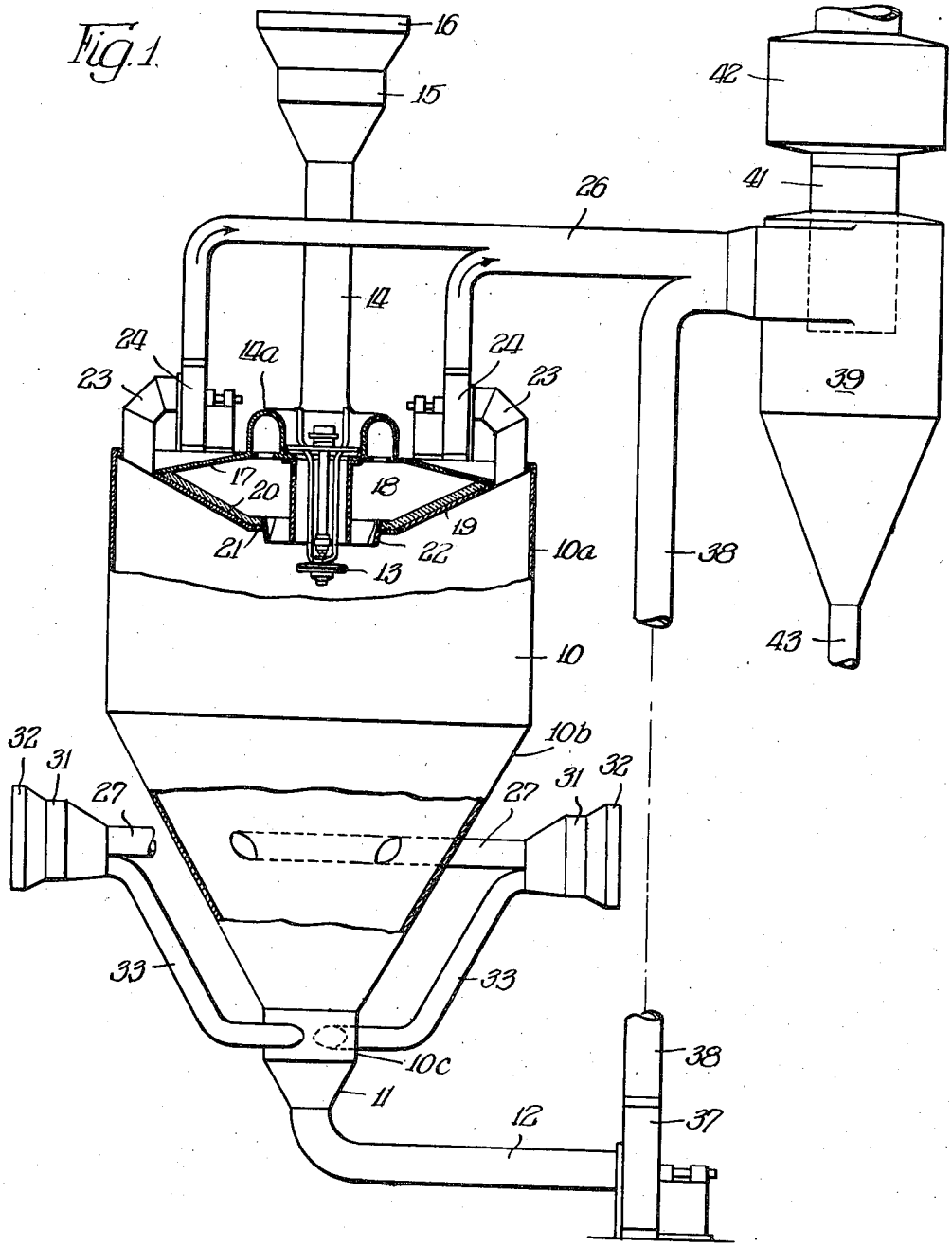
Feb. 11, 1947. D. D. PEEBLES 2,415,527

METHOD OF ATOMIZING AND DESICCATING SUBSTANCES, AND APPARATUS THEREFOR

Filed July 3, 1942 3 Sheets-Sheet 1

Fig. 1.



