Oct. 6, 1970 G. A. RAUSING ET AL 3,531,908

METHOD OF STERILIZING AND IN ASEPTIC CONDITIONS FILLING A FLEXIBLE CONTAINER WITH A STERILE LIQUID

Filed Feb. 19, 1968

4 Sheets-Sheet 1

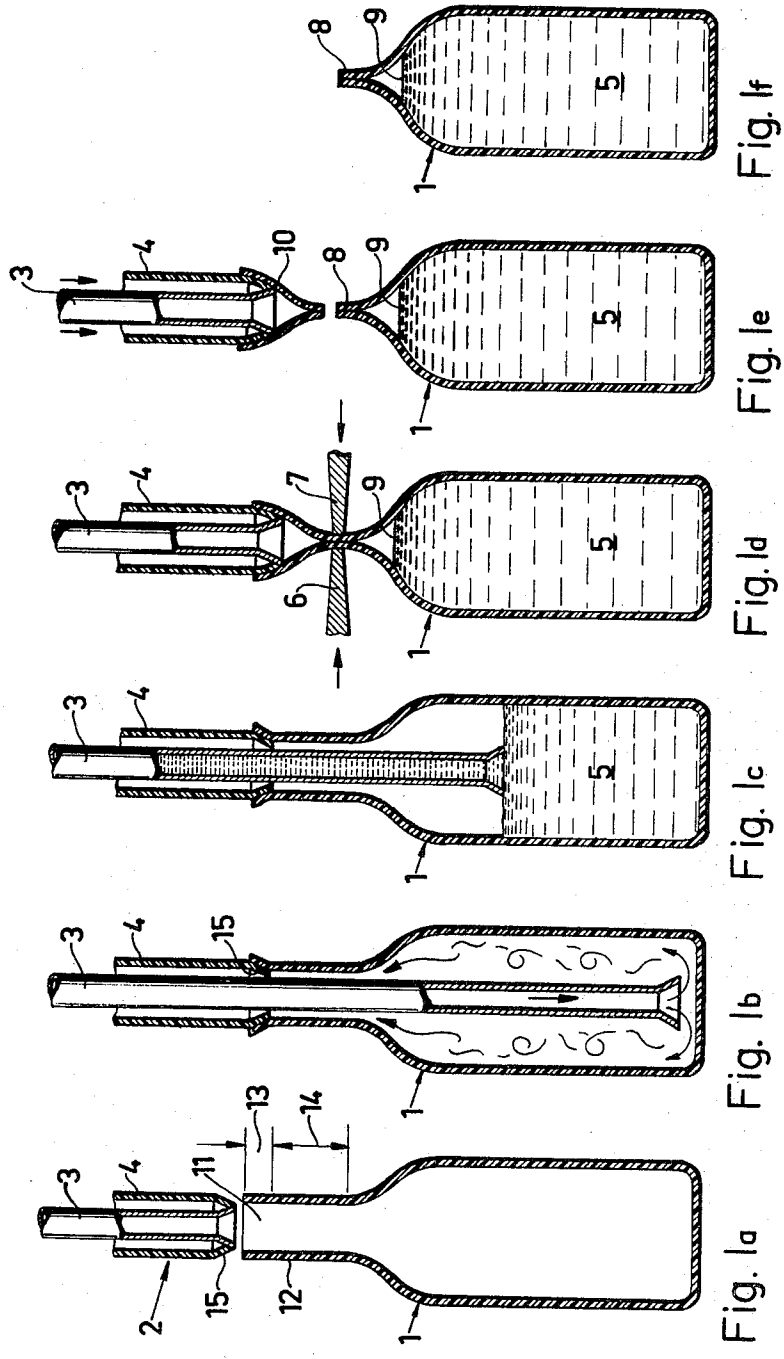


Fig. 2

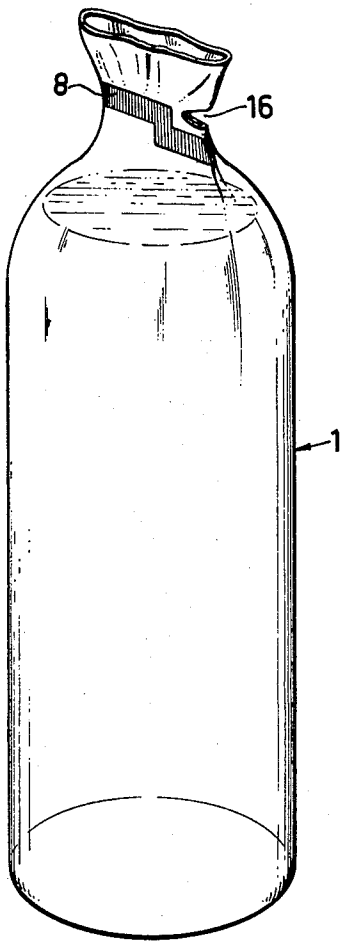
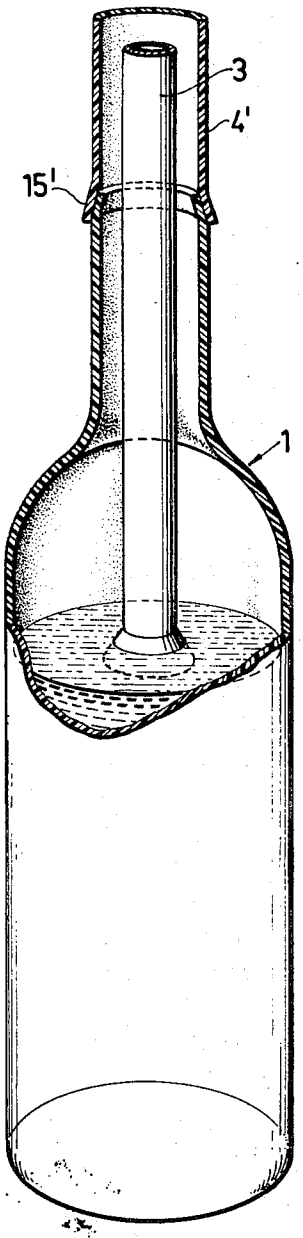


