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[54] **CONTINUOUS COOKING MEANS**
4 Claims, 4 Drawing Figs.

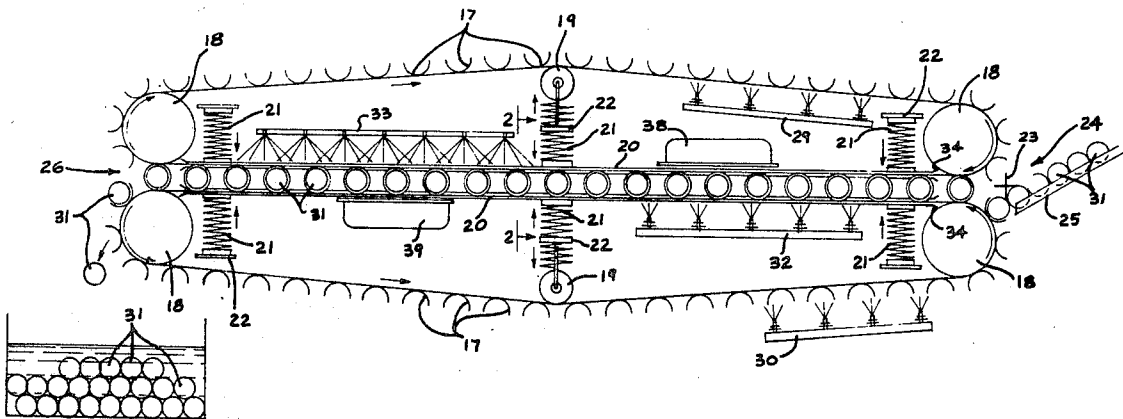
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369, 360—362

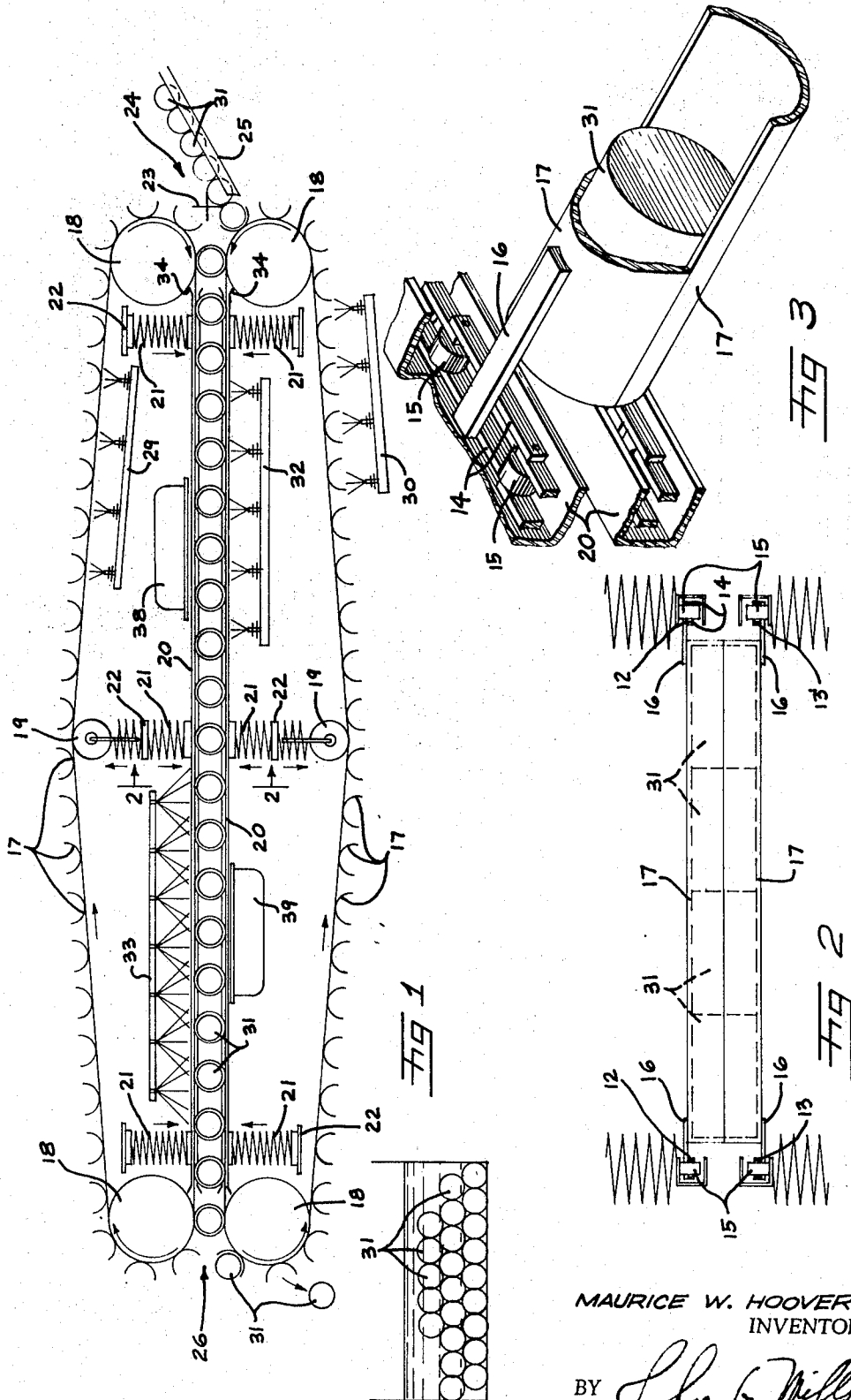
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ABSTRACT: In abstract, a preferred embodiment of this invention is a continuous cooker for canned goods which, through the use of jackets, allows high internal temperatures to be reached in a short time with associated high internal pressures without expanding, deforming or otherwise adversely affecting the shape of the can or its contents.





