

MEANS AND METHOD FOR STERILIZING
SPICES AND LIKE SUBSTANCES

The present invention relates to improved means and method for sterilising food products and particularly spices such as leafy herbs and other like spices and spice-like substances.

There are many known devices for sterilizing food products including leafy herbs and spices but all of the known devices have certain limitations and shortcomings. For example, the known devices, for the most part, use chemical sterilizers or wet steam and if wet steam is used, it is used in a sterilizing environment that is relatively hot and has a fairly high pressure. Such apparatus produces some contamination of the product being sterilized and may adversely affect the taste and/or flavor of the product being sterilized. Also, when wet steam is used as the sterilizing medium, relatively high pressures are required and the high pressures are usually exhausted to atmosphere suddenly and in the presence of the product being sterilized, and this sudden relatively high pressure loss frequently damages the product and in some cases, causes the products to undergo puffing. The use of sterilizing chemicals and wet steam also produces some chemical reaction in the product being sterilized and this can adversely affect its taste and flavor. Furthermore, where chemicals are used as the sterilizing medium, there is some danger to the person operating the apparatus and it is not altogether clear whether or not chemical sterilizers contaminate the products in such a manner as to make them unsafe. Thus, there are definite disadvantages and limitations of known apparatus and methods for sterilizing food products and these are overcome by the present apparatus and method which produces little or no chemical or physical change in the product being sterilized and it

is able to be operated in a continuous or in an intermittent mode to economically and efficiently sterilize large quantities of spice. The present apparatus also lends itself to being tailored to the characteristics of the product being sterilized which is not as true of known apparatus which are less flexible and less able to be tailored to each different product being sterilized.

The invention provides a process for sterilizing spices and leafy herbs comprising:

establishing a closed chamber having a pre-determined sterilizing temperature and pressure therein characterized by superheated steam in the closed chamber;

introducing a product selected from the group consisting essentially of spices and leafy herbs onto conveyor means in the closed chamber via an inlet chamber without exposing the closed chamber to ambient atmosphere;

exposing the product on the conveyor means to superheated steam in the closed chamber such that the superheated steam sterilizes the product;

transferring the product from the closed chamber to an outlet chamber without exposing the closed chamber to ambient atmosphere; and

relieving pressure in the outlet chamber at a rate selected to avoid puffing of the product without exposing the closed chamber to ambient atmosphere.

The invention also provides an apparatus for sterilizing spices and leafy herbs comprising:

a sealed sterilizing chamber, said chamber having conveyor means for conveying a product spread on the conveyor means between an inlet position and an outlet position;

means for maintaining an environment of super-heated steam under a pressure and at a temperature in the sterilizing chamber selected such that the superheated steam sterilizes the product;

an inlet chamber attached to the sterilizing chamber and aligned with the inlet position to deposit the product on the conveyor means at the inlet position;

an outlet chamber attached to the sterilizing chamber and aligned with the outlet position to receive the product from the conveyor means at the outlet position;

each of said inlet and outlet chambers comprising a respective sealed chamber and valve means for alternately opening the respective sealed chamber to the sterilizing chamber and to a respective space outside the sterilizing chamber; and

means for reducing pressure in the outlet chamber at a sufficiently slow rate to ensure that the product in the outlet chamber is not puffed when the respective opening means opens the outlet chamber to the respective space.

The invention further provides an apparatus for sterilizing fungible food products and like substances comprising a sealed housing member having a sterilizing chamber therein, an endless belt with spaced upper and lower belt reaches mounted in the sterilizing chamber and extending around spaced support members, means for moving the belt, inlet means including means forming a lock chamber attached to the housing at a location above the upper belt reach adjacent to one end thereof, outlet means including means forming a lock chamber attached to the housing at a location below the opposite end of the upper belt reach in position to receive products that fall off the belt end, each of said lock chambers having first valve means operable to control communication between the respective lock chamber and the sterilizing chamber and second valve means operable to control communication between the respective lock chambers and ambient atmosphere, means to control actuations of the first and second valve means so that the sterilizing chamber is never exposed to ambient atmosphere during operation of the _____

sterilizing apparatus, and means associated with the outlet lock chamber for controllably relieving the pressure therein toward atmospheric pressure.

