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(54) **APPARATUS FOR ASEPTIC PACKAGING**

(76) Inventor: **Thomas D. Taggart**, South Wales, NY (US)

Correspondence Address:
ARLEN L. OLSEN
SCHMEISER, OLSEN & WATTS
3 LEAR JET LANE
SUITE 201
LATHAM, NY 12110 (US)

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(60) Provisional application No. 60/118,404, filed on Feb. 2, 1999.

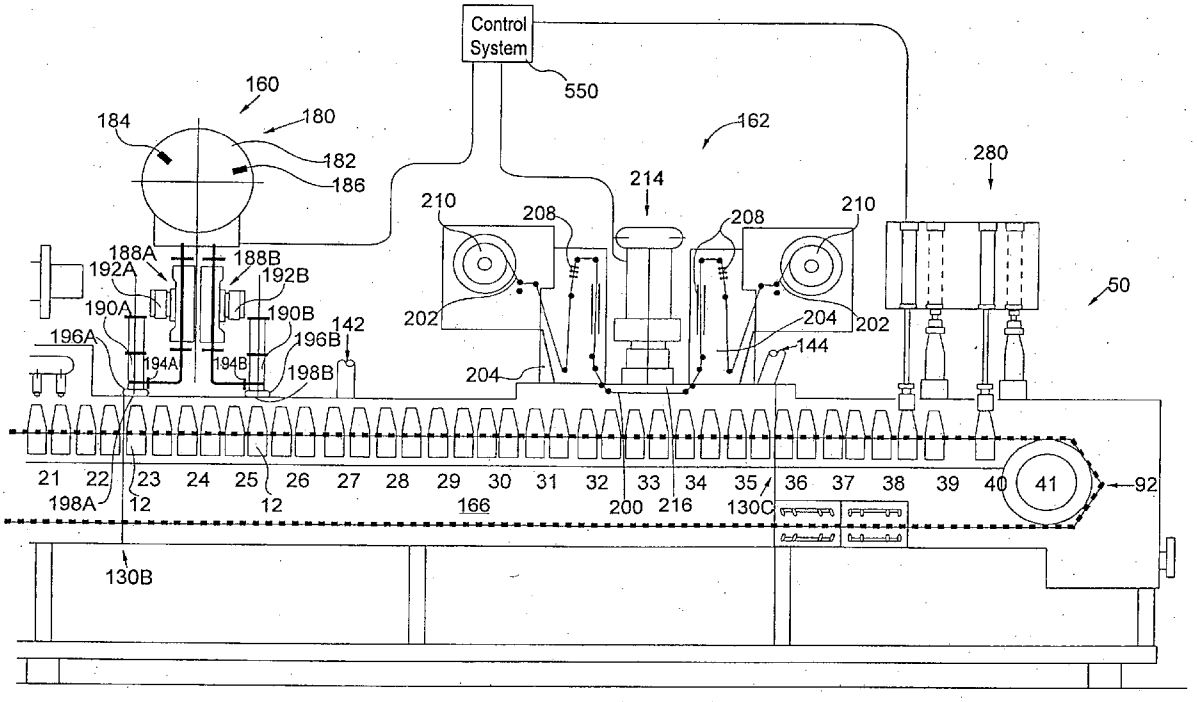
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(52) **U.S. Cl.** **53/167**; 53/282

(57) **ABSTRACT**

A method and apparatus for providing aseptically processed low acid products in a container having a small opening, such as a glass or plastic bottle or jar, at a high output processing speed.



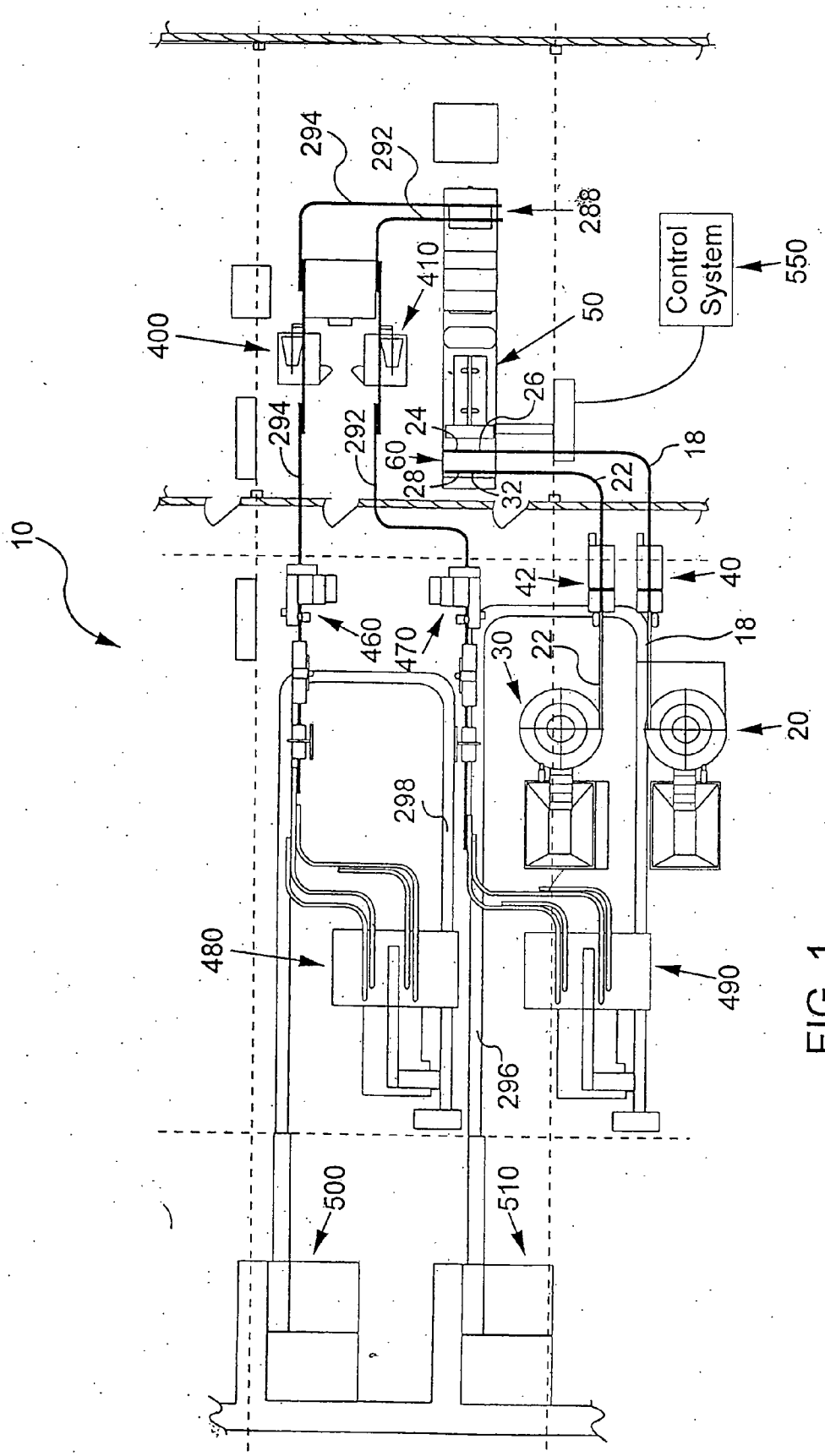

10
294
292
288
410
400
50
Control System
550
26
24
294
292
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470
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298
480
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296
500
510

FIG. 1

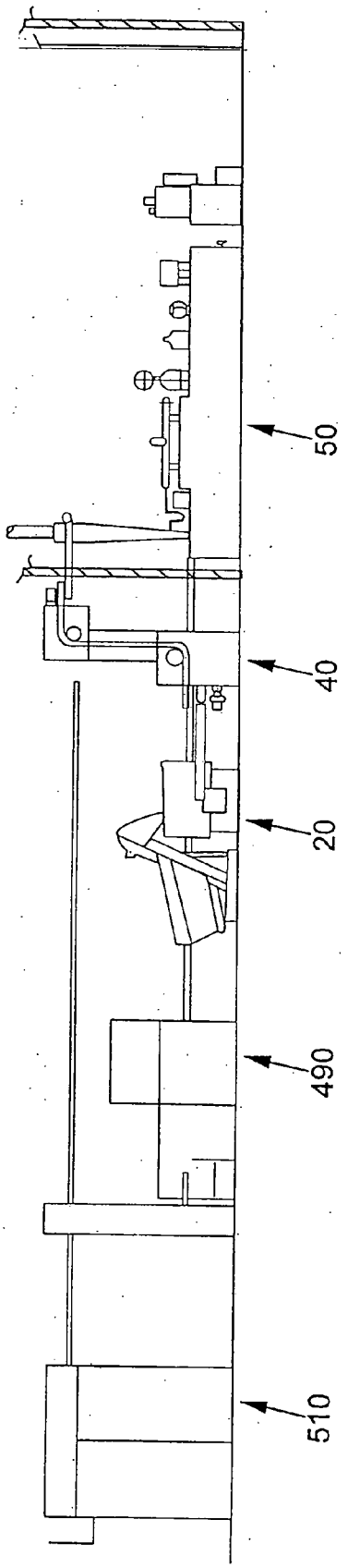


FIG. 2

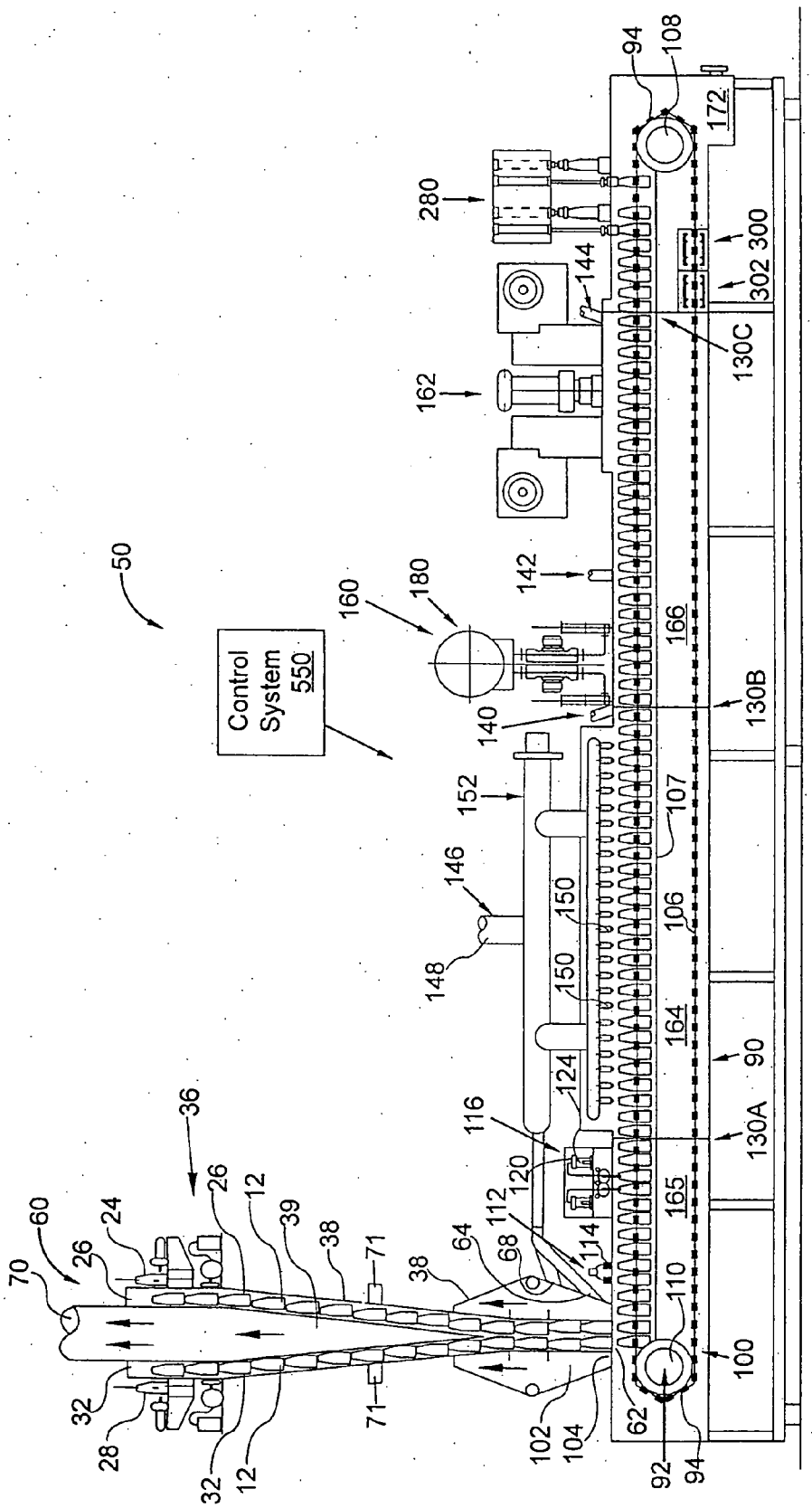

50
Control System 550
60
70
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24
36
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12
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38
71
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64
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114
116
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148
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152
140
142
160
180
162
280
144
94
108
172
130C
302
300
166
130B
107
106
164
165
130A
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110
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62
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71
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FIG. 3

