Oct. 29, 1968

P. CARVALLO

3,407,721

HYDROSTATIC PRESSURE TYPE CONTINUOUS STERILIZING AND COOLING APPARATUS

Filed Aug. 3, 1966

2 Sheets-Sheet 1

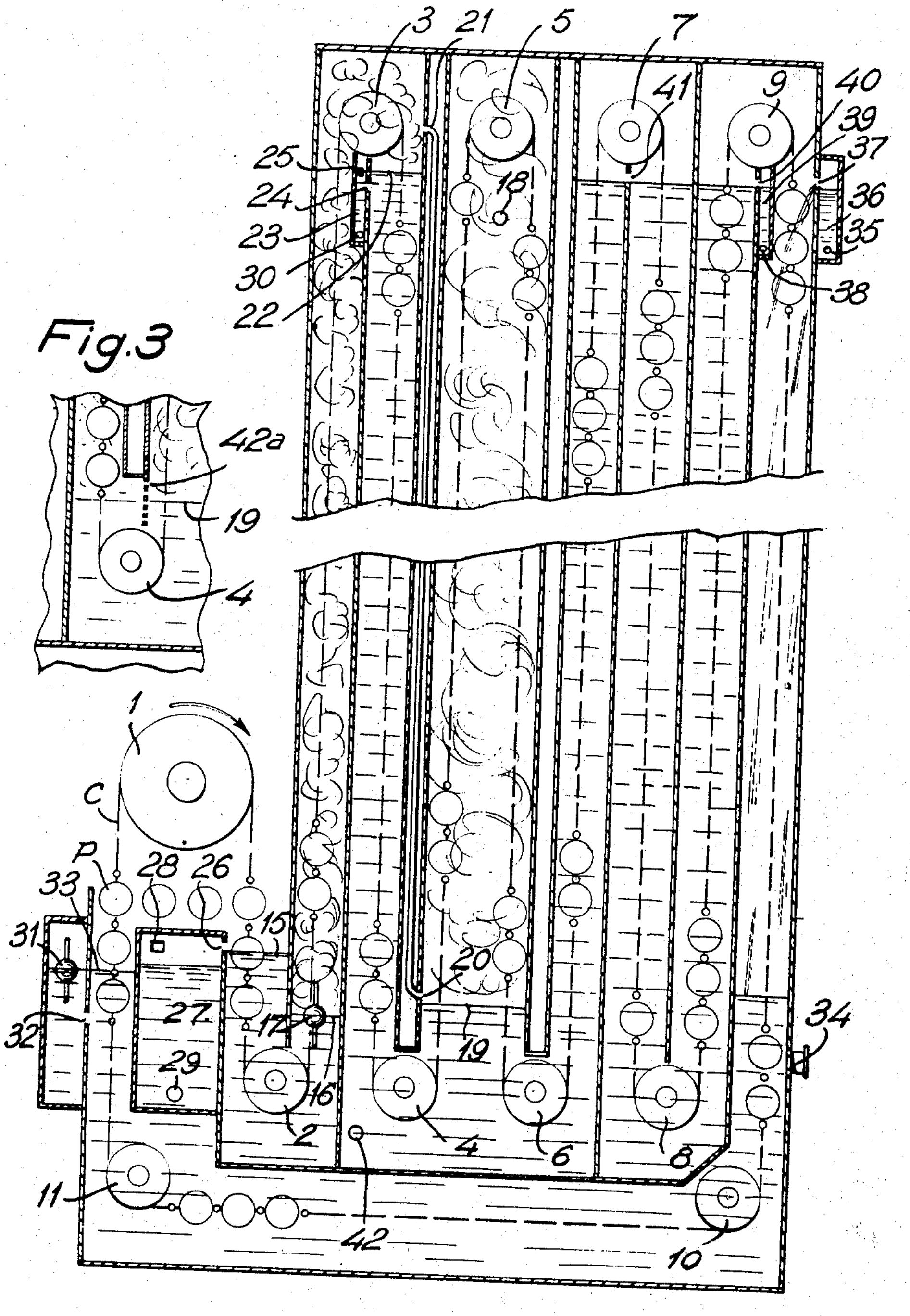
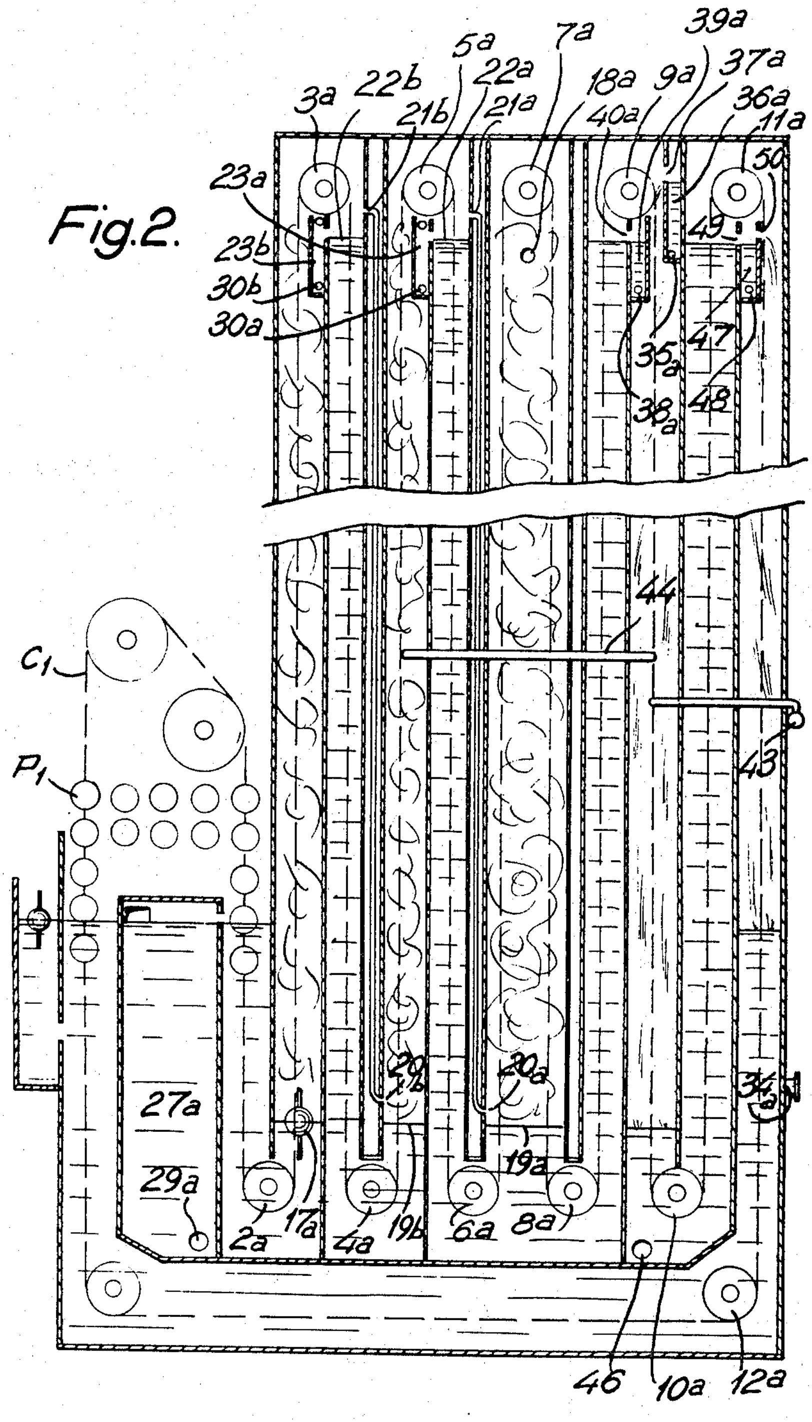


