No. 817,010. PATENTED APR. 3, 1906.

V. H. SCHÜTZE.

METHOD OF CRYSTALLIZING SUGAR, &c

APPLICATION FILED APR. 24, 1905.

Fig. 1.

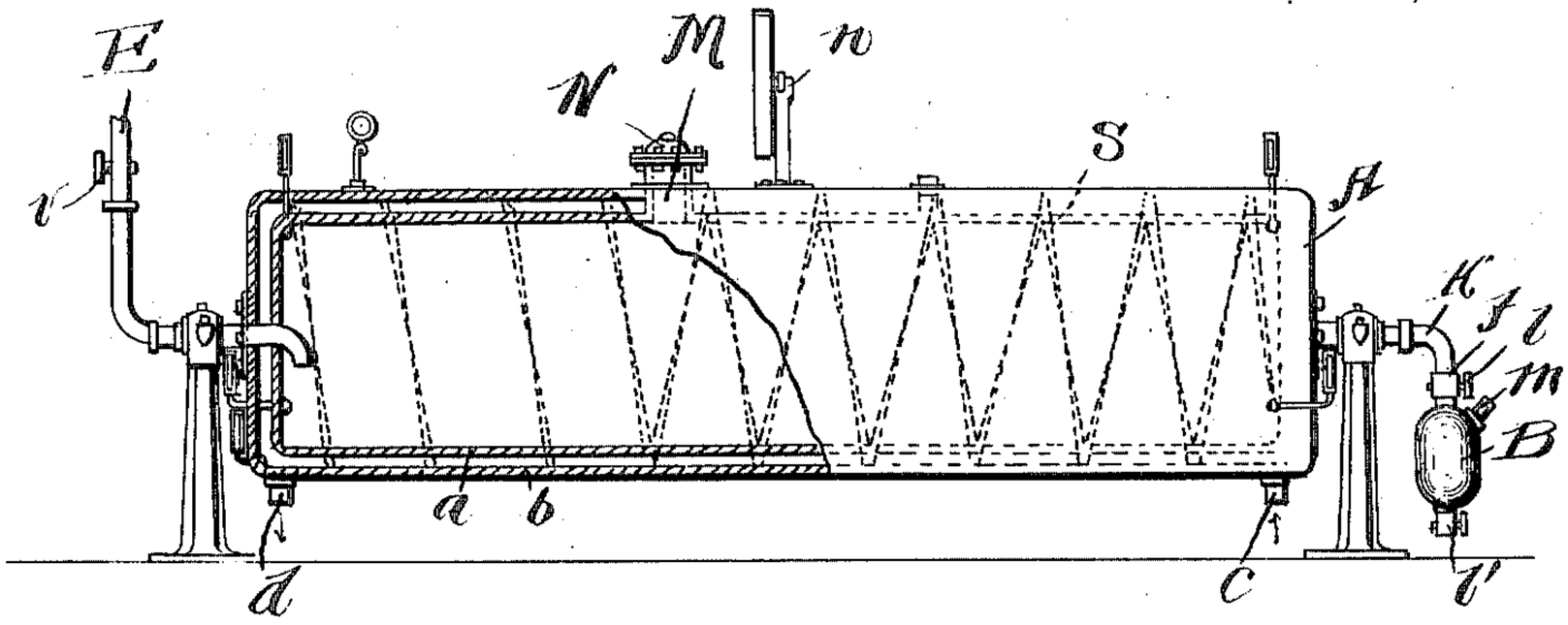


Fig. 2.