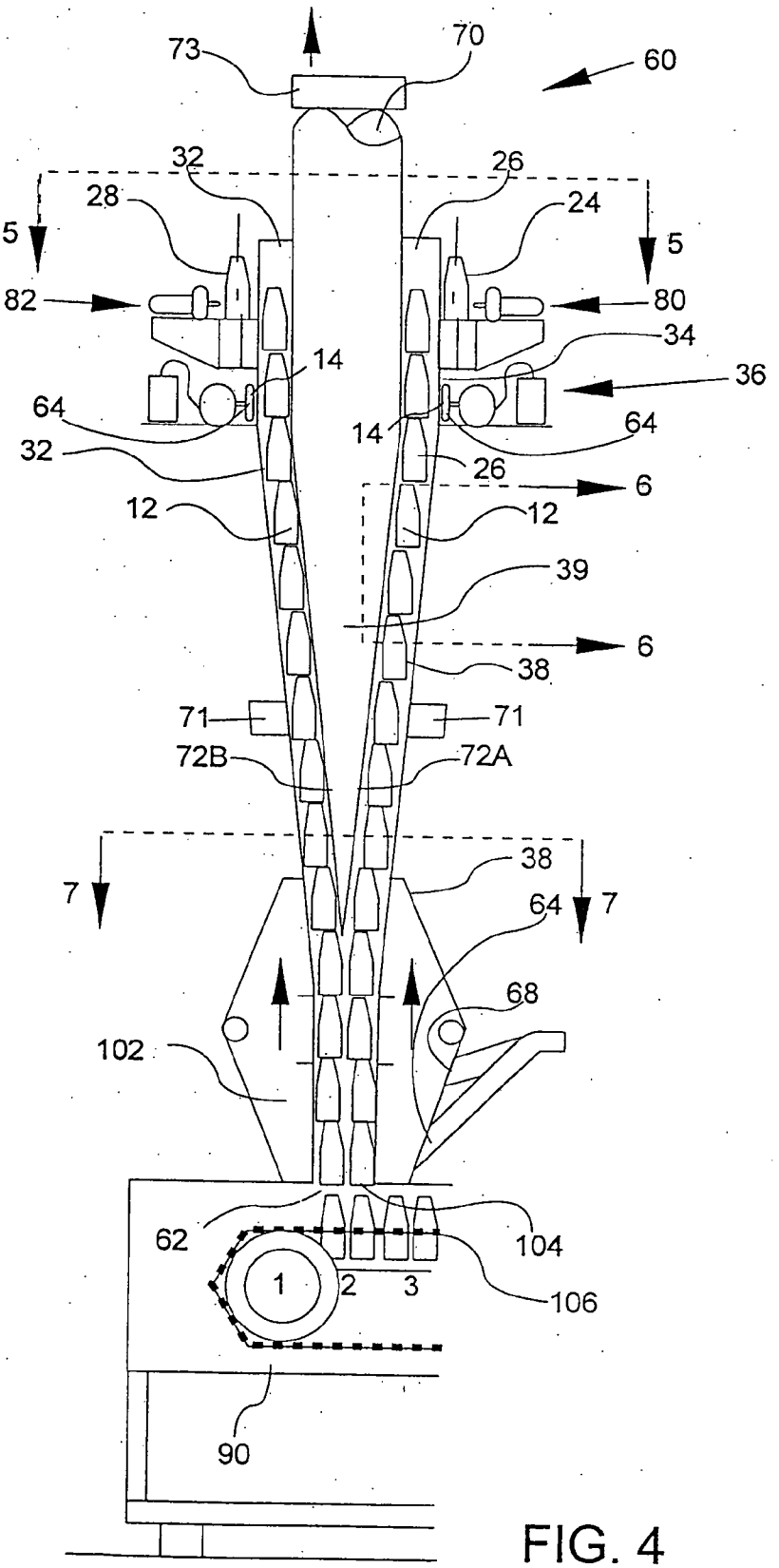

73
70
60
32
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24
5
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82
80
34
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36
64
14
64
32
26
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12
39
6
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72B
72A
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64
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68
102
62
104
1
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106
90

