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METHOD FOR CENTRIFUGING AND WASHING SUGAR MASSECUITES AND SIMILAR MIXTURES

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Fig. 2.

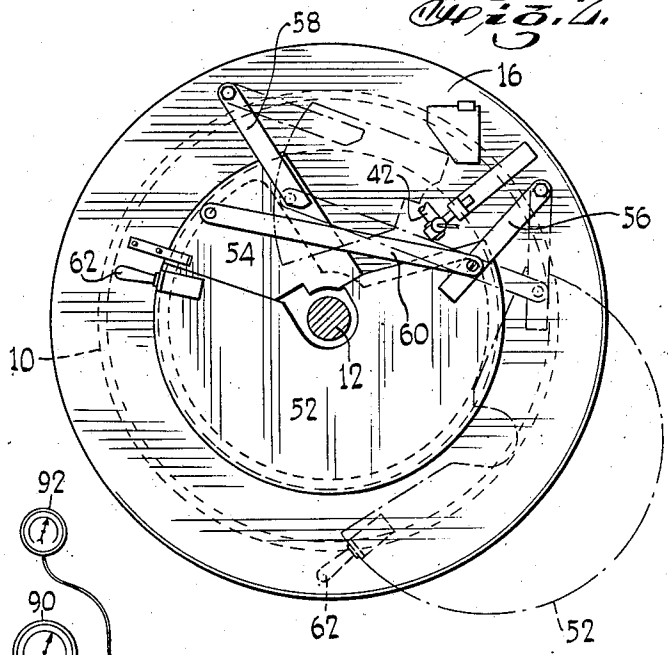


Fig. 1.

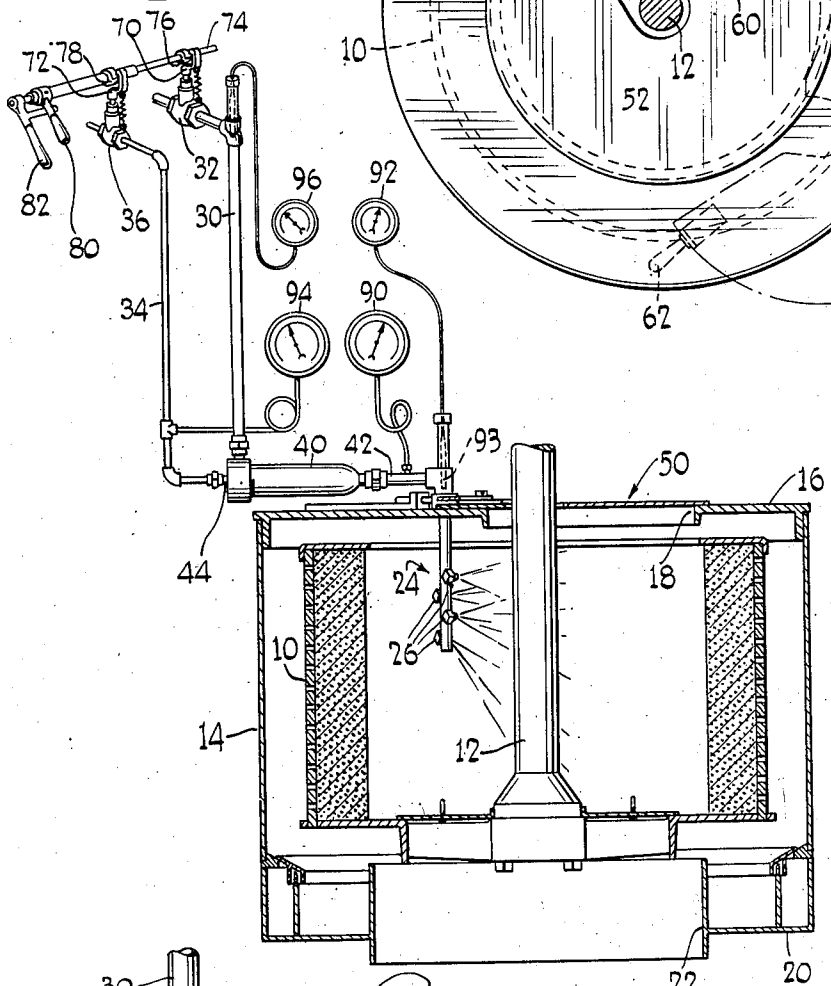
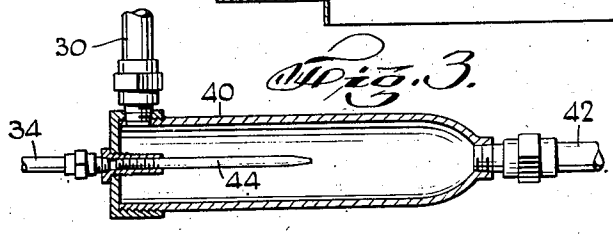


Fig. 3.



