

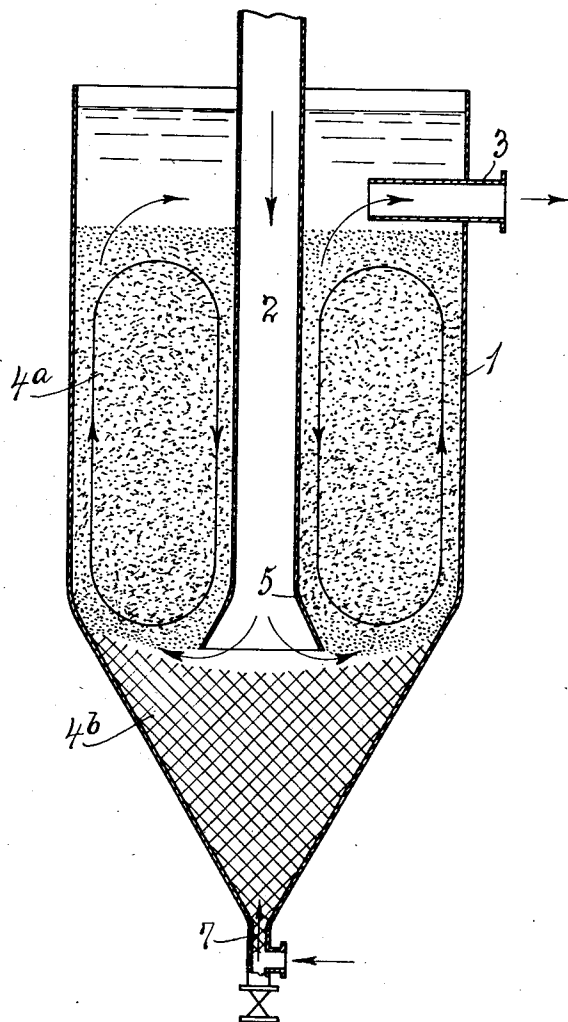
June 27, 1939.

F. JEREMIASSEN

2,164,111

APPARATUS AND METHOD FOR TREATING GRANULAR MATERIALS WITH FLOWING LIQUIDS

Filed March 27, 1936



F. Jeremiasen
INVENTOR

By: Glascock Downing & Seibold, Attys.

UNITED STATES PATENT OFFICE

2,164,111

APPARATUS AND METHOD FOR TREATING
GRANULAR MATERIALS WITH FLOWING
LIQUIDSFinn Jeremiassen, Oslo, Norway, assignor to Ak-
tieselskapet Krystal, Oslo, Norway, a Norwegian
concernApplication March 27, 1936, Serial No. 71,340
In Norway March 30, 1935

4 Claims. (Cl. 23-1)

This invention relates to crystallization and more particularly to that type of crystallization processes in which a supersaturated solution is caused to flow continuously through a suspension of constantly growing crystals. In this known type of crystallization processes the function of the suspension of crystals through which the supersaturated solution is passed is to bring about deposition of dissolved matter from the solution on the surface of the individual crystals of the suspension. The solution is thereupon subjected to a treatment by means of which it is again brought to a state of supersaturation whereupon it is caused to pass through the suspension of crystals to deposit the further quantities of dissolved substance on the surface of the crystals, thereby causing the individual crystals to grow in size. By operating in this way with circulating solution it is possible to prevent the total supersaturation of the solution from exceeding its metastable limit at the same time as the individual crystals of the suspension constantly increase in size. To attain these objects it is of importance to avoid that any part of the suspension is allowed to remain in a quiescent state for any appreciable length of time because in that event the crystals will cake in the supersaturated solution. On the other hand it is important that large size crystals are not carried along with the stream of liquid out of the suspension space as they will then be liable to be broken to pieces in the circulating pumps and other parts of the plant.

A suitable method of maintaining a high and dense suspension of crystals in a circulating flow of supersaturated solution consists in introducing the solution into the suspension space in a lateral direction immediately above a substantially horizontal bottom surface of the suspension space so as to bring about a revolving movement of the entire body of the suspension. Such a method has been disclosed for example in applicant's British Patent No. 418,349. In the apparatus described in the prior patent specification the bottom boundary of the suspension space consists of a smooth wall surface.

The present invention is based on the observation that important advantages are attainable by maintaining the suspension of growing crystals in a space in which the bottom boundary consists of the surface of a body of substantially stationary granules.

