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(54) **Title**: CONTROLLED COOLING OF FOOD EXITING A FRYER

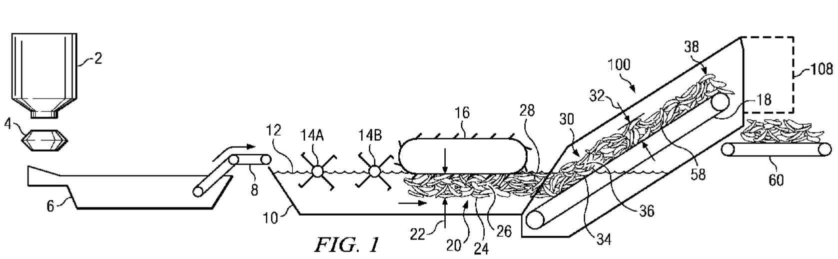

FIG. 1

(57) **Abstract**: A method, system and apparatus for controlling the variability in acrylamide formation, reducing acrylamide formation, and reducing oil uptake in fried food pieces. The invention uses an extended hood over a takeout conveyor from a hot oil fryer to reduce the temperature gradient between the top and bottom of a product bed. Custom cooling and drying profiles can be designed using different configurations of the extended hood. Insulation and/or heaters can be provided above the product bed to slow the cooling rate of the top of the product bed. A cooler can be used to increase the cooling rate of the bottom of the product bed.

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CONTROLLED COOLING OF FOOD EXITING A FRYER

BACKGROUND OF THE INVENTION

[0001] Technical Field

[0002] The present invention relates to a method, apparatus and system for controlling the level of acrylamide formation and the amount of oil uptake in bedded food products cooked in hot oil. This invention permits the production of bedded foods having more predictable and reduced levels of acrylamide and reduced levels of oil absorption. The invention relies on varying the parameters of various unit operations to accomplish its objectives.

[0003] Description of Related Art

[0004] In recent times, a wide variety of foods have tested positive for the presence of acrylamide. Acrylamide has especially been found primarily in carbohydrate food products that have been heated or processed at high temperatures. Examples of foods that have tested positive for acrylamide include coffee, cereals, cookies, potato chips, crackers, french-fried potatoes, breads and rolls, and fried breaded meats. In general, relatively low contents of acrylamide have been found in heated protein-rich foods, while relatively high contents of acrylamide have been found in carbohydrate-rich foods, compared to non-detectable levels in unheated and boiled foods. Reported levels of acrylamide found in various similarly processed foods include a range of 330 - 2,300 (μg/kg) in potato chips, a range of 300 - 1100 (μg/kg) in french fries, a range 120 - 180 (μg/kg) in corn chips, and levels ranging from not detectable up to 1400 (μg/kg) in various breakfast cereals.

[0005] It is presently believed that acrylamide is formed from the presence of amino acids and reducing sugars. For example, it is believed that a reaction between free asparagine, an amino acid commonly found in raw vegetables, and free reducing sugars accounts for the majority of acrylamide found in fried food products. Asparagine accounts for approximately 40% of the total free amino acids found in raw potatoes, approximately 18% of the total free amino acids found in high protein rye, and approximately 14% of the total free amino acids found in wheat.

[0006] Acrylamide has not been determined to be detrimental to humans, but its presence in food products, especially at elevated levels, is undesirable. As noted previously, relatively higher concentrations of acrylamide are found in food products that have been heated or thermally processed. The reduction of acrylamide in such food products could be accomplished by reducing or eliminating the precursor compounds that form acrylamide, inhibiting the formation of acrylamide during the processing of the food, breaking down or reacting the acylamide monomer once formed in the food, or removing acrylamide from the product prior to consumption. Understandably, each food product presents unique challenges for accomplishing any of the above options. For example, foods that are sliced and cooked as coherent pieces may not be readily mixed with various additives without physically destroying the cell structures that give the food products their unique characteristics upon cooking. Other processing requirements for specific food products may likewise make acrylamide reduction strategies incompatible or extremely difficult.

[0007] It would also be desirable to develop one or more methods of controlling and reducing the level of acrylamide in the end product of foods cooked at high temperatures. Ideally, such a process should substantially reduce or eliminate the acrylamide in the end product without adversely affecting the quality and characteristics of the end product. Further, the method should be easy to implement and, preferably, add little or no cost to the overall process.

SUMMARY OF THE INVENTION

[0008] The present invention is an apparatus, system and method for controlling and/or reducing the amount of acrylamide, and reducing the amount of oil uptake, in food products cooked in hot oil. In another embodiment, it is an apparatus, system and method for controlling and/or reducing the amount of acrylamide in food products that are thermally processed as a product bed.