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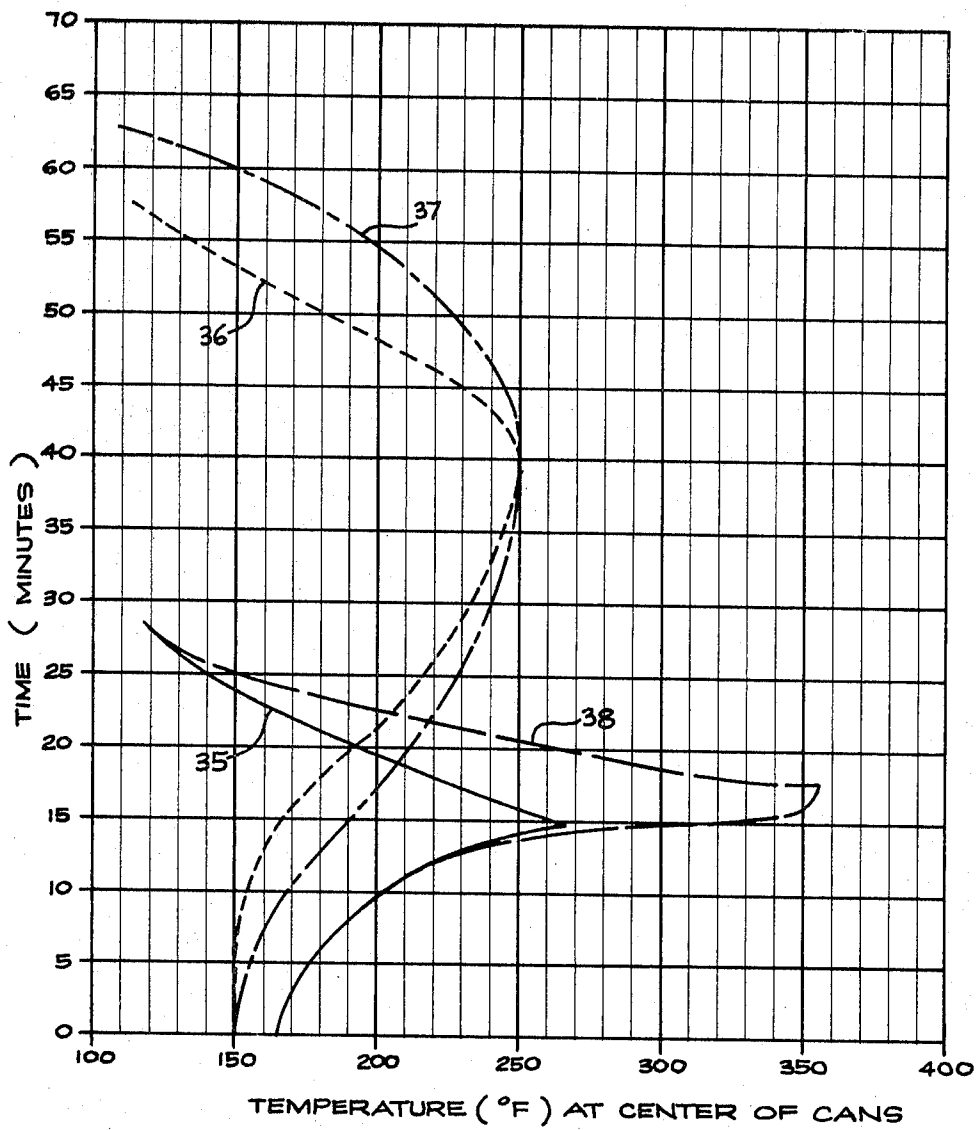


