

PATENT SPECIFICATION (11)

1 305 763

DRAWINGS ATTACHED

(19)

1 305 763

- (21) Application No. 10576/70 (22) Filed 5 March 1970
 (31) Convention Application No. 6903742 (32) Filed 11 March 1969 in
 (33) Netherlands (NL)
 (44) Complete Specification published 7 Feb. 1973
 (51) International Classification B01D 3/06 C02B 1/04
 (52) Index at acceptance B1B 3Q



(54) IMPROVEMENTS IN OR RELATING TO FLASH EVAPORATORS

(71) I, PIETER ROBERT BOM, of Willem de Zwijgerlaan 37, Santpoort, The Netherlands, a subject of the Queen of the Netherlands, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to flash evaporators for evaporating crude water and condensing the vapour.

It is known from United States Patent No. 3,213,000 to provide a flash evaporator comprising an elongated vessel divided by partitions into a plurality of series-connected chambers, in which crude water, to be partly evaporated, successively flows through said chambers, and the resulting vapour is condensed and falls into a receptacle provided in each chamber, said receptacles being interconnected for the passage of the condensate, a hood, having its opening directed downwardly, being disposed over each receptacle to form a collecting space for any non-condensable gases which may be present in the vapour, each collecting space being in communication with the next chamber, in the downstream direction of the condensate, for the passage of non-condensable gases.

This known flash evaporator has however the drawback that, if a chamber does not operate properly, it cannot be put out of operation separately without the entire plant becoming inoperative.

A further drawback is that the condensate which flows into a receptacle from the receptacle of a preceding chamber produces upwardly flowing vapour in the receptacle first-mentioned, which collides with the down-coming vapour from the crude water flowing into the next chamber, which impedes the condensation process and promotes corrosion, because it endangers the unidirectional flow of the vapour, which is required for a good condensation process, as a result of which stagnant zones may be formed, in which zones non-condensable gases are accumulated, which impede the condensation of water vapour, on the one hand, and owing

to their composition promote corrosion, on the other.

According to the present invention there is provided a flash evaporator comprising an elongated vessel having therein a plurality of evaporating chambers arranged to be traversed in series by crude water to be partly evaporated, cooling tubes disposed lengthwise in the vessel and extending through said chambers for the condensation of generated vapour, each chamber having a receptacle for collection of the condensate and a hood over the receptacle with an opening towards the condensing vapour to form a collecting space for any non-condensable gases which may be present in the vapour, each collecting space being connected with an evaporating chamber in the downstream direction of flow of crude water for the discharge of such non-condensable gases, and a common discharge duct for receiving condensate from the receptacles, each receptacle being in flow communication with the common duct through a separate conduit or throttle opening so that the receptacles are connected in parallel to said discharge duct.

The evaporator according to the invention has the advantage that, if one chamber must be put out of operation, the conduit or throttle opening can readily be closed. Due to the parallel connection of the condensate receptacles according to the invention the throughflow process of the condensate, except for the condensate from the inoperative chamber, can continue. There can thus be obtained a considerable gain in working hours, and the purity of the final product to be recovered is maintained. The second drawback of the prior flash evaporator, referred to above, is avoided, according to the invention, by virtue of the fact that the vapour from the condensate which has left a given receptacle flows into the condensation space of another chamber in the same direction as the vapour produced by the crude water in that chamber.

The evaporator according to the invention has the further advantage that it can be made

more cheaply than the previously mentioned known evaporator.

Each collecting space in the flash evaporator of the invention is preferably connected separately to the common discharge duct, and this duct connected in turn to the evaporating chambers, so that non-condensable gases can be discharged from each collecting space through the common duct to the evaporating chambers.

Embodiments of the invention will now be described, by way of example, with reference to the accompanying drawings.

In said drawings,
Fig. 1 shows a first embodiment of the invention;

Fig. 2 shows a second embodiment of the invention;

Fig. 3 shows a third embodiment of the invention; and

Fig. 4 shows a fourth embodiment of the invention.

