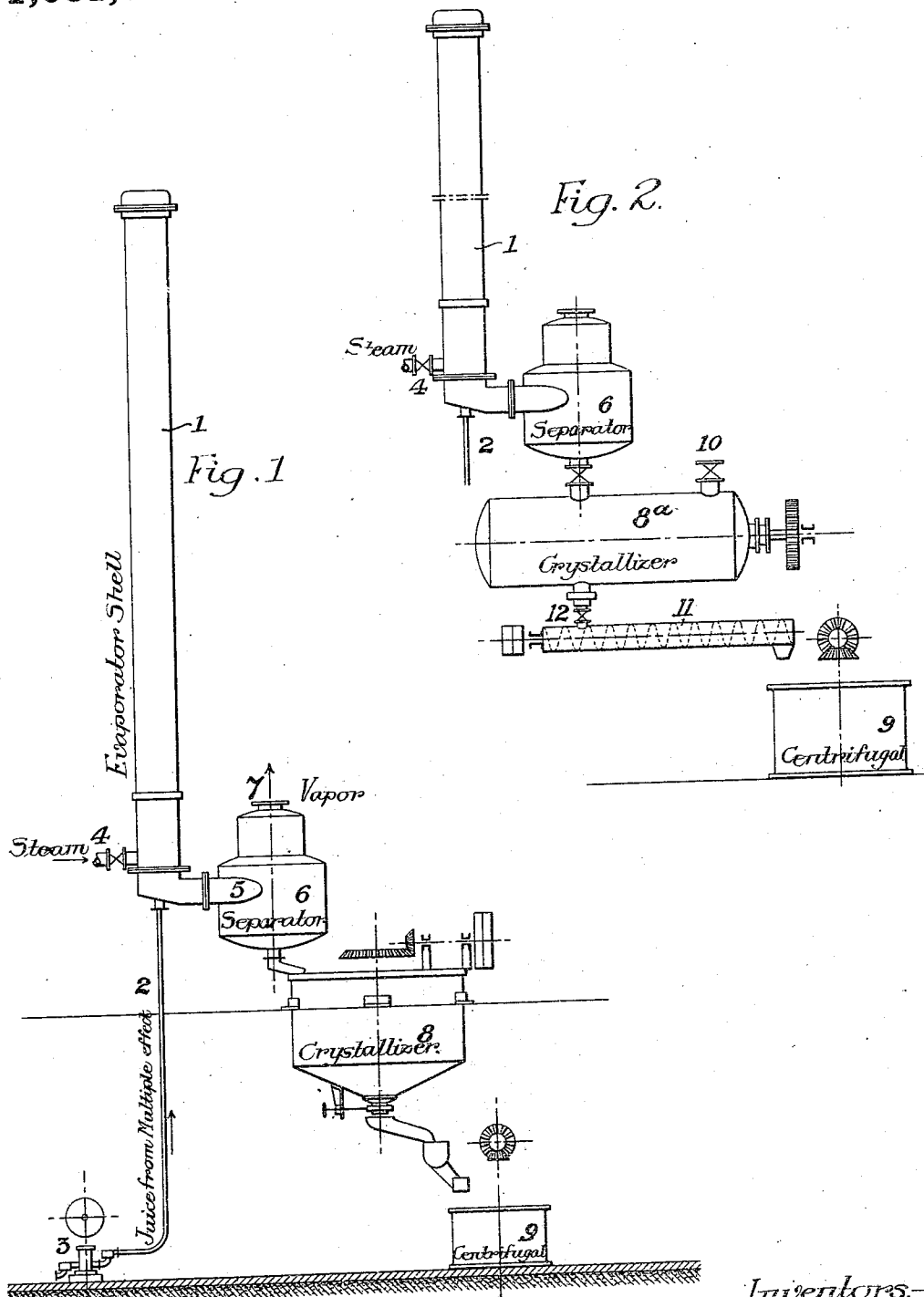


P. KESTNER & P. LAGRANGE.
 PROCESS OF CRYSTALLIZING SUGAR JUICES.
 APPLICATION FILED OCT. 14, 1908.

Patented July 2, 1912.

1,031,559.



Witnesses
 William H. Brown.
 O. A. Burness

Inventors:-
 Paul Kestner & Prosper Lagrange,
 by their Attorneys,-
 Howson & Howson

UNITED STATES PATENT OFFICE.

PAUL KESTNER, OF LILLE, AND PROSPER LAGRANGE, OF PARIS, FRANCE.

PROCESS OF CRYSTALLIZING SUGAR-JUICES.

1,031,559.

Specification of Letters Patent.

Patented July 2, 1912.