FIG. 4

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CONTINUOUS COOKING MEANS

This invention relates to food processing and more particularly to continuous canned product cooking and sterilizing devices which allow high internal temperatures to be reached in a short period of time without distorting the food container due to high internal pressures.

For many years, the partial cooking of and the sterilization of goods preserved in containers such as cans have been accomplished by placing the blanched or partly cooked product into the containers and placing such containers in a bath retort which allows temperature to be slowly raised to the point that all bacteria and other forms of life are killed. Very careful monitoring has to be maintained throughout the process to assure that adequate internal heat is accomplished while at the same time preventing too rapid heat-up and excessive temperature which might either distort the exterior of the can or even cause the same to explode. This monitoring of each individual batch or group of containers is time consuming and, therefore, costly to the processor. Additionally, the time and labor involved in loading and unloading the retort for each batch processed adds even more cost to the operation.

In recent years, efforts have been made to devise a system to eliminate the laborious task of loading and unloading the retort for each run. One system that is now being used is known as the Hydrostatic Cooker or Hydrostatic Sterilizer wherein steam in a steam chamber is controlled by pressure produced in a pair of water legs. A conveyor is used for continuously feeding the canned product down through one water leg into the steam chamber for cooking and out through the second water leg into a cooling area. Although the processing time for any given container is approximately the same as for the batch process due to the fact that the temperature must be gradually raised to prevent excessive internal pressures from building up, the advantage of the Hydrostatic process is that it is a continuous operation system thereby not only reducing the labor required but also allowing more containers to be processed per square foot of plant space. The disadvantage of the Hydrostatic systems, however, is that they are only recommended for large plants operating year round preferably on a two-shift basis. The reason for this is the large capital investment of approximately one-quarter of a million dollars for the initial installation exclusive of the high roofed building required to house the water leg towers.

In the last few years, a third process has been developed which has been called the Flash 18 Process which consists of pressurizing the entire processing room to 18 p.s.i. The product containers are then conveyed through this room where they are heated to approximately the same temperatures as in the Hydrostatic Process. The same disadvantages are found here as in the Hydrostatic system in that it is extremely expensive to purchase and install and the system additionally requires all workers to go through a decompression cycle similar to that required of divers.

Experiments have recently been conducted using a continuous conveyor to move cans over a direct flame for sterilization purposes. This type system, however, has only limited applications at best in that, due to the high internal pressure which rapidly builds up, only relatively small cans can be used and these must be of extra thick walls to prevent distortion and explosion during processing. It has also been found that undesirable heat caused discoloration invariably occurs on the exterior of the containers thereby reducing their consumer appeal.

Thus it can be seen that the present status of the art produces the situation that only large processors can afford to install the labor and time saving continuous feed systems embodied in the Hydrostatic and Flash 18 systems while the smaller processors must settle for the less expensive batch processing systems which are slower and cost more to operate.

The present invention has been developed after much research and study into the above mentioned problems and is designed to provide a continuous operation food processing system which can be afforded by both small and large proces-

sors while at the same time cutting the processing time by at least 50 percent. By reducing the processing time, a superior product in taste and texture is produced.

It is an object, therefore, of the present invention to provide a continuous operation cannery sterilization system which is less expensive to purchase, install and operate.

Another object of the present invention is to provide a canned food sterilization system which allows more rapid heat-up and cool-down with associated higher internal pressures than heretofore has been possible without distorting the containers or damaging to the product.

A further object of the present invention is to provide a canning system which can be readily adjusted to handle either a high acid product or a low acid product in less time than has heretofore been possible.

