Jan. 6, 1970 A. R. RAUSING 3,488,141

METHOD FOR STERILIZING TUBES

Filed June 22, 1967 2 Sheets-Sheet 1

Fig.1

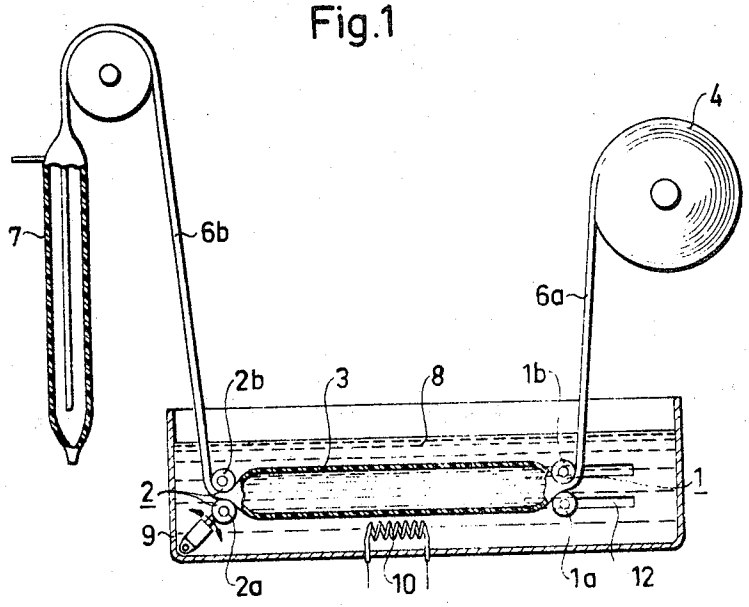
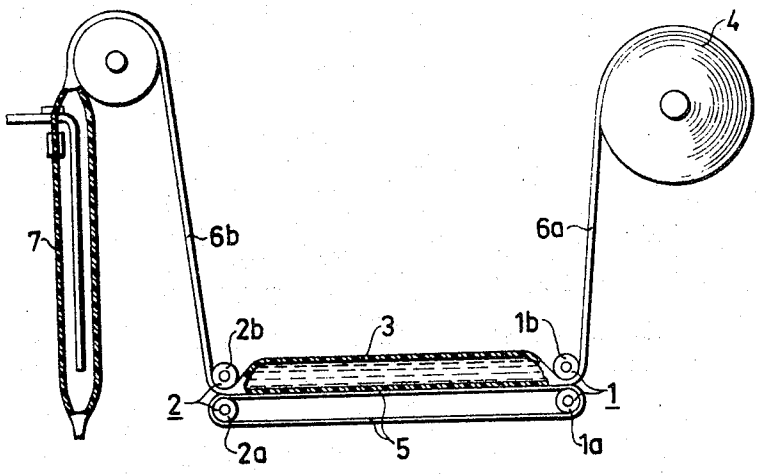


Fig.2

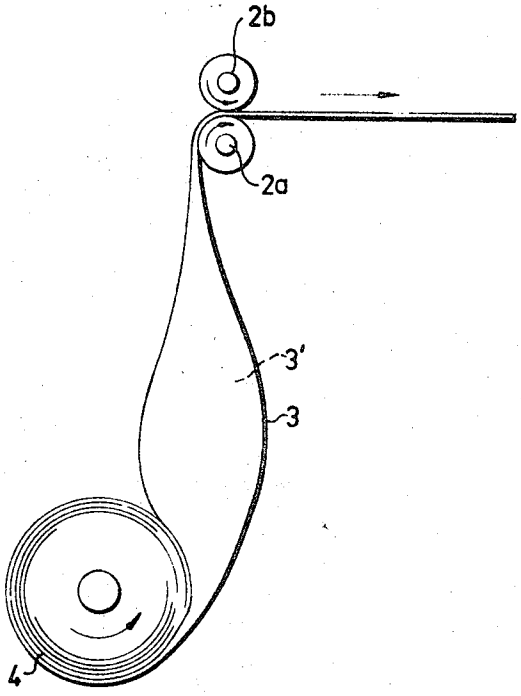


Jan. 6, 1970 A. R. RAUSING 3,488,141

METHOD FOR STERILIZING TUBES

Filed June 22, 1967 2 Sheets-Sheet 2

Fig. 3



United States Patent Office 3,488,141
Patented Jan. 6, 1970

3,488,141

METHOD FOR STERILIZING TUBES

Anders Ruben Rausing, Blentarp, Sweden, assignor to AB Tetra Pak, Lund, Sweden, a Swedish company

Filed June 22, 1967, Ser. No. 648,011
Claims priority, application Sweden, June 27, 1966, 8,689/66; Aug. 15, 1966, 10,994/66
Int. Cl. A61l 3/00
U.S. Cl. 21—92 5 Claims

ABSTRACT OF THE DISCLOSURE

Apparatus for continuously sterilizing a tube of packaging material which includes means for compressing spaced portions of the tube so that the portions of the tube between the compressed portions may be sterilized by a fluid maintained therein.

