

April 23, 1963

G. A. RAUSING ET AL

3,086,336

APPARATUS FOR PRODUCING ASEPTIC PACKAGES

Original Filed Dec. 21, 1959

3 Sheets-Sheet 1

Fig. 2

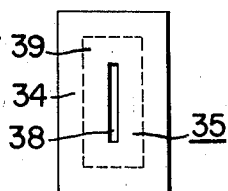


Fig. 1

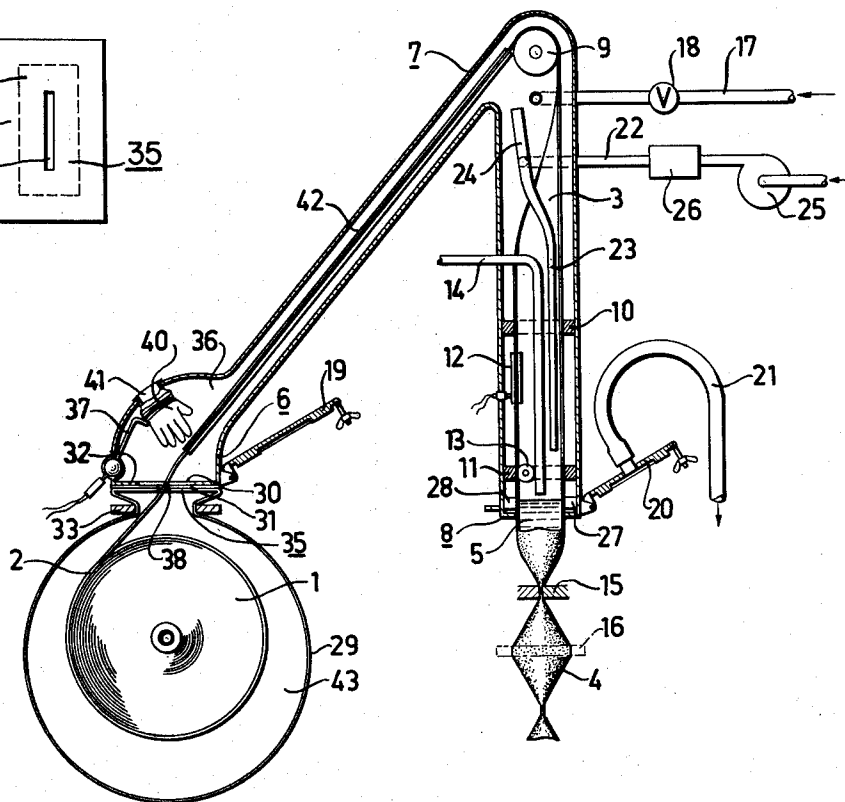


Fig. 6

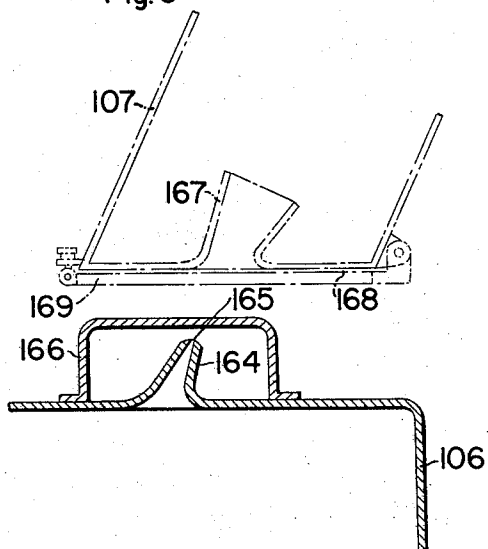
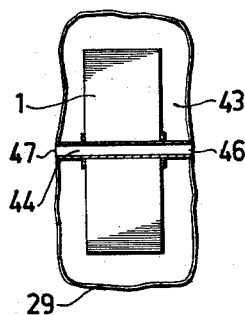


Fig. 3



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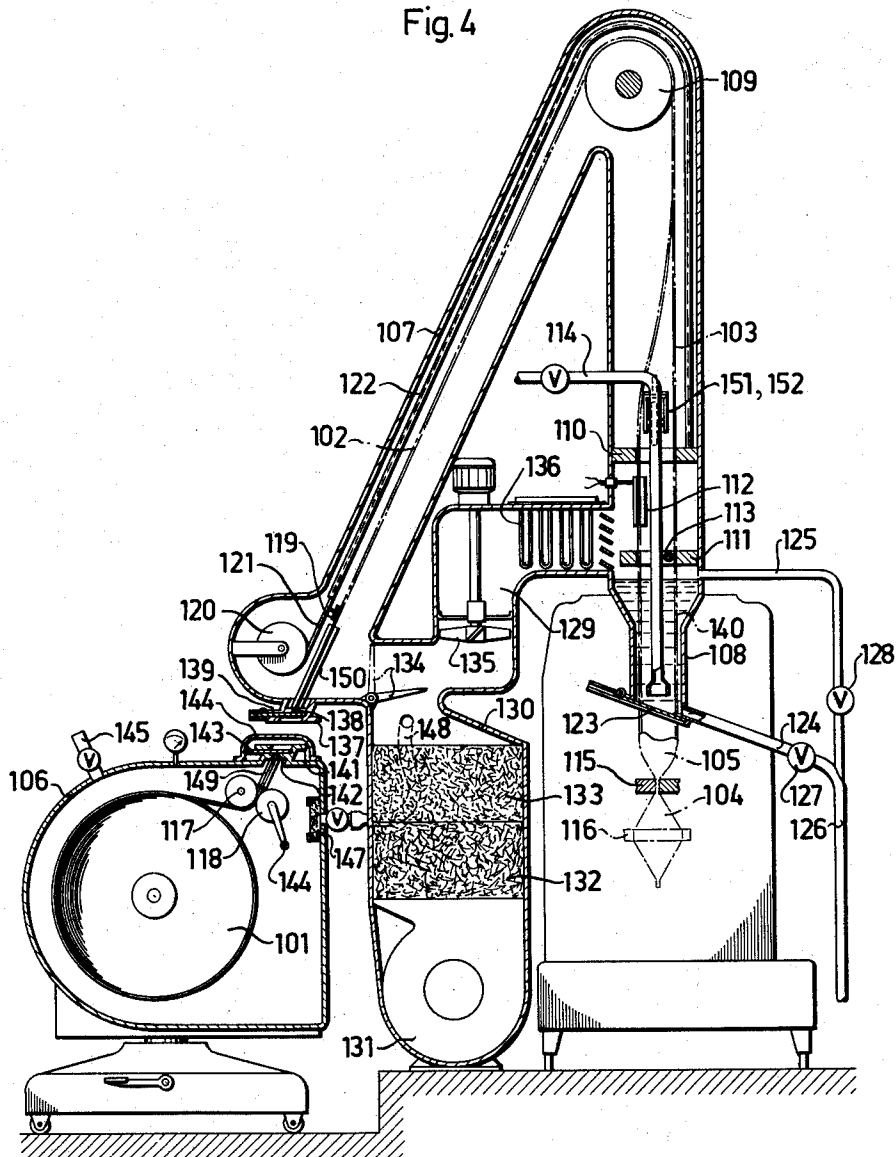
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Fig. 4