The invention further provides the apparatus for sterilizing fungible food products such as leafy herbs and spices comprising:

a jacketed housing having spaced inner and outer wall portions with a sealed spaced formed therebetween, the inner housing wall portion defining a sterilizing chamber therewithin;

means to introduce steam into the space between the inner and outer housing wall portions;

means to introduce superheated steam into the sterilizing chamber to produce a sterilizing environment therein;

an endless belt having upper and lower belt reaches and extending around spaced belt support members located in the sterilizing chamber;

motor means connected to one of the spaced belt support members to rotate said member to move the belt;

inlet means mounted on the housing at a location above the endless belt adjacent one end thereof, said inlet means including chamber forming means having an upper port for receiving products to be sterilized and a lower port for discharging products from the chamber into the sterilizing chamber and onto the upper belt reach, first valve means associated with the upper port to control communication therethrough, second valve means associated with the outlet port to control communication therethrough;

outlet means attached to the housing at a location below one end portion of the belt in position to receive products falling off the end of said belt, said outlet means including chamber forming means having an upper port in position to receive products falling off the belt and a lower port for discharging products from the chamber, first

outlet valve means associated with the outlet means to control communication between the sterilizing chamber and the outlet means, and second outlet valve means associated with the outlet means to control communication between the outlet means and ambient atmosphere; and

means associated with the outlet chamber to predeterminately relieve the pressure therein.

In use of apparatus in accordance with the invention the inlet and outlet chambers and associated valve means are periodically placed in communication with the sterilizing chamber and with ambient atmosphere and operate in a manner so as not to substantially alter the sterilizing environment in the sterilizing chamber when products are introduced into and removed therefrom. In a preferred apparatus the sterilizing environment in the sterilizing chamber has a relatively low pressure within the range from about 5 to about 30 pounds per square inch gauge (PSIG), (from about 1.35 atmosphere to about 3.05 atmosphere), ^(about 34.48 to about 206.9 kN/m²) a temperature within a range from about 180°F to about 300°F, (from about 82°C to about 149°C). Superheated (dry) steam preferably at a temperature between about 215°F and 350°F (101.5°C and 177°C) is introduced into the sterilizing chamber in a preferred process in accordance with the invention so that the environment maintained therein is able to sterilize products such as spice-like substances on the conveyor means without exposing the products to substantial amounts of moisture and therefore without increasing the moisture content of the products or spices being sterilized, and without otherwise altering the physical or chemical characteristics thereof. The present apparatus can be operated continuously to sterilize products and it does so without subjecting the products or spices to sudden pressure changes of sufficient magnitude to produce physical changes or puffing of the products. The preferred apparatus is ____

safer to use than known apparatus because it operates at lower pressures and uses relatively dry super-heated steam rather than steam with greater water content.

It is an object of the invention to provide improved means and method for sterilizing products such as leafy herbs and various spices and spice-like substances.

These and other objects and advantages of the present invention will become apparent after considering the following detailed specification in conjunction with the accompanying drawings.

Description of the Drawings

Fig. 1 is a side elevational view of a sterilizing apparatus constructed according to the present invention;

Fig. 2 is a right end view of the sterilizing apparatus shown in Fig. 1;

Fig. 3 is a cross-sectional view taken on line 3-3 of Fig. 1; and

Fig. 4 is a diagrammatical side elevational view that illustrates a typical order or sequence of operations that take place using the subject apparatus.

Description of Preferred Embodiment

Referring to the drawings more particularly by reference numbers, number 10 in Figs. 1 and 2 identifies a preferred embodiment of a sterilizing apparatus constructed according to _____

the teachings of the present invention. The apparatus 10 includes an elongated tubular jacketed housing 12 which is formed by a tubular member 14 or structure closed and sealed at both opposite ends by closure members 16 and 18 and suitable seals or gaskets. Mounted in the jacketed housing 12 are a pair of spaced parallel shafts 20 and 22 each having mounted on it a respective flanged belt support member 24 and 26. An endless flexible belt 28 is positioned extending around the flanged members 24 and 26 and around the shafts 20 and 22. The flanged members 24 and 26 are preferably constructed to give the belt 28 a trough shaped cross-section for reasons which will become apparent hereinafter. The housing structure 12 is supported in an elevated position by spaced support members 30 and 32, and the end caps or closure members 16 and 18 may be connected to the housing 12 by hinges 34 so that they can be swung open and closed without being completely removed for access to the interior of the elongated housing 12 as required. The housing also is preferably jacketed with pipes and chambers to further insulate the interior. When the closure members 16 and 18 are in their closed and locked positions a sealed sterilizing chamber 36 is formed in the housing 12.

