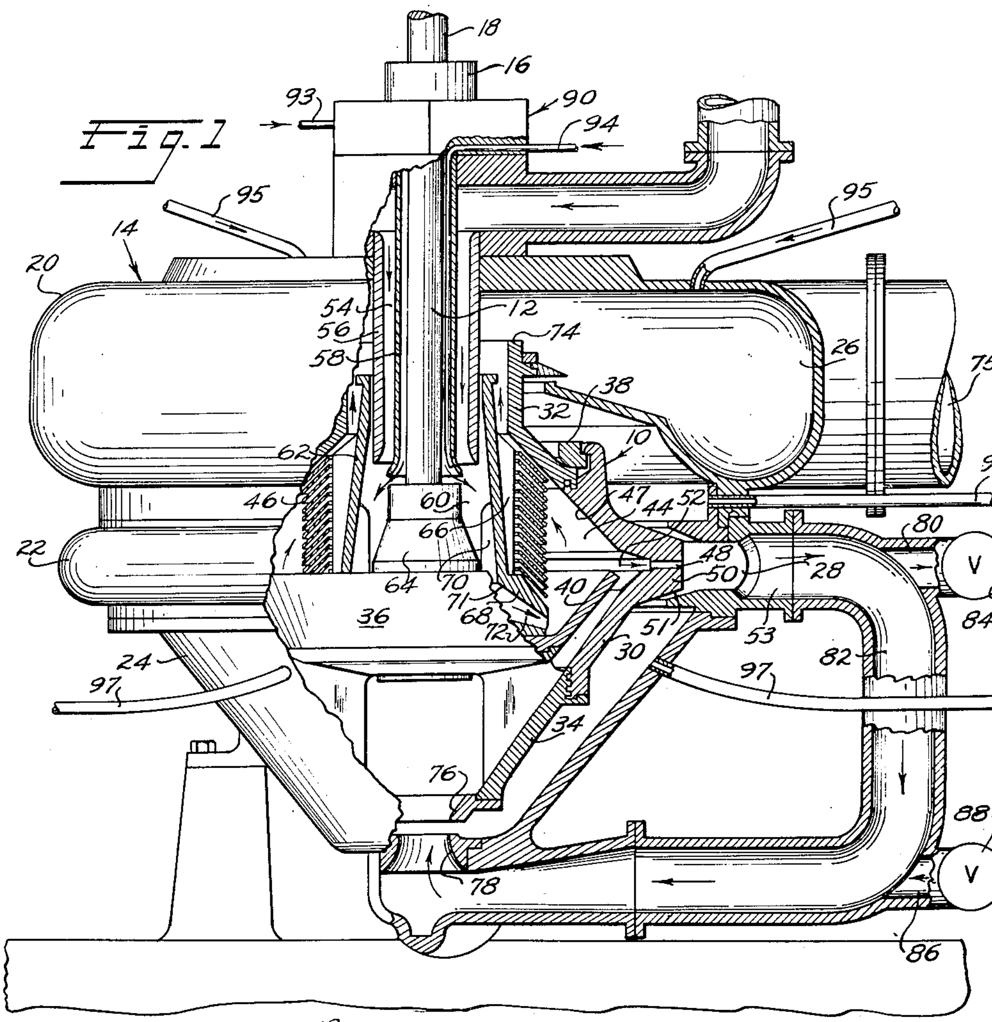
Jan. 29, 1957 H. H. POMEROY 2,779,536

ANTI-FOAMING CENTRIFUGAL METHODS AND APPARATUS

Filed Feb. 15, 1952



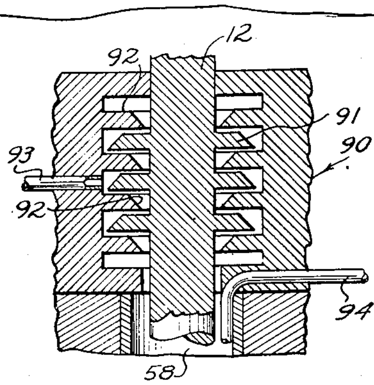


Fig. 2

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United States Patent Office

2,779,536

Patented Jan. 29, 1957

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2,779,536

ANTI-FOAMING CENTRIFUGAL METHODS AND APPARATUS

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Application February 15, 1952, Serial No. 271,790

19 Claims. (Cl. 233—13)

The present invention relates to improvements in centrifuging methods and apparatus, which render feasible the application of centrifugal separation or concentration of certain substances, which, heretofore, have been separable only by more expensive, more time-consuming, and generally less-efficient methods.