FIG. 4

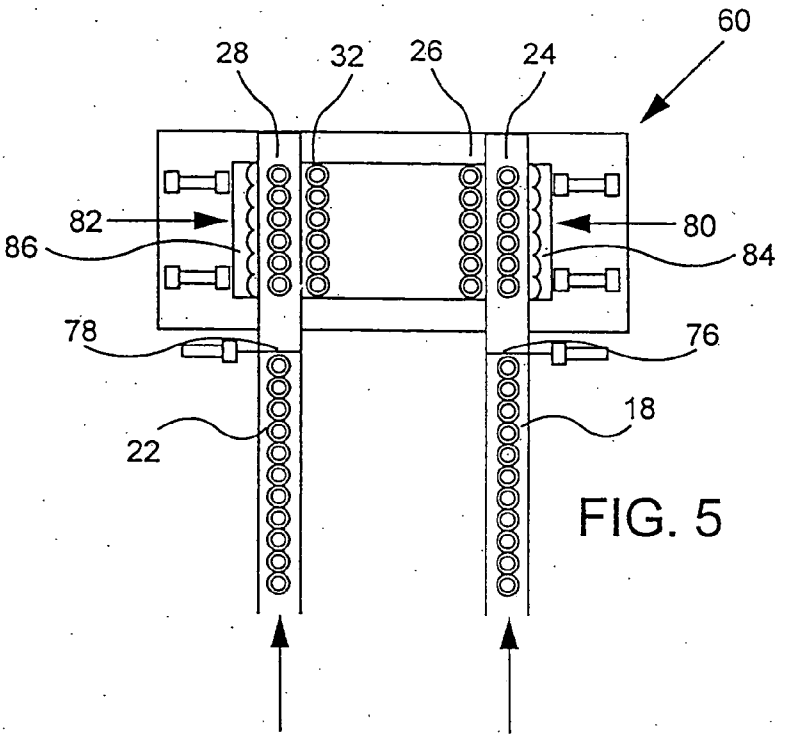


FIG. 5

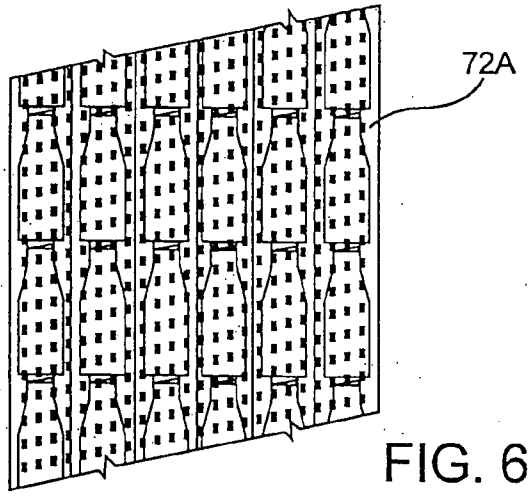


FIG. 6

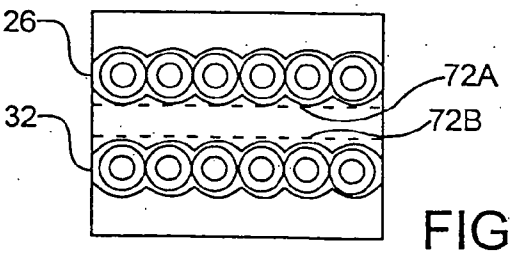


FIG. 7

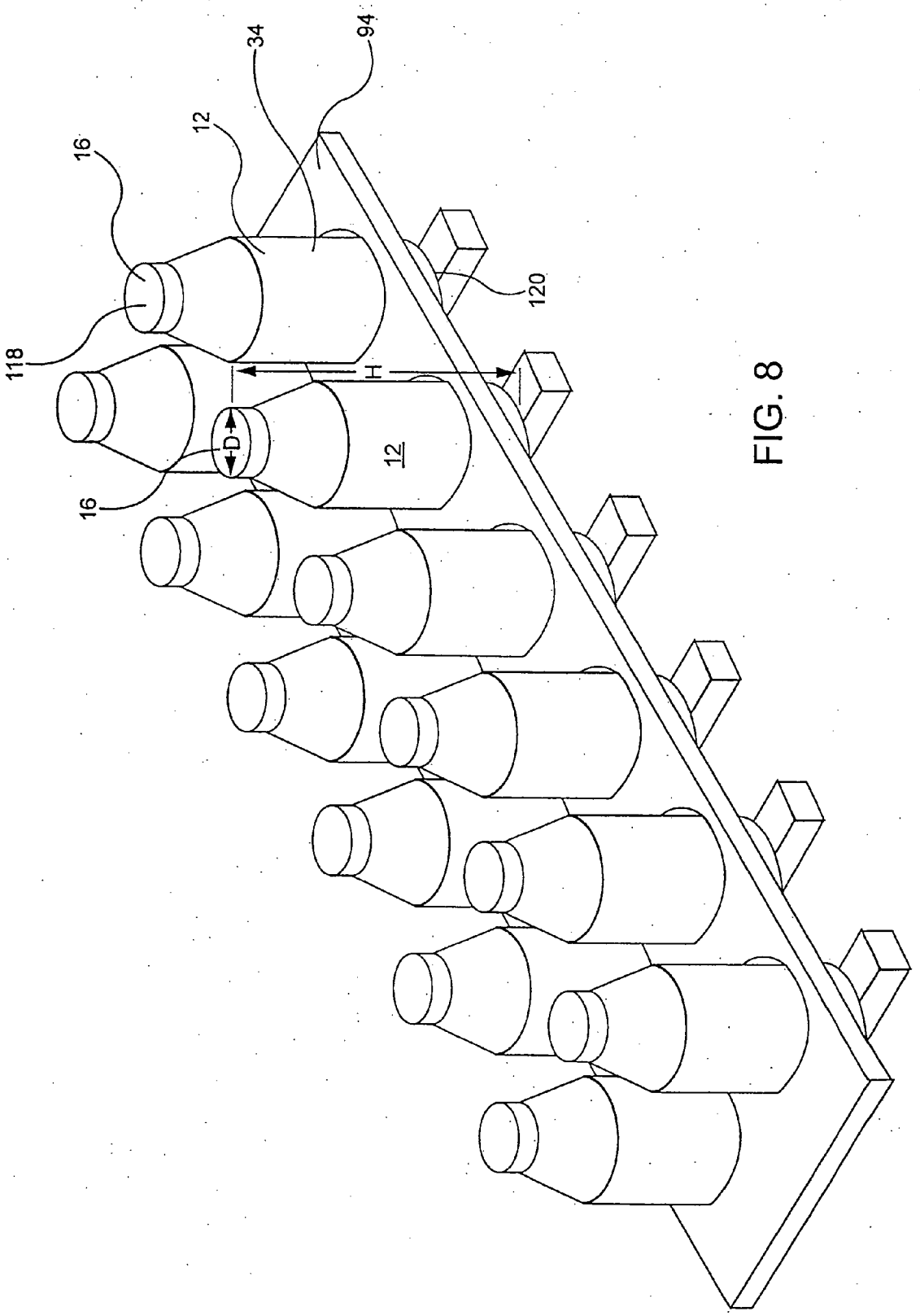


FIG. 8

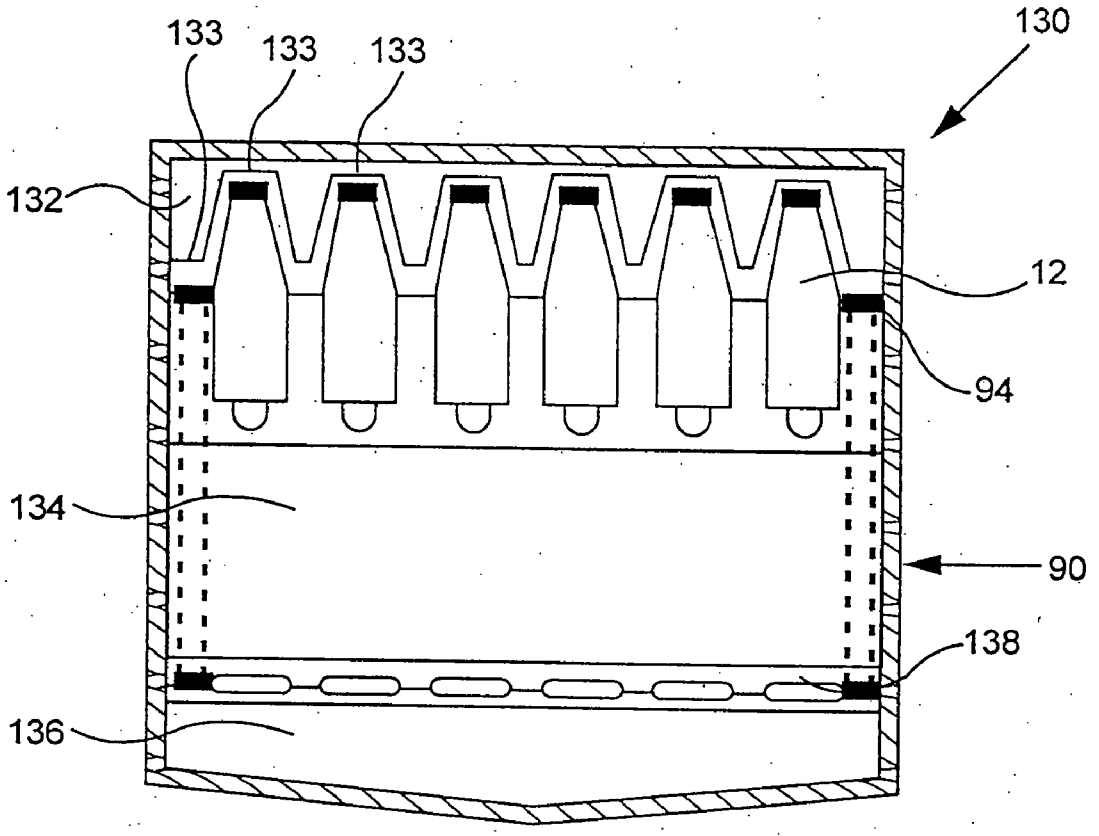


FIG. 9

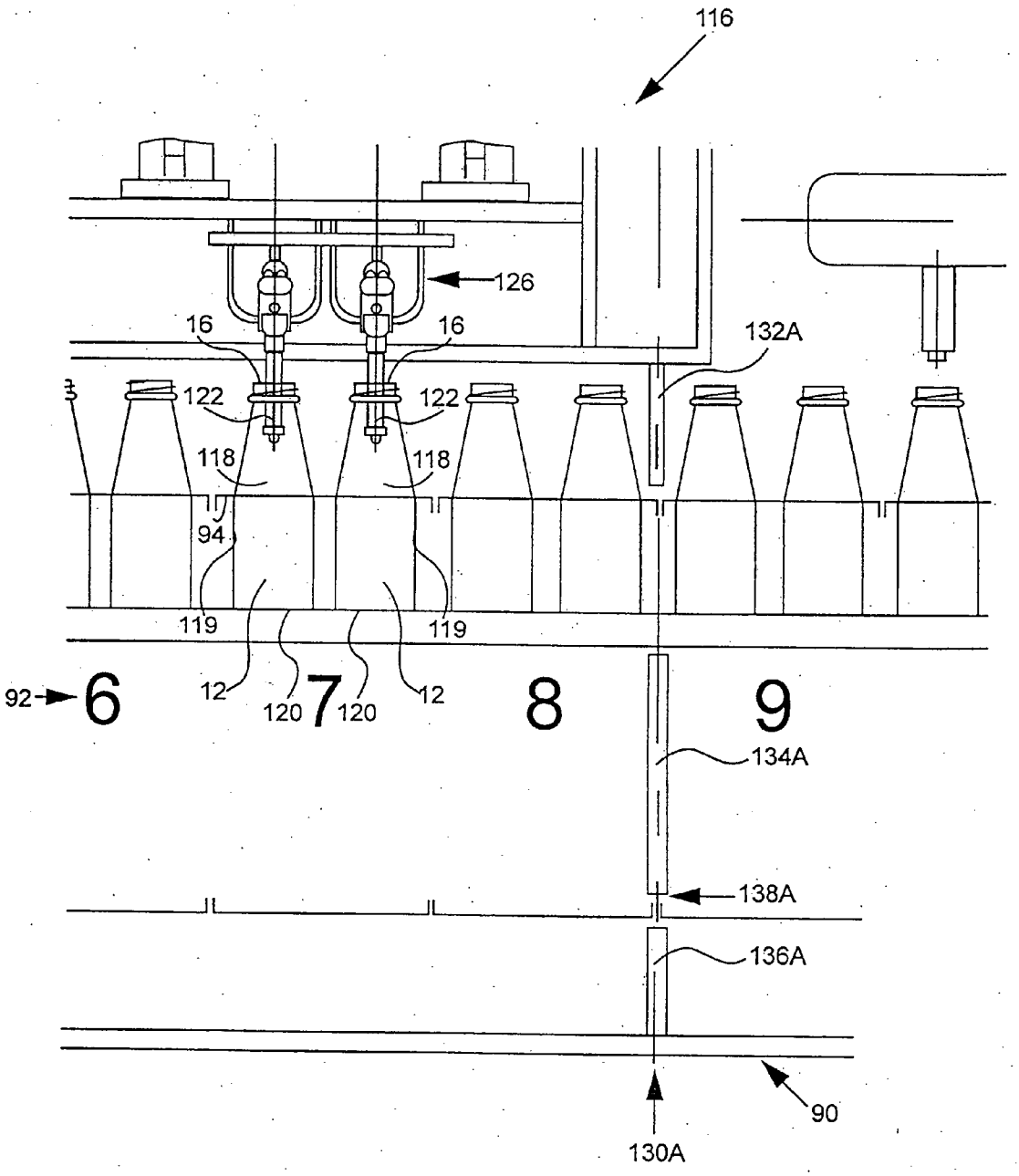

116
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132A
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134A
138A
136A
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130A

FIG. 10

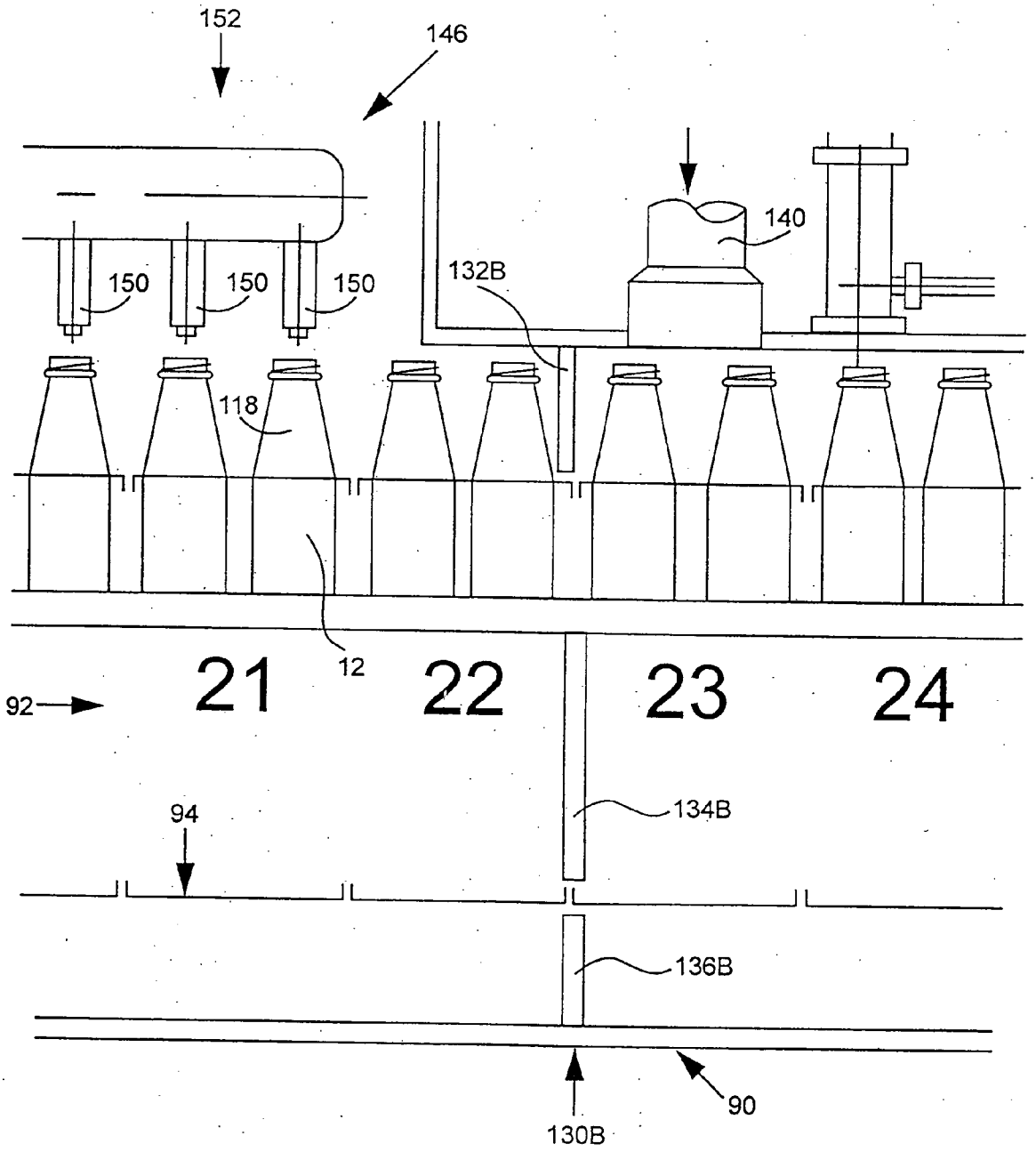

152
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132B
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134B
136B
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FIG. 11