[0009] In one embodiment, the invention comprises an extended hood disposed over the takeout conveyor of a food cooking unit (a cooker). The extended hood diminishes the temperature gradient typically present between the top and bottom of the product bed exiting the cooker, which minimizes the discrepancy between the amount of acrylamide formed in food pieces found on the top of the bed and food pieces found on the bottom of the bed. In one embodiment, the food pieces are removed from the cooker as a product bed having a top and bottom using a takeout conveyor, wherein the takeout conveyor comprises a hood adapted to reduce the temperature gradient that would otherwise occur between food pieces located on the top and bottom of the product bed if the product bed were exposed to ambient air while on said takeout conveyor. The product bed would be exposed to ambient air if no extended hood were used. If an extended hood is used, then the product bed is exposed to a controlled environment, as described herein.

[0010] In one embodiment, the extended hood is an insulated hood, with an insulated surface disposed above and, optionally, on either or both sides of the product bed. In another embodiment, the extended hood includes heaters disposed above and, optionally, on either or both sides of the product bed. These embodiments reduce the cooling rate of the food pieces on top of the product bed, and also allow for shorter cooker residence times because the fried food can be cooked to a higher moisture content inside the cooker. The cooked food pieces will continue to cook inside the extended hood, cooling more slowly and uniformly than if exposed to ambient, atmospheric conditions.

[0011] According to another embodiment, a cooling medium is contacted with the bottom of the product bed exiting the cooker by using a cooler underneath the product bed. A cooling medium can further reduce the temperature gradient found between the top and bottom of the food bed exiting the cooker.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] The novel features believed characteristic of the invention are set forth in the appended claims. The invention itself, however, as well as a preferred mode of use, further objectives and advantages thereof, will be best understood by reference to the following detailed description of illustrative embodiments when read in conjunction with the accompanying drawings, wherein:

[0013] **Figure 1** is a plan view of a fryer utilizing one embodiment of the present invention;

[0014] **Figure 2** is a perspective view of one embodiment of the extended hood of the present invention;

[0015] **Figure 3** is a perspective view of another embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0016] An embodiment of the invention will now be described with reference to Figure 1. Although the invention will be described with reference to a hot oil fryer, it will be understood by one skilled in the art based on the teachings herein that the invention applies to any thermally processed food product that is cooked, at least in part, as a product bed. For example, fabricated potato chips can be cooked in bedded form inside a hot air oven. The invention can also be used in microwave, ohmic, or infrared cookers.

[0017] In reference to Figure 1, whole potatoes stored in hopper 2 are dispensed into a slicing apparatus 4 which drops potato slices into a water wash 6. The slices are removed from the water wash 6 by an endless belt conveyor 8 and deposited in frying oil 12 contained within a fryer 10. Because the present invention applies to foods other than sliced potatoes, the invention will now be described generally as pertaining to food pieces. The term food pieces is used herein to describe both whole and cut or sliced food pieces, and generally refers to discrete units of food that can be fried in hot oil and removed as a product bed.

[0018] The frying oil entering the fryer is maintained at an initial temperature between about 320°F to about 380°F more preferably between about 335°F and about 370°F. Any conventional frying medium can be used in accordance with various embodiments of the present invention, including frying mediums with digestible and/or non-digestible oils. In one embodiment, the fryer is a continuous single flow or multizone fryer which utilizes devices such as paddle wheels, 14A and 14B, and a submergible conveyor belt 16 to control the flow of food pieces through the fryer 10. Although the invention will be described herein with reference to a continuous fryer, other embodiments of the invention can be used with batch and semi-batch fryers and frying methods. Typically, once the potato slices or food pieces have been fried to a water content of less than about 3% by weight, the food pieces are removed from the fryer by a mesh endless belt takeout conveyor 18. The takeout conveyor 18 typically runs at a speed of between about 1-inch to 2-inches per second. The fried food pieces can be routed by a higher speed draining conveyor 60 to a tumbler for seasoning. In previous processes, the takeout conveyor and draining conveyor are open to ambient conditions. The term ambient conditions or ambient art refers to the general atmospheric conditions of the room or facility in which the fryer is housed. The seasoned food pieces can then be packaged and shipped.

[0019] As shown by Figure 1, the food pieces beneath the submerger 16 are typically in a bedded configuration 20 having a bed thickness 22. In one embodiment, the bed thickness 22 is roughly about 6 inches. It has been surprisingly discovered that the location of a food piece in the bed 20 when in the fryer 10 is a factor in the level of acrylamide formed in the fried food piece. During the frying process, the food pieces generally maintain their elevational position as they navigate through the fryer 10 beneath the submerger 16. Specifically, the food pieces at the bed bottom 24 typically stay at the bed bottom 24, food pieces in the middle 26 of the bed typically stay in the bed middle 26 and the food pieces at the top 28 of the bed typically stay at the bed top 28 as the fried food pieces move through the fryer beneath the submerger 16.

