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SEPARATION OF NUTMEAT FRAGMENTS FROM SHELL FRAGMENTS

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The present invention relates to the shelling of nuts and, more particularly, to the separation of nutmeat fragments from shell fragments.

In a conventional commercial method of providing shelled nutmeats, whole nuts are initially passed through a suitable breaking machine which cracks the shell and provides access to the nutmeats. In the breaking process the shell is reduced to fragments but much of the nutmeat is also broken. The resulting product therefore consists of a mixture of shell fragments, nutmeat fragments and unbroken pieces of nutmeat which, in the case of pecans, walnuts, etc., are actually nutmeat halves and wholes. The unbroken nutmeat halves and wholes are then separated from the shell and nutmeat fragments by an air classification process which utilizes an air stream to carry away the lighter shell and nutmeat fragments, leaving the larger nutmeat halves and wholes behind. The nutmeat fragments are then separated from the shell fragments and the latter are discarded.

At the present time, the separation of shell and nutmeat fragments is accomplished by one of two methods. In accordance with one of these methods, the nutmeat and shell fragments are placed on a moving conveyor and caused to pass under a cylindrical roll provided with a plurality of outwardly projecting needles. The needles impale the nutmeat fragments but not the shells, thus removing the nutmeat fragments from the mixture while allowing the shell fragments to proceed past the roll and to be discarded. The nutmeat fragments are removed from the roll as it rotates. As can be appreciated, many of the nutmeat fragments are not susceptible to being impaled in this manner and thus are lost with the shell fragments. In addition, this method and apparatus cause an exceptionally large amount of breakage and meal of the fragments. It is estimated that as much as 10% of the nutmeats, by weight, are thus lost. Also, it is difficult to preserve sanitary conditions while performing this method.

In accordance with the other of these methods, a batch of nutmeat and shell fragments is placed in a large vessel partially filled with water. The vessel is sealed and a vacuum is drawn, removing entrapped air from the shell fragments so as to permit them to sink. The nutmeat fragments are buoyant, however, and their buoyancy is retained in the presence of a vacuum. Theoretically, therefore, the shell fragments settle to the bottom of the vessel and the nutmeat fragments float. However, as a practical matter, the initial drawing of the vacuum does not remove all of the air from all of the shell fragments and, consequently, not all of these fragments settle to the bottom of the vessel. Hence, in practice, the vacuum is normally broken, the suspension manually stirred, and the vacuum redrawn at least three times for increased efficiency. Hence, a single batch of shell and nutmeat fragments having a variable weight relative to the size of the vessel requires at least twenty minutes and the attention

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of one or possibly two men. In addition, the length of time that the nutmeats must remain in the vessel exposed to water causes them to become water soaked to the extent that many fragments lose their buoyancy and are lost. Further, some nutmeat fragments become trapped with the shell, while shell fragments become trapped with the nutmeats. Like the method employing the impaling needles, however, the efficiency of the batch method rarely exceeds 90% and, also, is relatively difficult to perform in a sanitary manner. Even when performed in its most efficient manner, however, the method is not economically desirable because of the manual labor involved in stirring the batch, drawing the vacuum, hand screening the nutmeats out of the water, and removing the shell from the vessel.

The principal object of the present invention is to provide a novel and improved method and apparatus for continuously separating nutmeat fragments from shell fragments.

It is a more specific object of the present invention to provide a method and apparatus for continuously separating nutmeat fragments from shell fragments under a vacuum pressure.

A further object of the present invention is to provide such a method and apparatus having a high rate of efficiency requiring essentially no manpower or supervision.

Other objects and advantages of the present invention will become more apparent from the following description and the associated drawing.

In the drawing:

FIGURE 1 is a side elevational view of an apparatus showing various of the features of the invention;

FIGURE 2 is a fragmentary sectional end view taken along line 2—2 of FIGURE 1; and

FIGURES 3 and 4 are perspective views of portions of the apparatus shown in FIGURE 1.

Very briefly, a separating apparatus 10 showing various of the features of the invention is illustrated in the drawing and comprises an elongated horizontally disposed tank 12 adapted to contain a quantity of water introduced in the form of jet streams by means of nozzles 14 positioned adjacent the upper portion of the tank and inclined relative to the vertical so as to tend to urge materials floating on the surface of the water toward one end of the tank. The tank is adapted to maintain an internal vacuum pressure as created by a vacuum pump 16. Supported adjacent the bottom of the tank is a conveyor 18 which tends to transport submerged materials adjacent the bottom of the tank in the direction of the opposite end of the tank.