Another advantage of the present invention is to provide, in a canned product sterilization system, a means for setting up internal currents and ebbs to speed up the heating and cooling steps of the process.

An additional object of the present invention is to provide a can sterilization system which allows internal pressures in excess of six times that ordinarily considered maximum in the retort and hydrostatic cooker to be reached without danger of distortion or explosion of the containers.

Another object of the present invention is to provide a sterilizer which may be operated regardless of the size of the can or the relative thickness of its walls up to an internal pressure of 100 p.s.i.

Other objects and advantages of the present invention will become apparent and obvious from a study of the following description and the accompanying drawings which are merely illustrative of the present invention.

In the drawings:

FIG. 1 is a side elevational view in schematic form of the canned product sterilizing system of the present invention;

FIG. 2 is a sectional view taken through lines 2-2 of FIG. 1;

FIG. 3 is a cutaway perspective of a portion of the conveyor showing its relationship to the channel members and semicylindrical pressure sleeves; and

FIG. 4 is a graphic comparison of the internal temperatures of the canned product during processing by various methods.

With further reference to the drawings, applicant's continuous feed canned food sterilization system indicated generally at 11 has a pair of upper conveyor chains 12 and 12' and a pair of lower conveyor chains 13 and 13'.

Although other forms could be readily substituted, one configuration of chain that works well within the system of the present invention is shown in a cutaway portion of FIG. 3. Here pairs of matching links 14 have mounted therebetween rotatable rollers 15 for reducing friction when the chain is in slidable contact with its channel member as will be hereinafter described in detail. As can be seen from both FIGS. 2 and 3, mounting arms are secured at spaced intervals to at least one of the links between two rollers and extend outwardly generally perpendicular therefrom. Secured to the outwardly projecting portion of each arm is one end of the generally semicylindrical shaped pressure sleeve half 17. Thus it can be seen, particularly from FIG. 2, that each of the sleeve halves 17 is carried by its ends being mounted between and to each of the pairs of chains.

Sprockets 18 are paired for operation in conjunction with each of the conveyor chains. At least one of these sprockets is rotatively powered by any convenient means (not shown) such as an electric motor.

In addition to the sprockets 18, an adjustable tension sprocket 19 is provided to prevent undesirable loose motion in the system.

A channel member, preferably U-shaped in cross section and flared outwardly at each end, is floatingly mounted in operative association with each of the chain conveyors. These channel members are disposed in pairs parallel to each other at a distance approximately equaling the diameter of two mated pressure sleeve halves 17 as is obvious from the drawings.

To maintain each pair of sleeve halves 17 in tight aligned relationship during the travel of the canned product through the sterilization system, tension means such as springs 21 are attached to each end and to the center of each of the channel members 20. The opposite end of each of these springs is attached to a fixed member indicated at 22. Thus it can be seen that adjacent floating channel members are biased toward each other in the direction of the arrows in FIG. 1 to assert a positive holding pressure against separation of the mated halves.

A feed sprocket 23 is provided at the entrance end 24 of the system 11. This sprocket which can operate similar to a Geneva gear, is synchronized through mechanical means (not shown) with either one of the sprockets 18 or one of the conveyor chains. The purpose of this sprocket is to feed one can at the time into the lower sleeve half just prior to its mating with the upper sleeve half. A means such as a channel rack 25 is provided to, through gravity force, feed the cans to the feed sprocket 23.

Adjacent the exit end 26 of the system 11 is a final cooling means such as liquid filled tank 27. The liquid 28 within said tank may be maintained in a cool state by either recirculating such liquid through a circulation system (not shown) or by providing means such as cooling coils (not shown) in or adjacent at least one wall portion.

If desired, an automatic conveyor (not shown) can be provided for removing the cooled containers from the final cooling area 27 to labeling and packing stations (not shown).

Located along the return path of the pressure sleeve halves 17 are upper and lower preheating means such as burners 29 and 30. As is evident from FIG. 1, the preheaters are located in the area adjacent entrance end 24 so that when the cans 31 containing food to be processed are clamped between the mating pressure sleeves, such cans will immediately begin their heating cycle.

Also located adjacent entrance end 24, but in the area where the pressure sleeve halves are mated, is the primary heating section 32. Although the heating means is disclosed as a flame system, it can, of course, be operated by electrical radiant heat, steam heat, or other convenient means.