[0020] A temperature gradient forms in the fryer oil from the bed top 28 to the bed bottom 24; the bed bottom 24 being warmer since it is adjacent to hot oil 12 and the bed top 28 being cooler because the bed top 28 food pieces are surrounded by product being cooled down by evaporating water. A higher level of heat flux also occurs at the bed bottom 24 because freshly heated hot oil 12 typically enters the fryer 10 at or near the bottom of the fryer. This temperature differential transfers to the product bed 30 that has exited the fryer 10. Alternatively, the food pieces can be stirred or agitated during frying to reduce or eliminate the temperature differential in the product bed so the bed exits with little or no temperature gradient.

[0021] Regardless of the temperature distribution between the top and bottom of the product bed that has exited the fryer, the fried food pieces on the bed bottom 34 of the exited product bed 30 will cool at a slower rate than the fried food pieces on the bed top 38, causing a temperature gradient between the top and bottom of the product bed, for several reasons. First, because the bed bottom 34 fried food pieces are adjacent to the hot belt takeout conveyor 18, which has been heated by the hot oil, the heat from the takeout conveyor 18 transfers to the bed bottom 34 and keeps it warmer than the bed top 38. Second, the bed bottom 34 is not exposed to the cooler gaseous fluid (typically ambient air) that the bed top 38 fried food pieces are exposed too. Finally, the product in the bed middle 36 and the bed bottom 34 are insulated from the surrounding air by adjacent fried food pieces, and the takeout conveyer 18, respectively. The bed thickness 32 is usually similar to the bed thickness 22 beneath the fryer and is typically about 6 inches. These fried food pieces typically stay on the takeout conveyor for 45 to about 60 seconds. Consequently, the fried food pieces on the bottom of the takeout conveyor 18 have lower moisture contents and higher acrylamide levels than the fried food pieces on the top of the bed with a top to bottom temperature gradient. The term “takeout conveyor” as used herein generally with respect to food cookers, refers to the conveyor that removes the bedded product from the cooker.

[0022] The bedded product 30 on the conveyor was tested at the bed bottom 34 the bed middle 36 and the bed top 38 for temperature, moisture content, and acrylamide level. The data in the tables below were taken from samples of product taken at the end of the takeout conveyor. The averages of the samples are provided below:

Location	Temperature (°F)	Moisture Content (% by weight)	Acrylamide (ppb)
Top	222	1.47	509
Middle	263	1.32	617

Bottom	289	1.16	712

Table 1. Positional average of temperature, moisture content, and acrylamide levels.

[0023] The above table demonstrates that the acrylamide level in a fried food product can be dependent upon the position of the fried food piece in the food product bed. Consequently, if the food pieces near the top of the bed 38 can be cooled at a slower rate, or if the food pieces near the bottom of the bed 34 can be cooled at a more rapid rate, than under previously known conditions, the variation of the acrylamide concentration in the fried food pieces can be reduced because most of the acrylamide formation occurs at higher temperatures and lower moisture contents.

[0024] The cooling rate variance between the bed bottom and bed top can be reduced by including an extended hood 100 over the takeout conveyor of the food fryer. In one embodiment, the extended hood is disposed over the takeout conveyor 18 and, optionally (not shown), the draining conveyor 60. The extended hood 100 modifies the atmospheric conditions experienced by the fried food pieces immediately after they exit the frying oil in order to reduce the temperature gradient through the product bed and control the cooling and drying profile of the food pieces.

[0025] In one embodiment, the extended hood is insulated to prevent the food pieces on the top of the product bed to contact with ambient air for at least a portion of the time the food pieces remain on the takeout and (optionally) draining conveyors. In another embodiment, the extended hood can comprise heaters (not shown) above the top of the bed. These embodiments will slow the cooling rate of the fried food pieces on top of the bed. In another embodiment, the extended hood is adapted to contact the bottom of the product bed with a cooling gaseous medium. This embodiment reduces the temperature gradient by increasing the cooling rate of food products found at the bottom of the bed. Each of these aspects of the extended hood can be used alone or in combination with one another to accomplish the ultimate goal of a reduced temperature gradient, which in turn will reduce variability in moisture content, oil content, and acrylamide formation, between food pieces located the top and bottom of the product bed after frying and during cooling.

