

- [54] **APPARATUS FOR PACKAGING UNDER STERILE CONDITIONS**
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- [51] Int. Cl.² **B65B 55/10**
- [58] Field of Search **53/167, 180 R, 180 M; 141/48, 63, 91, 92, 131, 198, 324, 90; 137/432, 433; 426/399; 21/78; 99/452; 134/122, 166 C**

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Primary Examiner—Travis S. McGehee

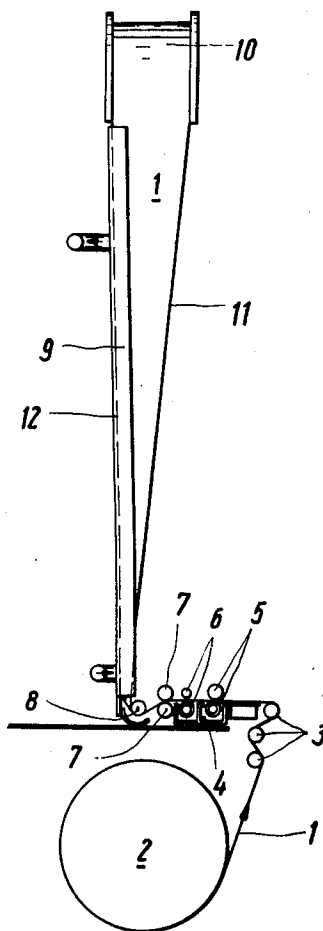
Assistant Examiner—John Sipos

Attorney, Agent, or Firm—Finnegan, Henderson, Farabow & Garrett

[57] **ABSTRACT**

A machine for packaging sterile liquids, such as milk, in a continuously formed packaging tube that is intermittently compressed to form discrete, filled containers, the improvement comprising a system for supplying a single source of sterile air to the flat, inner side of the web prior to forming, into the open top of the formed tube during filling, as well as into a float vessel acting as a pressure regulator for feeding the liquid to the tube to achieve and maintain in a simplified manner a total sterile environment in the machine and a constant pressure on the milk be supplied to the formed tube.