Fig. 3



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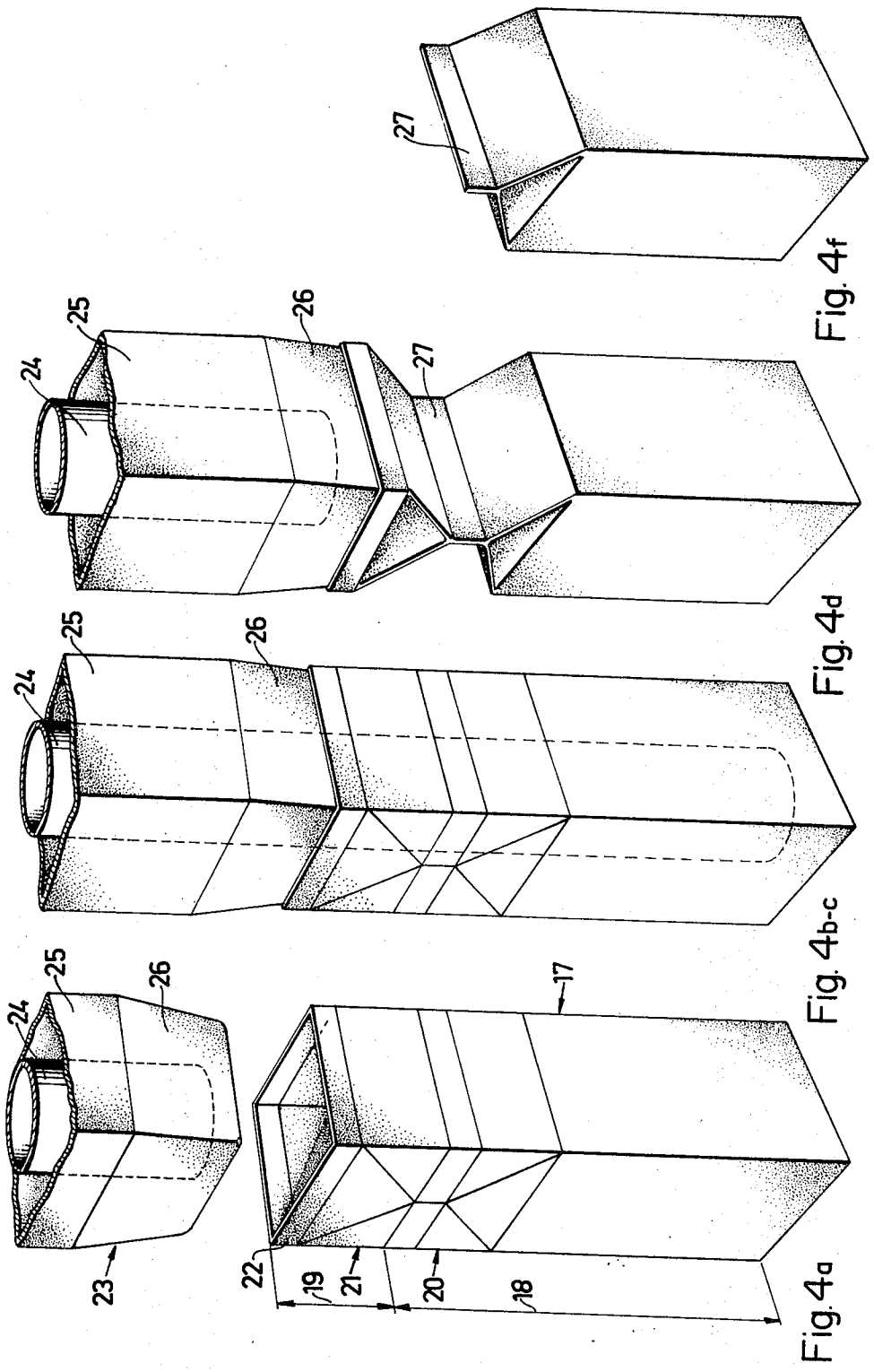
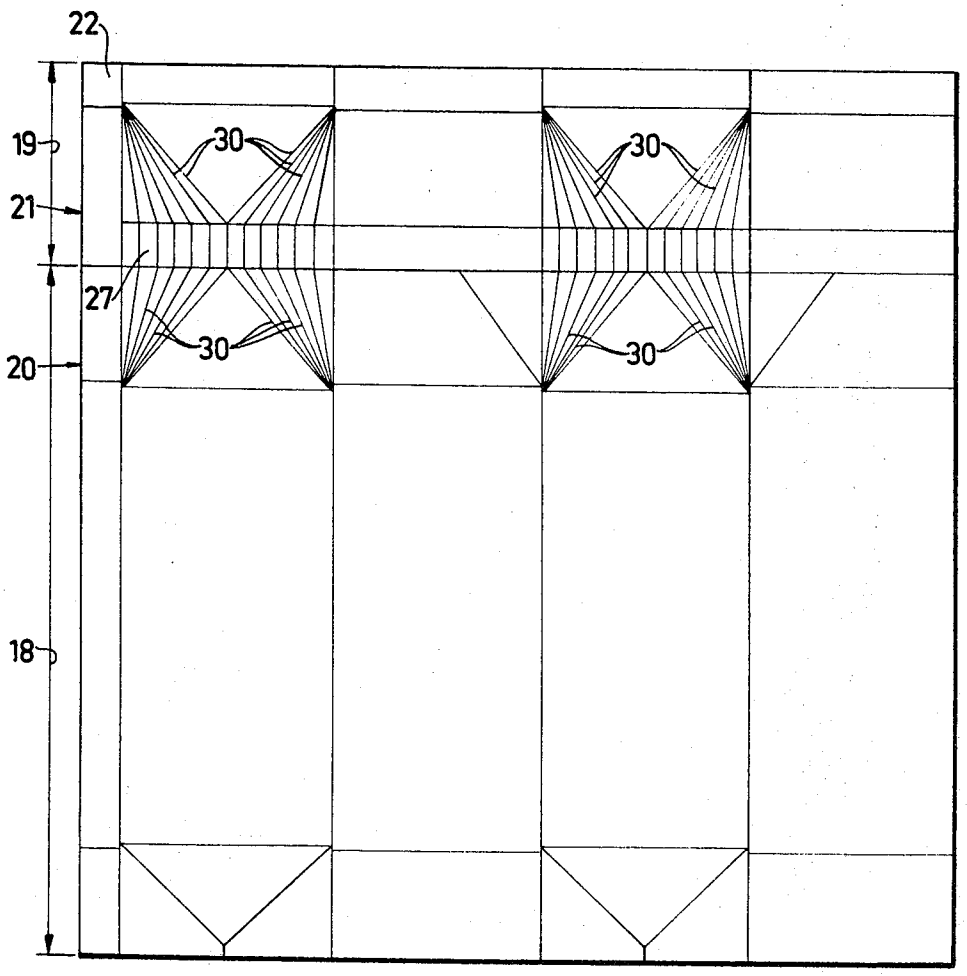