Referring again to Fig. 1, the belt 28 is shown as being movable in a clockwise direction, that is the upper reach of the belt moves from left to right. Attached to the upper surface of the housing 14 near the left end thereof and at a location above the left end portion of the upper belt reach is an inlet conduit 38 which has a flange 40 that sealably engages a flange 42 on the lower end of an input assembly 44. The input assembly 44 has a lower spout portion 46 which communicates with the inlet tube 38

and the upper end thereof is attached to a valve housing 48 which has a movable valve member 50 positioned therein. The movable valve 50 is attached to one end of an operating rod 52 which extends into and is attached at its opposite end to a piston 54 located in a cylinder housing 56. The cylinder housing 56 has hydraulic or pneumatic input tubes 58 and 60 which connect opposite ends thereof to a source of hydraulic or pneumatic pressure (not shown). When pressure is introduced into one or the other of the tubes 58 or 60 it causes the piston 54 and the connected rod 52 and valve 50 to move either to its open or to its closed position. The closed position of the valve is shown in Fig. 2 with the valve 50 engaging valve seat 61. The open position is when the valve 50 is spaced from the valve seat 61. In the closed position of the valve 50 the environment in the chamber 36 communicates with the chamber formed in the spout portion 46, terminating where the valve 50 engages with the valve seat 61. This means that there is communication between the chamber 36 and the space in the spout 46 and both will therefore have the same environment. It is expected that the volume in the spout 46 will be much smaller than the volume in the chamber 36 for its effect on the overall environment is negligible.

Another chamber is formed in the housing member 62 and extends from the valve seat 61 upwardly for communication with an inlet funnel 64 through another tubular valve housing 66 of valve assembly 68. The valve assembly 68 includes a movable valve member 70 attached to a rod 72 that extends into cylinder housing 74 where it is attached to piston 75. The housing 74 also has hydraulic or pneumatic connections 76 and 78 that communicate respectively with the housing 74 on opposite sides of the piston

75. The valve 70 is shown in Fig. 2 in its open position which is the position in which it is withdrawn downwardly from engagement with valve seat 80. In this position a quantity of a substance to be sterilized, such as a quantity of a leafy herb substance or the like, can be poured into the funnel 64 where it will pass down through the open valve seat 80 and into the chamber formed by the housing portion 62. A predetermined amount of such substance to be sterilized is introduced into the housing 62 in this manner, and once the desired charge of substance is in the housing 62, the valve 70 will be moved from its open to its closed position engaging the valve seat 80 and sealing the housing 62 closed. This is accomplished by introducing hydraulic or pneumatic pressure into the line 78 to move the piston 75, the rod 72 and the attached valve 70 in the upward direction as shown. When this is done the chamber formed in the housing 62 is blocked at both ends by the valves 70 and 50. Thereafter, at some later time the lower valve 50 will be opened by introducing fluid or pneumatic pressure into the conduit 58, moving the piston 54 in a downward and rightward direction as shown. As soon as the valve 50 is open the charge of product to be sterilized which is in the housing 62 will fall through the opening formed by the valve seat 61 and will land on the belt 28 where it will thereafter be carried in a rightward direction as shown in Fig. 1. The valves 70 and 50 and their associated valve seats serve to form a chamber lock between the inlet funnel 64 and the chamber 36 so that substances to be sterilized can be introduced without substantially changing the environment in the chamber 36. This is true in part because the chamber 36 is preferably substantially larger than the chamber in

the housing 62. This means that the sterilizing environment in the chamber 36 can be maintained at or near some desired sterilizing condition with minimal effort and with minimal introduction of added super-heated dry steam and pressure as will be explained. A rake or plow 82 or other type device is provided in the chamber 36 to spread the product out on the belt 28 and a doctor blade 83 is shown mounted below the belt 28 to scrape the belt clean as the product is discharged therefrom.

A similar chamber lock is provided at the outlet end of the tubular jacketed housing 12 where a product that has been sterilized is discharged after having spent a desired time in the chamber 36. The time required for a particular substance to remain in the chamber 36 will depend upon the characteristics of the product itself and the characteristics of the environment maintained in the chamber. A table listing typical ranges of temperatures and pressures for various substances to be sterilized is set forth below. It should be recognized however that in all cases the pressures used in the chamber 36 are relatively low compared to pressures used in sterilizers heretofore and even these relatively low sterilizing pressures will be further reduced so that when a sterilized product present in the outlet lock chamber is suddenly released for exposure to ambient atmosphere, the pressure change that occurs will be relatively small and clearly not so great as to damage the product such as by causing puffing or some other undesirable condition. This is very important to prevent damage and loss of flavor in many products including products such as leafy herbs and spices.