Fig. 1

Fig.2.


3a
22b
5a
22a
7a
39a
18a
9a
37a
21b
21a
40a
36a
11a
50
23a
23b
30b
30a
49
47
35a
38a
48
44
C1
P1
43
34a
20b
20a
27a
19a
29a
2a
17a
4a
19b
6a
8a
46
10a
12a

United States Patent Office

3,407,721

Patented Oct. 29, 1968

1

3,407,721

HYDROSTATIC PRESSURE TYPE CONTINUOUS STERILIZING AND COOLING APPARATUS

Pierre Carvallo, Amposta, Tarragone, Spain

Filed Aug. 3, 1966, Ser. No. 570,021
Claims priority, application France, Aug. 20, 1965, 28,911
9 Claims. (Cl. 99—249)

ABSTRACT OF THE DISCLOSURE

A continuous sterilizing and cooling apparatus in which a conveyor with a loading station for products to be treated and a discharge station, passes after said loading station in an ascending column closed at the bottom by a water seal enabling desired pressure and temperature conditions to be maintained in said ascending column, said ascending column being disposed in relation to the path of the conveyor, upstream of at least one hydrostatic pressure column which closes a sterilizing chamber.

This invention relates to improvements in hydrostatic pressure type continuous sterilizing and cooling apparatus, particularly for sterilizing preserved foodstuffs, milk, beverages, dietetic and pharmaceutical products and so on.

By their nature most equipment of this kind has great height, and therefore requires installation in a pit or as an above-ground tower. For the sake of convenience, in tower installations a loading and unloading station is provided at the bottom of the structure. Consequently, a first rising circuit, followed by a conveyor which starts from a loading station and goes through the sterilizing enclosure before returning to the unloading station, the first circuit preceding a descent in a hydrostatic entry column, is almost completely wasted in operation; similarly, only partial use is made of the aforesaid descent in the first hydrostatic pressure column. Associated with this partial use are inconstant heat conditions, with the result of indeterminate participation in the sterilization cycle.

An object of this invention is to obviate these disadvantages.

The invention accordingly comprises, in accordance with a first improvement, a first rising sectional column of the path followed by a conveyor, such section being closed at its bottom end by a water seal. It then becomes possible to maintain in the section a constant and controllable temperature as well as a constant and controllable pressure. Given such temperature constancy conditions, the heat exchange in this section can have a clearly defined participation in the overall sterilizing process.

According to another improvement, the adjacent descending section of the conveyor path, which section can form a pressure-maintaining hydrostatic column of the entry of the sterilizing enclosure, is also maintained at controlled temperature conditions, inter alia by heat-conductive contact with the aforesaid rising section.

In another embodiment, the temperature conditions are maintained through the agency of one or more vertical rows of holes at the bottom of the next pressurized steam column, the bottom level of the water therein uncovering a varying number of holes to allow a varying amount of steam to pass through them.

When an apparatus of this kind comprises a pressure steam-heated sterilizing enclosure, the situation of the aforesaid rising section which is disposed near the entry can be maintained by steam, so that such apparatus can comprise at least two steam columns with graded temperatures.

With this form of heating, and according to another improvement, the pressures and therefore the temperatures of the various sections can be controlled by the use of a single regulator, preferably of the float-controlled steam inlet valve kind, the float following the level of the water in the hydrostatic pressure columns, preferably at the bottom of the lower-space or lowest-pressure column—i.e., substantially in the water seal. With this control, the valve delivers steam to the hotter or hottest column, excess steam therein going to the less hot or least hot column.

Preferably, the steam inlet orifice in the hotter column is disposed at the base thereof and the orifice for delivering to the less hot column is disposed in the upper part thereof.

If a larg number of columns are disposed in series, the distributing and intake orifices are arranged similarly, to ensure automatic air bleeding from all the steam columns consecutively, the air bled from the final column being sent to the drain.

According to another feature, to maintain the top levels of the hydrostatic columns completely constant despite possible irregularities in the flow of treated receptacles going through the apparatus, one or more positive displacement type compensating pumps continuously raise the excess water at the bottom of the columns to accumulator capacities at the tops of the columns, the latter capacities having permanently open overflows to ensure that the top levels stay constant. Preferably, the intake and distribution of this water are effected by special compartments disposed at the top of the columns, with regular distributors over the whole width of the apparatus. These distributing overflow devices can be double, so as to provide the remainder of the flow ensuring a constant level in any particular hydrostatic column, and also to provide a trickle without mixing of waters of different temperatures in an adjacent steam column.

Advantageously, a heating column is supplied with steam through a single permanently open connecting tube, with the use inter alia of a heat separation which may exist between the system comprising a rising heating column and a descending section or hydrostatic pressure column and an adjacent system or actual sterilizing ber, thus automatically ensuring pressure grading and therefore temperature grading between these parts of the apparatus.

The following description, together with the accompanying exemplary non-limitative drawings, will show clearly how the invention can be carried into effect and disclose other advantageous features which of course form part of the invention.

In the drawings:

FIG. 1 is a diagrammatical elevation view in section, with parts broken away, of a single-column hydrostatic pressure sterilizing apparatus which precedes a sterilizing chamber.

FIG. 2 is a similar view of an apparatus having double pressure columns, and

FIG. 3 is a view of a portion of an alternative heating for a hydrostatic pressure column at the entry of a sterilizing chamber.