Prior to my invention, it was either impossible or highly inefficient to centrifugally separate certain substances, one or more of the components of which tend to produce foam or froth upon intermixture with air or other gas in centrifuges of the type in which the underflow and overflow is discharged across an air gap, of which nozzle type centrifuges are exemplary. In such prior operation the froth or foam formed loads the rotor, prevents accurate separation of the substances, and, as a consequence, results in low efficiency of the separating operation. This foam or froth formation becomes extreme in return circuit centrifuges because a portion of the foam containing underflow is reintroduced into the rotor internally of the discharge orifices resulting in blocking of the discharge orifices and disruption of the normal pattern of separation within the centrifuge chamber. Specifically therefore, the present invention relates to the prevention of the formation of froth or foam in centrifuges in the centrifugal separation of substances containing foam or froth producing constituents.

In certain type centrifuges it has at times, in the past, been found desirable to exclude air or other gas from contact with one of the separated components to prevent saturation thereof with the gas. For example United States Letters Patent No. 1,561,784, issued November 17, 1925, to Hall discloses maintenance of the separated component, such as oil under a pressure above atmosphere in a closed system from which gas is excluded. This method is, however, not applicable to forms of centrifuges in which the separated components are discharged from the centrifuge rotors through orifices.

Specific examples of the processes in which centrifugal separation in nozzle type centrifuges was not heretofore feasible, except by use of extremely small or relatively few nozzles due to this froth or foam formation, are the continuous separation of limed sludge from sugar liquor in the production of beet sugar by the lime process, the concentration of proteinaceous matter such as gluten, calcium phytate and the like, and the separation of digested clay from aluminum sulfate liquor and insoluble carbonates from sodium aluminate in the production of aluminum products. The value and importance of my present invention will accordingly best be understood by briefly reviewing the methods heretofore used in these three exemplary processes.

In the standard, generally accepted, method of producing beet sugar, in a "non-Steffens house," the beets are

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first shredded into crossettes, and cooked in diffusers. The liquid produced, which contains sugar in solution, is separated from the crossettes by straining. The separated liquor is limed, to precipitate the non-sugar components of the liquor. The mixture is then carbonated with carbon dioxide. This carbonation of the limed juice results in the formation of calcium salts which serve as a "filter-aid" material for the limed sugar sludge. It has been the practice to use about ten times as much precipitant as is needed chemically to purify the sugar liquor in this operation to produce the required quantity of "filter-aid" material. Because of the foaming which prevents efficient centrifugal separation in accordance with prior methods, manually operable "Kelly" or the newer "Oliver" filters have been used to separate the sludge from the juice. The juice is then recarbonated with carbon dioxide to remove the excess calcium salts and then refiltered to separate the precipitate formed in the recarbonation. A total of from five to nine percent solid is removed by the filters. The operation of the filters requires considerable service and labor. For example, about one hundred eighty man hours per day for a twelve hundred ton per day sugar beet plant in addition to the service of maintenance mechanics, are presently required. This process, which is known as the double carbonation process, is, therefore, quite expensive and time consuming.

By my invention, centrifugal separation in nozzle type centrifuges can be successfully substituted for the two filtering operations with great economy of time and cost, and substantial improvement of product.

The Peterson Company of Salt Lake City, Utah, has recently developed an improved process of making beet sugar in which no carbonation is required and in which only enough lime is added to the sugar liquor from the diffusers to precipitate the non-sugar components. By this method, the sludge present in the liquor is less than two percent of that found in the prior process and produces a much purer sugar juice. This process, which is known as the caustic lime process, differs from the previously described double-carbonation process in that only four pounds of calcium oxide per ton of beets is required, and no carbon dioxide is necessary. This is approximately one-tenth of the lime (calcium oxide) used in the double-carbonation process.

This substantial reduction in the amount of calcium oxide used is made possible by standardizing the strained, raw juice from the diffusers to a constant pH value with sodium hydroxide before the calcium oxide is added. The floc formed in this process is so delicate and siliceous that, when filters are used, an economical filter rate can be obtained only by the addition of filter-aid equal to twice or more the amount by weight of dry substance in the juice before filtration.

