Aug. 21, 1934. J. BERGÉ 1,970,552

APPARATUS FOR CENTRIFUGAL SEPARATION

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Fig. 1.

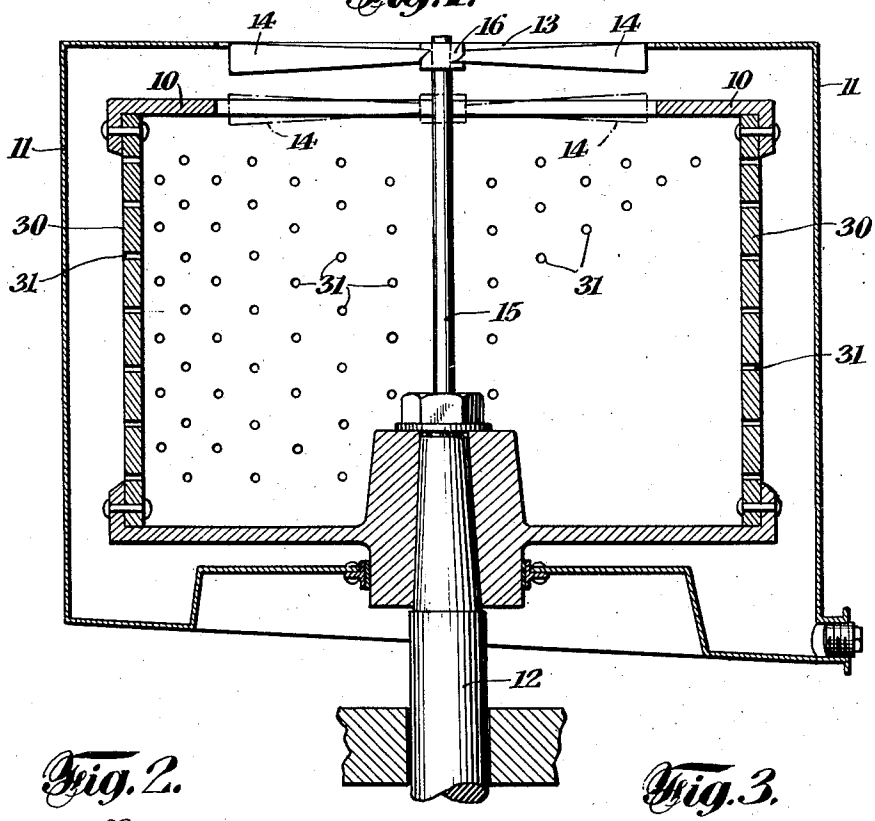


Fig. 2.

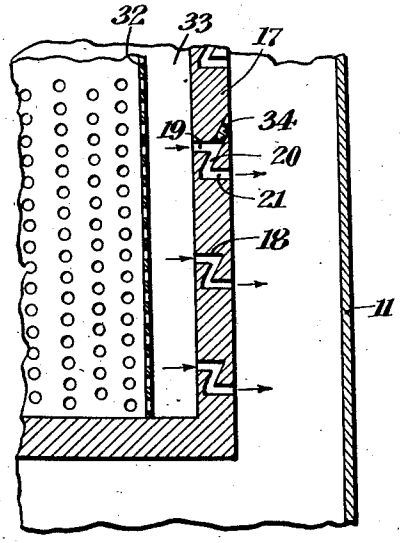
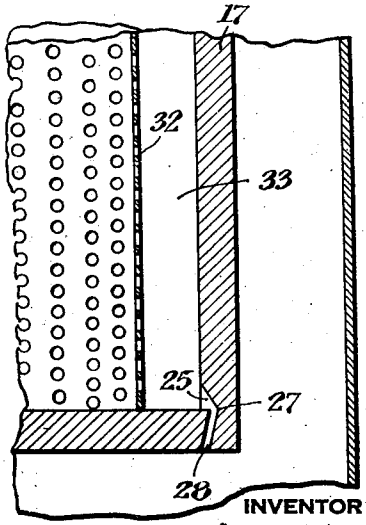


Fig. 3.



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Fig. 4.

