O. MANTIUS.

PROCESS OF EVAPORATING SOLUTIONS.

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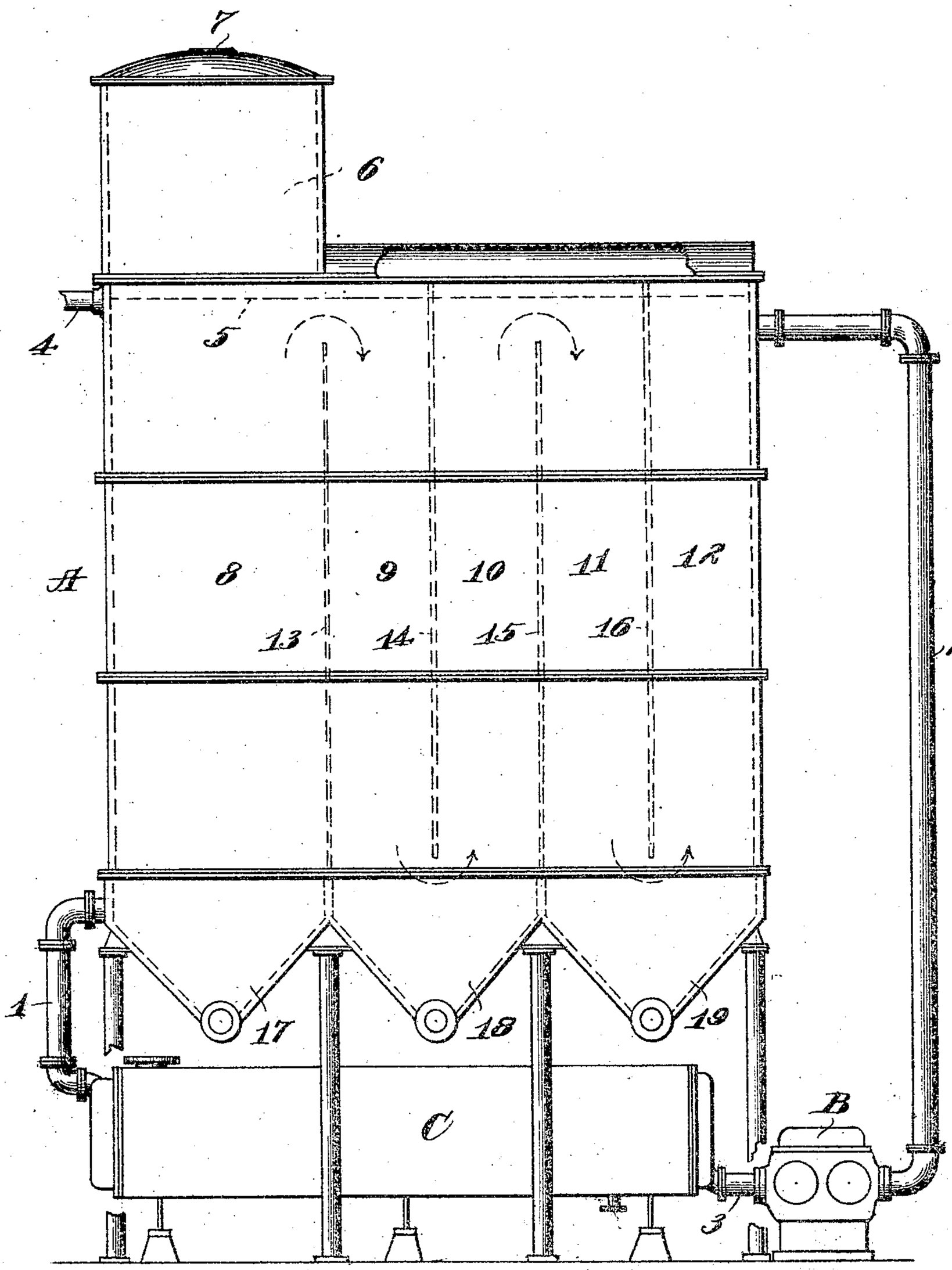
951,322. Patented Mar. 8, 1910.



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PROCESS OF EVAPORATING SOLUTIONS.

951,322. Specification of Letters Patent. Patented Mar. 8, 1910.