A mixture of nutmeat and shell is introduced into the tank through a charging valve 20. Because of the vacuum conditions prevailing in the tank, the shell fragments soon sink to the bottom and are transported in one direction by the conveyor 18 to a shell discharge valve 22. The nutmeat fragments, on the other hand, remain afloat and are driven in the opposite direction along the surface of the water to a nutmeat discharge valve 24 by the jet stream emitted from the nozzles 14. The valves 20, 22 and 24 are each adapted to permit the materials to pass through while maintaining a desired vacuum within the tank. Thus, the nutmeat and shell fragments introduced into the tank as a mixture are discharged in a completely separated condition through different exits.

Now considering the illustrated apparatus 10 in greater

detail, the tank 12 is in the form of an elongated trough and is preferably fabricated of stainless steel or other corrosion resistant material. The tank is preferably of an all-welded construction so as to enable it to maintain an internal vacuum and to contain a large quantity of water and includes a semi-cylindrical bottom wall 26, generally parallel upright side walls 28, a flat generally horizontally disposed top wall 30, and a pair of end walls 32 and 34 located at what will be referred to as the forward and rearward ends of the tank respectively. The tank is supported on a frame 36 which includes four upright corner posts or legs 38 and horizontal members 40 which extend between the posts and serve to support certain of the operating components of the apparatus such as the vacuum pump 16.

Water is supplied to the tank 12 through hot and cold water conduits 42 and 44 respectively which are connected through a temperature regulator 46 to one end of a manifold pipe 48. The flow of water through the manifold pipe is regulated by means of a valve 50 which, in turn, is controlled by a water level sensing device 52. The device 52, in conjunction with the valve 50, maintains the water in the tank at a given level.

The manifold pipe 48 passes through the rearward end wall 34 near the upper end thereof and extends along the length of the tank in relatively closely spaced relation to the top wall 30. Branch tubes 54 project laterally in opposite directions from the manifold pipe 48 at spaced points along its length (FIG. 2) and each tube has one of the nozzles 14 mounted on its outer end in downwardly and forwardly inclined disposition, e.g., at an angle of approximately 15° to the vertical. Water passing through the manifold pipe 48 is thus introduced into the tank above the water level in the form of downwardly and forwardly directed jets. The downward inclination of the nozzles causes the jets of water to impinge upon shell fragments supported on the surface of the water by surface tension and causes these fragments to sink, thus serving the same function as the manual stirring employed in the batch system. The forward inclination of the jets is effective to create a forwardly moving current on the upper surface of the water which carries the floating nutmeats toward the forward end of the tank. The nutmeats conveyed in this manner through the system are in the tank from thirty to forty seconds as compared to an exposure to water of over twenty minutes in the batch system.

The vacuum pump 16 is driven by a motor 56, both the pump and motor being mounted on the cross members 40 of the frame. The pump is connected to an outlet provided in the top upper wall 30 of the tank through a suitable trap 58 which prevents very small nutmeat or shell fragments from passing into the pump. The illustrated trap 58 includes a removable perforated basket 60 which is adapted to retain such fragments while permitting air to pass freely through the perforations of the basket to the vacuum pump. Preferably, the pump maintains a vacuum pressure of from twenty to twenty-five inches of mercury within the tank.

Thus, the tank 12 is kept partially filled with water at a pre-selected level while a vacuum is maintained in the upper portion of the tank above the water level.

The conveyor 18 is positioned adjacent the bottom of the tank 12 and is adapted to transport toward the rearward end of the tank those shell fragments which have settled to the bottom. As illustrated, the conveyor 18 is in the form of an elongated screw having an overall outer diameter which enables it to conform intimately to the inner surface of the semi-cylindrical bottom wall 26 of the tank. The screw conveyor is driven by a motor (not shown) which rotates it in such a direction as will cause the shell fragments to be moved rearwardly, i.e., toward the right as viewed in FIGURE 1. Thus, the nutmeats are transported forwardly along the surface of the water in the tank by the force imparted by the jets emitted by

the nozzles 14. The shell fragments, on the other hand, are moved rearwardly beneath the surface of the water by the screw conveyor 18. Due to the continuous rotation of the conveyor and the movement imparted to the shell fragments by it, the shell level at the bottom of the tank is minimized. Also, the agitation which the conveyor imparts to the shell minimizes the possibility of nutmeats becoming trapped with the shell.

A mixture of nutmeat and shell fragments is continuously introduced into the tank 12 through an opening provided in the top wall 30 generally midway between the forward and rearward end walls 32 and 34 by means of a feeding mechanism 64. The feeding mechanism includes a hopper 66 which receives the mixture of the shell and nutmeat fragments and a vibratory conveyor 68 which delivers a continuous flow of the mixture to the inlet of the charging valve 20.