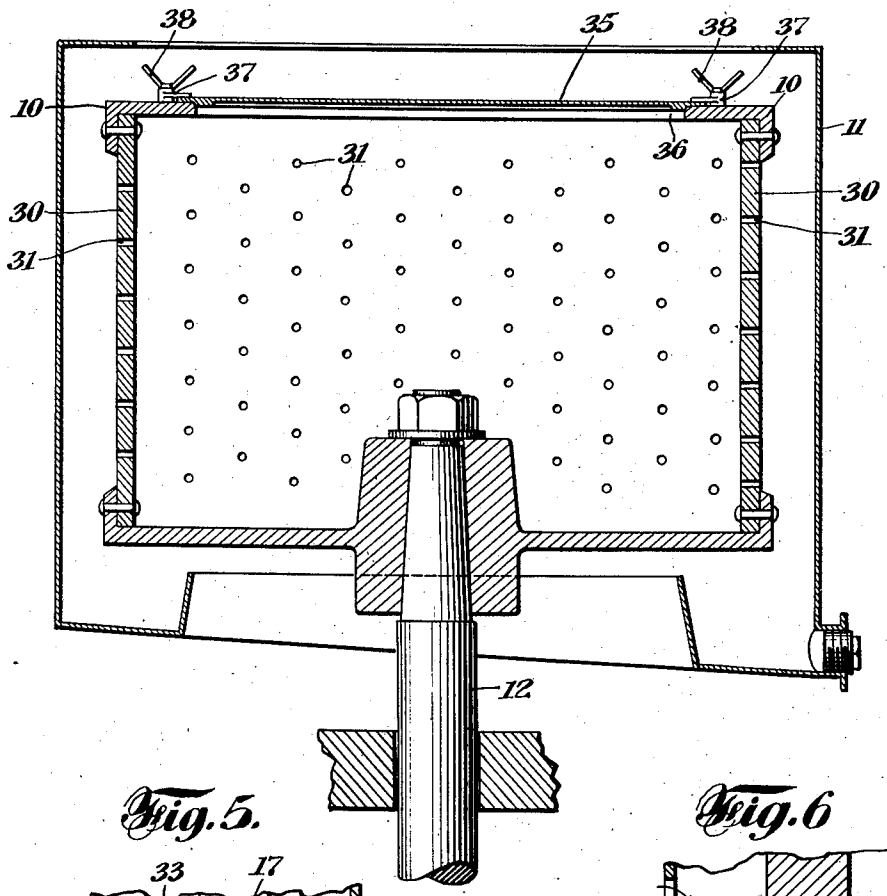


Fig. 5.

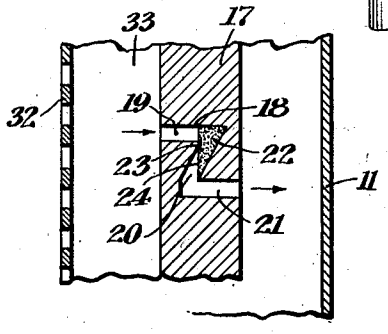
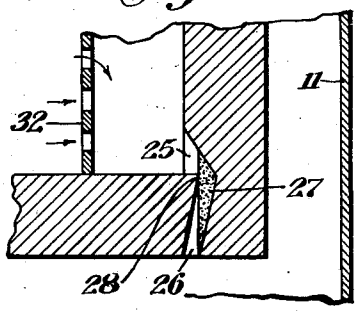


Fig. 6



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Fig. 7.

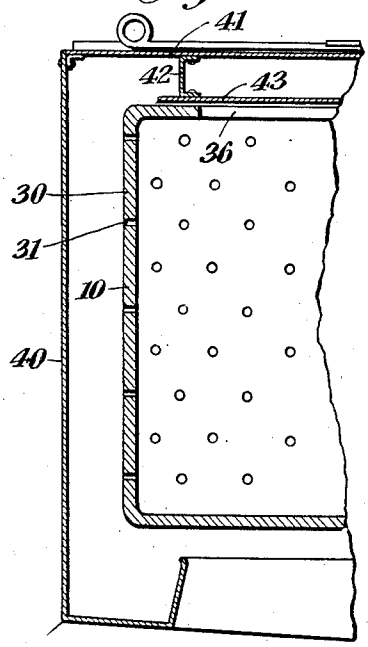


Fig. 9.