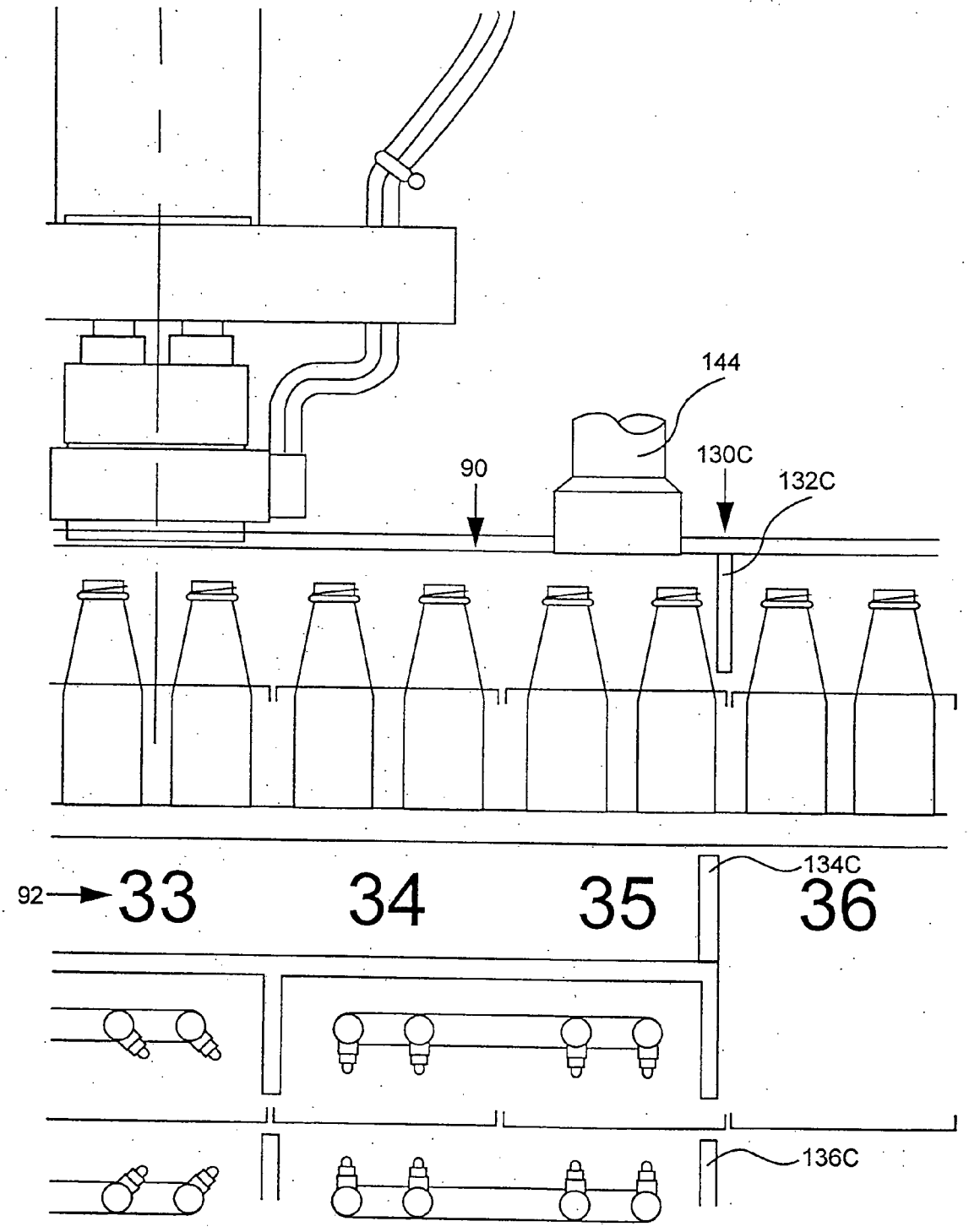


FIG. 12

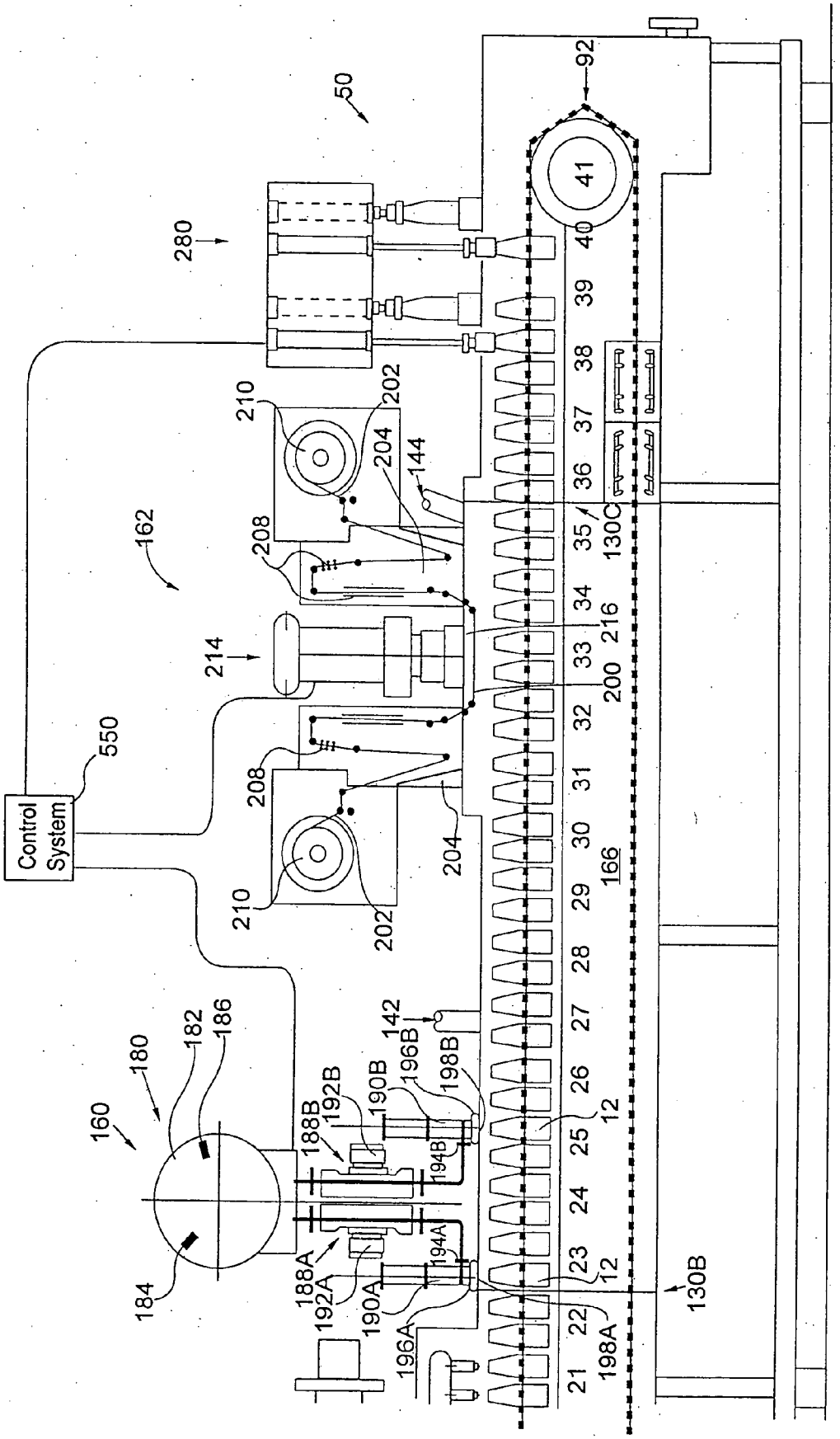

Control System
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144
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200
166
130C
130B
160
180
182
186
184
188A
192A
190A
196A
194A
198A
188B
192B
190B
196B
194B
198B
142
12

FIG. 13

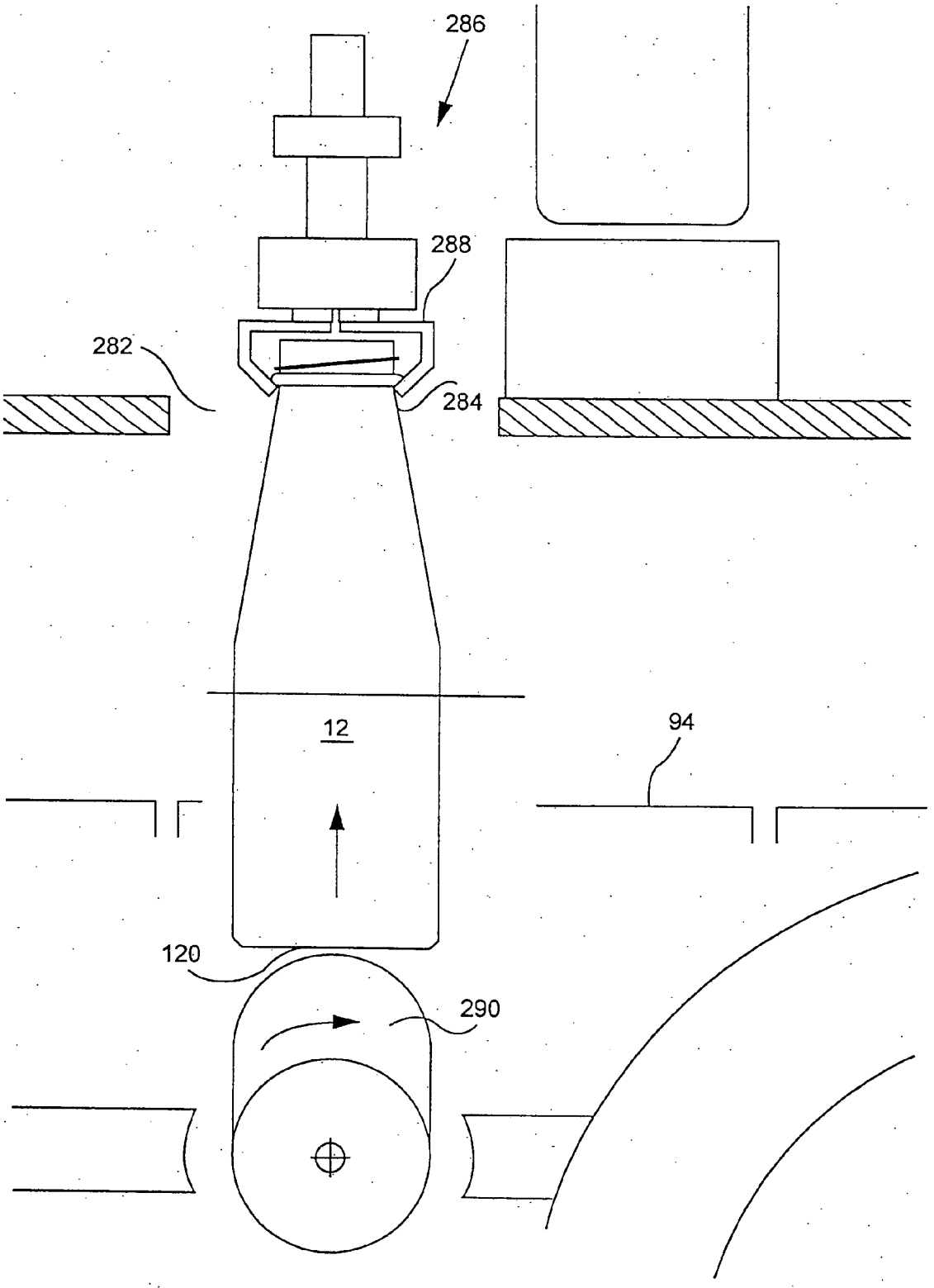


FIG. 14

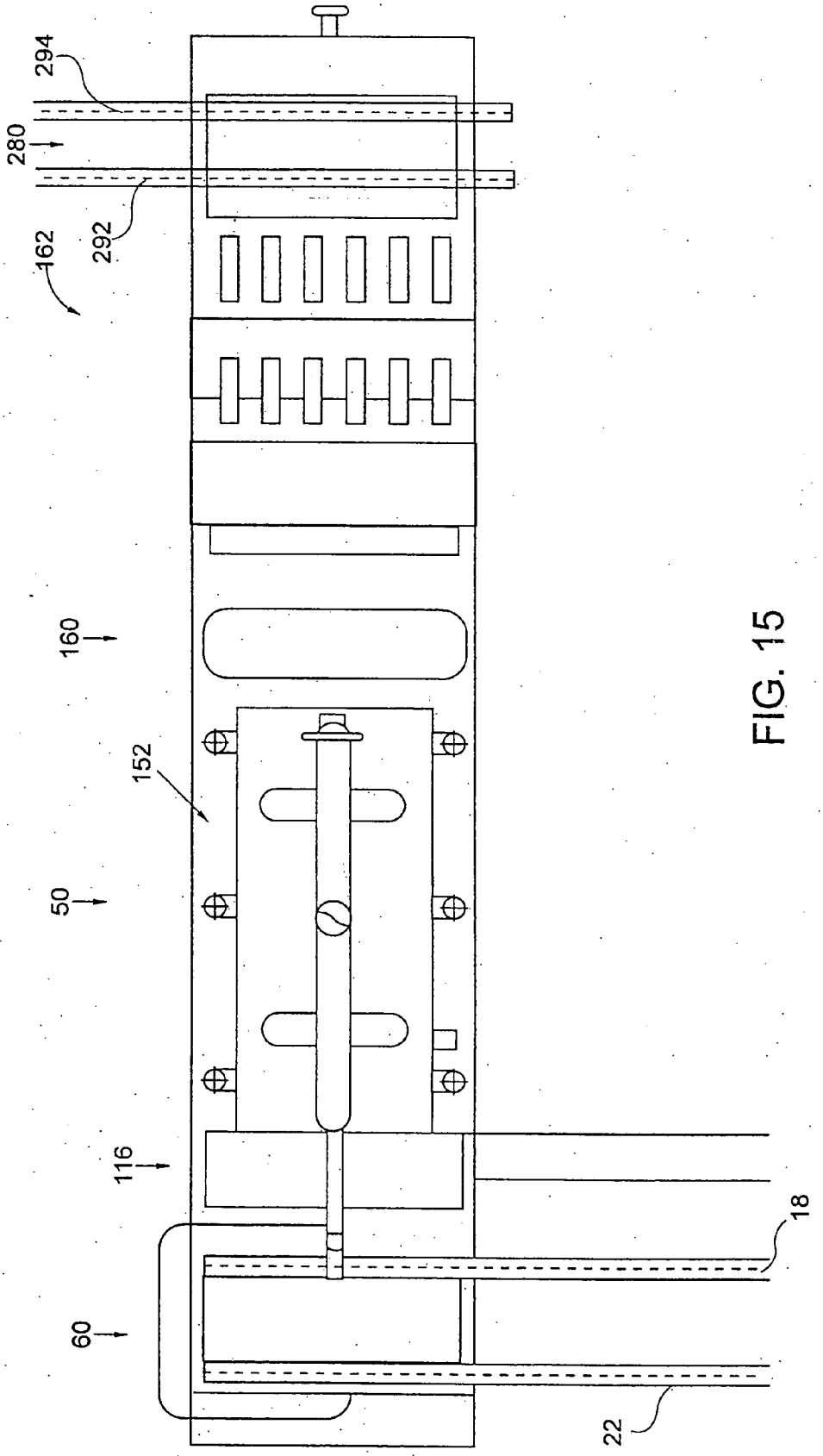


FIG. 15

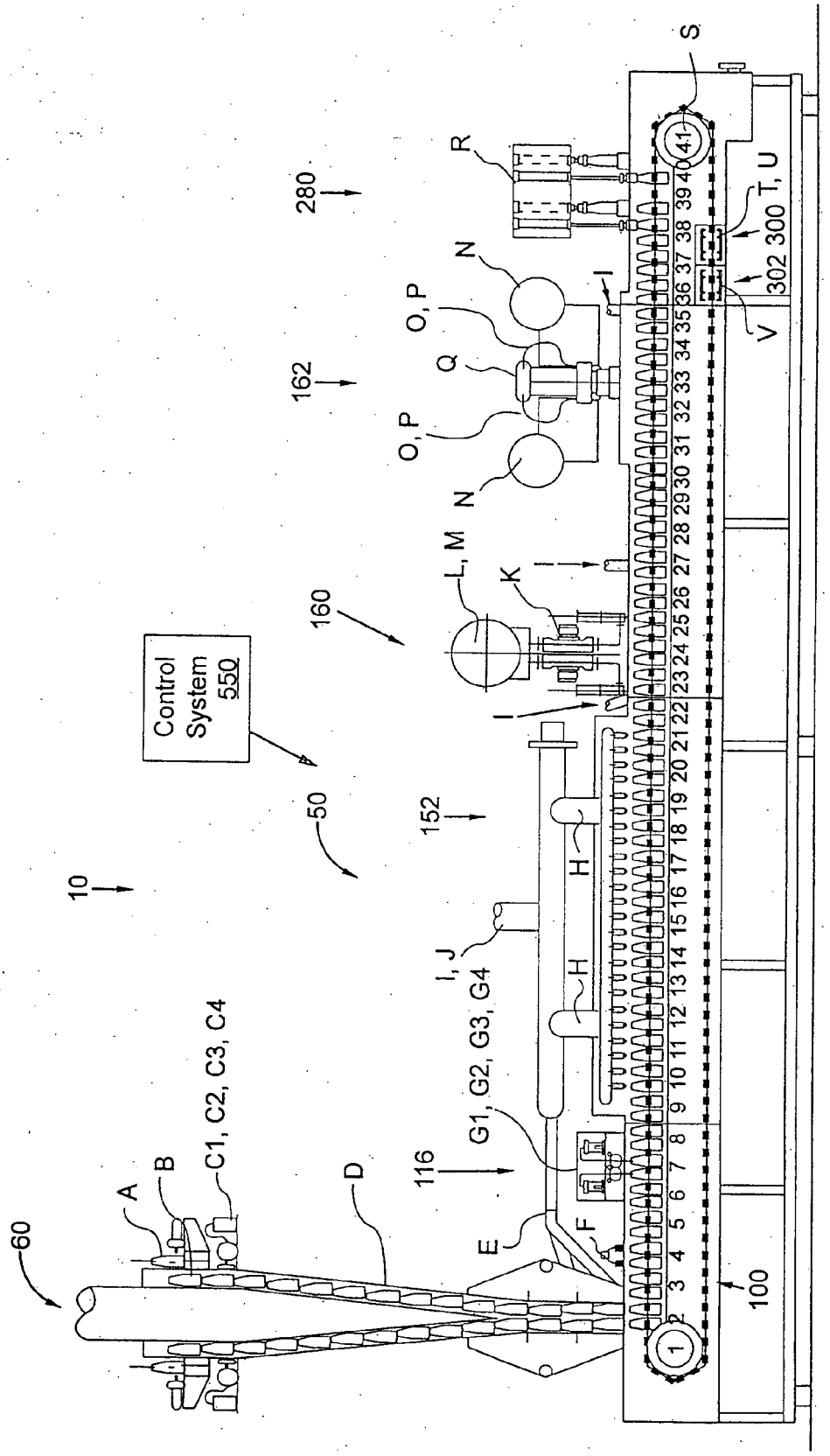

Control System 550
10
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100
116
152
160
162
280
A
B
C1, C2, C3, C4
D
E
F
G1, G2, G3, G4
H
I, J
K
L, M
N
O, P
Q
R
S
T, U
V
300
302
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41

FIG. 16

APPARATUS FOR ASEPTIC PACKAGING

[0001] This application is a divisional of Ser. No. 09/306,552, filed on May 6, 1999, which is a non-provisional of Ser. No. 60/118,404, filed on Feb. 2, 1999.

