United States Patent [19]

Kawahara et al.

[11] **3,824,917**

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[54] **STERILIZATION AND/OR COOKING APPARATUS**

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[51] **Int. Cl.** **A23l 3/04**

[58] **Field of Search** ..... 99/404, 470, 359–366, 99/473–478; 21/80, 56; 137/207.5, 576; 134/114; 34/242; 68/5 E; 8/149.1

[56] **References Cited**

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2,794,385	6/1957	Inghram	99/360
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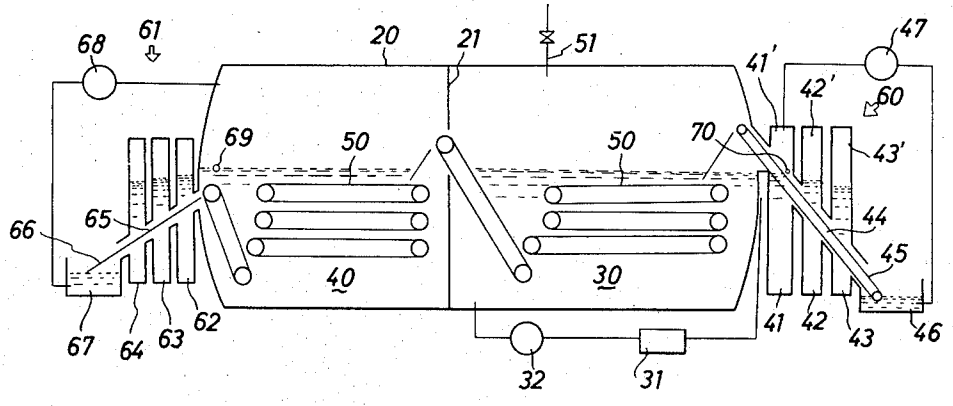
Primary Examiner—Leon G. Machlin
Attorney, Agent, or Firm—Browdy and Neimark

[57] **ABSTRACT**

A sterilization and/or cooking apparatus for the heat treatment of hermetically sealed containers such as cans, bottles, jars and the like, comprising a main chamber containing therein a high-temperature sterilizing and/or cooking medium under high pressure, an intermediate chamber containing therein a sealing liquid and communicated with said main chamber, and at least one auxiliary chamber containing therein a sealing liquid and communicated with the intermediate chamber in series at a level below the level occupied by the liquid in the auxiliary chamber. This chamber system may result in that the hydrostatic pressure applied or loaded on the outermost or final stage auxiliary chamber is reduced remarkably with respect to the pressure in the main chamber so that the leakage liquid from this auxiliary chamber can be suppressed in volume. The containers to be subjected to the heat treatment are introduced into the main chamber and withdrawn therefrom through the auxiliary chambers and intermediate chamber which are communicated in series to the main chamber through said communication system.