Referring to Fig. 1, there is shown a part 1, consisting of two chambers 6, 20, of an elongated vessel 2 which in actual fact consists of a considerably larger number of chambers. The main vessel 2 comprises the supply pipe groups 3, which in known manner supply the crude water to be subjected to evaporation, generally salt water, to the evaporator, thereby also functioning as condensation surface. Also in known manner, the stream of salt water passes a heater (not shown), in which the crude water is further heated, whereafter it is passed over the bottom 4 of the main vessel 2, in which a layer of crude water 5 is formed. Owing to the fact that a subatmospheric pressure is maintained in the chamber 6 (by means not shown) a great amount of vapour is generated, which vapour rises, flows through a demister 7, and condenses on pipes 3, the condensate 9 being collected in receptacle 8, 23. Since the vapour also entrains non-condensable gases, either from the salt water or from leakage, these will rise from the space, guided by a hood 10 which with the sidewalls 11 of the main vessel 2 defines a collecting space 12 for the non-condensable gases. A duct 13 is formed contiguously with the main vessel 2 in the longitudinal direction of the latter, which duct connects with the main vessel 2 in a particular way characteristic of the present invention. The bottom 14 of the duct 13 is higher than the lowest point of receptacle 8, but lower than the highest point of collecting space 12. The duct 13 is divided by partitions 16, 17 into compartments 18, 19 of approximately equal length to that of chambers 6, 20, formed by partitions 21, 22, but viewed in the longitudinal direction, the compartments 18, 19 are moderately off-set relatively to the chambers.

From a low point of each condensate

receptacle 8, 23, a pipe 24, 25 with a valve 26, 27 leads to the duct 13, in which it terminates in its bottom at 28, 29. A short-circuit pipe 30, 31, with a valve 32, 33 extends from a point of each condensate space, located at about the same height, to the crude-water space containing the liquid layer 5, 34. Depending U-shaped by-passes 35, 36, 37 provide a series-connection between the compartments 18, 19.

The operation of the flash evaporator according to Fig. 1 is as follows. The condensate 9 in chamber 6 is passed through pipe 24 to compartment 18 of the duct 13, whence the collected condensate flows through by-pass 36 to the next compartment 19. The non-condensable gases from space 12 in chamber 6 enter through holes 37, 38 into compartment 18 of duct 13 and flow through an aperture 39 into the next adjacent chamber 20, in which they are entrained by the downcoming condensing vapour of chamber 20 in the same direction and in a similar cycle, namely, via holes 40, 41 and aperture 42, etc. During this process, the valves 32, 33 are closed. If, however, at a given moment, a chamber, e.g. chamber 6, begins to produce impure condensate, valve 26 is closed and valve 32 opened. The condensate from chamber 6 now flows directly back to the crude water 5, so that chamber 6 is disconnected from the production process, but the flow of condensate from the chamber (not shown) preceding chamber 6 passes through by-pass 35 and compartment 18 into compartment 19, while the non-condensable gases can also continue their passage through the apparatus.

As the condensate flows from the openings 28, 29, partial evaporation occurs, since the pressure in compartment 18, 19 is lower than that in chamber 6, 20. These vapours flow through apertures 39, 42 to the next chamber 20, 43, in which they are entrained without colliding with the vapours from this chamber.

Fig. 2 shows an alternative embodiment of a plant according to the invention. An opening 124 connects each condensate receptacle 108 with a separate control chamber 120 separated from the interior of duct 113, which at this point is as high as the main vessel 2. A duct 125 connects control chamber 120 with the interior of duct 113. Control valve 126 controls the rate of flow of condensate through duct 125. In this instance, there are no connection like pipes 30 and 31 with valve 32 and 33 as in Fig. 1. In the embodiment of Fig. 2, the function of pipe 30 or 31 is performed by an U-shaped tube 131, which is also an overflow tube. When the evaporator has been in operation for some time, a water sealing 139 will be formed, by which the condensate receptacle and the crude water space will be separated from each

other. When a chamber must be put out of operation, as far as the condensate is concerned, the valve 126 is fully closed. The level of condensate in condensate receptacle 108 will then rise until U-tube 131 will start functioning as an overflow tube. Excess condensate then falls back into the crude water 105.

In the embodiment of Fig. 2, partitions 116, 117 together with openings 135, 136 perform the function which in the construction of Fig. 1 is performed by partitions 16, 17 together with the U-tubes 35, 36.

Even if it is decided to abandon the advantage that a chamber can be closed individually while the process continues, which for example is possible in stationary evaporation processes, the construction according to the invention has advantages over prior constructions, in particular the parallel duct 13, 113 and lower cost of manufacture. Such a construction is shown in Fig. 3, and a variant in Fig. 4. In these two embodiments, U-tubes 131 and ducts 125 are absent. Instead, one of the partitions 140, 141 is provided with an opening 142, adapted to the process concerned. In Fig. 4, the throttle opening is constituted by opening 224, which passes condensate from each condensate receptacle to duct 113. Adjacent the throttle opening is a partition 241 for maintaining the level of condensate, which level should be above throttle opening 224.