TABLE

**PREFERRED RANGES OF PRESSURE, TEMPERATURE
AND STERILIZING TIMES FOR PARTICULAR SPICES**

	Pressure		Temperature		Time (Seconds)
	(PSIG)	(kN/m ²)	°F	°C	
ALLSPICE	10-20	68.96-137.9	190-210	88-99	16-28
ANISE SEED	10-20	68.96-137.9	180-210	82-99	16-28
ANISE STAR	10-20	68.96-137.9	180-210	82-99	16-28
ARROWROOT	10-25	68.96-172.4	180-250	82-121	16-40
BASIL	5-15	34.48-103.4	110-210	43-99	5-15
BAY LEAVES	5-15	34.48-103.4	110-210	43-99	5-15
BLACK PEPPER	15-35	103.4 -241.4	150-270	66-132	15-40
CARAWAY	10-20	68.96-137.9	190-210	88-99	16-28
CARDAMOM	10-20	68.96-137.9	190-210	88-99	16-28
CELERY SEED	10-20	68.96-137.9	190-210	88-99	16-28
CELERY FLAKES AND STALKS	5-15	34.48-103.4	110-210	43-99	5-15
CHERVIL	10-20	68.96-137.9	190-210	88-99	16-28
CHILI PEPPER	10-20	68.96-137.9	150-210	66-99	15-30
CHIVES	10-20	68.96-137.9	150-210	66-99	15-30
CILANTRO	10-20	68.96-137.9	150-210	66-99	15-30
CINNAMON	10-20	68.96-137.9	190-210	88-99	16-28
CLOVES	15-35	103.4 -241.4	150-270	66-132	15-40
COMINO	10-20	68.96-137.9	190-210	88-99	16-28
CORIANDER	10-20	68.96-137.9	190-210	88-99	16-28
DILL SEED	10-20	68.96-137.9	190-210	88-99	16-28
FENNEL SEED	10-20	68.96-137.9	190-210	88-99	16-28
FENUGREEK	10-20	68.96-137.9	190-210	88-99	16-28
GINGER ROOT	15-35	103.4 -241.4	150-270	66-132	15-40
JUNIPER BERRIES	15-35	103.4 -241.4	150-270	66-132	15-40
MACE	10-20	68.96-137.9	190-210	88-99	16-28
MARJORAM	5-15	34.48-103.4	110-210	43-99	5-15
MINT LEAVES	5-15	34.48-103.4	110-210	43-99	5-15
MUSTARD	15-35	103.4 -241.4	150-270	66-132	15-40
NUTMEG	5-15	34.48-103.4	110-210	43-99	5-15
OREGANO, MEDITERRANEAN	15-35	103.4 -241.4	150-270	66-132	15-40
OREGANO, MEXICAN	15-35	103.4 -241.4	150-270	66-132	15-40
PAPRIKA	10-20	68.96-137.9	190-210	88-99	16-28
PARSLEY FLAKES	15-35	103.4 -241.4	150-270	66-132	15-40
PEPPERS, DEHYDRATED	15-35	103.4 -241.4	150-270	66-132	15-40
POPPY SEED	5-15	34.48-103.4	110-210	43-99	5-15
ROSEMARY	5-15	34.48-103.4	110-210	43-99	5-15
SAGE	5-15	34.48-103.4	110-210	43-99	5-15
SAVORY	5-15	34.48-103.4	110-210	43-99	5-15
SESAME SEED	10-20	68.96-137.9	190-210	88-99	16-28
TARRAGON	5-15	34.48-103.4	110-210	43-99	5-15
THYME	5-15	34.48-103.4	110-210	43-99	5-15
TURMERIC	15-35	103.4 -241.4	150-270	66-132	15-40
WHITE PEPPER	15-35	103.4 -241.4	150-270	66-132	15-40

Referring to Fig. 2 the outlet means includes a pair of hydraulic or pneumatic valve assemblies 84 and 86 which are similar to the assemblies 48 and 68 described above, and they operate similarly to establish a lock chamber condition in a housing structure 88 similar to the lock chamber formed in the inlet housing structure 62. The upper valve assembly 84 includes a movable valve member 90 which sealably cooperates with an upper valve seat member 92 to form a seal therebetween when closed, and the lower valve assembly 86 includes a valve member 94 which sealably cooperates with a valve seat member 96 to form a seal therebetween when closed.

