

Jan. 9, 1945.

W. DENNIS

2,366,958

APPARATUS FOR RECTIFICATION

Filed Dec. 23, 1942

2 Sheets-Sheet 1

Fig. 1,

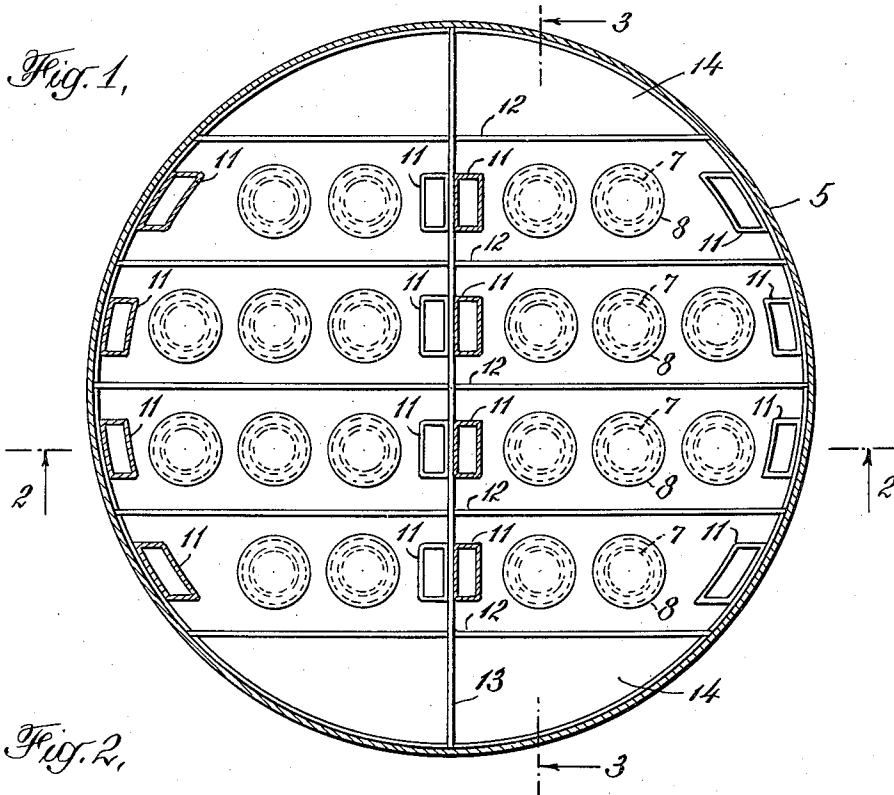
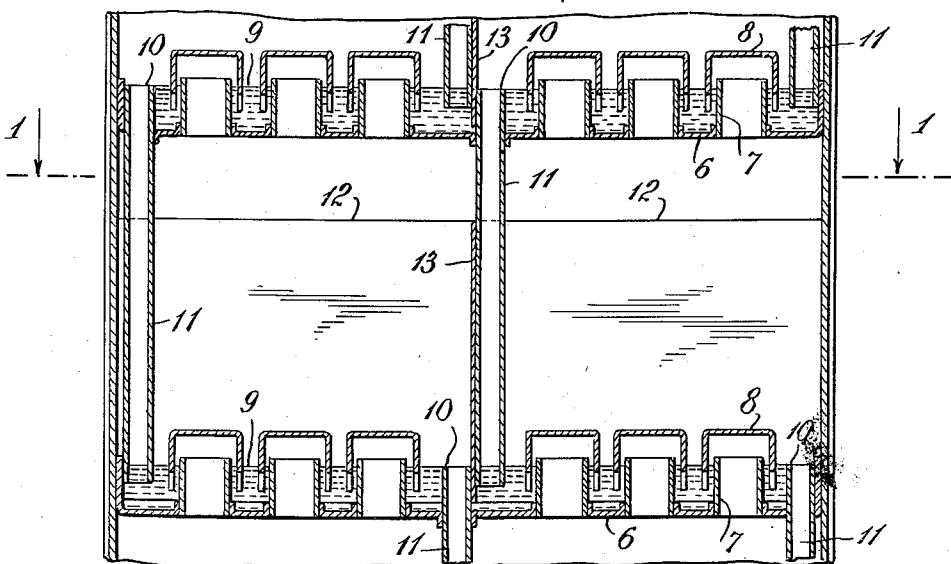