9 Claims, 5 Drawing Figures



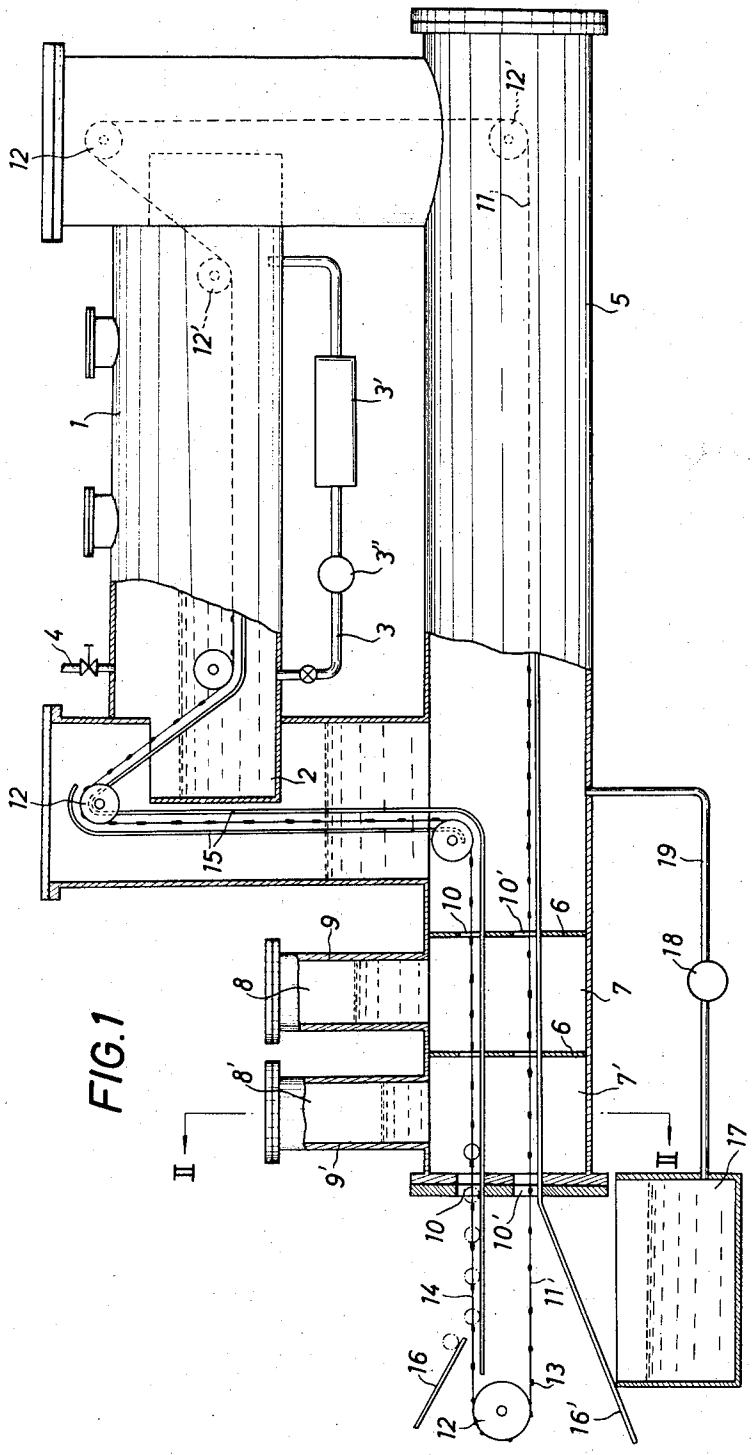

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FIG. 1

FIG.4

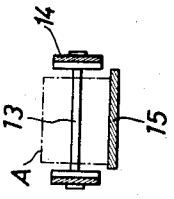


FIG.3

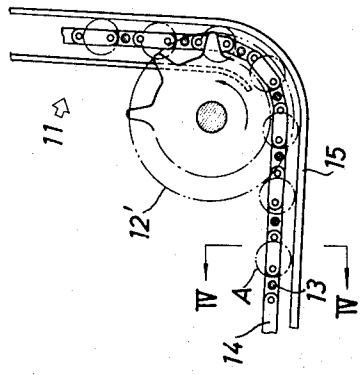


FIG.2

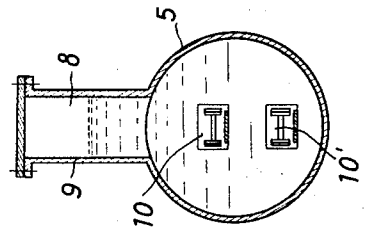
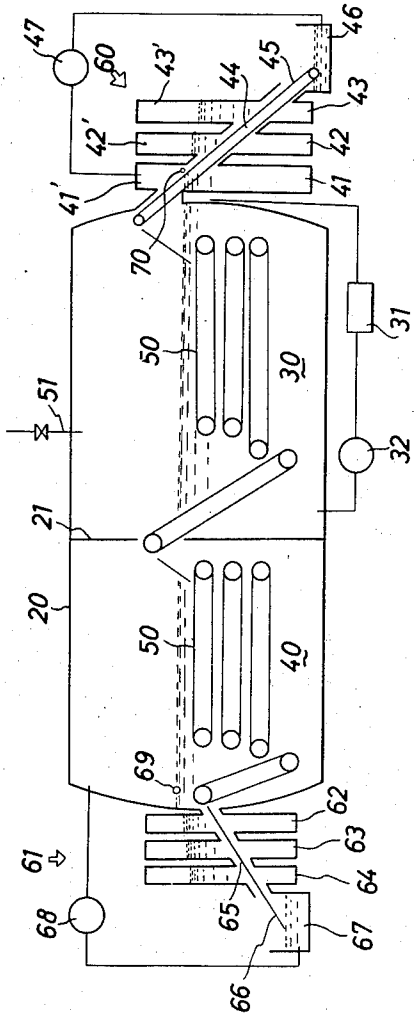


