March 15, 1966

J. H. FORKNER

3,239,946

DEHYDRATING APPARATUS

Filed Dec. 6, 1961

3 Sheets-Sheet 1

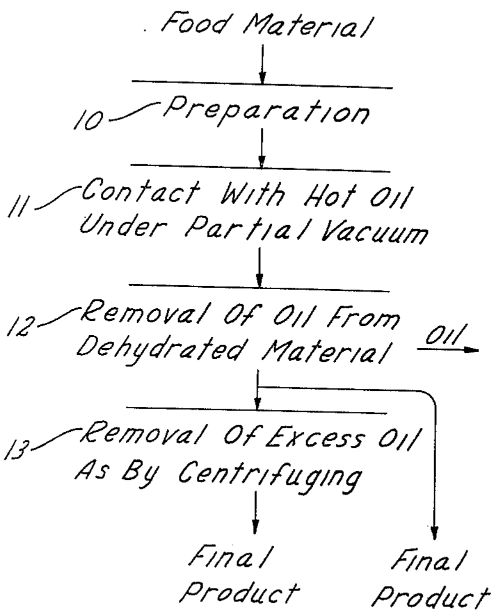

FIG_1_

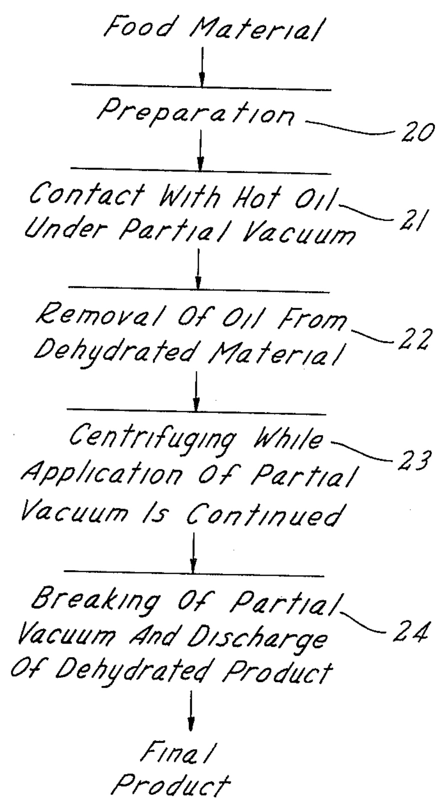

FIG_2_

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DEHYDRATING APPARATUS

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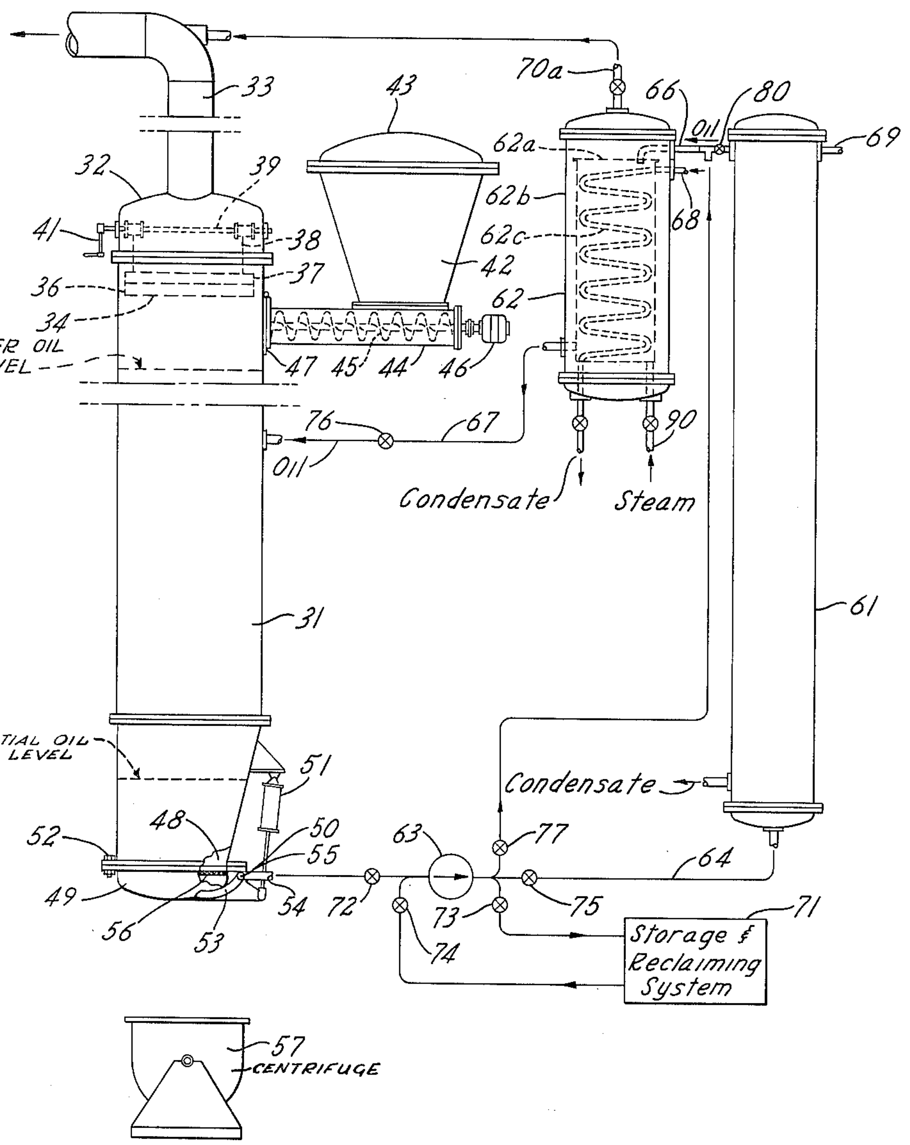