6 Claims, 9 Drawing Figures



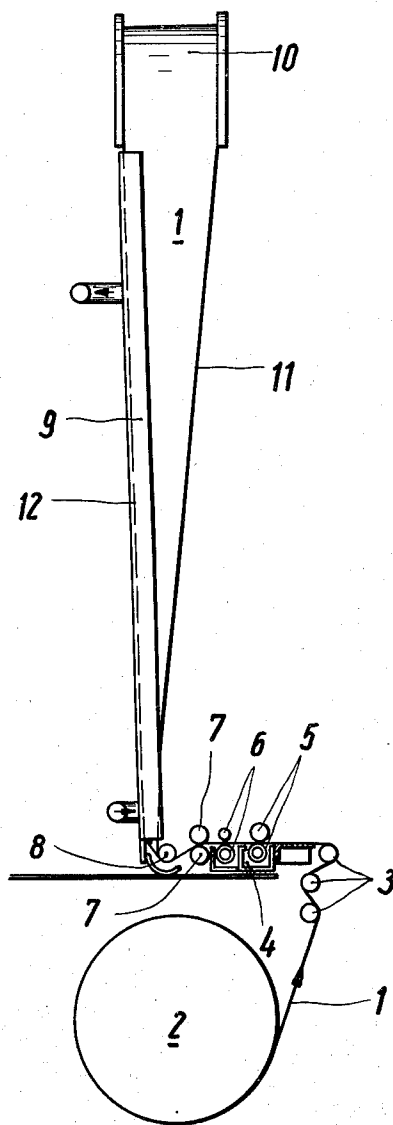


Fig. 1

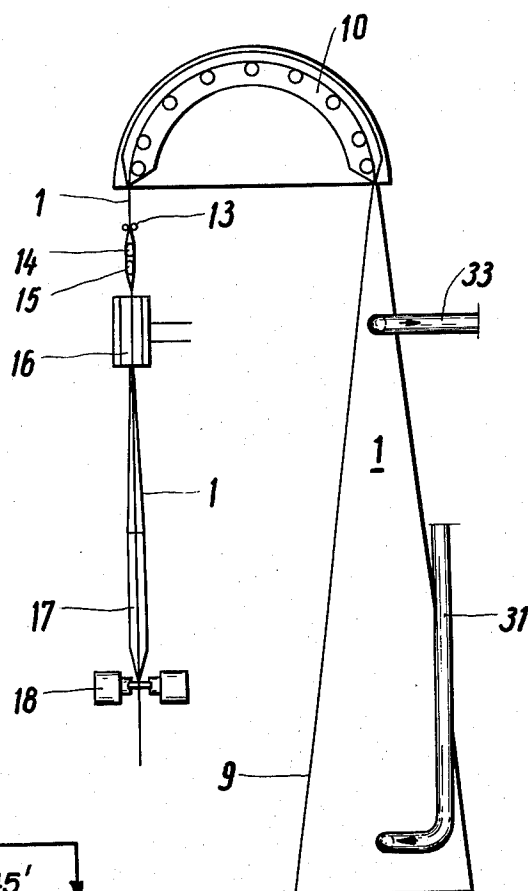


FIG. 2

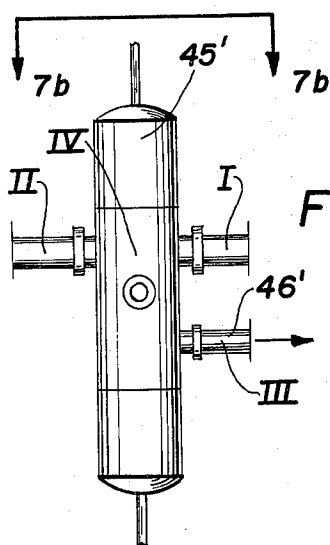


FIG. 7a

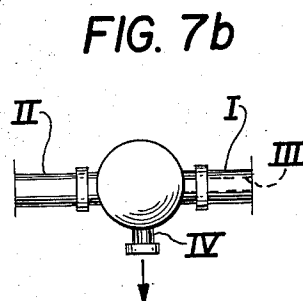
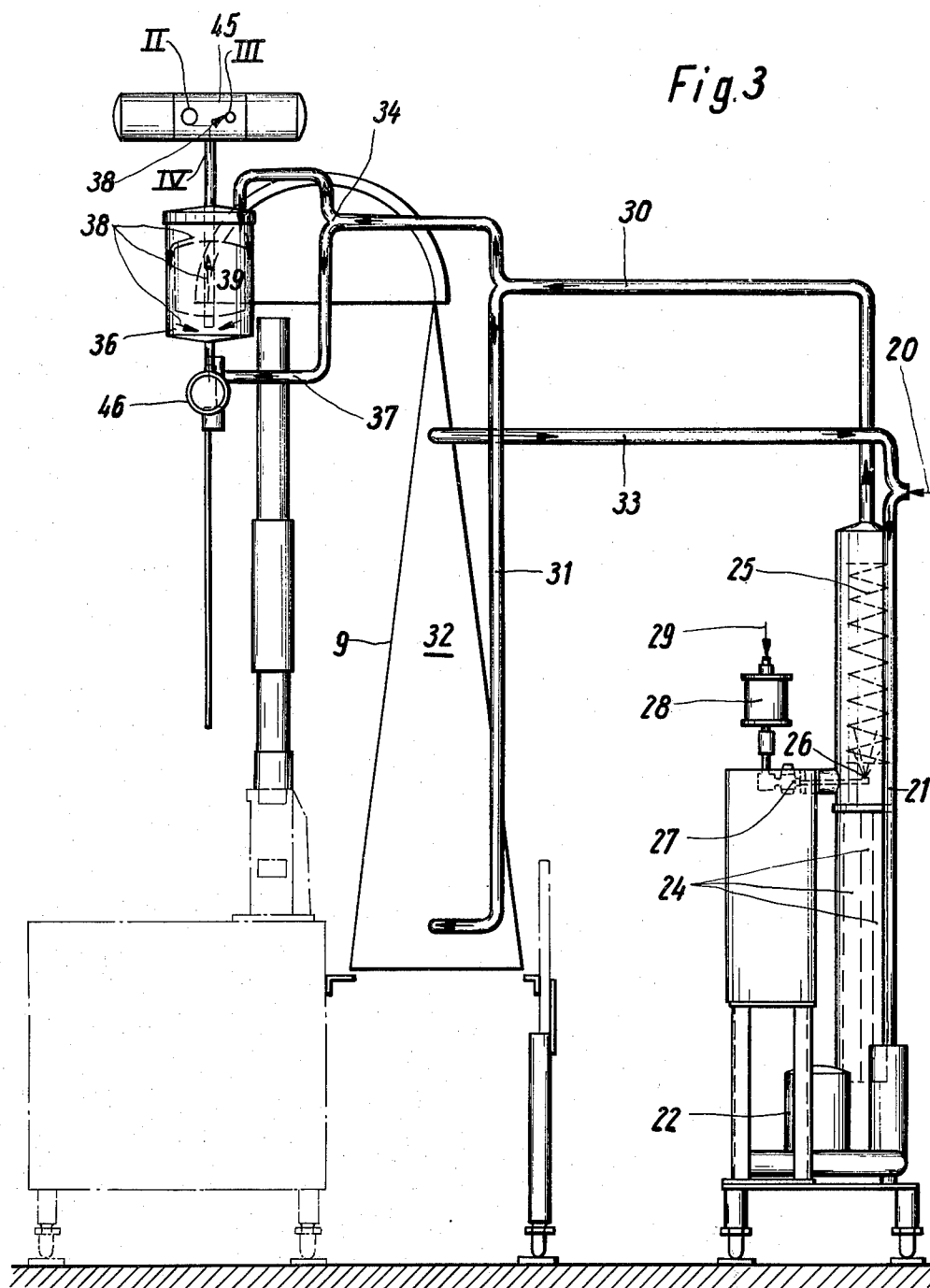