In this caustic lime process, the caustic addition which is required before the sugar liquor is limed, and the carefully controlled conditions under which the liming is performed, produce a sludge which would be centrifugally separable in nozzle type centrifuges, except for the formation of foam and froth by the sludge as it is discharged from the rotor. This froth forming or foaming tendency is much greater than in the double-carbonation process due to the higher solid concentration in the juice of the double carbonation process and reduced efficiency of the centrifugal separation so much that centrifugal separation was not commercially feasible. The foaming conditions which resulted prior to my invention overloaded the rotor and destroyed the separating ability of the unit.

Both the addition of water into the return circuit and the use of filter-aids to increase the solid content of the underflow in such centrifuges were tried in an effort to prevent the formation of froth or foam. Neither was successful. By my improved centrifuging method and apparatus, the sludge can now be centrifugally separated from the sugar liquor in a nozzle type centrifuge without the formation of foam and the resulting reduction of the centrifuging efficiency of the unit.

In the concentration of gluten, a by-product of the manufacture of corn starch, foaming conditions, also have rendered concentration in return type, nozzle type centrifuges inefficient. It has heretofore been customary to concentrate the gluten either in settlers, and in certain flush type centrifugal separators. By my invention, gluten can be more efficiently concentrated in underflow return circuit connected nozzle-type centrifuges as will more fully hereinafter appear.

Aluminum sulfate is formed from the alum liquor which results from the digestion of aluminum bearing clays by sulfuric acid, and prior to my invention, the residual solids were separated from the resulting alum liquor by settling in large, expensive, lead-lined tanks. Separation by such a settling process results in a loss of approximately six percent of the available aluminum sulfate. Centrifugal separation of solids from the alum liquor in stainless steel-continuous return type centrifuges using an agglomerant has resulted in substantial improvements in recovery, which are however limited by the formation of froth and foam and the high air content resulting in both the underflow and the overflow. By the use of my improved centrifuging method and apparatus, further substantial improvements in the recovery of alum liquor are effected, and heat necessary for efficient operation is supplied to the liquor.

It is, therefore, a primary object of my invention to provide improved methods and apparatus by which substances containing one or more constituents which tend to produce a foam or froth upon intermixture with a gas can be centrifugally separated in a nozzle type centrifuge without the formation of froth that overloads the rotor and produces inaccuracy of separation.

An equally important object of my invention is the provision of an improved centrifuge method and apparatus for the treatment of suspensions containing foaming substances in which return of a portion of the underflow discharge is effected to improve the efficiency of separation without excessive foaming.

More specifically, it is an object of my invention to provide a novel and improved method and apparatus by which fluid feed material containing froth or foam producing constituents can be centrifugally separated into its components in nozzle type centrifuges by the provision of a gas displacing rotor enveloping vapor of a substance which is compatible with the constituents of both the underflow or the overflow discharged from the rotor.

A further specific object of my invention is to provide an improved nozzle type centrifuge apparatus having a substantially vapor-tight housing and apparatus for continuously introducing a vapor which is compatible with the constituents of the material fed to the centrifuge, in such a manner as to envelop the centrifuge rotor and thus eliminate froth and foam formation during the centrifuge operation.

A still further specific object of my invention is to provide an improved centrifuging apparatus adapted to separate a fluid feed material, the components of which are not readily separable and which normally are froth producing, by the provision of a rotor enveloping vapor which is compatible with the constituents of the fluid feed material, a portion of which is introduced into the centrifuge housing to serve as a carrying fluid for an agglomerant for facilitating the introduction thereof into the fluid feed material.

The foregoing and other objects of my invention will become apparent by reference to the appended claims, and to the following detailed description which proceeds in reference to the accompanying drawing wherein:

Figure 1 is a partially sectioned, somewhat diagrammatic view of a nozzle type centrifuge; and

Figure 2 is an enlarged fragmentary sectional view of a labyrinth type seal and vapor and agglomerant feed arrangement surrounding the rotor shaft of the centrifuge of Figure 1.

The centrifuge shown in Figure 1 is a nozzle form of orifice discharge type centrifuge, provided with a connection for the return of a portion of the underflow to the centrifuge rotor. The disclosure of my invention in conjunction with this form of centrifuge is exemplary as the invention is equally applicable to other forms of orifice discharge type centrifuges of both the return and non-return types.