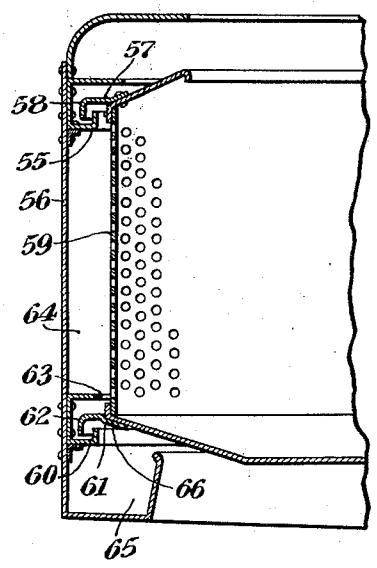


Fig. 10.

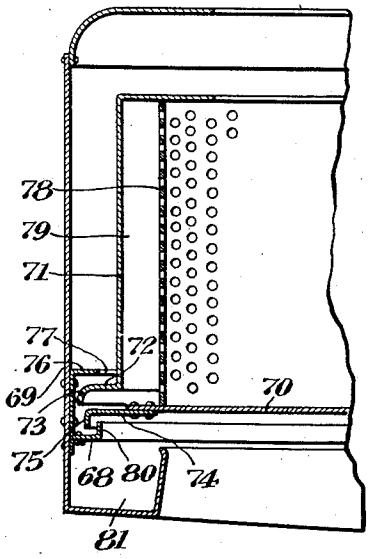
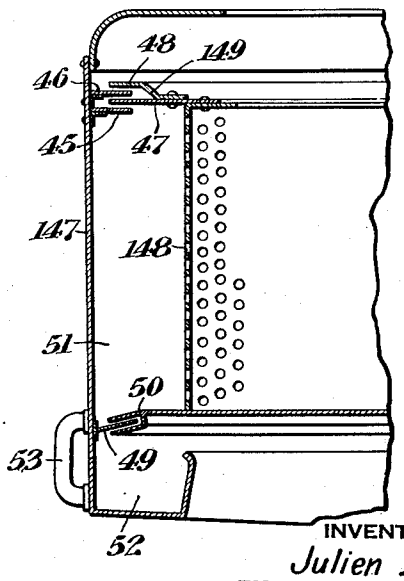


Fig. 8.



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UNITED STATES PATENT OFFICE

1,970,552

APPARATUS FOR CENTRIFUGAL SEPARATION

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Original application May 20, 1930, Serial No. 453,886. Divided and this application October 10, 1932, Serial No. 637,057. Renewed November 18, 1933. In Austria July 9, 1929

5 Claims. (Cl. 210—63)

This invention pertains to the general class of processes and apparatus for the separation of liquids from solids, and particularly to the class of processes and apparatus for the centrifugal separation thereof. The invention pertains more particularly to the regulation or prevention of the circulation of air through the mass during the rotation of the basket of the centrifuge, thus preventing a substantial degree of solidification of the liquid matter by evaporation.

The invention will be described in connection with the manufacture of sugar. However, it is understood that it may be applied to the manufacture of many other products.

In the manufacture of sugar, sugar crystals are produced by crystallization from solution and are thus obtained, coated with various quantities of adhering syrup or mother liquor. This syrup or mother liquor is generally separated from the sugar crystals in centrifuges which are more or less specially adapted for this purpose. The centrifuges employed prior to my invention, however, permit the circulation of air through the mass. This results in a certain degree of drying of the syrup or mother liquor, and causes the same to become more viscous and to adhere more tenaciously to the surfaces of the sugar crystals. In some instances the syrup or mother liquor may be dried to such an extent as to form a hard lacquer-like coating around the individual crystals or groups of crystals.

Prior to my invention disclosed in my copending application Serial Number 167,578, filed February 11, 1927, which has resulted in Patent 1,775,385, dated September 9, 1930, it was impossible to completely separate sugar solutions, such as syrup or mother liquor, from sugar crystals without washing the crystals in the centrifuge. The washing was accomplished by introducing a washing fluid, such as water, steam or syrup, into the centrifuge while in operation. The above mentioned drying of the sugar solution with the attendant increase in its adherence to the sugar crystals made necessary the use of larger quantities of washing fluids. The use of washing fluids is undesirable in view of the fact that such fluids carry away in solution considerable portions of crystallized sugar, thus reducing the yield.

