May 30, 1939. R. BONATH 2,160,533

APPARATUS FOR CONTINUOUSLY CRYSTALLIZING SOLUTIONS BY EVAPORATION OR COOLING

Filed Jan. 8, 1937

FIG. 1

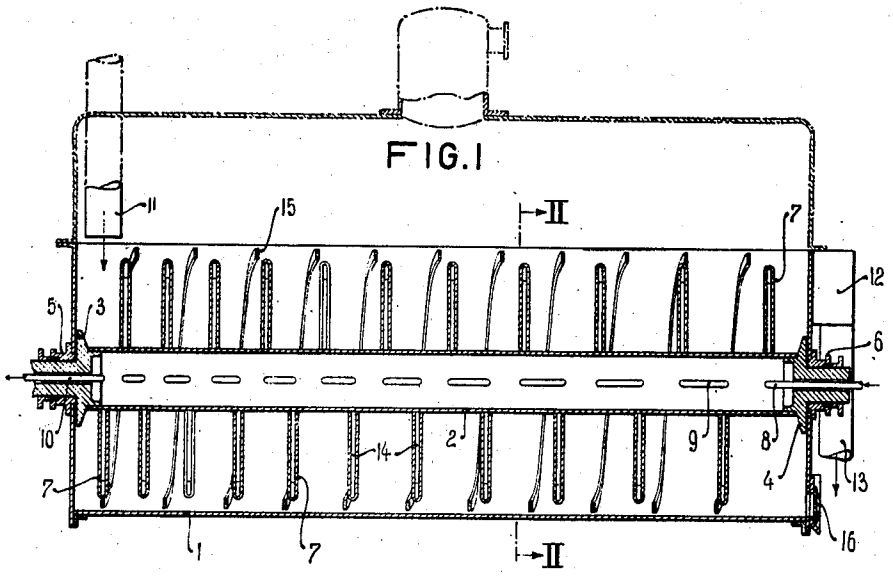
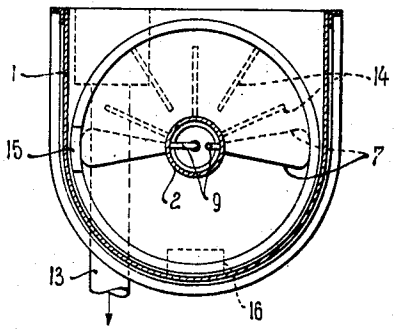


FIG. 2



R. Bonath
INVENTOR

By: Glascock Downing & Seebold
ATTYS.

Patented May 30, 1939 2,160,533

UNITED STATES PATENT OFFICE

2,160,533

APPARATUS FOR CONTINUOUSLY CRYSTALLIZING SOLUTIONS BY EVAPORATION OR COOLING

Richard Bonath, Bussum, Netherlands, assignor to Werkspoor N. V., Amsterdam, Netherlands

Application January 8, 1937, Serial No. 119,682
In the Netherlands January 11, 1936

7 Claims. (Cl. 127—16)

This invention relates to apparatus for continuously crystallizing supersaturated solutions or solutions tending to become supersaturated by evaporating or cooling, and more especially for cooling massecuite and like crystallized masses and for concentrating sugar juices and syrups.

In order to carry out said crystallisation continuously it has been proposed to use a receptacle or a series of receptacles connected one behind the other comprising a rotary shaft having secured thereto hollow plates mounted at right angles to the axis of the shaft and forming the cooling or heating elements. The solution to be crystallized may then be continuously supplied at one end of the apparatus and after having passed along the cooling or heating elements continuously be discharged at the opposite end of the apparatus for further treatment. These known crystallizers have hitherto been so constructed that the mass to be treated is subjected to uniform heat treatment during its passage through the apparatus, so that when using heat exchanging elements disposed at right angles to the longitudinal axis of the receptacle said elements are provided with an equal area and with equal mutual spacing, whereby each of the elements withdraws from or transmits to the mass under treatment a substantial equal amount of heat. This known arrangement of cooling elements, however, presents the disadvantage that the supersaturation of the mother liquor increases towards the discharge end of the apparatus which is due to the fact that in the latter stage of the apparatus in which the mass has already obtained a considerable lower temperature and a higher viscosity a greater amount of heat is withdrawn than corresponds to the reduced rate of crystallization, so that there is danger of a formation of false grain and the mass becomes so viscous in the neighbourhood of the cooling elements that the transfer of heat to the cooling elements is prevented, whereby the cooling action finally entirely ceases.

The same phenomenon occurs in a continuously operating vacuum-pan. In that case the supply of heat at the discharge end is such that a greater quantity of water is evaporated than corresponds to the decreasing speed of crystallisation of the already concentrated mass, so that here also the supersaturation increases and false grain is formed.

The present invention has for its object to avoid the above described drawback and to this end the cooling or heating elements are so arranged that the cooling or heating surface per volume-unit of the crystallizer decreases towards the discharge end of the apparatus.

According to a preferred embodiment of the crystallisation trough, the heat exchanging elements of which consist of hollow plates secured at right angles to a rotary shaft, said plates are so arranged that their relative spacing increases towards the discharge end of the trough and has therefore the smallest value at the entry of the trough. With such an arrangement a greater amount of heat is withdrawn in a cooling apparatus at the entry where the solution to be crystallized is still warm and has a smaller viscosity and consequently a higher rate of crystallisation than nearer to the discharge end and such an intensive cooling is allowable in view of the higher rate of crystallisation without danger of generating a too high degree of supersaturation. At the discharge end of the apparatus on the contrary, where the mass is highly concentrated and the rate of crystallisation is low a much smaller amount of heat is withdrawn from the mass, so that an unallowable high degree of supersaturation of the mother liquor and the formation of false grain are prevented. It is even possible to obtain a decrease of the supersaturation towards the discharge end of the crystallizer, so that the saccharose content of the mother liquor reaches a value corresponding to that of a completely exhausted molasses.