FIG.5



STERILIZATION AND/OR COOKING APPARATUS

The present invention relates to a continuous sterilization and/or cooking apparatus for products such as foodstuff or pharmaceutical products packed in containers of various forms, for example, cans, bottles, jars or bags. More particularly, it relates to an improvement in a sealing system which is provided for introducing the containers into a heat-treating chamber and withdrawing them therefrom without substantially changing or reducing the pressure in the heat-treating chamber.

BACKGROUND OF THE INVENTION

Conventionally, there have been developed various types of apparatus and systems for heat sterilizing and/or cooking the foods and drinks, pharmaceutical products hermetically sealed or packed in the suitable containers. One of the conventional, typical sterilization and/or cooking techniques is the batch process in a retort which is filled with a heat-treating medium under pressure. With such batch process, however, it is difficult or impossible to heat-treat the containers in a continuous manner.

Accordingly, many attempts have been proposed to sterilize and/or cook the containers in a continuous manner. The most serious difficulty encountered in such continuous heat-treating techniques for the containers is how to introduce the containers into the heat-treating chamber and withdraw them therefrom without substantially changing or reducing the pressure in the chamber. One of the most typical continuous heat-treating system well-known hereto is the hydrostatic cooker or hydrostatic sterilizer, for example, disclosed in U.S. Pat. No. 3,469,988 granted to Ernest S. Yawger. In accordance with this Yawger's U.S. patent, the inlet and outlet hydrostatic columns are provided in communication with the sterilizing and/or cooking chamber to keep the high-pressure, high-temperature sterilizing and/or cooking medium within the sterilizing chamber. The containers, having packed therein the content to be heat-treated, are introduced through the inlet hydrostatic column by means of an endless sprocket chain into the sterilizing chamber where the content in each container is subjected to the sterilization and/or cooking treatment during its movement through the sterilizing chamber along the serpentine path. Finally the containers thus sterilized and/or cooked are removed from the sterilizing chamber through the outlet hydrostatic column. Such hydrostatic sterilizer or cooker requires very high hollow columns for providing the hydrostatic columns or legs, which must inevitably be strongly built sufficient to resist against the large hydrostatic pressure. Thus, this technique involves the industrially disadvantageous problems of resulting in a high cost in its production and maintenance.

Another conventional continuous heat-treating technique is a rotary-type pressurized cooker or sterilizer disclosed in, for example, U.S. Pat. No. 3,347,155 granted to Samuel A. Mencacci, wherein the inlet and outlet mechanisms of rotary valve type are respectively provided at the inlet and outlet ports of the cooking and/or sterilizing chamber to substantially prevent the heat-treating medium from leakage upon introduction and withdrawal of the containers into and out of the cooking chamber. The disadvantageous problems in this rotary-valve type cooker, however, are in that the inlet and outlet mechanisms should be mounted so as

to resist the high pressure in the cooker and further in that it is substantially impossible to effectively process containers such as plastic film bags or the like, which are recently availed in package field, other than the solid containers such as jars, glass bottles, cans and the like.

Alternatively, there has been further proposed a sterilization apparatus of the type disclosed in U.S. Pat. No. 3,418,918 granted to Max Beauvais et al. This sterilization apparatus principally has a chamber adapted to be pressurized and to contain a sterilization medium in its upper portion or head space and a cooling liquid in its lower portion, and a sealing mechanism comprising a rotary drum immersed under the sealing liquid and serving both for entry and exit of the containers which are transported through an endless chain conveyor. This system disadvantageously requires the strongly built, large-sized sealing mechanism to sufficiently support the hydrostatic pressure exerted thereon by the sealing liquid and the pressurized heat-treating medium. Further, even if the sealing mechanism effectively accomplish its purpose, a relatively large amount of sealing liquid may leak out through this mechanism so that the pump for returning the leakage liquid to the retort or chamber should have a relatively large capacity.