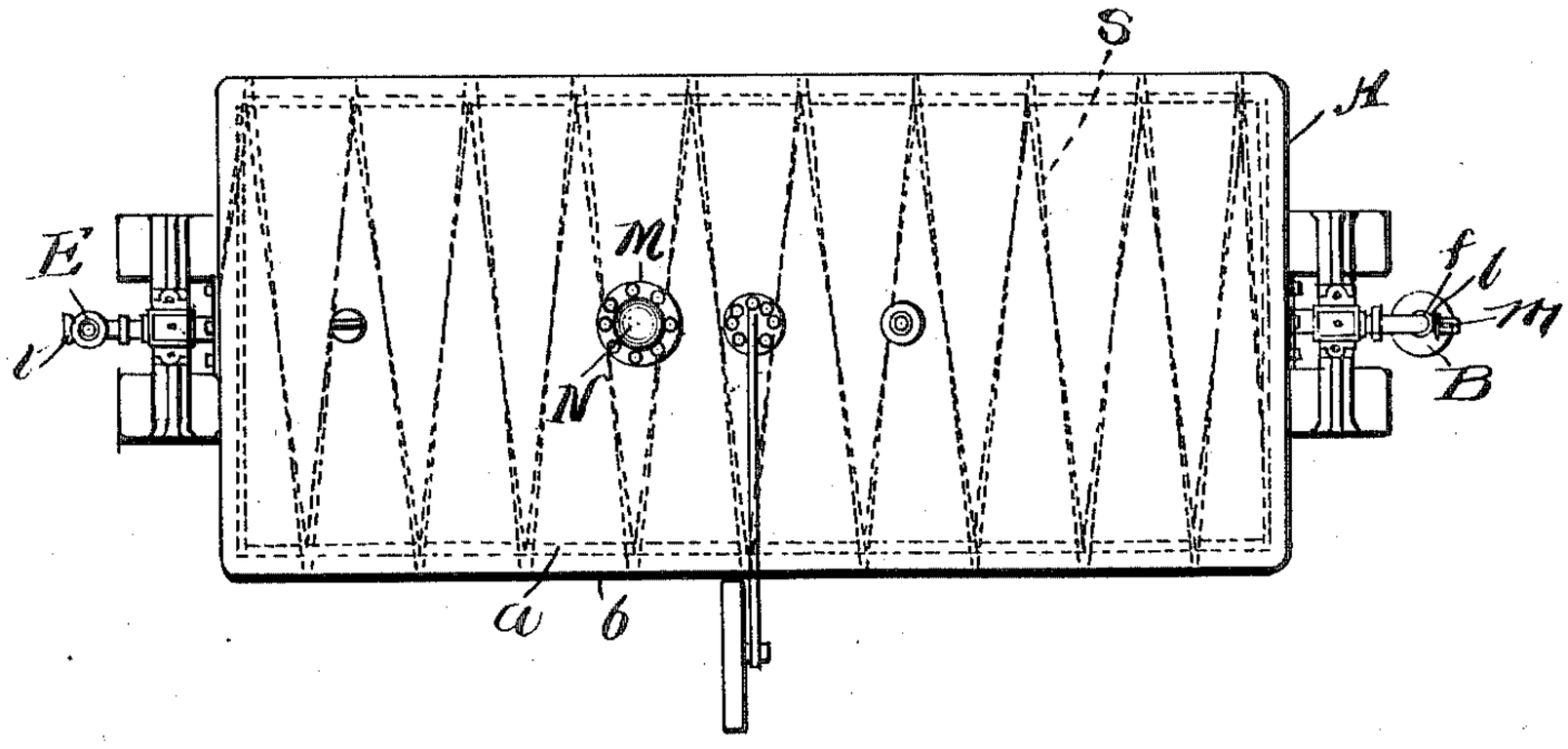
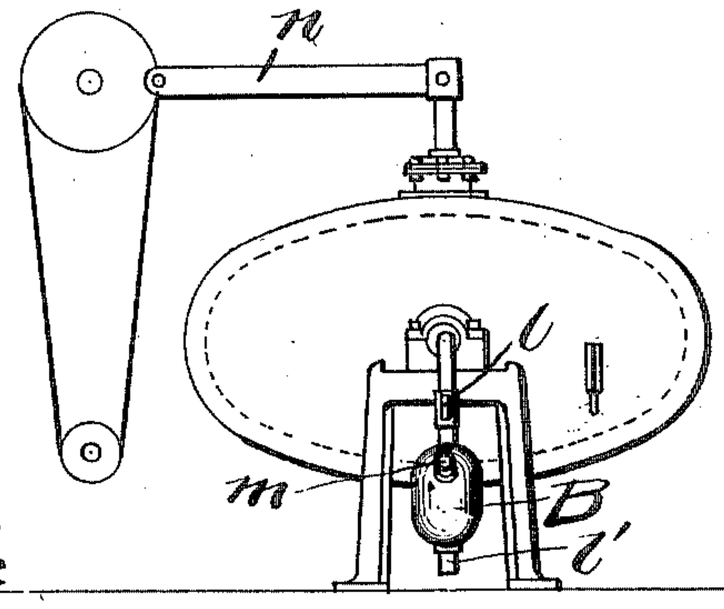


Fig. 3.



Witnesses
W. May. Duvall.
Martin J. Fisher.

Inventor
V. H. Schütze.
By Wilkinson & Fisher.
Attorneys.

UNITED STATES PATENT OFFICE.

VICTOR HERMANN SCHÜTZE, OF RIGA, RUSSIA.