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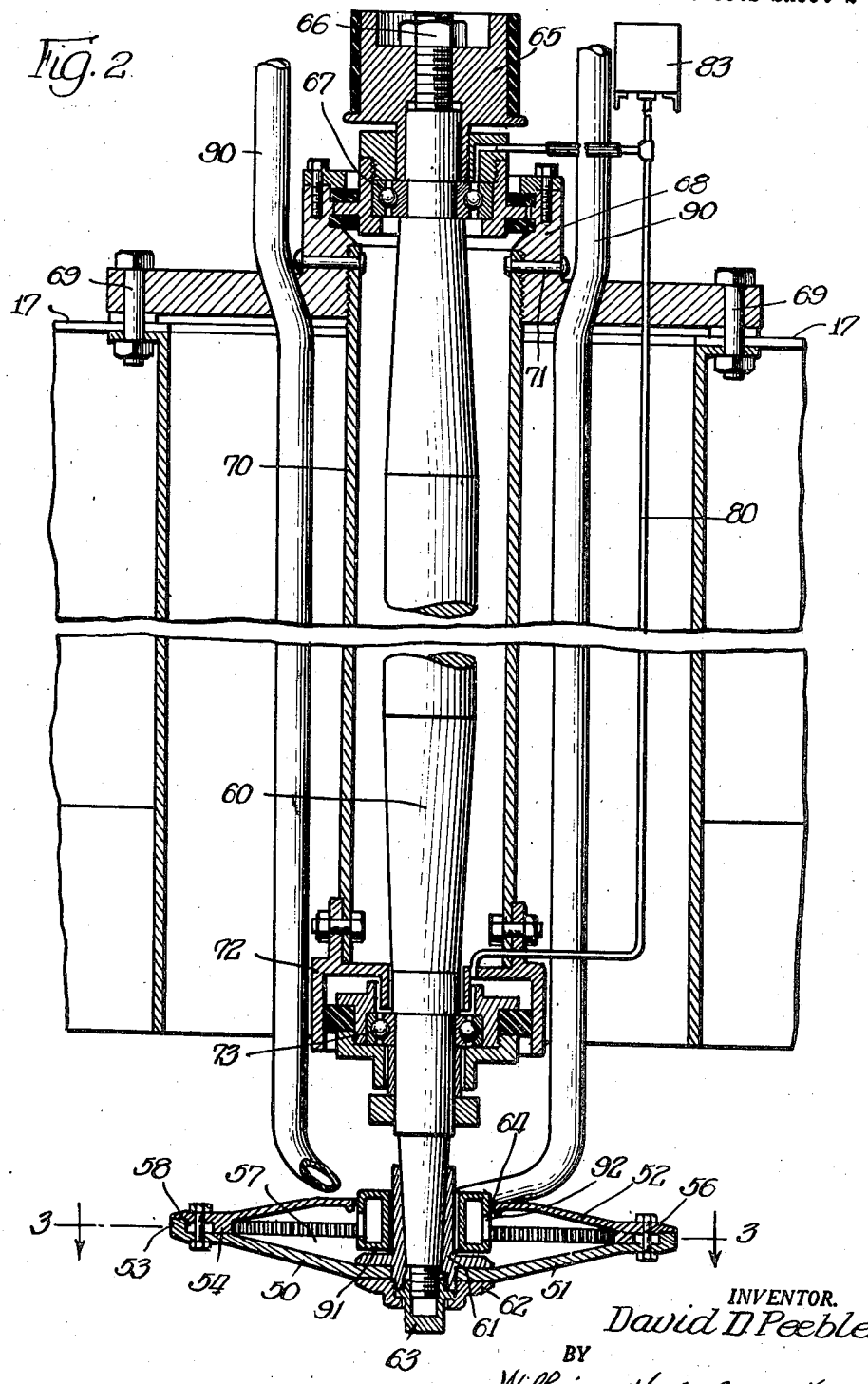
Filed July 3, 1942 3 Sheets-Sheet 2

Fig. 2.



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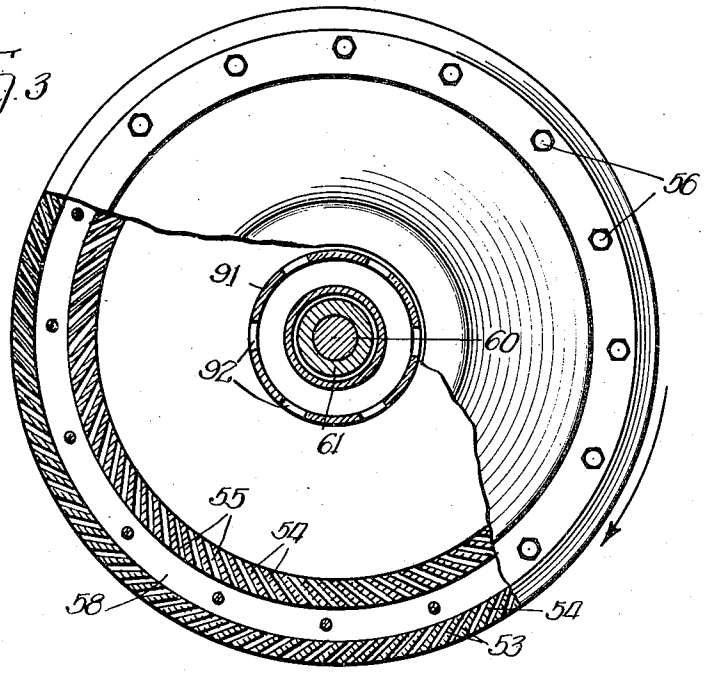
Filed July 3, 1942 3 Sheets-Sheet 3