FIG. 3

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DEHYDRATING APPARATUS

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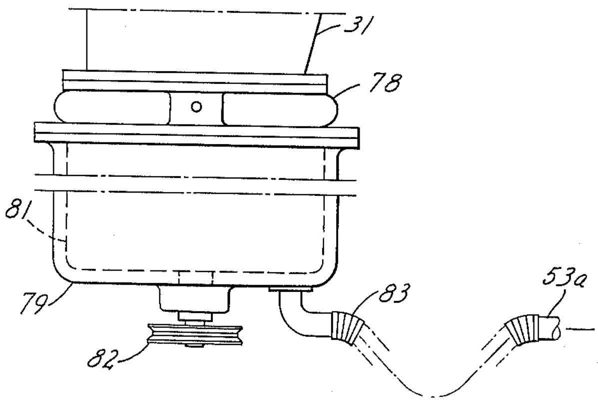

FIG. 4.

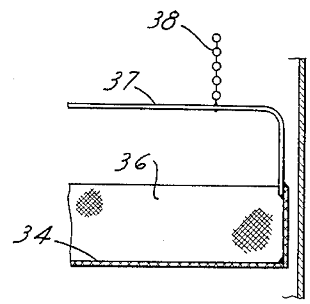

FIG. 5.

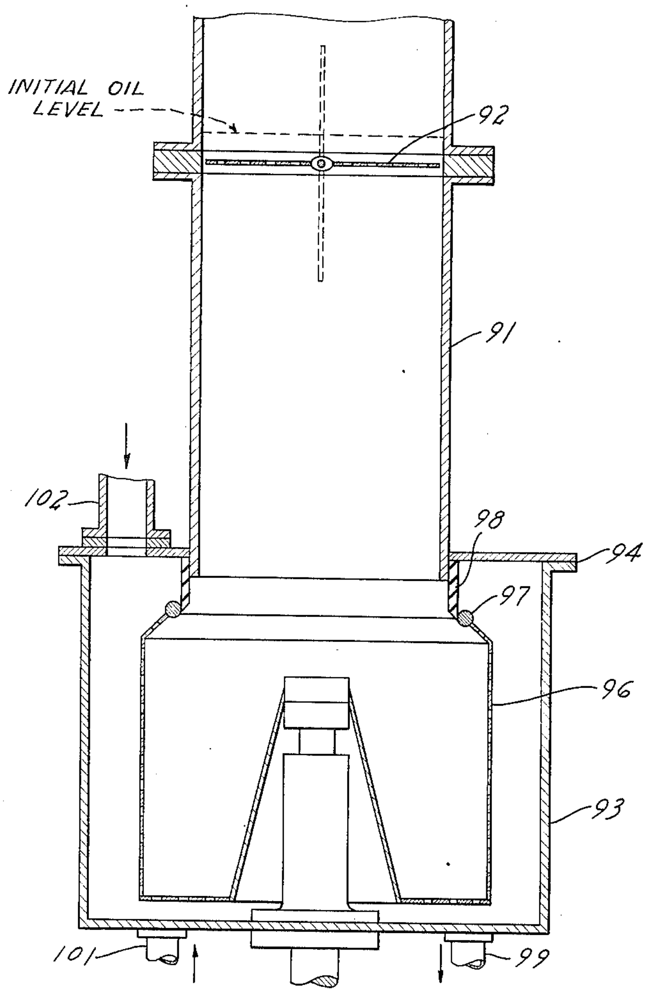

FIG. 6.