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METHOD FOR CENTRIFUGING AND WASHING SUGAR MASSECUITES AND SIMILAR MIXTURES

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7 Claims. (Cl. 127—56)

This invention relates to a new and improved method and apparatus for centrifuging sugar massecuites or similar mixtures of crystals and syrup, and particularly to improvements in the washing of crystals during a centrifugal cycle. By the use of the present improvements the amount of washing liquid and the dissolution of crystals may be substantially reduced, the duration of a centrifugal cycle may be shortened, and the quality of the washed crystalline product may be improved.

Various processes have been used for washing the wall of sugar in a centrifugal in order to remove adherent syrup remaining on the crystals after the preliminary purging stage. In some factories the washing has been done with steam; in others, a spray of warm water (e. g., 125° F.) has been delivered onto the sugar. The use of steam for washing has been attended by inferior results because of its poor penetration of the sugar wall, its retarded action and its characteristic of over-treating the inside of the sugar wall and dissolving too much grain before the average purity of the sugar can be brought to a satisfactory point. The use of warm water also has failed to give the desired results. In recent years an improved and more efficient practice has been provided which involves the application of a fine hot water spray to the sugar by forcing hot water (170° to 200° F.) through a spray nozzle under considerable pressure (e. g., about 30 lbs. per square inch).

This more recent method of washing has given results superior to those of earlier methods, particularly when carried out after the centrifugal has been accelerated to a very high speed, but it has still been impossible to wash the crystals of a very fine grained or smeared massecuite to a satisfactory purity without employing noticeably large quantities of water and dissolving large amounts of the sugar crystals, and difficulty has been encountered in purging, washing and drying the sugar crystals of such massecuites to a satisfactory moisture content without also prolonging the centrifugal cycle objectionably.

A further problem is encountered in the treatment of fine-grained or "smeared" crystallizer massecuite, in that certain massecuites of this type tend to form a tough "skin" of molasses on the inside of the sugar wall during the purging stage of the centrifuging cycle. This skin not only prevents proper purging of the mother liquor from the sugar but also prohibits efficient washing of the charge.

We have found that much of the trouble encountered in the drying of very fine grained massecuites during centrifugal treatment may be traced to local cooling of the inside portion of the charge in the revolving centrifugal basket, and that this local cooling to a large extent limits the effectiveness of existing washing methods in the treatment of various other types of massecuites and magmas. When the charge is introduced into the centrifugal basket, according to proper practice, it is preferably at a comparatively high temperature and has a viscosity at such temperature which might be expected to enable optimum washing and drying results. During the acceleration of the centrifugal, however, strong air currents develop inside the basket and cause a substantial temperature reduction. Although the average temperature of the charge may not be greatly reduced, pronounced cooling occurs near the inside face of the sugar wall.

Local cooling and congealing of syrup, in the case of certain smeared crystallizer massecuites (where fine crystals tend to fill the voids between coarser crystals), sometimes prevent some of the mother liquor from passing through the inner portion of the sugar wall, and this is believed to account for the formation of the tough "skin" mentioned hereinabove. Under such conditions it has not been possible to wash the charge in the centrifugal until the skin has been removed or otherwise eliminated.

In these and other cases, the application of a fine hot water spray to the charge during the latter part of, or after, the acceleration stage of the centrifugal cycle, even at spray nozzle temperature of 170° to 200° F., has been found insufficient to produce optimum centrifuging results, especially when treating mixtures containing very fine crystals. The hot water spray is so reduced in temperature, either by air circulation inside the centrifugal basket or by contact with the cooled inside portion of the sugar wall, or by both, that an objectionable quantity of washing liquid is often required to carry away the adherent syrup and bring the sugar crystals to the desired purity, and when the required quantities of water are used the sugar wall is not washed uniformly, objectionable amounts of the sugar are dissolved, and the centrifugal cycle must be prolonged in order to obtain a product of high purity and low moisture content.