As the canned-product within the pressure sleeve leaves the primary heating section 32, it enters the primary cooling section 33. Although there are several ways in which the encased canned product could be cooled, one of the more efficient ways has been found to be sprays of cool water.

Connected at least to one channel member and located adjacent, respectively, to the primary heating section 32 and the primary cooling section 33 is vibrator-shaker 38 and vibrator-shaker 39. The purpose of these two units is to set up flowing currents in the canned product to more rapidly distribute the heat or cold, as the case may be, to the interior of the product. The spring tensioning of the floating channel members not only maintains constant pressure against separation of the mated sleeve halves 17, but also allows adequate flexing for proper vibration of the shaker units.

OPERATION

In actual operation of the sterilization system of the present invention, the upper pair of conveyor chains 12-12' and a lower pair of conveyor chains 12-13' move at the same speed and in the direction indicated by the arrows in FIG. 1. The synchronization of these two sets of conveyor chains is controlled by synchronizing the drive forces (not shown) of the respective sprockets 18.

The preheaters 29 and 30 are placed in operation to raise the temperature of the sleeve halves 17 as they approach the entrance end 24 of the system 11. Cans or other containers 31 move by gravity down the rack 25 and into a lower sleeve half 17. The loading of the lower halves is controlled by feed sprocket 23.

As can be seen in the FIGS., particularly FIG. 3, the containers 31 fit snugly inside the mated sleeve halves 17. The sleeves can be made of any length desired and can be so constructed as to hold more than one container.

The length, however, of these sleeves must be the same length as the number of containers it is designed to operate with since otherwise end distortion would occur during the processing period although it is not shown, partitions can be placed between each can so that each can will have its own cell when the halves 17 are mated.

After the containers are fed by sprockets 23 into a lower pressure sleeve half 17, they ride the same upwardly until one of the upper halves 17 mates with such lower half. The links of the conveyor chains enter their respective channel members 20 at the flared end portions 34. The pressure of the tension springs 21 hold the pressure sleeve halves 17 tightly mated against internal pressures which build within the product contained in the cans 31.

As the canned product within the pressure sleeve moves through the system, it is first heated to a point that all damaged causing organisms are killed. It is then cooled to reduce the internal pressure on the can and to allow the sides of the same to contract so that, as the end 26 of the system is reached, the unmating of the halves may be smoothly accomplished. As the lower conveyor travels about its end sprocket, the cans will fall from the lower half 17 into the final cooling area 27. The halves 17 then travel back to the preheat area to again move through the processing portion of the system.

By way of example, when snap beans are to be processed by the sterilization system of the present invention, they are cut into one-inch pieces, and washed and blanched for five minutes in 170° F. water in the conventional manner. The blanched beans are then filled into cans of standard size, as for example No. 2½ covered with hot water and sealed. These sealed containers are then moved down rack 25 and into the preheated lower pressure sleeve halves 17. In the processing of this product, the halves are preheated to approximately 300° F. just before the cans are fed into them so that the heating of the can and its contents begins as the halves are mated.

Once the pressure sleeves are tightly held in mated relationship by the channel members 20, the primary heating section 32 raises the internal temperature of the product to approximately 225° F. before the product passes from such area. To assure even temperature distribution from the outer edge to the interior portion of the can contents, the vibrator-shaker 38 sets up currents and ebbs therein.

The residual heat in the mated pressure sleeves (which may be constructed of either steel, aluminum or other suitable material) will cause the temperature of the product to continue to rise. The spacing between the primary heating section and the primary cooling section is so adjusted that when the internal temperature of the product has risen to 265° F., the primary cooling section 33 will be entered. The distance of travel through this section is such that the internal temperature of the product is reduced to below 200° F. Uniform cooling is assured by the vibrator-shaker 39 located adjacent this portion of the system.

When the internal temperature of the product is cooled below 200° F., the danger of distortion due to excess internal pressures is eliminated and the containers 31 are removed from the mated pressure sleeves into a final cooling area. Here the containers and the product therein are cooled to approximately 100° F. so they can move to other processing stations for final labeling and packing.