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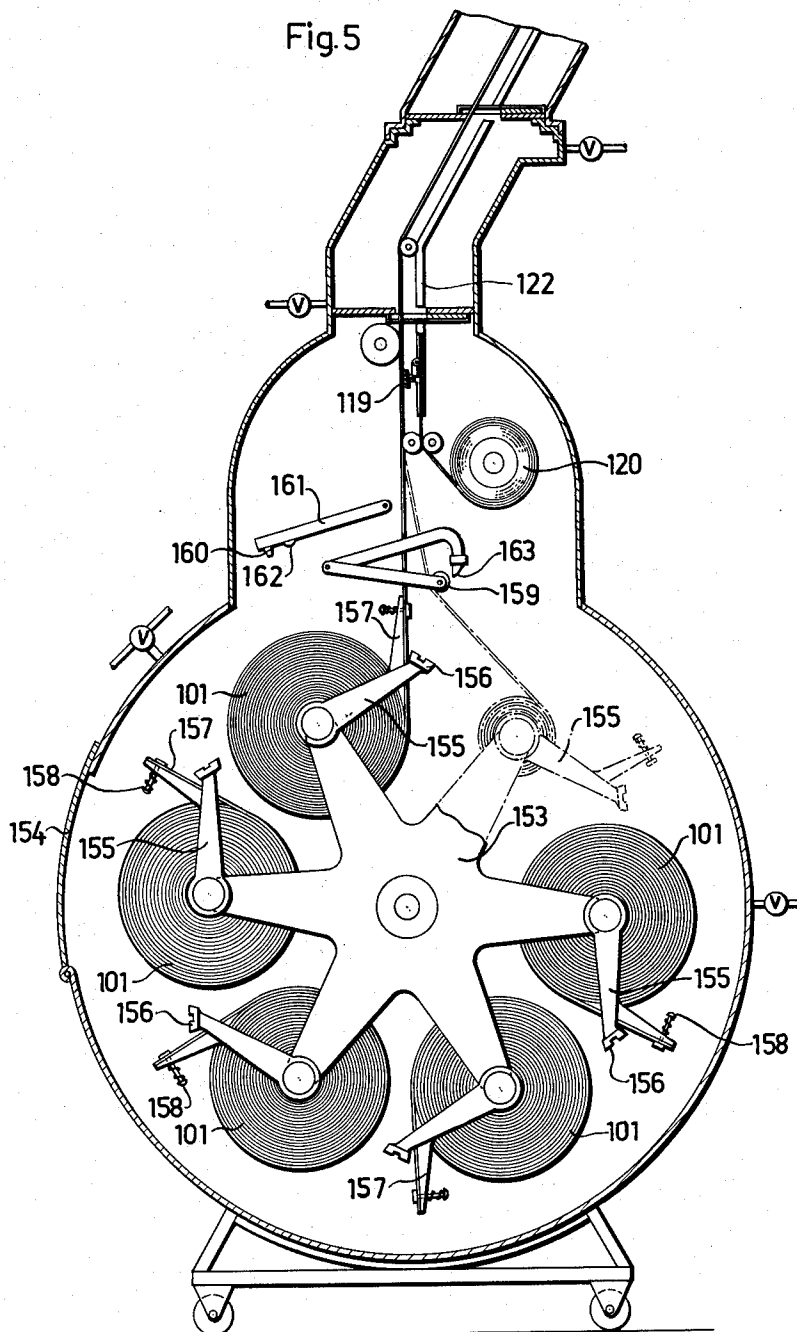
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APPARATUS FOR PRODUCING ASEPTIC PACKAGES

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Fig.5



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3,086,336 APPARATUS FOR PRODUCING ASEPTIC PACKAGES

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Continuation of application Ser. No. 860,880, Dec. 21, 1959. This application July 6, 1962, Ser. No. 208,146

Claims priority, application Sweden Jan. 2, 1959

7 Claims. (Cl. 53-180)

The present invention relates to apparatus for producing filled and sealed packages having sterile contents, and is a continuation of our co-pending application, Serial No. 860,880, filed December 21, 1959.

Foodstuffs and pharmaceutical industries have in recent years showed increasingly higher production packaged sterile products in order that such products might be safely stored for longer periods of shelf-life. According to one known mode of producing packaged sterile products, the filling material is introduced into the container without requiring the observance of any particular aseptic conditions, the container after a possible evacuation of air therein, being subsequently sealed closed and then, in an autoclave, heated to a sterilizing temperature and for a period of time sufficient to sterilize the contents. Another known mode of producing packages with sterile contents has been to incorporate an active sterilizing agent with the filling material itself or to include such an agent in the container so that the contents as well as the interior of the container are sterilized. Still another mode of producing packages with sterile contents, as exemplified by U.S. Patent No. 2,918,770, issued December 29, 1959 to Josef Stocker, is to provide a sterile atmosphere in the package forming and filling machine and to pre-sterilize the material from which the package is made just prior to entry into the package forming and filling machine by passing that material through a sterilizing chamber.

The present invention is directed to an improved mode of producing filled and sealed packages with sterile contents wherein a supply of the material from which the package is formed such as one or more rolls of a web is rendered completely sterile in its own container and such containers are then connected up to the package forming and filling machine proper under sterile conditions as they are needed.

A principal advantage in the new and improved apparatus is that the supply of material from which the packages are formed and filled may be established in individual sealed containers in which the material is completely sterilized before using it. Being in sealed containers, separate from the package forming and filling machine itself, obviously as much time as is considered desirable may be devoted to pre-sterilization of the packaging material, and any one of various types of pre-sterilizing techniques may be used such as chemical or physical. Thus, the step in the overall manufacturing operation of sterilizing the packaging material, is not operatively associated with the running of the machine itself but is rather completely independent. In this manner, one is better assured of complete pre-sterilization of the packaging material prior to its use on the machine. Also, by divorcing the pre-sterilizing step from actual operation of the package forming and filling machine, there is less likelihood of a forced stoppage of the machine should there be a failure in the sterilizing operation of the packaging material.

These and other objects will appear from the following detailed specification reference being made to the attached drawings on which:

FIG. 1 is a schematical view in elevation, partially

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in section, of an embodiment of a system according to the invention,

FIGS. 2 and 3 are detail views of the system in FIG. 1,

FIG. 4 is a view in elevation, partially in section, of another embodiment of system according to the invention,

FIG. 5 illustrates another embodiment of casing for the supply of packaging web material, and

FIG. 6 illustrates schematically an embodiment of aseptic coupling between the web supply casing and the aseptic tunnel.

Before entering into the description of the various embodiments shown on the drawings it seems appropriate for gaining in distinctness to unravel a few definitions of importance for the understanding of the specification.

By "container" as used in connection with the packaging operation here is meant a body having an outwardly opening container cavity generally defined by side and bottom walls. According to the same terminology "blank of container" or "container blank" means a body which in a normal packaging process, i.e., by such processing as sealing and/or bending deformation, will form a portion of or lend itself to being converted into a "container." Thus, by the expression "at least blanks of container" or "at least container blanks" there is meant bodies which either are container blanks in the just-mentioned sense or already have the nature of a container.

In conformity with the terminology used in bacteriology the adjective "aseptic" means: excluding septic matter, and hence, preventing re-infection. In analogy therewith, the noun "aseptic" means a device or a system providing aseptic conditions.

When a container is said to be filled with filling material and sealed in a "region," to such indication there will herein be attributed the purport that the filling material as well as the atmosphere of at least a portion of the region in question may enter the interior of the container before it is sealed to form the finished package. However, neither before nor after the sealing of the container the filling material will be exposed to another atmosphere than that of the just-mentioned region unless the sealed package is opened in such other atmosphere.