Fig. 3



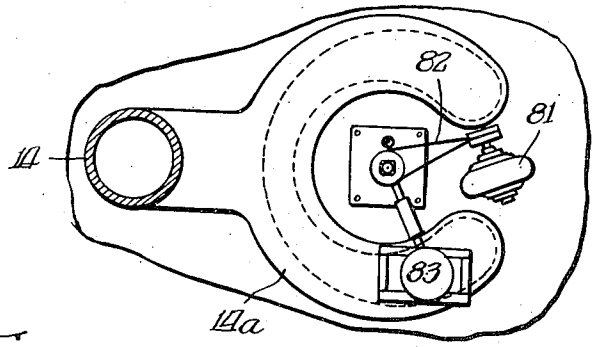
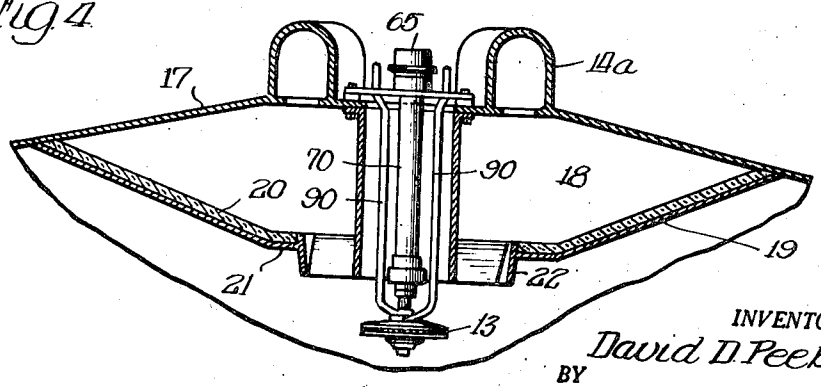


Fig. 5

Fig. 4



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UNITED STATES PATENT OFFICE

2,415,527

METHOD OF ATOMIZING AND DESICCATING SUBSTANCES AND APPARATUS THEREFOR

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Application July 3, 1942, Serial No. 449,653

14 Claims. (Cl. 159—4)

1

This invention relates to a new and improved method of atomizing various liquid substances, as well as to a novel method of drying or desiccating such substances in atomized or finely divided form.

This invention also relates to the novel product resulting from this method.

This invention further relates to new and improved apparatus for carrying out the atomization and drying methods of this invention.

It is an object of this invention to provide a new and improved method of atomizing and drying viscous substances in an efficient, satisfactory, and relatively inexpensive manner, with the result that the finished product has the desired properties and is free from damage or deterioration produced during the atomizing and drying treatment.

A further object of this invention is to provide a method and means for drying highly viscous substances, such as, for instance, corn syrup, molasses and the like, by the combined action of surface evaporation and simultaneous boiling of moisture from the interior of minute particles of such materials.

In the accomplishment of this object, the viscous material to be treated is projected at high speed into an atmosphere of drying gas which has been heated to a temperature above the boiling point of the viscous material being treated. In addition, the viscous material so projected is previously heated to a temperature at or near the boiling point of such material at atmospheric pressure and, while at such temperature, it is held under sufficient pressure to prevent the boiling of the liquid therefrom until the instant of release for projection. Furthermore, the viscous material is subdivided by mechanical or other action into minute globules or particles at the instant of projection, and the course of such projection is such as to bring each of the particles so projected progressively into the environment of new hot drying gas.

The accomplishment of the above-stated object is productive of dry, fragmentary, minute particles of the material desiccated, resembling in appearance and shape the fragments of broken, hollow globular bodies which vary somewhat in size and shape.

The desiccation of such material is accomplished through the conjoint and simultaneous actions of surface evaporation, produced by the hot drying gas, and the boiling from the interior of the subdivided particles of a portion of the moisture present. These conjoint actions occur

2

in such manner that at the outset the individual particles tend to form themselves into hollow globular bodies. These hollow bodies next undergo a certain amount of case hardening accompanying evaporation of moisture from their surfaces. Subsequently, the hollow bodies so formed are shattered or ruptured by the further boiling of the moisture located in the interior thereof. This boiling occurs on the interior of such particles rather than in the exterior regions thereof, for the reason that the boiling point of the material in the exterior region is elevated by virtue of the increased concentration resulting from surface evaporation. Furthermore, the boiling action is accelerated by the rise in temperature of the individual particles, due to the conversion of kinetic energy of the moving particles to heat energy, as the high speed of movement of the projected particles is diminished.

This process utilizes kinetic energy supplied by the movement of a high speed rotary device for imparting to the material to be atomized and dried, energy in the form of heat which serves to quickly and effectively raise the temperature of the material to be dried above the boiling point, and in such manner effects an immediate boiling of a portion of the water at the instant the material is cast off into the drying space.

It is a further object of this invention to provide a novel dried or desiccated product produced from various viscous materials, such as, for instance, corn syrup, molasses, or the like, which product is characterized as having a substantial portion made up of particles in shape and appearance like fragments of hollow globular bodies.