The tendency for the air to circulate through the revolving basket in considerably greater when high centrifugal forces, such as disclosed in my copending application above referred to, are employed. A considerable volume of air may in some instances be driven through the wall of sugar. This reduces the adhering sugar solution to a more viscous condition with the result that greater centrifugal forces are required to drive the sugar solution from the surfaces of the sugar crystals. While, by using centrifugal forces above 800 times the weight of the mass in the centrifuge and up to the amount required which may be as high as 7,000 times the weight of the mass or more as disclosed in my copending application, I am able to discharge adhering sugar solutions from sugar crystals even though the sugar solution be in a pasty state, it is of course obvious that somewhat greater centrifugal forces are required due to the increased adherence of the sugar solution when in a more viscous condition. It is, of course, understood that a certain loss of power results from the necessity of using the relatively higher high centrifugal forces.

Prior to the invention set forth in my copending application, the art was unable to completely discharge the adhering sugar solutions from the sugar crystals without washing mediums. However, by the use of the invention set forth herein in prior art centrifuging an increase in the degree of such separation without washing may be effected due to the absence of drying.

There are various types of apparatus by means of which my invention may be carried into practice. A few examples are shown more or less diagrammatically in the drawings, however, it is understood that this is merely by way of illustration, and that the invention is not limited thereto.

In the drawings,

Figure 1 is a sectional elevation of a portion of a centrifuge, part of which is shown in broken lines, illustrating one form of apparatus capable of carrying out the invention.

Figure 2 is a sectional elevation through a portion of a centrifuge, part of which is shown in broken lines, illustrating another form.

Figure 3 is a view similar to Figure 2 but illustrating a third form.

Figure 4 is a sectional elevation through a centrifuge, part of which is shown in broken lines, illustrating a fourth form.

Figure 5 is a view similar to Figure 2, illustrating the liquid air-seal resulting from the particular structure shown.

Figure 6 is a view similar to Figure 3, illustrating another form of liquid air-seal.

Figure 7 is a sectional elevation through a

centrifuge, part of which is shown in broken lines and illustrating another form.

Figure 8 is a sectional elevation, part of which is shown in broken lines illustrating a somewhat different form.

Figure 9 is a sectional elevation, part of which is shown in broken lines illustrating a different form of trap.

Figure 10 is a sectional elevation, part of which is shown in broken lines illustrating a labyrinth trap.

Referring to the drawings, at 10 is shown a conventional basket enclosed by a casing 11. The basket 10 is mounted upon a shaft shown conventionally at 12 and by means of which rotary movement is imparted to the basket. It is understood that the structure shown herein is purely for illustrative purposes and that the invention is by no means limited to the particular types of centrifuges shown.

One means for decreasing or preventing the circulation of air through the sugar wall in the revolving basket is by exhausting or partially exhausting air from the basket or the casing enclosing the basket.

In the form shown in Figure 1, the casing 11 completely encloses the basket 10 except for the opening shown at 13. The casing 11 is otherwise fitted about the moving parts so as to form an air-tight enclosure about the basket 10. To form a vacuum or a partial vacuum in the casing 11 fan blades 14 are caused to revolve in the opening 13. The fan blades 14 may be of any desired number, and are so arranged that when in motion their action tends to exhaust air from within the casing 11. Blades 14 may obviously be dropped to the position shown in dotted lines.

One means of mounting the fan blades 14 is shown in Figure 1 wherein the shaft 12 is provided with an extension 15 upon which the fan blades are mounted as shown at 16. However, it is understood that any other form of mechanism for the operation of the fan blades may be provided.

Instead of using fan blades 14 at the opening in the casing 11, I may completely close the casing 11, making same air-tight, and then build up a vacuum within the casing 11 of a sufficient value to prevent circulation or to regulate the same. Any suitable exhausting device may be used for this purpose.

Another means for decreasing or preventing the circulation of air through the basket is to provide means adjacent the outer wall of the basket which will permit the flow of a liquid but which will not permit the flow of a gas. Suitable devices for this purpose are shown in Figures 2, 3, 5, 6, 9 and 10.