WHAT I CLAIM IS:—

1. A flash evaporator comprising an elongated vessel having therein a plurality of evaporating chambers arranged to be traversed in series by crude water to be partly evaporated, cooling tubes disposed lengthwise in the vessel and extending through said chambers for the condensation of generated vapour, each chamber having a receptacle for collection of the condensate and a hood over the receptacle with an opening towards the condensing vapour to form a collecting space for any non-condensable gases which may be present in the vapour, each collecting space being connected with an evaporating chamber in the downstream direction of flow of crude water for the discharge of such non-condensable gases, and a common discharge duct for receiving condensate from the receptacles, each receptacle being in flow communication with the common duct through a separate conduit or throttle opening so that the receptacles are connected in parallel to said discharge duct.

2. A flash evaporator as claimed in claim 1, wherein each collecting space is connected separately to the common discharge duct which is in turn connected to the evaporating chambers.

3. A flash evaporator as claimed in claim 1 or 2, wherein each chamber is provided

with a closable short-circuit conduit for discharging condensate in the receptacle into the crude water.

4. A flash evaporator according to claim 2 or 3, wherein said common duct is disposed along and parallel to a long sidewall of the elongated vessel, there being provided a first connection with an elevated point of each of said collecting spaces for passing non-condensable gases to said duct, and a second connection with a low point of each condensate receptacle for passing condensate to said duct, said second connection comprising control means for controlling the rate of flow of condensate flowing to said duct, said duct being divided by means of partitions into compartments of a length approximately equal to that of the chambers, each compartment being connected adjacent its end, viewed in the direction of flow of the condensate, with the beginning, also viewed in the direction of flow of the condensate, of the next chamber, each pair of adjacent compartments communicating with each other via points adjacent the bottom and adjacent the partition on opposite sides thereof.

5. A flash evaporator according to claim 4, wherein the control means in said second connection is a control chamber in contiguous communication with said second connection and screened off from said duct, said control chamber being connected with the interior of said duct via a control valve.

6. A flash evaporator according to claim 4, wherein the control means in said second connection is a control chamber in contiguous communication with said second connection and screened off from said duct, said control chamber communicating with the interior of said duct via a throttle opening.

7. A flash evaporator according to claim 4, wherein said control means is provided by said second connection itself being formed as a throttle opening, and a baffle being disposed beside the mouth of said second connection in said duct in the downstream direction of the condensate, said baffle being slightly higher than the highest point of said mouth.

8. A flash evaporator according to claim 3, wherein the closable short-circuit conduit is provided by said condensate receptacle being connected with the crude-water space by a vertical U-shaped pipe, whose mouth in the condensate receptacle is adjusted at the height of the desired maximum level of condensate.

9. A flash evaporator according to claim 2 or 3, wherein said common duct is disposed in the vicinity of and parallel to a long sidewall of said elongated vessel, the bottom of said duct being at a level intermediate the lowest point of the condensate receptacles and the highest point of the collecting spaces for non-condensable gases,

other. When a chamber must be put out of operation, as far as the condensate is concerned, the valve 126 is fully closed. The level of condensate in condensate receptacle 108 will then rise until U-tube 131 will start functioning as an overflow tube. Excess condensate then falls back into the crude water 105.

In the embodiment of Fig. 2, partitions 116, 117 together with openings 135, 136 perform the function which in the construction of Fig. 1 is performed by partitions 16, 17 together with the U-tubes 35, 36.

Even if it is decided to abandon the advantage that a chamber can be closed individually while the process continues, which for example is possible in stationary evaporation processes, the construction according to the invention has advantages over prior constructions, in particular the parallel duct 13, 113 and lower cost of manufacture. Such a construction is shown in Fig. 3, and a variant in Fig. 4. In these two embodiments, U-tubes 131 and ducts 125 are absent. Instead, one of the partitions 140, 141 is provided with an opening 142, adapted to the process concerned. In Fig. 4, the throttle opening is constituted by opening 224, which passes condensate from each condensate receptacle to duct 113. Adjacent the throttle opening is a partition 241 for maintaining the level of condensate, which level should be above throttle opening 224.