The general structure of this somewhat diagrammatically illustrated form of the underflow return connected, nozzle-type centrifuge is substantially the same as that described in detail in U. S. Letters Patent Nos. 2,525,629 and 2,559,453, to which reference is made if an explanation, which is more detailed than that which follows, is found to be necessary to a complete understanding of the novel centrifuge structure and method of the present invention.

The structure of the centrifuge illustrated in Figure 1 of the drawing consists of a rotor **10** supported by a vertical shaft **12**, within stationary housing **14**. As will be presently described in more detail, the rotor is provided with various fluid passages, including an inlet for the fluid feed material, an outlet for discharge of the lighter centrifugally separable component of the feed material, known as the overflow, and an outlet for the heavier centrifugally separable component of the feed material, known as the underflow. The rotor **10** is supported and driven by the vertically disposed shaft **12**, which is connected by a coupling **16** to a vertical coaxially aligned motor driven shaft **18**. Shaft **18** is journalled at its upper end in a resiliently mounted bearing assembly (not shown).

Housing **14** can be conveniently formed of a plurality of separable sections **20**, **22** and **24**. Section **20** forms a volute or annular chamber **26** for receiving the centrifugally separated overflow discharge from the rotor **10**, and section **22** is formed to provide a volute or annular chamber **28** for receiving the underflow discharge from the rotor **10**.

The body of rotor **10** is, likewise, preferably made of a number of separable annular parts including a main part **30** and mating upper and lower conical-shaped parts **32** and **34** respectively. Part **30** is secured to the inner or bowl-like portion **36** of the rotor structure which is attached to the lower end of the rotor shaft **12**. Parts **30** and **32** are retained together by suitable means, such as an expandable clamping ring **38**. The inner structure **36** is formed with an upwardly facing truncated conical surface **40**, which with an opposed downwardly facng truncated conical surface **47** on the main rotor part **30**, defines a centrifuge or separating chamber **44**.

A stack of axially spaced annular separating discs **46**, which are of conventional, truncated conical form, is mounted in the chamber **44** coaxial with shaft **12**. A plurality of equiangularly spaced underflow discharge nozzles **48**, each of which is provided with a discharge orifice directed backwardly with respect to the direction of rotation of the rotor **10**, are formed through the outer peripheral wall **50** of the main rotor part **30**.

The peripheral portion of the main rotor part **30**, extends within the throat **51** of the volute chamber **28** formed by housing part **22**.

The underflow passes over the upper edge of the bowl-like member **36** into the annular channel **52**, from which it is discharged through the nozzles **48** into the underflow receiving volute 28 of housing member 22. The underflow passes continuously from underflow volute 28 through a pipe 53.

Fluid feed material is supplied to the rotor 10 through an annular channel 54 defined between the pair of coaxially aligned tubular members 56 and 58. Channel 54 discharges downwardly into a receiving chamber 60 defined between annular member 62 and the rotor mounting structure 64, centrally secured to the bowl-like inner rotor portion 36.

It is upon this annular member 62 that the stack of separating discs 46 is supported by a plurality of spaced radially extending vertical ribs 66. The lower portion 68 of member 62 is outwardly flared below the lowest of the stack of separating discs 46. The inner wall of annular member 62 is provided with a plurality of circumferentially spaced, inwardly extending vanes 70, which extend vertically from the upper internal edge 71 of the flared lower portion 68 to the upper end of member 62. These vanes serve as impellers to impart rotary movement to the feed material from annular channel 54. The feed material passes from the receiving chamber 60 to the main separating chamber 44 through a plurality of converging passages 72 formed through the flared lower portion 68 of member 62.

The upper rotor section 32 extends upwardly beyond the top of member 62 and is formed with an annular lip 74 at its upper end over which the overflow, which is fed upwardly through the stack of discs 46 from chamber 44, is discharged. This overflow material is received from the orifice formed by lip 74 in the overflow volute chamber 26, from which it is continuously discharged through outlet pipe 75.

The centrifuge illustrated is adapted for the return of a portion of the underflow to the rotor from the underflow receiving volute chamber 28. The lower portion 34 of the rotor 10 forms an impeller for the return of heavier, centrifugally separated underflow back into the centrifuge chamber. The lower end of the rotor part 34 is provided with a coaxially aligned opening 76 directly above an upwardly directed nozzle 78, carried by the lower part 24 of the housing 14 to direct a jet or solid stream of underflow materials upwardly into the rotor 10 through the opening 76.