FIG. 7b



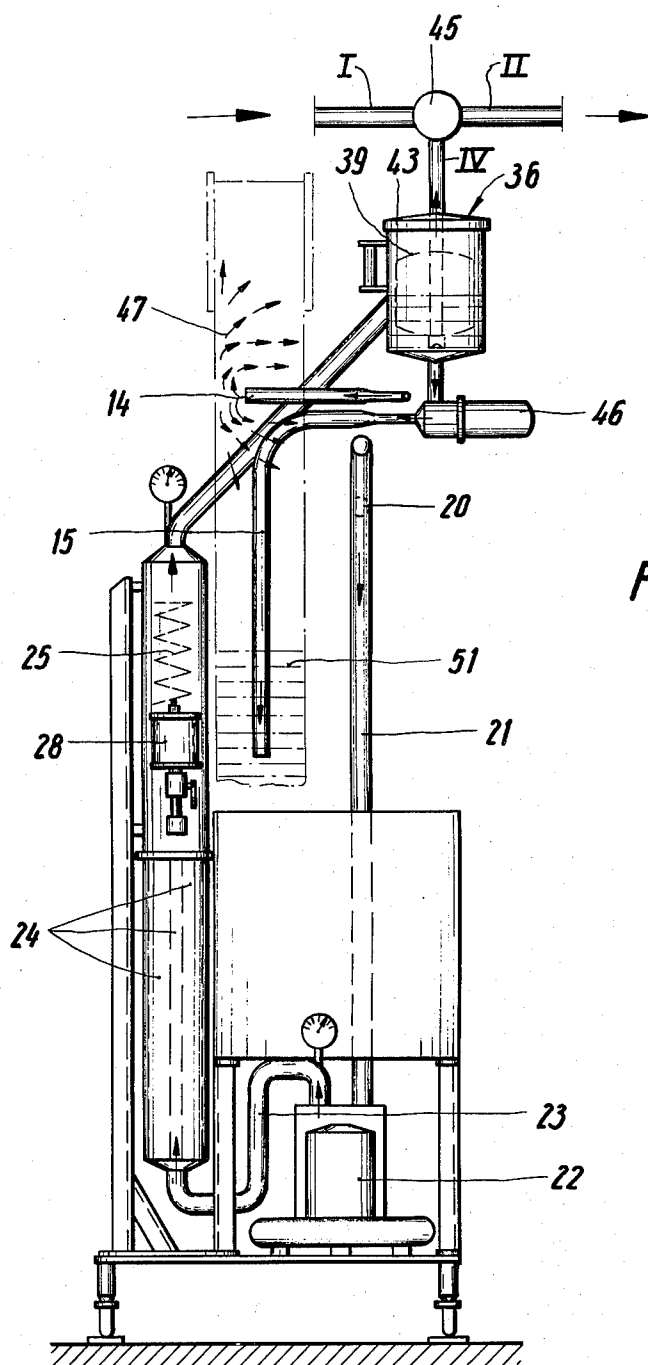
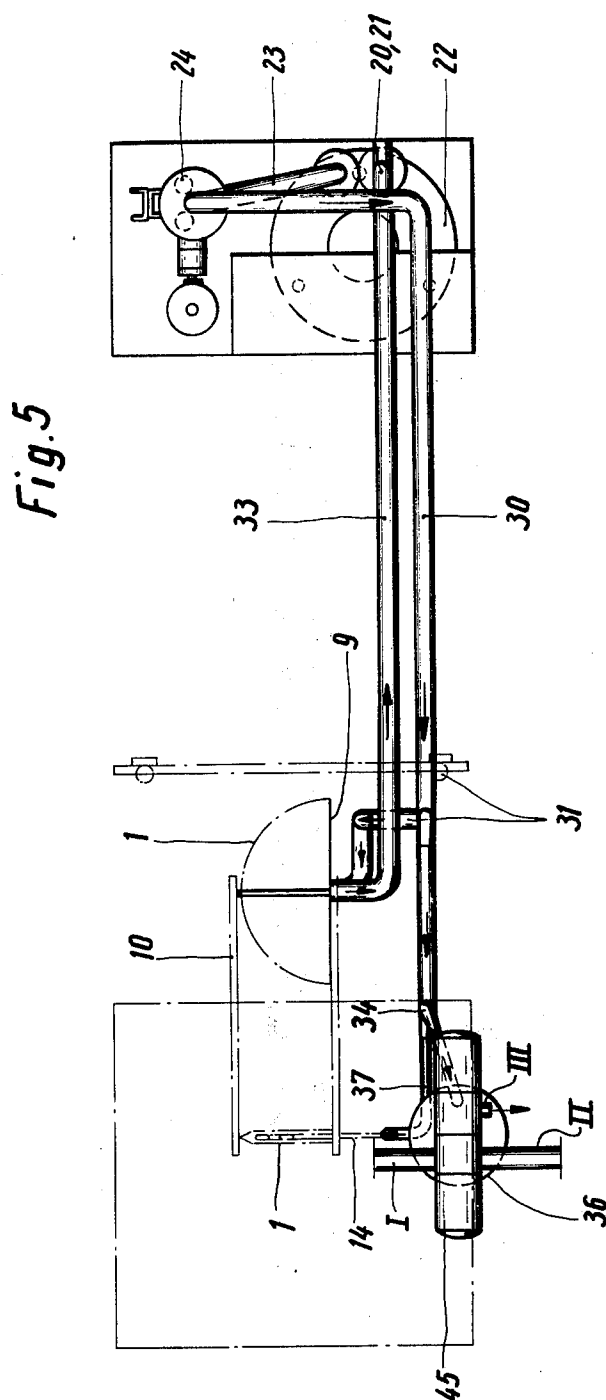