Fig. 5



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METHOD OF STERILIZING AND IN ASEPTIC CONDITIONS FILLING A FLEXIBLE CONTAINER WITH A STERILE LIQUID

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Int. Cl. B65b 3/04
U.S. Cl. 53—37 5 Claims

ABSTRACT OF THE DISCLOSURE

A method of sterilizing and thereafter filling under aseptic conditions a preproduced flexible container in which a dual concentric pipe assembly is first brought into sealing engagement with the initially open mouth of the container, the inner pipe is then lowered into the container and a gaseous sterilizing agent is discharged into the container through the lowered pipe, the sterile liquid is then discharged into the container through the lowered inner pipe which simultaneously forces out the gaseous sterilizing agent through the outer pipe, the inner pipe is progressively withdrawn during the filling operation to minimize frothing of the liquid, and the mouth of the container is then closed off and sealed by pressing and sealing the container walls together below the end of the pipe assembly.

The present invention is concerned with packaging technology and deals with a method of sterilizing and in aseptic conditions filling a flexible container with a sterile liquid. The invention also covers packaging material to be used in connection with the method.

In accordance with a known method of producing filled, sterile packages, the starting point in the operation is a flexible web-shaped material which is fed into a chamber and is there sterilized, e.g., by the application of heat and/or by being drawn through a sterilizing bath. The web-shaped material is folded in the sterile chamber to form a tube which is then sealed along its length and is filled with a sterile liquid up to a certain level. The individual packages are produced by clamping the tube along strips at right angles to the axis of the tube and by supplying heat to the said strips, as a result of which the inside surfaces of the tube which have been provided with a plastic coating are caused to adhere to one another, and finally by cutting the tube in the transverse sealing strips. The method has many advantages, but since one of the conditions for its use is that the packaging material should be web-shaped, it cannot be used, without substantial modification, when the containers used are, e.g., preproduced cartons or bottles. In such cases it may be best to make use instead of one of the methods developed for the aseptic filling of sterile liquids into glass bottles.

The sterilization of glass bottles can on the whole be carried out using conventional cleaning techniques. As an example of this may be mentioned treatment with sterilizing liquids. Treatment with sterilizing gases has also been suggested, but the use of these methods is in many countries restricted by prohibitions, and are also inconvenient since metal parts of the installation are heavily oxidized. Treatment of bottles with hot air or steam is also possible. There are thus a number of acceptable methods available for the sterilization of bottles which can even be carried out in comparatively simple installations. The conclusive difficulties only arise in connection with the filling of the sterilized bottles and the closure of the filled bottles. Since the space required for

the filling and closure units is comparatively large when techniques known at present are used, and since these spaces as well as the conveyors between them must be kept completely sterile in order that the sterilized bottles should not be recontaminated, the technical difficulties in connection with the maintenance and establishment of sterility should be obvious.