The illustrated charging valve 20 is adapted to continuously feed a mixture of nutmeat and shell fragments into the tank 12 while permitting a desired vacuum to be maintained within the tank and includes a housing or valve body 70 having a center section 72, an upper inlet section 74, and a lower outlet section 76. The illustrated center section 72 is in the form of a generally circular cylinder arranged with its central axis horizontally disposed and open at the top and bottom for connection to the upper and lower sections 74 and 76. The upper section 74 defines a flared mouth which receives the mixture of nutmeats and shell fragments from the vibratory conveyor 68. The lower section includes diverging side walls which guide the fragments from the center section to the interior of the tank 12.

Mounted within the center section 72 for rotation about the horizontally disposed axis thereof is a motor-driven valve element 78 comprising a central shaft 80 to which are keyed eight radially extending symmetrically arranged flat vanes 82 (FIGURE 3). Each vane is preferably formed of stainless steel and has a spring loaded steel tip 84 mounted adjacent its outer end and urged in a direction away from the shaft 80 so as to intimately engage the cylindrical side wall of the center section 72 and is of a width approximating that of the center section so as to preserve the vacuum within the tank. Defined between each adjacent pair of vanes 82 is a pie-shaped space or receptacle 86 which constitutes a segment of a circular cylinder. The vanes 82 are so arranged within the center section and relative to the openings in the upper and lower portions thereof as to insure that two vanes are always in engagement with each of the two cylindrical surfaces extending between the openings. Thus, air entering the upper section 74 of the valve must bypass the steel tips of two of the vanes before entering the tank 12 and at no time is there an unobstructed path between the inlet and outlet of the valve.

To further insure the maintenance of a vacuum incident to the operation of the charging valve 20, water is introduced into the spaces 86 after the spaces have been relieved of their load through deposit into the tank 12 and before they receive a new load. The water is conducted to the spaces by means of a pipe 87 which extends from the water manifold pipe 48 to the center section 72 of the valve body 70 and is effective to provide a water seal which minimizes the amount of air which might bypass the vanes. In addition, it rinses the vanes to loosen any fragments which might have adhered thereto and pre-wets the nutmeat prior to its introduction into the tank 12.

In the operation of the feeding mechanism 64, the vibratory conveyor 68 receives a mixture of nutmeat and shell fragments from the hopper 66 and operates to provide a continuous flow of these fragments into the upper section 74 of the valve body 70 and thence into the center section 72 in which the valve element 78 is rotating. Upon entering the center section 72, the fragments occupy one of the spaces 86 between a pair of the vanes 82 and, as the valve element rotates, are carried to the lower end

of the section 72 and are deposited into the lower section of the valve body which is in direct communication with the tank 12.

As noted above, the charging valve 20 provides this continuous flow or supply of the mixture of nuts and shells while permitting a desired vacuum to be maintained within the tank. More particularly, the side edges of the vanes are disposed closely adjacent the end walls of the center section 72 and the outer edges of the vanes, as fitted with spring biased steel tips 84, slidably engage the inner surface of the cylindrical wall of the section 72. Furthermore, the valve element and openings at the top and bottom of the section 72 are so constructed that any receiving space 86 which is in communication with the evacuated tank through the outlet section 76 cannot at the same time be in communication with the inlet section 74 but is blocked therefrom by the vanes 82.

As the fragments of nutmeat and shell fall into the water in the tank 12, the nutmeat fragments, which are naturally buoyant, float. Certain of the shell fragments may also float initially because of their porous nature and the fact that they contain entrapped air. Much of the mass of nutmeat and shell fragments thus is floating initially and is urged along the surface of the water in the tank in the direction of the forward end wall 32. After a very short period of time, however, the operation of the vacuum pump 16 in maintaining a vacuum within the tank withdraws entrapped air from the shell fragments and they either sink immediately or, if buoyed up by surface tension, are soon driven beneath the surface and are caused to sink upon engagement by the water jets emitted by the nozzles 14. When the floating mass reaches the forward end wall 32, therefore, essentially all of the shell fragments have gravitated toward the bottom of the tank and only nutmeat fragments remain afloat.