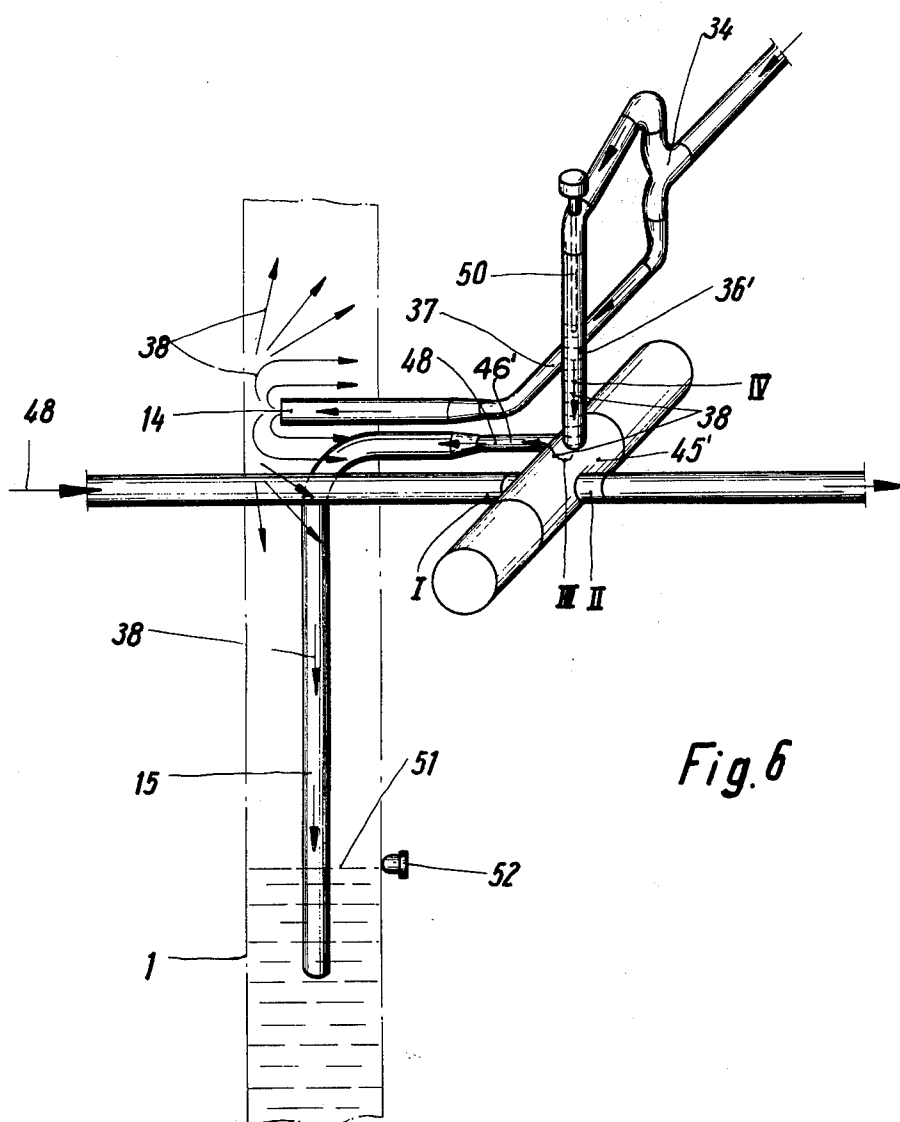
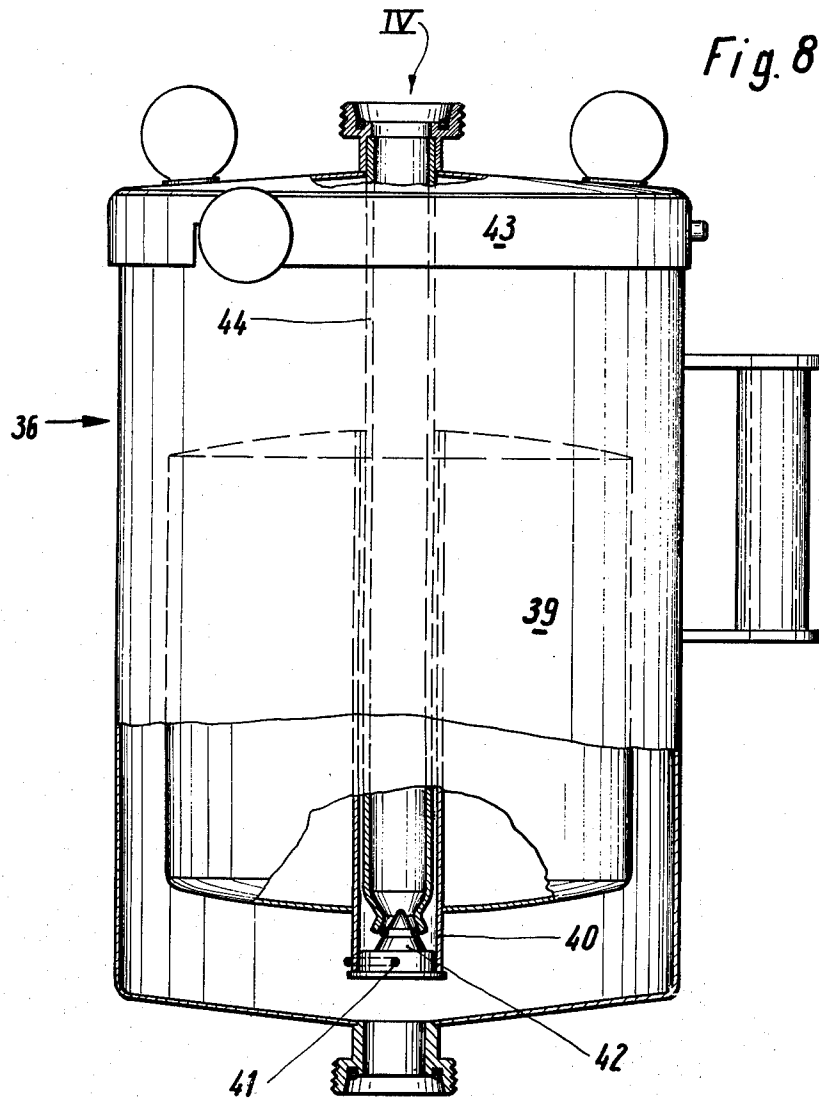


