ROTARY DRUM EVAPORATOR WITH CONCENTRIC EVAPORATING CHAMBERS

James E. Bibby
Inventor

By

Attorney
This invention is for improvements in or relating to evaporators of the kind adapted to be used for the separation or extraction, by evaporation, of one liquid from another, and as also disclosed in applicant's co-pending application, Serial No. 699,765 filed concurrently herewith.

One object of the invention is to provide a machine which is especially suitable for use with liquids having a tendency to foam or froth during evaporation, or liquids containing small quantities of finely divided solids.

A highly successful application of the invention is to a machine for the treatment of oil which has been extracted by means of solvents, the machine being used after the extraction process has been completed to separate and recover the solvents from the oil. A further application of the invention is to a machine for the deodorization and like treatment of oils, e.g. palm oil, cotton seed oil, soya bean oil and the like.

According to the present invention there is provided an evaporator comprising a casing having a heating jacket, a drum or like member in said casing and having its peripheral surface spaced from the interior of the casing to form an evaporation chamber, either or both of the casing and the drum being relatively rotatable, inlet means for introducing liquid to be treated (e.g., oil and solvent) into said evaporation chamber and an outlet for the evaporate (e.g. solvent).

In the preferred embodiment of the invention the casing is stationary and the drum is rotated. Due to the rotation of the drum residuum or excess solvent is centrifugally forced to the casing and the drum being relatively rotatable, inlet means for introducing liquid to be treated (e.g., oil and solvent), and outlet for the evaporate (e.g. solvent).

The combination of a primary evaporator having a steam jacket and rotating drum-like member, forming an evaporating chamber, and a secondary evaporator comprising a series of annular chambers as just described, provides a particularly compact and efficient machine.

One specific embodiment of the invention as applied to an evaporator for the evaporation and recovery of solvent from oil will now be described by way of example with reference to the accompanying drawings, the figures of which are semi-diagrammatic in character. On the drawings:

Figures 1 and 2 are complementary views showing the machine in sectional elevation, the section being taken vertically through the axis of the machine;

Figure 3 is a cross-section on the line III—III of Figure 2;

Figure 4 is a fragmentary detail perspective view of a part of the scraper construction for the primary evaporator part of the machine, and

Figure 5 is a fragmentary detail sectional view of the scoop construction which forms a part of the secondary evaporator part of the machine.

The machine comprises a cylindrical casing closed at its ends by end plates for supporting a ro-
3,498,880

3. A drum 20 is located within the casing 10 and is spaced from the interior thereof to form an annular evaporation chamber 18. The drum 20 is supported by end plates 14 fixed on the shaft 12. The shaft 12 also carries, for rotation within the casing 10, a cylindrical drg-like blade member comprising a sheet metal peripheral surface, built up from arcuate sections 16, supported by spaced brackets 26, from the drum 20. A steam or other heating jacket 17 (hereinafter called a steam jacket) surrounds the casing, this steam jacket being provided with an inlet 18 for steam and with the necessary drainage means 10 and the like. The steam jacket is lagged, as indicated at 28, to prevent loss of heat. An inlet 21 for the mixture of oil and solvent is provided at one end of the casing 10 and enters the aforementioned evaporation chamber 18 tangentially with respect to the drum-like member 14, 16. Rows of radially projecting blades 22 are punched up out of the arcuate sections of the barded structure 10 of the drum. There are also blades 24 or like members resiliently mounted on the arcuate sections 16 and pressed into contact with the interior surface of the casing 10 so as to scrape said surface. The blades 22 and 24 ensure changing of the liquid film on said interior surface continuously and this promotes rapid evaporation. The blades 22 and 24 are directed with respect to the plane of rotation of the drum so that as the drum rotates the liquid is traversed along the evaporation chamber 18 towards the end 23 thereof remote from the inlet 21 for oil and solvent. It will be noted that the arcuate sections overlap their supporting brackets 26 as indicated at 16 to provide the required resilient support for the blades 24. The end of the evaporation chamber 18, remote from the inlet 21, is open as indicated at 28 and the oil and any remaining solvent therein pass from the primary or first-stage part of the machine via this opening into an annular cavity 20, between the end plates 11 and 14, from which it flows to the secondary evaporation part of the machine hereinafter described, by way of a transverse collector tray 20a, a spout 20b, and an opening 18c in the right-hand gate 14. Solvent evaporated off from the mixture of solvent and oil in the evaporation chamber 18 finds its way to, and passes from, the machine via an outlet duct 20 at the end thereof remote from that in which the oil is discharged.