In consequence of the more intensive heat exchange at the supply end of the apparatus, where the rate of crystallisation has its highest value the crystallisation will be finished as rapid as possible so that the mass can be passed along the cooling or heating elements with a higher rate of flow than in the known crystallizers which results in an increase of the capacity.

The invention will now be described in detail with reference to the accompanying drawing in which Figs. 1 and 2 show a longitudinal sectional elevation and a cross section along the line II—II in Fig. 1 respectively of an apparatus adapted to be used as a cooling trough.

Rotatably mounted within the trough 1 is a hollow tubular shaft 2 closed at both ends by means of stops 3, 4 which form journals serving to support the shaft in the end walls of the trough. Both journals of the shaft extend through stuffing boxes 5, 6 and the left hand side journal carries a driving element not shown on the drawing, such as a wormwheel or a pulley. Secured to the shaft 2 are a series of hollow

sector-shaped plates 7 alternately arranged in juxtaposition and mounted at right angles to the shaft. The plates 7 extend through an angular distance of substantially 200° as clearly illustrated in Fig. 2. A pipe 8 for supplying cooling water extends in the right hand side journal 4 and is connected to the first plate 7. The cooling water flows through the successive plates which to this end are connected to each other by means of pipes 9 located within the hollow shaft. The cooling water leaves the left hand side plate 7 by means of the pipe 10. The massecuite is supplied through a pipe 11 near the front end of the trough and is discharged by an overflow 12 at the rear end thereof and carried off for further treatment by means of a pipe 13.

As appears from Fig. 1 the horizontal spacing of the plates 7 is the smallest at the entry of the trough and increases gradually towards the discharge end so that at this end of the trough the spacing is the widest. Within the hollow plates are baffles 14 which force the cooling water to follow a zigzag path in the plates.

The trough is further provided with a conveying screw blade 15 secured to the hollow shaft 2 by means of arms not shown on the drawing. Said screw blade furthers the travel of the mass through the receptacle but it will be understood that the mass can as well be caused to flow under the influence of gravity only.

In order that the trough may be completely emptied a slide valve 16 is provided in the rear face of the trough and near the bottom thereof.

By increasing the relative spacing of the cooling elements a smaller cooling surface at the discharge end of the trough results. This desired characteristic could also be obtained by decreasing the area of the plates which may then be arranged at the same spacing as at the entry of the trough.

The described apparatus can also be used for boiling thick juice and syrups, for which purpose the trough should be provided with an air-tight cover and be connected with means adapted to create a vacuum therein.

What I claim is:

1. Apparatus for continuously crystallizing sotions by evaporation or cooling comprising a receptacle having a shaft revolubly mounted therein, and a series of hollow plates secured at substantially right angles to said shaft and through which a temperature changing medium flows, said plates being so arranged relative to one another that their mutual spacing increases towards the discharge end of the apparatus.

2. Apparatus for continuously crystallizing solutions by evaporation or cooling comprising a receptacle having a shaft revolubly mounted therein, and a series of hollow plates secured at substantially right angles to said shaft and through which a temperature changing medium flows, said plates being in the form of circular disks adapted to partially fill the cross sectional area of the receptacle and so arranged relative to one another that their mutual spacing increases towards the discharge end of the apparatus.

3. In an apparatus for continuously crystallizing solutions by evaporation or cooling, a receptacle adapted to receive the solution at one end for movement therethrough so that the solution is discharged at the other end, a plurality of hollow heat exchange elements mounted in the receptacle so as to engage the solution, the heat exchanging surface presented by said elements per volume-unit of the mass under treatment decreasing towards the discharge end of the receptacle.

4. In an apparatus for continuously crystallizing solutions by evaporation or cooling a series of receptacles connected one behind the other the first of which being adapted to receive a continuous supply of the solution so that the solution moves through the receptacles in series and is discharged from the last receptacle, a plurality of hollow heat exchanging elements mounted in the receptacles so as to engage the solution, the heat exchanging surface involved by said elements per volume-unit of the mass under treatment decreasing towards the discharge end of the apparatus.

5. In apparatus for continuously crystallizing solutions by evaporation or cooling, a receptacle and a shaft rotatably mounted therein, a series of heat exchange elements carried by said shaft in a spaced relation therealong, and the surface area of the heat exchange elements decreasing towards the discharge end of the apparatus.

6. In apparatus for crystallizing solutions by evaporation or cooling, a receptacle adapted to receive the solution at one end for movement therethrough so that the solution is discharged at the other end, a plurality of hollow heat exchange elements mounted for rotation in the receptacle so as to engage the solution, and the surface area of heat exchange elements near the end of the receptacle first receiving the solution being greater than the surface area of the heat exchange elements at the discharge end.

7. In apparatus for crystallizing solutions by evaporation or cooling, a receptacle adapted to receive a continuous supply of the solution at one end thereof so that the solution moves through the receptacle and is discharged at the opposite end, a shaft mounted for rotation in the receptacle, a plurality of hollow heat exchange elements secured to the shaft in a spaced relation therealong with the mutual spacing thereof increasing towards the discharge end of the receptacle.

RICHARD BONATH.