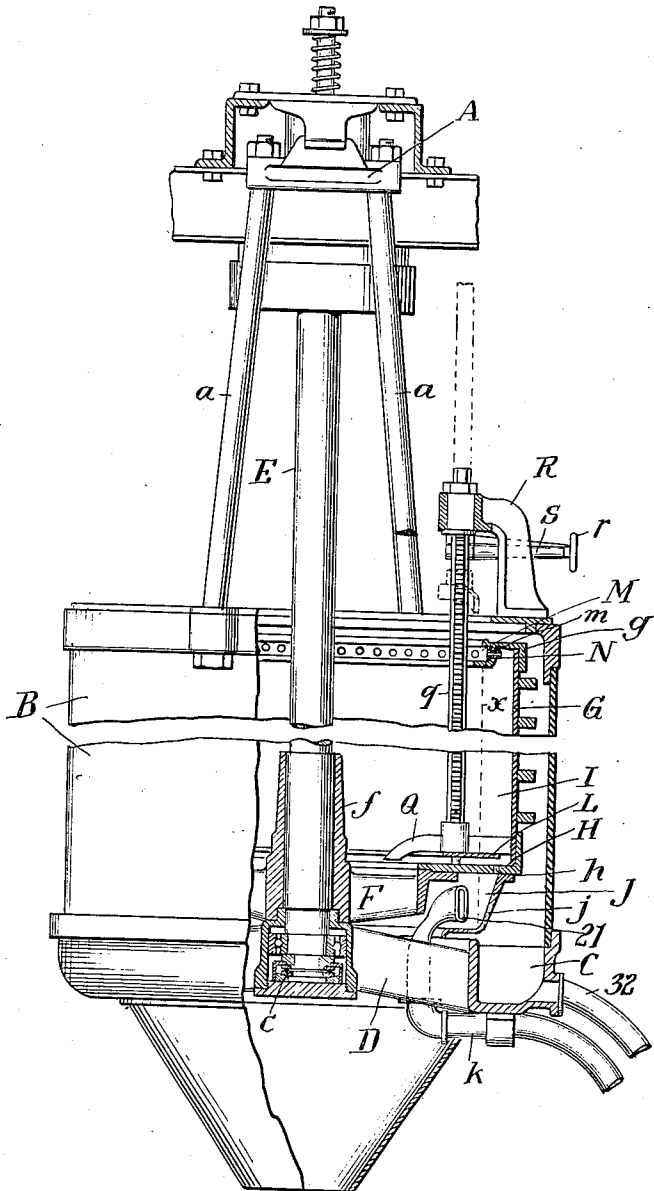


E. KÖPKE.
CLARIFICATION OF SUGAR SOLUTIONS.
APPLICATION FILED JULY 20, 1911.

1,101,940.

Patented June 30, 1914.



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CLARIFICATION OF SUGAR SOLUTIONS.

1,101,940.

Specification of Letters Patent.

Patented June 30, 1914.

Application filed July 20, 1911. Serial No. 639,523.

To all whom it may concern:

Be it known that I, ERNST KÖPKE, a citizen of the United States, and residing at Honolulu, Territory of Hawaii, have invented certain new and useful Improvements in Clarification of Sugar Solutions; 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.

This method of clarifying sugar solutions and solutions of substances having similar characteristics offers a more efficient, economical and expeditious procedure than that followed heretofore.

The new mode of procedure calls for the employment of a centrifuge of the type in which insoluble substances either heavier or lighter, or both heavier and lighter, than the liquid with which they may be associated can be segregated or separated by centrifugalization, and the cleansed liquid removed by a scoop or other suitable means.

The method as applied to the clarification of sugar solutions consists in removing the insoluble impurities from sugar solutions by centrifugalizing them as they come directly from the apparatus that separates them from the vegetable fiber and before they are treated by heat; removing the insoluble muds present in the solutions after heating and after the addition of the clarifying agents by centrifugalizing the treated solutions as soon as the insoluble substances appear in sufficient quantity to be advantageously separated; and centrifugalizing the washings or dilutions of the muds obtained at certain stages of the clarification of the juices to recover solutions of the sucrose which may be still associated with the muds. The cold juices may, if desired, be treated by some precipitating agent previous to centrifugalization.

The type of centrifugal machine which I prefer to employ, is illustrated in the accompanying drawing, but this machine is not of my invention. On the contrary, it is the invention of E. W. Kopke, and is the subject matter of an application for United States Letters Patent, Ser. No. 651,693, filed Sept. 28, 1911.