Fig. 4







APPARATUS FOR PACKAGING UNDER STERILE CONDITIONS

This invention relates to apparatus for sterilely packing or wrapping consumer goods in which a tube is formed from a sheet or web of flexible paper, plastic, or the like, and which is resistant as regards the sterilization environment. The tube is then partly filled with the goods to be packed and formed into a closed container by compressing transversely to its longitudinal direction, there being provided a pipe conduit feeding a sterile medium to the inlet side for the wrapping material sheet into the machine as well as into the top of said tube.

Apparatus of the initially described kind is known from German Pat. No. 1,053,740. In order to manufacture wrapping to be filled with goods, such as milk, from a sheet-like or web-like packing material, it is enough if only the inside of the packing sheet-to-be is sterilized, provided care be taken that the sterilized sheet side does not come in contact with non-sterile surfaces or germ-laden atmospheres causing after-infection. To that purpose, it is known to contact the sterile side of the sheet with a gaseous or steamlike, sterile medium prior to its introduction into the wrapping machine, said medium being spread upon the sheet towards the edges. The known apparatus is equipped with guidance means for the moving sheet or web and with walls apart from said web and with at least one outlet by means of which the flow of the sterile medium may be directed against the sterile side of the sheet or web.

Sterilization of one side of the sheet in the known device occurs by means of heat radiation. Air taken from the atmosphere and freed from germs in a ceramic filter may be applied to the sheet via the pipes or ducts of the described kind. The web consists of paper coated on one side with a plastic such as polyethylene, the plastic-coated side being the sterile one. Operation of the known apparatus begins with shaping the web sterilized on its plastic-coated side into a tube while the milk to be filled is retained from regular delivery, said tube being compressed transversely to its longitudinal direction and hence opening only upwards. While the filling and packing machine is still shut off, overheated steam at 350°C is introduced from above into the perforated web wall forming the tube. By means of the above described pipes and ducts and of other such, the inside of the tube and that of the remaining parts of the filling machine will thus be sterilized with steam. After some time, the supply of overheated steam will be shut off and sterile air will be introduced upon starting the filling and packing machine. The milk then being supplied will be filled under constantly sterile conditions.

The known apparatus suffers from the drawbacks of uneven pressure regulation of the milk upon entering the tube, of there being two stages in the sterilization process, that is, two sterile media are being used—on one hand for the initial sterilization of the apparatus, and on the other for maintaining sterilization during operation—and of the complex shaping of the tube which is circular in cross section.

Other publications show both the packing material and the machine being sterilized under heat. Various conditions and necessities are indicated for the appropriateness of inserting the heating elements into the tube itself. However, several processes and devices for

cooling the strongly heated walls or the wrapping are also well known.

Lastly, it is also known how to carry out the shaping of the tube in an enclosed sterile chamber. Again, the sterilization of this chamber is performed by heating from heating elements, heated steam preferably being used. The temperatures are 400°C. Only after half an hour of overheated steam will sterilization be considered complete, upon which sterile air is being introduced for the second stage.

The above known and described devices provide special measures for high temperatures of sterilization and also a complex valve control for feeding two different sterilizing media, all known devices suffering in common from significant pressure fluctuations of the sterile consumer goods, preferably milk, during initial filling, so that there will be difficulties in precisely metering the tube and in the sealing of same by welding.

The invention attacks the problem of so improving the apparatus of the initially mentioned kind that a pressure regulator obtained in simple manner will be provided for the sterile consumer good, which will operate without complex electronic or pneumatic controls and in reliable fashion and which will be kept sterile by the same means as are applied to the other pipe or duct elements, and which may be sterilized simultaneously with the entire piping system when operation is being started without thereby requiring additional auxiliary means, the one and same sterile medium being used for sterilization and maintaining same.

The problem is solved by the invention in that the ducts or pipes supplying the sterile air are equipped with a float vessel acting as the filling-in or bottling pressure regulator for the consumer goods and in that a pipe is being provided which will supply sterile air from above into the float vessel in order to create an air cushion. It is a surprisingly simple matter to mount a conventional float vessel into the above described duct system under certain conditions, so that constant pressure may simply be achieved in an apparatus for packing sterile milk by the float opening the supply of the sterile consumer goods when the filling level drops and by closing the supply when the filling level increases. The inner components of the float vessel thus may be those of conventionally known vessels, the essential matter being a seal for the control of the supply.

Pressure compensation by means of the conventional regulators could not be achieved so far in a short time, as regards the stroke-operating filling machines. As a rule, pneumatically controlled valves are used in the known systems. They are equipped with pneumatic references for remotely setting the nominal value. Varying pressure fluctuations in the pipes supplying milk to packing machines typically have pressure variations of from $\frac{1}{2}$ to $1\frac{1}{2}$ atmospheres gauge. With closing and opening times of 1, 3 and 6 seconds, examination showed an excess of 0.6 atm. gauge for a closing time of 3 seconds and 0.2 atm. gauge excess when starting. Such pressure fluctuations were considered inevitable, as better results could not be achieved without sacrificing conditions of sterility. However, such fluctuations may be appreciably improved by the measures of the present invention.