[0026] Figure 2 is a perspective view of one embodiment of the extended hood 100 of the present invention. As depicted therein, the hood 100 is similar to an enclosure, tunnel or passageway that at least partially shields the product bed from ambient conditions that are usually present upon takeout of the fried food pieces. Typically, the takeout conveyor on most frying equipment will comprise an oil pan underneath the takeout conveyor that drains the oil from the product bed back into the fryer, and side panels 104 on either side of the takeout conveyor to retain the product bed on top of the takeout conveyor. Depending on the embodiment of extended hood being used, the hood can surround the product bed on one, two, three or four faces. For example, when the insulated hood embodiment is used alone on a fryer, the extended hood can surround the product bed on one face (an insulated panel 102 disposed above the product bed that uses the side panels 104 and oil pan as the second, third and fourth sides) or three faces (insulation provided above the top 102 and at each side 104 of the product bed). Insulation can be provided above the product bed, and optionally, on either or both sides of the bed.

[0027] In another embodiment of the insulated hood, at least one vent 106 can be cut in the hood in the side panels 104 or 114, at a location below the product bed, or in the portion of the hood beneath the product bed (or both). The panels referred to in Figure 2 as 104 and 114 can be generally considered to constitute a side panel, whether together or separate. The key factor is that the vent is located below the product bed to allow the area underneath the product bed to cool with ambient air. The vents 106 allow hot air to escape from beneath the product bed, thereby increasing the cooling rate of the bottom portion of the bed while the insulation above the product bed decreases the cooling rate of the top portion of the product bed. The optional vents are depicted in Figure 2. In a preferred embodiment, the vents are adjustable between an open and a closed position, and in a most preferred embodiment are continuously or stepwise adjustable between an opened and a closed position.

[0028] In another embodiment, the insulated hood includes an end cap 108 extending beyond the downstream end of the takeout conveyor. The end cap is adapted to slow the escape of hot air from underneath the hood as it rises along the incline of the hood. The end cap slows the escape of hot air by creating a barrier to the movement of the air in the direction of the takeout conveyor. In a preferred embodiment, the end cap is insulated.

[0029] [0027] Similarly, when the actively heated extended hood is used, the extended hood can heat the product bed from the top, and optionally from either or both sides of the bed. The type of heaters used can be any heater known in the art. For example, the heaters can be infrared (IR) heaters, forced hot air heaters (gas fired, or otherwise), or any combination of these. In a preferred embodiment, the heaters maintain the temperature under the extended hood at a point that keeps the product temperature above the boiling point of water (typically about 100°C), but below the temperature of the frying oil (or the temperature of whatever cooking medium is used inside the cooker) to encourage further dehydration of the food pieces underneath the hood for a predetermined length of time. For example, even if the heater maintains an air temperature of 90°C under the extended hood, it will still allow the product bed to cool more slowly than if the bed was open to ambient air after it exits the hot oil. The temperature of the food pieces might fall enough to allow internal water to condense, but this point is reached much later than with previously used frying equipment with no hood. Preferably the product temperature does not fall under the boiling point of water until after the product has reached approximately the end of the takeout conveyor or reaches approximately the downstream end of the extended hood.

[0030] The insulated and heated hood embodiments provide advantages in addition to reducing the elevational temperature gradient in the product bed. First, because the food pieces in the product bed remain above the boiling point of water for a period of time after they exit the hot oil, the fried food pieces continue to lose moisture as oil drains from the pieces. As long as the water inside the fried food pieces remains in a vapor state, with some of it exiting the food pieces through voids, the hot oil has a difficult time absorbing into the fried food pieces. The more time the food pieces are allowed to drain with their constituent water in the vapor phase, the more oil will drain off and the less oil will be available to absorb into the food pieces when they cool to a point where the remaining water condenses. Therefore, in addition to reducing the variability in acrylamide formation, these embodiments of the present invention also reduce the oil uptake in fried food pieces.

[0031] Second, the insulated and/or heated hood embodiments allow a practitioner of the present invention to cook the food pieces to a higher moisture content than is possible in the prior art, and yet still obtain the desirable taste and texture characteristics of cooked food products, and the stable final moisture content below about 2%. Again, this can be done because the food pieces will continue to lose moisture for a longer period of time after exiting the cooker. A lower fry time allows a practitioner to save money by reducing the number of oil cycles in the case of a fryer, and reduce the heat load and increase the throughput of the cooker.