On the drawings the invention is shown as applied to one of the modern packaging techniques, in which, from a supply roll 1, a flexible heat-sealable packaging web material 2 is unwound and subsequently, through bending the web and through joining its longitudinal margins, is converted into a tube 3 which, in direct connection therewith, and through flat-pressing along relatively narrow zones transverse to the tube axis, is divided into individual packages 4 thereby to enclose a filling material 5 introduced in the tube 3. On the drawings there is indicated that the sealing of the packages 4 through flat-pressing the tube 3 is carried out in alternately one and the other of two mutually perpendicular planes imparting a tetrahedron shape to the packages 4. Packages of that kind are disclosed e.g. in Swedish specifications Nos. 123,250, 131,599 and 142,529.

In accordance with the invention the web 2 from the supply roll 1 is introduced in a tunnel-shaped aseptic 7 at one end 6 thereof, the finished tube 3 having a longitudinal seam being fed-out at the other tube end 8. In its portion corresponding to the tube forming operation said tunnel aseptic 7 contains appropriate means for such tube forming. Of these means there are shown a pulley roller 9, upper and lower tube forming annulus 10 and 11, respectively, and a longitudinal seam sealing means comprising an electrical heater 12 and a pressure roller 13 inside the tube 3. Furthermore, in the tunnel aseptic 7 there is inserted a supply pipe 14 adapted to open into the longitudinally seamed tube 3 for supplying

to the interior thereof the filling material 5 to be packaged from a tank or the like (not shown) containing a sterile filling material.

The final deformation of the tube 3 into the desired package 4 as well as the sealing thereof is carried out outside the tunnel aseptic 7 by means of clamping jaw pairs 15, 16 movable to and fro the output end 8 of the tunnel aseptic 7, said clamping jaws of each pair being movable to and fro each other and provided with heating means in order, by flat-pressing the tube 3 and supplying heat to the flat-pressing zone, to produce transverse tube seals closing the packages 4.

The tunnel aseptic 7 together with all devices and means enclosed thereby is pre-sterilizable, e.g., by superheated steam under overpressure, which steam may be supplied to the interior of the tunnel 7 by a supply line 17 opening into the tunnel 7 and having a cut-off valve 18. During such pre-sterilization of the tunnel aseptic 7 and the contents thereof the web 2 is not introduced therein, the tunnel 7 being closed at its two ends 6 and 8 by means of hinged flaps 19 and 20, respectively. The flap 20 swingable into a position in which it closes the output tube end 8, is provided with an escape hose 21 for draining off possible condensate from the tunnel 7 as well as for permitting a pre-sterilization of the supply pipe 14 for filling material by means of flowing sterilizing liquid the discharge of which is effected by the escape hose 21.

The tunnel aseptic 7 is also provided with a supply pipe 22 for sterile air under overpressure. On the drawings, said supply pipe 22 is shown as branched inside the tunnel aseptic 7, one branch 23 being adapted to open into the interior of the tube 3, the other branch 24 being arranged in the tunnel 7 to provide a stream of sterile air in a direction opposite to the feeding direction of the web 2. Sterile air is supplied to the air pipe 22 by a pump 25 via a sterilizing filter 26.

After the tunnel aseptic 7 together with the contents thereof has been pre-sterilized, the sterile air supply thereto is started, the superheated steam supply being shut off. The web 2 is introduced at the input tunnel end 6 and the tube 3 is fed out at the output end 8. If the web 2 upon entering the tunnel aseptic 7 is assumed to be sterile, the tunnel aseptic 7 will secure the sterility of the web portion forming the inner face of the tube 3 until the corresponding package 4 has been sealed closed, whereupon the continued sterility of the inside of such package will be secured by the closing seal. The reason is that in the tunnel aseptic 7 there prevails a sterile atmosphere under overpressure preventing reinfesting organisms from entering the tunnel aseptic 7 at the output end 8 thereof or otherwise through possible leaks or the like minor tunnel wall openings communicating with the ambient atmosphere.

When the first transverse tube seal has been produced by the momentarily upper one of the clamping jaw pairs 15 and 16, the sterile filling material supply through the supply pipe 14 is started. In the packaging operation such supply of filling material may be either continuous or intermittent. In case of continuous supply the transverse sealing of the tube 3 for dividing same into packages 4 is carried out below the level of a sterile filling quantity 5 in the tube, while in the other case a metered filling material quantity for one package 4 only is charged into the tube 3 upon each transverse sealing thereof. Because of the fact that sterile air at an overpressure is supplied continuously to the tunnel aseptic 7 during the packaging process and that a quantity of said sterile air is deflected into the tube 3 the sterile atmosphere thereof will prevail even in that portion of the tube 3 projecting outside the aseptic tunnel 7 at the output tunnel end and being closed at its outer end by a transverse seal. In order positively to prevent reinfection during that period of time when the tube 3 at the beginning of a packaging run projects from the output end of the aseptic tunnel 7 and still has

not been sealed closed by one of the clamping jaw pairs 15 and 16, the interior of the tunnel 7 may, in the vicinity of the tunnel output end 8 and preferably below the lower tube forming annulus 11 shown on the drawings, be provided with auxiliary clamping means 27, 28 operable from outside the tunnel 7. By such auxiliary clamping means 27, 28 the leading tube end may be closed through flat-pressing and heat-sealing thereby to make possible the feeding-out of the tube 3 having a sealed leading end from the aseptic tunnel 7.

A requisite for the above-described aseptic packaging process is of course that the web 2 in itself be sterile upon entering the aseptic tunnel 7 by the input end 6 thereof, or else the web 2 itself will imperil those sterile conditions which are a must when aseptically packaging sterile products. It is easily seen that in a modern packaging technique the period of time available for feeding a packaging web material from a supply roll to the point where the conversion of the web into container starts is too short to permit a sterilization of the web so that the interior of the container is sterile when introducing the sterile filling material therein. Regardless of the sterilizing methods and agents used there will still remain the fact that the web for its sterilization will require periods of time in the order of at least minutes, while packaging processes carried out on modern packaging apparatus will allow for treating times in the order of seconds only, or else such methods and apparatus will become bulky and impractical.

In addition, a web sterilization may hardly be carried out in the tunnel aseptic 7 in the packaging process for the reason that the risk of reinfesting the possibly sterilized web portion as well as the tube and, of course, the filling material is extremely great as the non-sterile web 2 when entering the tunnel aseptic 7 would carry bacteria which would reinfest the inside of the tunnel 7 together with all means and device contained therein for the carry-out of the packaging process, and thus the entire atmosphere in which the dominant portion of the process is effected.

Thus, for the above-mentioned reasons a sterilization of the web in, as to time, direct connection with the packaging process proper is not possible. In accordance with the present invention, however, the sterilization of the web 2 is yet carried out in a continuous connection with the packaging proper without adversely affecting the successful and rational accomplishment thereof. Since, as a rule, the web 2 in any case is not manufactured or prepared in the same machine or apparatus where it is converted into the packages but for the most part said two phases of the overall packaging method are separated both as to time and as to place, the invention provides a rational way of utilizing the inevitable interval between the production or preparation of the web material and the actual use thereof in the packaging apparatus as a treating period of time for sterilizing the web material. As the time interval between the preparation and the final use of the web material generally is of considerable duration and often amounts to days and months there is gained the obvious advantage that very mild sterilizing agents or means may be used. The sterilizing action is a direct function of time, and hence milder sterilizing agents or means may be resorted to as the sterilizing time available increases in length. This is illustrated in a clear way, e.g., by the temperature-time relationships of steam sterilizing processes where a steam temperature of 130 centigrades will require a sterilizing time of about 3 minutes, while a steam temperature of 100 centigrades will increase the treatment time to at least 30 minutes.