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3,239,946
DEHYDRATING APPARATUS
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Filed Dec. 6, 1961, Ser. No. 157,449
11 Claims. (Cl. 34—69)

This is a continuation-in-part of application Serial No. 78,977, filed December 28, 1960, now abandoned.

This invention relates generally to apparatus for the dehydration of various moist food materials. More specifically, it pertains to apparatus for carrying out dehydration methods of the type in which the moist food or similar organic materials are introduced into a bath of hot oil, under partial vacuum.

In my copending application, Serial No. 157,538 filed December 6, 1961, entitled "Dehydrating Method, Product and Apparatus," there is disclosed a method for the dehydration of a wide variety of moist food materials, involving contacting frozen food particles with hot oil under a partial vacuum. In typical instances the initial temperature of the oil may be within the range of 240 to 600° F. The applied partial vacuum can be of the order of 22 to 28 inches mercury column. Initial rapid heat transfer from the hot oil to the moist food material rapidly drops the temperature of the oil over a short period of the order of from ½ to 4 minutes. Also initial contact of the frozen material with the hot oil creates a foam-like medium of expanded volume comprising a mixture of water vapor and foam, which medium envelops the material being dehydrated. Thereafter the foam-like medium subsides and the dehydration cycle is completed at a lower temperature level, as for example, within the range of from 170 to 230° F. At the end of the dehydrating cycle the material may be treated as by centrifuging, to eliminate excess oil. In most instances centrifuging is applied while the partial vacuum is maintained. Thereafter the product may be impregnated with certain mediums, to impart desired characteristics. The method just described produces high grade dehydrated products, which are superior to products dehydrated by ordinary vacuum evaporation or other conventional methods.

In general it is an object of the present invention to provide novel apparatus for carrying out dehydration methods of the above character, whereby such methods are adapted to commercial operations.

Another object of the invention is to provide an improved apparatus of the above character which provides effective control over the dehydrating cycle.

Another object of the invention is to provide apparatus capable of centrifuging the material under an applied partial vacuum.

Further objects and features of the invention will appear from the following description in which the preferred embodiments have been set forth in detail in conjunction with the accompanying drawings.

Referring to the drawings:

FIGURE 1 is a flow diagram illustrating the general steps employed in my method;

FIGURE 2 is a flow diagram like FIGURE 1, but with additional procedural steps such as are employed in utilizing the apparatus of FIGURE 3;

FIGURE 3 is a schematic side elevational view, partly in section, illustrating apparatus for carrying out the method of FIGURES 1 and 2;

FIGURE 4 is a side elevational view, partly in section, showing another embodiment of the apparatus;

FIGURE 5 is a detail in section, showing a part of the adjustable screen; and

FIGURE 6 is a detail, partly in section, illustrating another embodiment of the invention in which centrifuging can be applied while partial vacuum is being maintained.

Referring to the simplified flow diagram of FIGURE 1, I have indicated hydrous food material being prepared in step **10** for the subsequent dehydration cycle. In general, the source material may be various fruits or berries, vegetables, meats, fowl, sea food, condiments, cereal grain, formulated bakery products, or moist formulated mixtures of the same. As pointed out in said copending application, preparation may include washing, peeling, pitting, and cutting into masses or particles of suitable size for further treatment. Also, it may include some preliminary processing, such as drying by contact with warm drying air, pre-cooking, pickling or so-called candying or glace treatments which impart a sugar-syrup content. In some instances dried or semi-dried material may be rehydrated before freezing. Freezing may be carried out by chilling to temperatures of the order of −20 to +10° F., as is commonly practiced in the frozen food industry. In typical instances, the individually frozen particles may measure from ⅛ to ⅝ inch in thickness, and preferably the weight of each particle does not exceed about 10 gms. If the particles are in the form of shreds or strings, they may be from $\frac{1}{64}$ to $\frac{3}{16}$ inch in thickness.

In step **11** the prepared material is shown being contacted by hot oil under partial vacuum, for dehydration. As will be presently explained during the initial phase of moisture removal, the material is enveloped in a foam-like medium comprising a mixture of water vapor and oil. Toward the end of the initial phase the foam-like medium subsides and thereafter the material is immersed in a liquid body of hot oil. The overall length of the dehydration cycle to reduce the moisture content to a predesired value (e.g. from ½ to 5%) depends on various factors, including the temperature of the oil, initial temperature of the material, the ratio between the weight of the charge of frozen material and the weight of the oil employed, the difference between the initial temperature of the material and the initial oil temperature, the value of the partial vacuum, the moisture content of the original source material, and the size of the particles. At the end of a typical dehydration cycle, as indicated in step **12**, the bulk of the free oil is removed or separated from the material before the vacuum is broken. The remaining dehydrated product may be the final product as indicated. Assuming, however, that it is desired to remove some of the retained free oil, the product is subjected to centrifuging in step **13**, whereby some further oil is removed to form the final product.

