CONTINUOUSLY OPERATING CENTRIFUGE

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 ABSTRACT

 A sugar centrifuge is provided with a feed-in arrangement for sugar massecuite in which a massecuite stream falling through an inlet tube is sprayed with water. Steam is also circulated around the stream of massecuite whereby the latter is exposed to steam jets. The massecuite falls into a distribution cup having vertical projecting mixing pins. An accelerating cone receives the massecuite from the cup and feeds it to the centrifuge proper.

 7 Claims, 1 Drawing Figure
CONTINUOUSLY OPERATING CENTRIFUGE

BACKGROUND OF THE INVENTION:

This invention relates to a continuously operating sugar centrifuge of the type having a conical screening basket which rotates around a perpendicular axis. In this type of centrifuge a massecuite feeding device comprising an inlet pipe is mounted coaxially to the rotation axis of the screening basket and a distribution cone is mounted at the hub of the screening basket and an acceleration cone.

The massecuite feeding arrangement of continuously operating centrifuges in the past have not been entirely satisfactory. It has been customary to feed the massecuite coming out of a slide valve to dose the massecuite feed in a free falling stream manner through an inlet pipe. This process frequently involves a break away of the massecuite stream. In such arrangements it is also possible for the massecuite stream to contact the inlet pipe. If this occurs, the massecuite adheres to the inlet pipe and runs off more slowly than in a free stream. As a consequence, the inlet pipe is filled rapidly with massecuite and overflows.

The rotating screening basket of a continuously operating centrifuge acts like a ventilator. As a result, the freely running massecuite stream in the inlet pipe is surrounded by an intense air flow which is sucked in from the outer atmosphere so that the massecuite is cooled and its viscosity increased.

A satisfactory run of a continuously operating centrifuge depends upon the equal distribution of the massecuite on the screening basket. As the viscosity increases, however, it becomes more difficult to attain the desired equal distribution. As the temperature of the massecuite reaching the screening basket decreases, the separating efficiency also decreases, since, due to the increase in the viscosity of the molasses, the curing power does not suffice to cure the thin layer of molasses adhering to the sugar crystals.

Final product massccuites usually have a very high viscosity. In some countries, the viscosity of final product massccuites is extremely high due to specific characteristics of the processed sugar cane that vary from country to country. In processing this type of final product massccuite, it is impossible to achieve an even massecuite feed and an even massecuite distribution by means of the known massecuite feeding devices. It often happens in the processing of this type of massecuite that the massecuite stream is interrupted. Single massecuite lumps may thus occur in the distribution cup, and upon being ejected from the distribution cup, the lumps reach the screening basket from the acceleration cone without any fundamental acceleration. These massecuite lumps often produce dangerous imbalances and hence often necessitate turning off of the centrifuge. An equal distribution in the distribution cup, as well as an equal distribution in the acceleration cone, is difficult to achieve even with normal operation, i.e., when the massecuite stream is not interrupted due to the high viscosity. The separating capacity in general is unsatisfactory and further processing is almost always necessary in order to remove molasses residues from the surface of the sugar crystals.

In order to overcome this problem wash water from the outside has been sprayed on the flowing massecuite stream. However, the wash water only wets the surface of the massecuite stream without amalgamating with the massecuite and without reducing its viscosity. The wash water had the effect of a lubricant in the distribution cup and in the acceleration cone. Even distribution did not occur because the massecuite was not driven from the wall of the distribution cup and the wall of the acceleration cone.

Attempts have also been made to feed steam or wash water into the inside of the massecuite stream. For this purpose, a vertical tube was positioned centrally in the massecuite stream, and the top of the tube was connected to a steam or wash water feed line. It was noted that this tube served to center the massecuite jet. The massecuite stream was not interrupted or deflected laterally to contact the wall of the inlet pipe as often in this arrangement. The centering of the massecuite jet, however, was the only improvement which was achieved with the use of such a tube since the desired cominuling of wash water or steam with the massecuite did not occur. The unwanted lubricating effect also occurred in this arrangement. In addition, the central tube acted as heating element. The massecuite was thus heated by the tube. Certain portions of the sugar which had previously been crystallized out by earlier cooling steps were dissolved again. Considerable sugar losses thus resulted as the dissolved sugar entered the final molasses during the curing process.