Referring to the drawing, the non-rotatable casing B of this machine is supported by rods *a* depending from a head A carried by the platform beams, and designed to ad-

mit of a certain amount of oscillation as is usual in suspended centrifugal machines. The lower part of the casing B consists of a casting in the outer edge of which an annular gutter C is formed. Arms D project inwardly from the gutter C and support a ball step bearing *c* in which the lower end of a rotating shaft E is journaled. The upper end of the shaft E is journaled in a suitable bearing in the head A and a spider F has a long hub *f* which is rigidly secured to the shaft E. The arms of which spider carry a rotatable imperforate drum or annular chamber G. The drum G is cylindrical, its interior being smooth and unobstructed, and is provided with an inturned flange *g* at its upper edge, while a peripheral annular ring H upon the spider F provides an inturned flange upon its lower edge. These inturned flanges *g*, H form the end walls of an annular stratifying chamber I which is adapted to contain a cylindrical body of liquid when the drum G is revolving. A flange *j* substantially L-shaped in cross-section, is secured to the bottom of the drum G and forms an annular ante-chamber J opposite the outermost part of which a circular series of apertures *h* are provided in the bottom wall of the drum G, affording communication between the ante-chamber J and the stratifying chamber I. The supply pipe *k* supported on the casing B passes upwardly between the arms D and terminates in a flat nozzle K which lies with its mouth parallel with and at an acute angle to the normal liquid level (indicated by dotted lines *x*) in ante-chamber J while the machine is in operation, and this nozzle K discharges in the direction of rotation of the machine, thus laying a flat ribbon of fluid upon the surface of the liquid in ante-chamber J. The juice flows with all its content of the heavier solid impurities from the ante-chamber J through the apertures *h* into the stratifying chamber I, as an inclination given the outer wall of the flange *j* deflects any mud which tends to collect thereon toward the apertures *h*. The streams of juice from the apertures *h* are separated into a substantially cylindrical axially moving body of fluid by the baffle plate L supported a short distance above the apertures *h* and extending within the liquid level. At the upper edge of the rotating drum G the inturned flange *g* is preferably provided with a channel M the lower wall *m* of which projects inwardly

farther than the flange *g* and constitutes a dam for holding back any lighter impurities which might find their way into the stratifying chamber I. In the practice of clarifying sugar solutions, such lighter particles are few and they usually connect in small quantity upon the surface in ante-chamber J and are rarely driven deep enough to enter chamber I through apertures *h*. The outer wall of the channel M is provided with a circular series of apertures into which are slipped tubules N through which the clarified juice rises into the channel M from that depth in the body of the liquid in chamber I from which it is desired to be drawn, and these tubules used of various lengths and quickly interchangeable serve as convenient means for altering the depth from which the clarified juice is to be drawn. The channel M offers a convenient place from which the juice may be scooped in the well known manner, if desired, without disturbing the contents of the stratifying chamber I but usually it is allowed to overflow the edge of the flange *g* to be caught by the casing B and drained from the gutter C through the outlet pipe 32.

For the purpose of removing the mud, a plow Q mounted upon the lower end of a racked rod *q* is provided. The racked rod *q* is mounted in a bracket R on the casing B and this plow Q is adapted to be moved downwardly into and throughout the length of the drum G by the engagement of a pinion with the rack upon the rod *q*, the pinion being actuated by a hand-wheel *r* on the end of the lever S. The lever S is splined to the rod *q* and by its annular movement the rod *q* may be turned to bring the plow into engagement with the inner surface of the drum G, in which position it operates to remove the layer of mud and may be moved throughout the length of the drum by hand-wheel *r*. The mud so thrown down falls through the hopper on a conveyor or other device intended for its disposal. The juice laid in a flat ribbon upon the surface of the liquid already contained in the ante-chamber I is gradually accelerated by contact with the preceding layer of liquid in the ante-chamber as it is moved outwardly by the continued introduction of juice and attains substantially the angular velocity of the machine as it passes through the apertures *h* into the stratifying chamber I. The baffle plate L joins the several streams of inflowing juice into a cylindrical sheet of axially flowing liquid which passes upwardly and is stratified in the stratifying chamber I. The clarified juice flows through the tubules N and over the inturned flange *m* into the casing B, from which it is drained through pipe 32, until a sufficient amount of mud has collected in the chamber I to render its removal advisable when the

machine is somewhat slowed down and the plow Q is brought into play to remove the mud. The introduction of juice is discontinued during the removal of the mud and is again established after the plow has been withdrawn.

A detailed description of the successive steps taken in carrying out this method or process is as follows: The juice as it comes from the rolls, press or other apparatus employed to separate it from the vegetable fiber is either first treated by some precipitating agent or is run directly into the centrifuge, where its impurities not in solution are separated in the form of a mud of the heavier particles collecting about the outer wall of the bowl of the centrifugal machine and a collection of lighter chips and particles nearer the axis. The clear solution between the collections of heavier and lighter impurities is scooped out of the rotating bowl by the utilization of its own velocity, or is removed in any other suitable manner. The remaining dross and mud is then washed by being admixed with a suitable quantity of added water whereby the considerable amount of sucrose associated with the dross and mud is dissolved. Thereupon, the solution with the insoluble matter is again subjected to the separating action of the centrifuge and a new solution recovered as in the first case.