[0032] Third, these embodiments allow a practitioner to more finely tailor the drying profile of the cooked food pieces in order to reduce the overall level of acrylamide formation. Acrylamide generally forms in food pieces when the food piece (not the heating medium) is raised to a product temperature above about 120°C. With respect to fried food products, this generally happens when the moisture content of the food piece falls below about 3%. Therefore, the extended hood of the present invention can allow a practitioner to design a drying profile for the product bed whereby the food pieces exit the cooker at a moisture content above about 3%, and then continue to lose moisture and cool at a controlled rate such that when the food pieces reach a moisture content below about 3%, the product temperature remains between about 100°C and about 120°C until the food pieces reach their final moisture content (typically between about 1% and about 2% by weight). In one embodiment, the food pieces are cooked to a moisture content between about 3% and about 10%, and the difference between this intermediate moisture content and the pieces' final moisture content is removed in the extended hood.

[0033] The custom drying profile can be designed using different combinations of heaters and insulation in different embodiments of the extended hood of the present invention. For example, in one embodiment, when the food pieces exit the fryer, they pass through a first zone of the hood that uses insulation only to provide a controlled and uniform cooling rate for the product bed, and then pass through a second zone of the hood, when the average moisture content of the food pieces has fallen below about 3%, with heaters adapted to maintain the product at a temperature above 100°C and below about 120°C until the food pieces reach their final moisture content below about 2%.

[0034] Other configurations for the extended hood are possible. For example, when the top of the product bed is below 120°C on takeout, heaters can be used in the first zone encountered by the product bed to maintain the temperature between 100°C and 120°C. A second zone could also contain heaters, or could be insulated, to allow the product bed to continue cooling at a slow rate throughout the length of the extended hood.

[0035] Figure 3 depicts another embodiment of the extended hood 100 of the present invention. As depicted therein, the hood comprises a cooler 110 that is adapted to contact the bottom of the product bed with a cooling medium. In one embodiment, the cooling medium is a gas. The gas can be air, nitrogen, or any other safe, relatively inert, nontoxic gas. The extended hood's cooler contacts the cooling medium with the bottom of the product bed by blowing the medium from below the product bed, and in the direction of the bottom surface of the conveyor belt holding the product bed. In one embodiment (not shown), at least one fan is provided below the product bed to blow the cooling medium towards the bottom of the conveyor belt. In another embodiment (shown), a cooling manifold 110 is disposed below the conveyor belt to direct cooling medium through the manifold and towards the bottom of the product bed. The takeout conveyor is typically a mesh conveyor, so the cooling medium will pass through the takeout conveyor 18 and contact the bottom of the product bed. An exhaust fan (not shown) disposed above the product bed may optionally be used to direct the flow of cooling medium towards the bottom of and through the product bed.

[0036] The temperature of the cooling medium will generally be less than the temperature of the frying oil and/or product bed as it exits the frying oil. In one embodiment, the cooling medium has a temperature that is below the temperature of the frying oil and above about 100°C. As with the insulated/heated hood embodiments, this embodiment can also be used to control the drying profile of the fried food pieces to reduce the overall level of acrylamide formation. This embodiment can also be used in combination with the insulated/heated hood embodiments to provide a practitioner even more flexibility in designing a drying profile for the food pieces in the product bed.

[0037] In another embodiment, the temperature of the cooling medium is lower than 100°C. At low enough temperatures, this embodiment will severely limit the amount of post-frying moisture reduction that occurs in the product bed because the fried food pieces will cool to a temperature below the boiling point of water more quickly than they otherwise would have. Therefore, if a lower temperature cooling medium is used, the fried food pieces will likely require a longer residence time in the frying oil in order to reduce the moisture content to a point that is closer to the final moisture content of the fried food pieces. This embodiment may cause the food pieces to absorb more oil than they otherwise would, and put more stress on the frying oil. However, this lower temperature embodiment will allow a practitioner to reduce the variability in the formation of acrylamide between the top and bottom of the product bed by controlling the cooling rate of the product bed.

[0038] EXAMPLES

[0039] One sample of potato slices were fried in hot oil, and removed from the oil by a takeout conveyor open to ambient conditions with no extended hood. The temperatures of the fried potato slices in the product bed were taken as the bed travelled along the takeout conveyor at 5 seconds, 20 seconds and 35 seconds after removal from the oil, and at the end of the takeout conveyor. The temperature at the bottom of the bed increased from about 260°F five seconds after takeout to about 280°F at the end of the takeout conveyor. The temperature at the top of the bed dropped off dramatically, from about 240°F five seconds after takeout to about 175°F at the end of the takeout conveyor. At the end of the takeout conveyor, the temperature difference between the top and bottom of the product bed was about 105°F.

[0040] The acrylamide content of the same fried potato slice product bed was also analyzed. At the end of the takeout conveyor, the difference in acrylamide content between potato slices at the top and bottom of the product bed was about 180 parts per billion (ppb), or 41.3% of mean acrylamide content.