In Figure 2, for instance, the outer wall 17 is provided with a plurality of pocket forming channels 18. The channels 18 are shown more or less S shaped. However, it is understood that the channels 18 may be of any convenient shape so as to form a pocket within which the liquid will collect in sufficient amount to close the channel when the device is in operation. The seal thus provided will not permit the flow of gases but will permit the flow of liquids. The thickness of the wall of liquid in the pocket is increased by liquid entering the channel 18. An increase in the thickness of the wall of liquid results in a part of the liquid being forced into portion 21 of the channel 18 from which it is discharged to the exterior. The total centrifugal force applied to the mass of liquid in the portion 19 of channel 18 when the portion 19 is filled, for instance, is sufficient to overcome the resisting centrifugal force applied to the mass of liquid in the reversing portion 20 of the channel 18. This is true in view of the fact that the reversing portion 20, as shown, does not entirely overlap the portion 19. In other words, the portion 20 is of lesser length measured in a radial direction than the wall of liquid acting upon the portion 19. The result is that a portion of the liquid in the reversing portion 20 is forced into the outlet portion 21 of the channel 18.

The area covered by the pocket is clearly illustrated in Figure 5 wherein the darkened portion in pocket 22 represents the minimum amount of liquid which remains in the channel 18 while the centrifuge is in motion. The condition represented in Figure 5 exists when all of the liquid has been discharged from the basket, but the basket is still in motion. An effective seal is provided at all times inasmuch as the tip 23 formed at the intersection of the portions 19 and 20 is always covered by the inner surface 24 of the liquid held in the pocket 22.

The portion 20 is shown having a downward slope in order that the liquid will drain from the pocket to the outside of the basket when the basket is stopped. However, the portion 20 may be horizontal or inclined if this may be desired for any reason.

The channels 18 need not have three portions such as shown in Figures 2 and 5 but may be made up of two portions as shown in Figures 3 and 6. In this case there is an inlet portion 25 and an outlet portion 26 so as to form a pocket 27 illustrated by the darkened portion in Figure 6. In this case a tip 28 is formed by the intersecting portions 25 and 26 which tip is at all times covered by the fluid held in the pocket 27 while the basket is in motion. By means of this construction the liquid may be made to escape from the bottom of the basket.

Other forms of channels will suggest themselves to persons skilled in the art and familiar with this invention. For instance, a tube having its outer end U-shaped or I-shaped or otherwise, to provide a reversing channel, might be substituted for either of the forms shown in Figures 2, 3, 5 and 6. The plain ends of the tubes would be inserted into the openings 31, as shown, for instance, in Figure 4. In this case the cover 35 would be omitted. Each of the openings 31 would be provided with one of these tubes or a circumferential row at the bottom would be so provided and the remainder of the openings closed. However, any other arrangement might be employed. In the case of a tube having a U-shaped end with the U pointing downward, all of the liquid would drain from the tube when the basket comes to rest. In the case of a tube having an eye at its end with the opening above the lowest part of the bend, a portion of the liquid would always remain in the tube to form a seal. The outer ends of such tubes may have many other forms. For instance, the end of a tube might be straight and empty into the mouth of a cup-shaped device, the mouth of the cup being in a more or less vertical plane. Other forms of tubes will suggest themselves to persons skilled in the art and familiar with this invention.

Centrifugals of the ordinary type can be readily adapted for applicant's purpose by merely mounting the tubes in the apertures. This can be readily effected, for instance, with screw threads.

In the forms shown in Figures 1 and 4 the

screen is formed in the outer wall 30 of the basket 10 by providing a plurality of apertures 31 in the outer wall 30. In Figures 2, 3, 5 and 6 an inner screen 32 spaced from the outer wall 17 is shown. The construction of such inner screen and the means of attaching same inside of the basket is known in the art and forms no part of this invention. When the screen 32 is used the solids are held within the screen and only liquids find their way into the space 33 between the screen 32 and the outer wall 17. By providing the screen 32 the channels 18 may not only be larger in diameter but may be fewer in number. It is understood that the channels 18 are suitably distributed about the wall of the basket. In many instances one circumferential row at the bottom of the basket would be sufficient.

Any means may be employed for forming the channels in the walls, such as drilling, casting, etc. In the form shown in Figures 2 and 5, for instance, the portions 19 and 21 may be readily drilled. The portion 20 may also be formed by drilling into the outer wall 17 at an angle so as to connect the portions 19 and 21. Sections of the portion 20 not to be used may then be plugged by any convenient means. The plugs may be held in place by brazing, special cements, screw-threads, etc. A plug of this character is illustrated at 34.