We have now found that much of the difficulty heretofore encountered may be avoided, and that the centrifuging and washing of massecuites and magmas, or of other mixtures of crystalline materials in their mother liquor, can be carried but

with increased efficiency by applying to the charge in the centrifugal, while the basket is revolving at high speed, a very hot mist consisting of both liquid and steam at a spray nozzle temperature substantially above 212° F. The application of a washing agent of this type, which is forced through the spray nozzle under elevated pressures, permits a large volume of liquid to reach and pass uniformly through the sugar wall in a comparatively short interval of time, and the temperature of the mist as it strikes the inside face of the sugar wall remains high enough, notwithstanding the cooling influence of air currents in the basket at high centrifugal speeds, to raise the temperature of locally cooled areas and largely to cure their tendency to prevent efficient washing and drying of the crystals in the basket. This effect, together with the very rapid and uniform passage of the washing agent through the charge, permits the washing operation to be carried out with much less washing agent than heretofore, and the amount of sugar dissolved by the washing operation is substantially reduced. The washed sugar wall is hotter, cleaner and more pervious, so that the drying stage of the centrifugal cycle requires less time in order to produce a product of the desired low moisture content. Furthermore, the sugar discharged from the centrifugal may be of higher quality and is less eroded by the washing agent. In the case of white or refined sugar still another advantage is realized in that the temperature of the sugar is higher when discharged, so that the final drying process may be facilitated.

When the method herein disclosed is used in the centrifuging of skin-forming crystallizer massecuites, the washing of the charge by the mist of superheated liquid and steam results in immediate melting of the skin and purging thereof through the sugar wall. No mechanical removal of the skin is necessary; yet the centrifugal cycle proceeds without delay, and the sugar may be washed to a high purity with only a small quantity of washing agent.

We have discovered, contrary to expectations based on prior experience with steam as a washing agent, that an exceedingly efficient cleansing action is obtained by the use of the present method and that the sugar crystals are not damaged by the hot mist at spray nozzle temperatures as high as 250° F. The actual temperature to be employed may be varied, for example, according to the type of mixture being treated, the atmospheric temperature conditions at the centrifugals, and the nature of the centrifuging operations. The temperature of the washing agent, however, should not be raised substantially above 250° F., as the liquid component at such temperatures becomes essentially a vapor and does not possess sufficient body for an efficient washing action.

It is advantageous to cover the top or bottom opening of the curb, or both openings, after the basket has been loaded, so that the harmful effect of cooling air currents may be reduced during the spinning of the centrifugal, and so that the hot mist may be confined during the washing stage of the cycle.

In a preferred example of the practice of the present invention, a charge of the massecuite or other mixture to be centrifuged is introduced into the centrifugal basket, the opening in the curb top is covered, the basket and charge are accelerated to a high speed in such manner as to purge most of the syrup from the crystals, and after the acceleration stage the wall of material remaining in the rapidly revolving basket is washed with a very hot mist of superheated water and steam, which is delivered through a spray nozzle at a final temperature of about 225° to 235° F. and under elevated pressure of about 30 to 50 lbs. per square inch.

While the most satisfactory liquid component of the washing mixture is water, we also contemplate that clear sugar solutions may be used under some conditions.

The mist of hot water and steam used as the washing agent is preferably produced as follows: A supply of hot water is provided at a temperature between about 160° and 200° F. and under pressure of about 20 to 70 lbs. per square inch. A separate supply of saturated steam is provided under pressure of about 20 to 70 lbs. per square inch, the steam pressure preferably being approximately the same as the water pressure. When a washing operation is to be carried out, the steam and hot water are admitted together into a common chamber, where co-mingling occurs, and from this chamber the resulting mixture, at a temperature initially only slightly higher than the water temperature but progressively increasing to a temperature as high as 250° F., passes through a pipe into the spray nozzle of the centrifugal, from which a mist of superheated water and steam is delivered onto the wall of material in the centrifugal basket.

These ranges of temperatures and pressures are not intended as limitations, except as may be required by the appended claims, but they represent approximate boundaries of the most efficient practical operations. In our usual practice the temperature of the water-steam mixture entering the spray nozzle is recorded at about 225° to 235° F. in the latter part of the washing stage. The pressure at the spray nozzle is usually about 30 to 50 lbs. per square inch, but this factor is subject to rather wide variation, depending on the steam and water pressures, the size of the nozzle orifices and the desired rate of applying the washing mixture.