OBJECTS OF THE INVENTION:

It is therefore the object of this invention to overcome the above problems and to provide a massecuite feeding device for centrifuges of the above mentioned type so that massecuite may reach the screening basket with even distribution, even though the massecuite has a high viscosity.

SUMMARY OF THE INVENTION:

In accordance with the invention the above objects are achieved by providing a continuously operating sugar centrifuge of the first above disclosed type and having a vertical inlet tube which projects into the inside of a distribution cup. The distribution cup is equipped with several perpendicular distributing pins spaced between inlet tube and the lateral wall of the distribution cup. The top ends of the pins are located between the bottom edge of the inlet tube and the top edge of the distribution cup. The inlet tube has a funnel-shaped upper end. An annular tube adapted to be connected to a wash water feed line is provided at the upper end of the inlet tube. The annular tube is perforated at the inside of the ring in order to direct wash water jets radially toward the center of the inlet tube and onto the massecuite jet. The lower end of the inlet tube is perforated at least in the upper part of its length, and equipped with a double shield to form an annular cavity connected to a steam feed line.

When designing massecuite feeding devices for sugar centrifuges, carriers are, in general, avoided because of the assumption that the mechanical affects of these carriers might destroy sugar crystals. Nevertheless, it has now been proved, in spite of this wide-spread assumption, that unwanted crystal break with sugar massccuites having an extremely high viscosity does not happen. The massecuite coming out of the inlet tube is immobile when entering the distribution cup in relation to its rotation and at first will be seized by the distribution pins. Then, due to its own inertia and viscosity, it
is moved in equally radial directions to the outside of the cup and pressed against the lateral walls of the distribution cup. At the same time, an acceleration in turning direction occurs. It is important for this distribution process that the bottom edge of the inlet tube be located sufficiently below the top ends of the distributing pins. If the bottom edge of the inlet tube is located too close to the top ends of the distributing pins or even is above the top ends, then the distributing pins are unable to seize the massecuite and to press it against the wall of the distribution cup. Then the massecuite will just be deflected, and the disadvantages mentioned above are not overcome.

With the aid of the distributing pins, it is possible for the first time to generate a homogeneous mixture of highly viscous final product massecuite and wash water as well as from steam or condensate in the massecuite feeding device of a continuously operating centrifuge. A short term increase in temperature of the massecuite results when the steam is added. The viscosity is thus reduced and the molasses becomes thinner so that a better distribution of the massecuite is achieved, thereby providing better flow properties in the centrifuge. The reduced viscosity of the molasses facilitates the separation. The quantity of heat and the duration of heating of the massecuite resulting from the added vapor are limited so that the desired reduction of viscosity will be achieved, while the dissolution of sugar crystals will be avoided. The wash water, which is added to the massecuite when reducing the viscosity and which is well integrated into the massecuite, has enough time on its way to the screening basket from the distribution cup to act upon the molasses and to increase its ability to flow. Tests have proved that sugar of high quality may be produced with the sugar centrifuge in accordance with the invention without the necessity of after-curing.

Considering the centrifuge in accordance with the invention, a measured quantity of wash water is sprayed on the massecuite jet, the jet falling through the inlet tube due to the influence of gravity. Normally this would entail considerable disadvantages because wash water does not mix with highly viscous massecuite and acts as lubricant in the distributing cup and the acceleration cone. However, the invention takes advantage of this normally disadvantageous lubricating effect of the wash water in order to avoid the known and so far unavoidable overflow of the inlet tube. If the massecuite jet in the centrifuge in accordance with the invention contacts the inlet tube, it easily pulls itself off the pipe surface due to the mentioned lubricating effect without the development of a massecuite accumulation.

A vapor shell is formed in the upper part of the inlet tube between the outer double shell and the inlet tube, and steam from the vapor shell enters the space between the massecuite jet and the inlet tube. The vapor circulates around the massecuite jet from the outside and due to the ventilation effect of the screening basket the massecuite jet will be sucked downwards to the distributing cup where it will be mixed with the massecuite by the distributing pins. The vapor emitted in the upper part of the inlet tube prevents the cold outer air from being sucked in. It thus avoids the previously unavoidable cooling of the free-running massecuite jet in the inlet tube. Another advantage of inserting steam into the inlet tube is seen by the fact that the outer surface of the massecuite jet is thereby at least slightly heated, resulting in a slighter viscosity than usual. If the inlet tube is of a metallic material, it will be heated for its total length by the vapor shell. If the massecuite jet contacts the hot surface of the inlet tube, the high temperature of the inlet tube provides for a quick removal of the massecuite jet therefrom without resulting in a massecuite accumulation.