According to the invention the supply roll 1 in more or less direct connection to the production or preparation of the corresponding web 2 is introduced in a casing or enclosure 29, which is subsequently sealed closed. In said enclosure 29 and together with the atmosphere prevailing therein the web 2 is pre-sterilized in its supply roll shape. Such sterilization may be effected, e.g., through

applying an appropriate sterilizing agent to at least one face of the web 2 when winding the same into a supply roll 1, and subsequently enclosing said supply roll 1 in the enclosure 29, where the sterilizing agent is permitted to act for a period of time of sufficient length for effecting sterilization of the web as well as of the atmosphere in the enclosure 29. In the supply roll the two web faces are in contact with each other, and therefore, generally, sterilizing agent need only be applied to one web face. Among suitable sterilizing agents for the web are in this connection: biethylene oxide, iodine, chlorine, formaldehyde, hypochlorites, chloramine, iodofores, potassium iodide, etc. Either in liquid (solution) gaseous or solid state the sterilizing agent is applied to or caused to act on the web material. Suitably, an agent is chosen that may be applied to the web material in solid or liquid state and subsequently pass into an active gas phase.

Either one sterilizing agent may be used or a combination of several agents. The application thereof is carried out not later than at the time when the web material is wound-up into a supply roll. Suitably a sterilizing agent of the kind mentioned is also introduced in the enclosure 29 in order to contribute to the sterilizing of the atmosphere which, together with the roll 1, is enclosed in the enclosure 29.

Of course, other sterilizing agents than chemical ones may be used. Thus, it is quite possible to use chemical and physical agents or means individually or in combination with each other.

In the enclosure or casing 29 the web material in its entirety is kept for a period of time of sufficient length for securing sterilization of the web and the atmosphere of the enclosure 29. Suitably, this period of time is utilized for the transport of the supply roll 1 to the place where the packaging machine is, and for storing until finally used in the packaging process in such machine. During such transportation and storing the enclosure 29 may also serve the function of transport and storage container.

When introduced in the aseptic tunnel or casing 7 the web 2 should be sterile, as already mentioned. In this connection the problem is to realize an aseptic introduction of the web 2 in the input end 6 of the aseptic tunnel. The drawings show how the web 2 may be introduced aseptically in the aseptic tunnel 7 through the input end 6 thereof from the enclosure 29. It is assumed that the enclosure 29 consists of a heat-sealable flexible plastic material which has been heat-sealed closed when closing the enclosure 29. Thus, the enclosure 29 is best described as a plastic sack. Over the opening 30 to be shut by the flap 19 when pre-sterilizing the tunnel aseptic 7 there is arranged, e.g., a heat-sealable plastic film 31 which, by heat sealing or in another suitable manner, is sealed to the edges, i.e., the flanges 32 in the present case, of the tunnel opening 30 at the input end of the tunnel 7. Preparatory to introducing in the tunnel 7 the web 2 enclosed in the enclosure 29 the flexible heat-sealable plastic wall thereof is stretched or tented over the opening 30 and subsequently heat-sealed, in a reentrant seal 34 (see FIG. 2), to the outside face of the covering film 31 by a frame-shaped sealer 33 movable to and from the flanges 32, said reentrant seal 34 defining a double-walled area 35 one wall of which comprises a corresponding portion of the film 31, the other wall comprising a corresponding portion of the wall of the enclosure 29. Suitably, this area 35 should be of dimensions at least corresponding to those of the web 2.

At its input end 6 the tunnel aseptic 7 has a section of wider cross-sectional dimensions than those of the next-succeeding tunnel section. In this widened entry section 36 of the tunnel 7 there is provided an electrical sealing and punching means 37 operable from outside the tunnel 7 to move to and from said double-walled area 35 defined by the reentrant seal 34 thereby to punch or

cut out an input opening 38 for the web while simultaneously sealing the edges defining such opening 38 so that of said area after punching the opening 38 therein there will remain a generally frame-shaped double-walled portion 39 surrounding and defining the web input opening 38. In that manner, bacteria that may possibly have been enclosed between the respective outside faces of the film 31 and the enclosure 29 facing each other are prevented from entering the tunnel 7 when the input opening 38 is punched or cut in the double-walled area 35. Before sealing the wall of the enclosure 29 to the covering film 31, to the two sides facing each other there may preferably be applied a suitable fast-acting sterilizing agent for greater security.

By means of rubber gloves 40 entered in the widened entry section 36 of the tunnel 7 and sealingly fastened in their respective openings 41 in the tunnel wall the operator may, through the just-mentioned input opening 38, seize the leading end of the web of the supply roll 1 and pull said leading end into the tunnel 7 in order, by means of suitable guiding and feeding means which in FIG. 1 are indicated schematically as web margin guiding plates 42, to start the conversion of the web 2 into the tube 3 as previously described. If, during the packaging process proper, the web feed is effected only by the sealing jaw pairs 15 and 16 when moving away from the output end 8 of the tunnel 7 the initial feed of the web, viz., until the sealing jaw pairs 15 and 16 engage the tube 3, must be effected by the operator either manually or by the aid of especial feeding means (not shown) in the interior of the tunnel 7.

In the present case, with a view to the unwinding of the web 2 from the supply roll 1, the enclosure 29 should be in the form of an annular chamber 43 (see FIG. 3) the spool shaft 44 defining the central wall thereof. The shaft 44 may consist of a plastic tube permitting the heat-sealing of the enclosure 29 to the shaft 44 thereby to secure tight seals therebetween. After such heat-sealing operation the wall of the enclosure 29 is perforated at the ends 46 and 47 of the hollow shaft 44 so that the latter when mounting the supply roll in the packaging machine, may be located by means of pivot studs or the like insertable into the hollow shaft ends 46 and 47. The shaft may also be provided with suitable sealing or packing means between which the walls of the enclosure 29 may be sealingly clamped for securing a region even bacteriologically closed with respect to communication from the surroundings, which region contains the supply roll.

Thus, the apparatus of the invention as illustrated in FIG. 1 generally contemplates that the packaging web material 2 in a wound state is sterilized in and together with a closed atmosphere distinct from the package forming and filling machine and is subsequently aseptically introduced in and caused to pass through an aseptic in the sterile atmosphere of which the packaging process proper, including filling a sterile filling material, is carried out to such an extent that the resulting filled and sealed packages will have sterile contents. The simplest way of characterizing the invention is by using the term "sterile line" or "sterile chain" because from the moment when the web 2 enclosed in the separate enclosure 29 has reached sterility and to the moment, when a corresponding filled and sealed package 4 produced from such web 2 is opened in a non-sterile atmosphere, the interior of the package has been kept sterile.

In the above described embodiment it was assumed that the web material 2 be of the kind comprising a paper body one face of which, viz., the web face to form the inside of the finished package, has applied thereto a coating of a heat-sealable plastic material, e.g., polyethylene or polyvinylchloride. Particularly for this kind of webs 2 the method of the invention is advantageous since the paper body of the web 2, in order not to be damaged dur-

ing the sterilizing step, must undergo long-time sterilization by mild sterilizers.