Application filed October 14, 1908. Serial No. 457,735.

To all whom it may concern:

Be it known that we, PAUL KESTNER and PROSPER LAGRANGE, citizens of the Republic of France, and residents of Lille, Department Nord, and Paris, France, respectively, have invented an Improved Process of Crystallizing Sugar-Juices, of which the following is a specification.

Our invention relates to the manufacture of sugar and the object of our invention is to so evaporate the sugar syrup as to increase the yield of the crystallizable content as "first" sugar, thereby avoiding the large percentage of "second" and "third" crystal formation common under the present methods of manufacturing sugar.

In the accompanying drawings, Figures 1 and 2 are diagrammatic views illustrating apparatus capable of carrying our improved process into effect. It has been proposed to increase the yield of "first" crystals by gradual cooling and agitation, such action taking place in a closed vessel under atmospheric pressure or in the open air. An improved method for obtaining "massecuite" has been employed in France in which evaporation to saturation and subsequent crystallization are carried out in two distinct and separate operations in two separate apparatus. Under this process, the syrup at 28° or 30° Bé., just after it leaves the triple or multiple effect is drawn into the apparatus which is ordinarily used for boiling to grain. Evaporation in vacuum is carried to the point of "string proof", without forming grains, and then finally, under pressure, a high degree of saturation is obtained without, however, reaching the final state of saturation in which the massecuite does not contain more than 5% of water; and then, to augment the saturation without being obliged to evaporate still higher and thereby increase the temperature, some crystallized sugar is dissolved in the syrup thus concentrated. The whole mass of saturated syrup thus obtained is allowed to crystallize in a crystallizer by progressive cooling, which may be more or less rapid. By this method an increased amount of a rich and regular grain is obtained with an ease that cannot be secured by crystallization effected simultaneously with evaporation in the pan ("cuite"). The process just described, however, presents two inconveniences which we desire to

overcome. The first of these is the necessity of carrying on the evaporation in two phases; first in a vacuum and then under pressure, and second the necessity of adding sugar to the syrup to obtain the necessary saturation that will enable crystallization to take place. These inconveniences seem to be the result of a well-rooted prejudice against submitting sugar syrups to high temperatures. In order to obtain, by evaporation without the use of a vacuum, saturated syrup not containing more than 5 per cent. of water, it is necessary to maintain a boiling temperature of about 120° to 122° C. It has also been thought, up to the present time, that excessive heat altered the syrup, and all operators heretofore have attempted to concentrate at low temperatures. We have found, however, that this alteration of syrup is much slower than was previously supposed; that in reality sugar juices can be evaporated at atmospheric pressure nearly to complete saturation when their boiling temperature is more than 120° centigrade without any apparent inversion of sugar and no appreciable coloration, providing the operation is not too long continued.

Our work has been carried on with the usual evaporators in use at the present time, notably those of the film climbing type having elongated tubes constructed in accordance with the designs of Paul Kestner, of Lille, France, such for instance as that forming the subject of his British Patent No. 6,372, March 19, 1903. In recent operations of this evaporator we have discovered that sugar juices were much less sensitive to heat than was usually supposed, and we have been able to concentrate them at very high temperatures, a condition due to their rapid circulation in this apparatus, and the question of circulation coupled with high temperature seems to be the secret of the results we have obtained.

In an evaporator such as described, we have concentrated a thin juice at a temperature of 128° C., and have been unable to discover any alteration by analysis. We have been proved, by trials on concentrated syrups, that the conditions are the same as above, and we believe that we can use a still higher temperature without risk. Under such conditions we have been able to realize a new process which may be described as follows: In this process, the

sugar juice just as it comes from the existing multiple effect evaporators, or if the work is in a refinery, the juice as it is generally sent to the boiling to grain pan is delivered to an evaporator which works at atmospheric pressure and not in a vacuum. It is possible to use the existing pans in sugar factories if they have a heating surface sufficiently large to permit rapid evaporation, unless it should be necessary to give too high a pressure to the heating surface. But we prefer to employ an evaporator in which concentration is made at a single passage through the tubes, in such a manner as is described in Patent No. 965,822 because it is under these conditions of evaporation that we can be certain that no discernible alteration of the syrup takes place. Under these circumstances the syrup may reach such a degree of concentration as to contain only 5 per cent. of water, and in refineries this would be even less.