[0041] An extended hood was placed over the takeout conveyor of a potato chip fryer and another sample of potato slices were fried in hot oil, and removed by the takeout conveyor. The extended hood covered the product bed on three sides, and provided insulation above the product bed for substantially the entire length of the takeout conveyor. The insulation was rockwool insulation with an R-value of about 3, and a thickness of about

1 inch. The surface of the hood closest to the product bed was about 3 to 7 inches above the top of the bed.

[0042] The temperature difference between the top and bottom of the product bed was reduced by about 35% to about 40% when an insulated extended hood was disposed over the first takeout conveyor. Thus, the temperature difference can be reduced by at least 35%. The difference in acrylamide content of the food slices at the top and bottom of the product bed at the end of the takeout conveyor using the insulated extended hood was about 42 ppb, or about 15% of mean acrylamide content. Thus, the elevational variability in temperature and acrylamide content in a cooked food product bed can be drastically reduced using the extended hood of the present invention.

[0043] While the invention has been particularly shown and described with reference to one or more embodiments, it will be understood by those skilled in the art that various approaches to the reduction of acrylamide in thermally processed foods may be made without departing from the spirit and scope of this invention. For example, while the process has been disclosed herein with regard to potato products, the process can also be used in processing of food products made from corn, barley, wheat, rye, rice, oats, millet, and other starch-based grains. In addition to potato chips, the invention can be used in making corn chips and other types of fabricated snack chips, as well as in cereals, cookies, crackers, hard pretzels, breads and rolls, and the breading for breaded meats. In each of these foods, the present invention's extended hood can be combined with other strategies for the reduction of acrylamide to produce an acceptable acrylamide level without adversely affecting the taste, color, odor, or other characteristics of an individual food.

CLAIMS:

We claim:

1. A method for cooking food pieces, said method comprising the steps of:

cooking said food pieces in a cooker;

removing said food pieces from said cooker as a product bed having a top and bottom using a takeout conveyor, wherein said takeout conveyor comprises an extended hood adapted to reduce the temperature gradient that would otherwise occur between food pieces located on the top and bottom of the product bed if the product bed were exposed to ambient air while on said takeout conveyor.

2. The method of claim 1 wherein said extended hood comprises an insulated surface disposed above the top of the product bed.

3. The method of claim 1 wherein said extended hood comprises at least one heater disposed above the top of the product bed.

4. The method of claim 1 wherein said extended hood comprises a cooler beneath the bottom of the product bed.

5. The method of claim 1 wherein said food pieces comprise a moisture content of greater than about 3% upon said removing.

6. The method of claim 1 wherein the difference in temperature between food pieces found on the top and bottom of the product bed is reduced by at least 35% from a

temperature difference that would otherwise occur if the product bed were exposed to ambient air upon said removing.

7. The method of claim 5 wherein said extended hood is adapted to allow said food pieces to cool to a product temperature below about 120°C and then maintain said product temperature between about 100°C and about 120°C until the moisture content of the food pieces has been reduced to below about 2%.

8. The method of claim 1 wherein said cooker comprises a fryer.

9. The method of claim 1 wherein said extended hood comprises and end cap at a downstream end of said takeout conveyor.

10. The method of claim 1 wherein said extended hood comprises a first zone having insulation disposed above said product bed, and a second zone having a heater disposed above said product bed.

11. An apparatus for cooking food pieces comprising:

a cooker;

a takeout conveyor for removing said food pieces from said cooker as a product bed;

an extended hood over said takeout conveyor, wherein said hood is adapted to reduce the temperature gradient that would otherwise occur between food pieces located on the top and bottom of the product bed if the product bed were exposed to ambient air while on said takeout conveyor.

12. The apparatus of claim 11 wherein said extended hood comprises an insulated surface disposed above the top of the product bed.

13. The apparatus of claim 11 wherein said extended hood comprises at least one heater disposed above the top of the product bed.

14. The apparatus of claim 11 wherein said extended hood comprises a cooler beneath the bottom of the product bed.

15. The apparatus of claim 11 wherein said takeout conveyor removes said food pieces when said food pieces comprise a moisture content of greater than about 3% upon said removing.

16. The apparatus of claim 11 wherein food pieces found on the top and bottom of the product bed comprise a temperature difference which is reduced by at least 35% from

a temperature difference that would otherwise occur if the product bed were exposed to ambient air upon said removing.

17. The apparatus of claim 15 wherein said extended hood is adapted to allow said food pieces to cool to a product temperature below about 120°C and then maintain said product temperature between about 100°C and about 120°C until the moisture content of the food pieces has been reduced to below about 2%.