Thus far the disclosure has been restricted deliberately to packaging processes of the kind where a packaging web material is converted or transformed into packages which are filled and sealed in direct connection to such conversion. The invention may, however, be applied as well to other kinds of packaging processes. Thus, the principles of the invention may be utilized in the production of filled and sealed packages from package blanks originally being of container shape in the previously defined sense. In that application, the invention would then contemplate the pre-sterilization of a predetermined quantity of containers such as bottles, cartons, etc. in a separate enclosure and the subsequent introduction of such containers when in sterile state, in an aseptic tunnel, the sterile "milieu" of which the corresponding packages leave when filled and sealed. In such a case it is quite possible to carry out the entire packaging process in the interior of the aseptic tunnel so that the outside of the packages will leave the sterile atmosphere of the aseptic tunnel only after the sealing of the packages.

Within the scope of the invention there may be included packaging processes of the kind involving the production of packages from several partial blanks such as several webs, or a carton and at least one closure foil or the like. In that case supplies of partial blanks may be sterilized either in a common enclosure from which they are fed simultaneously into the aseptic tunnel, or in individual enclosures from which the respective supplies are individually fed into the tunnel.

The aseptic feed-in may, of course, be obtained in another manner than that shown in FIG. 1. Thus, the pre-sterilized web material 2 or the container blanks may be introduced in the tunnel from the separate enclosure and via a supplementary sterilizing bath forming a sluice between the enclosure in question and the tunnel. In such an embodiment one mode of operation may be to immerse a portion of the enclosure into the sterilizing bath. After a sufficient sterilizing time the enclosure is opened under the surface level of the liquid, whereupon the web or the blanks, entirely immersed in the bath, are introduced in the aseptic tunnel the input end of which also is located below the surface level of the sterilizing bath. The bath may also serve the purpose of securing the removal of possible residues of the sterilizing agent used for the pre-sterilization of the web 2 thereby to prevent such residues from dissolving or mixing in the sterile filling material.

Although the separate enclosure 29 has been characterized as a plastic sack enclosing the supply roll 1, it may of course be of another nature. Since, preferably, it should also serve the purpose of a transport and storage container for the web stock roll 1 or for the corresponding container or container blank supply, a casing type of enclosure may be desired particularly for web material stock.

For suitable web materials or container blanks, sterilization by autoclave may replace other kinds of sterilizing methods and means. When sterilizing by autoclave the web material roll 1 is enclosed in its enclosure 29 and heated in an autoclave to a sterilizing temperature for a sufficient period of time to impart sterility to the roll 1 and the atmosphere of the enclosure 29.

In conclusion, the above-described application of the invention to the production of filled and sealed packages having sterile contents starting from a packaging web material may involve the following steps:

In more or less direct connection with the production of the web material which may include, e.g., applying a plastic film to one face of a paper web, printing a design or other printing matter on the opposite face of the coated web, slitting the coated web into partial webs of the desired width, and winding such partial webs into supply rolls, the partial webs are enclosed each in an individual

enclosure after a suitable sterilizing agent has been applied to at least one face of the webs and either the same or another sterilizing agent has been introduced in the closure.

Enclosed in its enclosure the supply roll is transported to the place where the packaging machine is installed. After the sterilizing agent or agents have been permitted to act under the period of time required and the web material proper as well as both the inside and the atmosphere of the enclosure have become sterile, the roll is ready for use. Of course, the sterilizing agent or agents should be such that storage for a time longer than that required for the sterilization will not damage the web material.

Before the packaging process, the tunnel aseptic of the packaging machine together with the supply system for the sterile filling material has been pre-sterilized, as indicated, by steam and a stream of sterilizing liquid, respectively. Then, sterile air is continuously supplied to the interior of the tunnel thereby to maintain therein an overpressure preventing reinfection.

In the manner indicated, the interior of the supply roll enclosure is connected aseptically to the input end of the aseptic tunnel, and the web material is introduced in the aseptic tunnel to be converted to a tube therein. The leading tube end is sealed closed, before it leaves the tunnel and thereafter the supply of sterile filling material to the interior of the tube may start. The tube is divided into individual sealed and filled packages outside the aseptic tunnel.

When a web material supply roll has been exhausted, a portion of the wall of the roll enclosure may be stretched or tented over the tunnel input end opening 30 and be sealed to the edges 32 thereof to form a new closing diaphragm corresponding to the film 31, while the remaining portion of the enclosure as well as the spool shaft are removed. Thereafter a new enclosure containing a full supply roll may be connected aseptically to the aseptic tunnel in a manner similar to that used for the first roll.

Roll changes do not require any repeated presterilization of the tunnel and the supply system for the filling material, such repeated sterilization normally being required only after an extended operation stop or the like when there will be a definite risk of reinfesting the aseptic system.

FIG. 4 illustrates in greater detail another embodiment of the system schematically shown in FIG. 1. In the present case a supply roll 101 is located in a casing 106 forming one end of an extended chamber for the rest defined by a tunnel 107 connecting to the casing 106, the web material 102 being passed through said chamber while successively being converted into the finished longitudinally seamed tube 103 which is fed out of the chamber at the other end 108 thereof. In its portion corresponding to the tube forming operation said chamber contains appropriate means for such tube forming. Of these means there are shown a pulley roller 109, upper and lower tube forming annulus 110 and 111, respectively, and a longitudinal seam sealing means comprising an electrical heater 112 and a pressure roller 113 inside the tube 103. Furthermore, in the tunnel 107 there is inserted a supply pipe 114 adapted to open into the longitudinally seamed tube 103 for supplying to the interior thereof the filling material 105 to be packaged from a tank, or the like (not shown) containing a sterile filling material.

The final deformation of the tube 103 into the desired package 104 and the sealing thereof is carried out outside the chamber by means of clamping jaw pairs 115, 116 movable to and from the output end 103 of the chamber, said clamping jaws of each pair being movable to and from each other and being provided with heating means in order, by flatpressing the tube 103 and supplying heat to the flatpressing zone, to produce transverse tube seals closing the packages 104.

In addition to the above-mentioned devices and means directly necessary for the tube forming operation, the chamber defined by the casing 106 and the tunnel 107 also contains a web conveying means indicated in FIG. 4 partly by a pair of co-operating feed rollers 117, and 118 situated in the casing 106, partly by a conveyor situated in the tunnel 107 and comprising a carrier 119 movable along a rail or plate 122 substantially parallel to the travelling path of the web 102 and the tube 103, respectively, in the tunnel 107 by means of a strip-shaped actuating element 121 from a supply roll 120. In the present case said conveying means is adapted to carry the leading end of the web 102 from the casing and into operative engagement between the corresponding leading end of the tube 103 and the transverse sealing jaws 115 and 116 which take over the packaging web feed from the conveying means.

The chamber formed by the casing 106 and the tunnel 107 defines, together with the supply pipe 114, a space or region pre-sterilizable together with all devices and means contained therein. Such pre-sterilization will also include the atmosphere as well as said web supply roll 101 in the region in question.

As with the packaging system shown in FIG. 1, in the present system illustrated in FIG. 4 the just-mentioned pre-sterilization is assumed to be effected separately with respect to the two region sections defined by the casing 106 and by the tunnel 107 and the supply pipe 114, respectively. Thus, the chamber portion defined by the casing 106 is sterilized separately together with the web supply roll 101 and is subsequently connected aseptically to the likewise separately pre-sterilized chamber portion comprising the tunnel 107.

The just-mentioned space or region together with both its atmosphere and the web supply roll 101, however, might as well be pre-sterilized as a unit, if desired.

In the packaging system chosen as an example and shown in FIG. 4 the tunnel 107 and the supply pipe 114 are pre-sterilizable together with each other by superheated steam, the casing 106 and the web supply roll 101 being pre-sterilizable by an appropriate sterilizing gas.