Instead of using the same oil throughout the cycle, a clarified oil, at a proper temperature, may be substituted for a predetermined portion of the oil used in the initial phase of the cycle. In such an event, a portion of the first oil is drained from the treatment tank at a point in the cycle where it is desired to modify the body of the oil, as for example, after the first intial phase during which rapid evaporation takes place, and thereafter a clarified hot oil applied at a temperature such that the aggregate body of oil attains a temperature level of the order of 195° F., after which the dehydrating cycle proceeds to completion. In some instances more than one such modification of the oil body can be employed during the complete cycle. In most instances the temperature of the oil at the end of the first initial phase tends to drop below 195° F. By introducing a predetermined amount of oil at a temperature above 195° F., the temperature of the oil can be quickly raised to the desired level (e.g. 195° F.) for continuing the cycle.

In some instances it is desirable to employ the procedure shown in FIGURE 2, wherein the food product to be treated is subjected to preliminary preparation **20** in the same manner as described with reference to FIGURE 1. Thereafter in step **21**, the frozen material is charged into a body of hot oil under partial vacuum. Dehydration proceeds as in FIGURE 1, with an initial phase during which the material is enveloped and dispensed in a foam-like medium of vapor and oil, and a following phase in which the material is immersed in a liquid body of oil. In step **22** oil is withdrawn from the dehydrated material, and while application of partial vacuum is continued, the product is subjected to centrifuging in step **23** to remove excess oil. As indicated, in step **24** the vacuum is broken and the final product discharged. Centifuging before the vacuum is broken is desirable because it results in a final product having a lower oil content, and having certain desirable properties as described in said copending application Serial No. 157,538 filed simultaneously herewith. Also it tends to prevent crushing of the cells by atmospheric pressure. Removal of the product from the oil body under partial vacuum, is accompanied by a cooling of the product, due to further evaporation of moisture. Toward the end or immediately following centrifuging, a somewhat higher partial vacuum can be applied for a short interval to accentuate evaporative cooling by further moisture removal. The higher vacuum causes some increase in volume and cooling sets the cell structure and solidifies the oil, thus providing rigidity before the vacuum is broken.

The apparatus schematically illustrated in FIGURE 3 is suitable for carrying out the procedure outlined in FIGURE 1. The tank **31** is of sufficient size to contain a measured quantity of hot oil. It will be noted that this tank is relatively high in comparison to its diameter. In a typical operation the body of oil within the tank at the start of a dehydrating cycle occupies only the lower one-eighth of the tank. The sealed cover **32** of the tank is shown connected to an evacuating conduit **33**. The evacuating equipment may include suitable condensing means for condensing moisture (e.g. a water spray condenser having a barometric column) and suitable vacuum pumping means.

Within the upper part of the tank there is a horizontally disposed barrier screen **34** which is suspended in such a manner that it can be positioned at a desired level. It is provided with a perforated rim **36** of substantial height, and with a bail **37** which is carried by suitable supporting means such as the cables **38**. The upper ends of these cables are wrapped about a winch shaft **39**, which has an exterior operating crank **41**. At a proper time in the dehydrating cycle the screen **34** is lowered below the oil level, thereby (by its weight) retaining particles of material being dehydrated submerged and in good heat transfer contact with the oil. Rim **36** is of sufficient height to extend above the oil surface, thus preventing particles being dehydrated from finding their way about the edges of the screen **34** and upon top of the same.

The means employed for charging the tank can consist of a heat insulated or refrigerated hopper **42** which is provided with the sealed removable cover **43**. A feed screw housing **44** communicates with the lower end of hopper **42**, and with the interior of the tank **31** through one side wall. The feed screw **45** is operated by suitable means such as the electrical motor **46**. The tank end of housing **44** may be provided with a closure means **47**, such as one of the hinged flap type as illustrated.

The side walls of the tank preferably are provided with heat insualting means or a steam jacket (not shown) to minimize loss of heat from the body of oil.

The lower portion of the tank **31** is provided with a downwardly extending opening **48** which is normally closed by the discharge door **49**. This door is shown hinged at **50**, and may be power operated by suitable means such as the hydraulic jack **51**. When closed, this door can be clamped by suitable means such as the clamping screws **52**. The door **49** is dished or formed as a vessel, and its interior communicates with the exterior pipes **53**, **54**, through the swing joint **55**. The upper side of the discharge door is provided with a screen **56** which supports the dehydrated material while oil is being removed.