Three effects remain in the centrifuge according to the invention, i.e., (1) the lubricating effect of the wash water sprayed on the massecuite jet at the upper part of the inlet tube, (2) the viscosity reducing effect of the vapor, which circulates around the massecuite jet, and (3) the viscosity reducing effect of the inlet tube heated by the vapor. The result of these added effects is the fact that centrifuges may be fed evenly with sugar massecuites having an extremely high viscosity. Contact between the massecuite stream and the inlet tube may be disregarded with the centrifuge according to the invention, because the massecuite jet does not stick to the inlet tube.

In order to avoid cooling of the massecuite, it is advantageous to design the centrifuge according to the invention so that the inside of the acceleration cone at the pass of the inlet tube is almost completely sealed against air entering from outside. In order to achieve the desired effect it is sufficient if an annular disk is assembled on the outside of the inlet tube and slightly axially spaced from the acceleration cone bottom through which the tube extends so that a gap of only a few millimeters remains between this disk and the acceleration cone. A relatively great radial clearance may then be left between the acceleration cone and the inlet tube.

The air stream entering the inside of the acceleration cone through the small annular gap will be considerably impeded and will additionally be heated by the inlet tube. The advantages of the centrifuge according to the invention are especially obvious when processing highly viscous final product massecuites, as this type of massecuite for the first time may be cured with satisfactory capacity and satisfactory separating effect according to the invention. However, considerable operational improvements occur when processing different types of massecuite. Depending upon the quality of the massecuite it is possible to eliminate the use of wash water spraying or vapor ventilation. The bottom edge of the inlet tube may be vertically adjustable to vary the distance therefrom to the bottom of the distribution cup in an improved design of the sugar centrifuge according to the invention. This adjustment is important in order to compensate for the qualities of various types of massecuite.

BRIEF FIGURE DESCRIPTION:
In order that the invention may be clearly understood, it will now be described, by way of example, with reference to the accompanying drawing, wherein the single figure is an axial sectional view of a centrifuge according to the invention.

DETAILED DESCRIPTION OF EXAMPLE EMBODIMENTS:
Referring to the drawing, sugar massecuite in a free running massecuite stream 2 falls under the influence of gravity from a slide valve 1. The funnel-shaped upper part 3 of the inlet tube 4 is located in a space below the slide valve, the tube 4 having a vertical axis.
An annular tube 5 is connected to the wash water feeding line 6, the inner side of the ring being perforated and constituting the upper termination of the funnel-shaped part 3. Wash water jets 8 ejected funnel-shaped the holes 7 are directed radially inwardly toward the center of the inlet tube 4, and reach the outer surface of the massecuite jet 2.

In the area located directly beneath the funnel-shaped part 3, the inlet tube 4 is equipped with holes 9 and an outer double shell 10. The annular cavity 11 between the outer double shell 10 and the inlet tube 4 is connected to a steam feeding line 12a and constitutes a vapor shell. Vapor jets are directed from the cavity through the screen holes 9 to circulate around the massecuite jet 2 from the outside, the vapor jets thus constituting a vapor shell around the massecuite jet. The inlet tube 4 projects deeply into the distribution cup 12 located below the tube. This distribution cup 12 is equipped with several perpendicular distributing pins 13 projecting upwardly from the bottom of the cup. It is necessary in accordance with the invention that these distributing pins 13 are positioned between the lateral wall of the distribution cup 12 and the outer side of the inlet tube 4, and it is furthermore necessary that the bottom edge 14 of the inlet tube 4 extends to a position spaced from the bottom 15 of the distribution cup 12 and particularly below the top ends of the distributing pins 13. Only if the bottom edge 14 is located far enough below the upper ends of the distributing pins 13 and close enough to the bottom 15 of the distribution cup 12, will it be ensured that the massecuite entering the inside of the distribution cup 12 will be seized by the distributing pins 13, and will be processed to a homogeneous mixture with the wash water and with the steam entering at the same time so that it will be distributed evenly on the lateral wall of the distribution cup. In order to adjust the position of the bottom edge 14 of the inlet tube 4 to various massecuite qualities it is advantageous if the bottom edge 14 is vertically adjustable, for example by means of spacer rings 10'. Inlet tube 4 may alternately be slideable in the collar 32. The desired position of the bottom edge 14 is then fixed by means of a set screw 10".