FIELD OF THE INVENTION

[0002] The present invention relates generally to systems for the aseptic packaging of food products. More particularly, the present invention relates to an aseptic packaging system for the aseptic packaging of food products in containers such as bottles or jars.

BACKGROUND OF THE INVENTION

[0003] Sterilized packaging systems in which a sterile food product is placed and sealed in a container to preserve the product for later use are well known in the art. Methods of sterilizing incoming containers, filling the containers with pasteurized product, and sealing the containers in an aseptic tunnel are also known.

[0004] Packaged food products can generally be categorized as high acid products (Ph below 4.5) or low acid products (Ph of 4.5 and above). The high acid content of a high acid product helps to reduce bacteria growth in the product, thereby increasing the shelf life of the product. The low acid content of a low acid product, however, necessitates the use of more stringent packaging techniques, and often requires refrigeration of the product at the point of sale.

[0005] Several packaging techniques, including extended shelf life (ESL) and aseptic packaging, have been developed to increase the shelf life of low acid products. During ESL packaging, for example, the packaging material is commonly sanitized and filled with a product in a presterilized tunnel under "ultra-clean" conditions. By using such ESL packaging techniques, the shelf life of an ESL packaged product is commonly extended from about 10 to 15 days to about 90 days. Aseptic packaging techniques, however, which require that the packaging take place in a sterile environment, using presterilized containers, etc., are capable of providing a packaged product having an even longer shelf life of 150 days or more. In fact, with aseptic packaging, the shelf life limitation is often determined by the quality of the taste of the packaged product, rather than by a limitation caused by bacterial growth.

[0006] For the aseptic packaging of food products, an aseptic filler must, for example, use an FDA (Food and Drug Administration) approved sterilant, meet FDA quality control standards, use a sterile tunnel or clean room, and must aseptically treat all packaging material. The food product must also be processed using an "Ultra High Temperature" (UHT) pasteurization process to meet FDA aseptic standards. The packaging material must remain in a sterile environment during filling, closure, and sealing operations.

[0007] Many attempts have been made, albeit unsuccessfully, to aseptically fill containers, such as bottles or jars having small openings, at a high output processing speed. In addition, previous attempts for aseptically packaging a low acid product in plastic bottles or jars (e.g., formed of polyethylene terepthalate (PET) or high density polyethylene (HDPE)), at a high output processing speed, have also failed. Furthermore, the prior art has not been successful in providing a high output aseptic filler that complies with the stringent United States FDA standards for labeling a packaged product as "aseptic." In the following description of the present invention, the term "aseptic" denotes the United States FDA level of aseptic.

SUMMARY OF THE INVENTION

[0008] In order to overcome the above deficiencies, the present invention provides a method and apparatus for providing aseptically processed low acid products in a container having a small opening, such as a glass or plastic bottle or jar, at a high output processing speed.

[0009] Many features are incorporated into the aseptic processing apparatus of the present invention in order to meet the various United States FDA aseptic standards and the 3A Sanitary Standards and Accepted Practices.

[0010] The aseptic processing apparatus of the present invention uses filtered air to maintain a positive pressure within a filler apparatus. The filler apparatus includes a sterile tunnel that is pressurized to a level greater than atomospheric pressure using filtered sterile air. The filler apparatus includes three interfaces with the ambient environment, each of which eliminates the possibility of external contamination. The first interface is where containers first enter the sterile tunnel through a bottle infeed and sterilization apparatus. In accordance with the present invention, there is always an outflow of aseptic sterilant (e.g., hydrogen peroxide) enriched sterile air from the first interface to prevent contaminants from entering the sterile tunnel. The second interface with the sterile tunnel is the path where incoming lid stock enters a lid sealing and heat sealing apparatus. To prevent contamination, the lid stock passes through a hydrogen peroxide bath that provides an aseptic barrier for any contaminants that enter the sterile tunnel through the second interface. The third interface with the sterile tunnel is at an exit opening of a discharge apparatus where sealed containers leave the sterile tunnel. Positive sterile air pressure within the sterile tunnel ensures that sterile air is continuously flowing out of the exit opening of the discharge apparatus, thereby preventing contaminants from entering the sterile tunnel through this interface.

[0011] The aseptic processing apparatus includes a conveying apparatus for transporting the containers through a plurality of processing stations located within the sterile tunnel. The entire conveying apparatus is enclosed within the sterile tunnel, and is never is exposed to unsterile conditions.

[0012] The interior surface of a container such as a bottle or jar is much more difficult to aseptically sterilize than the interior surface of a cup. A cup generally has a large opening compared to its height, whereas a bottle or jar generally has a small opening compared to its height and its greatest width (e.g., the ratio of the opening diameter to the height of the container is less than 1.0). A sterilant can be introduced, activated, and removed in a cup much more rapidly than in a bottle or jar. The processing speed when using a bottle or jar is limited, in part, by the time required to aseptically sterilize the interior surface of the bottle or jar. The aseptic processing apparatus of the present invention overcomes the processing speed limitations associated with the use of containers such as bottles or jars.

[0013] A high output processing speed is achieved in the present invention by applying a hot atomized sterilant, such as a hydrogen peroxide spray onto the interior surface of each container, and by subsequently activating and removing the sterilant in a plurality of drying stations using hot sterile air. For example hydrogen peroxide breaks down into water and oxygen, and thus oxidizes and kills bacteria within the container. To achieve aseptic sterilization, a minimum container temperature is developed and held for a predetermined period of time (e.g., 131° F. for 5 seconds) after application of the sterilant. Hot sterile air is delivered at a high volume and a relatively low temperature to dry the container and to prevent the container (if formed of plastic) from being heated to its softening temperature. After container drying, the residual hydrogen peroxide in the container is below a predetermined level (e.g., about 0.5 PPM (parts per million)).

[0014] The present invention generally provides a method for aseptically bottling aseptically sterilized foodstuffs comprising the steps of:

[0015] providing a plurality of bottles;

[0016] aseptically disinfecting the plurality of bottles;

[0017] aseptically filling the aseptically disinfected plurality of bottles with the aseptically sterilized foodstuffs; and

[0018] filling the aseptically disinfected plurality of bottles at a rate greater than 100 bottles per minute.

[0019] The present invention additionally provides a method for aseptically bottling aseptically sterilized foodstuffs comprising the steps of:

[0020] providing a plurality of bottles;

[0021] aseptically disinfecting the bottles at a rate greater than 100 bottles per minute; and

[0022] aseptically filling the bottles with aseptically sterilized foodstuffs.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023] The features of the present invention will best be understood from a detailed description of the invention and a preferred embodiment, thereof selected for the purposes of illustration, and shown in the accompanying drawings in which:

[0024] **FIG. 1** is a plan view of an aseptic processing apparatus in accordance with a preferred embodiment of the present invention;

[0025] **FIG. 2** is a side view of the aseptic processing apparatus of **FIG. 1**;

[0026] **FIG. 3** is a partial cross-sectional side view of the aseptic processing apparatus of **FIG. 1**;

[0027] **FIG. 4** is a cross-sectional side view of a bottle infeed and sterilization apparatus;

[0028] **FIG. 5** illustrates a cross-sectional top view of the bottle infeed and sterilization apparatus taken along line **5-5** of **FIG. 4**;

[0029] **FIG. 6** is an interior sectional view of an interior wall taken along line **6-6** of **FIG. 4**;

[0030] **FIG. 7** is a cross-sectional view of the bottle infeed and sterilization apparatus taken along line **7-7** of **FIG. 4**;

[0031] **FIG. 8** is a perspective view of a conveying plate for use in the aseptic processing apparatus of the present invention;

[0032] **FIG. 9** is a perspective view of a partition in a sterile tunnel;

[0033] **FIG. 10** is a cross-sectional side view of an interior bottle sterilization apparatus and the partition located between stations **8** and **9**;

[0034] **FIG. 11** is a cross-sectional side view of the partition located between stations **22** and **23**;

[0035] **FIG. 12** is a cross-sectional side view of the partition located between stations **35** and **36**;

[0036] **FIG. 13** is a cross-sectional side view of a lid sterilization and heat sealing apparatus;

[0037] **FIG. 14** is a side view of a lifting apparatus with a gripper mechanism for lifting the bottles from the sterile tunnel;

[0038] **FIG. 15** is a top view of the aseptic processing apparatus; and

[0039] **FIG. 16** is a side view of the aseptic processing apparatus indicating the control and monitoring locations that are interfaced with a control system.

DETAILED DESCRIPTION OF THE INVENTION

[0040] Although certain preferred embodiments of the present invention will be shown and described in detail, it should be understood that various changes and modifications may be made without departing from the scope of the appended claims. The scope of the present invention will in no way be limited to the number of constituting components, the materials thereof, the shapes thereof, the relative arrangement thereof, etc., and are disclosed simply as an example of the preferred embodiment. The features and advantages of the present invention are illustrated in detail in the accompanying drawings, wherein like reference numerals refer to like elements throughout the drawings. Although the drawings are intended to illustrate the present invention, the drawings are not necessarily drawn to scale.

[0041] The present invention provides an aseptic processing apparatus **10** that will meet the stringent FDA (Food and Drug Administration) requirements and 3A Sanitary Standards and Accepted Practices required to label a food product (foodstuffs) as "aseptic". Hereafter, "aseptic" will refer to the FDA level of aseptic. The present invention provides a method and apparatus for producing at least about a 12 log reduction of *Clostridium botulinum* in food products. In addition, the present invention produces packaging material with at least about a 6 log reduction of spores. Actual testing of the aseptic processing apparatus is accomplished with spore test organisms. These test organisms are selected on their resistance to the media selected used to achieve sterility. For example, when steam is the media, the

test organism is Bacillus stearothermophilus. When hydrogen peroxide is the media, then the test organism is *Bacillus subtilis* var. *globigii*.

[0042] The present invention processes containers such as bottles or jars that have a small opening compared to its height and its greatest width (e.g., the ratio of the opening diameter to the height of the container is less than 1.0). In the preferred embodiment, a bottle **12** (see, e.g., **FIG. 8**) is illustrated as the container. The container may alternately comprise a jar. The bottle **12** is preferably formed of a plastic such as polyethylene terepthalate (PET) or high density polyethylene (HDPE), although other materials such as glass may also be used. The present invention uses an aseptic sterilant such as hydrogen peroxide (H_2O_2) or oxonia to sterilize the bottles **12**. In the preferred embodiment of the present invention, hydrogen peroxide is used as the sterilant. The present invention uses hydrogen peroxide with a concentration of less than about 35% and ensures that the bottles **12** have less than about 0.5 ppm of residual hydrogen peroxide after each bottle **12** is sterilized.

[0043] **FIGS. 1-3** illustrate several views of an aseptic processing apparatus **10** in accordance with a preferred embodiment of the present invention. As shown, the aseptic processing apparatus **10** includes a first bottle unscrambler **20**, a second bottle unscramble **30**, and a bottle lifter **40** for providing a supply of properly oriented empty bottles. The empty bottles are delivered to a filler apparatus **50** after passing through a bottle infeed and sterilization apparatus **60** for aseptic sterilization. The filled bottles are sealed at a first capping apparatus **400** or a second capping apparatus **410**. A control system **550** monitors and controls the operation of the aseptic processing apparatus **10**. The filled and sealed bottles are packed and palletized using a first case packing apparatus **480**, a second case packing apparatus **490**, a first palletizer **500**, and a second palletizer **510**.

[0044] The bottles **12** arrive at a first bottle unscrambler **20** with a random orientation, such that an opening **16** (see **FIG. 8**) of each bottle **12** can be oriented in any direction. The first bottle unscrambler **20** manipulates the bottles **12** until the opening **16** of each bottle **12** is in a top vertical position. The bottles **12** leave the first bottle unscrambler **20** in a series formation with the opening **16** of each bottle **12** oriented vertically. The bottles **12** travel in single file in a first lane **18** to a first bottle lifter **40**. The first bottle lifter **40** lifts and transports the bottles **12** to a bottle infeed and sterilization apparatus **60**. A second bottle unscrambler **30** may also used to provide a supply of vertically oriented bottles **12**. The bottles **12** output from the second bottle unscrambler **30** travel in single file in a second lane **22** to a second bottle lifter **42**, which lifts and transports the bottles **12** to the bottle infeed and sterilization apparatus **60**.