In accordance with the process covered by the invention, however, which is begun by using preproduced flexible containers, for instance plastic bottles or cardboard cartons, there are no sterile tunnels, sterile chambers or any sterile spaces at all required, apart from the actual packaging containers which need not however be sterile at the beginning of the process. These substantial advantages have been realized through fully making use of the fact that the containers are flexible. In accordance with the method covered by the invention, a double-barrelled pipe is made to engage with the opening of the container and a sterilizing agent is introduced into the container through one of the pipes so that the inside of the container is sterilized, and the internally sterile container is also filled with the sterile liquid through one of the said pipes. The invention is in this connection characterized by the container being closed through the walls of the container in an area beyond the lower ends of the pipes by pressing the container walls together and sealing them, while the pipes are still in engagement with the opening of the container.

The two pipes are preferably coaxial, the outer pipe being inserted into the opening of the container and brought into contact with the inside of the wall of the container in such a way as to form a leakproof seal. By virtue of the fact that this pipe will all the time remain in the position effecting the seal, the filling and the closure of the internally sterile container can be carried out without the inside of the container being recontaminated by the surroundings. In order that the seal should be more secure, an outer clamping device may also be provided, which between itself and the outsides of the two pipes will compress the wall of the neck of the container. The procedure can also be modified by the outer pipe being only lowered to the general level of the upper edge of the container, or being made to surround the outside of the container in the edge zone area of the container opening. Furthermore, it is not an unchangeable requirement that complete seal should be established between the outer pipe and the container. Aseptic conditions inside the container can instead be guaranteed by the maintenance of excess pressure inside the container.

Two examples of the application of the invention will now be more closely explained by reference to the enclosed drawings, of which

FIG. 1 diagrammatically shows a plastic bottle during the different stages (FIGS. 1*a* to 1*f*) of the sterilizing, filling and closure operations,

FIG. 2 shows a perspective view of the filled and closed bottle,

FIG. 3 illustrates the filling stage in accordance with a modification of the procedure covered by the invention,

FIG. 4 shows the sequential production steps (FIGS. 4*a* to 4*f*) of a strip-top package, and

FIG. 5 shows a flat blank which is to be used for the production of this package.

A plastic bottle in FIG. 1 is generally denoted **1**. The material is the kind that is capable of being sealed by conventional sealing methods, for instance by the direct supply of heat or by treatment with high-frequency electricity or high-frequency sound. The bottle should preferably be made of polyethylene but other thermoplastic materials may also be considered. Bottle **1** has an opening **11** and a neck **12**. The neck may be divided into two

sections, namely an upper edge zone area **13** next to opening **11** and an area **14** below edge zone area **13**.

A pipe system for the supply of the contents and the sterilizing agent to bottle **1** is further denoted generally **2** in FIG. 1. The pipe system may within the framework of the invention be given a number of different forms. There are, however, two pipes as the basis of the arrangement which are preferably fitted coaxially. The inner pipe in FIG. 1 has been denoted **3** and the outer pipe **4**. The lower portions of the pipes may also be shaped so as to form a valve, or may be fitted with a separate valve stem, e.g., in accordance with the principles demonstrated in French Pat. No. 1,214,060 or German Pat. No. 616,368. The pipe system **2** can be lowered and raised and pipes **3** and **4** are also capable of displacement relative to one another. The outer pipe **4** has at its lower end a cone **15** which tapers inwards, its least diameter being smaller than that of the opening of the bottle.

FIG. 1*a* shows an empty plastic bottle **1** placed in position below pipe system **2**.