This invention is particularly useful in connection with the desiccation of highly viscous materials. It is found in practice that it is much more economical to remove water from liquid substances by evaporation, such as evaporation under reduced pressure, than it is to dry the same by atomizing the material in atmospheres of heated gases. On the other hand, complete drying or removal of the final moisture cannot be carried out by the evaporation method with the same results accomplished by the spraying method. An ideal procedure, therefore, is that of utilizing the evaporation method to the desired extent to produce an extremely viscous material, and then removing the residual moisture from the viscous material by the spray-drying method. This requires a satisfactory method and means for handling extremely viscous materials, and consequently the provision of the method and

means of this invention constitutes an important and valuable contribution to this art.

Other objects not specifically mentioned are contemplated for this invention, as will be apparent to one skilled in the art as the following description proceeds.

The process of this invention is based upon the discovery that an effective atomizing and drying can be carried out, particularly with various viscous substances such as corn syrup, molasses and the like, when the same is subjected to conditions which cause a substantially instantaneous boiling of the water contained therein, at the moment the same is projected in a finely divided or atomized form into an atmosphere of drying gas. More specifically, the process is predicated upon the discovery that drying or desiccating of such substances can be effectively accomplished by eliminating the water by boiling in the manner referred to, by feeding the liquid to be dried to a rotary nozzle or atomizing device, at a temperature closely approaching the boiling temperature of the substance, and by causing it to undergo an increase in temperature in amount sufficient to raise its temperature to a point above the boiling point, through the action of kinetic energy supplied by the motion of the rotary atomizing device.

The invention may be illustrated by pointing out that the additional heat derived from kinetic energy required to raise the temperature of the substance above its boiling point can be imparted to the substance through the action of a rotary device hereinafter referred to as a "runner" or "basket," which is adapted to rotate at relatively high speed, and which is provided with outlet openings adjacent its periphery disposed at such an angle with respect to the direction of rotation as to establish a substantial pressure within the runner itself in opposition to the centrifugal force which acts on the substance to ultimately discharge the same into a zone of drying atmosphere. It is found that pressure established by the novel characteristics of the runner ultimately is effectively opposed and overcome by the centrifugal force, with the result that the substance is cast off tangentially at a relatively high speed and that the kinetic energy is converted into heat in amount sufficient to raise the temperature of the substance to a point above the boiling point.

The success of this invention is believed to be attributable to the fact that the additional heat which elevates the temperature of the substance being treated, from a point slightly below the boiling point to a point above the boiling point, is derived entirely from the kinetic energy imparted to the substance as a result of its movement through the drying atmosphere surrounding the runner. In other words, the rise in temperature is the result of the movement of the substance through the drying zone at the speed established to overcome the pressure created by the movement of the runner itself. This action prevents the substance being treated from reaching a temperature above the boiling point while in the runner or at any time when it is likely to dry on the walls or in the outlet openings of the runner, such as would be likely to cause the dried substance to adhere to the surface of the runner and eventually clog the passages therethrough and interfere with the success of the operation. Such a detrimental result would also occur with viscous substances, if the product should be introduced into the runner at a temperature which is too high, or, in other words, at a temperature which would cause boiling to occur in the runner. Even when the operation is carried out by feeding the substance to the runner at a temperature too closely approaching the boiling point, some boiling may occur in the runner itself. When boiling occurs in the runner, the material being treated may become unequally distributed in the runner, with the result that the runner is unbalanced. Such unbalancing of the runner at operating speeds is detrimental to the success of the procedure and ultimately results in a complete breakdown and failure. Furthermore, any appreciable boiling in the runner will unduly increase the pressure in the runner and thereby damage the runner and cause failure whether or not the runner has become unbalanced.

The present invention, therefore, has for one of its objects, the provision of a method and means whereby various substances, especially viscous substances, may be fed to a runner or rotary atomizer of special construction, at a temperature sufficiently below the boiling point to avoid the danger of unwanted boiling in the runner and yet at a temperature sufficiently high to permit the same to be raised to a point above the boiling point, and, in addition, cause the increase in temperature to occur through the action of kinetic energy supplied by the motion of the runner itself.

The process of this invention will be more readily understood by reference to the accompanying drawings in which one apparatus is shown as illustrative and by which the process may be carried out. The apparatus itself constitutes a new and useful invention which is covered hereby.

In the drawings—

Figure 1 is a side elevational view, partly in cross section, of a drying apparatus constructed in accordance with this invention and which is capable of carrying out the process herein described and claimed.

Figure 2 is an enlarged elevational view in cross section, of the upper central portion of the drying apparatus shown in Figure 1, which more clearly shows the construtcion of the rotary runner or so-called basket and its associated parts.

Figure 3 is a cross sectional view taken on the line 3—3 of Figure 2 and looking in the direction of the arrows.

Figure 4 is a slightly enlarged view of the upper end of the drier shown in Figure 1; and

Figure 5 is a fragmentary plan view showing the upper part of the drier as it would appear when looking down upon it.

The process of this invention will be better understood by reference to the following description of one form of apparatus by which the same may be practiced. It is to be understood, however, that the process is not limited to this particular means, as it will be clear to one skilled in the art that other devices may be used with success.