Another means for decreasing or preventing the circulation of air through the basket is to provide the basket with a tight fitting cover 35 as shown in Figure 4. The cover 35 tightly closes the opening 36 in the basket 10, and may be secured in place by any suitable means such as clamps 37 secured in place by wing nuts 38. It is, of course, obvious that any other structure may be provided for holding the cover 35 in place or for closing the opening 36.

Another means for decreasing or preventing the circulation of the air through the basket is by inserting various devices between the outlets and the inlet of the basket. For instance, in Figure 7 the basket 10 is provided with a casing 40 which is adapted to support a member 41. Secured to the member 41 by any suitable means such as the member 42 is a cover 43 for the opening 36 in the basket 10. The cover 43 may or may not contact the upper face of the basket 10 but is preferably not in contact therewith. This results in a small annular aperture 44 between the basket and the cover 43.

In operation the motion of the basket tends to cause the air to be thrown outward through the apertures 31 in the outer wall 30. If the opening 36 is not closed, this air returns to the basket through this opening. The path of the air is completely cut off except for the aperture 44. However, due to the churning or other action between the rotating basket and the stationary cover the air is not permitted to pass inward through the aperture 44. The action of the basket and the cover is such as to tend to cause the air to build up a sort of pressure, and due to the centrifugal action of the basket any flow would be outward through the aperture 44 apparently the same as if small vanes were positioned on the basket and between it and the stationary cover 43. Such vanes may, of course, be provided if desired.

In Figure 8 annular rings 45 and 46 are secured to the inner wall of the casing 147. An annular disc-like ring 47 secured to the basket 148 is positioned between the rings 45 and 46 and may or may not be contacted thereby. In this form the rings are preferably constructed so that moving parts do not contact the stationary parts, so that the device may operate without friction. However, the parts may operate in contact with each other and packing may be provided if desired. A second moving annular ring 48 is shown secured to the ring 47 through an off-set portion 149 so as to inclose the ring 46 between the rings 47 and 48. In operation air is restricted from passing the rings due to the churning pressure and/or other action between the rings. The ring 48 may be omitted if desired.

A second seal is shown at the bottom of Figure 8 which comprises an annular disc-like ring 49 secured to the casing 147 and a U-shaped annular member 50 secured to the basket 148 and inclosing the member 49. The member 49 is shown with a slight upward slope and preferably does not contact the U-shaped member 50. The liquid is conducted from the chamber 51 around the outer edge of the basket 148 to the chamber 52 below the basket by means of tubes 53. Any other form of cooperating parts may be provided between the casing and the basket.

Another means for carrying out the invention is shown in Figures 9 and 10 wherein a liquid air seal is provided which operates irrespective of the movement of the basket.

In Figure 9, for instance, a cup-like member 55 is secured to the inner wall of the casing 56 and an annular member 57 having downwardly turned flange 58 dipping into the cup 55 is secured to the upper edge of the basket 59.

In operation the cup 55 is filled with liquid into which the flange 58 dips. After the cup 55 has been once filled, a refilling is unnecessary. The upper edge of the cup 55 is turned inward to retain liquid thrown against the outer wall of the cup by centrifugal force.

A liquid seal is also shown at the bottom edge of the basket 59 and comprises an annular cup-like member 60 attached to the inner wall of the casing 56 and an annular member 61 secured to the lower edge of the basket 59. The member 61 has a flange 62 which dips into the cup 60. The cup 60 is so shaped as to leave a space 63 between the upper edge of the cup and the basket 59 to permit the liquid thrown off from the basket to flow downward into the cup 60. This structure permits the liquid to flow from the chamber 64 on the outside of the basket 59 to the chamber 65 below the basket 59. After the cup 60 is full any excess liquid flows over the inner upturned edge 66 of the cup 60 and falls into the chamber 65 from which it may be removed at will.

In the forms shown in Figures 8 and 9, the seals at the bottom of the basket are preferably provided to prevent any circulation of the air downward out of the casing and around the same and through the upper opening of the basket.