The screw conveyor 18 receives the shell fragments which have gravitated to the bottom of the tank 12 and carries them in the direction of the rearward end wall 34 to a shell discharge mechanism 88 which is disposed adjacent an outlet opening 90 and which includes a discharge chamber 92, the discharge valve 22 and a conveyor 94. The discharge chamber 92 is in the form of a vertically disposed pipe which extends downwardly from the bottom wall of the tank 12 in encircling relation to the discharge opening or outlet 90. Disposed within the chamber 92 are a pair of vertically staggered diverter plates or baffles 96, the uppermost of which is secured adjacent the forward portion of the pipe and extends downwardly and rearwardly, and the lowermost of which is secured adjacent the rearward portion of the pipe and extends downwardly and forwardly. These baffles serve to minimize such turbulence within the discharge pipe as would tend to aerate the water. Such turbulence is further minimized by the provision of a tube 97 which provides communication between the chamber and the evacuated interior portion of the tank, thus removing air which might have entered the chamber. A small amount of air is permitted to escape past the diverter plates to further agitate the mass of shell fragments before it is discharged, thereby further minimizing the possibility of any nutmeat becoming entrapped.

The discharge valve 22 is essentially identical in construction to the charging valve 20 and is adapted to permit the shell fragments to be withdrawn from the tank 12 while maintaining a desired vacuum within the tank. Thus, the valve 22 includes a housing or valve body 98 having a generally cylindrical center section 99, an upper flared section 100, and a lower outlet section 102. The inlet section 100 and the outlet section 102 are arranged above and below the center section 99 adjacent openings in the upper and lower portions thereof respectively. A valve element 104 having a shaft 106 and radially extending vanes 108 is positioned within the center section 99 for motor driven rotation about a horizon-

tal axis. The vanes 108 are essentially identical to the vanes 82 of the valve 20 as shown in FIGURE 3 dimensioned so that their side edges are positioned immediately adjacent the end walls of the center section 99, and their outer ends are provided with spring biased steel tips 109.

The lower outlet section 102 of the valve 22 is connected through an intermediate chute 110 to the lower end of the conveyor 94. The conveyor 94 includes an upwardly and rearwardly inclined conduit 112 having disposed therein a screw conveyor 114. The conduit 112 extends upwardly to a point above the valve body 22 and, preferably, above the bottom of the tank 12. The screw conveyor is continuously rotated by a suitable motor (not shown) to move the shell fragments upwardly into a shell discharge chute 116 from which they are exhausted into a suitable waste receptacle (not shown).

Since the shell discharge valve is located below the level of the water in the tank, rotation of the valve element 104 initially removes some water from the tank 12 in addition to shell fragments. This water fills the chute 110 and partially fills the conduit 112 until an equilibrium is established, after which the water level remains essentially constant and the shell fragments are moved continuously out of the tank and discharged by the conveyor 94.

As previously mentioned, the nutmeat fragments which enter the tank 12 through the charging valve 20 are buoyant and are carried along the surface of the water in the tank by virtue of the current created by the water jets emitted from the nozzles 14. These nutmeat fragments eventually reach the forward end wall 32 of the tank and enter the nutmeat discharge valve 24 which, in certain respects, is similar to the charging and shell discharge valves 20 and 22, respectively.

More specifically, the nutmeat discharge valve 24 comprises a valve body 118 which includes a generally cylindrical center section 120, an inlet section 122 and an outlet section 124. The inlet section 122 is connected to the center section in surrounding relation to an inlet opening in the rearward portion of the side wall thereof. The outlet section is connected to the center section in surrounding relation to an opening provided in the forward portion of the side wall thereof. Thus, the sections 120, 122 and 124 of the valve body 118 of the nutmeat discharge valve 24 are horizontally aligned and, in this respect, the valve body 118 differs from the valve bodies of the valves 20 and 22 in which the respective sections are vertically aligned.

Disposed within the center section 120 of the valve body 118 is a valve element 126 which includes a central shaft 128 and twelve radially extending equally spaced vanes 130. The vanes 130 (FIGURE 4) are proportioned so as to provide minimum clearance between their side edges and the end walls of the center section 120 and includes spring biased steel tips 132 similar to those provided on the vanes 82 and 108 of the valves 20 and 22.

In the operation of the nutmeat discharge valve 24, the valve element 126, the major portion of which is submerged and which is in communication with the interior of the tank 12 through the inlet section 122, is rotated by a suitable motor (not shown). The vanes 130 of the valve element move upwardly through the water at the forward end of the tank and engage floating as well as partially submerged fragments carried to the forward end of the tank by the current previously referred to. As the vanes continue to move upwardly toward a vertical position but are still submerged, the engaged fragments move along the vane toward the shaft 128 and, as the vanes pass through the vertical position, are deposited on the adjacent surface (previously the lower surface) of the immediately preceding vane. The nutmeat fragments are swept from the surface with the flow of water

carried from the tank and travel down a chute 134 to a suitable receiving conveyor or receptacle (not shown).

In order to enable the vanes 130 to more readily engage and retain the floating nutmeat fragments and remove them from the tank 12, each vane has a scoop 136 in the form of a perforated steel strip secured adjacent its outer edge. Accordingly, as the valve element rotates, the scoops of each vane engage floating and partially submerged fragments and retain them on the vane until the vane has been rotated to a generally vertical position.