The portion of the tunnel 107 in the vicinity of and just above the output end 108 thereof is substantially vertical and the output end 108 is closable by a slide 123 forming with the horizontal an angle differing from zero. In its closed position the slide 123 thus forms an inclined bottom wall of the corresponding portion of the tunnel. At the lowest portion of such bottom wall the tunnel output end 108 is connected to a bottom outlet line 124 which together with an overflow line 125 connected to the tunnel 107 at a point spaced from and above said bottom wall connects to a drain 126. Both the bottom outlet line 124 and the overflow line 125 are provided with a shutoff valve 127 and 128, respectively.

In the vertical tunnel portion and immediately above that level determined by the overflow line 125 there opens out a circulation passage 129 the other end of which connects with the input end portion of the tunnel 107. In the vicinity thereof the circulation passage 129 is connected to a source 130 to sterile air comprising a blower or pump 131 communicating with the ambient atmosphere, and two sterilizing air filters 132 and 133 in series with each other. At the circulation passage end connected to the input end portion of the tunnel 107 there is provided a valve flap 134 swingable from one position in which it partially closes the communication between the sterile air source 130 and the circulation passage 129 but keeps the communication between the two end portions of the tunnel 107 through the passage 129 completely open, to another position, in which it keeps the communication between the sterile air source 130 and the circulation passage 129 completely open but closes

the communication between the tunnel end portions through the passage 129 completely.

Between the point where the sterile air source 130 connects to the circulation passage 129 and the mouth thereof in the vertical tunnel portion there are provided, counting in the direction towards said tunnel portion, a circulation blower 135 and a heater unit 136.

The input end of the tunnel 107 is provided with an input connecting piece 137 defining an input slot 138 and closable by means of a slide 139.

When pre-sterilizing the tunnel 107 and the supply pipe 114 the tunnel 107 is maintained closed at its two ends by means of the slides 123 and 139, respectively. In the vertical tunnel portion there is introduced a sterilizing liquid 140 up to the level defined by the overflow line 125. Before that time the shut-off valve of the overflow line 125 has been opened, the shut-off valve 127 of the bottom outlet line 124, however, having been closed.

With the valve flap 134 in the position corresponding to unrestricted communication through the circulation passage 129 and with the pump 131, the circulation blower 135, and the heater unit operating steam is introduced in the sterilizing liquid quantity 140 in the vertical portion of the tunnel 107 through the supply pipe 114. During the time when said sterilizing liquid quantity 140 still is cold, the steam, of course, will condensate therein, such condensation tending to raise the liquid level in the tunnel 104. This, however, will be counteracted by the overflow line 125 draining the excess quantity of liquid.

As the temperature of the sterile liquid quantity 140 raises, steam will evaporate from the surface thereof, said steam being caused to circulate in the closed circuit comprising the tunnel 107 and the circulation passage 129. The circulation is promoted by the circulation blower 135 in the passage 129 blowing in the direction towards the vertical tunnel 107. Thus, the circulation is in the direction from the tunnel output end 108 through the tunnel 107 to the input end thereof and from the input end back to the vertical portion of the tunnel 107. When passing through the circulation passage 129 the flow is heated by the heater unit 136. In addition, on the suction side of the circulation blower 135, the flow is supplied with a quantity of sterile air from the source 130, said auxiliary sterile air quantity serving to prevent the positive circulation in all points of the circuit from causing suck-in from the surroundings through possible leaks or other openings otherwise possible due to local depression phenomena.

When a state of equilibrium with respect to temperature has been reached in all points of the flow circuit this state will be maintained for a period of time required for obtaining absolute sterility in that point having the lowest equilibrium temperature.

When sterility has been obtained the steam supply in the supply pipe 114 is interrupted, said supply pipe 114 instead being connected to a source of sterile filling material. For the time being, however, there is no supply of sterile filling material through the supply pipe 114. The valve 127 of the bottom outlet line 124 is opened for removing the sterilizing liquid quantity from the tunnel 107, and then the valve 127 as well as the valve 128 of the overflow line are closed.

In connection with the just-mentioned measures, the valve flap 134 will be set in the position in which it prevents communication between the input end portion of the tunnel 107 and the circulation passage 129. Therefore, the sterile air source 130 by the circulation passage 129 will force a flow of sterile air at an overpressure into the vertical portion of the tunnel 107. Before starting the packaging operation, the slide 123 is preferably maintained in its closed position, the slide 139 of the input connecting piece 137 being removed from the input slot 138. The flow of sterile air from the source 130 will fill the

tunnel 107 completely and will, at least partially escape through the slot 138 in the open state thereof. For drying possible condensate in the tunnel 107 the heater unit 136 may be operated also for a period of time after the completion of the pre-sterilization phase proper.

The supply of sterile air at an overpressure to the tunnel 107 will prevent reinfection of the region defined by the tunnel 107 and the supply pipe 114, and hence said region will constitute an "aseptic" in the above defined sense of the word.

In the packaging system according to the invention, shown in FIG. 4, it is assumed, as mentioned above, that the sub-region defined by the casing 106 and the web supply roll 101 are sterilized separately in relation to the tunnel 107 and the supply pipe 114.

For that purpose the casing 106 is designed as a pressure vessel adapted to accommodate rotatably a web supply roll 101. In addition, the casing 106 has an output connecting piece 141 defining an output slot 142 closable by means of an airtight slide 143. A removable cover 144 is adapted to be applied over the output connecting piece 141 and the slide 143 thereof in closed position on the outside of the casing 106 and with a tight fit thereto. Thus, when the cover 141 is mounted, the output connecting piece 141 is enclosed in a space defined by the cover 141 and the outside of the casing 106, said space communicating with the interior of the casing 106 through the slot 142 and the leaks between said slot 142 and the slide 143.

As previously mentioned, the casing 106 also contains a pair of cooperating feed rolls 117 and 118 of which the roll 118 is driven from the outside of the casing 106 by means of a crank 144'. The leading end of the packaging web material 102 in the roll 101 is inserted in the nip between those two rolls 117 and 118 and is drawn a distance into the output connecting piece 141 before the casing 106 is closed preparatory to the sterilizing step. The casing 106 is provided with two pipe fittings 145 and 146 both having a shut-off valve. One fitting or connector 145 opens out directly into the interior of the casing 106, the other pipe connector 146 communicating therewith through a sterilizing filter 147.

The first mentioned pipe connector 145 is preferably connected to a source of sterilizing gas and a vacuum pump via a two-way valve. With the pipe connector 146 closed and the casing 106 sealed also in other respects, the connection between said vacuum pump and the interior of the casing 106 through the pipe connector is opened, and thereafter the air enclosed in the casing 106 and hence in the web supply roll 108 is evacuated to the highest extent practicable. When reaching the desired degree of vacuum in the casing 106 the connection to the vacuum pump is closed and instead the connection to the previously mentioned source of gas is opened thereby to supply to the interior of the casing 106 a sterilizing gas at an appropriate overpressure. A suitable sterilizing gas is, e.g., ethylene oxid which, at an overpressure in the order of 2.5 atmospheres, is caused to act in the casing 106 for a sufficient period of time. Due to the pre-evacuation step the gas may penetrate the web supply roll thereby to sterilize even the inner portions thereof.

Of course, the gas will also penetrate into that space defined by the cover 144 and the corresponding portion of the outside of the casing 106, and therefore this space will also be sterilized.