In Figure 10 a labyrinth trap is shown. This comprises an annular cup 68 secured to the inner wall of the casing 69. The basket 70 is provided with an outer wall 71 which is imperforate. At the bottom this wall is turned outward as shown at 72 and then downward as shown at 73. Secured to the bottom of the basket 70 is an annular disc-like member 74 having a downwardly extending portion 75 which dips into the cup 68. The upper edge 76 of the cup 68 is shown turned inwardly toward the casing 71 to retain liquid thrown outward by centrifugal force, but may be spaced therefrom if desired, as shown at 77. A basket of this type is provided with an inner screen 78.

In operation the liquid is thrown into the

chamber 79 on the outside of the screen 78 and flows downward and is thrown outward between the portion 72 and the annular member 74. It then is guided into the cup 68 by the flange 73, the liquid impinging against the outer inside wall of the cup. The excess flows over the inner upturned edge 80 of the cup 68 and falls into the chamber 81 at the bottom of the basket from which it may be removed.

Any of the means described for carrying out the process may be adapted to any type of centrifuge, no matter how it is driven, charged or discharged or otherwise constructed. Modifications of the apparatus herein shown and/or described will suggest themselves to persons skilled in the art and familiar with this invention.

By preventing the circulation of air through the mass while in the centrifuge, the adhering sugar solution is maintained in substantially its original condition respecting fluidity and is thus more readily discharged from the sugar crystals.

While the invention has been described with respect to the separation of sugar solutions from sugar crystals, it is applicable to any separation of liquids from solids involving similar problems.

The invention has been described in connection with a centrifuge having a basket. It is obvious that the same may apply to any other form of centrifuge having a receptacle of any shape or contour. Many other modifications may be made within the scope of the claims without departing from the spirit of the invention.

The term air as used in the specification and claims is intended to include any gas of whatever nature.

This application is a division of my copending application Serial No. 453,886 filed May 20, 1930.

I claim:

1. In a high speed centrifuge having a circumferentially perforated revolving receptacle and adapted for substantially completely removing adhering mother liquor from sugar crystals without the aid of a washing medium, means for preventing the circulation of air through said crystals, and an independently mounted receiving receptacle about the perforated circumference of said revolving receptacle, said receiving receptacle being freely open to the atmosphere.

2. In a high speed centrifuge having a circumferentially perforated revolving receptacle provided with an inlet opening, and adapted for substantially completely removing adhering mother liquor from sugar crystals without the aid of a washing medium, means adapted to cooperate with said receptacle to restrict the passage of air through said inlet opening, and a casing about said receptacle for collecting and holding discharged liquid, said casing being freely open to the atmosphere to permit free flow of liquid outwardly through the circumferential perforations of said revolving receptacle and to prevent building up of air pressure inside of said casing.

3. In a high speed centrifuge having a circumferentially perforated revolving receptacle provided with an inlet opening, and adapted for substantially completely removing adhering mother liquor from sugar crystals without the aid of a washing medium, means for restricting the passage of air through said opening, comprising a cover fitting tightly over said opening to close the same, and a casing about said receptacle to collect and hold the mother liquor, said casing being freely open to the atmosphere to permit free flow of liquid outwardly through the circumferential perforations of said revolving receptacle and to prevent building up of air pressure inside of said casing.

4. In a high speed centrifuge having a perforated revolving receptacle provided with an inlet opening and adapted for substantially completely removing adhering mother liquor from sugar crystals without the aid of a washing medium, means for restricting passage of air through said inlet opening during the operation of said revolving receptacle, comprising a stationary cover in close proximity to said inlet opening but out of contact with said receptacle and adapted to cooperate with said revolving receptacle to prevent passage of air into said revolving receptacle through said opening, and a casing about said receptacle to collect and hold the mother liquor, said casing being open to the atmosphere to permit free flow of liquid outwardly through the circumferential perforations of said revolving receptacle and to prevent building up of air pressure inside of said casing.

5. In a centrifuge having a circumferentially perforated revolving receptacle with an inlet opening, means for opposing passage of air inwardly through said inlet opening during rotation of said revolving receptacle, said means comprising an air propeller positioned in close proximity to said inlet opening, said propeller mounted to rotate with said receptacle and to urge air particles in a direction outwardly from said inlet, and a casing about said receptacle to collect and hold mother liquor, said casing having an outlet to the atmosphere to prevent building up of air pressure inside of said casing.

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