As can be seen in FIG. 1, two endless chains C forming part of a conveyor bear baskets P containing receptacles for treatment. The chains run over consecutive reversing pulleys or sprocket wheels or the like. Pulley **1** is disposed above a loading and unloading station for the baskets P and has one side above a bottom reversing pulley **2** which is at the entry of the apparatus. Other consecutive pulleys **3–9** make the chains C follow a sinuous path along the adjacent vertical columns. A bottom pulley **10** receives the chains from pulley **9** and in turn advances the chain at the same level to a final pulley **11** disposed vertically below pulley **1**. The conveyor shown is of the kind comprising tubular baskets P which are open at their ends and not secured to the chains C, however, the baskets can be of any other known kind and, for instance, comprise baskets rigidly secured to the chains, section members secured to the chains and forming receptacles which open on curves, or any other system which, as well as providing the required conveyance, enable the conveying elements to be provided with receptacles for treatment and to have the receptacles removed from such elements after treatment of the receptacles.

During the first rise of the chains between the pulleys 2 and 3, the chains are in a hermetic chamber whose bottom part is closed by a water seal. All the water seals which will be mentioned hereinafter are designated in references attached to the two levels which bound the seals. The water seal associated with the pulley 2 is bounded by a top level **15** on one side of a partition and by a bottom level **16** on the other.

Downstream of the pulley **3** is a column which is disposed between the top pulley **3** and the bottom pulley **4** and which is filled with water and which forms a hydrostatic pressure column bounded at one end by a bottom level **19** and at the other end by a top level **22**. The receptacles for treatment are heated in this column before entering a sterilizing chamber, which is in the form of a closed space bounded at the bottom by the level **19** and disposed between the pulleys **4** and **6**, which are at the same level as one another and below the pulley **5**.

Disposed between the pulley **6** and the pulley **7** is a column which is a cooling column as well as a hydrostatic pressure column. The following columns, between the pulley **7** and the bottom pulley **8**, and then between the pulley **8** and the top pulley **9**, are extra cooling columns. A final column between the pulley **9** and the pulley **10** is a final cooling column before a bottom passage disposed between the pulleys **10** and **11** which are at the same level as one another, the pulley **11** being disposed at the bottom of a return column for receptacles which have been treated at the station situated where is attached the reference P.

A regulating float is disposed in the water at the level **16** at the water seal exit and operates a steam inlet valve automatically in accordance with variations of the level **16**, the steam entering the sterilizing chamber through an orifice **18**. The opening of the valve tends to increase when the level **16** rises and to decrease when the level **16** drops. The pressure of the inlet steam maintains the level **19** at the bottom of the sterilizing chamber. An exhaust orifice **20** opens into this region above the level **19** and communicates through a tube with an orifice **21** with which the chamber receiving the pulley **3** is formed above the level **22**. The latter tube extends through an insulating space between the hydrostatic column identified by its top level **22** and the actual sterilizing chamber where the water reaches the level **19**.

The surplus steam flowing through the orifice **21** can therefore maintain the pressure and therefore the temperature constant in the column which is disposed between the pulleys **2** and **3** and which is bounded by the level **16**. The top level **22** of the water column extending between the pulleys **3** and **4** is maintained constant by an overflow of water from a chamber **23** communicating, via a row of evenly spaced holes **24**, with the latter column; the compartment **23** has an overflow device **25** which delivers surplus water, for instance, by trickling, to the water seal between the levels **15** and **16**. The top level **15** of the latter water seal is maintained constant by the overflow from a chamber **27** via a row of evenly spaced connecting holes **26**; the chamber **27** has an overflow device **28** adapted to deliver surplus water to a drain or, if required, to some form of heat recovery device.

The chamber **27** is formed near the bottom with an orifice **29** communicating with a positive displacement compensating pump (not shown) delivering to an orifice **30** near the bottom of the chamber **23**. This water supply automatically keeps the level **22** constant, more particularly in the event of drops due to irregularities, such as a considerable drop in the flow of the receptacles contained in the conveyor baskets P during movement of the conveyor C.

The level **33** in the bottom passage where the pulleys **10**, **11** are disposed is kept constant by a float valve **31** disposed in an adjacent tank or chamber or the like communicating through orifices **32** with the latter passage, the orifices **32** being disposed in a row and being evenly distributed over the whole width of the passage.