Upon completion of the sterilization of the casing 106 together with its contents the casing 106 may be connected to the tunnel 107 if, for some reason, the sterilizing gas may not be allowed to escape freely the casing 106 it may, preparatory to the joining of the casing and the tunnel, be evacuated by means of the above-mentioned vacuum pump and via the connector 145. Thereafter, sterile air at an overpressure is supplied to the interior of the casing 106 through the connector 146

which for that reason is connected, e.g., to the previously mentioned source 130 of sterile air as indicated by the hose 148.

Under continued sterile air supply to the casing 106 the output connecting piece 141 is aligned with the input connecting piece 137 of the tunnel 107, said tunnel 107 having been pre-sterilized as mentioned above. In connection therewith the cover 144 is removed, and thereafter the slide 143 of the output connecting piece 141 is displaced to its open position in order to open the slot 142. At that time the slide 139 at the input end of the tunnel 107 is assumed to be in its open position, and therefore sterile air is escaping through the corresponding input slot 138. Thus, when the output slot 142 of the casing 106 is completely opened the flow of sterile air escaping the tunnel 107 will meet a flow of sterile air from the casing 106 and hence, the two flows will be laterally deflected establishing a pattern of flow preventing bacteria and other micro-organisms from entering the casing 106 or the tunnel 107 even if the output connecting piece 141 of the casing 106 and the input connecting piece 137 of the tunnel 107 will not be connected tightly but so as to allow leakage to a certain extent therebetween.

With the tunnel 107 aseptically connected with the casing 106, the leading end of the web 102, by operating the crank 144' of the feed roll 118, is fed through two connecting pieces 141 and 137 to a position inside the tunnel 107 at the input end thereof where the above mentioned carrier 119, by means of a mechanism (not shown) in the tunnel 107, may be brought into positive engagement with the web 102. For guiding the leading end of the web when carrying the latter to the said position in the tunnel 107, there are preferably provided guide plates 149 and 150 both in the casing 106 and in the tunnel 107.

The carrier 119 is caused to move along its guiding plate 122 thereby to carry the web 102 over the above-mentioned pulley roller 109 and downwardly through the vertical portion of the tunnel 107 where the web 102 is successively bent into a tube 103. The carrier 119 may be disconnected when it reaches a point in the vicinity of the upper tube forming annulus 110. The continued initial tube feed in such a case must be taken over by a third conveying stage. For the sake of simplicity said stage in the present case is assumed to comprise of feed rollers 151 and 152 co-operating with the wall of the tube 103 under formation. These rollers 151 and 152 push the leading end of the tube 103 downwardly through the tube forming annulus 110 and 111 and into the tunnel end 108 substantially corresponding to the cross dimensions of the finished tube 103. At the passage between the tube forming annulus 110 and 111 the heater element 112 together with the pressure roller 113 will produce the longitudinal seam of the tube 103.

Just before the leading end of the tube 103 reaches the still closed slide 123 of the tunnel output end 108 said slide 123 is removed so as not to obstruct the feed-out of the tube 103 into engagement with the transverse sealing jaws 115 and 116. By means of said jaws the tube 103 is divided into the individual packages 104 through transverse seals and at the same time the jaws effect the feed of the tube 103, and therefore the conveying stage comprising the feed rollers 151 and 152 may be made inoperative as soon as the sealing jaws 115 and 116 positively engaged the tube 103.

As soon as the first transverse seal of the tube 103 has been obtained, in any case as soon as any perforations or similar ruptures in the packaging material caused by the carrier 119 or by the feed rollers 151 and 152 have passed beyond the upper transverse sealing level, the packaging operation proper may be started. In such operation the sterile filling material 105 is supplied through the pre-sterilized supply pipe 114 discharging in the interior of the tube 103 closed at its lower end.

As an overpressure of sterile air prevails in the pre-sterilized tunnel 107, and, in addition, the likewise pre-sterilized supply pipe 114 communicates partly with the interior of the tunnel 107 via the tube 103 and partly with the source of sterile filling material 105, the packaging of the sterile filling material 105 is effected under aseptic conditions in a sterile region or "milieu" bacteriologically isolated from the non-sterile surroundings. In the present case said region is defined partly by the casing 106 the tunnel 107 and the supply pipe 114 and partly also by any leak flows of sterile, e.g., the sterile air flows between the connecting pieces 137 and 141, and that portion of the sealed tube 103 projecting from the tunnel 107. That portion of the region in question defined by the projecting tube portion, of course, will disappear if, for some reason a technically more complicated solution should be preferred comprising enclosing also the sealing jaws 115 and 116 as well as associated mechanisms in the tunnel 107. The same is true for the application of the invention to other kinds of packaging processes than that previously described. Thus, in packaging system according to the invention for producing sealed packages filled with a sterile filling material starting from package blanks already being of container shape in the above-defined sense, a supply of containers such as bottles, cartons, etc. first could be sterilized in and together with a region, and subsequently, without by any portion of their walls (e.g., not even by the outside thereof as in the above-described case) leaving such region, be filled and sealed and finally be fed out from said region.

Within the scope of the invention there are also packaging systems for methods of the kind where the packages are produced from several partial blanks, e.g., several web materials, or a carton and at least a closure foil or the like. In that case supplies of partial blanks may be enclosed in a common casing corresponding to the casing 106 or each in an individual casing of that kind.

In FIG. 5 there is shown another embodiment of the casing schematically illustrated in FIG. 4. The casing, according to FIG. 5, is adapted to accommodate several web material rolls 101 simultaneously. For that purpose it contains a rotatable six-armed roll stand 153 each arm of which is arranged rotatably to carry a web supply roll 101. Through an opening in the casing wall shutable by a door 154 the supply rolls 101 are insertable in the casing one by one to be placed on the stand 153 which for that purpose is rotated through an angle of 60 degrees at a time into a receiving portion in which an arm is aligned with the wall opening. From each arm of the stand there projects a fork 155, one branch of which at its free end carries an anvil plate 156 parallel to the roll axis, the other branch 157 being adapted to support a web portion unwound from the roll 101. Said other branch 157 is also provided with a holder 158 arranged to assume an operative grip position in which it holds the web portion unwound from the roll 101 onto the supporting branch 157 and to be tipped into a normal inactive position in which it does not cooperate with the supporting branch 157.

Instead of being located in the tunnel 107 as in the packaging system shown in FIG. 4 the conveyor stage comprising the carrier 119 and the strip supply roll 120 as well as the corresponding portion of the guide plate 127 may be contained in the present casing proper.

When inserting the rolls 101 in the casing the leading end of the corresponding web material 102 is placed onto the supporting branch 157 and is held thereto by the holder 158 in operative position. When the desired number of rolls 101 have been inserted the door 154 is closed and thereafter, through a closable opening (not shown) at the output end of the casing the holder 158 of a roll stand arm carrying a roll 101 in the unwinding position intended is tripped to its inactive position and an additional length of web is unwound from the roll 101 in

question, so that the carrier 119 assuming its starting position may be operatively engaged with the leading end of the corresponding web 102. Thereafter, the casing is closed so that the sterilization of the casing interior and the rolls 101 may be carried out in the same way as described in connection with the casing 106.

The casing is subsequently connected aseptically to the tunnel 107 whereupon the conveying means may introduce the leading end of the web 102 unwound from the roll 101 in unwinding position, and the packaging process starts.