While the separation of the nutmeat and shell fragments within the tank 12 is relatively complete so that essentially all of the shell fragments have gravitated to the bottom of the tank before they reach the forward end, the speed at which the nutmeat fragments are conveyed through the tank permits some slow sinking shell fragments to enter the nutmeat discharge valve 24. To effect a final separation of these shell fragments from the nutmeat fragments, that surface of each of the vanes 130 which is uppermost when the vane is moving downwardly, i.e., when the vane is adjacent the outlet section of the valve, is provided with a transversely extending rib 137 which defines a wall 138 disposed generally normal to the plane of the vane intermediate the forward and rearward portions.

The wall 138 serves to further separate the shell fragments from the nutmeat fragments by retaining the shell fragments on the vane while the nutmeat fragments are washed away with the water. More specifically, as the vane is rotated toward the vertical position, the fragments and water carried by it shift toward the shaft 128 supporting the vane. As the vane passes its vertical position, the fragments and water are dumped from the inner portion of the surface of one vane to the inner portion of the adjacent surface of the preceding vane, as previously set forth. Since this inner portion of the vane on which the fragments and water are ultimately deposited is behind the rib 137, the wall 138 serves as a shallow barrier to the fragments and water. As the vane is further rotated, the water flows from the vane and carries with it the floating nutmeat fragments. The shell fragments, however, which do not float, are retained on the vane by the wall 138 and continue to be retained by the wall even when the vane again reaches a vertical downwardly directed disposition within the lower portion of the center section. Tubes 140 provide communication between each side of this lower portion of the center section of the valve and the evacuated portion of the tank and serve to remove such retained shell fragments from the vanes and return them to the tank.

In the use of the above-described method and apparatus, the nutmeat fragments and shell fragments are introduced into the hopper 66 and pass through the valve 20 into the tank 12. The nutmeat fragments are carried along the surface of the water in the tank and are discharged through the valve 24. Preferably, the nutmeat fragments remain in the water only thirty to forty seconds and are thus discharged long before they become so waterlogged as to be lost. Also, the rapid movement of the nutmeats and the minimum volume in the tank at any one time eliminates the possibility of their becoming trapped in the shells. When the nutmeat fragments reach the valve 24, they are scooped from the water in such a manner that fragments floating on the surface as well as those immediately below the surface are engaged and withdrawn.

The shell fragments are rapidly withdrawn from the tank through the valve 22, thus preventing them from remaining in the water long enough to effect its discoloration so as to subject the nutmeat fragments to discoloration as well. The inflow of water through the nozzles 14 and the outflow of water through the valves 22 and 24 causes the water in the tank to be changed as much as seven times an hour, thus further preventing such discoloration. The rapid movement of the shell fragments

minimizes the possibility of nutmeat fragments becoming entrapped therewith.

The valves 20, 22 and 24 permit the introduction and discharge of materials from the tank while a vacuum pressure of from fifteen to twenty-five inches of mercury is maintained in the tank. The presence of the spray nozzles, the constant movement of fluid and materials through the tank, plus its preferably stainless steel construction, enable it to flush itself, thereby eliminating manual labor for cleaning.

The method for separating nuts described above provides continuous operation at high efficiency, high speed, with a minimum of labor, and under the most sanitary conditions. The illustrated separating apparatus 10, which provides a particularly effective structure for performing the method, incorporates various desirable and useful features which contribute to its simplicity, efficiency and dependability.

Various modifications and changes may be made in the described method and/or illustrated structure without departing from the spirit and scope of the present invention.

Various features of the invention are set forth in the following claims.

What is claimed is:

1. An apparatus for continuously separating naturally buoyant fragments of nutmeat from a mixture of such nutmeat fragments and fragments of nut shell which are not buoyant in a vacuum environment, said apparatus comprising a sealed tank adapted to contain a body of water, means for maintaining a vacuum in said tank above the surface of the body of water, means for continuously introducing a flow of the mixture of nutmeat and shell fragments into said tank and body of water while maintaining the vacuum, means for continuously moving floating fragments of nutmeat in a given direction on the surface of the body of water, means for continuously moving submerged pieces of nut shell in a determined direction adjacent the bottom of the body of water, and means for removing the nutmeat fragments from the tank separate from the shell fragments while maintaining the vacuum within the tank.