SUMMARY OF THE INVENTION

A principal object of the present invention is to provide a novel and improved sealing system which may be predominantly used in the apparatus for continuously sterilizing and/or cooking containers such as tins, bottles, jars, bags and the like.

Another object of the present invention is to provide a novel and improved sealing system which is simple in structure and also remarkably reduced in the mechanical strength necessary against the hydraulic pressure.

Further object of the present invention is to provide a novel and improved sealing system in which the leakage of the sealing liquid out of the sterilizing and/or cooking system may be greatly minimized so that the pump of relatively small capacity may be used for circulating the leakage liquid into the sterilizing and/or cooking system.

In accordance with a feature of the present invention, there is provided a sterilizing and/or cooking apparatus, more particularly for treatment of containers having packed therein products comprising a main chamber adapted to contain a high-temperature heat-treating medium under high pressure, an intermediate chamber containing a sealing liquid in its lower portion and having a head space of gaseous phase which is communicated with said main chamber through an aperture, at least one auxiliary chamber containing the sealing liquid in its lower portion and communicated in series with the intermediate chamber through ports which are each provided at a level below the level occupied by the liquid in this auxiliary chamber, the final-stage auxiliary chamber being provided with an opening which is opened at a level below the level occupied by the liquid in this chamber, conveyor means for introducing the containers into the main chamber and withdrawing them therefrom through said opening, ports and aperture, and means for replenishing the sealing liquid equivalent in volume to the leadkage liquid out of the final-stage auxiliary chamber through its opening.

In accordance with another feature of the present invention, there is also provided a sterilizing and/or cooking apparatus wherein the aperture of the intermediate chamber for the communication with the main chamber, the ports of at least one auxiliary chamber and the opening of the final-stage auxiliary chamber are each provided in pairs in such a manner that one side of them serves for the entry of the containers and another side of them serves for the exit of the containers, and the conveyor means extends into the main chamber through the entry or inlet opening, ports and aperture and further extends out of the final-stage auxiliary chamber through the exit or outlet aperture, ports and opening.

These and other objects and advantages of the present invention will become apparent from the following description and the accompanying drawings, in which:

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is schematic elevational view, a part thereof being broken away, showing an embodiment of a sterilizing and/or cooking apparatus which is incorporated with a sealing system according to the present invention;

FIG. 2 is a cross-sectional view taken along the line II — II of FIG. 1;

FIG. 3 is a fragmentary schematic view showing an endless chain conveyor carrying the containers;

FIG. 4 is a schematic cross-sectional view substantially taken along the IV — IV of FIG. 3; and

FIG. 5 is a schematic elevational view of a modified sterilizing and/or cooking apparatus in which the inlet mechanism and the outlet mechanism for the containers are arranged in opposite relationship.

DESCRIPTION OF PREFERRED EMBODIMENTS

Referring now FIGS. 1 and 2 in which a preferred embodiment of the present invention is illustrated, a tank indicated generally at reference numeral **1** comprises a main chamber **2** containing therein a heat-treating medium, for example, hot water, under pressure and an intermediate chamber **5** as described hereafter in details. The products such as foodstuffs and pharmaceutical products heremetically packed or sealed within containers are subjected to the sterilization and/or cooking in the main chamber **2** to which a heat-treating medium supply line **3** and a high-pressure gas supply line **4** are connected in a fluid communication manner. The heat-treating medium is heated up to a predetermined temperature by a suitable heating unit **3'** and further supplied through the heat-treating medium supply line **3** into the main chamber **2** in a circulating manner and on the other hand a suitable gas such as air is first highly pressurized up to, for example, about 2 to 3.5 kg/cm^2 in atmospheric pressure, and then applied through high-pressure gas supply line **4** into the main chamber **2** to thereby provide the temperature rise of the heat-treating medium above 100° C and also prevent the heat-treating medium from boiling or vaporization.