The secondary evaporating part of the machine is housed within the drum 20 and comprises a series of radially spaced circumferential partitions 31 secured at their ends in the end plates 14 and located concentrically one within the other so as to divide the interior of the drum into a plurality of annular chambers 32.

Each of the annular partitions 31 comprises a series of radially spaced circumferential partitions 31 secured at their ends in the end plates 14 and located concentrically one within the other so as to divide the interior of the drum into a plurality of annular chambers 32.

Each of the annular partitions 31 comprises a series of radially spaced circumferential partitions 31 secured at their ends in the end plates 14 and located concentrically one within the other so as to divide the interior of the drum into a plurality of annular chambers 32.

Each of the annular partitions 31 comprises a series of radially spaced circumferential partitions 31 secured at their ends in the end plates 14 and located concentrically one within the other so as to divide the interior of the drum into a plurality of annular chambers 32.

Each of the annular partitions 31 comprises a series of radially spaced circumferential partitions 31 secured at their ends in the end plates 14 and located concentrically one within the other so as to divide the interior of the drum into a plurality of annular chambers 32.

Each of the annular partitions 31 comprises a series of radially spaced circumferential partitions 31 secured at their ends in the end plates 14 and located concentrically one within the other so as to divide the interior of the drum into a plurality of annular chambers 32.

Each of the annular partitions 31 comprises a series of radially spaced circumferential partitions 31 secured at their ends in the end plates 14 and located concentrically one within the other so as to divide the interior of the drum into a plurality of annular chambers 32.

Each of the annular partitions 31 comprises a series of radially spaced circumferential partitions 31 secured at their ends in the end plates 14 and located concentrically one within the other so as to divide the interior of the drum into a plurality of annular chambers 32.

Each of the annular partitions 31 comprises a series of radially spaced circumferential partitions 31 secured at their ends in the end plates 14 and located concentrically one within the other so as to divide the interior of the drum into a plurality of annular chambers 32.

Each of the annular partitions 31 comprises a series of radially spaced circumferential partitions 31 secured at their ends in the end plates 14 and located concentrically one within the other so as to divide the interior of the drum into a plurality of annular chambers 32.

Each of the annular partitions 31 comprises a series of radially spaced circumferential partitions 31 secured at their ends in the end plates 14 and located concentrically one within the other so as to divide the interior of the drum into a plurality of annular chambers 32.

Each of the annular partitions 31 comprises a series of radially spaced circumferential partitions 31 secured at their ends in the end plates 14 and located concentrically one within the other so as to divide the interior of the drum into a plurality of annular chambers 32.

Each of the annular partitions 31 comprises a series of radially spaced circumferential partitions 31 secured at their ends in the end plates 14 and located concentrically one within the other so as to divide the interior of the drum into a plurality of annular chambers 32.

Each of the annular partitions 31 comprises a series of radially spaced circumferential partitions 31 secured at their ends in the end plates 14 and located concentrically one within the other so as to divide the interior of the drum into a plurality of annular chambers 32.

Each of the annular partitions 31 comprises a series of radially spaced circumferential partitions 31 secured at their ends in the end plates 14 and located concentrically one within the other so as to divide the interior of the drum into a plurality of annular chambers 32.

Each of the annular partitions 31 comprises a series of radially spaced circumferential partitions 31 secured at their ends in the end plates 14 and located concentrically one within the other so as to divide the interior of the drum into a plurality of annular chambers 32.

Each of the annular partitions 31 comprises a series of radially spaced circumferential partitions 31 secured at their ends in the end plates 14 and located concentrically one within the other so as to divide the interior of the drum into a plurality of annular chambers 32.

Each of the annular partitions 31 comprises a series of radially spaced circumferential partitions 31 secured at their ends in the end plates 14 and located concentrically one within the other so as to divide the interior of the drum into a plurality of annular chambers 32.

Each of the annular partitions 31 comprises a series of radially spaced circumferential partitions 31 secured at their ends in the end plates 14 and located concentrically one within the other so as to divide the interior of the drum into a plurality of annular chambers 32.

Each of the annular partitions 31 comprises a series of radially spaced circumferential partitions 31 secured at their ends in the end plates 14 and located concentrically one within the other so as to divide the interior of the drum into a plurality of annular chambers 32.

Each of the annular partitions 31 comprises a series of radially spaced circumferential partitions 31 secured at their ends in the end plates 14 and located concentrically one within the other so as to divide the interior of the drum into a plurality of annular chambers 32.