[0045] **FIG. 3** illustrates the bottle infeed, sterilization, and conveying apparatus **60** attached to the filler apparatus **50**. **FIG. 4** illustrates a cross-sectional side view of the bottle infeed, sterilization, and conveying apparatus **60**. **FIG. 5** illustrates a cross-sectional top view of the bottle infeed, sterilization, and conveying apparatus **60** taken along line **5-5** of **FIG. 4**. The bottle infeed and sterilization apparatus **60** preferably inputs six bottles **12** in a horizontal direction from the first lane **18** and six bottles in a horizontal direction from the second lane **22** (**FIG. 5**). A gate **76** in the first lane **18** selectively groups six bottles **12** at a time in first horizontal row **24**. A gate **78** in the second lane **22** selectively groups six bottles **12** at a time in a second horizontal row **28**. An infeed apparatus **80** includes a pushing element **84** for pushing the bottles **12** in the first horizontal row **24** into a first vertical lane **26**. A corresponding infeed apparatus **80** includes a pushing element **86** for pushing the bottles **12** in the second horizontal row **28** into a second vertical lane **32**. The six bottles **12** in the first vertical lane **26** and the six bottles **12** in the second vertical lane **32** are directed downward into the bottle infeed and sterilization apparatus **60**.

[0046] Referring to **FIG. 4**, as the bottles **12** move downward in the first vertical lane **26** and the second vertical lane **32**, a sterilant **14**, such as heated hydrogen peroxide, oxonia, or other aseptic sterilant, is applied to an outside surface **34** of each bottle **12** by a sterilant application apparatus **36**. The outside surface **34** of a bottle **12** is illustrated in greater detail in **FIG. 8**. The bottles **12** may move downward in the first vertical lane **26** and the second vertical lane **32** by the force of gravity. Alternatively, controlled downward movement of the bottles **12** can be created by the use of a conveying device such as a moving conveying chain. A plurality of pins are attached to the conveying chain. Each bottle **12** rests on one of the pins attached to the conveying chain. Therefore, the motion of each bottle is controlled by the speed of the moving conveying chain.

[0047] A sterilant such as hydrogen peroxide may be provided to the sterilant application apparatus **36** in many ways. For example, liquid hydrogen peroxide may be provided in a reservoir at a level maintained by a pump and overflow pipe. A plurality of measuring cups (e.g., approximately 0.5 ml each) connected by an air cylinder are submerged into the reservoir and are lifted above the liquid level. Thus, a measured volume of liquid hydrogen peroxide is contained in each measuring cup.

[0048] Each measuring cup may include a conductivity probe that is configured to send a signal to the control system **550** indicating that the measuring cup is full. A tube (e.g., having a diameter of about 1/16") is positioned in the center of the measuring cup. A first end of the tube is positioned near the bottom of the measuring cup. A second end of the tube is connected to the sterilant application apparatus **36**. The sterilant application apparatus **36** includes a venturi and a heated double tube heat exchanger. When the measuring cup is full, and a signal is received from the control system **550**, a valve is opened allowing pressurized sterile air to enter the venturi. The pressurized air flow causes a vacuum to be generated in second end of the tube causing liquid hydrogen peroxide to be pulled out of the measuring cup. The liquid hydrogen peroxide is sprayed into a sterile air stream which atomizes the hydrogen peroxide into a spray. The atomized hydrogen peroxide enters the double tube heat exchanger in order to heat the atomized hydrogen peroxide to its vaporization phase. The double tube heat exchanger is heated with steam and the temperature is monitored and controlled by the control system **550**. In **FIG. 4**, the application of the sterilant **14** by the sterilant application apparatus **36** is accomplished through the use of spray nozzles **64** that produce a sterilant fog which is directed to the outside surface **34** of each bottle **12**.

[0049] Alternatively, a direct spray of heated hydrogen peroxide may be continuously applied to the outside surface **34** of each bottle **12**. For producing the direct spray, a

metering pump regulates the amount of hydrogen peroxide, a flow meter continuously measures and records the quantity of hydrogen peroxide being dispensed, a spray nozzle produces a fine mist, and a heat exchanger heats the hydrogen peroxide above the vaporization point.

[0050] **FIGS. 3 and 4** illustrate the sterilization chamber **38** for activation and drying of bottles **12** which is included in the bottle infeed, sterilization, and conveying apparatus **60**. The sterilization chamber **38** sterilizes the outside surface **34** of each bottle **12**. The sterilization chamber **38** encloses a conduit **39**. Sterile heated air, which is generated by a sterile air supply system **146** (**FIG. 3**), enters the conduit **39** of the sterilization chamber **38** through ports **64** and **68** located at the bottom of the sterilization chamber **38**. The sterile heated air also enters through a bottom opening **62** of the bottle infeed and sterilization apparatus **60**. The sterile heated air travels up through the conduit **39** of the sterilization chamber **38**, and exits the top of the sterilization chamber **38** through an exhaust conduit **70**. The sterile heated air continuously flows in an upward direction through the sterilization chamber **38**, thus preventing any contaminants from entering the bottle infeed and sterilization apparatus **60**. To create the sterile heated air, the air is first passed through a filtering system (e.g., a group of double sterile air filters) to sterilize the air. The air is then heated in a heating system (e.g., an electric heater) to about 230° F. The air temperature is regulated by the control system **550**. Other techniques for providing the sterile heated air may also be used. The control system **550** monitors the air pressure and flow rate of the sterile heated air to ensure that an adequate flow of the hot sterile air is maintained in the bottle sterilization chamber **38** of the bottle infeed and sterilization apparatus **60**.

[0051] As illustrated in **FIGS. 4, 6**, and **7**, the sterilization chamber **38** includes two opposing, interior, perforated walls **72**A, **72**B. The perforated walls **72**A and **72**B guide the bottles **12** downward in the first vertical lane **26** and the second vertical lane **32**, respectively. The perforated walls **72**A, **72**B also allow the complete circulation of hot sterile air around the outside surface **34** of each bottle **12** in the sterilization chamber **38**. The sterilization chamber **38** supplies hot sterile air to the outside surface **34** of each bottle **12** between the sterilant application apparatus **36** and the bottom opening **62** of the bottle infeed and sterilization apparatus **60**. This sterilant may be hydrogen peroxide or oxonia (hydrogen peroxide and peroxyacetic acid).

[0052] In accordance with the preferred embodiment of the present invention, twelve drying positions are provided in the sterilization chamber **38**. Each bottle **12** is exposed to the hot sterile air in the sterilization chamber **38** for about at least 24 seconds. This provides time sufficient time for the hydrogen peroxide sterilant to break down into water and oxygen, to kill any bacteria on the bottles **12**, and to evaporate from the outside surface **34** of the bottles **12**.

[0053] An exhaust fan **73** is located at a top of the exhaust conduit **70** to provide an outlet from a sterile tunnel **90**, and to control the sterile air flow rate through the sterilization chamber **38**. The exhaust fan **73** is controlled by the control system **550**. The control system **550** controls the sterile air temperature preferably to about 230° F., and controls the sterile air flow rate through the sterilization chamber **38**. The flow rate is preferably about 1800 scfm through the sterilization chamber **38**. The bottles **12** leave the sterilization chamber **38** with a hydrogen peroxide concentration of less than 0.5 PPM.

[0054] As shown in **FIGS. 3 and 4**, a plurality of proximity sensors **71** located along the sides of the vertical lanes **26**, **32** detect any bottle **12** jams that occur within the sterilization chamber **38**. The proximity sensors **71** transmit an alarm signal to the control system **550**. The bottles **12** leave the bottle infeed and sterilization apparatus **60** through the bottom opening **62**, and enter the sterile tunnel **90** of the filler apparatus **50**.

[0055] In the preferred embodiment of the present invention, the filler apparatus **50** includes forty-one (41) index stations **92**, hereafter referred to as "stations." Various index stations **92** are illustrated in **FIGS. 3, 4**, and **11-15**. The conveying motion of the bottles **12** to the various stations **92** through the filler apparatus **50** is based on an indexing motion. The filler apparatus **50** is designed to convey the bottles **12** through the various operations of the filler **50** in a two by six matrix. The twelve bottles **12** in the two by six matrix are positioned in, and displaced by, a conveying plate **94** as illustrated in **FIG. 8**. Therefore, twelve bottles **12** are exposed to a particular station **92** at the same time. A conveying apparatus **100** moves the set of twelve bottles **12** in each conveying plate **94** sequentially through each station **92**.

[0056] Referring to **FIGS. 3 and 4**, the bottles **12** are supplied from an infeed chamber **102** to station **2** of the filler apparatus **50** through the bottom opening **62** of the bottle infeed and sterilization apparatus **60**. The infeed chamber **102** is enclosed to direct heated hydrogen peroxide laden air completely around the outer surface **34** of the bottles **12**. A mechanical scissors mechanism and a vacuum "pick and place" apparatus **104** position twelve bottles **12** at a time (in a two by six matrix, **FIG. 8**) into one of the conveying plates **94**.

[0057] A plurality of conveying plates **94** are attached to a main conveyor **106**. The main conveyor **106** forms a continuous element around conveyor pulleys **108** and **110** as illustrated in **FIG. 3**. A bottle support plate **107** supports a bottom **120** of each bottle **12** as the bottles **12** are conveyed from station to station through the filler apparatus **50**. Each conveying plate **94** passes through stations **1** through **41**, around pulley **108**, and returns around pulley **110** to repeat the process. The main conveyor **106**, conveying plates **94**, and pulleys **108** and **110** are enclosed in the sterile tunnel **90**.

[0058] At station **4**, the bottles **12** in the conveying plate **94** enter a bottle detection apparatus **112**. The bottle detection apparatus **112** determines whether all twelve bottles **12** are actually present and correctly positioned in the conveying plate **94**. Proximity sensors **114** detect the presence and the alignment of each bottle **12**. In the present invention, a bottle **12** with correct alignment is in an upright position with the opening **16** of the bottle **12** located in an upward position. Information regarding the location of any misaligned or missing bottles **12** is relayed to the control system **550**. The control system **550** uses this location information to ensure that, at future stations **92**, bottle filling or sealing will not occur at the locations corresponding to the misaligned or missing bottles **12**.

[0059] At station **7**, as illustrated in **FIGS. 3 and 10**, the bottles **12** in the conveying plate **94** enter an interior bottle

sterilization apparatus **116**. A sterilant, such as hydrogen peroxide, oxonia, or any other suitable aseptic sterilant is applied as a heated vapor fog into the interior **118** of each bottle **12**. Preferably, hydrogen peroxide is used as the sterilant in the present invention. The application of sterilant is accomplished with the use of a plurality of sterilant measuring devices **120** and applicator spray nozzles **122**. A separate measuring device **120** and applicator spray nozzle **122** are used for each of the twelve bottle **12** locations in the conveying plate **94**. Each bottle **12** is supplied with the same measured quantity of sterilant, preferably in the form of a hot vapor fog. The measured quantity of sterilant may be drawn from a reservoir **124** of sterilant, heated, vaporized, etc., in a manner similar to that described above with regard to the sterilant application apparatus **36**.

[**0060**] The control system **550** monitors and controls a spray apparatus **126** that includes the applicator spray nozzles **122**. Each applicator spray nozzle **122** sprays the sterilant into the interior **118** of a corresponding bottle **12** as a hot vapor fog. The applicator spray nozzles **122** are designed to extend through the bottle openings **16**. The applicator spray nozzles **122** descends into the interior **118** and toward the bottom of the bottles **12**. This ensures the complete application of sterilant to the entire interior **118** and interior surface **119** of each bottle **12**. Alternately, the applicator spray nozzles **122** may be positioned immediately above the bottle openings **16** prior to the application of sterilant.

[**0061**] **FIG. 9** illustrates a perspective view of a partition **130** that provides control of sterile air flow within the sterile tunnel **90** of the filler apparatus **50**. The partition **130** includes a top baffle plate **132**, a middle baffle plate **134**, and a bottom baffle plate **136**. The top baffle plate **132** and the middle baffle plate **134** are provided with cut-outs **133** which correspond to the outer shape of each bottle **12** and to the outer shape of the conveyor plate **94**. The cut-outs **133** allow each bottle **12** and each conveyor plate **94** to pass through the partition **130**. A space **138** between the middle baffle plate **134** and the bottom baffle plate **136** allows each empty conveyor plate **94** to pass through the partition **130** as it travels on its return trip from the pulley **108** toward the pulley **110**.

[**0062**] As illustrated in **FIG. 3**, partitions **130**A, **130**B, and **130**C, are located within the sterile tunnel **90**. **FIG. 10** illustrates a cross-sectional view of partition **130**A including baffle plates **132**A, **134**A, and **136**A. The partition **130**A is located between stations **8** and **9**. **FIG. 11** illustrates a cross-sectional view of partition **130**B including baffle plates **132**B, **134**B, and **136**B. The partition **130**B is located between stations **22** and **23**. **FIG. 12** illustrates a cross-sectional view of partition **130**C including baffles **132**C, **134**C, and **136**C. The partition **130**C is located between stations **35** and **36**. As illustrated in **FIG. 3**, sterile air is introduced through sterile air conduits **140**, **142**, and **144** into the sterile tunnel **90**. The sterile air conduit **140** is located at station **23** (**FIG. 11**), the sterile air conduit **142** is located at station **27** (**FIG. 3**), and the sterile air conduit **144** is located at station **35** (**FIG. 12**).