When a quantity of substance falls on the belt 28 it is retained in the chamber 36 for a period of time sufficient to sterilize it, which time is controlled at least in part by the speed of movement of the belt 28 from where the substance is deposited by the inlet assembly 44 to where the substance falls off the right end 98 thereof into outlet chute or tube 100 and into the lock chamber formed in the housing structure 88. This occurs when the upper valve 90 is in its open position as shown in Fig. 2. After a predetermined quantity of the substance has fallen into the housing 88, the valve 90 will be actuated to move to its closed position sealably engaged with the valve seat 92 to maintain a sealed condition in the sterilizing chamber 36. At this instant of time the environment in the sterilizing chamber 36 and in the housing 88 will be the same or very close to each other. Thereafter at some predetermined later time the lower valve 94 will be operated to move from its closed to its open position allowing the now sterilized material contained in the housing 88 to fall out through an outlet structure or tube 101.

into a suitable cooler means or bin as will be described which is positioned to receive same. It is anticipated as indicated that with the present construction because of the use of super-heated steam instead of wet steam, much lower pressures will be required in the sterilizing process than has been true in the past but even so, the discharged product may be relatively hot, and need to be cooled. The reduced pressure differential, however, means that the sterilized substances discharged into the housing 88 will undergo relatively little sudden pressure change as stated when the valve 94 opens. This is very important because the relatively small pressure change that occurs will not be sufficient to cause the sterilized products to undergo physical or chemical changes such as puffing or the like. Also the fact that the present apparatus and process uses dry as opposed to wet steam is important because it means that the substances being sterilized will pick up relatively little, if any, moisture from the sterilizing environment, a highly desirable condition from the standpoint of maintaining natural taste and flavor.

As clearly shown in Fig. 2, a relief valve 102, which may be in the form of adjustable needle valve, is mounted on the housing 88 and is adjusted to continuously relieve the pressure therein from the sterilizing pressure down to about 5 PSIG (0.3 Atm.) by the time the valve 94 opens to discharge the contents thereof. This is done to further reduce the pressure differential when the product is discharged and prevent damage to the product by a sudden large pressure change. This is extremely important to the improved operation of the present device.

The main sterilizing housing 12 is shown in Fig. 3 containing a substantially enclosed structure 106 which is shown

positioned centrally between the upper and lower reaches of the belt 28. The structure 106 has perforations or orifices 107 distributed over the surfaces and is connected by a conduit 108 and a suitable fitting 109 mounted in the walls of the jacketed housing 12, to another conduit 110 which has its opposite end connected to a steam super-heater 111 which receives steam from a device such as from boiler 113. The source of super-heated steam required to maintain the sterilizing environment in the chamber 36 can be relatively small since with the present structure it is only necessary to maintain the environment in the chamber 36 and not to re-establish the sterilizing environment each time a quantity of the product being sterilized enters or is discharged therefrom. This is made possible because of the operation of the lock chambers described above. The orifices 107 in the enclosed structure 106 are provided to relatively uniformly distribute the super-heated steam fed into the structure 106 into the chamber 36. The housing 12, as shown in Fig. 3, is a jacketed housing formed by spaced wall portions 14 and 14' having a closed jacket chamber 112 therebetween which receives jacket steam directly from the boiler 113 through tube 114 and fitting 116. The jacket steam typically will be in a range between about 200°F to 210°F (93.3°C to 99°C) and at a pressure in the range from about 40 to 70 PSIG (3.7 Atm. to 5.77 Atm.). ^(about 276 to 483 kN/m²) The super-heated dry steam fed to the sterilizing chamber 36, on the other hand, will typically be in a range closer to 300°F (149°C) and at a lower pressure than the jacket steam pressure, as desired.

The drive means for the belt 28 can be constructed to be internal or external of the jacketed housing 12, as desired. If the drive means are located externally it will be necessary to

provide a sealed bearing structure mounted in the double wall jacket structure of the jacketed housing 12 through which the drive shaft such as the shaft member 20 (or 22) extends. The speed at which the belt 28 moves, which may be continuous or intermittent, will depend upon the environment maintained in the chamber 36, the length of the belt 28 and the sterilizing requirements of the particular product, all of which can be varied as required.

Referring to Fig. 4, there is shown a sequence of operations of the input lock chamber 62 and the output lock chamber 88. The term lock chamber as used herein refers to a chamber that can be sealed closed or opened at one or both ends and therefore can communicate with ambient temperature, or with the sterilizing chamber 36 or with neither. Four different conditions for the inlet chamber 62 and four different conditions for the outlet chamber 88 are shown in Fig. 4. The first condition of the inlet chamber 62 is the condition wherein the inlet valve 70 is open and a product or substance to be sterilized can fall through past the valve 70 into the chamber 62. The outlet valve 50 is closed in this situation so that the chamber 62 is in communication with ambient atmosphere but not with the sterilizing chamber 36. Subsequently, the inlet valve 70 will close as shown in the second position so that both the inlet and outlet valves 70 and 50 are closed at the same time. Still later as shown in the third position, the outlet valve 50 for the inlet chamber 62 is open so that the quantity of product that is contained in the chamber 62 can fall through the outlet and into the sterilizing chamber 36 where it lands on the upper reach of the belt 28 near the left end thereof. While the product