Each of the annular partitions 31 comprises a series of radially spaced circumferential partitions 31 secured at their ends in the end plates 14 and located concentrically one within the other so as to divide the interior of the drum into a plurality of annular chambers 32.

Each of the annular partitions 31 comprises a series of radially spaced circumferential partitions 31 secured at their ends in the end plates 14 and located concentrically one within the other so as to divide the interior of the drum into a plurality of annular chambers 32.

Each of the annular partitions 31 comprises a series of radially spaced circumferential partitions 31 secured at their ends in the end plates 14 and located concentrically one within the other so as to divide the interior of the drum into a plurality of annular chambers 32.

Each of the annular partitions 31 comprises a series of radially spaced circumferential partitions 31 secured at their ends in the end plates 14 and located concentrically one within the other so as to divide the interior of the drum into a plurality of annular chambers 32.

Each of the annular partitions 31 comprises a series of radially spaced circumferential partitions 31 secured at their ends in the end plates 14 and located concentrically one within the other so as to divide the interior of the drum into a plurality of annular chambers 32.

Each of the annular partitions 31 comprises a series of radially spaced circumferential partitions 31 secured at their ends in the end plates 14 and located concentrically one within the other so as to divide the interior of the drum into a plurality of annular chambers 32.
ferred from one annular chamber 32 to the next depends, of course, on the position of the scoops 37, i.e. the spacing of the scoops from the neighbouring partition 31 from which they gather the liquid.

It is convenient, in order to facilitate assembly of the several elements forming a partition 31, to secure such elements to the interior plate of the drum by means of bolt-like devices 44 which are slido into holes in the end plates 14 and are trapped against being removed therefrom, as each succeeding partition element or plate is located in position.

The faces of the secondary evaporation part of the machine may be dispensed with, whereas in other cases the secondary part may comprise a machine separate from (i.e. not within) the primary part. A machine of this character forms the subject matter of our co-pending application for Patent No. 690,768 filed August 15, 1946 now Patent 2,484,445 granted October 11, 1949.

A condenser and suction apparatus are generally connected to the machine as indicated diagrammatically at 45 and 46 respectively in Figure 1 for the purpose of the deodorisation of oils it is desirable to maintain a high degree of vacuum in the machine.

In some cases the passage ways 39 may be closed entirely, or be dispensed with, in the neighbourhood of the spacing pieces 36. In such an arrangement the steam flows counter-current to the oil by way of the scoops 37.

I claim:

1. An evaporator, comprising a casing, a cylindrical drum rotatably mounted in said casing with its axis of rotation horizontal and having its peripheral surface spaced from the interior surface of the casing to provide an evaporation chamber between said surfaces, a heating means for said chamber, inlet means for introducing liquid to be treated into said evaporation chamber, an outlet for vapor, discharge means for residual liquid, blades on the drum working on the interior surface of the casing, some at least of the blades extending in a slant-wise direction around and along the peripheral surface of the drum, spaced apart apertured circumferential partitions within the drum dividing it into a series of annular chambers, means connecting the evaporation chamber to the outermost annular chamber for the passage of residual liquid thereto, at least one scoop on each partition and in register with an aperture therein for scooping up liquid from a body of liquid thrown by centrifugal force due to the speed of rotation of the drum against the outer peripheral surface of an annular chamber, said scoop transferring the liquid inwardly to the next inner chamber as the drum rotates, means for passing steam through each of the annular chambers in turn counter-current to the liquid, an outlet means for the vapor from the annular chambers and at least one scoop on each partition and in register with an aperture therein for scooping up liquid from a body of liquid thrown by centrifugal force due to the speed of rotation of the drum against the outer peripheral surface of an annular chamber and transferring the liquid inwardly to the next inner chamber as the drum rotates.

2. An evaporator, comprising a casing, a cylindrical drum rotatably mounted in said casing with its axis of rotation horizontal and having its peripheral surface spaced from the interior surface of the casing to provide an evaporation chamber between said surfaces, heating means for said chamber, inlet means for introducing liquid to be treated into said evaporation chamber, an outlet for vapor, discharge means for residual liquid, blades on the drum working on the interior surface of the casing, some at least of the blades extending in a slant-wise direction around and along the peripheral surface of the drum, spaced apart apertured circumferential partitions within the drum dividing it into a series of annular chambers, means connecting the evaporation chamber to the outermost annular chamber for the passage of residual liquid thereto, at least one scoop on each partition and in register with an aperture therein for scooping up liquid from a body of liquid thrown by centrifugal force due to the speed of rotation of the drum against the outer peripheral surface of an annular chamber, means for passing steam through each of the annular chambers in turn counter-current to the liquid, outlet means for the vapor from the annular chambers and at least one scoop on each partition and in register with an aperture therein for scooping up liquid from a body of liquid thrown by centrifugal force due to the speed of rotation of the drum against the peripheral surface of an annular chamber and transferring the liquid inwardly to the next inner chamber as the drum rotates.