Under the influence of wash water and vapor as well as due to the homogeneity achieved with the help of the distributing pins 13, the massecuite runs with an even distribution out of the distribution cup 12 and into the acceleration cone 16 externally surrounding the distribution cup. The cone 16 is connected to the cup 12 via straps 17. The diameter of the cone 16 gradually increases from the top thereof to which the straps 17 are connected toward its bottom edge 18. In other words, the cone 16 is in the form of a frustum of a cone with the lower base open and the inlet tube extending through the upper base. The massecuite leaves the bottom edge of the cone in an accelerated manner, evenly distributed on the circumference thereof and its thence discharged into the feeding area 19 of a conical screening basket 20.

The massecuite is cured when it passes through the screening basket 20. Molasses is discharged through the screening areas of the screening basket, whereas sugar is released by way of the top edge of the basket. A disk 30 is affixed to the outside of the tube 4 just below the point where the tube passes through the bottom 31 of the inverted core 16. The perimeter of this disk is slightly axially separated from the bottom 31 to provide a seal against circulating air. Besides, the disk 30 closes the steam cavity 11.

Although the invention has been described with reference to specific example embodiments, it is to be understood that it is intended to cover all modifications and equivalents within the scope of the appended claims.

What is claimed is:

1. A massecuite feeding arrangement for a continuously operating sugar centrifuge having a conical screening basket rotatable around a vertical axis and having a massecuite feeding device positioned to feed massecuite coaxially to the center of rotation of the screening basket, said feeding arrangement comprising a vertical inlet tube having a lower free end, a rotatable distribution cup positioned beneath said tube, whereby said lower free end of said inlet tube reaches into said cup to form a gap between the inner wall of the cup and the outer surface of said inlet tube, a plurality of vertically distributing pins mounted in said cup to reach into said gap, the lower free end of said tube terminating a distance spaced from the bottom of said cup and below the tops of said pins, means for introducing massecuite to the top of said inlet tube, rotatable acceleration cone means located in said screening basket and surrounding said cup to receive massecuite from said cup and to direct the massecuite toward said screening basket, means for introducing steam into said vertical inlet tube, as well as means for exposing said massecuite to washing water as the massecuite flows through said vertical inlet tube.

2. The massecuite feeding arrangement of claim 1, wherein said acceleration cone means is frustoconical with a lower base open and wherein the inlet tube extends through the upper base.

3. The massecuite feeding arrangement of claim 2, comprising sealing means on said inlet tube for substantially sealing spaces between said tube and said acceleration cone means to prevent the passage of air between them.

4. The massecuite feeding arrangement of claim 1, wherein said means for introducing steam into said vertical inlet tube comprises a double shell surrounding said vertical inlet tube to form a cavity for receiving steam from a source of steam, and apertures in the walls of said vertical inlet tube for directing steam from said cavity radially inwardly relative to said vertical inlet tube and onto said massecuite.

5. The massecuite feeding arrangement of claim 1, wherein the top of said vertical inlet tube has a funnel-shape having a top diameter greater than the bottom diameter to form said means for introducing massecuite, said means for exposing the massecuite to washing water being arranged around the top of said funnel-shape whereby the washing water is introduced at the top of the funnel-shape.

6. The massecuite feeding arrangement of claim 1, wherein said means for exposing the massecuite to washing water comprises an annular tube positioned at the top of said vertical inlet tube and having inwardly facing apertures, whereby water introduced into said annular tube is directed radially inwardly into said inlet tube and onto the massecuite.

7. The massecuite feeding arrangement of claim 1, further comprising means for adjusting the spacing between the bottom edge of said inlet tube and the bottom of said cup.