FIGURE 3 shows suitable heating means for heating oil being supplied to the tank **31** to a desired temperature level (e.g., from 325–440° F.). Thus, two heaters **61** and **62** are provided, with oil being supplied to the heater **61** by pump **63** and pipe **64**. From heater **61** the oil passes through pipe **66** to the heater **62**, and then through pipe **67** to the tank **31**. Steam is shown being supplied to heaters **61** and **62** by pipes **68** and **69**. Heater **62** serves to elevate the oil temperature to a desired level and in addition can be used to heat the oil during a dehydrating cycle. Because many hot oils tend to deteriorate at temperatures in excess of 200° F., when in contact with air, it is desirable for the oil in heater **62** to be under vacuum. Thus, I employ a heater of the open kettle type as schematically indicated, which may include the open kettle **62*a*** enclosed within the shell **62*b***. Steam from pipe **68** passes through the heating coil **62*c***. A small amount of steam is shown being bled into kettle **62*a*** through pipe **90**, thereby providing agitation. Pipe **70*a*** connects shell **62*b*** to an evacuating system. The tank or kettle **62*a*** should have sufficient capacity to supply at least one charge of oil to tank **31**.

A storage and oil reclaiming system **71** is shown connected to the piping described above, whereby oil from a preceding cycle can be sent from tank **31** to storage, and whereby reclaimed or reconditioned oil can be supplied for the next dehydrating cycle, or at the end of the initial phase of the cycle. Briefly the storage and oil retaining system can consist of suitable storage tanks to receive used oil, together with filtering and centrifuge means for removing solid and liquid fractions derived from the food material being processed. Also the storage and reclaiming system can be adapted to receive fresh makeup oil, and storage tanks for holding oil in readiness for further use.

Operation of the apparatus described above is as follows: Valves **72** and **76** are closed and cover **43** opened to receive a charge of material, after which cover **43** is closed. Tank **31** and hopper **42** are now evacuated. With valves **74**, **75**, **76** and **80** open, and valves **73** and **77** closed, pump **63** withdraws oil from storage and delivers it serially through the heaters **61** and **62**, whereby the temperature of the oil is raised to the level desired. This oil is supplied to the tank **31** until the level reaches a predetermined height (e.g. about one-eighth full as indicated). Then motor **46** is placed in operation whereby the food material is quickly delivered into the upper part of tank **31** and dropped into the body of hot oil. At that time the partial vacuum applied can for example be within the range of 26 to 28 inches mercury column.

Rapid evolution of moisture occurs immediately as the particles are received in the body of hot oil and a vapor-oil foam is created, which expands upwardly and envelops and disperses the particles. This is accompanied by considerable agitation and by a large increase in volume. The foam level rises about 3 to 10 times the normal initial oil level. During this part of the cycle the particles are not restrained and may move freely in the tank. A small amount of oil tends to be carried the the vapor flow to the condenser, where it mixes with the condenser water. Such oil can be recovered by subjecting the condenser water to separation, as by flotation. Screen **34** at this time is in the upper part of the tank and interposed in the path of vapor flow, where it tends to prevent carry over of particles being dehydrated and to inhibit carry over of foam and oil.

There is an immediate and rapid temperature drop during the initial phase of the cycle which reduces the temperature of the oil to a substantially lower value, (e.g. 130–230° F.). For the remainder of the cycle it is desirable to maintain a lower temperature level (e.g. 170–230° F.). The extent of temperature drop in the first phase can be reduced to some extent by supplying heat to the oil, as for example by supplying steam to a heating jacket on the tank, or by circulating the oil through the heater 62 by having valves 72, 76 and 77 open, and valves 74, 73, 75 and 80 closed. Also the oil and particles being dehydrated can be quickly heated to a desired temperature level at or near the end of the first phase, as by blending in hot fresh oil as will be subsequently explained.

During the dehydrating cycle and while the vacuum is maintained the particles tend to be buoyant. Toward the end of the initial phase of the dehydrating cycle and as the oil level subsides, the buoyant particles tend to float as a mat upon the surface of the oil. At that time the screen 34 is lowered to a position in which it is below the surface of the oil, whereby the particles are held submerged below the surface of the oil for good heat transfer.