In Fig. 1 of the accompanying drawings we have shown diagrammatically apparatus available for use in carrying out one part of our improved process. In this structure 1 represents an up and down current evaporator of the type shown in the Kestner patent before referred to in which tubes are arranged for the ascent and descent of the sugar juice or syrup received from the multiple effect. This juice enters from a pipe 2 under the influence of a pump 3 and steam enters the casing of the evaporator at the point 4. The juice as it comes from the multiple effect evaporator is concentrated in the evaporator 1 in one passage. The steam pressure in the shell is from 3 to 3½ atmospheres, and we regulate the feed into the evaporator in such a way that the syrup leaves the evaporator with only about 5% water. The boiling temperature of this syrup is between 125° and 128° C. The entering juice or syrup is of a density equaling 30° Bé. or higher, and after passing up and down within the elongated tubes of the evaporator it is discharged at 5 into the separator 6 at a temperature of from 115° to 125° centigrade. The accompanying vapor escapes at 7 and the concentrated syrup or juice enters the crystallizer 8 where its entering temperature is substantially maintained until this receptacle is filled. The vessel receiving the hot concentrated juice is provided with a cooling and stirring arrangement and when filled the mass is allowed to cool. Crystallization starts at about 110° C. or 115° C. It is difficult to ascertain the exact point, but the cooling is gradual and progressive according to the desired size of the grain: slower cooling producing large grains, and from the crystallizer the crystallized mass passes to the centrifugal 9 for the usual treatment. When great crystals are required we pro-

pose to substitute for the open crystallizer a closed crystallizer under vacuum, and in Fig. 2, we have shown diagrammatically such apparatus. The concentrated syrup delivered from the evaporator will be drawn into the crystallizer 8^a consisting preferably of a horizontal cylinder with an agitator. When this is full the crystallizer will be connected by means of a valve 10 with some condenser and will be put under a vacuum which at first will be only very small, and which will increase slowly and regularly. Thus the temperature will be lowered regularly through the whole mass which is not possible with surface cooling with such a thick and non-conducting mass. From the crystallizer, the mass will pass to a conveyor 11, through a valved outlet 12, and thence to the centrifugal for the usual treatment. By not forcing the concentration too high it is possible, particularly in refineries, to make more concentrations and to make successive crystallizations.

Concentration can be carried out in a multiple effect, and as a matter of fact in a double effect. In this case the direction of travel of the juice in the pans would preferably be "counter-current"; that is to say, the pan heated by direct steam would receive the partially concentrated juice delivered by the pan receiving the initial juice and heated by steam from the other pan. We may note a still greater advantage of this process, in that the vapors given off by evaporation from the surface are utilizable, sometimes in the preliminary evaporating apparatus, and sometimes in other heaters. Besides it is possible, without any inconvenience, to give a slight counter-pressure to the evaporator in order to be able more easily to utilize this vapor, and the boiling temperature may thus be increased by several degrees. We have proved that evaporating in a single pass as is done in the Kestner evaporator referred to there is not the slightest alteration in the sugar juice.

We wish to affirm a last advantage in this process, in that it permits the preliminary multiple effect concentration to be carried to a higher point than has been possible heretofore. Under the usual working conditions it is customary to send the juice to the boiling to grain pan when it reaches a density from 28° to 30° Baumé, because of certain exigencies in the work of boiling. In our improved process where we replace the pan, by evaporation to saturation, we are able to deliver the concentrated juices to the form of evaporator illustrated just at the limit of saturation.

We claim:

1. The process of obtaining crystallized sugar from sugar juices, which comprises evaporating the juice to a density of from 28° to 30° Baumé under suitable tempera-

ture conditions, then rapidly circulating such juice in an evaporator under a temperature of from 125° to 130° C., and upward until it is a substantially saturated solution, separating therefrom the vapor accompanying such saturated solution, maintaining such body of saturated solution in this condition and subjecting the same to agitation and during agitation gradually lowering the temperature of the mass to the point of crystallization, continuing the cooling of the entire mass for the formation of grain, and finally separating the crystallized and uncrystallized portions of the solution.

2. The process of obtaining crystallized sugar from sugar juices, which comprises evaporating the same to a density of from 28° to 30° Baumé under suitable temperature conditions, then rapidly circulating such juice in a transit evaporator under a

temperature of from 125° to 130° C., and upward until it is a substantially saturated solution, separating therefrom the vapor accompanying such saturated solution, maintaining such body of saturated solution in this condition and subjecting the same to agitation and during agitation gradually lowering the temperature of the mass to the point of crystallization, continuing the cooling of the entire mass *in vacuo* for the formation of grain and continuing agitation and finally separating the crystallized and uncrystallized portions of the solution.

In testimony whereof, we have signed our names to this specification in the presence of two subscribing witnesses.

PAUL KESTNER.
PROSPER LAGRANGE.

Witnesses:

HENRI CHARRIER,
J. BELOIT.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."