18. The apparatus of claim 11 wherein said cooker comprises a fryer.

19. The apparatus of claim 11 wherein said extended hood comprises an end cap at a downstream end of said takeout conveyor.

20. The apparatus of claim 11 wherein said extended hood comprises a first zone having insulation disposed above said product bed, and a second zone having a heater disposed above said product bed.

21. The apparatus of claim 11 wherein said extended hood comprises sidewalls with at least one vent located below said product bed.

22. An extended hood for a cooker adapted to reduce a temperature gradient that would otherwise occur between food pieces located on the top and bottom of a product bed removed from the cooker by a takeout conveyor if the product bed were exposed to ambient air while on said takeout conveyor

23. The extended hood of claim 22 comprising an insulated surface disposed above the top of the product bed.

24. The extended hood of claim 22 comprising at least one heater disposed above the top of the product bed.

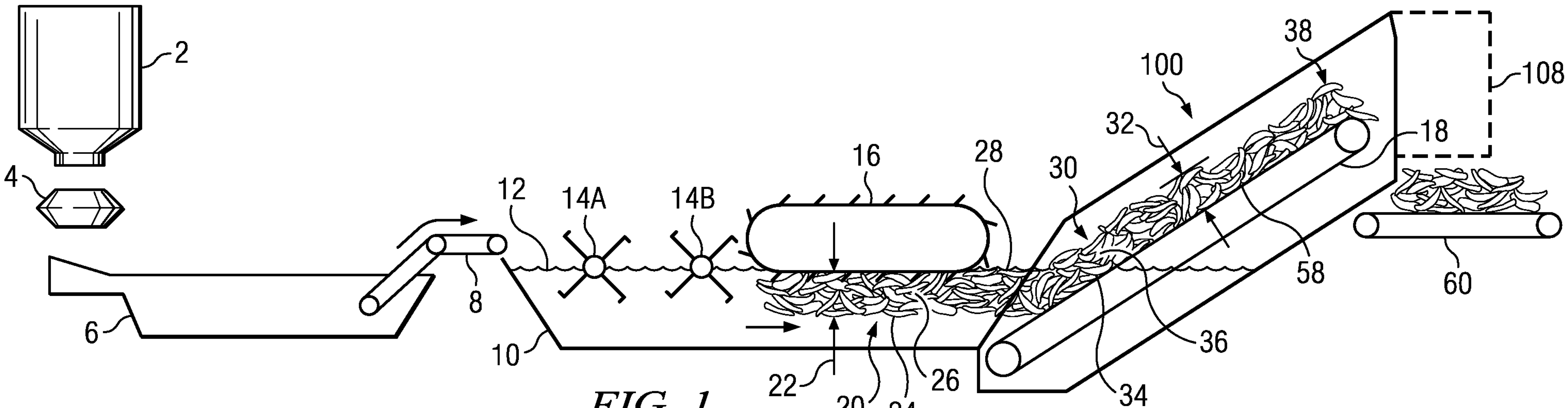
25. The extended hood of claim 22 comprising a cooler beneath the bottom of the product bed.

26. The extended hood of claim 22 further adapted to allow said food pieces to cool to a product temperature below about 120°C and then maintain said product temperature between about 100°C and about 120°C until the moisture content of the food pieces have been reduced to below about 2%.

27. The extended hood of claim 22 comprises an end cap at a downstream end of said takeout conveyor.

28. The extended hood of claim 22 comprising a first zone having insulation disposed above said product bed, and a second zone having a heater disposed above said product bed.

29. The system of claim 22 comprising sidewalls with at least one vent located below said product bed.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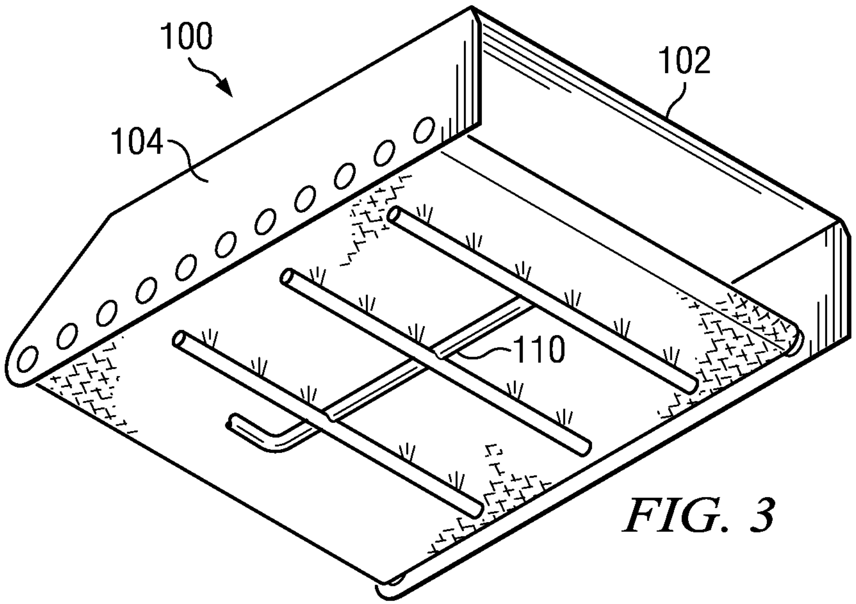
60
100
108