is falling, the belt 28 can be in a stationary or a moving condition as desired. After the charge of product in the chamber 62 has been completely dispensed, the lower valve 50 will again be closed, again sealing the chamber 62 and isolating it from the sterilizing chamber 36 and the process will be repeated for the next charge. It can, therefore, be seen from what has been said that during operation the sterilizing chamber 36 is never exposed to ambient condition and therefore never completely loses its sterilizing environment. However, when the valve 50 opens as shown in the third position, the ambient temperature trapped in the chamber 62 will communicate with the temperature in the sterilizing chamber 36 and, to some small extent, will dilute the sterilizing environment which means that some additional super-heated steam will need to be introduced into the sterilizing chamber from time to time to maintain the desired sterilizing environment. Obviously, the amount of additional steam that needs to be introduced due to this dilution will be minimal.

In the lower portion of Fig. 4, the operation of the outlet lock chamber 88 is shown in its four operating positions. In the first position, the upper valve 90 is open and the lower valve 94 is closed so that the sterilizing chamber 36 communicates with the lock chamber 88. As the belt 28 moves, some of the product being carried thereby will move over the right end 98 of the belt 28 and fall into the sealed chamber 88 past the upper valve 90. This will occur until the desired amount of product is in the chamber 88 whereupon the valve 90 will move to its closed position as shown in the second position and the lock chamber 88 will then be sealed closed at both opposite ends and the sterilizing chamber 36 will also be sealed. However, and

importantly, at all times the relief valve 102 will be open to some extent to relieve the pressure to atmosphere. At some later time, the outlet valve 94 will open while the upper valve 90 remains closed and when this happens, the charge of product in the chamber 88 will fall out the bottom of the lock chamber 88 past the valve 94 onto a device such as a tilted screen device 120 with an upwardly facing fan 122 positioned therebelow as shown. The air blown by the fan 122 will pass through the screen 120 and through product positioned thereon to cool and, if necessary, dry the product which thereafter will fall off the end of the screen 120 into a container 124 for further processing or packaging. The product as it leaves the chamber 88 will undergo only a slight pressure change due to the action of the relief valve 102 and no damage will be caused to the product as it falls onto the screen 120. When this operation has been completed, the bottom valve 94 will again close and the process will be repeated a step at a time. The screen 120 is shown pivotal about one end at 126 and the opposite end is urged down by spring 128. The screen 120 is shown supported on a cam 130 which cooperates with follower 132 so that when the cam 130 is rotated, it vibrates the screen to aid in moving the product therealong.

In the preferred form of the present construction, the openings and closings of the valves 70, 50 and 90 and 94 will be staggered so that the sterilizing chamber 36 will never be exposed to both of the lock chambers 62 and 88 at the same time. This means that the sterilizing chamber will never be diluted at any one time by more than the volume of one of the lock chambers 62 or 88. This is desirable since it means that less dilution of the sterilizing chamber will occur and therefore less

super-heated steam will be required to be introduced into the sterilizing chamber 36 to maintain the sterilizing environment.

One of the important features of the present construction therefore is that it requires less energy to maintain the sterilizing environment and the sterilizing environment is also produced using super-heated or dry steam as distinguished from wet steam. The use of super-heated steam is greatly preferred since super-heated steam, being dry steam, does not adversely affect the moisture content of the food product or spice being sterilized nearly as much and therefore, it has relatively little or no effect on the taste of the product being sterilized. Also, with the present construction, relatively low sterilizing pressures can be used in the sterilizing chamber 36 typically in the range from about 5 PSIG to about 30 PSIG, (about 1.35 Atm. to about 3.05 Atm.) ^(about 34.48 to 206.9 kN/m²) so that there is much less of a pressure differential between the pressure inside the sterilizing chamber 36 and the pressure of ambient atmosphere and even this lower pressure is further reduced in the outlet lock chamber 82 by action of the relief valve 102 before the product is discharged. This is important because it means that when the product is discharged from the sterilizing chamber into the lock chamber 88 and thereafter the lock chamber is opened to atmospheric pressure, the product undergoes relatively small and gradual pressure changes and hence, the product is not as likely to be damaged due to puffing or the like as compared to known sterilizing apparatus that use much higher sterilizing pressures and saturated or wet steam. As stated, all known prior art devices use much higher sterilizing pressures and temperatures and no known apparatus uses dry steam as distinguished from wet

steam in the sterilizing of products such as leafy herbs and spices. The present apparatus therefore has marked advantages over prior art constructions and the present apparatus is able to sterilize spices and like products with much less damage to the product, with much less loss of flavor and without substantial physical change.