2. An apparatus for continuously separating naturally buoyant fragments of nutmeat from a mixture of such fragments and fragments of nut shell which are not buoyant in a vacuum environment, said apparatus comprising a sealed tank adapted to contain a body of water, means for maintaining a vacuum in said tank above the surface of the body of water, means for continuously introducing a flow of the mixture of nutmeat and shell fragments into said tank and body of water while maintaining the vacuum, means for continuously moving floating fragments of nutmeat from said tank while maintaining the vacuum, means for continuously discharging submerged pieces of nut shell from said tank while maintaining the vacuum, means for continuously moving floating fragments of nutmeat along the surface of the body of water toward said nutmeat discharging means, and means for continuously moving fragments of submerged nut shell toward said nut shell discharging means.

3. An apparatus for continuously separating naturally buoyant fragments of nutmeat from a mixture of such fragments and fragments of nut shell which are not buoyant in a vacuum environment, said apparatus comprising a sealed tank adapted to contain a body of water, means for maintaining a vacuum in said tank above the surface of the body of water, means for introducing a continuous flow of the mixture of nutmeat and shell fragments into said tank while maintaining the vacuum, means adjacent one end of the body of water for continuously discharging floating fragments of nutmeat from said body while maintaining the vacuum, means adjacent the opposite end of the body of water for continuously discharging submerged pieces of nut shell from said body while maintaining the vacuum, means for continuously moving

floating fragments of nutmeat in one direction toward said nutmeat discharging means, and means in said tank for continuously moving submerged pieces of nut shell in the opposite direction toward said nut shell discharging means.

4. An apparatus for separating naturally buoyant fragments of nutmeat from a mixture of such nutmeat fragments and fragments of nut shell which are not buoyant in a vacuum environment, said apparatus comprising means defining an elongated, horizontally extending sealed tank adapted to contain a body of water, means for creating a vacuum in said tank above the surface of the body of water, means for moving floating fragments of nutmeat in one direction along the surface of the body of water, means for discharging nutmeat fragments from said tank while maintaining the vacuum in said tank, and means for moving submerged pieces of nut shell in the opposite direction adjacent the bottom of the body of water.

5. An apparatus in accordance with claim 1 wherein the floating fragments of nutmeat are moved in a given direction along the surface of the body of water by jets of water emitted from nozzles positioned above the surface of the body of water and inclined downwardly and in said given direction.

6. An apparatus in accordance with claim 1 in which means are provided for controlling the level of the water in the tank.

7. An apparatus for continuously separating naturally buoyant fragments of nutmeat from a mixture of such fragments and fragments of nut shell which are not buoyant in a vacuum environment, said apparatus comprising an elongated horizontally extending sealed tank adapted to contain a body of water, the lower portion of said tank being defined by a generally semi-cylindrical upwardly open bottom wall, means for creating a vacuum in said tank above the surface of the body of water, a first valve for continuously introducing a flow of the mixture of nutmeat and shell fragments into said tank while maintaining a vacuum, means for continuously moving floating nutmeat fragments along the surface of the body of water in a given direction, means for continuously moving pieces of submerged nut shell along the bottom of said body of water, said last-mentioned means including an elongated rotatable screw conveyor disposed generally horizontally along the bottom of said tank so proportioned as to intimately engage the inner surface of the semi-cylindrical bottom wall of said tank when said screw conveyor rotates, said screw conveyor along substantially its entire length being open upward to said body of water, a second valve for continuously discharging nut shell fragments from said tank while maintaining the vacuum and a third valve for continuously discharging nutmeat fragments from said tank while maintaining a vacuum.

8. An apparatus for continuously separating naturally buoyant fragments of nutmeat from a mixture of nut material including such nutmeat fragments and fragments of nut shell which are not buoyant in a vacuum environment, said apparatus comprising an elongated horizontally extending sealed tank having a forward and rearward end and adapted to contain a body of water, means for maintaining a vacuum in said tank above the surface of the body of water, a first valve for continuously introducing a flow of the mixture of nutmeat and shell fragments into said tank and body of water while maintaining the vacuum, means for continuously moving floating nutmeat fragments forwardly along the surface of the body of water toward one end of the tank, said last-mentioned means including a plurality of nozzles disposed along said tank above the surface of the body of water and adapted to direct jets of water in a downwardly and forwardly inclined direction over substantially the entire surface of the body of water to cause the floating fragments to move forwardly and to cause the floating fragments to be at least partially submerged to break surface tension and to facilitate settling of pieces of nutshell to the bottom of

said tank, means for continuously moving fragments of nut shell that have settled to the bottom of said tank rearwardly, said last-mentioned means including an elongated screw conveyor rotatably supported in said tank and extending along the bottom thereof, means for maintaining the level of water within said tank within a given range, a second valve supported adjacent the forward end of said tank for continuously discharging nutmeat fragments floating in the water from said tank while maintaining the vacuum, and a third valve supported adjacent the rearward end of said tank for continuously discharging submerged nut shell fragments from said tank without appreciably disturbing the vacuum.