Provided at the opposite ends of the main chamber **2** are vertical columns which are connected at their lower portions with one another to thereby constitute in unision and intermediate chamber **5** which contains a sealing and cooling liquid in its lower portion and has the fluid communication at its head space with the head space of the main chamber through apertures or passages for permitting the containers to move therethrough. The intermediate chamber **5** is further connected through a partition wall **6** to a plurality of compartments which form auxiliary chambers **9, 9'** each containing the sealing and cooling liquid in its lower portion to thereby define a head space **8, 8'** above a level occupied by the sealing and cooling liquid. It is to be noted that the partition walls **6** are each formed below the liquid level with a pair of vertically spaced ports **10** and **10'** for permitting the containers to be conveyed across the partition wall. It is further to be noted that the final-stage auxiliary chamber is provided at its end plate or wall with a pair of vertically spaced openings **10, 10'** which may serve respectively for entry and exit of the containers. It will be understood that the openings **10** and **10'** in the end wall of the final-stage auxiliary chamber are also arranged a level below the liquid level as in the ports in another auxiliary chamber.

Next, referring to FIGS. **3** and **4,** endless conveyor means is indicated generally at **11** and comprises a pair of laterally spaced endless chains **14** looped over a driving sprocket wheel **12** and a suitable number of idler sprocket wheels **12'** and connected to each other with a plurality of spaced traverse rods **13** extending across the chains, and container guide rails **15** arranged along the path of the endless chains. An upper platform **16** for loading the containers-to-be-treated on the conveyor means and a lower platform **16'** for receiving the treated containers thereon from the conveyor means are arranged in a vertically opposite relation with respect to the conveyor portion of the conveyor means which portion is exposed out of the final-stage auxiliary chamber. A reservoir **17** is located to receive therein the sealing liquid which will leak out through the openings **10** and **10'** of the final-stage auxiliary chamber **9'**. The sealing liquid thus received in the reservoir **17** is returned into the intermediate chamber **5** through a line **19** by the action of a pump **18.** Although the reservoir **17** illustrated in FIG. **1** is of the type such that the level occupied by the sealing liquid in this reservoir is always below the openings **10** and **10'** of the final-stage auxiliary chamber **9'**, it will be apparent to those skilled in the art that a modified reservoir may be alternately used in which the liquid level in this reservoir may be above the level of the openings **10** and **10'**.

Now assuming that the tank **1** including the main chamber **2** is kept at a predetermined internal pressure, for example, at 2 kg/cm^2, it has been found that the head space **8** defined in the auxiliary chamber **9** is applied with the pressure somewhat less than the pressure kept in the tank **1,** namely 1.33 kg/cm^2 and further the following head space **8'** defined in the auxiliary chamber **9'** is applied with the more reduced pressure with respect to the pressure determined at the head space **8,** namely 0.67kg/cm^2. From the foregoing, it will be understood that the hydrostatic pressure exerted on the openings **10** and **10'** of the final-stage auxiliary chamber, that is, the sealing liquid flow discharged out through the openings **10** and **10'** is gradually reduced in proportion to the number of the auxiliary chambers installed there and, therefore, the volume of sealing liquid to be replenished by the pump **18** may be reduced considerably.

When supplying successively containers A onto the endless conveyor means **11,** the containers are ad-

vanced along the guide rails **15** under engagement with the traverse rods **13** of the driven endless chains **14.** Thus, these containers are forcibly moved into the outermost auxiliary chamber **9'** through its openings **10** against the sealing liquid flow which is now hydrostatically forced out through the same opening and then moved into the intermediate chamber **5** after passing successively the auxiliary chambers **9'** and **9.** The containers are charged from the intermediate chamber **5** into the main chamber **2** where they are subjected to the heat treatment or sterilization and/or cooking. The containers thus heat-treated are returned from the main chamber **2** into the intermediate chamber **5** and conveyed again through the auxiliary chambers **9** and **9'** until they are released on the lower platform **16'** from the conveyor means after passing through the lower opening **10'** of the final-stage auxiliary chamber **9'**.

Meanwhile the sealing liquid issued from the openings **10** and **10'** of the auxiliary chamber **9'** into the reservoir **17** is returned by the pump **18** through line **19** into the intermediate chamber **5** to maintain the level in the latter constant.