The passage is formed below water level with an orifice **34** communicating with the intake of a pump (not shown); the delivery thereof comprises a branch through which some of the pump delivery goes to an orifice **35** at the bottom of an auxiliary chamber **36** having at the top an evenly spaced row of holes **37** communicating with the column which extends between the pulley **9** and the pulley **10**. Through the holes **37** water can trickle in an evenly distributed form on to the products going through the column. Another portion of the water delivered by the last-mentioned pump, in a quantity which is preferably thermostatically controlled, goes to a bottom hole **38** of another auxiliary chamber **39** adjacent the column extending between the pulleys **8** and **9**. The chamber **39** is formed with a number of holes **40** communicating with the column between the pulleys **8** and **9**. The water flowing through the holes **40** descends in the latter column but rises in the column between the pulleys **7** and **8**, then enters the column between the pulleys **6** and **7** through a row of holes **41** which are evenly spaced in a line and which are in a separating partition between these two adjacent columns. Below the level **19** this flow of water rises in the column between the pulleys **3** and **4** and is finally removed through the holes **24** and overflow device **25**, then goes through the holes **26** and overflow **28** either to a drain or to heat recovery.

Consequently, the water which is first used for cooling in the passage between the pulleys **11** and **10** flows in a complete circuit in countercurrent to the conveyor (except for the trickling in the column between the pulleys **9** and **10**), and is then heated by heat recovery; the heat recovered during cooling in the output columns of the sterilizing chamber and in the extra cooling columns is used to heat the products for treatment between the levels **19** and **22**.

Depending upon the height of the water column between the levels **19** and **22**, the pressure and therefore the temperature in the sterilizing chamber—i.e., in the passage bounded by the pulleys **4–6**—is kept constant, for instance, about 120° C., by steam injection through the hole **18**. The water seal between the levels **15** and **16** keeps the pressure and therefore the temperature constant—e.g. at 101° C.—in the column between the pulleys **2** and **3**. Consequently, the water of the adjacent column is also maintained at this constant temperature of 101° C. by contact with the aforesaid steam column between the pulleys **2** and **3** and possibly by the bubbling of a steam injection through a nozzle **42** at the bottom of the column between the pulleys **3** and **4**.

As can be seen in FIG. 3, instead of a nozzle **42**, the bottom of the column between the pulleys **3** and **4** could be formed with a number of holes **42*a*** preferably arranged in parallel vertical rows, to provide automatic supervision, according to the position of the level **19**, of the amount of steam bubbling into the column between the pulleys **3** and **4**. In this system, the passage **20** is normally omitted and the pressure column between the pulleys **3** and **4** is automatically maintained at a graded temperature going, for instance, from 110° C. at the bottom to 120° C. at the top of the column where the water, which enters boiling, supplies steam to the column which extends between the pulleys **2** and **3**; consequently, the bottom level **16** of the latter column controls automatically, and via a single regulator, the three columns which extend between the pulleys **2, 3** and **3, 4** and **4, 5, 6** respectively, equilibrium being achieved through the agency of the level **19** which uncovers a varying number of holes **42a**.

If required, both procedures can be combined, in which event the passage **20** is controlled by an adjustable valve.

The dwell time in the steam column between the pulleys **2** and **3** and in the water column between the pulleys **3** and **4** at an appropriately controlled temperature can therefore be taken into account in determining the total sterilization time of the products being treated.

Another advantage of using a water seal as the bottom closure for the column between the pulleys **2** and **3** is that a stream of water at a predetermined temperature can be provided inside the latter column if required, for instance; for low-temperature pasteurization.

FIG. 2 shows a variant of a similar apparatus but having a double loading station P_1 and having double hydrostatic pressure columns. To enable higher temperatures to be maintained with a reduced overall height, the columns between the levels **19b** and **22a** and between the levels **19b** and **22b**, in order to have additive effects, maintain a relatively high total pressure in a high-pressure sterilizing chamber through which the conveyor C_1 runs over pulleys, sprockets or the like **6a, 7a, 8a** similar to those described with reference to FIG. 1 and having the same references as in FIG. 1 plus the index *a*.