After the initial phase of the cycle, some of the oil first contacted by the material being dehydrated may be withdrawn through pipe 53, and hot clarified oil substituted. The amount withdrawn may vary over wide limits. In general as the withdrawal approaches 100 percent of the oil present, the method and the product during the remaining part of the cycle are less affected by any characteristics of the initial oil that are acquired in the initial phase of the cycle. The temperature of the fresh hot oil is such that when mixed with the material and the oil permitted to remain, a temperature is attained that is suitable for the rest of the cycle. This has the advantage of contacting the material with clarified oil for the latter phases of dehydration, instead of making use of oil containing solids derived from the material being dehydrated in both the initial and subsequent dehydrating phases. Furthermore this procedure applies heat to clarified oil, and avoids supplying heat to oil containing solids derived from the product, as by conventional heat exchange means (e.g. steamjackets or tubular heaters). The latter procedure causes formation of incrustations on the heating surfaces, thus requiring frequent shutdown for cleaning. In addition it tends to burn solids derived from the product, such as sugars, dextrins, etc., thereby contaminating the oil. Such contamination detrimentally affects the product, as by imparting a burned flavor and causing a darkening in color. In general, therefore, substitution of clarified oil serves to reduce the amount of soilds present in oil used to continue the cycle, it provides a means to impart heat to the oil without the disadvantages of conventional heating means, and because of both of the foregoing, it minimizes flavor changes and discolorations which might occur if burned solids were permitted to accumulate in the oil. In addition the substituted oil may differ from the initial oil and may for example have a higher melting point or may impart a desired flavoring. If desired, more than one modification of the oil can be made before the dehydration cycle is completed.

At the end of the dehydrating cycle, pump 63 is again placed in operation, and with valves 72 and 73 open, the valves 75, 77 and 74 closed, oil is withdrawn through pipe 54 and from the lower door 49 below the screen 56. The used oil is sent to the storage and reclaiming system 71, where it is treated to centrifuging and filtration and then stored for use in a succeeding cycle. In the event the oil has not become seriously contaminated by use in one cycle, it may in the treatment of some products be stored and then returned through the heaters 61 and 62 for the next cycle, or it may be blended with varying amounts of fresh or reclaimed oil, and reused. By pumping out oil from the door 49 below the screen 56, substantially all of the free oil can be removed from below the floating product and drained from the product after the latter deposits on screen 56. Only a minor

amount of oil remains upon the surfaces of the particles, and within some of the pores. When the product is separated from the body of oil under a partial vacuum, it cools because of continued evaporation of moisture. At this time a somewhat higher vacuum can be applied for a short interval to remove further moisture and to accentuate such evaporative cooling. Thereafter the partial vacuum within the tank 31 may be broken by connecting conduit 33 to the atmosphere, and door 49 opened to discharge the dehydrated material into the vessel 57. The dehydrated material can then be subjected to centrifuging for the removal of some of its retained oil in the manner described in said copending application.

The apparatus described above can be altered as shown in FIGURE 4, to carry out the method outlined in FIGURE 2. Thus, in this instance the lower end of the tank 31 is provided with a valve 78, as for example, one of the butterfly type. Below this valve there is a hinge housing 79 which contains a centrifuge basket 81, adapted to be driven through suitable means such as the exterior pulley wheel 82. Below the basket 81 the housing connects with the flexible tubing 83, which in turn connects to the pipe 53*a* leading to the pump 63. The housing 79 may have a separate connection with evacuating means.

With the equipment of FIGURE 4, the butterfly valve 78 remains closed during the dehydrating cycle, whereby the material being dehydrated is retained within the tank 31. At the end of the cycle the butterfly valve is opened, without releasing the partial vacuum, whereby oil and the dehydrated material may enter the centrifuge basket 81. Pump 63 is now placed in operation to withdraw oil through the pipe 83 and the perforations of the centrifuge basket, until all of the oil has thus been removed. While application of partial vacuum is maintained the centrifuge is placed in operation to remove some remaining oil, and this is again removed through the pipe 83. Thereafter the vacuum is broken and housing 79 swung downwardly to permit removal of the dehydrated and centrifuged material.

FIGURE 6 shows an embodiment in which a different means is provided in place of the screen 34, to retain the material being dehydrated below the surface of the oil for the latter phase of the dehydrated cycle. Thus, in this instance in place of the screen 34, which can be raised or lowered, the tank 91 intermediate its ends is equipped with a screen 92 that is pivoted for rotation about a horizontal axis. When turned to a vertical position, 90° from the position shown in solid lines, this screen does not interfere with passage of particles of material being dehydrated. When in the position shown it is pervious to oil but will retain the material being dehydrated. The centrifuge housing 93 in this instance is attached by the coupling flanges 94 to the lower end of tank 91, and serves to house the foraminous centrifuge basket 96. The rim 97 at the upper end of the basket is arranged to engage a collar 98 of resilient material, the latter being attached to the lower end of the tank. Pipe 99 is provided for the removal of oil, and pipe 101 may be provided for introducing an impregnating medium, such as a liquid or vapor. Pipe 102 normally is closed, but may be opened at the end of the cycle to break the vacuum with dehumidified air, an anhydrous inert gas like nitrogen, or other treatment gas.