Fig. 2,



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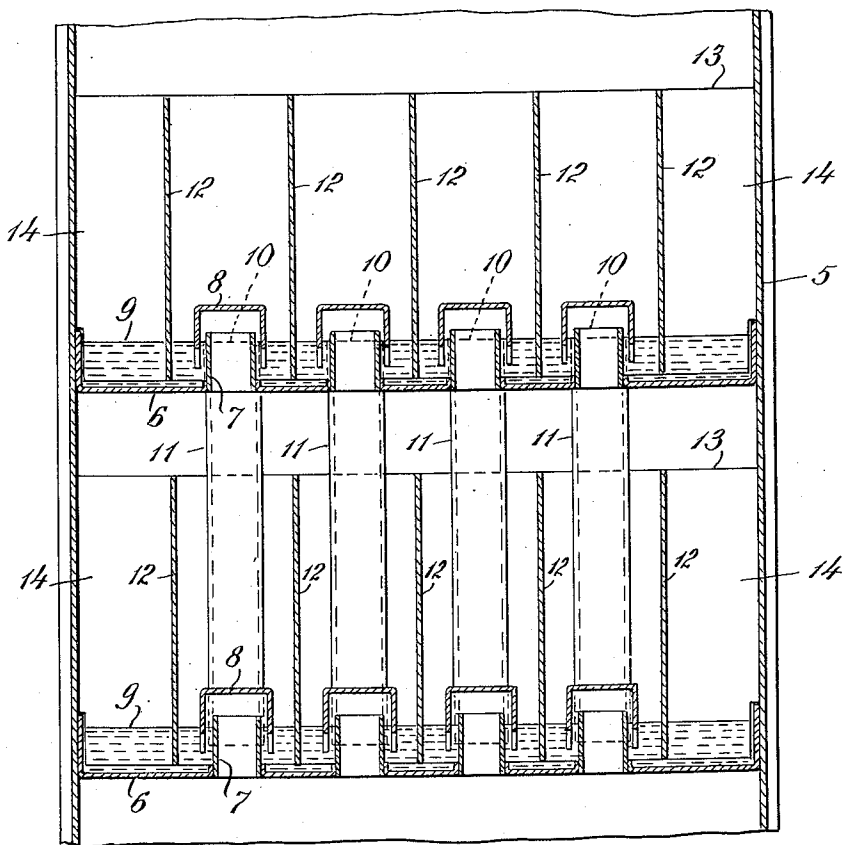
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2 Sheets-Sheet 2

Fig. 3.



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APPARATUS FOR RECTIFICATION

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Application December 23, 1942, Serial No. 469,886

3 Claims. (Cl. 261—114)

This invention relates to apparatus for rectification employed particularly in the separation of the constituents of gaseous mixtures. While the invention applies especially to the separation of oxygen from the atmosphere, it may be utilized to recover constituents of other gaseous mixtures.

In the conventional rectification column employed in the separation of the constituents of gaseous mixtures following liquefaction thereof, a plurality of trays are arranged in the column, each provided with a plurality of vapor risers and bubble caps with downflows disposed to establish the liquid level on the trays and to permit liquid to flow downwardly from tray to tray. The vapor traveling through the risers and under the bubble caps passes through the liquid on the trays with the result that the vapor becomes enriched in one of the constituents while the other accumulates in the liquid flowing over the trays. Such equipment is designed for stationary operation.

Modern steel ships and especially naval ships carry quantities of oxygen stored in steel cylinders under pressure for use in oxyacetylene welding and cutting apparatus which is employed in making repairs. The steel cylinders charged with oxygen are extremely dangerous when struck by bullets, shells and similar missiles. Consequently, before a naval ship enters a battle the oxygen cylinders are usually thrown overboard. For this reason and for the purpose of economy, it has been suggested that a liquefaction and rectification unit be installed in each ship requiring oxygen to provide this material when needed.

Ships are subject in operation to continuous rolling motion, the amplitude of which varies with the conditions at sea. In addition, the ship may be subject to substantial pitching movement under certain conditions. If the conventional rectification column is set up in a ship, the liquid on the trays will, when the ship is at sea, continuously move from side to side on the trays and frequently may likewise move in the fore-and-aft direction of the ship as a result of the pitching movement. Such movements of the liquid would result in permitting vapor to travel upwardly through the hats and bubble caps without contact with the liquid and would result in serious loss of efficiency in the rectification operation.

It is the object of the present invention to provide a rectification column in which movement of the liquid on the trays is retarded in both directions, that is transversely and longitudinally with respect to the axis of the ship in which the column is installed, thereby assuring proper con-

tact of the vapors with the liquid and practical efficiency in the rectification operation.

Other objects and advantages of the invention will be apparent as it is better understood by reference to the following specification and accompanying drawings in which

Fig. 1 is a sectional view through a rectification column embodying the invention;

Fig. 2 is a fragmentary vertical section on the line 2—2 of Fig. 1, showing two trays installed in the column;

Fig. 3 is a similar sectional view on the line 3—3 of Fig. 1.

