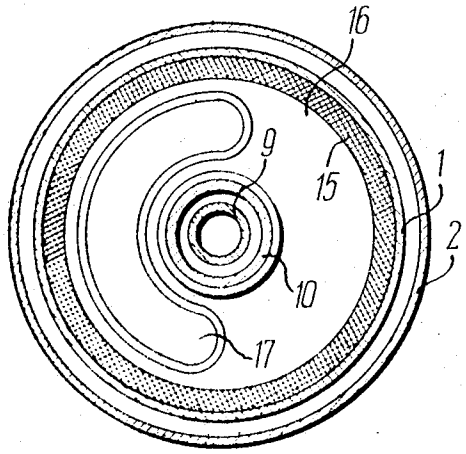


FIG. 3

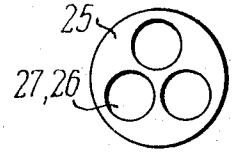


FIG. 6

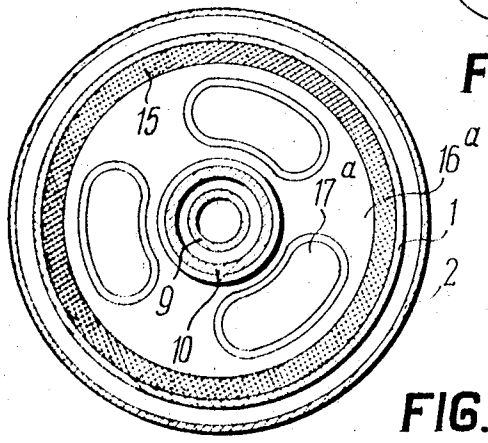


FIG. 4

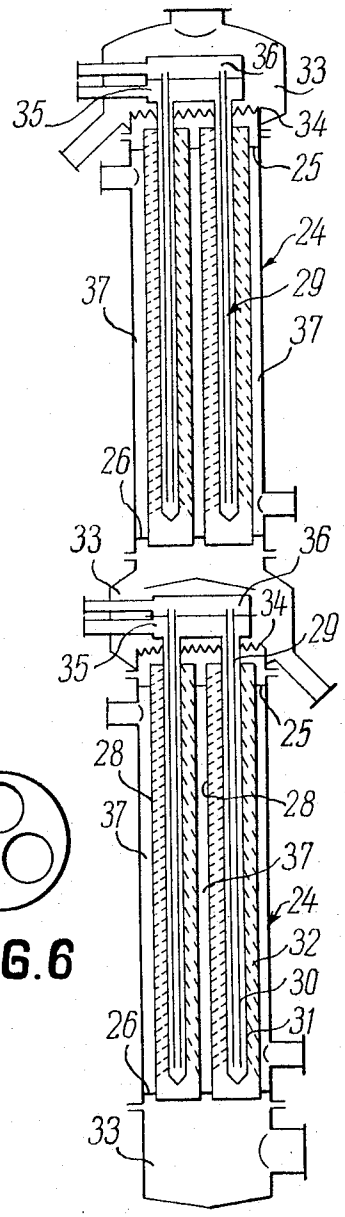


FIG. 5

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3,464,893

RECTIFIER HAVING SIEVE RIM AND TAPERED DISC DISTRIBUTING MEANS

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Int. Cl. B01d 3/28, 3/10
U.S. Cl. 202—158 1 Claim

ABSTRACT OF THE DISCLOSURE

A rectifier in which vapor condensed on a heat exchanger is led to the inner wall of a surrounding and heated shell by a conical disk having a peripheral mesh rim.

This invention relates to apparatus for rectification processes, and more particularly to apparatus for vacuum rectification, and may be used to advantage in the chemical, petrochemical, pharmaceutical and vitamin industries.

An apparatus is known for pseudoadiabatic rectification (U.S. Pat. No. 2,609,355) which comprises a heated vertically disposed shell, a condenser rigidly mounted therein, and a helical distributing arrangement intended for conveying the condensate from said condenser to the internal surface of the heated shell.

This prior art apparatus suffers from the following limitations:

(a) The distributing arrangement provides no means of spreading the condensate uniformly over the entire evaporation surface, insofar as protrusions on the helix are the only sites of condensate flow in the form of separate jets from the distributing arrangement, whereby liquid evaporation is impaired and there appear dry and hot spots on the evaporation surface.

(b) The annular gap between the edge of the distributing arrangement helix and the apparatus shell enables a part of the vapor stream to break through and pass along the heated surface of the shell, thereby affecting adversely the contact between the vapor and the condensation surface and causing the vapor to undergo non-equilibrium heating.