[**0063**] The partition **130**A separates an activation and drying apparatus **152** from the interior bottle sterilization apparatus **116**. The partition **130**B separates the activation and drying apparatus **152** from a main product filler apparatus **160** and a lid sterilization and heat sealing apparatus **162**. Thus, a first sterilization zone **164** is created that includes the activation and drying apparatus **152**. Partition **130**C separates the main product filler apparatus **160** and the lid sterilization and heat sealing apparatus **162** from a bottle discharge apparatus **280**. Thus, partitions **130**B and **130**C create a second sterilization zone **166** that includes the main product filler apparatus **160** and the lid sterilization and heat sealing apparatus **162**. A third sterilization zone **172** includes the bottle discharge apparatus **280**. A fourth sterilization zone **165** includes the interior bottle sterilization apparatus **116**. The second sterilization zone **166** provides a highly sterile area where the bottles **12** are filled with a product and sealed. The second sterilization zone **166** is at a higher pressure than the first sterilization zone **164** and the third sterilization zone **172**. Therefore, any gas flow leakage is in the direction from the second sterilization zone **166** out to the first sterilization zone **164** and the third sterilization zone **172**. The first sterilization zone **164** is at a higher pressure than the fourth sterilization zone **165**. Therefore, gas flow is in the direction from the first sterilization zone **164** to the fourth sterilization zone **165**.

[**0064**] The partitions **130**A, **130**B, and **130**C create sterilization zones **164**, **165**, **166**, and **172** with different concentration levels of gas laden sterilant (e.g., hydrogen peroxide in air). The highest concentration level of sterilant is in the fourth sterilization zone **165**. An intermediate concentration level of sterilant is in the first sterilization zone **164**. The lowest concentration level of sterilant is in the second sterilization zone **166**. Advantageously, this helps to maintain the main product filler apparatus **160** and the lid sterilization and heat sealing apparatus **162** at a low sterilant concentration level. This prevents unwanted high levels of sterilant to enter the food product during the filling and lidding process.

[**0065**] Stations **10** through **21** include twelve stations for directing hot sterile air into each bottle **12** for the activation and removal of the sterilant from the interior of the bottle **12**. The sterile air supply system **146** supplies hot sterile air to a plurality of nozzles **150** in the activation and drying apparatus **152**. Hot sterile air is supplied to the sterile air supply system **146** through conduit **148**. The air is first passed through a filtration system to sterilize the air. The air is then heated in a heating system to about 230° F. The air temperature is regulated by the control system **550**. Also, the control system **550** monitors the air pressure and flow rate to ensure that an adequate flow of hot sterile air is maintained in the sterile tunnel **90** of the application and drying apparatus **152**.

[**0066**] As shown in **FIG. 8**, each bottle **12** generally has a small opening **16** compared to its height "H." A ratio of a diameter "D" of the bottle **12** to the height "H" of the bottle **12** is generally less than 1.0. The small bottle opening **16** combined with a larger height "H" restricts the flow of hot gas into the interior **118** of the bottle **12**. Also, PET and HDPE bottle materials have low heat resistance temperatures. These temperatures commonly are about 55° C. for PET and about 121° C. for HDPE. Typically, in the aseptic packaging industry, a low volume of air at a high temperature is applied to the packaging materials. This often results in deformation and softening of packaging materials formed of PET and HDPE. In order to prevent softening and deformation of the bottles **12**, when formed from these types

of materials, the present invention applies high volumes of air at relatively low temperatures over an extended period of time in the activation and drying apparatus **152**. The plurality of nozzles **150** of the activation and drying apparatus **152** direct hot sterile air into the interior **118** of each bottle **12** (**FIG. 11**). A long exposure time is predicated by the geometry of the bottle **12** and the softening temperature of the material used to form the bottle **12**. In the present invention, about 24 seconds are allowed for directing hot sterile air from the plurality of nozzles **150** into each bottle for the activation and removal of sterilant from the interior surface **119** of the bottle **12**. To achieve aseptic sterilization, a minimum bottle temperature of about 131° F. should be held for at least 5 seconds. To achieve this bottle temperature and time requirements, including the time required to heat the bottle, the sterilant is applied for about 1 second and the hot sterile air is introduced for about 24 seconds. The hot sterile air leaves the nozzles **150** at about 230° F. and cools to about 131° F. when it enters the bottle **12**. The hot sterile air is delivered at a high volume so that the bottle **12** is maintained at about 131° F. for at least 5 seconds. The about 24 seconds provides adequate time for the bottle **12** to heat up to about 131° F. and to maintain this temperature for at least 5 seconds. After bottle **12** has dried, the residual hydrogen peroxide remaining on the bottle **12** surface is less than 0.5 PPM.

[**0067**] A foodstuff product is first sterilized to eliminate bacteria in the product. An "Ultra High Temperature" (UHT) pasteurization process is required to meet the aseptic FDA standard. The time and temperature required to meet the aseptic FDA standard depends on the type of foodstuff. For example, milk must be heated to 282° F. for not less than 2 seconds in order to meet the aseptic standards.

[**0068**] After UHT pasteurization, the product is delivered to a main product filler apparatus **160**. The main product filler apparatus is illustrated in **FIGS. 3 and 13**. The main product filler **160** can be sterilized and cleaned in place to maintain aseptic FDA and **3**A standards. A pressurized reservoir apparatus **180** that can be steam sterilized is included in the main product filler apparatus **160**. As illustrated in **FIG. 13**, the pressurized reservoir apparatus **180** includes an enclosed product tank **182** with a large capacity (e.g., 15 gallons). The product tank **182** is able to withstand elevated pressures of about 60 psig or more. The pressurized reservoir apparatus **180** also includes a level sensor **184**, a pressure sensor **186**, a volumetric measuring device **188**, and a filling nozzle **190**. The product tank **182** includes a single inlet with a valve cluster including a sterile barrier to separate the product process system from aseptic surge tanks and the main product filler apparatus **160**. The product tank **182** has an outlet with twelve connections. At each connections is a volumetric measuring device **188** such as a mass or volumetric flow meter. A plurality of filling nozzles **190**A, **190**B are provided at stations **23**, **25**, respectively. In addition, there are a plurality of volumetric measuring devices **188**A and **188**B to measure the volume of product entering each bottle **12** at stations **23** and **25**, respectively. The control system **550** calculates the desired volume of product to be inserted into each bottle **12**, and controls the product volume by opening or closing a plurality of valves **194**A and **194**B. The activation mechanisms for valves **194**A and **194**B have a sterile barrier to prevent contamination of the product. The plurality of valves **194**A control the volume of product flowing through a corresponding plurality of nozzles **196**A into the bottles **12** at station **23**. The plurality of valves **194**B control the volume of product flowing through a corresponding plurality of nozzles **196**B into the bottles **12** at station **25**. The control system **550** uses the previously stored information provided by the bottle detection apparatus **112** to only allow filling to occur at the locations where bottles **12** are actually present and correctly aligned.

[**0069**] The initial sterilization process for the pressurized reservoir apparatus **180** includes the step of exposing all of the surfaces of the pressurized reservoir apparatus **180** that come in contact with the product to steam at temperatures above about 250° F. for a minimum of about 30 minutes. Elements such as cups **198**A and **198**B are used to block off nozzle outlets **196**A and **196**B respectively, to allow a build-up of steam pressure to about 50 psig inside the pressurized reservoir apparatus **180**. Condensate generated as the steam heats the interior surfaces of the pressurized reservoir apparatus **180** is collected and released from the nozzles **198**A and **198**B. This condensate is released when the cups **198**A and **198**B are removed from the nozzle outlets **196**A and **196**B. Once the interior surfaces of the pressurized reservoir apparatus **180** are sterilized, the steam is shut off, and sterile air is used to replace the steam. The sterile air reduces the interior temperature of the pressurized reservoir apparatus **180** to the temperature of the product before the product is allowed to enter the enclosed product tank **182**. Sterile air is directed through sterile air conduits **142** and **144** into the second sterilization zone **166** at a volume rate of about 800 scfm (**FIG. 13**). The sterile air flow entering the second sterilization zone **166** provides sterile air to the main product filler apparatus **160** and to the lid sterilization and heat sealing apparatus **162**.

[**0070**] The main product filler apparatus **160** includes a separate filling position for each bottle. The bottle **12** filling operation is completed for six bottles at station **23** and for six bottles at station **25**.

[**0071**] **FIGS. 3 and 13** illustrate the lid sterilization and heat sealing apparatus **162**. A lid **200** is applied to each of the twelve bottles **12** at station **31**. For a fully aseptic bottle filler, complete lid **200** sterilization is necessary, and therefore a sterilant such as hydrogen peroxide is typically used. In the present invention, the lids are formed of a material such as foil or plastic. The lids **200** are joined together by a small interconnecting band that holds them together to form a long connected chain of lids **200**, hereinafter referred to as a "daisy chain"**202**. A daisy chain **202** of lids **200** is placed on each of a plurality of reels **210**. For the twelve bottle configuration of the present invention, six of the reels **210**, each holding a daisy chain **202** of lids **200**, are located on each side of a heat sealing apparatus **214**. Each daisy chain **202** of lids **200** winds off of a corresponding reel **210** and is sterilized, preferably using a hydrogen peroxide bath **204**. A plurality of hot sterile air knives **208**, which are formed by jets of hot sterile air, activate the hydrogen peroxide to sterilize the lids **200** on the daisy chain **202**. The hot sterile air knives **208** also remove the hydrogen peroxide from the lids **200** so that the residual concentration of hydrogen peroxide is less than 0.5 PPM. The hydrogen peroxide bath **204** prevents any contaminants from entering the sterile tunnel **90** via the lidding operation. Once sterilized, the lids **200** enter the sterile tunnel **90** where they are separated from the daisy chain **202** and placed on a bottle **12**. Each lid is slightly larger in diameter then that of the opening **16** of a

bottle **12**. During the placement of the lid **200** on the bottle **12**, a slight mechanical crimp of the lid **200** is formed to locate and hold the lid **200** on the bottle **12**. The crimp holds the lid **200** in place on the bottle **12** until the bottle **12** reaches a station **33** for sealing.

[**0072**] At station **33**, the lids **200** are applied to the bottles **12**. The heat sealing apparatus **214** includes a heated platen **216** that applies heat and pressure against each lid **200** for a predetermined length of time, to form a seal between the lid **200** and the bottle **12**. The heated platen **216** is in a two by six configuration to seal twelve of the bottles **12** at a time.

[**0073**] At station **37**, the lid **200** seal and bottle **12** integrity are checked in a known manner by a seal integrity apparatus (not shown) comprising, for example, a bottle squeezing mechanism and a proximity sensor. Each bottle **12** is squeezed by the bottle squeezing mechanism which causes the lid **200** on the bottle **12** to extend upward. The proximity sensor detects if the lid **200** has extended upward, which indicates an acceptable seal, or whether the seal remains flat, which indicates a leaking seal or bottle **12**. The location of the defective bottles **12** are recorded by the control system **550** so that the defective bottles will not be packed.

[**0074**] Bottle discharge from the sterile tunnel **90** of the filler apparatus **50** occurs at stations **38** and **40** as illustrated in **FIGS. 3, 13** and **14**. A bottle discharge apparatus **280** is located at stations **38** and **40**. At this point in the filler apparatus **50**, the filled and sealed bottles **12** are forced in an upward direction such that a top portion **284** of each bottle **12** protrudes through an opening **282** in the sterile tunnel **90** (**FIG. 14**). A rotating cam **290** or other suitable means (e.g., an inflatable diaphragm, etc.) may be used to apply a force against the bottom **120** of each bottle **12** to force the bottle **12** in an upward direction.

[**0075**] As illustrated in **FIG. 14**, the bottle discharge apparatus **280** comprises a lifting apparatus **286** that includes a gripper **288** that grasps the top portion **284** of each bottle **12** and lifts the bottle **12** out through the opening **282** in the sterile tunnel **90**. In order to ensure that contaminated air cannot enter the sterile tunnel **90**, the sterile air in the sterile tunnel **90** is maintained at a higher pressure than the air outside the sterile tunnel **90**. Thus, sterile air is always flowing out of the sterile tunnel **90** through the opening **282**. In addition, the gripper **288** never enters the sterile tunnel **90**, because the top portion **284** of the bottle **12** is first lifted out of the sterile tunnel **90** by the action of the rotating cam **290** before being grabbed by the gripper **288**.

[**0076**] **FIG. 15** illustrates a top view of the filler apparatus **50** including the bottle infeed and sterilization apparatus **60**, the interior bottle sterilization apparatus **116**, and the activation and drying apparatus **152**. **FIG. 15** additionally illustrates the main filler apparatus **160**, the lid sterilization and heat sealing apparatus **162**, and the bottle discharge apparatus **280**.

[**0077**] Referring again to **FIGS. 1 and 14**, the lifting apparatus **286** lifts the bottles **12** at station **38** and places the bottles **12** in a first lane **292** that transports the bottles **12** to a first capping apparatus **410**. In addition, the lifting apparatus **286** lifts the bottles **12** at station **40** and places the bottles **12** in a second lane **294** that transports the bottles **12** to a second capping apparatus **400**.

[**0078**] The first capping apparatus **410** secures a cap (not shown) on the top of each bottle **12** in the first lane **292**. The second capping apparatus **400** secures a cap on the top of each bottle **12** in the second lane **294**. The caps are secured to the bottles **12** in a manner known in the art. It should be noted that the capping process may be performed outside of the sterile tunnel **90** because each of the bottles **12** have previously been sealed within the sterile tunnel **90** by the lid sterilization and heat sealing apparatus **162** using a sterile lid **200**.

[**0079**] After capping, the bottles **12** are transported via the first and second lanes **292, 294** to labelers **460** and **470**. The first labeling apparatus **470** applies a label to each bottle **12** in the first lane **292**. The second labeling apparatus **460** applies a label to each bottle **12** in the second lane **294**.