Thus, there has been shown and described novel means and method for sterilizing substances such as food products including leafy herbs and spices which fulfils all of the objects and advantages sought therefor. It will be apparent to those skilled in the art, however, after considering this specification and the accompanying drawings, that many changes, modifications, variations, and other uses and applications for the subject means and methods are possible and are deemed to be covered by the invention which is limited only by the claims which follow.



CLAIMS

1. A process for sterilizing spices and leafy herbs comprising:

establishing a closed chamber having a pre-determined sterilizing temperature and pressure therein characterized by superheated steam in the closed chamber;

introducing a product selected from the group consisting essentially of spices and leafy herbs onto conveyor means in the closed chamber via an inlet chamber without exposing the closed chamber to ambient atmosphere;

exposing the product on the conveyor means to superheated steam in the closed chamber such that the superheated steam sterilizes the product;

transferring the product from the closed chamber to an outlet chamber without exposing the closed chamber to ambient atmosphere; and

relieving pressure in the outlet chamber at a rate selected to avoid puffing of the product without exposing the closed chamber to ambient atmosphere.

2. The process of Claim 1 wherein the conveyor means comprises an endless belt by which the product is conveyed to a discharge location aligned with the outlet chamber.



3. The process of Claim 1 wherein the establishing step comprises the step of introducing superheated steam at a temperature in the range of 215°F to 350°F (about 101°C to about 177°C) and a pressure in the range of about 5 PSIG to about 30 PSIG ^(about 34.48 to 206.9 kN/m²) into the closed chamber.

4. The process of Claim 1 further comprising the step of heating at least an exterior portion of the closed chamber.

5. The process of Claim 4 further comprising the step of heating the inlet and outlet chambers.

6. The process of Claim 1 further comprising the step of exposing the product in the inlet chamber to superheated steam.

7. An apparatus for sterilizing spices and leafy herbs comprising:

a sealed sterilizing chamber, said chamber having conveyor means for conveying a product spread on the conveyor means between an inlet position and an outlet position;

means for maintaining an environment of super-heated steam under a pressure and at a temperature in the sterilizing chamber selected such that the superheated steam sterilizes the product;

an inlet chamber attached to the sterilizing chamber and aligned with the inlet position to deposit the product on the conveyor means at the inlet position;



an outlet chamber attached to the sterilizing chamber and aligned with the outlet position to receive the product from the conveyor means at the outlet position;

each of said inlet and outlet chambers comprising a respective sealed chamber and valve means for alternately opening the respective sealed chamber to the sterilizing chamber and to a respective space outside the sterilizing chamber; and

means for reducing pressure in the outlet chamber at a sufficiently slow rate to ensure that the product in the outlet chamber is not puffed when the respective opening means opens the outlet chamber to the respective space.

8. The invention of Claim 7 wherein the conveyor means comprises an endless belt and means for moving the belt to convey the product from the inlet position to the outlet position.

9. The invention of Claim 7 wherein the pressure reducing means comprises a needle valve.

10. The invention of Claim 8 wherein the conveyor means comprises means for spreading the product on the belt.

11. The invention of Claim 7 wherein the environment maintaining means introduces the steam at a temperature in the range of 215°F to 350°F (about 101°C to about 177°C).



12. The invention of Claim 11 wherein the environment maintaining means introduces the steam at a pressure in the range of 5 PSIG to 30 PSIG, (about 1.35 Atm. to about 3.05 Atm.)
(about 34.48 to 206.9 kN/m²)
h

13. The invention of Claim 7 further comprising means for heating at least an exterior portion of the sterilizing chamber.

14. An apparatus for sterilizing fungible food products and like substances comprising a sealed housing member having a sterilizing chamber therein, an endless belt with spaced upper and lower belt reaches mounted in the sterilizing chamber and extending around spaced support members, means for moving the belt, inlet means including means forming a lock chamber attached to the housing at a location above the upper belt reach adjacent to one end thereof, outlet means including means forming a lock chamber attached to the housing at a location below the opposite end of the upper belt reach in position to receive products that fall off the belt end, each of said lock chambers having first valve means operable to control communication between the respective lock chamber and the sterilizing chamber and second valve means operable to control communication between the respective lock chambers and ambient atmosphere, means to control actuations of the first and second valve means so that the sterilizing chamber is never exposed to ambient atmosphere during operation of the sterilizing apparatus, and means associated with the outlet lock chamber for controllably relieving the pressure therein toward atmospheric pressure.



15. The apparatus defined in Claim 14 wherein the means associated with the outlet lock chamber for relieving the pressure therein includes a needle valve.

