Oct. 1, 1957 R. S. COOK 2,808,103

CRYSTALLIZING EVAPORATORS, VERTICAL CURRENT CLASSIFIERS AND THE LIKE

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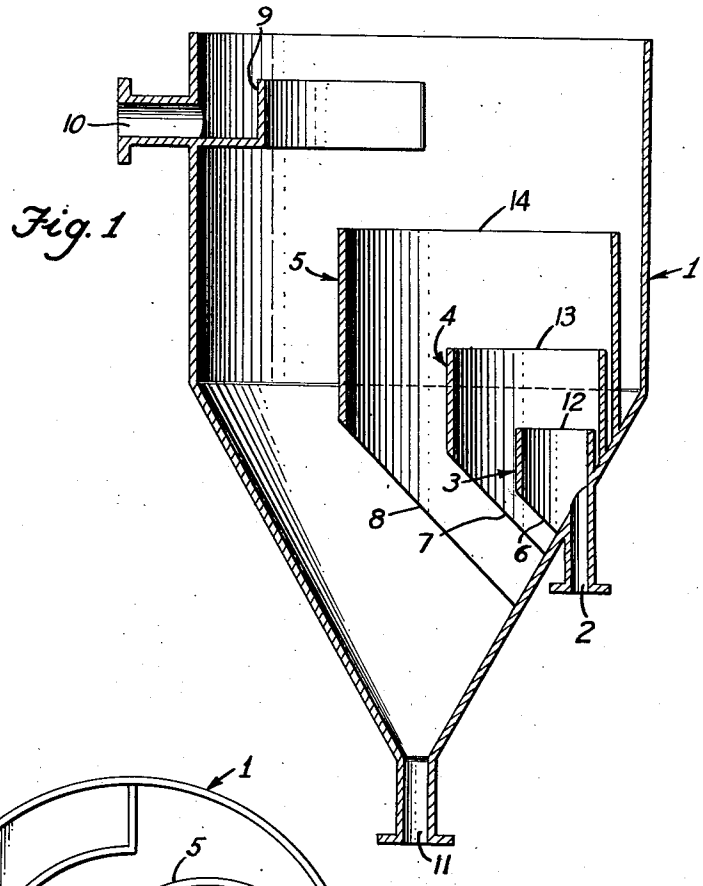


Fig. 1

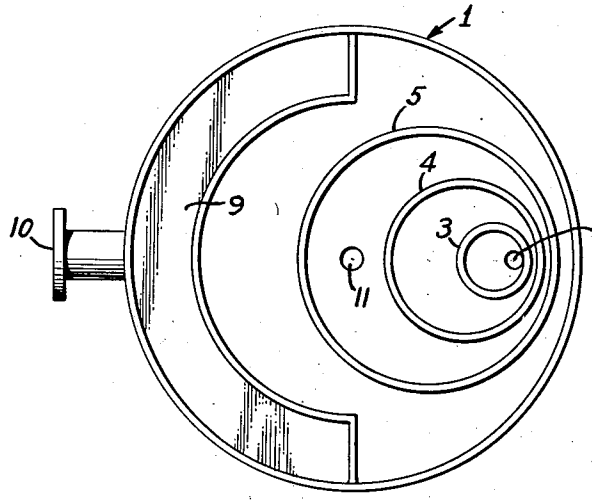


Fig. 2

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CRYSTALLIZING EVAPORATORS, VERTICAL CURRENT CLASSIFIERS AND THE LIKE

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Application November 14, 1955, Serial No. 546,448

5 Claims. (Cl. 159—45)

This invention is a continuation in part of applicant's prior application, Serial No. 280,147, filed April 2, 1952, and now abandoned.

The invention relates to an improvement for effecting the conditions in which crystals grow or settle in any type of device in which a classifying influence may be of advantage, whether it be in a crystallizing exaporator or hydraulic classifier not necessarily involved with evaporation.

In its application to a crystallizing evaporator, the objective is to provide more favorable crystallizing and vaporizing conditions which will better promote the growth of the smaller crystals. In the case of an hydraulic classifier the object is to promote the more complete separation of small crystals from larger ones. This latter objective is also valid for a crystallizing evaporator, in that more small crystals may be detained for further growth in an evaporator operating on a continuous flow basis.

In a crystallizing evaporator, conditions more favorable to the growth of crystals and to the suppression of formation of new crystals will be improved by reducing the vaporizing potential, which is usually evaluated in terms of the elevation of the liquid temperature above that at which the liquid would boil at the pressure existing at the surface. One of the objects of the improvement is to reduce the vaporizing potential without increasing the circulation of liquor through the heat exchange element.

Another object of the invention with respect to evaporation is to produce a pattern of boiling and flow within the vapor releasing body which is more stable and uniform in order to give a more efficient disengagement of vapor in the available space, resulting in a consequent gain in capacity and a reduction of formation of aggregate on the inside surfaces.

I attain these objectives with the structure and arrangement illustrated in the accompanying drawing, in which—

Figure 1 is a half section taken vertically on a conventional cone bottom tank with cylindrical upper section, which is customarily used in the settling or classifying of solids against a rising current of fluid, or as the liquor section of a vapor releasing body, usually known as a vapor body or chamber or evaporator body. Figure 2 is a full plan view of the arrangement shown in half section in Figure 1.