METHOD OF CRYSTALLIZING SUGAR, &c.

No. 817,010. Specification of Letters Patent. Patented April 3, 1906.

Application filed April 24, 1905. Serial No. 257,280.

To all whom it may concern:

Be it known that I, VICTOR HERMANN SCHÜTZE, a subject of the Emperor of Russia, residing at Riga, Russia, have invented certain new and useful Improvements in Methods of Crystallization; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

In the specification of Letters Patent No. 780,448, for an improved method of crystallization, granted to Victor Schütze, January 17, 1905, is described a process of obtaining large well-formed crystals from hot saturated solutions, the essential feature whereof consists in this, that the hot saturated solution moving continuously and slowly is met by a liquid, such as water, surrounding the same, which acts simultaneously as a cooling agent and as a jacket for retaining the heat on the counter-current principle, so that the difference in temperature between the solution and the cooling liquid is uniform and relatively slight. The present invention relates to an improvement upon this process which is based on the following known physical laws: First, the boiling-point of a solution depends on the degree of concentration and on the pressure of the surrounding atmosphere; second, the degree of viscosity of a liquid is under like conditions of air-pressure dependent on the temperature and under like conditions of temperature is dependent on the air-pressure. Accordingly under the process forming the subject of the invention, which is adaptable for all crystallizable, organic, or inorganic substances, especially, however, for the obtaining of sugar direct from the sugar juice or syrup in one operation and the removal of the molasses the operations of concentrating and crystallizing are carried out entirely to the finish in one apparatus—that is, in a vacuum apparatus kept in continuous motion. The mother-liquor is brought to concentration in the first part of the vacuum apparatus and is in the second part of the apparatus, while, however, remaining throughout *in vacuo*, cooled down to the atmospheric temperature, or even considerably lower, so that it leaves the apparatus as a solution crystallized out as far as possible.

The apparatus serving to carry out this process, which also forms an improvement over the construction described in the said specification, is constructed on the following principles: If a hot liquid flows in axial direction through the inner cylinder of a stationary cylindrical double-walled horizontally-disposed vessel while at the same time in the annular space between the cylinders a cold liquid flows in the opposite direction, the cold liquid will gradually become warmer and the hot liquid will cool. The cold liquid flowing through the annular space will not be uniformly warmed, however, but it will become considerably warmer in the upper half than in the lower half—that is, than the liquid flowing along the bottom. On the other hand, the hot liquid flowing through the inner cylinder will have a considerably higher temperature at the top of the cylinder than at the bottom. In order that the heating of the liquid circulating through the annular space may proceed gradually and uniformly, indicating the like temperature at top and bottom, and that the reduction of temperature in the liquid flowing through the inner cylinder be gradual and uniform, the liquid in the annular outer space is caused to circulate in a helical path around the inner cylinder. Accordingly the double shell of the apparatus is intersected by a spiral partition, while the entire structure is so mounted as to be able to oscillate or rotate freely around its horizontal axis.

The apparatus serving to carry out the said process is illustrated in the annexed drawings, in which—

Figure 1 is a part vertical section, Fig. 2 a plan, and Fig. 3 an end view, of the same.

The apparatus A comprises a vessel absolutely air-tight, having double walls with a passage between the same and of elliptical transverse section. In the interspace between the walls is a spiral partition S, having a water-tight and air-tight connection with the inner wall *a* and the outer wall *b* and which serves to give the required direction to the liquid serving as a heat-retainer and flowing through the annular space between the walls. The said spiral partition has a relatively slow pitch, so as to give as many turns as possible for the length of the apparatus. The distance between the walls is naturally proportionate to the size of the apparatus. Inlet and outlet openings *c* and *d* for the jacketing liquid are provided at both ends of the apparatus. The apparatus has also a manhole M, with an air-tight cover N, a coupling-piece for attaching the manometer for reading off the degree of vacuum at any time, a

coupling-piece *f* for the vacuum-pump, and several connections for attachment of thermometers. Further, the apparatus has an inflow-pipe E with a hermetically-closable valve *v* for the sugar solution to be concentrated and crystallized and an outflow-pipe *k*, to which is attached a hermetically-closable cylindrical receptacle B, preferably of glass, for the crystals delivered from the apparatus along with the mother-liquor. This receptacle B has also a connection *m*, which terminates in a hermetically-closing valve or cock, and has also two cocks *l* and *l'*. The entire vacuum apparatus is rotatable around its horizontal longitudinal axis and must receive a slow rocking movement, which is in the present case imparted by the lever-arm *n*.