The operation of this embodiment is characterized by the fact that the rate of flow of washing water, that is, the body and cleansing action of the washing medium, is comparatively large in the initial part of the washing stage, which conforms to the need for removing substantial amounts of adherent syrup from the crystals, and as the washing proceeds a smaller quantity of water and a larger quantity of steam are applied to the charge, at a higher temperature, which has the effect of increasing the temperature of the crystals and improving their drying qualities so that the drying stage of the cycle is carried out more efficiently.

As an alternative but somewhat less desirable procedure, due primarily to the need for more expensive equipment, a supply of superheated water may be provided and maintained under pressure for admission to the spray nozzle during the washing stage of the centrifugal cycle. A hot mist of water and steam is produced from the nozzle and sprayed onto the charge in the basket when the pressure is released. In this embodiment of the method, the water is preferably held at a temperature of about 225° to 250° F.

The accompanying drawing illustrates a new arrangement of apparatus which we have provided for carrying out a preferred embodiment of the present invention. In the drawing:

Figure 1 is an elevation, partly diagrammatic, illustrating part of a centrifugal machine equipped with means for practicing the improved method;

Figure 2 is a plan view of the centrifugal curb top, showing a suitable construction of curb top cover for use in excluding cool air from the charge during the spinning cycle; and

Figure 3 is a cross section showing details of the mixing unit which co-mingles the hot water and steam during their passage to the spray nozzle.

Referring to the drawing for illustrative details, Figure 1 shows parts of a high speed sugar centrifugal, including a perforate basket 10, suspended on a spindle 12, and a surrounding curb 14 having a curb top 16 with a central opening 18 and a curb bottom 20 with a central opening 22. A spray nozzle 24 is mounted on the curb top and projects downwardly inside the basket. Outlets 26 on the sprayer have orifices which direct the washing agent against the wall of material in the basket during the washing stage of a centrifugal cycle. The outlets are preferably directed toward the sugar wall in such manner as to minimize the distance of travel of the washing agent and the cooling effect thereon of air currents.

A supply of hot water (not shown) is provided under pressure for admission to a water line 30, controlled by a valve 32. A supply of steam (not shown) is provided under pressure for admission to a steam line 34, controlled by a valve 36. Means are provided, conveniently on the curb top 16, for combining the steam and hot water to form a very hot mixture suitable for delivery through the spray nozzle 24. In the illustrated form (see Figure 2) this means includes an elongated chamber 40 which is reduced in diameter at its forward end and there connected with a pipe 42 leading to the spray nozzle. The water line 30 is connected with chamber 40 near its back end, preferably so that the water enters in radial direction. The steam line 34 is connected with an injector 44, which projects axially into the chamber to a point beyond the water inlet. It is therefore apparent that, when valves 32 and 36 are open, hot water is forced through chamber 40 from pipe 30 and steam is forced through chamber 40 from pipe 34 and injector 44. The resulting mixture passes onward through pipe 42 and nozzle 24, and from the latter a very hot mist of water and steam is delivered onto the charge in the basket 10.

A cover 50 is preferably provided on the curb top 16 for closing the opening 18 during the spinning cycle. While either the top opening 18 or the bottom opening 22, or both, may be covered to advantage, the use of only a top cover gives satisfactory results and is more convenient than other arrangements.

The curb top cover 50 (see Figure 3) includes two dissimilar sector-like sections 52 and 54, which are swivelled to the curb top from links 56 and 58, respectively. A connecting link 60 causes the two sections to move together. A handle 62 is provided on section 52 to facilitate movement of the cover to and from closed position. The curb top 16 has an integral sector-like section 17 which projects toward the spindle 12 and through which extends the spray nozzle pipe. When the cover is closed the entire opening 18 is covered, with the exception of a small space around the spindle to allow swaying movement of the latter. Under such conditions the objectionable cooling influence of air currents inside the revolving basket is somewhat reduced. The positions assumed by the cover sections when the cover is open are indicated by the broken lines in Figure 3.

It is obvious, of course, that other types of curb top covers may be employed, and also that the use of a cover is unnecessary, although advantageous. The preferred type of cover herein mentioned is disclosed and claimed in a copending application of Walter Hoffman, Serial No. 202,900, filed April 19, 1938.