Pipe 53, which receives the underflow from underflow volute chamber 28, branches into channels 80 and 82. Channel 82 directs a portion of the underflow back into the rotor 10 through nozzle 78 while channel 80 carries the remainder of the underflow from the centrifuge through control valve 84 for further processing if necessary. Wash liquid may be introduced into channel 82 via a duct 86 controlled by valve 88 for flow to the rotor. The structure thus far described is that of a "Merco" return, nozzle-type centrifuge.

My invention will increase the efficiency of nozzle-type centrifuges, such as shown in the drawing and disclosed in United States Letters Patents 1,847,751, 1,923,454, 1,954,786, 2,013,688, and 2,060,239. The term multiple discharge type centrifuge or multiple discharge rotor centrifuge as used in the specification, including the claims, is intended to refer to centrifuges of the type having a rotor provided with more than one discharge, e. g., overflow and underflow discharges, and in which the underflow discharge may, for example, comprise a plurality of nozzles or multiple discharge means spaced about the rotor periphery. Examples of the structural form which this type of centrifuge may assume are shown in the above cited group of United States Letters Patents.

As previously indicated, prior to my invention, orifice discharge or nozzle type centrifuges could not be efficiently used to centrifugally separate substances containing substantial froth or foam producing constituents. Foam is formed in such centrifuges in the underflow and overflow upon discharge from the rotor into their respective receiving chambers. This dam builds up in the receiving

chambers and back into the rotor 10, thus preventing proper discharge from the orifices and producing an unnecessary load upon the rotor. Prevention of the proper discharge from the nozzle in turn modifies the separation pattern and impairs separating efficiency within the separating chamber, so that a part of the component which should be found in the underflow chamber will be collected in the overflow chamber.

In the usual centrifuges which are connected for the return of a portion of the underflow to the rotor adjacent the bowl periphery as is the practice in separating the components of a feed material having close classifying characteristics, a portion of the foam or froth produced in the underflow is fed back into the rotor interiorly of the underflow discharge orifices, and aggravates the foaming problems. The foam or froth content of the returned underflow portion also disrupts the optimum proportional relation between the quantity of returned underflow to the wash fluid and the total underflow discharged from the rotor.

I have discovered that the foregoing troublesome conditions arising from the formation of froth can be eliminated by proper control of the atmosphere enveloping the rotor of nozzle type centrifuges. Such proper control of the enveloping atmosphere consists of the displacement of substantially all foam forming gas within the centrifuge housing by a vapor which will condense when intermixed with the constituents of the underflow and the overflow to form a liquid. The vapor used is compatible with the constituents of the fluid feed material and the wash fluid used, so that adulteration of the separated components is avoided.

To avoid adulteration of the feed materials, and the underflow and overflow discharge components, the vapor should (*a*) be a vapor of a substance which, when condensed, is soluble in one of the constituents of the separated components, or in which one of the constituents is soluble, preferably a constituent of the underflow or (*b*) be a vapor of a substance which is a constituent of one of the separated components, or (*c*) be a vapor of the substance used as a carrying liquid in the fluid feed material or that used as a wash liquid. A vapor meeting any one of these conditions is a compatible vapor for the purposes of my present invention and is suitable for the elimination of froth and foam formation.

Vapors have been introduced into the housings of centrifugal separating apparatus in the past for heating purposes. Steam has been used in centrifugal separators for heating waxes to prevent their solidification in the dewaxing of petroleum distillates, as is disclosed in United States Letters Patent No. 1,782,028, issued November 18, 1930, to E. F. Burch, and, in the separation of molasses from sugar crystals, dry steam has been used to heat the molasses to increase its fluidity and thus facilitate the centrifugal separation. This latter use of steam as a heating agent is disclosed in U. S. Patent No. 744,503, issued November 17, 1903, to Dentsch. These early uses of steam in centrifuges were purely as heating agents to increase the fluidity of the one or more of the separable components, the formation of froth not being a problem in the separation of the substances involved.

The vapor which I have found to be most useful for eliminating froth and foam formation is steam because steam is the most economical vapor produced to use and is compatible with the suustances used in most processes in which froth formation results during centrifuging, water being either the carrying liquid of the liquid feed material, being found therein, or being used as a wash liquid in return type centrifuges.