It was found to be especially appropriate that the air cushion above the float be kept at a pressure of about 180 mm water by means of sterile air supply and at a temperature of about 130°C in conformity with the invention. The temperatures of 400°C or more provided

for in other equipment are not required in the apparatus of the invention, so that obviously there will be simplification without paying for it by poor sterilization.

Surprisingly, the double-stage nature of the known processes is also avoided in the present invention by providing the pipe system between filter and heater with a device for injecting hydrogen peroxide. This device is merely a hydrogen peroxide reservoir connected to the pipe system through a magnetic valve and subjected to an air pressure of 1 atm. gauge. After having treated the air used up in the pipe system or after having treated the freshly aspired, germ-laden air from the atmosphere which replaces that used up, in a sterilization filter, this air will flow past a nozzle where hydrogen peroxide will be injected into the air and into a heat exchanger, raising the air to a temperature of about 150°C. When starting the system, that is, during the initial sterilization, hydrogen peroxide will be injected for a total time of 20 minutes and periodically for 0.3 seconds each time, followed by a period of 10 seconds for drying. The hydrogen peroxide laden air will be passed through the entire pipe system and machine during said initial sterilization, including the float vessel, so that the entire system, including the pipe or duct system for the sterile consumer goods, may heat up to about 130°C and become sterile. The presterilization terminates after those 20 minutes. Immediately thereafter, there will be a drying time, preferably of 10 minutes, during which the strongly gaseous atmosphere (i.e., H_2O_2) will become normalized. Thereupon the packing and filling machine is turned on, there being no changes in the circulatory system of the sterile air.

Because of the advantageous and procedurally simple use of sterile hot air both for the initial sterilization and the further maintenance of same during the operation of filling, one obtains another inventive advantage, namely that the sheet or web of the packing material may even be sterilized by means of liquid hydrogen peroxide. The invention thus provides for a hydrogen peroxide bath equipped with two depositing and two wiping rollers in front of the inlet side of the packing web being fed into the machine for the purpose of unilateral wetting of the sheet or web. The first pair of depositing rollers ensures flawless wetting of one of the surfaces of the sheet, which later will form the inside of the tube, while the second roller pair causes even distribution of the deposited liquid film. Upon further entry of sheet into the machine, the hot sterile air will flow past the wetted surface and dry it. This advantageously ensures that no liquid hydrogen peroxide will remain on the sterile surface.

Further advantageous embodiment of the invention provides for drying the hydrogen peroxide in such manner that an air evacuation pipe is mounted at the upper end of a drying path for the wetted sheet of the packing material. This air evacuation pipe forms a drying path ensuring air flow, so that sufficient drying of the liquid film will always occur.

More compact design of the packing machine is further provided under the invention by mounting a semi-circular reversing or deflecting rail between the upper end of the drying path and the upper end of the filling and welding stretch. Following wetting of the packing material sheet, a folding line is imparted to it about midway and the folding is performed when passing through the drying path in such manner that the edges of the unilaterally open tube to be formed are guided into a unilaterally open, ever narrowing box or channel.

Because of the sterile air constantly being supplied, no external atmospheric, germ-laden air may penetrate the inside of the tube being formed; this tube, after its inner surfaces have been dried, will pass into the above described semi-circular deflection rail.

Further advantages, characteristics and applications of the present invention will be shown in the following description in connection with the drawings.

Of the drawings:

FIG. 1 is a schematic side elevation of the apparatus showing the path of the packing material, sheet or web from the feeding spool through the hydrogen peroxide bath to the semi-circular deflection rail;

FIG. 2 shows a further path of the sheet or web, seen as a front view of the apparatus of FIG. 1, and from the left;

FIG. 3 shows the front view of a liquid float controlled storage tank means for the liquid and the pipe system for supplying sterile air during initial sterilization looking in the direction of FIG. 2;

FIG. 4 shows the side elevation, partly broken away, of the pipe system of FIG. 3, looking in the direction of FIG. 1;

FIG. 5 shows a top view of the entire apparatus including the path of the web, the system for supplying sterile air, and the pipe system of FIGS. 3 and 4;

FIG. 6 is a diagrammatic view of the sterile air supply and milk supply system schematically illustrating the relationship of an alternate standpipe type of liquid float vessel, the filling pipe, and the tube formed from the packing material;

FIGS. 7a and 7b show the two-way valve of FIG. 6; and

FIG. 8, in fragmentary side elevation, partly in section, shows the construction of the float vessel of FIGS. 3 and 4.

As shown in FIG. 1, a sheet or web 1 of the packing material is guided from the feed spool 2 via deflecting rollers 3 to a hydrogen peroxide bath 4 of constant level through a first pair of coating rollers 5, a second pair of wiping rollers 6 and a third pair of rollers 7 for scoring the web, past a deflecting roller 8 and into the unilaterally open channel 9 to the semi-circular reversing rail 10.