The apparatus illustrated in the drawings consists of a desiccating chamber 10 which preferably includes an upper substantially cylindrical portion 10*a*, and a lower substantially conical-shaped portion 10*b*. At the lower end of the portion 10*b* there is a cylindrical portion 10*c* which has a lower cone 11 connected to the discharge conduit 12. A centrifugal atomizing nozzle 13 is located at the upper end of the chamber aligned with the vertical axis of the chamber. This atomizing nozzle is herein sometimes referred to

as the runner or basket and is of a special construction hereinafter described in detail. The construction of the runner is such that it will be effective in imparting energy, derived from the motion of the runner, in the form of heat to the material being treated.

A hot drying gas, such as heated air, is introduced into the upper portion of the chamber in the region surrounding the atomizing nozzle 13. Thus, with the construction illustrated, hot air is introduced through the conduit 14 which terminates in a suitable duct, such as the horizontal duct 14a on top of the drier, for conducting the air into the air chamber 18. The air duct 14 has its opposite end connected to a suitable heater 15 which is in turn connected to an air filter 16. The air duct 14a in this illustration is of horseshoe shape and communicates with the air chamber 18 through openings in the top wall 17 of the air chamber. This chamber is formed by an inverted, conical-shaped wall 19, together with the wall 17 and lower horizontal wall 21. The conical-shaped collar 22 is mounted centrally of the wall 21 and serves to conduct the hot gas downwardly about the centrifugal atomizing nozzle 13. The lower walls of the chamber 18 are preferably lined with a heat insulating material 20.

A certain amount of air is removed from the upper portion of the chamber through the exhaust conduits 23, which communicate through the conical-shaped wall 19 and connect with the inlets of the blowers 24. A common conduit 26 is connected to the exhaust of the blowers and extends to and communicates with a cyclone separator 39.

In conjunction with the lower part of the desiccating chamber, means is provided for the additional introduction of drying gas. Thus, the conduits 27 communicate through the side wall of the conical portion 10b at several points with the discharge arranged tangentially of the desiccating chamber. In this instance, two general points of introduction of gas are shown for each conduit 27, with the flow of gas being in a tangential direction. Conduits 27 connect with heaters 31 and also with air filters 32.

Additional drying gas is introduced into the lower extension 10c, and for this purpose conduits 33 are provided which communicate through the side walls of the extension 10c in such manner that the flow of gas is directed in a tangential direction. The direction of introduction of gas into the extension 10c is the same as for the conduits 27. Gas introduced through conduits 33 is likewise heated and filtered and, as a matter of convenience, the conduits may be fed from the heaters 31 and filters 32, as illustrated in Figure 1 of the drawings.

Some of the material being dried falls down to the base of the desiccator, and some of the material along with some of the gas is removed through the conduit 12. This removal prevents the accumulation of any appreciable amount of the material at the bottom of the desiccator.

As representative of a suitable apparatus that may be employed to separate the dried material from the treated gas, there is shown a blower 37 having an intake which connects with the conduit 12, and a discharge which connects with the cyclone separator 39 through the conducting pipe 38. Thus, through the pipes 26 and 38 all of the dried material and treating gas are conveyed to the cyclone separator 39, where the ultimate separation of the material and gas is effected.

The separator 39 may be of any suitable type but is here shown as a cyclone type having an exhaust conduit 41 connected to a washer 42 which serves to remove any solid material which has not been separated in the separator itself. The material collected in the separator 39 feeds downwardly and passes into the discharge pipe 43 which may serve to conduct it to any suitable place for storage, cooling, and sacking, as may be desired.

Referring now more particularly to the disclosure of Figure 2, it will be noted that the runner or rotary atomizing device comprises a horizontally disposed circular member 50 formed of a lower part 51 and an upper part 52. At the periphery of the lower part 51 are a plurality of spaced lugs 53 which are separated one from the other by angularly disposed slots 54, (see Figure 3). These lugs collectively form an annular support on which rests the outer edge of the upper member 52. The upper member 52 has a series of similarly formed lugs 54 which are separated by angularly disposed slots 55, as more clearly shown in Figure 3. It will be noted particularly that the angularly disposed slots 55 of the inner ring attached to the upper member 52, extend in a direction opposite to that of the slots 54 of the outer ring. It will also be observed that the inner series of lugs also form a supporting surface, but these depend from the upper member 52 into position for engagement with the opposed or lower member 51. The upper and lower members of the runner are preferably held together by bolts 56 which extend through the peripheries thereof, as clearly shown in Figures 2 and 3.

From the foregoing description, it will be apparent that the runner is provided with an internal space 57 adapted to receive the material to be desiccated, and that the space 57 has communication with the exterior through the slots 55 and 53, respectively. It will further be noted that an annular chamber 58 is formed between the inner and outer annular series of lugs, through which space the material must pass on its way from the interior of the runner to the exterior.