[**0080**] From the first labeling apparatus **470**, the bottles **12** are transported along a first set of multiple lanes (e.g., 4) to a first case packing apparatus **490**. From the second labeling apparatus **460**, the bottles **12** are transported along a second set of multiple lanes to a second case packing apparatus **480**. Each case packing apparatus **480, 490** gathers and packs a plurality of the bottles **12** (e.g., twelve) in each case in a suitable (e.g., three by four) matrix.

[**0081**] A first conveyor **296** transports the cases output by the first case packer **490** to a first palletizer **510**. A second conveyor **298** transports the cases output by the second case packer **480** to a second palletizer **500**. A vehicle, such as a fork lift truck, then transports the pallets loaded with the cases of bottles **12** to a storage warehouse.

[**0082**] Referring again to **FIG. 3**, the main conveyor **106** and each conveying plate **94** are cleaned and sanitized once during each revolution of the main conveyor **106**. Specifically, after each empty conveying plate **94** passes around the pulley **108**, the conveying plate **94** is passed through a liquid sanitizing apparatus **300** and a drying apparatus **302**. The liquid sanitizing apparatus **300** sprays a mixture of a sterilizing agent (e.g., oxonia, (hydrogen peroxide and peroxyacetic acid)) over the entire surface of each conveying plate **94** and associated components of the main conveyor **106**. In the drying apparatus **302**, heated air is used to dry the main conveyor **106** and conveying plates **94**.

[**0083**] Stations **1** through **40** are enclosed in the sterile tunnel **90**. The sterile tunnel **90** is supplied with air that is pressurized and sterilized. The interior of the sterile tunnel **90** is maintained at a pressure higher than the outside environment in order to eliminate contamination during the bottle processing. In addition, to further ensure a sterile environment within the sterile tunnel **90**, the sterile air supply provides a predetermined number of air changes (e.g., 2.5 changes of air per minute) in the sterile tunnel **90**.

[**0084**] The bottle infeed and sterilization apparatus **60** and the filler apparatus **50** meet the 3A Sanitary Standards of the Sanitary Standards Symbol Administrative Council. The 3A Sanitary Standards ensure that all product contact surfaces can be cleaned and sterilized on a regular basis such as daily. The present invention allows the product contact surfaces to be cleaned-in-place without dismantling the bottle infeed and sterilization apparatus **60** or the filler apparatus **50**. The 3A Sanitary Standards includes requirements such as the material type, the material surface finish, the elastomer selection, the radius of machined parts and the ability of all

surfaces to be free draining. For example, the material type is selected from the 300 series of stainless steel and all product contact surfaces have a finish at least as smooth as No. 4 ground finish on stainless steel sheets.

[0085] Before bottle production is initiated, the bottle infeed and sterilization apparatus **60** and the filler apparatus **50** are preferably sterilized with an aseptic sterilant. For example, a sterilant such as a hot hydrogen peroxide mist may be applied to all interior surfaces of the bottle infeed and sterilization apparatus **60** and the filler apparatus **50**. Then, hot sterile air is supplied to activate and remove the hydrogen peroxide, and to dry the interior surfaces of the bottle infeed and sterilization apparatus **60** and the filler apparatus **50**.

[0086] **FIG. 16** is a side view of the aseptic processing apparatus **10** of the present invention indicating the location of the control and monitoring devices that are interfaced with the control system **550**. The control system **550** gathers information and controls process functions in the aseptic processing apparatus **10**. A preferred arrangement of the control and monitoring devices are indicated by encircled letters in **FIG. 16**. A functional description of each of the control and monitoring devices is listed below. It should be noted that these control and monitoring devices are only representative of the types of devices that may be used in the aseptic processing apparatus **10** of the present invention. Other types and combinations of control and monitoring devices may be used without departing from the intended scope of the present invention. Further, control system **550** may respond in different ways to the outputs of the control and monitoring devices. For example, the control system **550** may automatically adjust the operational parameters of the various components of the aseptic processing apparatus **10**, may generate and/or log error messages, or may even shut down the entire aseptic processing apparatus **10**. In the preferred embodiment of the present invention, the control and monitoring devices include:

[0087] A. A bottle counter to ensure that a predetermined number of the bottles **12** (e.g., six bottles) on each upper horizontal row **24**, **28** enter the loading area of the bottle infeed and sterilization apparatus **60**.

[0088] B. A proximity sensor to ensure that the first group of bottles **12** has dropped into the first bottle position in the bottle infeed and sterilization apparatus **60**.

[0089] C1. A conductivity sensor to ensure that the measuring cup used by the sterilant application apparatus **36** is full.

[0090] C2. A conductivity sensor to ensure that the measuring cup used by the sterilant application apparatus **36** is emptied in a predetermined time.

[0091] C3. A pressure sensor to ensure that the pressure of the air used by the sterilant application apparatus **36** is within predetermined atomization requirements.

[0092] C4. A temperature sensor to ensure that each heat heating element used by the sterilant application apparatus **36** is heated to the correct temperature.

[0093] D. A proximity sensor (e.g., proximity sensor **71**, **FIG. 3**) to ensure that a bottle jam has not occurred within the bottle infeed and sterilization apparatus **60**.

[0094] E. A temperature sensor to ensure that the temperature of the heated sterile air entering the bottle infeed and sterilization apparatus **60** is correct.

[0095] F. A proximity sensor that to ensure that each conveying plate **94** is fully loaded with bottles **12**.

[0096] G1. A conductivity sensor to ensure that the measuring cup used by the interior bottle sterilization apparatus **116** is full.

[0097] G2. A conductivity sensor to ensure that the measuring cup used by the interior bottle sterilization apparatus **116** is emptied in a predetermined time.

[0098] G3. A pressure sensor to ensure that the pressure of the air used by the interior bottle sterilization apparatus **116** is within predetermined atomization requirements.

[0099] G4. A temperature sensor to ensure that each heat heating element used by the interior bottle sterilization apparatus **116** is heated to the correct temperature.

[0100] H. A temperature sensor to ensure that the air drying temperature within the activation and drying apparatus **152** is correct.

[0101] I. A plurality of flow sensors to ensure that the airflow rate of the sterile air entering the sterile tunnel **90** is correct.

[0102] J. A pressure sensor to ensure that the pressure of the sterile air entering the activation and drying apparatus **152** is correct.

[0103] K. A measuring device (e.g., volumetric measuring device **188**, **FIG. 3**) to ensure that each bottle **12** is filled to a predetermined level.

[0104] L. A pressure sensor to ensure that the pressure in the product tank **182** is above a predetermined level.

[0105] M. A level sensor to ensure that the level of product in the product tank **182** is maintained at a predetermined level.

[0106] N. Proximity sensors to ensure that the daisy chains **202** of lids **200** are present in the lid sterilization and heat sealing apparatus **162**

[0107] O. A level sensor to ensure that the hydrogen peroxide level in the hydrogen peroxide bath **204** in the lid sterilization and heat sealing apparatus **162** is above a predetermined level.

[0108] P. A temperature sensor to ensure that the temperature of the hot sterile air knives **208** of the lid sterilization and heat sealing apparatus **162** is correct.

[0109] Q. A temperature sensor to ensure that the heat sealing apparatus **214** is operating at the correct temperature.

[0110] R. Proximity sensors to ensure that the bottles **12** are discharged from the filler.

[0111] S. A speed sensor to measure the speed of the conveying apparatus **100**.

[0112] T. A concentration sensor to ensure that the concentration of oxonia is maintained at a predetermined level in the sanitizing apparatus **300**.

[0113] U. A pressure sensor to ensure that the pressure of the oxonia is maintained above a predetermined level in the sanitizing apparatus **300**.

[0114] V. A temperature sensor to ensure that the drying temperature of the drying apparatus **302** is correct.

[0115] The foregoing description of the present invention has been presented for purposes of illustration and description. It is not intended to be exhaustive or to limit the invention to the precise form disclosed, and many modifications and variations are possible in light of the above teaching. Such modifications and variations that may be apparent to a person skilled in the art are intended to be included within the scope of this invention defined by the accompanying claims.

1-21. (canceled)

22. A device for automatically aseptically bottling aseptically sterilized foodstuffs comprising:

means for providing a plurality of bottles;

means for aseptically disinfecting the bottles at a rate greater than 100 bottles per minute wherein the means for aseptically disinfecting the bottles further includes means for disinfecting an interior of the bottles with a hot atomized hydrogen peroxide further wherein said plurality of bottles are in an upright position; and

means for aseptically filling the bottles with aseptically sterilized foodstuffs.

23. An aseptic processing apparatus for aseptically bottling aseptically sterilized foodstuffs comprising:

a sterile tunnel for surrounding a plurality of bottles with pressurized sterile air;

a conveying apparatus for moving the plurality of bottles through the sterile tunnel;

a bottle infeed, sterilization and conveying apparatus for sterilizing an exterior surface of each bottle and for feeding the sterilized bottles into the sterile tunnel;

an interior bottle sterilization apparatus for applying a sterilant to an interior surface of each bottle;

an activation and drying apparatus for activating and removing the sterilant from the interior surface of each bottle;

a product filler apparatus for filling the aseptically sterilized plurality of bottles with the aseptically sterilized foodstuffs;

a lidding apparatus for applying a sterilized lid to each bottle; and

a bottle discharge apparatus for removing the bottles from the sterile tunnel.

24. The aseptic processing apparatus according to claim 23, wherein the sterile tunnel further includes a plurality of partitions forming a plurality of sterilant concentration zones.

25. The aseptic processing apparatus according to claim 23, wherein each bottle has an opening size to height ratio of less than one.

26. The aseptic processing apparatus according to claim 23, wherein the sterilant is hydrogen peroxide.

27. The aseptic processing apparatus according to claim 23, wherein the sterilant is oxonia.

28. The aseptic processing apparatus according to claim 23, further including a lid sterilization apparatus.

29. The aseptic processing apparatus according to claim 23, wherein the plurality of bottles are made from plastic.

30. The aseptic processing apparatus according to claim 29, wherein the plastic is polyethylene terepthalate.

31. The aseptic processing apparatus according to claim 29, wherein the plastic is high density polyethylene.

32. The aseptic processing apparatus according to claim 23, further including a feedback control system for maintaining aseptic bottling conditions.

33. The aseptic processing apparatus according to claim 23, wherein the product filling apparatus fills the plurality of bottles at a rate greater than 360 bottles per minute.

34. The aseptic processing apparatus according to claim 23, wherein the sterile tunnel encloses the interior bottle sterilization apparatus, the activation and drying apparatus, the product filler apparatus, and the lidding apparatus.

35. The device according to claim 22, wherein each bottle has an opening size to height ratio of less than one.

36. The device according to claim 22, wherein the plurality of bottles are made from a glass.

37. The device according to claim 22, wherein the plurality of bottles are made from a plastic.

38. The device according to claim 37, wherein the plastic is selected from the group: polyethylene terepthatlate and high density polyehylene.

39. The device according to claim 22, wherein the means for disinfecting an interior of the bottles includes an application of the hot hydrogen peroxide spray for about 1 second and an activation and removal of the hot hydrogen peroxide using hot aseptically sterilized air for about 24 seconds.

40. The device according to claim 22, further including means for feedback control for maintaining aseptic bottling conditions.

41. The device according to claim 22, wherein means for aseptically disinfecting is provided by one of the group: hydrogen peroxide and oxonia.

42. The device according to claim 22, wherein means for aseptically disinfecting the bottles includes disinfecting an outside surfaces of the bottles with hydrogen peroxide.

43. The device according to claim 42, wherein the disinfecting the outside surfaces includes about 1 second for the application of the hot hydrogen peroxide spray and about 24 seconds for an activation and removal of the hot hydrogen peroxide using hot aseptically sterilized air.

44. The device according to claim 22, wherein the means for aseptically disinfecting the bottles further comprises: aseptically disinfecting the bottles at a rate greater than 360 bottles per minute.

45. The device according to claim 22, wherein the means for aseptically filling the bottles further comprises: aseptically filling the bottles at a rate greater than 100 bottles per minute.

46. A device for automatically aseptically bottling aseptically sterilized foodstuffs comprising:

means for providing a plurality of bottles;

means for aseptically disinfecting the bottles at a rate greater than 100 bottles per minute; and

means for aseptically filling the bottles with aseptically sterilized foodstuffs, wherein the aseptically sterilized foodstuffs are sterilized at a level producing at least a 12 log reduction in *Clostridium botulinum*.

47. A device for automatically aseptically bottling aseptically sterilized foodstuffs comprising:

means for providing a plurality of bottles;

means for aseptically disinfecting the bottles at a rate greater than 100 bottles per minute, wherein the aseptically disinfected bottles are sterilized to a level producing at least a 6 log reduction in spore organisms; and

means for aseptically filling the bottles with aseptically sterilized foodstuffs.

48. A device for automatically aseptically bottling aseptically sterilized foodstuffs comprising:

means for providing a plurality of bottles;

means for aseptically disinfecting the bottles at a rate greater than 100 bottles per minute, wherein the means for aseptically disinfecting the bottles further includes means for disinfecting an interior of the bottles with a hot hydrogen peroxide spray, further wherein the means for disinfecting an interior of the bottles includes an application of the hot hydrogen peroxide spray for about 1 second and an activation and removal of the hot hydrogen peroxide using hot aseptically sterilized air for about 24 seconds, wherein the residual level of hydrogen peroxide is less than 0.5 PPM; and

means for aseptically filling the bottles with aseptically sterilized foodstuffs.

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