16. The apparatus defined in Claim 14 wherein the sealed housing member is a jacketed housing having inner and outer walls with a space formed therebetween, a source of steam and means connecting said source to the housing member to introduce steam from said source into the space between the inner and outer walls, and means for introducing superheated steam into the sterilizing chamber.

17. The apparatus defined in Claim 14 including means for introducing a substance to be sterilized into the inlet lock chamber when the second valve means associated therewith is open, and means for discharging the product introduced into the inlet lock chamber when the first valve means associated therewith is open so that the product can fall on the upper belt reach therebelow.

18. The apparatus defined in Claim 14 wherein some of the product on the upper reach of the belt being sterilized in the sterilizing chamber falls off the opposite belt end during movement thereof into the outlet lock chamber when the first valve means associated therewith are in a position establishing communication between the sterilizing chamber and the outlet lock chamber, and means for discharging the product contained in the outlet lock chamber when the second valve means associated therewith establish communication between the second lock chamber and ambient atmosphere.



19. The apparatus defined in Claim 18 including means for cooling the product discharged from the outlet lock chamber, said cooling means including a screen member positioned below the outlet lock chamber and means for blowing air upwardly through the screen member and through the product positioned thereon.

20. The apparatus defined in Claim 19 wherein the screen is mounted at an angle relative to horizontal.

21. The apparatus defined in Claim 20 including means to vibrate the screen to cause the product thereon to move toward the lower side thereof.

22. The apparatus defined in Claim 16 wherein the source of steam includes a boiler.

23. The apparatus defined in Claim 14 including motor means operatively connected to one of the spaced belt support members.

24. The apparatus defined in Claim 23 wherein the motor means include means producing intermittent operation thereof.

25. The apparatus defined in Claim 14 including means to maintain a predetermined sterilizing temperature in the sterilizing chamber in the range from about 215°F to 350°F (about 101°C to about 177°C).

26. The apparatus defined in Claim 14 including means to maintain a predetermined pressure in the sterilizing chamber in a range from about 5 PSIG to 30 PSIG (1.35 Atm. to 3.05 Atm.).
(about 34.48 to 206.9 kN/m²)



27. The apparatus defined in Claim 14 wherein the means for relieving the pressure in the outlet lock chamber relieves the pressure therein to about 5 PSIG ^(about 34.48 kN/m²) (1.35 Atm.) before the second valve means associated therewith operates to establish communication between the second lock chamber and atmosphere.

28. The apparatus defined in Claim 14 including means in the sterilizing chamber for maintaining the upper reach of the endless belt in a trough-shaped condition.

29. The apparatus defined in Claim 14 including means in the sterilizing chamber for relatively uniformly distributing the product being sterilized on the upper reach of the belt.

30. The apparatus defined in Claim 14 including means adjacent the opposite end of the upper reach of the belt to scrape the belt to remove product therefrom.

31. The apparatus defined in Claim 16 including means in the sterilizing chamber to relatively uniformly distribute superheated steam introduced therein.

32. The apparatus for sterilizing fungible food products such as leafy herbs and spices comprising:

a jacketed housing having spaced inner and outer wall portions with a sealed spaced formed therebetween, _____



the inner housing wall portion defining a sterilizing chamber therewithin;

means to introduce steam into the space between the inner and outer housing wall portions;

means to introduce superheated steam into the sterilizing chamber to produce a sterilizing environment therein;

an endless belt having upper and lower belt reaches and extending around spaced belt support members located in the sterilizing chamber;

motor means connected to one of the spaced belt support members to rotate said member to move the belt;

inlet means mounted on the housing at a location above the endless belt adjacent one end thereof, said inlet means including chamber forming means having an upper port for receiving products to be sterilized and a lower port for discharging products from the chamber into the sterilizing chamber and onto the upper belt reach, first valve means associated with the upper port to control communication therethrough, second valve means associated with the outlet port to control communication therethrough;

outlet means attached to the housing at a location below one end portion of the belt in position to receive products falling off the end of said belt, said outlet means including chamber forming means having an upper port in position to receive products falling off the belt _____



and a lower port for discharging products from the chamber, first outlet valve means associated with the outlet means to control communication between the sterilizing chamber and the outlet means, and second outlet valve means associated with the outlet means to control communication between the outlet means and ambient atmosphere; and

means associated with the outlet chamber to predeterminately relieve the pressure therein.

33. The process of Claim 1 wherein the product is exposed to superheated steam in the closed chamber for between 5 seconds and 40 seconds.

34. The process of Claim 1 wherein the predetermined sterilizing temperature and pressure established in the closed chamber ensure that the product is sterilized in the closed chamber without any substantial increase in its moisture content.