In carrying the invention into effect a downwardly directed flow of supersaturated solution is introduced into the suspension space at a point

above the central part of the said stationary body of granules in a direction substantially perpendicular to the top surface of said body. Hereby the flow is deflected outwardly in substantially radial directions into the suspension space thereby imparting to the body of growing crystals therein the desired revolving movement referred to above.

One important advantage of the method of operation which is the object of the present invention consists therein that the grinding effect of the revolving body of suspended crystals on the bottom of the suspension chamber is avoided. Another advantage consists therein that the height of the horizontally deflected stream of entering solution is capable of being controlled simply by increasing or decreasing the height of the body of substantially stationary granules maintained at the bottom of the suspension space. Other advantages of the method will appear from the following description.

An apparatus constructed in accordance with the invention comprises a suspension chamber having a discharge outlet in the top part and means to cause a laterally directed jet of liquid to enter the suspension chamber immediately above the bottom boundary of the said suspension chamber, the said bottom boundary of the chamber consisting of the top surface of a body of substantially stationary granules of a size and weight sufficiently large to withstand the entraining influence of the entering jet of liquid.

The body of granular material constituting the bottom of the suspension space may consist of the same type of material as that constituting the treated suspension, but it may also consist of other materials soluble or not such for example as granules of glass, burnt clay, gravel and the like.

Other important features of the apparatus and method according to the invention will appear from the following description of an embodiment thereof.

In the annexed drawing an apparatus embodying the invention is diagrammatically illustrated by way of example.

The drawing represents a vertical sectional view of the essential parts of the apparatus.

In making use of the illustrated arrangement one may proceed as follows:

In a container 1, constituting the suspension chamber, an upward flow of a solution is brought about by introducing the solution through pipe 2 and removing it through pipe 3. The suspension chamber contains a body of granular material,

4a, to be maintained in suspension and another body of granules 4b, to a certain height below the discharge pipe 3.

5 The granules 4a consist of the same substance as that contained in the entering supersaturated solution. The granules 4b may consist of the same or another substance but are of such a size or weight as to be capable of resisting the entraining effect of circulating solution.

10 The body of granules 4a—marked by dots—is, in the same manner and for the same reasons as in arrangements disclosed in the British Patent No. 418,349, above referred to, maintained in suspension describing a revolving movement, whereas only a very small part of the solution from pipe 2 takes its course through the hatched part of the body of granules 4b because the cross-sectional area of pipe 2 is made sufficiently large to provide for a small velocity of flow in the pipe and to prevent stirring up of the body of granules immediately below the pipe opening. The assembly of granules 4b will, therefore, practically not be subjected to the effects of an upwardly directed flow of solution; it will remain comparatively compact and undisturbed, thus forming a sufficiently stable bottom for the maintenance of the suspension in 4a, practically no part of the layer 4b being carried along up into the revolving movement of the body 4a.

30 When the pipe 2 is properly dimensioned in relation to the volume of liquid in the suspension chamber and the volume of liquid entering in the unit of time is suitably controlled, a revolving movement of the entire body of granules above the level of the pipe opening can be maintained. And it is this revolving movement of the body of suspension which has been found to render it possible to obtain a practically uniform distribution of the ascending flow of liquid over the entire horizontal sectional area of the container and to maintain an even and dense suspension of the body of growing granules without dead spaces where the granules would be liable to cake at the same time as the bulk of the growing granules are prevented from being carried along out of the suspension chamber and into the outlet 3.

As already mentioned the body 4b of granular material constituting the bottom of the suspension space may consist of the same type of material as that constituting the treated suspension, but it may also consist of other materials, such for example as gravel, glass, burnt clay or the like. Even if the body of granules 4b consists of the same type of material as 4a, it will remain in a comparatively quiescent state, partly because in that case it will largely build up from somewhat larger crystals than are contained in 4a, and partly because the conditions of the ready movability of 4a, i. e. that the granules are caused to float by a stream of liquid passing upwards from below, are not present in the body of granules 4b.

When the body of granules 4b consists of the same kind of crystals as 4a, it may however, be of advantage to direct a special stream of liquid into the part 4b, which does not carry this part in the same manner as the main stream carries the part 4a, but yet maintains it in slight motion. Such a secondary stream may be introduced through the branch pipe 7, above which baffles (not shown) may be arranged.

70 The crystals in 4b may in this way be prevented from growing together. On the whole, the tendency of caking is very limited, in view of the fact that the bulk of the supersaturated

solution, as just mentioned, passes over and above the body of granules 4b, but in the course of time caking may occur if the crystals remain completely undisturbed. The same kind of solution as that forming the main stream should be used for the secondary stream, but in an undersaturated or such a slightly supersaturated state as will make the weak motion to which the crystals are subjected, sufficient to prevent their caking.