Foam or froth is produced by the intermixture of a gas, such as air, with a liquid which itself has a high surface tension characteristic or with a liquid having a substance therein effective to produce such a high surface tension characteristic. The bubbles of a froth are produced by the envelopment of a quantity of gas by such a substance which has a high surface tension characteristic. A vapor, such as steam, will not produce a froth or foam with such a substance under normal conditions because the vapor will condense to form a liquid. Thus by enveloping the rotor of a nozzle type centrifuge by a vapor which displaces substantially all gas, such as air, from the centrifuge housing and which will condense when intermixed with the underflow or overflow discharge from the rotor at the normal temperature of these components during the centrifuging operation, I have substantially eliminated the formation of foam and froth.

In the production of beet sugar, I have found that, by enveloping a centrifuge rotor with steam, the sugar sludge can be centrifugally separated from the sugar liquid in a nozzle type centrifuge, the froth and foam formation being substantially eliminated. The sugar liquid resulting from such a separation is of an improved quality and is unadulterated. While due to the higher concentration of solids found in the juice of the double-carbonation process, the frothing conditions have been less in the centrifugal separation of juice from that process than in centrifuging of the juice from the caustic lime process, the envelopment of the rotor with steam produces greatly improved results as applied to both processes.

In the concentration of gluten, the envelopment of the centrifuge rotor with steam likewise eliminates the formation of froth, and, in addition, increases the solids yield over that heretofore attainable by prior art methods by producing coagulation of certain of the soluble proteins. The envelopment of a nozzle-type centrifuge rotor with steam, while it is being used to separate residual solids from the alum liquor resulting from the digestion of clay by sulfuric acid in the production of aluminum sulfate, improves the efficiency of operation of the centrifuge by eliminating froth and foam formation and by eliminating the air heretofore found in both the overflow and the underflow.

In order that the rotor of a nozzle-type centrifuge may be enveloped with a vapor during its operation, I have developed an improved centrifuge apparatus having a substantially vapor tight housing and apparatus for introducing vapor, such as steam, from a suitable vapor generator into the centrifuge housing.

Referring once again to Figure 1 of the drawing, in order to render the housing 14 vapor tight, suitable sealing elements (not shown), are interposed between the mating edges of the housing sections 20, 22 and 24, and a rotary sealing element 90 is interposed between the shaft 12 and the portion of housing section 20 immediately surrounding it. Sealing element 90 is disclosed somewhat diagrammatically in Figure 2 as a form of a labyrinth type seal, having alternately annular rotor blades 91 fixed to the shaft 12 and annular stator blades 92 fixed relative to the housing 14. A connection 93 from a suitable vapor generator (not shown) is provided for introducing vapor centrally of the labyrinth seal to prevent passage of air from the atmosphere through the housing 14 along shaft 12. In operation sufficient vapor may be fed through 93 so that a visible amount escapes through the running clearance around shaft 12 indicating that no air is entering through this clearance.

An inlet 94 connected to a suitable agglomerant supply passes through seal element 90 and downward in the duct formed between tubular member 58 and shaft 12 below the labyrinth sealing element 90 and is used when treating materials where agglomerants may be effectively used to aid the separatory action. The major part of the vapor introduced through connection 93 passes through the lower portion of the labyrinth seal 90 and into the housing 14 along shaft 12 internally of the tubular member 58. Vapor thus entering housing 14 aids in carrying the agglomerant when used with it and thus facilitates the feeding of agglomerant downward along the shaft to the rotor for intermixture with the feed material entering through channel 54 at the bottom of tubular member 58.

Vapor is also preferably introduced into the housing 14 at other points to assume complete envelopment of the rotor 12 through a plurality of vapor conduits opening into the housing 14 through the walls thereof at spaced points. I have found that a plurality of conduits, such as 95, equiangularly spaced around the housing section 20 for introduction of vapor into the overflow receiving volute chamber 26, a plurality of conduits 96, spaced equiangularly around the housing 14 and opening thereinto intermediate overflow receiving volute chamber 26 and overflow receiving volute chamber 28, and a plurality of conduits 97, opening into the housing 14 below the underflow of the volute chamber 28 and equiangularly spaced above the axis of the housing 14, provide an entirely adequate vapor distribution for envelopment of the rotor 12 and elimination of froth and foam formation in the "Merco" type centrifuge illustrated. It will however, be understood by those skilled in the art that the manner of vapor introduction will vary with the centrifuge used and may be varied in accordance with the materials treated.