This invention relates to a method for use in the sterilization of tubes, particularly of tubular packaging material, and to an arrangement for carrying out the method.

The packaging industry utilizes in many cases tubular material as starting material for the manufacture of packagings. Tubular starting material offers the advantage that the tube needs only be filled, sealed and separated along small zones transverse to the tube axis for forming a complete packaging unit. The tubular work-pieces generally are made of plastic material and preferably of thermoplastics which are easy to seal by heat and pressure. In those cases when the filling material for a packing is a sterile product, the packaging operation, of course, must be carried out under satisfactory sterile conditions in order not to cause the filling material to lose its sterility, and also the packaging material used must be sterilized, at least the surfaces which will be in contact with the filling material.

Plastic tubes usually are manufactured by extruding a heated plastic mass through an annular nozzle. Due to the high temperature of the extruded plastic mass the resulting tube is relatively free of bacteria. It is, however, not possible to count on sterility of the tube, but sterilizing measures have to be taken into consideration when the plastic tube is supposed to be used as packaging material for a sterile product.

It has been proposed previously to direct the plastic tube into a bath containing a sterilizing liquid and within the bath to cut open the tube with a knife for allowing the sterilizing liquid to penetrate into the tube interior.

The tube cut open is thereafter filled with filling material, and the open incision is restored by sealing with a longitudinal joint. This method, however, involves certain practical difficulties in connection with cutting open the thin plastic film in the bath and, besides, with the removal of residues of the sterilizing agent from the inside of the tube before the tube is filled with filling material.

The present invention, however, provides the teaching of a method to avoid the aforesaid inconveniences of known methods and also instructs on an arrangement for carrying out the method according to the invention, which is characterized in that a portion of the tube is sealed from the remaining tube by spaced clips or rolls compressing the tube, and that the said portion of the tube is filled with a sterilizing agent.

A specially advantageous embodiment of the invention is characterized in that the tube continuously or intermittently is fed between two pairs of spaced co-operating pressure rollers whereby the tube at the passage between the pressure rollers is sealingly compressed in such a manner, that between the said pairs of rollers is formed a portion defined relative to the remaining part of the

tube, which portion is filled with sterilizing agent, and that the said portion of the tube by its feed is displaced in relation to the tube in such a manner, that the entire tube length which was fed past the pressure rollers was on its inside brought into contact with the sterilizing agent.

The invention, as mentioned above, also relates to an arrangement which is characterized by pressure rollers squeezers or the like mounted in spaced relationship to each other arranged to receive between themselves a tube which is sealingly compressed to form a tube portion defined by the said pressure means in relation to the remaining tube, which tube portion is adapted to be filled with a sterilizing liquid.

Some particularly advantageous embodiments of the invention are described in the following, with reference to the accompanying schematic drawings, in which FIG. 1 shows how a tube is sterilized by an arrangement wherein the pressure rollers are mounted in a vessel containing liquid; FIG. 2 shows an arrangement for sterilizing a tube in which the tube portion subjected to treatment is supported by a supporting belt; and FIG. 3 illustrates how a supply roll may define one of the two pressure means, which define tube portion filled with a sterilizing agent.

In the described embodiments of the invention the starting material is assumed to be a plastic tube without longitudinal joint which is extruded in a known manner, but the invention may, of course, also be applied to any type of tubular material, irrespective of whether it is made of plastics or laminate, and irrespective of whether the tube has no joint or is provided with a longitudinal joint.

In the embodiment of the invention shown in FIG. 1 the pre-manufactured flat plastic tube **6***a* is unrolled from a supply roll **4** and directed downwards into a vessel **9** containing liquid **8** which in this embodiment is assumed to be water. The tube **6***a* is directed in between a first pair **1** of pressure rollers **1** and **2** mounted in the vessel **9**, which rollers sealingly press the inner surfaces of the tube against each other. The tube is then directed in between a second pair of pressure rollers **2** of substantially the same appearance and function as the pressure rollers **1** and mounted spaced from the pressure rollers **1**. Also the pressure rollers **2** press the inner surfaces of the tube against each other with such a force that a sealing cut-off of the tube is effected.

The portion **3** of the tube **6** which is defined by the pressure rollers **1** and **2** is entirely filled with a liquid sterilizing medium which due to the sealing capacity of the pressure rollers is prevented from leaking out from the portion **3**.

The liquid sterilizing medium in the tube portion **3** is supplied in an initial phase, subsequent to the introduction of the flat tube between the pressure roller pairs **1** and **2**, in such a manner, that the tube wall is pierced through by a cannular tube and sterilizing liquid, for example hydrogen peroxide, is injected. When the portion **3** of the tube between the pressure rollers **1** and **2** is filled entirely with sterilizing liquid, the hole made by the cannular tube is restored, and the arrangement is ready for operation.