9. A method of continuously separating naturally buoyant fragments of nutmeat from a mixture of such nutmeat fragments and fragments of nut shell which are not buoyant in a vacuum environment, said method comprising the steps of continuously introducing a flow of the mixture into a sealed compartment partially filled with a liquid and having a vacuum above the liquid while maintaining the vacuum, continuously moving floating fragments of nutmeat toward a nutmeat discharge while continuously moving submerged fragments of shell toward a shell discharge, and continuously discharging fragments of nutmeat and fragments of shell from the compartment through the respective discharges without appreciably disturbing the vacuum within the compartment.

10. A method of continuously separating naturally buoyant fragments of nutmeat from a mixture of such nutmeat fragments and fragments of nut shell which are not buoyant in a vacuum environment, said method comprising the steps of continuously introducing a flow of the mixture into a sealed compartment partially filled with a liquid and having a vacuum above the liquid without appreciably disturbing the vacuum, continuously moving floating fragments of nutmeat toward a nutmeat discharge while continuously moving submerged fragments of shell toward a shell discharge, continuously agitating the surface of the liquid so as to at least partially submerge floating material and break surface tension to permit pieces of nut shell to settle to the bottom of said compartment, and continuously discharging fragments of nutmeat and fragments of shell from the compartment through the respective discharges while maintaining the vacuum within the compartment.

11. A method of continuously separating naturally buoyant fragments of nutmeat from a mixture of such nutmeat fragments and fragments of nut shell which are not buoyant in a vacuum environment, said method comprising the steps of continuously introducing a flow of the mixture intermediate the ends of a sealed compartment partially filled with water and having a vacuum above the water, while maintaining the vacuum, continuously moving floating fragments of nutmeat on the surface of the water in one direction toward one end of the compartment while continuously moving submerged pieces of nut shell along the bottom of the compartment in the opposite direction toward the other end thereof, and continuously, and while maintaining the vacuum in the compartment, discharging fragments of nutmeat from one end thereof and fragments of nut shell from the other end thereof.

12. A method for separating naturally buoyant fragments of nutmeat from a mixture of such fragments of nutmeat and fragments of nut shell which are not buoyant in a vacuum environment, said method comprising the steps of introducing a quantity of the mixture into a sealed compartment having liquid in its bottom and a vacuum region above the liquid, moving floating fragments of nutmeat in one direction along the surface of the liquid adjacent the vacuum region to a nutmeat discharge, discharging the nutmeat fragments from the compartment while maintaining the vacuum, and moving submerged fragments of nut shell in the opposite direction to a shell discharge while maintaining the vacuum.

13. A method for separating fragments of nutmeat

from a mixture of nut material including such fragments of nutmeat and pieces of nut shell, said method comprising the steps of introducing a quantity of the mixture into a sealed compartment having liquid in its bottom and a vacuum region above the liquid, moving floating nut material along the surface of the liquid adjacent the vacuum region in one direction toward a nutmeat discharge in a manner that agitates the surface of the liquid and submerges the material to break surface tension and allow pieces of nut shell to settle, discharging the nutmeat fragments from the compartment while maintaining the vacuum, and moving submerged pieces of nut shell in the opposite direction to a shell discharge while maintaining the vacuum.

14. An apparatus for continuously separating naturally buoyant fragments of nutmeat from a mixture of such nutmeat fragments and fragments of nut shell which are not buoyant in a vacuum environment, said apparatus comprising a sealed tank adapted to contain a body of water, means for maintaining a vacuum in said tank above the surface of the body of water, means for continuously introducing a flow of the mixture of nutmeat and shell fragments into said tank and body of water while maintaining the vacuum, said last-mentioned means including a valve body, a valve element disposed within said body for rotation about a fixed axis, said valve element having a plurality of vanes extending radially from said axis, said vanes being adapted to receive fragments at one point and deposit them at a second point incident to the rotation of said valve element, and means for introducing water into said valve body for contact with said vanes as said vanes pass from said second point to said first point, means for continuously moving floating fragments of nutmeat in a given direction on the surface of the body of water, means for continuously moving submerged pieces of nut shell in a determined direction adjacent the bottom of the body of water, and means for removing the nutmeat fragments from the tank separate from the shell fragments while maintaining the vacuum within the tank.