In the first embodiment of the present invention as described above, the high-temperature, high-pressurized main chamber is connected at its opposite ends in a fluid communication manner with the intermediate chamber **5** which is integrally provided with a plurality of auxiliary chambers in which the sealing liquid is contained to define a head space above the liquid level and also the ports are provided below the liquid level. The containers to be subjected to the heat treatment are introduced into the main chamber and withdrawn therefrom in a continuous manner under favour of the hydraulics characteristics of the auxiliary chambers.

Finally referring to FIG. **5** illustrating a modification it is seen that the entry side and the exit side for the containers are arranged opposed with respect to the high-temperature, high-pressurized main chamber. A highly pressurized retort **20** is divided by an insulating vertical wall member **21** into two adjacent compartments one of which is a main chamber **30** containing therein a heat-treating medium, for example, hot water, and the other of which is a first intermediate chamber **40** containing a sealing and cooling liquid. These chambers are provided therein with a bucket-type conveyor system or other suitable conveyor systems to continuously moving the containers such as cans, jars, bottles and the like from the entry of the main chamber **30** to the exit of the first intermediate chamber **40.**

Although the heat-treating medium in the main chamber **30** is heated up to a predetermined temperature and makes circulation by the action of a pump **32,** it will be heated up above normal 100° C under the high-pressure air as described just below. Upon sterilizing and/or cooking process, both of the main chamber **30** and the first intermediate chamber **40** are equally applied with the pressurized air of, for example, 2 to 3.5 kg/cm² in pressure, which may be delivered through a line **51** from a compressor (not shown), whereby the temperature rise of the heat-treating medium and the prevention of the medium from boiling are accomplished.

The entry means for introducing the containers into the main chamber **30** of the retort **20** is indicated generally at **60** and comprises a second intermediate chamber **41** and a plurality of auxiliary chambers **42, 43** which are connected in series through fluid communication paths **44** each being arranged between any adjacent chambers in such a manner that the initial internal pressure applied in the main chamber **30** is step-by-step reduced along the chambers other than the main chamber. and second intermediate chamber, and conveyor means of, for example, a bucket type extending through the second intermediate chamber and auxiliary chambers and also through the fluid communication paths **44.**

The fluid communication paths **44** include a communication path which connects the head space **41'** of the second intermediate chamber **41** to the air-filled head space of the main chamber **30** and also include other communication paths each of which connects any two adjacent chambers other than the main chamber to one another at a level below the liquid level so that the head spaces **42', 43'** of the auxiliary chambers **42, 43** are confined independently from each other by the sealing liquid.

It has been found that, when the main chamber **30** as well as the head space **41'** of the second intermediate chamber **41** are both maintained at a predetermined pressure of 2 kg/cm², the head space **42'** provided in the auxiliary chamber **42** has the pressure of 1.33 kg/cm² and the following head space **43'** of the auxiliary chamber **43** has the pressure of 0.67 kg/cm². It will be seen that the hydrostatic pressure applied to the outermost auxiliary chamber, that is, the sealing liquid flow issued out through openings of the outermost auxiliary chamber may be gradually reduced in proportion to the number of the auxiliary chambers installed there. The containers, for example, cans are charged into the main chamber **30** by the conveyor means **45** against the sealing liquid flow discharged out of the auxiliary chambers.

The sealing liquid leaked out from the outermost or final-stage chamber **43** is directly received in a reservoir **46** and then returned therefrom to the second intermediate chamber **41** by a pump **47** to thereby keep the second intermediate chamber **41** at a constant liquid level. It is preferable that the sealing liquid described above has a high temperature sufficient to preheat the containers prior to the introduction into the main chamber **30.**

The exit means for withdrawing the containers from the first intermediate chamber **40** of the retort **20** is indicated generally at **61** and comprises a plurality of auxiliary chambers **62, 63, 64** which are connected in series through fluid communication paths **65** each being arranged between any two adjacent chambers in such a manner that the initial internal pressure applied in the first intermediate chamber **40** is step-by-step reduced along the auxiliary chambers, and conveyor means **66** of, for example, a chute type or roller type extending through the auxiliary chambers and also through the fluid communication paths **65.**

It will be seen that the fluid communication paths **65** are provided so as to connect any two adjacent chambers to one another at a level below the liquid level so that the head space of the first intermediate chamber **40** and the head spaces **62', 63', 64'** of the auxiliary chambers **62, 63, 64** are confined independently from each other by the sealing liquid.