As clearly shown in Figure 2, the upper half 52 of the runner is entirely supported on the lower half, and the lower half provides the means of attachment of the runner on the shaft 60. The runner is fitted on the sleeve 61 and held by means of the nut 62. The sleeve 61 is held on the shaft by means of the nut 63 which is locked in position by the nut 62. The opening in the upper member 52 is sufficiently large to provide a space 64 between the inner edge of the runner and the sleeve for the purpose of accommodating a feeding bowl, hereinafter more fully described.

The shaft 60 extends upwardly beyond the upper wall 17 of the drying chamber and is equipped with a pulley 65 mounted on the upper end thereof by means of the nut 66. The upper end of the shaft is mounted in an antifriction bearing, designated generally 67, which is suitably mounted in a support 68 mounted by means of bolts 69 on the upper wall 17 of the drying chamber. The support 68 also serves as a mounting for the downwardly extending sleeve 70 which may be screw-threaded into the support and also held by rivets 71. This sleeve extends downwardly and serves as a mounting for a collar 72 which in turn serves as a mounting for a suitable antifriction bearing 73 which supports the lower end of the shaft 60.

It will be noted that this entire assembly

derives its main support from the upper support member 68, and that it is hung on the upper wall of the drying chamber. It will also be noted that it extends down through the central opening provided in the upper wall 17 into what constitutes a cylindrical space defined by the wall 80. This wall is attached to the upper wall 17 of the drying chamber and it constitutes the inner wall of an annular feeding passage for hot drying gas.

As more clearly shown in Figure 5, the pulley 65 on the upper end of the shaft 60 may be driven by a suitable motor 81 connected by means of the belt or other gearing element 82. The container 83, shown in Figures 2 and 5, are for lubricant for the upper and lower antifriction bearings, respectively.

From the above description, it will be apparent that the runner is adapted to be mounted in the upper end of the drying chamber substantially as shown in Figure 1, and that it is capable of being given a relatively high speed of rotation by means of the electric motor.

The material to be desiccated is fed to the runner by means of pipes 90—90 which extend downwardly from a point above the upper wall of the desiccating chamber into the annular space defined by the cylindrical wall 80. These pipes extend down below the lower edge of the wall 80, or, in other words, into the upper portion of the drying chamber, and are caused to bend at right angles so as to extend horizontally and then to communicate tangentially with the upper, outer edges of an annular feeding bowl 91. This feeding bowl fits within the space provided between the inner surface of the upper wall 52 of the runner and the collar 61 of the shaft, and it serves to effectively close such space. The annular bowl 91 is provided with a series of windows 92 around its outer cylindrical face, which communicate directly with the interior space 57 of the bowl. Any suitable number of windows may be employed, but it is found that good results are obtained when six windows are employed.

The tangential feed of the material to be desiccated through the pipes 90—90 acts to give the material being treated a rotary motion within the annular bowl, the direction of which is opposite to that of the direction of rotation of the runner itself. It is to be understood that the runner rotates in the direction indicated by the arrow of Figure 3, or, in other words, a direction opposing the outlet openings at the ends of the slots 53.

The manner of feeding and discharging the material through the runner, according to this invention, is effective to impart to the material undergoing treatment the energy required to raise its temperature to and above the boiling point in the manner hereinbefore pointed out. The heated air which comes in at the top through the duct 14, passes through the annular air space provided by the sleeve 22 and the inner wall 80, and in passing therethrough it is preferably given at least a slight rotary motion which in most instances will be concurrent with the direction of rotation of the runner. In addition, the best results will be obtained when the currents of air introduced at the lower part of the drying chamber, that is, through the pipes 27 and 33, respectively, are introduced so as to create a swirl rotating in a direction opposite or counter to the direction of rotation of the runner.

By means of the foregoing apparatus, it is found that the high speed of rotation which is employed serves to build up a pressure opposing the outward centrifugal feed of the material through the runner; and that the feeding of the material in opposition to such pressure, coupled with the instantaneous and prompt release thereof into the drying atmosphere, causes a rise in temperature from a point slightly below the boiling point to a point above the boiling point, with the result that an instantaneous boiling and drying is effected at the instant the material is atomized and exists in finely divided form in the drying space.

For purposes of illustration, the following specific examples of actual runs carried out in accordance with this invention will now be given. These operations involved the treatment of corn syrup, which was sprayed from the nozzle at approximately 38.5° Baumé and 40° Baumé, respectively:

Example 1

The first run is the 38.5° Baumé run, which was carried out under the following conditions: The temperature of the material fed to the runner was approximately 210° F. The inlet temperature of the air fed into the drying chamber was between 326° F. and 344° F. The temperature of the tangent inlets was approximately 189° F. to 192° F. The temperature of the outlet gas was approximately 229° F. to 238° F. Approximately 71.37% of solids were recovered, and the output of commercial product for the unit as run was 2525 pounds per hour.

The atomizing runner was 12½ inches in diameter and was operated by a 50 horsepower motor, which was operated at 3450 revolutions per minute when the runner was under load.