10 The use of the same kind of crystals in 4b as in 4a carries the advantages that the finished crystals from 4a may be removed through the pipe 7, continuously or intermittently. In that event the largest crystals will sink from the suspension 4a and commence building up the upper, practically undisturbed layer of 4b, the height of the annular opening below the outlet of pipe 5 adjusting itself automatically. At the moment when the removal through pipe 7 makes the annular opening too large, the entraining force of the stream will decrease and the heaviest crystals in the lower part of 4a will therefore come to rest and form part of 4b.

20 That the removal of the crystals is rendered possible from the lowermost and central point of the apparatus is already in itself an advantage of the present invention. For in the case of a unilateral removal, such as will have to be used in arrangements according to my British Letters Patent No. 418,349 the risk is involved, in suspension containers with a large diameter, that part of the crystals grow to sizes above that desired before they arrive at the distant discharge opening, in view of the fact that the movements of the crystals along the bottom towards the lateral point of removal are brought about by comparatively weak and incidental forces, whereas in the case of the present invention the crystals need only sink a short distance right down during the removal in order to be completely protected against undesired further growth in the stream of supersaturated solution.

30 The part of the container carrying the body of granules 4b is drawn conical, by way of example; it may, however, also be of a different shape, for example like a hemisphere.

35 The part of the container enclosing the body of granules 4a need not be cylindrical; in certain cases it may be of advantage to make the diameter a little larger at the top than at the bottom in order to reduce the carrying along of small crystals out of the suspension chamber. The application of a layer of granules 4b according to the invention carries important advantages. In corrosive solutions, for instance, a metal bottom frequently will become heavily corroded. In such a case, in an arrangement according to the British Letters Patent No. 418,349, one is usually compelled to make the bottom of a highly expensive material. However, in an arrangement according to the present invention, an ordinary bottom immediately below the constantly circulating body of granules 4a becomes superfluous, and the conically shaped container part carrying the body of granules 4b will be far less liable to corrode and can be made of a cheaper material. Because the body of granules 4b being in slight motion only has a much smaller grinding effect on the walls of the bottom cone than the powerful circulating movement of the suspension 4a which, in the event of an ordinary metal bottom being used, would constantly grind away the thin surface film formed on metal sheets which frequently acts as a corrosion-protective agent.

I claim:

1. Method of crystallizing substances from solutions comprising maintaining a suspension of growing granules in an upwardly directed flow of supersaturated solution in a suspension space, maintaining another body of substantially stationary granules below the said suspension of growing granules and below the upward flowing volume of supersaturated solution, forcing a downwardly directed stream of supersaturated solution into the suspension space at a point above the said body of substantially stationary granules and so as to impinge on the top surface of said stationary body of granules and to be deflected outwardly in a substantially horizontal direction into the bottom part of suspension space, controlling the volume per unit of time of the said downwardly directed stream of entering supersaturated solution so as to enable it to impart to the bulk of the suspension a revolving movement in the suspension space, withdrawing liquid at a point above the revolving body of suspended growing crystals, and reintroducing supersaturated solution into the bottom part of the suspension space, and withdrawing granules from the bottom of the body of substantially stationary granules at such a rate as to maintain a substantially constant level of said stationary granules.

2. Method according to claim 1, in which the body of substantially stationary granules maintained below the revolving body of growing crystals consists of the same kind of material as

that of the said revolving body of growing crystals.

3. Method according to claim 1, in which a secondary flow of liquid is maintained in an upward direction through the body of substantially stationary granules maintained below the suspension space, this secondary flow of liquid being insufficient in force and volume to raise any substantial part of the said body of granules into the suspension space.

4. Apparatus for carrying out the crystallization of substances from super-saturated solutions comprising a container having a downwardly tapering bottom section, a body of substantially stationary granules in the said bottom section, said body of granules having a concave upper surface, an outlet opening for liquid in the top part of the container, a centrally arranged vertical pipe having a flared lower end for introducing super-saturated solution to the container, the said pipe opening into the container at a point above and adjacent to the upper concave surface of the said bottom body of granules, the upper surface of said body of granules and the flared opening of said pipe cooperating so as to direct the circulation of the solution in a rotary manner, and a discharge opening at the lowermost part of the tapering bottom section of the container for removing the granules therefrom.

FINN JEREMIASSEN.