The example just given is shown graphically in FIG. 4 as line 35. The internal temperature of the product is slightly below the blanching temperature of 170° F. as it enters the system. The internal temperature immediately continues to rise rapidly as it passes through the primary heating section 32. The temperature continues to rise above 225° F. after this section is left due to the residual temperature within the pressure sleeve until approximately 265° F. is reached just as the primary cooling section is entered. Due to the continuous currents set up within the product and its associated fluid, the cooling system rapidly reduces the temperature to below 200° F. where the product is discharged into the final cooling section to further reduce the temperature to below 140° F.

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As can be seen from plotted line 35, approximately 12½ minutes from the time the canned product enters the system the primary heating source is removed and in an additional 2½ minutes the primary cooling section is entered. The cooling continues for another 12½ minutes before the temperature is low enough for the containers to be labeled and packed. Thus a total elapse time of 27½ minutes is required compared to the batch retort method indicated by line 36. Here the temperature is slowly raised until a peak of 250° F. is reached at an elapsed time of 40 minutes. Then the cooling cycle begins which takes another 17½ minutes to complete for a total elapse time per batch of 57 minutes not including unloading time.

The Hydrostatic method indicated by line 37 on the graph in FIG. 4 begins with a slightly faster temperature rise but still requires some 40 minutes for any given container to reach the necessary 250° F. for sterilization. The cooling portion of this method requires an extended period of approximately 22½ minutes for completion. This is primarily due to the problem of partial heating of the cooling water leg by the steam within the chamber. Thus the Hydrostatic method for any given container requires approximately 62½ minutes to accomplish what the system of the present invention can accomplish in 27½ minutes.

To exemplify the versatility of the present invention, the primary cooling system was moved further from the primary heating system with the result being plotted by line 38. The heat as usual was removed at 225° F. and the residual temperature continued to raise the product's internal temperature until it began to level off at approximately 355° F. At this point, the cooling cycle was entered and the temperature dropped rapidly. Although this method took longer to reach 200° F., 140° F. was reached in the same length of elapsed time as in the first example.

Since nonacid food products require higher temperatures for sterilization than acid foods, it is considered advantageous to be able to readily vary the peak temperature obtained in the system without noticeably varying the processing time for any given container passing through the system. Thus with only slight adjustment, the present invention can be quickly and easily converted from processing acid to processing nonacid foods and vice versa.

From the above, it is obvious that the present invention has the advantage of providing a simple, inexpensive canned food cooking and sterilizing system which requires less space to house and which takes considerably less time per container to process than has heretofore been possible. Through the use of container conforming sleeves or jackets, the sterilizing process can be carried out without regard to rapidity of heating or in-

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ternal pressures reached. Additionally, no system for increasing atmospheric pressure is necessary before reaching the desired sterilization temperature since a mechanical means is used to prevent internal pressures from causing container distortion.

The terms "upper," "lower" and so forth have been used herein merely for convenience of the foregoing specification and in the appended claims to describe the canned product cooking and sterilizing system and its parts as oriented in the drawings. It is to be understood, however, that these terms are in no way limiting to the invention since the system may obviously be disposed in many different positions when in actual use.

The present invention may, of course, be carried out in other specific ways than those set forth without departing from the spirit and essential characteristics of the invention. The present embodiments are, therefore, to be considered in all respects as illustrative and not restrictive and all changes coming within the meaning and equivalency range of the appended claims are intended to be embraced therein.

I claim:

1. A product sterilization system comprising: a first endless conveyor means having a series of spaced sleeve members mounted thereon; a second endless conveyor means having a series of spaced sleeve members mounted thereon and being so disposed that the members on said second conveyor means will mate with corresponding members of said first conveyor means along a portion of their travel to form an enclosed jacket; means for injecting into one of said members just prior to its mating to form said jacket at least one airtight container filled with product to be sterilized; a heating means to heat the product to sterilization temperatures and a cooling means to cool the product below its boiling point located consecutively adjacent the mated portion of travel of said conveyors; and means for supporting said container upon separation of said mated member whereby a product container can be rigidly held to prevent container distortion during the sterilization process.

2. The system of claim 1 wherein a vibrator means is operatively attached to at least one of said conveyors adjacent said heating means whereby currents and ebbs may be created within the product to aid in temperature transfer.

3. The system of claim 1 wherein vibrator means are operatively connected to at least one of said conveyors adjacent said cooling means whereby currents and ebbs may be created within said product to aid in temperature transfer.

4. The system of claim 1 wherein each jacket formed by the mating of two of the semicylindrical members is of such a length to receive a multiplicity of airtight product containers.

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