Due to the fact that the tube portion filled with sterilizing liquid is substantially heavier than the remaining portions of the tube, the said filled portion sags by its own weight and thereby becomes formless to handle. This can be overcome, as shown in FIG. 1, by arranging the pressure rollers in a vessel **9** filled with a liquid **8** which has approximately the same density as the sterilizing liquid. Hereby the sag of the tube portion **3** is reduced to a great extent, and the tube during its feeding moves easier, which among other results in considerably

reduced stresses on the tube material when the tube is being fed past the pressure rollers **1** and **2**.

For facilitating the tube feed still more, one or several of the pressure rollers can be provided with a drive means **11** imparting to the roller or rollers a circumferential speed corresponding to the feed speed of the tube.

A further advantage obtained by immersing the pressure rollers **1** and **2** and the tube portion **3** between said pressure rollers in a liquid **8** is, that the liquid **8** and thereby the sterilizing liquid can be heated by special means **10**, for example electric heating elements, to such a temperature that the sterilizing action of the sterilizing liquid is stimulated.

The heating of the sterilizing liquid is very effective, for example in those cases when the sterilizing liquid is hydrogen peroxide, the sterilizing effect of which is multiplied at rising temperature.

After having passed through the second pressure roller pair **2**, the inwardly sterilized tube **6***a* is directed upwards via a guide roller whereafter it is filled in a packaging machine **7** with the sterile filling material and converted to packages.

The tube **6** is fed all the time continuously or intermittently from the supply roll **4** to the packaging machine **7** and is thereby brought to pass between the pressure roller pairs **1** and **2** which between themselves define a tube length **3** containing sterilizing liquid. This sterilizing liquid, thus, always is between the pressure roller pairs **1** and **2** whilst the tube is being fed past the same, i.e. the sterilizing liquid is displaced relative to the tube in such a manner, that the entire inner surface of the tube length **6***b* having passed through the pressure rollers **1** and **2** has been in contact with the sterilizing liquid.

Depending on the structure of the tube, the feed speed, the degree of infection and the sterilizing agent used, the treatment periods required can be different for different cases. The treatment period can easily be determined by adjusting the distance between the pressure roller pairs **1** and **2** to the feed speed applied.

This adjustment of the distance between the pressure roller pairs can be made with the help of the guides **12** along which the shafts of the pressure rollers **1** can be displaced.

Even if there is a very effective sealing at the pressure rollers **2**, it should be unavoidable that a small amount of sterilizing liquid follows with the tube, so that the amount of sterilizing liquid in the tube portion **3** successively decreases. For compensating for this decrease of sterilizing liquid the pressure rollers **1** can be displaced successively along the guides **12**, thereby reducing the distance between the pressure roller pairs and, thus, compensating for the loss of sterilizing liquid.

If the tube to be sterilized has a very great length, it is to be expected that sterilizing liquid must be refilled.

This is preferably done in a way analogous with the initial filling operation, i.e. by filling with a hypodermic needle. In operational state the arrangement, thus, works in such a manner, that the tube **6***a* which is not yet sterilized is unrolled from the supply roll **4** and directed downwards into the vessel **9** and in between the pressure roller pairs **1** and **2** where the tube is treated with sterilizing liquid, whereafter the tube **6***b* which is sterilized on its inside is directed to a packaging machine **7**.

In the embodiment according to FIG. 2 no liquid vessel is comprised, but the tube portion **3** filled with sterilizing liquid is supported by a belt **5**. In the same way as in the embodiment according to FIG. 1, the tube **6***a* which is not yet sterilized is directed from a supply roll **4** and in between a first pair **1** of pressure rollers which by pressing the inside surfaces of the tube against each other sealingly closes the tube between the pressure rollers **1***a* and **1***b*. The tube is moved on between the pressure roller pair **2** where the pressure rollers **2***a* and **2***b* in an analogous manner sealingly close the tube. The tube portion **3** between the pressure roller pairs **1** and **2** contains

a sterilizing liquid which was injected through the tube wall. In the same way as in the aforedescribed embodiment the sterilizing liquid always is held between the pressure roller pairs whilst the tube is being fed past the same. For preventing the tube portion **3** which contains sterilizing liquid from sagging between the pressure roller pairs **1** and **2** and from being exposed to stresses caused by the weight and motion of the sterilizing liquid, the said tube portion is supported by an endless supporting belt **5** mounted about the lower rollers **1***a* and **2***a* in the two roller pairs **1** and **2**. In this case, thus, the tube is not pressed directly between the pressure rollers **1***a* and **1***b* and **2***a* and **2***b* respectively, but between the rollers **1***b* and the belt **5** and between **2***b* and the belt **5** respectively. However, it was found that satisfactory sealing of the tube also can be obtained when the supporting belt **5** is arranged about the lower pressure rollers. Owing to the fact that the tube portion **3** filled with sterilizing liquid rests against the belt **5**, the otherwise unavoidable sagging of the tube portion **3** is prevented.