In FIG. 1*b*, the outer pipe **4** has been lowered down into the bottle opening **11** to the level of the lower boundary of the edge zone area **13**. Cone **15** will now be pressed against the inside of the neck of the bottle in such a way as to form a leakproof seal. Inner pipe **3** is lowered down into the bottle to a level just above the bottom of the bottle. A two-way valve, not shown in the figures, is now opened, so that a sterilizing agent is introduced into bottle **1** through inner pipe **3**, the inside of the bottle is flushed through by the sterilizing agent which is then removed through outer pipe **4**. The bottle **1** and the pipe system **2** will in this way be sterilized internally. It is preferable that the sterilizing agent should be steam, but other sterilizing fluids may also be considered, e.g., sterilizing gases such as ethylene oxide and chlorine dioxide. In this case however the inside of the bottle should be flushed through after sterilization by a neutral gas, for instance sterile air. In principle it is also possible to use a liquid sterilizing agent, in which case it is best to turn the bottle upside down and to insert the pipe from below. Hydrogen peroxide may be mentioned as a liquid sterilizing agent. If the subsequent filling operation is also carried out with the bottle turned upside down, complete filling of this will further be facilitated. Closure will in this case be carried out through the liquid in the neck of the bottle, and the quantity of liquid inside the bottle will be regulated by means of calibrating flaps which limit the expansion of the plastic bottle.

When the sterilizing agent has been circulating for such a long time that both the pipe line and the bottle have been completely sterilized internally, the said two-way valve, which is not shown, is switched over so that the liquid contents **5** will instead be introduced into bottle **1**, FIG. 1*c*. As the level of the liquid in the bottle rises, so the filling pipe (inner pipe **3**) is raised, which results in frothing being practically eliminated. By virtue of the fact that the outer pipe remains all the time in leakproof contact with the inside of the neck **12** of the bottle, sterility inside the bottle is maintained. It is as an alternative possible to assure sterility by means of maintaining the inside of the bottle at a pressure above atmospheric, in which case the bottle must be connected to an external source of pressure.

When the bottle has been filled with the sterile liquid to a certain level **9**, the supply is stopped by the said two-way valve being closed. Filling pipe **3** is raised to its original level relative to outer pipe **4** which is still in contact with the inside of the neck of the bottle. When the filling pipe is thus raised up into the edge zone area **13**, two sealing blocks **6** and **7** are driven towards one another, at the same time pressing together the lower portion **14** of the neck **12** of the bottle, FIG. 1*d*. A supply of energy, for instance in the shape of high-frequency electric tension between the blocks which will induce high-frequency currents in the plastic material, will cause the compressed thermoplastic surfaces to melt together within a narrow sealing strip **8**, FIG. 1*e*. The pipe system **2** and bottle **1** can now be separated. The major part of the excess material **10** above the sealing zone **8** is finally removed by means of an air blast as shown by the arrows. At the same time as punching is carried out, the package may be provided with an indication as to how it is to be opened, e.g., in the form of a cut **16** or some similar arrangement, FIG. 2.

If it is intended that the bottle should be completely filled, sealing is carried out through the liquid in the neck of the bottle. As a result of this, there will be liquid in the filling pipe after filling has been completed. If a connection is established between the lower portions of the pipes, this quantity of liquid can be forced away by means of air that is introduced into pipe **4**. Part **10** will be retained in its position by an external holding unit and will not be removed until the remaining liquid has been cleared away.

The filling stage in accordance with a modification of the process covered by the invention is shown in FIG. 3. The difference between this operation and the previous one lies in the fact that the cone **15'** of the outer pipe **4'** now tapers outwards and is brought into contact with the outside of the neck of the battle to form a leakproof seal.

The different stages in the production of a strip-top package, in accordance with the principles of the invention, are shown in FIG. 4. The various stages have been denoted in the same way as in FIG. 1.