In Figure 1, the whole unit, designated by the reference number **1**, represents a type of vertical current classifier or the liquor section of an evaporator body. The unit has a fluid entrance **2** into a primary mixing chamber **3**. A second mixing chamber **4** is placed around and above the first mixing chamber **3** in substantially the same relation that the first mixing chamber **3** is placed with respect to the fluid entrance **2**. A third mixing chamber **5** is shown around and above the second mixing chamber **4** in like manner. Additional stages may be added in like manner or the invention used in its elementary form with only one mixing chamber.

Each mixing chamber is attached to the bottom of the vessel by joining a substantial portion of its lower end periphery to the bottom of the classifier or evaporator

chamber. The portion of the lower end so joined is approximately semicircular in extent when projected onto a plane perpendicular to the longitudinal axis of the mixing chamber. The non-contacting portion of the lower end periphery of each mixing chamber forms a substantial opening, designated by the numbers **6**, **7**, and **8** for the respective chambers. These openings are for the free entry and recirculation of the surrounding liquid with its suspended salt.

The semi-annular section **9** is used in the classifier application to spread the upflow over about one half of the vessel periphery and collecting the upflow for eduction at the outlet **10**. The bottom outlet **11** is for the eduction of the downflow of liquid with the coarser crystals.

When this mixing chamber arrangement is used in the lower section of an evaporator chamber, liquor enters at a predetermined velocity through the entry **2** at a temperature above that at which it will boil at the liquid-vapor interface in the evaporator chamber. At this entering velocity, the fluid has the energy to aspirate the liquid contents of the body through the openings **6**, **7**, and **8** into the respective mixing chambers, the respective stage mixtures being discharged at the exit ends **12**, **13**, and **14**. The temperature of the entering fluid is thereby reduced, thus reducing its potential flashing range while spreading it into a larger mass of fluid. Boiling is suppressed at the lower depths due to reduction of temperature upon mixing. As the mixture rises, vapor separates from the mixture, leaving the greater part of the liquid to recirculate with its suspended salt toward the bottom outlet **11**. As the suspension passes downward past the respective entrances to the mixing chambers, the influence toward recirculation becomes greater and the smaller particles will be more liable to follow the recirculating stream than the larger ones, so that the net downflow of mixture will contain a higher percentage of larger particles, which is desirable.

The operation of the invention in a vessel acting as a classifier without the boiling influence is the same as that just described except that no vapor separation occurs and a portion of the effluent liquid rises with a predominance of small particles in suspension to be carried to the outlet **10**.

Having described and explained the application of the invention with respect to crystallizing type evaporators and vertical current solid particle classifiers, I claim:

1. The improvement in crystallizing type evaporators and vertical current solid particle classifiers or the like, comprising a substantially cylindroidal mixing chamber attached through a portion of its basal periphery in contact with the bottom of an evaporator or classifier body, the mixing chamber being positioned eccentrically in the vertically projected area of said bottom, said contact being in substantially symmetrical enveloping arrangement with an opening in said bottom, the remaining part of non-contacting basal periphery constituting a substantial opening at the basal end of said mixing chamber, said opening being directed to the center of said bottom.

2. An evaporator chamber in which a substantially cylindroidal mixing chamber is attached through a portion of its basal periphery in contact with the inner surface of the bottom of said evaporator chamber, the mixing chamber positioned eccentrically in the bottom of said evaporator chamber, the contacting portion of the mixing chamber basal end periphery being in substantially symmetrical enveloping arrangement with an opening in said evaporator chamber bottom, the remaining portion of non-contacting basal end periphery constituting a substantial opening at the basal end of said mixing chamber, said opening being directed to the center of the evaporator chamber bottom.

3. An evaporator body in which a nested arrangement of a multiplicity of substantially cylindroidal mixing

chambers is attached through a portion of each mixing chamber basal end periphery in approximate semicircular contact with the inner surface of the bottom of said evaporator body, the assembly of mixing chambers in nested arrangement being positioned eccentrically on the bottom of the evaporator body, the contacting portion of the innermost mixing chamber being in substantially symmetrical enveloping arrangement with an opening in the evaporator body bottom, the contacting portions of each surrounding mixing chamber being in substantially symmetrical enveloping arrangement with the next inner mixing chamber, the remaining non-contacting portion of each mixing chamber basal end periphery constituting a substantial opening at the basal end of each mixing chamber, said opening of each mixing chamber being directed to the center of the evaporator body bottom.

4. A vertical current solid particle classifier in which a substantially cylindroidal mixing chamber is attached through a portion of its basal periphery in contact with the inner surface of the bottom of said classifier, the mixing chamber being positioned eccentrically on said bottom, said contacting portion of basal periphery being in substantially symmetrical enveloping arrangement with an opening in said bottom, the remaining portion of non-contacting basal periphery constituting a substantial opening at the basal end of said mixing chamber, said opening being directed to the center of said bottom.

5. A vertical current solid particle classifier in which a nested arrangement of a multiplicity of substantially cylindroidal mixing chambers is attached through a portion of each mixing chamber basal end periphery in approximate semicircular contact with the inner surface of the bottom of said classifier, the assembly of mixing chambers in nested arrangement being positioned eccentrically on the bottom of said classifier, the contacting portion of the innermost mixing chamber being in substantially symmetrical enveloping arrangement with an opening in the classifier bottom, the contacting portions of each surrounding mixing chamber being in substantially symmetrical enveloping arrangement with the next inner mixing chamber, the non-contacting portion of each mixing chamber basal end periphery constituting a substantial opening at the basal end of each mixing chamber, said opening of each mixing chamber being directed to the center of the classifier bottom.

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