The atomizer was operated by a 3 inch pulley carried on the runner shaft, which in turn was driven by a 10½ inch pulley on the motor.

Example 2

A similar run was carried out with 40° Baumé syrup in which the material was supplied to the runner at a temperature between 208° F. and 210° F. The inlet temperature of the drying gas was 336° F. to 340° F. The tangent temperature was between 196° F. and 200° F. The outlet temperature was between 228° F. and 236° F.

The runner, motor, and runner drive, as well as the revolutions per minute, were the same as in the first example. In this run, the output of commercial product was 2828 pounds per hour.

Example 3

A run was conducted in all respects like the run of Example 1, with the exception however, that the material was fed to the runner at a temperature of approximately 213° F. A product having a slightly different physical form resulted, and the product was in all respects an excellent commercial product.

Example 4

A run was conducted in all respects like the run of Example 1, with the exception, however, that the material was fed to the runner at a temperature of approximately 224° F. A product having a slightly different physical form resulted, and the product was in all respects an excellent commercial product.

Example 5

A run was conducted in all respects like the run of Example 1, with the exception, however that the material was fed to the runner at a temperature of approximately 228° F. A product

having a slightly different physical form resulted, and the product was in all respects an excellent commercial product.

From the foregoing, it will be seen that this invention provides a method as well as means by which the substance to be desiccated, such as syrup, is brought to the nozzle under a temperature and pressure relationship which is closely approaching the boiling point of the substance treated, and that through the action of the nozzle itself, additional energy derived from the motion of the nozzle is imparted to the material, with the result that heat is added to the material and the temperature thereof is increased; and finally, that the material is suddenly released into the zone of low pressure, whereby an instantaneous flashing and boiling of the water present takes place, which is productive of an instantaneous drying of the material.

It is recognized that it is old to deliver substances of this type to nozzles under pressures and at temperatures above the boiling point, and applicant does not make any claim to such procedure, but the applicant does contend that it is novel to subject material being treated to the action of a nozzle or atomizing device while the same is undergoing a rapid and extensive movement at a temperature-pressure relationship below the boiling point of the material, and to impart to the material kinetic energy derived from the motion of the nozzle or atomizing device, and finally to cause the substance to be suddenly released into an atmosphere of lower pressure with the result that its temperature is instantaneously raised above the boiling point through the energy conversion and a consequent boiling and drying of the product occurs.

This application is a continuation-in-part of applicant's copending application Serial No. 315,432, which on November 2, 1943, matured into Patent No. 2,333,333.

What is claimed is:

1. In a desiccating apparatus of the character described, a desiccating chamber, atomizing means in the upper portion of the chamber, and means for introducing a hot drying gas into the chamber in a region adjacent the atomizing means, and discharge means connected to said chamber, said atomizing means comprising a high speed, centrifugal rotor having openings in the periphery thereof disposed at an angle inclined in the direction of rotation in such manner as to maintain a pressure in said atomizer to be overcome in the discharge of substances therefrom.

2. In a desiccating apparatus of the character described, a desiccating chamber, atomizing means in the upper portion of the chamber, and means for introducing a hot drying gas into the chamber in the region adjacent the atomizing means, and discharge means connected to said chamber, said atomizing means comprising a horizontally disposed centrifugal rotor having an internal space adapted to receive the substance to be atomized, slots in the lateral face area of said rotor communicating with said internal space, said slots extending at an angle to the radii and being inclined in the direction of rotation and spaced and angled in such manner that the wall between adjacent slots prevents material moving along a radial path from escaping unimpeded into the drying zone.

3. In a desiccating apparatus of the character described, a desiccating chamber, atomizing means in the upper portion of the chamber, and means for introducing a hot drying gas into the chamber in a region adjacent the atomizing means, and discharge means connected to said chamber, said atomizing means comprising a horizontally disposed centrifugal rotor having an internal space adapted to receive the substance to be atomized, and peripheral discharge passages communicating with said space and extending at an angle to the radii of said rotor, the angularity of said discharge passages being in opposition to the movement of said rotor, whereby a pressure is created in said atomizer during operation thereof, and means driving said rotor in the direction opposed to the outlets of said discharge passages and at a speed sufficient to cast off substances from said rotor through said discharge passages by centrifugal force in opposition to the pressure created in said discharge passages during such rotation.

4. The method of desiccating a viscous substance, which comprises the steps of heating the substance to be desiccated to an initial elevated temperature, supplying the substance so heated to a point of discharge and subjecting said substance at said point of discharge to a pre-discharge pressure slightly in excess of the vapor pressure of said substance at said point of discharge, causing said substance to be discharged in an atomized state at a predetermined velocity into a drying zone of drying gas having a pressure less than said pre-discharge pressure and of predetermined value, said pressure of pre-determined value and said initial elevated temperature being related in such manner that said substance, upon being discharged, will not be dried without the introduction therein of additional heat, converting the kinetic energy possessed by said substance into heat energy in said drying zone, said predetermined velocity being such that the kinetic energy so converted to heat energy produces heat in quantity sufficient to elevate the temperature of said substance to a point above the boiling point of said substance at said pressure of predetermined value, and said initial elevated temperature being close to but below the point where said substance will boil at said pre-discharge pressure, and thereby instantaneously boiling and drying said substance in said drying zone while in an atomized state.