During the passage through the second pressure roller pair **2** practically all sterilizing liquid is pressed aside from the inside of the tube, so that the tube **6***b* after having passed through the pressure roller pair **2** is sterilized as well as free of sterilizing liquid.

In the same way as mentioned above the tube **6***b* which has been sterilized inside is directed to a packaging machine in order to be filled with sterile filling material and converted into packages.

It is, of course, possible, in the embodiment according to FIG. 1 to apply a sterilizing liquid **8** instead of water. In such a case also the outside of the tube is sterilized, which may be advantageous in certain cases when the filling of the sterilized tube is carried out such, that the tube is cut open with a sterile knife and filled through the resulting slot which immediately thereafter is restored by sealing.

Also in the embodiment according to FIG. 2 the tube can be caused to pass through a bath containing sterilizing liquid and thereby to sterilize the outside of the tube.

The aforedescribed embodiments of the invention can, of course, be modified within the scope of the inventive idea. The invention, thus, is not restricted only to the sterilization of tubes intended for packaging purposes, even if this has been the primary object when the invention came into being, but the invention also can be applied to any sterilization of tube material, for example tubes adapted for medical or technical application. Furthermore, the constructional design of the pressure rollers and supporting belt can be varied within wide limits without changing their function in principle, and, finally, the choice of the sterilizing agent depends among others on the properties of the tube material.

In FIGURE 3 there is shown how the supply roll, to which the tube is wound up, might be utilized for sealing off the sterilizing agent from the other portions of the tube. Similarly to the previous embodiments, numeral **3** designates the portion of the tube, which in one end is sealed off by the supply roll **4** and in the other end by a pair of pressure rollers, **2***a* and **2***b*. The interior **3'** of the tube portion **3** contains a sterilizing agent—a liquid or a gas—which has been supplied to the interior of the tube in connection with the tube being unwound from the supply roll **4** or has been supplied through a cannula, which has been inserted through the tube wall. Among liquid sterilizing agents might be mentioned hydrogen peroxide and among gaseous agents ethylene oxide and chlorine dioxide. When the tube has been unwound from the supply roll **4** and is being fed between the pressure rollers **2***a* and **2***b*, the interior of the tube will continuously—as the sterilizing liquid is prevented from leaving the space **3'**—be subjected to the action of the sterilizing agent.

Particularly in the case, when the sterilizing agent is a liquid, it is advantageous to arrange the pressure rollers above the supply roll, so that the portion **3** is caused to adapt a substantially vertical position. A gaseous steriliz-

ing agent is preferably compared with a liquid therein, that it is easier to handle and in that it is easier to prevent from escaping between the pressure rollers.

The apparatus can be completed with means described in connection to the previous embodiments.

What is claimed is:

1. Apparatus for sterilizing a tube of tubular packaging material comprising means for moving said tube, a pair of means for compressing said tube at spaced points to seal a portion thereof from the remainder of said tube, means for adjusting the distance between said spaced points to vary the length of sealed portion whereby varying amounts of a sterilizing fluid may be contained in said sealed portion.

2. Apparatus as claimed in claim 1 wherein one of the means for compressing the tube comprises a supply roll of said tubular packaging material, wound upon itself to compress said tube to form one end of the sealed portion of said tube.

3. Apparatus as claimed in claim 2 wherein the other means for compressing the tube is disposed above said supply roll whereby the sealed portion assumes a substantially vertical position.

4. Apparatus as claimed in claim 1 and further comprising means for heating the sterilizing fluid in said sealed portion of the tube.

5. Apparatus as claimed in claim 1 and further comprising a movable endless belt extending between said spaced points and beneath said sealed portion of said tube to support said sealed portion containing the sterilizing fluid.

References Cited

UNITED STATES PATENTS

938,489	11/1909	James	118—408 XR
1,967,773	7/1934	Hewitt	99—176 XR
2,210,436	8/1940	Weingand et al.	117—95 XR
2,267,488	12/1941	Becker	99—176 XR
2,901,358	8/1959	Undwerwood et al.	
3,163,971	1/1965	Loliger et al.	21—2 XR
3,383,831	5/1968	Goldsmith et al.	21—58 XR

FOREIGN PATENTS

883,151	11/1961	Great Britain.
616,350	7/1935	Germany.

MORRIS O. WOLK, Primary Examiner

D. G. MILLMAN, Assistant Examiner

U.S. Cl. X.R.

21—58; 99—176; 134—23, 166