The sealing liquid leaked out from the outermost or final-stage chamber **64** is directly received in a reser-

voir **67** and then returned therefrom to the first intermediate chamber **40** by a pump **68** to thereby keep the first intermediate chamber **40** at a constant liquid level.

It has been, accordingly, found that when the retort **20** or the first intermediate chamber **40** is maintained at a predetermined pressure of 2 kg/cm², the head space **62'** provided in the auxiliary chamber **62** has the pressure of 1.5 kg/cm² and the following head space **63'** of the auxiliary chamber **63** has the pressure of 1.0 kg/cm² and finally the head space **64'** of the auxiliary chamber **64** has the pressure of 0.5 kg/cm². It will be thus understood that the hydrostatic pressure applied to the outermost or final-stage auxiliary chamber, that is, the sealing liquid flow issued out through the openings of the outermost auxiliary chamber **64** may be gradually reduced in proportion to the number of the auxiliary chambers provided there.

Reference numerals **69** and **70** indicate holes which are each provided in the first and second intermediate chambers for automatically controlling the liquid level of these chambers.

Operation of this second embodiment of the present invention is as follows:

The containers, for example, cans, bottles or the like are successively charged into the main chamber through the auxiliary chambers **42, 43,** the second intermediate chamber **41** and also the fluid communication paths **44** by the conveyor means **45** against the sealing liquid flow discharged out of the outermost auxiliary chamber **43.** The containers are subjected to the heat treatment during its movement in the main chamber which contains therein the heat-treating medium under high pressure and they are then cooled down in the first intermediate chamber **40** which contains the cooling liquid under the same pressure as in the main chamber. Finally the treated containers are successively discharged out by the conveyor means **66** through the sealing system comprising the intermediate chamber and the auxiliary chambers which are in series connected to the main chamber through the fluid communication paths each arranged between any two adjacent chambers so as to step-by-step reduce the internal pressure exerted on the main chamber. Thus, the main chamber are hydrostatically kept under high pressure by the sealing system through which the products or containers are successively introduced into the main chamber and withdrawn therefrom with successful sterilization and/or cooking treatment in a continuous manner.

The hydrostatic pressure exerted on the outermost or final-stage auxiliary chamber may be gradually reduced with respect to the initial internal pressure in the main chamber in proportion to the number of the auxiliary chambers employed there and, accordingly, the sealing liquid flow issued out of the outermost or final-stage auxiliary chamber may be reduced with increasing of the auxiliary chambers. In accordance with the present invention, advantageously, the sealing liquid to be returned into the intermediate chambers to keep the liquid level thereof may be rendered little in its volume and also the pressure exerted on the containers is gradually changed along the movement thereof with the result that the risk of damage is substantially minimized.

Although the preferred modes contemplated for carrying out the present invention have been herein shown and described it will be apparent that modification and variation may be made without departing from what is regarded to be the subject matter of the present invention as set forth in the appended claims.

Having completed a detailed description of the invention so that those skilled in the art could practice the same.

We claim:

1. A sterilizing and/or cooking apparatus, more particularly for treatment of packed containers comprising;

a main chamber adapted to contain a high-temperature, heat-treating medium under high pressure;

an intermediate chamber containing a sealing liquid in its lower portion and having a head space of gaseous phase which is communicated with said main chamber through an aperture;

at least two auxiliary chambers containing the sealing liquid in its lower portion and communicated in series with said intermediate chamber through ports which are each provided at a level below the level occupied by the sealing liquid in this auxiliary chamber, the final-stage auxiliary chamber being provided with an opening at a level below the level occupied by the liquid in this chamber;

conveyor means for introducing the containers into said main chamber and withdrawing them therefrom through said opening, ports and aperture; and

means for replenishing said sealing liquid equivalent in volume to the leadkage liquid out of said final-stage auxiliary chamber through its opening.