In addition to the foregoing equipment, the apparatus is provided with means for simultaneously opening the valves 32 and 36. While various means may be used for this purpose, the valves may have stems 70 and 72, respectively, which are spring-held in closed position. A control shaft 74 may be arranged with fingers 76 and 78 which cooperate with the stems 70 and 72, respectively. When shaft 74 is turned the fingers lift the valve stems against spring tension and open both valves at the same time. The turning of shaft 74 may be effected manually, for example, by a lever 80, or by automatic time-controlled means such as heretofore invented by Eugene Roberts and now well known in the art.

Means also may be provided for opening the steam valve 36 independent of the water valve 32, as in some cases the admission of steam into the centrifugal basket before or after the washing stage of the cycle may result in some advantage. For this purpose the finger 78 may be movable independently, by means of a lever 82.

It is desirable that the apparatus be provided with instruments for indicating temperature and pressure conditions, so that departures from desired practice may be observed and corrected. A pressure gauge 90 may be connected with pipe 42 to indicate the pressure of the steam-water mixture entering the spray nozzle. A temperature recorder 92 may be provided, with its bulb located near the entrance to the nozzle, as at 93, to record the temperatures of the washing mixture. In addition, another pressure gauge 94 may be connected with the steam line 34, and another temperature recorder 96 may be connected with the hot water line 30.

The use of the present invention in the centrifuging of extremely fine-grained white massecuites, as compared with the best prior practice, permits an increase of centrifugal capacity, by shortening the cycle, of from 8 to 20%, permits the amount of wash water to be reduced from 25 to 40%, with a proportionate reduction in the dissolution of sugar crystals, and produces centrifuged sugar of lower moisture content. Improvements of similar extent are obtained in the treatment of other types of massecuites and magmas.

The improved method and apparatus herein disclosed and claimed are particularly useful for carrying out centrifugal washing operations in processes such as disclosed in the following pending applications: Eugene Roberts, Serial No. 113,542, filed December 1, 1936; Eugene Roberts, Serial No. 140,092, filed May 1, 1937; and George E. Stevens, Serial No. 151,772, filed July 3, 1937.

While we have described and illustrated numerous details of preferred embodiments in order to facilitate the practice and use of the invention, it should be understood that the invention is not restricted to these illustrative details but may be varied in practice without departing from its full

contribution to the art, as intended to be set forth in the appended claims.

We claim:

1. The method of centrifuging mixtures consisting of crystals in their mother liquor which comprises introducing a charge of the mixture into a centrifugal basket, spinning the basket and charge to purge mother liquor from the crystals, and washing the charge while it is spinning with a hot mist consisting of superheated aqueous liquid and steam.

2. The method of centrifuging mixtures of sugar crystals and syrup which comprises introducing a charge of the mixture into a centrifugal basket, spinning the basket and charge to purge syrup from the crystals, and washing the charge while it is spinning with a hot mist consisting of superheated water and steam.

3. The method of centrifuging mixtures of sugar crystals and syrup which comprises introducing a charge of the mixture into a centrifugal basket, accelerating the basket and charge substantially to maximum speed to purge most of the syrup from the crystals, and thereafter washing the charge while it is spinning at high speed with a hot mist consisting of superheated water and steam.

4. The method of centrifuging mixtures of sugar crystals and syrup which comprises introducing a charge of the mixture into a centrifugal basket, spinning the basket and charge to purge syrup from the crystals and spraying onto the charge while it is spinning, from a spray nozzle located inside the basket, a watery mist consisting of superheated water and steam at a nozzle temperature between about 212° and 250° F.

5. The method of washing adherent liquid from crystals in a revolving centrifugal basket which comprises providing a supply of hot water in liquid form under elevated pressure, providing a separate supply of steam under elevated pressure, releasing the pressure on the water and steam and co-mingling the same in a common mixing chamber, and delivering the resulting hot mist of water and steam through a spray nozzle and onto the charge in the basket.

6. The method of washing syrup from sugar crystals in a revolving centrifugal basket which comprises providing a supply of hot water at a temperature between 160° and 200° F. and under pressure of between 20 and 70 lbs. per square inch, providing a separate supply of saturated steam under pressure of between 20 and 70 lbs. per square inch, leading streams of said water and steam together and co-mingling the same and spraying the resulting hot mist of superheated water and steam onto the charge in the basket.

7. The method of washing syrup from sugar crystals in a revolving centrifugal basket which comprises providing a supply of superheated water under pressure at a temperature between about 225° and 250° F., releasing the pressure and leading the water to a spray nozzle located inside the revolving basket, and spraying onto the charge in the basket a resulting hot mist of superheated water and steam.

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