FIG. 1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110

FIG. 3

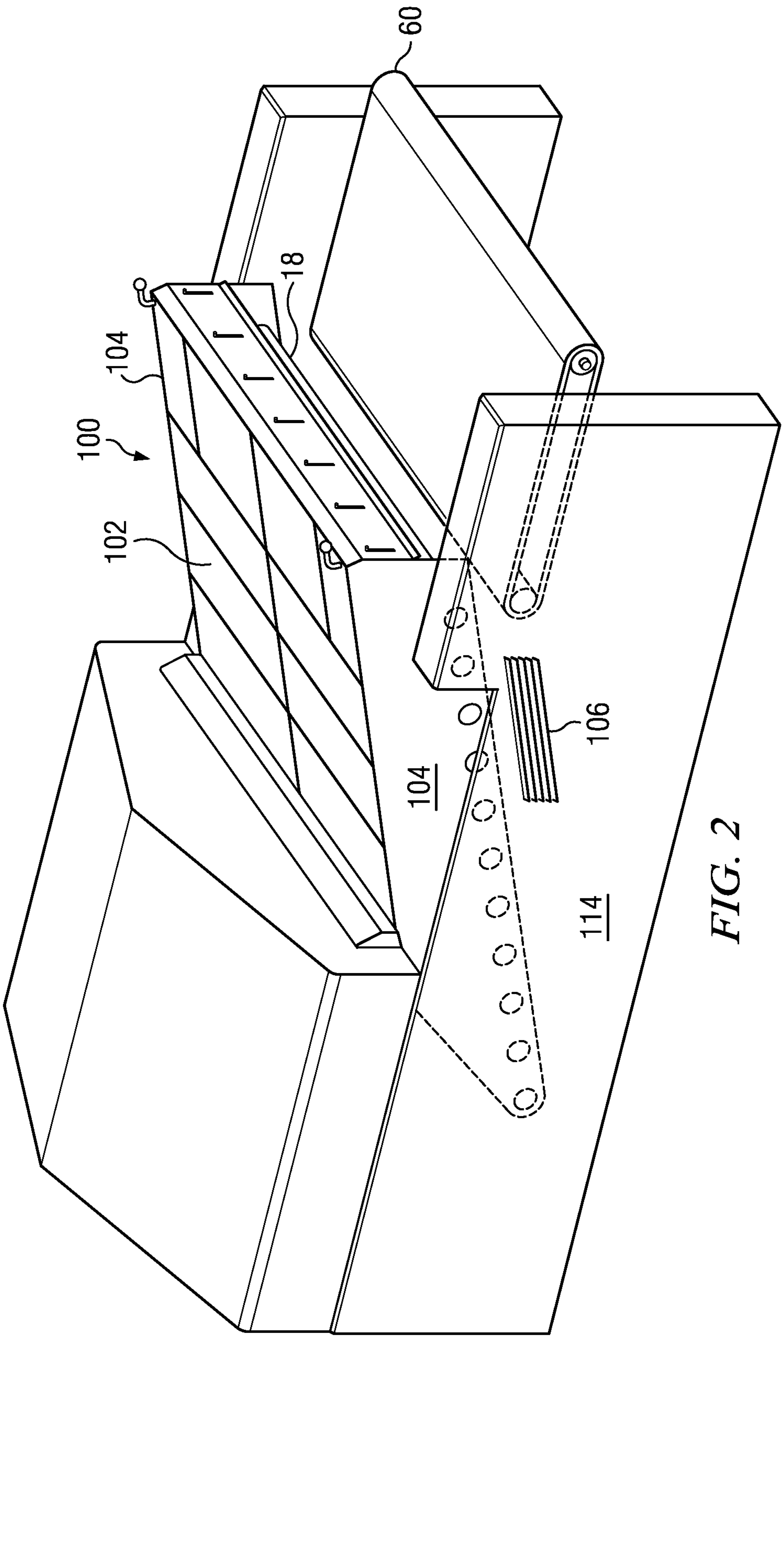

FIG. 2