(c) Manufacturing and mounting the apparatus presents difficulties, insofar as a minimum gap should be provided between all protrusions of the distributing arrangement helix and the apparatus shell.

It is an object of the present invention to provide an apparatus for don-adiabatic rectification, preferably vacuum rectification, which is noted for its simpler design and higher efficiency due to improved conditions of condensate distribution over the evaporation surface and to the elimination of partial vapor passage along the appartus wall.

In accordance with the above and other objects, the rectifier of the present invention comprises a vertical shell in which provision is made for a heated surface; a cooled double-pipe heat exchanger mounted in stationary relationship in said shell; distributing arrangements which deliver the product that condenses on said heat exchanger to said heated surface of said shell, each distributing arrangement being made in the form of a tapered disk with flanged openings for vapor passage and having a sieve rim or wire gauge collar which effects uniform distribution of the product being evaporated over said heated surface of said shell, said distributing arrangements being mounted on said heat exchanger.

An apparatus for rectification, preferably vacuum rectification, may also be of multitube and multisection type,

wherein each tube comprises a self-contained rectifying element and houses an internal condenser with distributing arrangements mounted thereon, said distributing arrangements being identical to those used in the single-tube apparatus. All tubes are secured in tube sheets of a section, and tube walls will be heated by a heat carrier fed to the intertubular space of a section, which space serves as the heating jacket. The multisection apparatus consists of a plurality of identical sections mounted one above the other, which disposition is conducive to the provision of a fortifying and an exhausting section. In the multitube and multisection apparatus, provision is made for headers intended for coolant supply into and discharge from the condensers mounted in tubes.

Other objects and advantages of the present invention will be apparent from the description of an exemplary embodiment and accompanying drawings, wherein

FIG. 1 is a longitudinal sectional view of a vacuum rectifier according to the invention;

FIG. 2 shows the distributing arrangement of the vacuum rectifier, according to the invention, in longitudinal section;

FIG. 3 illustrates a modified distributing arrangement corresponding to a sectional view taken on line I—I of FIG. 1;

FIG. 4 illustrates another modified distributing arrangement;

FIG. 5 is a longitudinal section of a modified vacuum rectifier, according to the invention, and

FIG. 6 is a cross-sectional view of the tube sheet in the vacuum rectifier, according to the invention.

The vacuum rectifier shown in FIG. 1 includes a vertical shell **1**, in which provision is made for heating jacket **2** and a plurality of sleeves, e.g., sleeve **3** for vapor inlet from an evaporator (not shown), sleeve **4** for vapor outlet to a reflux condenser (not shown), sleeve **5** for reflux introduction, sleeve **6** for liquid phase flow to the evaporator, and also sleeve **7** for the delivery of feed stock solution when rectification is carried out continuously.

Mounted in the apparatus shell is cooled heat exchanger **8**, which is comprised of two pipes **9** and **10**. To secure the heat exchanger on shell **1**, use is made of hermetic flanged joint **11**. In outer pipe **10** of heat exchanger **8**, bottom end **12** is sealed, while in inner pipe **9** provision is made for open bottom end **13**. In order to distribute uniformly the condensate that forms on the cooled outer pipe **10** of heat exchanger **8** in the course of rectifier operation, the rectifier is furnished with distributing arrangements **14** disposed one above another and affixed to outer pipe **10**.

Distributing arrangement **14**, the longitudinal section of which is shown in FIG. 2 is comprised of sieve rim or wire gauge collar **15** and tapered disk **16** with flanged openings **117** and cylindrical hub **18**.

Sieve rim **15** is secured to the bottom of tapered disk **16** of distributing arrangement **14** so that it contacts heated internal surface **19** of rectifier shell **1**. Sieve rim **15** is intended for the uniform distribution of the liquid over heated internal surface **19** of shell **1** and so functions due to capillary action and surface tension phenomena.

The shape of openings **17** is illustrated in FIG. 3. Shown in FIG. 4 are modified openings **17***a* of tapered disk **16***a*. Flanged openings **17** (FIG. 3) in distributing arrangement **14** provide free upward passage of vapors in the rectifier, the flanges being intended for preventing the liquid from flowing through the openings. With a view to providing optimum conditions for the rectification process, vapors are caused to ascend in the apparatus in crisscross fashion or along a spiral path. This mode of vapor travel is attained due to the fact that openings **17** in adjacent tapered disks **16** are displaced by a specified angle with respect to one another.

Mounted on the top part of cooled heat exchanger **8** is reflux distributor **20** (FIG. 1) made in the form of inverted truncated cone **21** with serrated bottom edge **22**. Feed stock solution distributor **23** disposed in the middle of the rectifier is identical in design to reflux distributor **20**.