With the apparatus of FIGURE 6 the housing 93 functions as a part of the tank for carrying out the dehydrating cycle. Initially screen 92 is open or in vertical position for free movement of material during the initial phase. Care is taken whereby before the screen 92 is closed, the oil level is well below its path of movement, whereby particles floating on the oil will be below the screen. In general, this may require removal of some oil from the lower portion of the tank, until the oil level is well below the screen. After the screen has been closed, the oil level is adjusted to a level above the screen, by introduction of additional clarified hot oil, whereby thereafter the material being dehydrated is retained below the screen and below the oil level.

At the end of the dehydrating cycle, making use of the apparatus shown in FIGURE 6, removal of oil through pipe **99** while the partial vacuum is maintained permits free oil to drain from the dehydrated material. After a short holding period, during which drainage is completed, centrifuge basket **96** is rotated whereby additional oil is removed from the material, with this oil being likewise returned to storage through pipe **99**. A higher vacuum can now be applied for a short interval to accentuate evaporative cooling. Centrifuging under vacuum serves to produce products having novel characteristics, as disclosed in said last mentioned application. After centrifuging has been completed, the vacuum is released, and thereafter the flanged coupling **94** disconnected for removal of the housing **93** and basket **96**. To release the vacuum I prefer to use a cool gas of low relative humidity, such as dehumidified air. With some materials it is desirable to employ an anhydrous sterile inert gas like nitrogen, whereby subsequent oxidation is inhibited. Particularly where the product is packaged in a gas like nitrogen, this procedure can be employed immediately before the packaging operation. Sterilizing or mold inhibiting gases can be effectively applied to the product by using the same procedure, that is by breaking the vacuum with an anhydrous gas like ethylene oxide. Application of a treatment gas to break the vacuum is particularly effective because the porous product at that time has a minimum amount of absorbed and occluded gas, and in the process of breaking the vacuum the introduced gas is caused effectively to penetrate into the pores or cells of the product.

As previously stated, the apparatus can be employed for the dehydration of a variety of food materials, including fruits and berries, vegetables, condiments, meats, fowl and seafood. A wide variety of fruits can be treated by my method, including fresh apples, peaches, apricots, pineapple, cherries, bananas, grapes, dates, strawberries, blueberries and the like. Vegetables which are applicable include peas, carrots, potatoes, celery, cabbage, bean sprouts, onion, peppers, sweet potatoes, corn, cereals and the like. The cereals may include wheat, rice, barley, and malt, fresh or with pretreatment such as milling to remove such fractions as cortex, bran and germs, and preliminary drying and rehydration. Meats that are applicable include beef, pork, lamb, processed meats such as ham, corned beef, cured pork and the like. As to fowl, reference can be made to chicken, turkey, pheasant, duck and the like. As to seafood, reference can be made to shrimp, both fresh and cooked, tuna and other fish such as commonly marketed, oysters, clams, lobster, crab and the like. As condiments, reference can be made to mushrooms, water chestnuts, and various spices and herbs.

As disclosed in my aforesaid copending application, a wide variety of oils and fats can be used. For example, I can employ various oils and fats of vegetable or animal origin. As examples of vegetable oil reference can be made to corn, cotton seed, rice bran, soy, olive, peanut, coconut, sesame, tomato seed and the like. As examples of animal oil, reference can be made to fish oil, lard, butter oil, tallow, and the like. Generally, it is desirable to use oils or fats which have been refined to the point where they do not impart any undesirable odor or flavor to the product. The so-called hydrogenated oils have been used with good results, such as hydrogenated shortening fats.

In addition to the oils and fats referred to above. I can employ edible waxes that are stable liquids at temperatures of the order employed in my method. For example, natural or refined beeswax has been used with good results. Such a wax can be blended in various amounts with a suitable oil or fat, thereby modifying

certain physical characteristics of the oil. Particularly introduction of the wax raises the melting point of the oil and increases its viscosity. Also it provides a medium which is more stable and therefore better adapted for reuse, and which tends to be absorbed to a lesser extent by the product. Greater stability of the blended oil tends to increase shelf life and to better protect the product against atmospheric moisture. Another example is Jojoba wax which can be blended with oil (e.g. hydrogenated shortening), and which likewise modifies the oil by increasing the melting point, lowering the smoking point, and making the oil more stable and better adapted for repeated reuse.