15. An apparatus for continuously separating naturally buoyant fragments of nutmeat from a mixture of such fragments and fragments of nut shell which are not buoyant in a vacuum environment, said apparatus comprising a sealed tank adapted to contain a body of water, means for maintaining a vacuum in said tank above the surface of the body of water, means for continuously introducing a flow of the mixture of nutmeat and shell fragments into said tank and body of water while maintaining the vacuum, means for continuously discharging floating fragments of nutmeat from said tank while maintaining the vacuum, means for continuously discharging submerged pieces of nut shell from said tank while maintaining the vacuum, said last-mentioned means including a conduit adapted to receive shell fragments from said tank and having inclined baffle plates disposed therein, means providing communication between the evacuated portion of said tank and said conduit, and a conveyor adapted to receive shell fragments from said conduit and transport them therefrom, means for continuously moving floating fragments of nutmeat along the surface of the body of water toward said nutmeat discharging means, and means for continuously moving fragments of submerged nut shell toward said nut shell discharging means.

16. An apparatus for continuously separating naturally buoyant fragments of nutmeat from a mixture of such fragments and fragments of nut shell which are not buoyant in a vacuum environment, said apparatus comprising a sealed tank adapted to contain a body of water, means for maintaining a vacuum in said tank above the surface of the body of water, means for continuously introducing a flow of the mixture of nutmeat and shell fragments into said tank and body of water while maintaining the vacuum, means for continuously discharging floating fragments of nutmeat from said tank while maintaining the

vacuum, said last-mentioned means including a valve body having an inlet and an outlet, a valve element disposed within said valve body for rotation about a fixed axis, said valve element including a plurality of vanes extending radially from said axis, said vanes being proportioned so that the side and outer edges thereof fit closely to the adjacent walls of said valve body, and a perforated scoop secured to that surface of each vane which is uppermost as the vane moves upwardly adjacent the inlet of said valve, means for continuously discharging submerged pieces of nut shell from said tank while maintaining the vacuum, means for continuously moving floating fragments of nutmeat along the surface of the body of water toward said nutmeat discharging means, and means for continuously moving fragments of submerged nut shell toward said nut shell discharging means.

17. An apparatus for continuously separating naturally buoyant fragments of nutmeat from a mixture of such fragments and fragments of nut shell which are not buoyant in a vacuum environment, said apparatus comprising a sealed tank adapted to contain a body of water, means for maintaining a vacuum in said tank above the surface of the body of water, means for continuously introducing a flow of the mixture of nutmeat and shell fragments into said tank and body of water while maintaining the vacuum, means for continuously discharging floating fragments of nutmeat from said tank while maintaining the vacuum, said last-mentioned means including a valve including a valve body having an inlet and an outlet, a valve element disposed within said valve body for rotation about a fixed axis, said valve element including a plurality of vanes extending radially from said axis, said vanes being proportioned so that the side and outer edges thereof fit closely to the adjacent walls of said valve body, means defining a wall generally transverse to the plane of each of said vanes and extending across that surface thereof which is uppermost as the vane passes adjacent the valve outlet, thereby enabling said wall to retain submerged fragments of nut shell on said vane, means for continuously discharging submerged pieces of nut shell from said tank while maintaining the vacuum, means for continuously moving floating fragments of nutmeat along the surface of the body of water toward said nutmeat discharging means, and means for continuously moving fragments of submerged nut shell toward said nut shell discharging means.

18. An apparatus for continuously separating naturally buoyant fragments of nutmeat from a mixture of such fragments and fragments of nut shell which are not buoyant in a vacuum environment, said apparatus comprising a sealed tank adapted to contain a body of water, means for maintaining a vacuum in said tank above the surface of the body of water, means for continuously introducing a flow of the mixture of nutmeat and shell fragments into said tank and body of water while maintaining the vacuum, means for continuously discharging floating fragments of nutmeat from said tank while maintaining the vacuum, said last-mentioned means including a valve including a valve body having an inlet and an outlet, a valve element disposed within said valve body for rotation about a fixed axis, said valve element including a plurality of vanes extending radially from said axis, said vanes being proportioned so that the side and outer edges thereof fit closely to the adjacent walls of said valve body, the outer portion of each of said vanes being offset relative to the inner portion so as to provide a wall generally transverse to the plane of said vane, said offset being in such a direction as to cause the outer portion of each said vane to be disposed above the inner portion thereof as the vane passes adjacent the valve outlet, thereby enabling said wall to retain submerged fragments of nut shell on said vane, and means providing communication between the evacuated portion of said tank and that portion of said valve body which said vanes enter immediately after passing said

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outlet so as to remove retained shell fragments from said vanes, means for continuously discharging submerged pieces of nut shell from said tank while maintaining the vacuum, means for continuously moving floating fragments of nutmeat along the surface of the body of water toward said nutmeat discharging means, and means for continuously moving fragments of submerged nut shell toward said nut shell discharging means.

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