A float regulator **17a** controls the entry of steam into this chamber through a nozzle **18a**, and the excess steam goes consecutively through orifices **20a, 21a**, as in the sterilizing chamber of the first embodiment, to the first hydrostatic pressure column, then through orifices **20b, 21b** therein to the second such column, under the same conditions as in FIG. 1, the separating walls or partitions between the hydrostatic columns and the sterilizing chamber being in all cases far enough apart and adequately insulated. Similarly, the constancy and grading of the temperatures between the columns of the sterilizing chamber are maintained automatically, the sterilizing chamber (pulleys **6a, 7a, 8a**) being at a temperature, for instance, of 125° C., whereas the temperature in the columns **4a, 5a** is 115° C. and in the columns **2a, 3a** is only 101° C. As in the previous embodiment and as shown in FIG. 3, the orifices **20a, 20b** can be replaced or supplemented by vertical rows of holes **42a**, in which event the single regulator **17a** can control the temperatures in the three steam columns (**6a, 7a**), (**4a, 5a**) and (**2a, 3a**) and in the two pressure columns (**5a, 6a**) and (**3a, 4a**). The pressure in an intermediate cooling column disposed between the pulleys **9a** and **10a** is maintained by compressed air supplied from a bank or battery **43** in turn supplied by a compressor (not shown); a connecting joint **44** equalizes the pressures as between the chamber between the pulleys **4a, 5a** and the chamber between the pulleys **9a** and **10a**.

Via an orifice **46** immersed in the liquid at the bottom of the column between the pulleys **9a** and **10a**, the cooling water is taken up by a pump (not shown) and distributed directly to a chamber **36a** at the top of the latter column, the latter chamber being formed with orifices **37a** via which water can trickle on to the products descending therein. Some of the delivery of the latter pump, the exact amount being controlled by a thermostat, goes to an adjacent chamber **39a** formed with orifices **40a** to maintain the level in the column which is passed through between the pulleys **8a** and **9a** and which is the first pressure-maintaining column.

Via an immersed orifice **34a** in the last column extending between the pulleys **11a** and **12a**, another pump takes up the water and delivers it through an entry **48** to a chamber **47** formed with a single horizontal row of orifices **49** serving to keep the level constant in the column extending between the pulleys **10a** and **11a** and an overflow trickle through orifices **50** on the opposite side which open at the top of the column between the pulleys **11a** and **12a**. As will be apparent, the chamber **47** is so devised that the cool water arriving via the entry **48** maintains the level in the second pressure column **10a, 11a** by a make-up of cool water distributed over the whole width of the conveyor, but the excess trickling through the orifices **50** over the whole width of the conveyor does not mix with the warm water in the column **10a, 11a**. This is an important feature for satisfactory grading of the cooling temperatures, particularly for treating glass receptacles.

As in the case shown in FIG. 1, a compensating positive displacement pump (not shown) is adapted to take up water from the reserve chamber **27a** through the orifice **29a** and to deliver such water to the inlets **30a, 30b** in two chambers **20a, 23b** which keep the levels **22a, 22b** constant despite possible variations in the loading of the conveyor C_1.

The embodiments hereinbefore described can of course be modified without departing from the scope of the invention. More particularly, the number and arrangement of the circuits of the progressive pressure stations of the extra cooling of sterilizing columns can be other than specified. Similarly, the kind of conveyor used and, consequentially, the devising of the single or multiple loading and unloading stations, can be other than specified. The heating steam can be bubbled through at the bottom of each entry column with any means, with or without control of steam flow by the levels.

What I claim is:

1. A sterilizing and cooling apparatus comprising a conveyor traveling along a closed path between a loading station for products to be treated and an unloading station for removal of treated products, a vessel through which said conveyor passes for the treatment of said products, said vessel including a sterilizing chamber adapted to contain steam, at least two hydrostatic pressure columns containing a liquid, at least one each on the upstream and downstream sides of said chamber, said vessel including a bottom portion and an elevated portion extending above the bottom portion, said loading and unloading stations being located at the level of said bottom portion, said conveyor having at least a first travel section extending between said loading station immediately in the vicinity of said bottom portion and an inlet of the first upstream hydrostatic pressure column at the top thereof, an entry column receiving said first travel section of the conveyor, said entry column being on the upstream side of said steam chamber, said entry column having a liquid seal at the lower end thereof, said conveyor passing in succession through said seal, said entry column, along an ascending path then through each of said upstream hydrostatic pressure columns, and thereafter through said steam sterilizing chamber and each of said downstream hydrostatic pressure columns, and means for the passage of steam from said steam sterilizing chamber to said entry column for regulating the temperature in said entry column and maintaining controlled temperature conditions in the adjacent hydrostatic pressure column which is in heat conductive relation with said entry column.