As apparent from FIG. 5, the tunnel input end is provided with a slide which upon removal opens an input slot. In addition it has a coupling flange which together with the corresponding coupling flange of the casing forms a sealing labyrinth. Spaced inwardly from the coupling flange of the output passage of the casing there is provided a partition wall in the output passage, said wall parting the latter from the casing chamber proper and having an output slot closable by means of a slide. When mechanically connecting the casing and the tunnel 107 to each other the two slides are kept closed, so that there will be defined a sluice chamber between the casing and the tunnel 107. Before operating the slides (from outside the system in a manner not illustrated) to their opened positions said sluice chamber is sterilized by an appropriate gaseous or liquid sterilizing agent supplied to and discharged from the sluice chamber through valved lines connected thereto.

When the roll 101 being unwound is almost exhausted, the roll stand 153 is rotated counterclockwise as on the drawing through and angle of 60 degrees to a final unwinding position in which the running web 102 passes under a swingable guide roll 159. At the same time, of course, the next succeeding roll 101 is carried to the unwinding position. Immediately before the running web 102 has been unwound completely the guide roll 159 is swung towards the leading web end held to the next supporting branch 157, while towards the opposite face of said leading web end is swung a heat sealing element 160 carried by one end of a lever 161, said lever also having a trip dog 162. Upon swinging, the guide roll 159 carries the running web 102 towards the leading end of the web 102 of the roll 101 in unwinding position. In the supporting plane defined by the supporting branch 157 the sealing element 160 and the guide roll 159 meet each other thereby sealing the two webs 102 to each other. A swingable cutting edge 163 is arranged in connection with the swinging movements of the sealing element 160 and the guide roll 159 towards the stationary web 102, to swing towards the anvil plate 156 of the roll stand arm in the unwinding position from the same side of the running web 102 as the guide roll 159 so that the running web 102 through cooperation between the anvil plate 156 and the cutting edge 163 will be severed from its roll 101 and at the same time be heat sealed to the next web to be unwound. Upon swinging towards the web 102 the lever 161 by its trip dog 162 will trip the holder 158 holding the leading end of the new web 102 to the corresponding supporting branch 157 to inactive position.

After the joining of the two webs through heat sealing, the old web will pull the new one through the packaging system.

All operations necessary for effecting the rotation of the roll stand and for joining the two webs may, of course, be controlled and supervised from outside the casing in question.

FIG. 6 illustrates schematically another embodiment of the output end of a web roll casing of the just-mentioned types. As in the previous embodiment the present casing is provided with an output connecting piece 164 which, however, tapers outwardly with regard to at least one cross-dimension thereof and at its free end defines

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a rectangular mouth slot 165 having a sharp mouth edge. When sterilizing the casing together with the contents thereof said output connecting piece is kept covered by an outer cover 166 having a tight seal to the outside of the casing and together with said outside defining a space only partly occupied by the connecting piece 164. For that reason also in this case the sterilization will affect even the outside of the connecting piece in question.

As illustrated by dotted lines in FIG. 6 the input end of the tunnel 107 is modified in relation to that shown in FIG. 4. Thus, it has a funnel-shaped input connecting piece 167 which flares outwardly at least with respect to one cross-dimension thereof to correspond with the just-mentioned output connecting piece 164. During the sterilization of the tunnel 107 said input connecting piece 167 is kept closed at its free end by a diaphragm 168 of a plastic film or the like and possibly also by an outer shutter 169 supporting said diaphragm 168. When connecting the casing and the tunnel to each other, the cover 166 of the casing is removed and the shutter 169 of the tunnel 107 is swung away, whereupon the output connecting piece 164 of the casing is inserted in the input connecting piece 167 of the tunnel 107. On such insertion the sharp mouth edge of the output connecting piece 164 will cut through the diaphragm 168. The sterile air at an overpressure in the tunnel 107 will escape through the space between the inside of the input connecting piece 167 and the outside of the output connecting piece 164 thus preventing the ambient atmosphere from entering in the packaging system. In contradistinction to the aseptic coupling between the casing and the tunnel as illustrated in FIG. 4 the embodiment of FIG. 6 does not require oppositely directed flows of sterile air from the tunnel and the casing, respectively, during the packaging process, but the sterile air supply to the casing may be from the tunnel 107 through the connecting pieces 167 and 164.

To prevent reinfection of the packaging system when connecting the casing and the tunnel to each other it is of course necessary, that the diaphragm 168 has a sterile outside. Such sterility may be realized by wiping the outside of the diaphragm with a highly efficient sterilizing agent or by enclosing an active sterilizing agent between the outside of the diaphragm and the shutter 169 when closing the same.

We claim:

1. Apparatus for producing aseptically filled and sealed packages having sterile contents comprising a first casing having an initially closed inlet thereto through which is fed a supply of container material in the form of at least container blanks, means within said casing for introducing a sterile filling material into containers formed from said material, means for sterilizing the interior of said casing, a second casing having stored therein a pre-sterilized supply of said container material, said second casing being structurally independent of said first casing and including an initially closed outlet therefrom, and means for interconnecting said outlet from said second casing with said inlet to said first casing and establishing an aseptic communication therebetween by which to lead said container material out of said second casing into said first casing.

2. Apparatus for producing aseptically filled and sealed packages having sterile contents comprising a first casing having an entrance tunnel through which a supply of

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container material in web form is fed, means for sterilizing the interior of said casing and entrance tunnel, means within said casing forming said web into tubular form, means within said casing for introducing a sterile filling material into the tube, means thereafter forming said tube with the filling material therein into separate packages, a second casing having stored therein a pre-sterilized supply of said container material in web form, said second casing being structurally independent of said first casing, said tunnel being provided with an initially closed inlet thereto and said second casing being provided with an initially closed outlet therefrom, and means interconnecting said outlet from said second casing with said inlet to said tunnel and establishing an aseptic communication therebetween by which to lead said web out of said second casing into and through said tunnel into said first casing.

3. Apparatus as defined in claim 2 and which further includes means for maintaining an overpressure of sterile air within said first casing and tunnel subsequent to sterilization thereof.

4. Apparatus as defined in claim 2 wherein said second casing is made at least in part from a heat sealable flexible plastic material and a portion of said material constitutes the said initially closed outlet therefrom.

5. Apparatus as defined in claim 2 wherein said initially closed inlet to said tunnel and said initially closed outlet from said second casing are established by puncturable cover members arrangeable in face-to-face contact, and said means for establishing communication between said inlet and outlet includes a knife member in said tunnel and actuatable to puncture said cover members when arranged face-to-face.

6. Apparatus as defined in claim 2 wherein said second casing is constituted by substantially rigid wall structure, the top wall of said casing including an outwardly projecting mouth having a sharp edge and a removable cover member therefor, said mouth and cover member constituting said initially closed outlet from said second casing, and wherein said initially closed inlet to said tunnel is constituted by a puncturable cover member over the end thereof and a funnel shaped connecting piece disposed on the inside of said puncturable cover member and adapted to receive said outwardly projecting mouth on said second casing, said sharp edge of said mouth serving to puncture said cover member as it enters said funnel shaped connecting piece, and said web of material being passed through said mouth and funnel shaped connecting piece.

7. Apparatus as defined in claim 2 wherein said second casing is constituted by substantially rigid wall structure, the top wall of said casing including a plate member having a slot therein closable by a slide member and a removable cover member over said slotted plate member and slide member, said slotted plate member in conjunction with said slide member constituting said initially closed outlet from said second casing, and wherein said initially closed inlet to said tunnel is also constituted by a slotted cover member over the end thereof and a slide cooperative with said slotted cover member for opening and closing the slot therein.

No references cited.