In the treatment of sugar solution the operations are as follows: The syrup purified by diffusion, separation, saturation, and filtration and evaporated to 48° to 50° Brix. flows from the evaporating apparatus through the pipe E in a continuous stream regulated by the valve *v*, with a temperature of about 70° centigrade, into the vacuum apparatus A. Before commencing the operation, however, the liquid serving as a heat-retainer is led from *c* at a temperature of about 80° centigrade through the jacketing-space until the liquid issuing at *d* has a temperature of about 70° to 80°, that is, until the entire vacuum apparatus has reached this temperature. Then the supply of hot liquid is turned off, and now through the tube *c* a cold liquid is led in a slow current into the annular space until the liquid issuing at *d* shows a fall in the temperature of the originally hot liquid. During the passage of liquid through the jacket the vacuum-pump is set in motion in order to bring the vacuum apparatus to the desired vacuum. At this time naturally the valve *v* in the tube E and also the valve between the apparatus A and the receptacle B must be closed. From the manometer it can be determined whether the apparatus is closed hermetically, and the valve is then opened and the hot syrup is permitted to flow into the slowly oscillating vacuum apparatus. The inflow of syrup is so regulated that in the interior of the apparatus a vacuum as constant as possible is maintained. The manometer should indicate no air-pressure greater than seventy millimeters of mercury.

In the interior of the apparatus the following operations take place: The sugar solution entering with a temperature of about 70° centigrade and of 18° to 50° Brix. meets the wall heated to about 70° centigrade and cannot, therefore, cool, but as a reduced pressure is in the apparatus boils and gives off part of its water content as vapor to the evacuated space. This vapor is at once drawn off by the vacuum-pump, which always endeavors to maintain the same vacuum. The hot syrup moving in the apparatus toward the outlet meets at the next point a part of the inner wall having a temperature of about 69° centigrade and must therefore give up part of its heat, but at the same time warms with the heat given off the liquid slowly flowing through the outer jacket and having at this point a temperature of nearly 69° centigrade. The sugar solution having still a temperature of 69° flowing farther toward the outlet meets at the next point a part of the inner wall having a temperature of only 68° centigrade and gives up again part of its heat, cools somewhat, and at the same time warms the jacketing liquid. On the other hand, the sugar solution is concentrated in the vacuum apparatus, and, on the other hand, it is cooled; but not only does concentration take place in the vacuum apparatus, but also crystallization and growth of the separated sugar crystals. The syrup entering with a concentration of 48° Brix. and with a temperature of about 70° centigrade boils in the vacuum apparatus, and is thus concentrated further, and if this concentrated solution is now cooled then naturally as the solubility of the sugar increases with the temperature a part of the sugar must separate out. As in the vacuum apparatus there are the conditions necessary for good crystallization— namely, as small as possible diminution of temperature and least possible movement— the crystals separate in good forms. The crystals come in contact with the solution and gradually grow in size. On the inner wall of the apparatus new crystals are always forming. These crystals deposit on the foot of the apparatus, but do not adhere, but migrate or wander, as the entire apparatus is in continuous slow motion, and arrive at the outlet of the apparatus after following a double or circuitous path. They move in a wavy route toward the outlet, wandering at the same time and increasing in size and acquiring a larger surface. When the crystals reach the outlet-nozzle and leave the vacuum apparatus, they are surrounded with mother-liquor, which, however, will not be viscous, because there is a vacuum throughout, and the viscosity of a solution is not only a function of the temperature, but also a function of the external pressure. On leaving the apparatus the crystals fall into the receptacle B, which is also evacuated. When B is about two-thirds full of crystals, the valve *k* is closed and the valve *m* opened, and by opening the valve *l* the crystals in the receptacle B are caught on a sieve, the mother-liquor being allowed to drip off, and the crystals are separated in a centrifugal machine with only a little water. The crystals so obtained are of chemically-pure sugar in beautiful transparent forms.

The process is not only applicable to treatment of sugar solutions, but also to all other

organic and inorganic crystallizing substances.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is—

The method of obtaining crystals from a hot saturated solution, which consists in causing said solution to slowly travel under the influence of a vacuum through an elliptical vessel which is steadily rocked and simultaneously causing a cooling liquid to travel in a helical path around the outside of said vessel in the opposite direction to the flow of said solution, substantially as described.

In testimony whereof I affix my signature in presence of two witnesses.

VICTOR HERMANN SCHÜTZE.

Witnesses:
CONSTANTIN PYCHLAU,
LUDW. EHRTMANN.