Where the vacuum rectifier should be a high efficiency and large capacity apparatus, it is expedient to manufacture the vacuum rectifier in the form of a multitube apparatus assembled from sections **24** (FIG. 5) disposed one above the other, rather than to resort to increasing the diameter and height of the apparatus. The number of sections is selected to meet the requirements as to separation efficiency, while the number of tubes is governed by the desired capacity of the vacuum rectifier.

In each section **24** provision is made for top tube sheet **25** and bottom tube sheet **26** (with tubes **28**) (FIG. 5) rigidly mounted in openings **27** (FIG. 6).

Each tube **28** of section **24** comprises a rectifier shell as shown in FIG. 1 and also incorporates cooled heat exchanger **29** (FIG. 5) consisting of two pipes, viz., inner pipe **30** and outer pipe **31**, distributing arrangements **32** being rigidly mounted on outer pipe **31**. In this case all tubes **28** in each section **24** communicate with common mixing-and-distributing chambers **33** for the liquid and the vaporphase disposed respectively above top tube sheet **25** and under bottom tube sheet **26**. Mounted above each top tube sheet **25** are arrangement **34** for uniform reflux distribution in the tubes, header **35** for feeding the cooling agent to heat exchanger **29**, and header **36** for the cooling agent discharge from heat exchangers **29**.

Here intertube space **37** of section **24**, to which heat carrier is delivered, functions as a heating jacket.

The vacuum rectifier functions in the following manner. A mixture of vapors of the components to be separated is fed from the evaporator via sleeve **3** into apparatus **1**, where, on reaching cooled surface **38** of heat exchanger **8**, the vapors undergo partial condensation on said surface. The vapors of less volatile components condense on lower portions of heat exchanger **8**, while vapors of more volatile components condense on cooled surface **38** of heat exchanger **8**. The condensate thus obtained flows down outer pipe **10** of heat exchanger **9** into distributing arrangements **14**, where tapered disks **16** direct the condensate to sieve rim **15**, which effects uniform distribution of the condensate over heated internal surface **19** of shell **1**. While descending along heated surface **19** of shell **1**, the liquid undergoes partial evaporation so that more volatile components of the liquid vaporize on higher portions of the heated interior surface, whereas less volatile components undergo evaporation on lower portions of this surface of flow via sleeve **6** into the evaporator.

Continuous and repeatedly alternating processes of partial condensation and partial evaporation result in the flow of vapors of readily volatile components to the reflux condenser, whereas in the evaporator there collects a liquid consisting of less volatile components of the feed stock.

The rectifier of the present invention provides, therefore, highly efficient separation of the feed stock.

Although the present invention has been described with reference to a preferred embodiment thereof, it will be readily understood by those skilled in the art that various changes and modifications may be resorted to without deviating from the spirit and scope of the invention.

These changes and modifications are to be considered as falling within the spirit and scope of the present invention as defined in the appended claim.

I claim:

1. An apparatus for rectification, comprising:

a vertical cylindrical shell whose internal surface is an evaporation surface;

a heating jacket fixed on said shell;

a heat exchanger-condenser with a double tube located stationary and axially in said shell;

distributing means delivering into said shell a phase that condenses on the external tube of said heat exchanger-condenser, said distributing means being vertically spaced and made as a tapered disc annularly mounted on the condenser and inclined downwardly and outwardly therefrom;

said tapered disc having at least one flange opening for the passage of vapor therethrough and a sieve rim rigidly fixed with its internal edge on said tapered disc and with other edge contacting the heated surface of said shell;

a reflux distributing means made as an inverted truncated cone with serrated bottom edge located on the external tube of said heat exchanger-condenser coaxially therewith, said reflux distributing means being arranged in the place of the reflux entrance above the upper of said condensate distributing means;

and a feed distributing means made as an inverted truncated cone with a serrated bottom edge fixed axially on the external pipe of said heat exchanger-condenser, said feed distributing means being arranged in the place of the feed entrance.

References Cited

UNITED STATES PATENTS

2,317,101	4/1943	Lecky	202—158
2,353,551	7/1944	Dexter	203—89
2,580,646	1/1952	Belden.	
2,606,146	8/1952	Luten	202—236
2,810,562	10/1957	Eld et al.	202—158
3,198,241	8/1965	Baird	202—187
3,266,555	8/1966	Thier.	

FOREIGN PATENTS

950,397	10/1956	Germany.

WILBUR L. BASCOMB, JR., Primary Examiner

U.S. Cl. X.R.

159—13, 15; 202—186, 187, 205, 236; 261—113