2. A sterilizing and cooling apparatus comprising a conveyor traveling along a closed path between a loading station for products to be treated and an unloading station for removal of treated products, a vessel through which the conveyor passes for the treatment of the products, said vessel including a sterilizing chamber adapted to contain steam, at least two hydrostatic pressure columns containing a liquid, at least one each on the upstream and downstream sides of said chamber, and an entry column between the loading station and the first hydrostatic pressure column on the upstream side of the steam chamber, the entry column having a liquid seal at the lower end thereof, the conveyor passing in succession through said entry column, along an ascending path, then through each of the upstream hydrostatic pressure columns, and thereafter through the sterilizing chamber and each of the

downstream hydrostatic pressure columns, means defining a passageway between the sterilizing chamber and one of the upstream pressure columns at the lower end thereof to permit upward flow of steam through the liquid in the latter pressure column and thereby control the temperature therein, and means for the passage of steam from the sterilizing chamber to the entry column for regulating the temperature in the entry column and maintaining controlled temperature conditions in the adjacent hydrostatic pressure column which is in heat conductive relation with the entry column.

3. Apparatus as claimed in claim **2**, wherein said conveyor includes a first travel section extending between the loading station and the inlet to the first pressure column on the upstream side of the chamber, said first travel section being disposed for its greatest part in said entry column.

4. Apparatus as claimed in claim **3**, wherein said passageway between the sterilizing chamber and said one upstream pressure column is constituted by at least one vertical row of holes disposed at the bottom of a partition dividing the chamber and said one upstream column, such that the quantity of steam which passes varies with the level of the liquid at the base of said hydrostatic pressure column.

5. Apparatus as claimed in claim **3**, comprising a steam inlet duct and a steam outlet duct in said sterilizing chamber, said steam outlet duct being connected to the entry column whereby when the chamber is heated by steam under pressure, a part of said steam is passed through said outlet duct into said entry column.

6. Apparatus as claimed in claim **3**, comprising a steam inlet duct at the top of the sterilizing chamber, a steam outlet duct at the bottom of said chamber, in the vicinity of the normal liquid level in said chamber, said steam outlet duct communicating with the adjacent upstream hydrostatic pressure column, so that, upon pressure decrease in said chamber, the steam outlet duct is progressively closed by ascension of the liquid level, thus causing a pressure reduction in said entry column, whereby the liquid level at the base of said entry column is raised, a float regulator in said liquid at the base of said entry column for increasing the steam input in said chamber when the float is elevated, whereby increase of the liquid level in said chamber corresponds to an opening of the

steam inlet in said chamber, resulting in stabilization of pressure in said chamber.

7. Apparatus as claimed in claim **6**, comprising a duct connected to the steam outlet duct in said chamber for conveying steam to the upper part of an adjacent upstream column.

8. Apparatus as claimed in claim **6**, comprising a steam outlet at the base of an intermediate hydrostatic pressure column, in the vicinity of the lower liquid level in said column, a duct connected to the latter said steam outlet, and to a steam inlet in an upstream adjacent column, the latter steam inlet being located above the upper liquid level in said adjacent upstream column.

9. Apparatus as claimed in claim **3**, wherein the downstream liquid hydrostatic columns constitute cooling columns, the apparatus further comprising a first cooling column located on the downstream side of the last downstream liquid column and a second cooling column located on the upstream side of said last downstream liquid column, and means for supplying said first and second cooling columns with a cooling liquid for descending flow therein, an overflow chamber at the top of said first cooling column, said overflow chamber being supplied with liquid from the bottom of said first cooling column, said overflow chamber having an outlet at a particular level opening into the last downstream liquid column to furnish cooling liquid thereto to maintain a constant level in said last liquid column, said chamber having a further outlet at a higher level than the first outlet and opening into the first cooling column for the supply thereinto of cooling liquid in the form of a trickle.

References Cited

UNITED STATES PATENTS

1,419,139	6/1922	Hunter	99—362
1,584,397	5/1926	Paxton	99—362 X

FOREIGN PATENTS

448,693	7/1936	Great Britain.
648,345	1/1951	Great Britain.
730,781	7/1955	Great Britain.
731,550	7/1955	Great Britain.

WALTER A. SCHEEL, *Primary Examiner.*

J. M. NEARY, *Assistant Examiner.*