2. An apparatus defined by claim **1,** wherein the aperture of the intermediate chamber for the communication with the main chamber, the ports of at least one auxiliary chamber and the opening of the final-stage auxiliary chamber are each provided in pairs in such a manner that one side of them serves for the entry of the containers and another side of them serves for the exit of the containers, and the conveyor means extends into said main chamber through the entry opening, ports and aperture and further extends from said main chamber out of the final-stage auxiliary chamber through the exit aperture, ports and opening.

3. An apparatus defined by claim **1,** wherein said means for replenishing the sealing liquid into the intermediate chamber comprises a reservoir for receiving the sealing liquid flow leaked out from the final-stage auxiliary chamber, and a pump for returning the sealing liquid from said reservoir into the intermediate chamber through a pipe line.

4. A sterilizing and/or cooking apparatus, more particularly for treatment of packed containers comprising;

a retort including two compartments which are separated from each other by an insulating partition wall, one of which compartments serves as a main chamber adapted to be pressurized and adapted to contain a heat-treating liquid in its lower portion, another of which compartments serves as a first intermediate chamber adapted to be pressurized and adapted to contain a sealing and cooling liquid in its lower portion, and said both compartments being communicated to each other through an aperture at their head space of gaseous phase;

a second intermediate chamber containing the heat-treating liquid in its lower portion, said second intermediate chamber being arranged in opposition to said first intermediate chamber with respect to said main chamber and communicated at its head space to the head space of said main chamber through an aperture;

a first auxiliary chamber assembly comprising a plurality of auxiliary chambers each of which contains the sealing and cooling liquid in its lower portion and communicated to its adjacent chambers at their liquid phases through ports, the outermost auxiliary chamber of which chambers is provided below its liquid level with an opening for exit of the containers, and said auxiliary chamber assembly being communicated to said first intermediate chamber at their liquid phases;

a second auxiliary chamber assembly comprising a plurality of auxiliary chambers each of which contains the heating and sealing liquid in its lower portion and communicated to its adjacent chambers at their liquid phases through ports, the outermost auxiliary chamber of which chambers is provided below its liquid level with an opening for entry of the containers, and said scond auxiliary chamber assembly being communicated to said second intermediate chamber at their liquid phases;

conveyor means arranged for advancing the containers into said second auxiliary chamber assembly through its entry opening, moving them through said ports of said auxiliary chamber assembly into said second intermediate chamber and further moving them from said second intermediate chamber through said main chamber and said first intermediate chamber into said first auxiliary chamber assembly, and finally withdraw them from said first auxiliary chamber assembly through its exit opening; and

means for replenishing the sealing liquid into said intermediate chambers, said sealing liquid being equivalent in volume to the leakage sealing liquid out of said auxiliary chamber assemblies through their openings.

5. An apparatus defined by claim **1**, wherein there is further provided means for heating and circulating the heat-treating medium in the main chamber.

6. An apparatus defined by claim **4**, wherein there is further provided means for heating and circulating the heat-treating medium in the main chamber.

7. In a sterilization device for the treatment of packed containers, comprising:

a sterilization chamber for containing a heating medium of high temperature under high pressure, means to provide heated and pressurized fluid to said sterilization chamber, inlet means to said chamber and outlet means from said sterilization chamber, means to pressure seal said inlet means and outlet means to maintain said high pressure, and means for conveying packed containers through said inlet, through said sterilization chamber and out said outlet, the improvement wherein:

said pressure seal means comprises a plurality greater than two of subsidiary chambers connected in series adjacent one another and communicating through openings with one another and with said sterilization chamber, said subsidiary chambers containing liquid at a level above said openings, and a pressure head in each subsidiary chamber such that the pressure head is highest in the subsidiary chamber closest to said sterilization chamber and becomes progressively lower for each subsequent subsidiary chamber, and

wherein said conveying means pass through said openings between adjacent chambers.

8. A sterilization device in accordance with claim **7** comprising only one said series of subsidiary chambers and wherein two openings are provided between each adjacent pair of chambers, one said opening for said inlet means and one said opening for said outlet means.

9. A sterilization device in accordance with claim **7** comprising two said series of subsidiary chambers, one for said inlet means and one for said outlet means.

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