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To all whom it may concern:

Be it known that I, OTTO MANTIUS, a subject of the Emperor of Germany, and a resident of Chicago, in the county of Cook and State of Illinois, have invented a certain new and Improved Process of Evaporating Solutions, of which the following is a specification.

This invention relates to an improved process of evaporating solutions.

It is found in practice that, where evaporation of solutions is effected in closed evaporators, as standard types of vacuum pans, the liquor boils so rapidly that the separated salts have no time to form into large crystals. Heretofore when it has been desired to produce large crystals, this has been effected by boiling and concentrating the liquor in open tanks and then permitting it to cool gradually, or in open pans where the boiling is done very slowly, as, for example, strike pans used in sugar factories and grainers used in salt factories. This process is necessarily a slow and relatively expensive one and the production of large crystals in commercial quantities would necessitate the use of many of said strike pans or grainers.

The object of the present invention is to provide a process for evaporating solutions, whereby large crystals of the solid carried in solution may be produced in a closed evaporator and as a continuous operation.

To this end my improved process consists of the various steps hereinafter described and claimed.

For purposes of illustration, I have, in the drawing forming part of the application, shown an evaporator especially designed and adapted for the evaporation of solutions in accordance with my improved process, in which the figure is a side elevation of said evaporator.

Referring to the drawing, A presents an evaporating pan or receptacle, B a pump, and C a heater, all of which may be of any usual or approved construction, and which are connected in series by means of pipes 1, 2 and 3.

As shown, the pan A is of the familiar type known as a vacuum pan, being provided with a liquor supply pipe 4, which may be controlled either manually or automatically to maintain a substantially uniform liquor level, indicated by the dotted line 5, in said evaporator. Said evaporator A also comprises a vapor space 6 above the liquor level 5 and a vapor outlet 7 adapted for connection with a pump, condenser or the like, for maintaining a partial vacuum in the vapor space 6.

The interior of the evaporating pan A is divided into a plurality of communicating chambers or compartments 8, 9, 10, 11 and 12, by means of transverse partitions 13, 14, 15 and 16, of which the partitions 13 and 15 are continuous from the bottom of said pan to a point below the liquor level 5, preferably about equal to the width of the succeeding compartment of the evaporator, the alternate partitions 14 and 16 extending above the liquor level 5 and terminating a sufficient distance above the bottom of the evaporator to provide for the accumulation of separated granular matter in the bottom of the evaporator and, at the same time, to insure a free passageway between adjacent compartments at the lower ends of said partitions about equal in size to the liquor passages defined by the upper ends of the partitions 13 and 15 and the liquor level 5. Said partitions 14 and 16 preferably terminate below the top of the pan A, so that all of the compartments 8, 9, 10, 11 and 12, above the liquor level 5, will be in open communication with the vapor space 6, thus providing for evaporation in all of said chambers, with consequent cooling and concentration of the liquor. This construction also provides for maintaining a common liquor level in all of said compartments.

The chamber or compartment 8, which the liquor being treated enters directly from the heater, is preferably considerably larger than the other chambers or compartments, being shown in the drawings as about twice the size. This relation, as also the number of said chambers or compartments, may be varied, as desired, to meet different conditions and requirements.

The admission pipe 1 preferably communicates with the first compartment 8 adjacent to its lower end and the discharge pipe 2 with the last compartment 12 just below the liquor level, thus providing for the liquor traversing the entire length of each of said compartments in its passage through the evaporator.

While I have, in the drawing, shown the heater C as separate from and located outside of the vacuum pan A, my invention contemplates equally the use of heating means, as heating-tubes, located directly in the compartment 8, substantially as in the standard types of vacuum pans. With this construction, the circulating pipe 1 will communicate directly with the discharge end of the pump B.

My improved process, which I will now describe, involves an application of the principle that where supersaturated solutions in a quiet state are allowed to cool gradually, the solid matter carried in solution will be deposited in the form of large crystals.