WHAT I CLAIM IS:—

1. A flash evaporator comprising an elongated vessel having therein a plurality of evaporating chambers arranged to be traversed in series by crude water to be partly evaporated, cooling tubes disposed lengthwise in the vessel and extending through said chambers for the condensation of generated vapour, each chamber having a receptacle for collection of the condensate and a hood over the receptacle with an opening towards the condensing vapour to form a collecting space for any non-condensable gases which may be present in the vapour, each collecting space being connected with an evaporating chamber in the downstream direction of flow of crude water for the discharge of such non-condensable gases, and a common discharge duct for receiving condensate from the receptacles, each receptacle being in flow communication with the common duct through a separate conduit or throttle opening so that the receptacles are connected in parallel to said discharge duct.

2. A flash evaporator as claimed in claim 1, wherein each collecting space is connected separately to the common discharge duct which is in turn connected to the evaporating chambers.

3. A flash evaporator as claimed in claim 1 or 2, wherein each chamber is provided

with a closable short-circuit conduit for discharging condensate in the receptacle into the crude water.

4. A flash evaporator according to claim 2 or 3, wherein said common duct is disposed along and parallel to a long sidewall of the elongated vessel, there being provided a first connection with an elevated point of each of said collecting spaces for passing non-condensable gases to said duct, and a second connection with a low point of each condensate receptacle for passing condensate to said duct, said second connection comprising control means for controlling the rate of flow of condensate flowing to said duct, said duct being divided by means of partitions into compartments of a length approximately equal to that of the chambers, each compartment being connected adjacent its end, viewed in the direction of flow of the condensate, with the beginning, also viewed in the direction of flow of the condensate, of the next chamber, each pair of adjacent compartments communicating with each other via points adjacent the bottom and adjacent the partition on opposite sides thereof.

5. A flash evaporator according to claim 4, wherein the control means in said second connection is a control chamber in contiguous communication with said second connection and screened off from said duct, said control chamber being connected with the interior of said duct via a control valve.

6. A flash evaporator according to claim 4, wherein the control means in said second connection is a control chamber in contiguous communication with said second connection and screened off from said duct, said control chamber communicating with the interior of said duct via a throttle opening.

7. A flash evaporator according to claim 4, wherein said control means is provided by said second connection itself being formed as a throttle opening, and a baffle being disposed beside the mouth of said second connection in said duct in the downstream direction of the condensate, said baffle being slightly higher than the highest point of said mouth.

8. A flash evaporator according to claim 3, wherein the closable short-circuit conduit is provided by said condensate receptacle being connected with the crude-water space by a vertical U-shaped pipe, whose mouth in the condensate receptacle is adjusted at the height of the desired maximum level of condensate.

9. A flash evaporator according to claim 2 or 3, wherein said common duct is disposed in the vicinity of and parallel to a long sidewall of said elongated vessel, the bottom of said duct being at a level intermediate the lowest point of the condensate receptacles and the highest point of the collecting spaces for non-condensable gases,



there being provided one or more passages from each of said collecting spaces for non-condensable gases to said duct, and a closable pipe, located outside the cross-sectional contour of the elongated vessel and said duct, extending from a low point of each condensate receptacle to the bottom of said duct, said duct being divided by means of partitions into compartments of a length approximately equal to that of the chambers, each compartment being connected adjacent its end, viewed in the direction of flow of the condensate, with the beginning, also viewed in the direction of flow of the condensate, of the next chamber, each pair of adjacent compartments communicating with each other via points adjacent to the bottom and adjacent to the partition on opposite sides thereof.

10. A flash evaporator according to claim 9, wherein adjacent compartments in said duct are connected adjacent the bottom thereof and adjacent each partition on opposite sides thereof by a depending, U-shaped pipe.

11. A flash evaporator according to any one of claims 4-10, wherein the elongated vessel and the duct have a common sidewall.

12. A flash evaporator according to claim 11, wherein the compartments are longitudinally off-set somewhat relative to the chambers, the connection between each compartment and the next chamber being an aperture in the common sidewall of the elongated vessel and the duct.

13. A flash evaporator constructed, arranged and adapted to operate substantially as hereinbefore described with reference to any of the Figures of the accompanying drawings.

MATHYS & SQUIRE,
Chartered Patent Agents,
10 Fleet Street,
London, E.C.4,
Agents for the Applicant.

(9818)

Printed in Scotland by Her Majesty's Stationery Office
at HMSO Press, Edinburgh, 1972.

Published by The Patent Office, 25 Southampton Buildings, London, WC2A 1AY,
from which copies may be obtained.



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