For an explanation of the appended claims the term oil as used therein is intended to include oils, fats and waxes (all of which are esters of fatty acids) and blends thereof, with or without hydrogenation, decolorizing, deodorizing or other refining. Also it includes materials having characteristics like oils or fats, which are edible, and which are stable under the temperatures and partial vacuums involved.

Preferably the oil has a melting point above atmospheric, as for example from 102 to 160° F. Flavor containing oils, such as butter oil or natural animal fats (e.g. chicken fat) may in some instances be used to impart a desired flavoring. Special flavoring ingredients can be inserted in the oil, with retention of some such flavoring in material undergoing treatment. At temperature levels ranging up to 400° F., and with an applied partial vacuum, the more prominent vegetable and animal oils are not subject to serious breakdown or changes in their molecular structure. Certain oils are sufficiently stable for commercial use at temperatures ranging up to about 600° F., in vacuum.

I claim:

1. In apparatus for the dehydration of discrete masses of moist material, tank means adapted to contain a quantity of hot oil, charging means connected to the tank means and operable to introduce said material into the tank means, evacuating means for placing the interior of the tank under partial vacuum and serving to evacuate vapors and gases from the tank means, said charging means having a space normally closed with respect to the atmosphere and adapted to contain a quantity of material to be introduced into the tank means for dehydration and also adapted to be in communication with the interior of the tank means whereby said evacuating means serves to place both the interior of the tank means and the space of said charging means under partial vacuum, said charging means being operable under such conditions of partial vacuum to feed material from said space into the interior of the tank means, and means for removing discrete masses of dehydrated material from the tank means.

2. Apparatus as in claim 1 together with screen means within the tank means movable between one position in the tank means in which it does not interfere with movement of the discrete masses within the tank means, and a second position in the tank means in which it extends across the tank means to keep the uppermost level of the masses submerged in the hot oil.

3. Apparatus as in claim 2 in which said screen means is rotatable within the tank means to move the same between said two operating positions.

4. Apparatus as in claim 2 in which said screen means is movable vertically within the tank means between said two positions.

5. In apparatus of the character described for the dehydration of discrete masses of moist material in hot oil, a tank adapted to contain a body of hot oil, charging means for introducing discrete masses of moist material to be dehydrated into the tank at a level above the level of oil therein, said charging means including a closed hopper under partial vacuum and serving to evacuate be in communication with said tank, feed means operable

to deliver material from the hopper into the tank, evacuating means for placing the interior of the tank and said hopper under partial vacuum and serving to evacutae vapors and gases from the tank, and means for removing dehydrated material from the tank.

6. In apparatus of the character described for dehydration of discrete masses of moist material in hot oil, a tank adapted to contain a body of hot oil, evacuating means for placing the interior of the tank under partial vacuum serving to evacuate vapors and gases therefrom, means for delivering a charge of said material to be dehydrated into an upper portion of the tank above the level of oil therein, discharge means at a lower portion of the tank serving normally to close the same, piping connected to said discharge means for removing oil from both the discharge means and the tank, and means within the discharge means above the lower end thereof serving to support dehydrated material deposited thereon when oil is removed from the tank and the discharge means.

7. Apparatus of the character described for dehydration of discrete masses of moist material in hot oil, a tank adapted to contain a body of hot oil, evacuating means for placing the interior of the tank under partial vacuum and serving to evacuate vapors and gases from the tank, charging means for delivering a charge of said material to be dehydrated into an upper portion of the tank, discharge means at a lower portion of the tank serving normally to close the same, said discharge means comprising a structure forming a vessel, screen means associated with the vessel to support dehydrated material deposited thereon, and piping connected to the discharge means for removing oil from the tank, whereby free oil is separated from the discrete dehydrated masses.

8. Apparatus as in claim 7 in which said discharge means consists of an enclosing structure removably coupled to the lower end of the tank, together with a foraminous centrifuge basket disposed within said structure, said centrifuge basket being disposed to receive dehydrated material from the tank.

9. Apparatus as in claim 8 in which the piping connected to the discharge means is connected to said structure at a point below said centrifuge basket.

10. In apparatus of the character described for the dehydration of discrete masses of moist material in hot oil, tank means adapted to contain a body of hot oil, evacuating means serving to apply partial vacuum to the tank means and to evacuate vapors and gases therefrom, means in communication with the tank means for introducing a quantity of said moist material to be dehydrated into the tank means, a housing at the lower end of the tank means and normally communicating therewith, a foraminous centrifuge basket disposed in said housing and adapted to receive dehydrated material from the tank means, and means for removing oil from the tank means and the housing.

11. Apparatus as in claim 10 in which the housing is separable from the tank means to facilitate removal of the dehydrated material.

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