In the practice of my improved process, a steam pressure, corresponding to a desired initial temperature, is maintained in the heater C, as, for example, 18 pounds absolute (3 pounds above atmospheric), corresponding to a temperature of 222 degrees F., so that, allowing for radiation, the liquor enters the compartment 8 of the vacuum pan A at a temperature of about 221 degrees F. Assuming that the pressure in the vapor space 6 is 8 pounds absolute (7 pounds atmospheric), the boiling point of water at the surface is 183 degrees F. and assuming that the solution being treated is saturated brine, the boiling point of which is 6 per cent. higher than that of water, the boiling point of the liquor at the surface is 194 degrees F. That is, the liquor enters the chamber 8 of the vacuum pan A at a temperature approximately 27 degrees F. above the boiling point thereof at the surface. The liquor in said chamber will therefore boil vigorously, with attendant rapid evaporation and cooling thereof, resulting in the supersaturation of said liquor and the separation of the solid matter (salt) held in solution in the form of small crystals.

From the compartment 8 the concentrated liquor passes successively through the compartments 9, 10, 11 and 12 at a low velocity or rate of speed, becoming gradually cooler from radiation and evaporation. Thus, soon after leaving the compartment 8, said liquor will fall to a temperature below the boiling point or point of ebullition and will become perfectly calm and quiet except for its slow current through the evaporator.

As the solubility of most substances increases with the temperature and vice versa, it results that, as the temperature of the liquor falls during its passage through the evaporator, due to evaporation and radiation, the solid matter carried in solution will separate in the form of crystals, which become larger and larger the longer they are held in suspension, so that said crystals will become progressively larger in the various compartments from front to rear of the evaporator.

From the last compartment 12 of the evaporator, the clear liquor enters the pipe 2 and passes to the pump, which affords convenient means for regulating the velocity or flow of the current of liquor through the evaporator. In practice, in evaporating saturated brine, I have obtained very satisfactory results by operating the pump at such a speed as to produce a current or flow of liquor in the evaporator of about $\frac{3}{8}$ of an inch per second. This speed can, however, be varied as it may be desired to produce larger or smaller salt crystals and will also vary in treating different solutions.

Actual tests have shown that, whereas in evaporating saturated brine in standard types of evaporators, the salt crystals or grains produced vary in size from $\frac{1}{64}$ to $\frac{1}{32}$ of an inch square, by the practice of my improved process, with a liquor current or velocity of substantially $\frac{3}{8}$ of an inch per second, the sizes of the salt crystals or grains produced vary from $\frac{1}{32}$ of an inch square in the first chamber, to about $\frac{3}{16}$ of an inch square in the last chamber.

The sizes of the crystals can be varied by increasing the number of compartments and by reducing the liquor current or velocity in the evaporator, either or both, if it is desired to produce larger crystals, or, by reducing the number of compartments and increasing the liquor speed or velocity, either or both, if it is desired to produce smaller crystals.

As the solid matter held in solution separates, it settles to the bottom of the evaporator, which, to provide for separating the different grades of salt produced in the different compartments of the evaporator, and for conveniently discharging the same, comprises hopper shaped sections 17, 18 and 19, the section 17 forming the bottom of the first compartment 8, the section 18 forming the bottom of the compartments 9 and 10, and the section 19 forming the bottom of the compartments 11 and 12 and receiving the salt deposited in said compartments, respectively.

Any desired or approved means may be employed for removing the salt from the evaporators. Said means, however, are in no way related to the present invention and need not, therefore, be described.

I claim:—

1. The process of evaporating solutions to effect precipitation of the solids carried in solution, which consists in passing a saturated liquor successively through a series of communicating compartments at a low speed or velocity, boiling said liquor in the first compartment to a point of supersaturation, and permitting said liquor to cool gradually in its passage through the other compartments to a temperature below the boiling point, and thereby to become calm and quiet,

2. The process of evaporating solutions to effect precipitation of the solids carried in solution, which consists in admitting the solution in a superheated condition to the first of a series of communicating compartments and passing said liquor successively through said compartments at a low speed or velocity, permitting said liquor to boil in said first compartment to a point of supersaturation and to cool gradually in its passage through the other compartments to a temperature below the boiling point, and thereby to become calm and quiet.

In testimony, that I claim the foregoing as my invention, I affix my signature in presence of two subscribing witnesses, this 26th day of February, A. D. 1908.

OTTO MANTIUS.

Witnesses:
CHARLES B. GILLSON,
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