The lower of the coating roller pair 5 moves in the liquid (hydrogen peroxide) that is kept at a constant level, so that hydrogen peroxide will be deposited on the lower side of web 1. This lower side will later become the inner side of the tube. The second pair of rollers 6 forms the wiping and squeezing rollers ensuring even distribution of a thin film of hydrogen peroxide on the lower or inner side of the web. Preferably, a paper web coated with aluminum foil will be used in the invention. The upper roller of the third pair 7 is the negative scoring roller, mounted opposite a positive one. The folding line is shown by line 11 in FIG. 1. Thus, the tube being formed will open leftward after channel 9, the dashed line 12 showing the tube's edge resting in channel 9.

As shown in FIG. 2, web 1 upon leaving deflection rail 10 will pass between a pair of rollers 13, upon which the two lateral halves of web 1 will pass around a sterile air pipe 14, then around filling pipe 15. Longitudinal sealing of the top of the container occurs at the welding station 16. Initially, the tube will be open only at the top, so that a liquid column of the sterile goods 17 may form at the bottom of the container. The lower end of this column is determined by the second welding

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apparatus 18 for the transverse sealing of the bottom of the container.

FIGS. 3-5 show the system of the invention for feeding the sterile medium in greater detail.

Atmospheric air taken in through fitting 20 first flows through pipe 21 in the direction of the arrows shown to a high pressure blower 22 producing 180 m³/hour at a maximum pressure of 0.25 atm. gauge. The air compressed at 850 mm water leaves high pressure blower 22 at pipe 23 (see FIG. 4) and flows into sterilizing filter 24. The filters have a pore size of, for example, from about 0.1 to 0.2 microns. Microbiological reliability and/or safety is ensured by a 100% bacterial test of each filtering element in the form of a standard quality control check. The filter is equipped with minimum and dually acting sealing systems with easily accessible inside components and with a special surface treatment and other characteristics of known designs. The filter unit may, for instance, consist of a stainless steel housing and of a number of cartridges corresponding to the flowrate. The container, seal and auxiliary connector materials may be easily mounted and operated. Suitable filters are made by Pall GmbH, for instance.

A spraying nozzle 26 is located between the sterilization filter outlet and the inlet for sterile air to the heat exchanger 25, the latter serving to raise the air temperature to about 150°C. The spray nozzle injects hydrogen peroxide into the air stream. Spray nozzle 26 is connected to a magnetic valve 27 communicating with a vessel 28 for the hydrogen peroxide. An air connection of 1 atm. gauge is provided at the top 29 of vessel 28. The sterile hot air after exiting heat exchanger 25 passes through pipe 30 at a pressure of about 150 mm water and at a temperature of about 150°C where it divides on one hand via pipe 31 into the drying stretch 32 formed by channel 9, to be fed back as return air through pipe 33 to the air inlet pipe 21, and on the other hand via pipe fork 34 to the supply float vessel 36 and via pipe 37 to the sterile air pipe 14 for introducing the air into the open container tube.

Regarding the pre-sterilization shown in FIGS. 3-5, the air leaving the sterilizing filter 24 will be sprayed periodically with hydrogen peroxide for about 0.3 seconds each time and for a total time of 20 minutes, of 0.3 seconds of spraying followed by 10 seconds of ensuing drying. Some of the sterile air leaving fork 34 will arrive at the top of the float vessel 36 in the direction of the arrows 38. The air brushes past float 39 and enters the pipe 40 (see FIG. 8) mounted in float 39, through four orifices 41 located apart from each other at the lower end of said pipe, past the sealing cone 42 and into the pipe 44 extending downward from cover 43 along the vessel's center. The hot sterile air leaves the float vessel through said pipe 44, and passes through the air-controlled, two-way valve 45, where it is discharged to the atmosphere through connection III.

FIG. 4 shows the further pre-sterilization path of the rest of the hot air passing into vessel 36. From vessel 36 the hot air passes through the filling valve 46 connected to the liquid outlet of the vessel and into filling pipe 15. Here again, and at the outlet of the pipe in the open tube 1, the air temperature is about 130°C.

FIG. 4 also shows the flow path of the hot air flowing into pipe 37 where it exits from the sterilizing air pipe 14 into the open tube, as shown by arrows 47. This flow is continued during both the initial sterilization as well as for the entire operation, the penetration of germ-car-

6

rying external air thereby being prevented by the counter flow of this sterile air.

In FIG. 6, arrows 38 show the course of the sterilized air during pre-sterilization and arrows 48 the flow path of the liquid product, such as milk.

The arrangement of FIG. 6 first will be described with respect to pre-sterilization. After the sterile hot air has left fork 34, the lower part, as already mentioned, passes through pipe 37 into sterilizing pipe 14 and enters the tube in the direction of arrows 38. The other part of the hot air leaving the fork 34 enters the supply float vessel, represented in FIG. 6 as a pipe stub 36', at the top and leaves it at the bottom through connection IV and a port 46' to exit through connection III into filling pipe 15. The air leaves the tube 1 which is not filled during pre-sterilization by flowing upwardly.

The two-way valve 45' shown in FIG. 7a is somewhat similar to the valve 45 in FIG. 3 and is provided with connections I through IV. The line from stub I to II, or vice versa, represents the passage of the product circulation system and is always open. Connection III in FIG. 6 is open during pre-sterilization, that is, there will be communication between connection IV and connection III through port 46' to permit the hot air to pass into filling tube 15. There is no communication from connections I and II to connections III or IV during pre-sterilization.