In the treatment of materials containing soluble heat coagulable substances, such for example as in the concentration of gluten in accordance with my invention, the temperature of the vapor may be maintained sufficiently high to coagulate such soluble constituents without substantial deterioration of the final product, thus further increasing the efficiency of separation as a result of such functioning.

It will accordingly be seen that I have thus invented a novel method of centrifugally separating substances which contain froth or foam producing constituents by the use of a nozzle type centrifuge in which foam and froth formation is eliminated. I have also invented an improved nozzle-type centrifuge apparatus which may be used in the performance of my method of centrifugally separating substances containing froth and foam producing constituents and an improved nozzle-type centrifuge apparatus including novel means for facilitating the introduction of agglomerant into the fluid feed material.

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiments are therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

What is claimed and desired to be secured by United States Letters Patent is:

1. In a method of centrifugally separating a fluid feed material containing a froth or foam producing constituent characterized by the use of a multiple discharge type centrifuge embodying a separatory rotor; the step of enveloping the rotor of said centrifuge during operation with a vapor to prevent the formation of froth.

2. In a method of centrifugally separating a fluid feed material containing a froth or foam producing constituent compatible with water, characterized by the use of a centrifuge embodying a multiple discharge type separatory rotor: the step of enveloping the rotor of said centrifuge, during operation, with steam to prevent the formation of froth.

3. In a method of centrifugally separating a liquid feed material containing froth or foam producing constituents which is characterized by the use of a multiple discharge type centrifuge; the step of eliminating foam or froth formation within the centrifuge by displacement of substantially all bubble forming gas from the centrifuge during operation by injection of vapor condensible in the liquid of the feed material at spaced points to completely envelop the centrifuge rotor.

4. The method as defined in claim 3, wherein said gas

displacing vapor is compatible with said constituents of the underflow discharge.

5. The method as defined in claim 3, wherein said gas displacing vapor is a vapor of one of the constituents of the underflow.

6. The method as defined in claim 3, together with the step of feeding an agglomerant with the vapor into said apparatus.

7. A method of centrifugally separating the components of a fluid feed material which have different classifying characteristics and at least one of which contains a froth or foam producing constituent, characterized by the use of a multiple discharge type centrifuge apparatus and comprising the steps of continuously supplying such fluid feed material to said apparatus, establishing a zone of separation between the components thereof within said apparatus and an overflow and an underflow discharge therefrom, and enveloping the flowing material in said apparatus with gas displacing vapor which is compatible with the constituents of one of said flow discharges to eliminate formation of froth or foam in said centrifuge.

8. In the production of beet sugar a method for separating intermixed sugar sludge and sugar liquor resulting from the liming of raw juice characterized by the use of multiple discharge type centrifuge and which comprises the steps of supplying intermixed sugar sludge and sugar liquor to said centrifuge; establishing a zone of separation therebetween within said apparatus, an overflow discharge containing the sugar liquor and underflow discharge containing the sugar sludge; and substantially enveloping the flowing liquor and sludge with steam to prevent the formation of froth by the liquor and sludge as it is discharged through the rotor of the centrifuge.

9. In the manufacture of gluten, a method of concentrating the gluten content of a carrying fluid characterized by the use of a multiple discharge type centrifuge and comprising the steps of supplying intermixed gluten and carrying liquid to the centrifuge; establishing a zone of separation between the gluten and the carrying liquid, an overflow discharge containing the carrying fluid, and an underflow discharge containing primarily concentrated gluten; and enveloping the flowing material within the centrifuge with a vapor of the carrying fluid to prevent the formation of froth or foam as the gluten is discharged through the rotor of the centrifuge.

10. The method defined in claim 9 wherein the carrying fluid is water and the enveloping vapor is steam.

11. In the manufacture of aluminum sulfate, a method of separating alum liquor from solid residue resulting from digesting clay with sulfuric acid characterized by the use of a multiple discharge type centrifuge which comprises the steps of supplying intermixed alum liquor and digested clay residue to the centrifuge; establishing a zone of separation therebetween within said centrifuge, and an overflow containing the alum liquor and an underflow containing primarily digested clay residue; and enveloping the flowing material within the centrifuge with steam to eliminate air from the underflow and overflow discharges from the rotor.