Cartons **17** in FIG. 4*a* may be said to consist of two parts, namely a lower part **18** designed to form the finished packaging container, and an upper part **19** to be used in connection with the sterilization and filling operations and to be removed afterwards. The lower part **18** consists in the usual way of four walls and a bottom and a concertina-fold system **20** which, as will be shown with reference to FIG. 5, is best prepared in a certain way. The upper part **19** may be said to correspond to part **10** in FIG. 1*e* and has a concertina-fold system **21** which is a true mirror-image of the concertina-fold system **20**, as well as an upper rib-shaped area **22** which corresponds to edge zone area **13** in FIG. 1*a*.

As in the case described earlier, there is a pipe system **23** provided which comprises an inner (filling) pipe **24** and an outer (return and sealing) pipe **25**. Outer pipe **25** has as before a cone **26** and has a square cross section in order that it should be capable of being inserted into carton **17** to form a leakproof seal.

Stages *a*, *b* and *c* in FIG. 4 should not require any further commentary, it is only necessary to refer to what has been said in connection with the corresponding stages in FIG. 1. The principal difference between the processes in FIGS. 1 and 4 respectively lies in the fact that in the latter case the operation is begun with a rectangular upright casing the bottom of which is closed, which has been processed in such a way that its top can be closed up as shown in FIG. 4*d*. A supply of heat to area **27** (the sealing blocks used for this are not shown in the figure) will cause the compressed plastic-coated walls to adhere to one another and to form a durable closure. The finished sterile package is shown in FIG. 4*f*. The excess material, in the shape of the upper part **19**, has been removed in the figure. In order to save material, part **19** need not be coated with plastic, and can thus be allowed to be returned as usable paper waste or can be used in some other way.

The packaging blank as shown in FIG. 5, which is to be used for the production of the strip-top container depicted in FIG. 4, has its parts that correspond to parts in FIG. 4 denoted by the same numbers. That part of the blank which is to form the finished container has thus been denoted **18** while the upper part, which is only provided as an aid to the sterilization, filling and closure of

the container, has in the same way as before been denoted **19**. A large number of fold lines, which serve to facilitate the folding-up of the concertina-fold pattern, have been denoted **30** in the figure.

The methods and arrangements described above have proved to be very useful and the sterilizing effect is good. It is of course possible to substitute the double walled tube **3**, **4** by a single tube through which the sterilizing agent as well as the filling goods can be introduced in the package. The function of such a device will however not be so good as the function of the device described, which will be preferred.

We claim:

1. The method of sterilizing and thereafter filling under aseptic conditions a preproduced flexible container with a sterile liquid which comprises the steps of contacting the initially open mouth of the container with the outer pipe of a dual pipe assembly consisting of inner and outer laterally spaced pipes so as to establish a tight seal between the container mouth and said outer pipe, lowering said inner pipe into the container while maintaining said outer pipe in sealing engagement with the container mouth, sterilizing the interior of said container by introducing a gaseous sterilizing agent through one of said pipes, introducing the sterile liquid into said container through said inner pipe and thereby simultaneously forcibly discharging the gaseous sterilizing agent outwardly from said container through the gap between said inner and outer pipes, withdrawing said inner pipe, and closing and sealing off the top of said container below the end of said pipe assembly by pressing together and joining the walls of the container and while said outer pipe is maintained in engagement with the mouth of said container.

2. The method as defined in claim **1** wherein said inner pipe is progressively withdrawn from said container during the time that the sterile liquid is introduced into the container through said inner pipe to minimize frothing of the liquid.

3. The method as defined in claim **1** wherein the container including the area where the container walls are subsequently pressed together is completely filled and which includes the further step of forcing the liquid at the closure area away while the seal is being made.

4. The method as defined in claim **1** and which includes the further step of cutting off the top portion of the container above the closure seal and thereafter removing said top portion from said pipe assembly by directing a blast of gas downwardly through said outer pipe.

5. The method as defined in claim **1** wherein said container is provided with upper and lower concertina fold systems, the upper fold system being a mirror image of the lower fold system, said upper fold system forming the mouth of the container and which is engaged with said pipe assembly for sterilizing and filling the container, and the junction between said upper and lower fold systems constituting the container part which is closed and sealed subsequent to the filling operation.

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