3. An evaporator, comprising a casing, a cylindrical drum rotatably mounted in said casing with its axis of rotation horizontal and having its peripheral surface spaced from the interior surface of the casing to provide an evaporation chamber between said surfaces, heating means for said chamber, inlet means for introducing liquid to be treated into said evaporation chamber, an outlet for vapor, discharge means for residual liquid, blades extending in a slant-wise direction around and along the peripheral surface of the drum, spaced apart apertured circumferential partitions within the drum dividing it into a series of annular chambers, means connecting the evaporation chamber to the outermost annular chamber for the passage of residual liquid thereto, at least one scoop on each partition and in register with an aperture therein for scooping up liquid from a body of liquid thrown by centrifugal force due to the speed of rotation of the drum against the outer peripheral surface of an annular chamber, means for passing steam through each of the annular chambers in turn counter-current to the liquid, outlet means for the vapor from the annular chambers and at least one scoop on each partition and in register with an aperture therein for scooping up liquid from a body of liquid thrown by centrifugal force due to the speed of rotation of the drum against the peripheral surface of an annular chamber and transferring the liquid inwardly to the next inner chamber as the drum rotates.
An evaporator, comprising a casing, a cylindrical drum rotatably mounted in said casing with its axis of rotation horizontal and having its peripheral surface spaced from the interior surface of the casing to provide an evaporation chamber between said surfaces, a heating means for said chamber, inlet means for introducing liquid to be treated into said evaporation chamber, an outlet for vapor, discharge means for residual liquid, blades projecting outwardly from arcuate plates mounted on the drum concentrically therewith, some of the arcuate plates having a resilient part which carries the scraper blades and maintains them operative to scrape the interior surface of the casing, some of the blades being arranged in several axially extending rows, other blades extending in a slant-wise direction around and along the peripheral surface of the arcuate plates to cause the liquid to move along the evaporation chamber from the liquid inlet means to the residual liquid discharge means, the latter being displaced along the chamber with regard to said liquid inlet means, spaced-apart partitions comprising several imperforate arcuate sections spaced apart radially and overlapped at their ends, said partitions being concentrically arranged and dividing the interior of the drum into several annular chambers and providing apertures for the flow of vapor from one annular chamber to the next, means connecting the residual liquid discharge means in the evaporation chamber to the outermost of the annular chambers, means for passing steam through each of the annular chambers in turn countercurrent to the liquid, outlet means for the vapor from the annular chambers and at least one scoop on each partition arranged alternatively at the right and left hand ends of the partitions and in register with apertures between overlapping arcuate plates for scooping up liquid from a body of liquid thrown by centrifugal force due to the speed of rotation of the drum against the outer peripheral surface of an annular chamber and transferring the liquid inwardly to the next inner chamber as the drum rotates.

7. An evaporator as claimed in claim 6, wherein baffles are provided where one annular chamber communicates with another for the passage of vapor.

JAMES EDWARD BIBBY.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

<table>
<thead>
<tr>
<th>Number</th>
<th>Name</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>447,210</td>
<td>Thelsen</td>
<td>Feb. 24, 1891</td>
</tr>
<tr>
<td>552,456</td>
<td>Thelsen</td>
<td>Dec. 31, 1895</td>
</tr>
<tr>
<td>661,162</td>
<td>Campbell</td>
<td>Feb. 19, 1901</td>
</tr>
<tr>
<td>706,087</td>
<td>McCormack</td>
<td>Aug. 5, 1902</td>
</tr>
<tr>
<td>723,636</td>
<td>Shaw</td>
<td>Mar. 10, 1903</td>
</tr>
<tr>
<td>853,563</td>
<td>Guttner et al.</td>
<td>May 14, 1907</td>
</tr>
<tr>
<td>939,983</td>
<td>Ericsson</td>
<td>Nov. 16, 1909</td>
</tr>
<tr>
<td>1,308,819</td>
<td>Taylor</td>
<td>July 8, 1919</td>
</tr>
<tr>
<td>1,936,524</td>
<td>Placek</td>
<td>Nov. 21, 1933</td>
</tr>
</tbody>
</table>