12. In the method set forth in claim 11, the steps of feeding an agglomerant with enveloping vapor into the centrifuge.

13. Apparatus for centrifugally separating a fluid feed material containing a froth or foam producing constituent into its components, comprising a multiple discharge type rotor centrifuge and means for preventing the formation of froth or foam therein by such constituent, said centrifuge and froth preventing means comprising a sealed vapor filled housing completely enclosing the centrifuge rotor and means connected to said housing at spaced points for introducing vapor into said housing to completely envelope the centrifuge rotor with such vapor.

14. A multiple discharge type centrifuge apparatus adapted to continuously and centrifugally separate a fluid feed material into its components, at least one of which contains a froth or foam producing constituent, said centrifuge apparatus comprising: a housing; a rotor mounted for rotation about a vertical axis within said housing, and of such construction as to define a centrifuge chamber therein and an underflow and an overflow discharge orifice from said chamber; inlet means through said housing for supplying fluid feed material to the centrifuge chamber of said rotor; means in fluid communication between the interior and exterior of said housing for separately removing the underflow and overflow components discharged through said orifices from said centrifuge chamber, and means connected to said housing at spaced points for continuously supplying vapor to the interior of said housing to completely envelope said rotor with such vapor during operation.

15. A multiple discharge type centrifuge apparatus, adapted to centrifugally separate a fluid feed material into its components, at least one of which contains a froth or foam producing constituent, said apparatus comprising: a substantially vapor-tight housing; means passing through said housing at spaced points for continuously supplying to said housing a vapor which is compatible with the constituents of one of the components of said substance; a centrifuge rotor journalled for rotation about a vertical axis in said housing and having means therein defining a centrifuge chamber and discharge outlet orifices for the centrifugally separated overflow and underflow components; a first receiving chamber formed in said housing in the path of the underflow discharge; a second receiving chamber formed in said housing in the path of the overflow discharge; inlet means through said housing for continuously supplying feed material to said rotor; and conduit means in fluid communication with said receiving chambers for separately removing the separated components from said receiving chambers; the spaced points for introducing vapor into said housing being so located relative to said discharge outlet orifices and said receiving chambers as to maintain said rotor completely enveloped with such vapor.

16. The apparatus as defined in claim 15, wherein said rotor is supported by and driven through a vertically extending shaft passing through the wall of said housing; together with a labyrinth seal between said shaft and said housing; and of means for introducing a portion of the vapor supplied to said housing at a point intermediate the ends of said labyrinth seal.

17. The apparatus of claim 16, including means of introducing an agglomerant into said housing along said shaft between said labyrinth seal and said rotor so that the agglomerant is carried into said rotor by said vapor.

18. A centrifuge apparatus comprising: a housing having an overflow receiving volute chamber and an underflow receiving volute chamber formed therein, a centrifuge rotor mounted for rotation within said housing and having a centrifuge chamber, an overflow discharge orifice adapted to direct overflow from said centrifuge chamber into said overflow receiving volute chamber and multiple discharge means for directing underflow from said centrifuge chamber to said underflow receiving volute chamber, inlet means through said housing for introducing feed material, including a carrying liquid into said centrifuge chamber, and means located at spaced points on said housing for introducing a vapor of the same substance as the carrying liquid into said housing to envelope said rotor.

19. A centrifuge apparatus comprising: a housing; a vertically aligned shaft extending through the top wall of said housing; means for rendering said housing substantially vapor tight including a rotary fluid sealing element interposed between said shaft and said housing; a centrifuge rotor fixed to the end of said shaft within said housing; a first supply duct disposed within said housing surrounding said shaft and having a discharge opening at its lower end within said rotor; means in fluid communication from the exterior of the housing to the interior of said first supply duct for supplying agglomerant to the

interior of the first supply duct; a second supply duct disposed within said housing surrounding said first supply duct and having a discharge opening at its lower end within said rotor; means in fluid communication with said second supply duct for supplying feed material to said second duct; and means in fluid communication with said sealing element for introducing a vapor of the substance forming the carrying fluid of the feed material intermediate the outer end of said sealing element and the point of entry of agglomerant into said first supply duct so that the agglomerant feeds into said rotor with the vapor thus introduced.

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