The treatment thus far has been directed to the removal of all the insoluble matters present in the sugar solutions which might detrimentally affect the sugar by reason of the subsequent application of heat and clarifying agents if allowed to be acted on thereby, and, in pursuance of the general policy of removing at the earliest opportunity all the impurities which may then be attainable. The muds and impurities removed from the solutions, having been divested of the sucrose which could be advantageously recovered in the manner stated, are discarded and only the sugar solutions removed from the centrifuge enter into the subsequent steps of the process. These solutions may now be treated with suitable agents such as lime, sulfur, etc., to prepare them for clarification and are then heated in the customary manner, after which procedure, insoluble matters again appear admixed with the solutions in the form of added matters or precipitates or both, and they are again subjected at this stage to the separating action of the centrifuge and clear solutions and muds obtained. The muds now collected may be washed as in the former case by the admixture of added water and the greater part of the sucrose associated with them may be recovered by centrifugalizing the new solution with the insoluble matter and recovering the clear solution.

The above centrifugalization of the treated and heated solutions may take place before or after the concentration of the solution in evaporating apparatus, the economy of this step being naturally determined by the amount of insoluble matter then present. However, this method of clarification contemplates successive centrifugalizations of the diluted solutions after their concentration in evaporating apparatus so long as an economic saving of sucrose is possible, as concentration causes the precipitation of substances that were in solution when in the presence of a greater quantity of water, and it is desirable to promptly eliminate in this way as soon as they appear the impurities arising at all stages, from the original juice state through the syrup and molasses states wherever it can be economically and efficiently done.

What I claim is:

1. The method of clarifying sugar solutions consisting in centrifugalizing the juices coming from the expressing apparatus to separate the insoluble dross and muds from the solution, washing the dross and muds so separated by the admixture therewith of added water, and centrifugalizing the resulting mixture to separate out in solution the greater part of the sucrose remaining associated with said dross and mud, treating the solutions so obtained with suitable clarifying agents and heat, centrifugalizing the treated solutions to separate out insoluble matter incident to said treatment, washing by the admixture of added water the muds incident to such treatment, centrifugalizing the mixtures incident to such washings to recover the clear solutions, concentrating the solutions incident to such washings, and centrifugalizing the concentrated solutions to separate out the insoluble matter present after said concentration.

2. In a method of clarifying sugar solutions, the separation of insoluble matter from said solutions by centrifugal stratification and selection prior to the application of heat thereto.

3. In a method of clarifying sugar solutions, the separation of insoluble matter from said solutions by centrifugal stratification and selection prior to the application of clarifying agents and heat to said solutions.

4. The method of clarifying sugar solutions which consists in centrifugalizing the juices coming from the expressing apparatus to separate the insoluble dross and muds from the solution, treating the solution so obtained with suitable clarifying agents and heat, and centrifugalizing the treated solution to separate out insoluble muds incident to such treatment.

5. The method of clarifying sugar solu-

tions which consists in centrifugalizing the juices coming from the expressing apparatus to separate the insoluble dross and muds from the solution, heating the solution to coagulate impurities therein, and centrifugalizing the heated solution to separate out the coagulated impurities.

6. In a method of clarifying sugar solutions the washing, by admixture of added water, of muds collected from the sugar solutions, the concentration of the mixture resulting from said washing, and the centrifugal stratification and selection of the concentrated mixture to separate out insoluble matter and such precipitates as may appear in consequence of said concentration before crystallization takes place.

7. In a method of clarifying sugar solutions, the separation of insoluble matter from the solutions, the concentration of the clear solutions, and the centrifugal stratification and selection of the concentrates to separate out precipitates incident to the concentration before crystallization takes place.

8. The method of clarifying sugar solutions which consists in centrifugalizing the juices coming from the expressing apparatus to separate the insoluble dross and muds from the solution, treating the solution so obtained with suitable clarifying agents and heat, centrifugalizing the treated solution to separate out insoluble muds incident to such treatment, concentrating the clear solution thus obtained, and centrifugalizing the concentrated solution to separate out the insoluble muds present after such concentration.

9. The method of clarifying sugar solutions, which consists in centrifugalizing the juices coming from the expressing apparatus to separate the insoluble dross and muds from the solution, treating the solution so obtained with suitable clarifying agents and heat, centrifugalizing the treated solution to separate out insoluble muds incident to such treatment, concentrating the clear solution thus obtained, centrifugalizing the concentrated solution to separate out the insoluble muds present after such concentration, washing the muds separated at different stages of the process by the admixture therewith of added water, and centrifugalizing the resulting mixtures to separate out in solution and thereby recover the greater part of the sucrose remaining associated with said muds.

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

ERNST KÖPKE.

Witnesses:

FRED T. P. WATERHOUSE,
ALBERT WATERHOUSE.

It is hereby certified that in Letters Patent No. 1,101,940, granted June 30, 1914, upon the application of Ernst Köpke, of Honolulu, Territory of Hawaii, for an improvement in "Clarification of Sugar Solutions," errors appear in the printed specification requiring correction as follows: Page 2, line 6, for the word "connect" read *collect*; same page, line 35, for the reference letter "g" read *q*; and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 4th day of August, A. D., 1914.

[SEAL.]

J. T. NEWTON,
Acting Commissioner of Patents.