5. The process defined in claim 4, further characterized in that at said point of discharge said substance is rotated at an angular velocity which, together with the pre-discharge pressure on said substance, imparts to said substance said predetermined velocity.

6. The process defined in claim 4, further characterized in that said drying zone comprises an atmosphere of heated gas.

7. The process defined in claim 4, further characterized in that at said point of discharge said substance is rotated at an angular velocity which, together with the pre-discharge pressure on said substance, imparts to said substance said predetermined velocity, and in that said substance is discharged into an atmosphere of heated gas.

8. The method of desiccating a viscous substance, which comprises the steps of heating the substance to be desiccated to an initial elevated temperature, supplying the substance so heated to a point of discharge and subjecting such substance at said point of discharge to a superatmospheric pressure in excess of the vapor pressure of said substance at said point of discharge, causing said substance to be discharged in an atomized state at a predetermined velocity into a drying zone of drying gas having a pressure less than

said superatmospheric pressure and of predetermined value, said pressure of predetermined value and said initial elevated temperature being related in such manner that said substance, upon being discharged, will not be dried without the introduction therein of additional heat, converting the kinetic energy possessed by said substance into heat energy in said drying zone, said predetermined velocity being such that the kinetic energy so converted to heat energy produces heat in quantity sufficient to elevate the temperature of said substance to a point above the boiling point of said substance at said pressure of predetermined value, and thereby instantaneously boiling and drying said substance in said drying zone while in an atomized state.

9. The process defined in claim 8, further characterized in that at said point of discharge said substance is rotated at an angular velocity which, together with the superatmospheric pressure on said substance, imparts to said substance said predetermined velocity.

10. The process defined in claim 8, further characterized in that said drying zone comprises an atmosphere of heated gas.

11. The process defined in claim 8, further characterized in that at said point of discharge said substance is rotated at an angular velocity which, together with the superatmospheric pressure on said substance, imparts to said substance said predetermined velocity, and in that said substance is discharged into an atmosphere of heated gas.

12. The method of desiccating a viscous substance, which comprises the steps of heating the substance to be desiccated to an initial elevated temperature, supplying the substance so heated to a point of discharge and subjecting said substance at said point of discharge to a pre-discharge pressure slightly in excess of the vapor pressure of said substance at said point of discharge, rotating said substance at a predetermined angular velocity and tangentially casting off said substance in a fine spray into a drying zone of drying gas having a pressure lower than said pre-discharge pressure and of predetermined value, said pressure of predetermined value and said initial elevated temperature being related in such manner that said substance upon being cast off, will not be dried without the introduction therein of additional heat, and converting kinetic energy possessed by said substance into heat energy in said drying zone, said predetermined angular velocity being such that said substance will be so cast off tangentially by centrifugal force and that the spray droplets will have imparted to them convertible kinetic energy productive, when converted, of heat in quantity sufficient to elevate the temperature of said substance to a point above the boiling point of said substance at said pressure of predetermined value, and said initial elevated temperature being close to but below the point where said substance will boil at said pre-discharge pressure, and thereby simultaneously boiling and drying the sprayed droplets of said substance in said drying zone.

13. The method of desiccating milk concentrates, which comprises the steps of heating the concentrate to an initial elevated temperature close to the boiling point of water, conducting the heated concentrate to a point of discharge, subjecting said substance at said point of discharge to a predischarge pressure in excess of the vapor pressure of water at 212° F., imparting a high speed of movement thereto in a circular path until the concentrate is cast off tangentially in a fine spray into a drying zone of drying gas having a pressure lower than said pre-discharge pressure and of predetermined value, said pressure of predetermined value and said initial elevated temperature being related in such manner that said substance, upon being cast off, will not be dried without the introduction therein of additional heat, and converting the kinetic energy possessed by said substance into heat energy, said high speed being sufficient to elevate, by said energy conversion, the temperature of the spray droplets to a point above the boiling point of water at said pressure of predetermined value and causing boiling and drying of said concentrate to produce a dry powder.

14. In a desiccating apparatus of the character described, a desiccating chamber, atomizing means in the upper portion of the chamber, and means for introducing a hot drying gas into the chamber in a region adjacent the atomizing means, and discharging means connected to said chamber, said atomizing means comprising a horizontally disposed centrifugal rotor having an internal space adapted to receive the substance to be atomized, and slots extending from the inner to the outer circumferential surfaces of said rotor communicating with said internal space, said slots being inclined in an outward direction at an angle to the radii of said rotor, said angle being a leading angle in the direction of rotation, said slots being spaced and angles so that the outer opening of each slot is in radial alignment with the inner opening of the next adjacent slot preceding with respect to the direction of rotation.

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