The packing machine of FIG. 3 or FIG. 6 is put into operation after completion of pre-sterilization. The product supply I or II then will be open in direction of IV until the level of the consumer goods or of other products has reached a pre-set height in chamber 43 or in stand pipe 36'. In FIG. 6, an electrode 50 schematically indicates that the level has been reached in stand-pipe 36' for the embodiment of FIG. 6. The electrode then emits a pulse to close off further infeed of fluid from I or II.

In the embodiment of FIG. 8, it is the rise of float 39 to a given level which causes shutting the seal at cone 42 and in effect closes off the supply of milk to float vessel 36. As the filling level drops and milk passes out vessel 36 and into the formed container through pipe 15, the float will lower and again open the supply to the vessel. In this manner one maintains a constant pressure level of the milk in float vessel 36. Thus, there will be constant pressure on the liquid column in filling pipe 15, so that for every filling cycle, there will be even and consistent packing regardless of the pressure fluctuations in the supply of milk to the float vessel.

When the liquid level 51 in the formed container tube drops to a level below that as shown in FIG. 6, an electrical switch 52 emits a pulse opening transmission from IV to III and permitting the milk to flow from the stand pipe 36' into tube 1. When level 51 is again reached, transmission is shut off by switch 52, thus maintaining a constant level of milk in the formed container tube.

The path of the milk during bottling to the float vessel of FIG. 8 from supply passes through the central pipe 44 if the float is down, and past the seal at cone 42, through orifices 41 into the chamber around float 39. At a given level, the float will have risen so much that the seal at cone 42 will be shut and then the supply of the milk will be interrupted. The micro switch 52 is operative to actuate filling valve 46 under the float vessel 36 to fill the milk into the formed container tube.

It can thus be seen that the invention provides a system for supplying sterile air to the inside of the web ma-

terial prior to forming as well as into the top of the shaped tube prior to filling and also into the top of a float vessel acting as pressure regulator for the milk supply to thereby achieve and maintain a totally sterile environment in the machine with a single sterile medium. By supplying sterile air to the float vessel, not only will it be initially sterilized but it will be kept sterile by the same means as are applied to the packaging material and will provide an air cushion on the milk in the supply vessel to ensure a constant pressure of milk being supplied to the packaging tube regardless of the pressure fluctuations in the supply of the milk to the float vessel.

What is claimed is:

1. In a fluid container filling apparatus having a fluid supply system, a tube formed from a ribbon, the tube being filled with a fluid and then intermittently compressed to form discrete filled containers, the apparatus having means for filling sterile liquids into the tube and comprising a constant pressure fluid storage means, conduit means to feed fluid during the filling procedure from said storage means into said tube, feed pipe means between the fluid supply and said constant pressure fluid storage means, valve means between said feed pipe supply and storage means, the valve being responsive to the level of fluid in said storage means to control the feeding of fluid to said constant pressure fluid storage means, constantly open air flow sterilizing means for continuously supplying a stream of hot, sterile air under a pressure above atmospheric pressure, said sterilizing means including air directing means to direct said air stream to flow against the inside of said tube and throughout said conduit, valve and storage means before said storage means is filled and into said tube and the fluid filled therein and over the fluid in the storage means during the tube filling and compressing procedure whereby a pre-sterilization procedure and a continuously operative sterile filling condition can be maintained throughout the fluid flow passages of the filling and storage apparatus by the use solely of the air flow sterilizing and directing means.

2. An apparatus as in claim 1, wherein said fluid storage means includes a float chamber having liquid inlet and outlet passages; and said means to direct sterile air includes a passage connected to said chamber to fill the chamber and to flow air through said inlet and outlet passages during said pre-sterilization procedure, and to fill the top of the chamber to maintain a constant pres-

sure head on the fluid in said chamber during the tube filling operation.

3. An apparatus as in claim 1, wherein said fluid storage means includes a liquid stand pipe means having a liquid infeed and outlet at its lower end; and said means to direct sterile air includes a passage connected to the upper end of said stand pipe to fill the stand pipe and force air through said outlet means during said pre-sterilization procedure, and to press against the top of the fluid column in the stand pipe to produce a constant head on the fluid during the tube filling operation.

4. An apparatus as in claim 1, wherein said tube is stored as a flat ribbon prior to tube formation and the apparatus further includes shaping means to convert the ribbon into said tube that is adapted to be filled with fluid and formed into discrete containers, applicator means to apply liquid hydrogen peroxide to the side of said ribbon that will be exposed on the inside of said tube, and said air directing means includes passages for flowing sterilizing hot air against the wetted side of the ribbon while it is in said shaping means by normalizing the hydrogen peroxide and then drying the water left from the surface of the ribbon as it moves through the shaping means to be filled with liquid.

5. An apparatus as in claim 4, wherein said shaping means includes a forming channel having a ribbon infeed end and ribbon outlet end and said air directing means includes an inlet passage for sterile air adjacent said inlet end of the forming channel and an air suction means near the outlet end of said channel to recover the flow of sterile air exiting from said inlet passage for recycling to said air stream supply means.

6. An apparatus as in claim 4, including a semicircular deflecting rail positioned after the shaping means and said shaping means is located in the path the ribbon follows through the apparatus to fold the ribbon along its longitudinal centerline to place the two sterilized halves of the ribbon in contact, and said air directing means having a branch positioned in the path of said ribbon after it passes through the deflecting rail over which branch the two halves of the ribbon are spread to cause sterilizing hot air to fill the sterile space between said spread-apart halves, and said fluid supply system including a fluid infeed means positioned between the spread-apart halves whereby the fluid is filled into the tube under sterile conditions.

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