Referring to the drawings, 5 indicates a column of circular cross-section. The column will be surrounded by suitable insulation (not shown) in accordance with the usual practice. A plurality of trays 6 are arranged in the column one above the other. While only two are shown, it will be understood that the number will be determined by the size of the column and the desired purity of the products. Each tray is provided with vapor risers 7 and bubble caps 8 of the usual form permitting vapor to pass upwardly from the compartment below each tray through the liquid 9, the level of which is determined by the upwardly projecting ends 10 of the downflows 11 which permit liquid to pass from each tray to the tray below. In addition to the conventional arrangement of the downflows at opposite sides of the column, downflows are provided in the central portion of the column for reasons hereinafter more fully explained. As is apparent from the drawings, the downflows are arranged so that the liquid follows a zigzag course over the trays as it travels downwardly through the column.

To limit the movement of liquid on the trays, as the result of rolling movement of a ship in which the column is installed, I provide a plurality of partitions 12 arranged in parallel relation and extending in the direction of the fore-and-aft axis of the ship. The partitions 12 extend from a plane below the upper limit of the compartment in which they are installed to a plane below the level of the liquid on the tray forming the bottom of the compartment. The amount of space left beneath the partitions is such as to ensure equalization of the level of the liquid on the tray. These partitions prevent surges of liquid from one side to the other of the tray during rolling movement of the ship. Thus the liquid is maintained at a sufficient level throughout the tray to prevent free passage of

vapor upwardly without contact with the liquid, and the efficiency of the column is maintained.

To attain the same result in respect to pitching movement of the ship, it is usually sufficient to provide a single partition 13 extending in a direction transverse to the fore-and-aft axis of the ship. In extent, the partition 13 is similar to the partitions 12, that is, its lower edge is below the level of liquid on the tray but permits limited movement of the liquid beneath it. Because of the inclusion of the partition 13, the downflows 11 are arranged on opposite sides thereof as well as at the periphery of the trays. The liquid can therefore follow its usual course from tray to tray and thus downwardly through the column independently of movement of the liquid beneath the partition 13.

Preferably spaces 14 are provided at the sides of the column beyond the partitions 12 in which no vapor risers or downflows are provided. These spaces afford reservoirs for liquid when the ship is rolling badly. The liquid will flow into the spaces beneath the partitions 12 and backwardly beneath the partitions into the spaces where vapor risers and downflows are provided. This tends to ensure sufficient flow of liquid across each tray so that the composition of the liquid is reasonably uniform. Uniformity of the liquid is of considerable importance because in any particular chamber of the column the ratio of vapor flow through the risers to liquid flow through the downflows may not be correct, and if such distribution errors exist in any appreciable number of chambers the efficiency of rectification would be low. The invention avoids this difficulty and ensures high efficiency of operation by the maintenance of substantially the correct level and a proper composition of the liquid on the tray.

The invention permits the installation of rectification columns for the separation of the constituents of gaseous mixtures on ships and the proper operation thereof to recover the desired constituent of the gaseous mixture while the ship is at sea.

Various changes may be made in the form and arrangement of the apparatus without departing from the invention or sacrificing the advantages thereof.

I claim:

1. In a liquefaction and rectification column, a plurality of trays in spaced relation dividing

the column into compartments, a plurality of vapor risers and bubble caps in each tray, downflows for liquid establishing the liquid level on the trays and extending from each tray to the tray below it, and a plurality of partitions disposed in spaced planes and a single partition in a plane normal thereto in each compartment extending below the liquid level of each tray but affording a limited space for the retarded flow of liquid below its normal level, the downflows being located between each of the plurality of partitions alternately at the peripheries of the compartments and adjacent the single partition.

2. In a liquefaction and rectification column, a plurality of trays in spaced relation dividing the column into compartments, a plurality of vapor risers and bubble caps in each tray, downflows for liquid establishing the liquid level on the trays and extending from each tray to the tray below it, and a plurality of partitions disposed in spaced planes and a single partition in a plane normal thereto in each compartment extending below the liquid level of each tray but affording a limited space for the retarded flow of liquid below its normal level, the partitions remote from the center of the column affording spaces on the trays having no liquid outlets except beneath the partitions and no vapor passages through the trays, whereby such spaces may act as reservoirs when the column is tilted in a direction to cause liquid on the trays to flow towards them.

3. In a liquefaction and rectification column, a plurality of trays in spaced relation dividing the column into compartments, a plurality of vapor risers and bubble caps in each tray, downflows for liquid establishing the liquid level on the trays and extending from each tray to the tray below it, and a plurality of partitions disposed in spaced planes in each compartment extending below the liquid level of each tray but affording a limited space for the retarded flow of liquid below its normal level, the partitions remote from the center of the column affording spaces on the trays having no liquid outlets except beneath the partitions and no vapor passages through the trays, whereby such spaces may act as reservoirs when the column is tilted in a direction to cause liquid on the trays to flow towards them.

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