

[54] APPARATUS FOR CONTROLLING THE ATMOSPHERE OF THE STERILE CHAMBER IN AN ASEPTIC PACKAGING MACHINE

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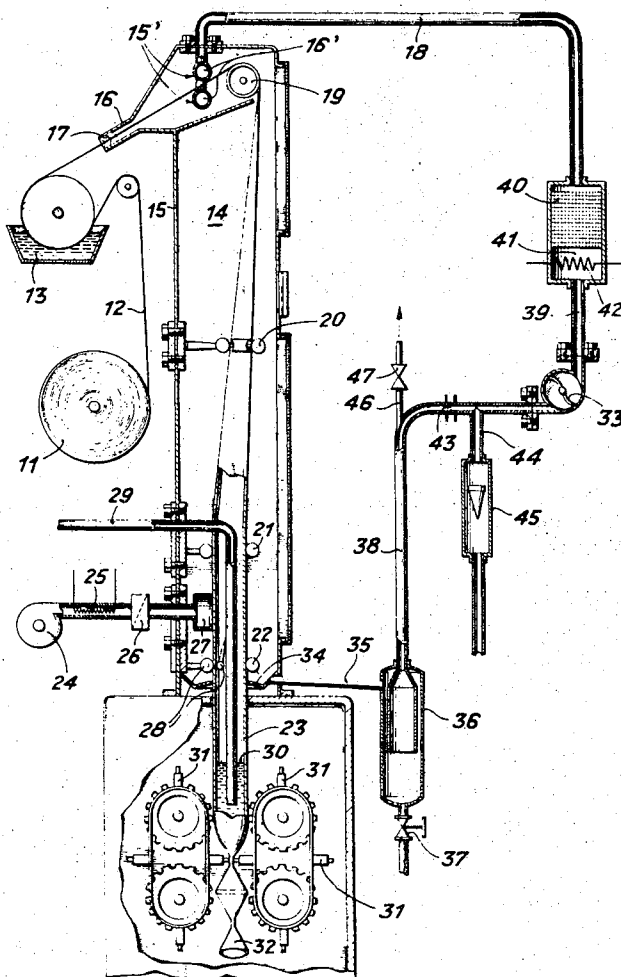
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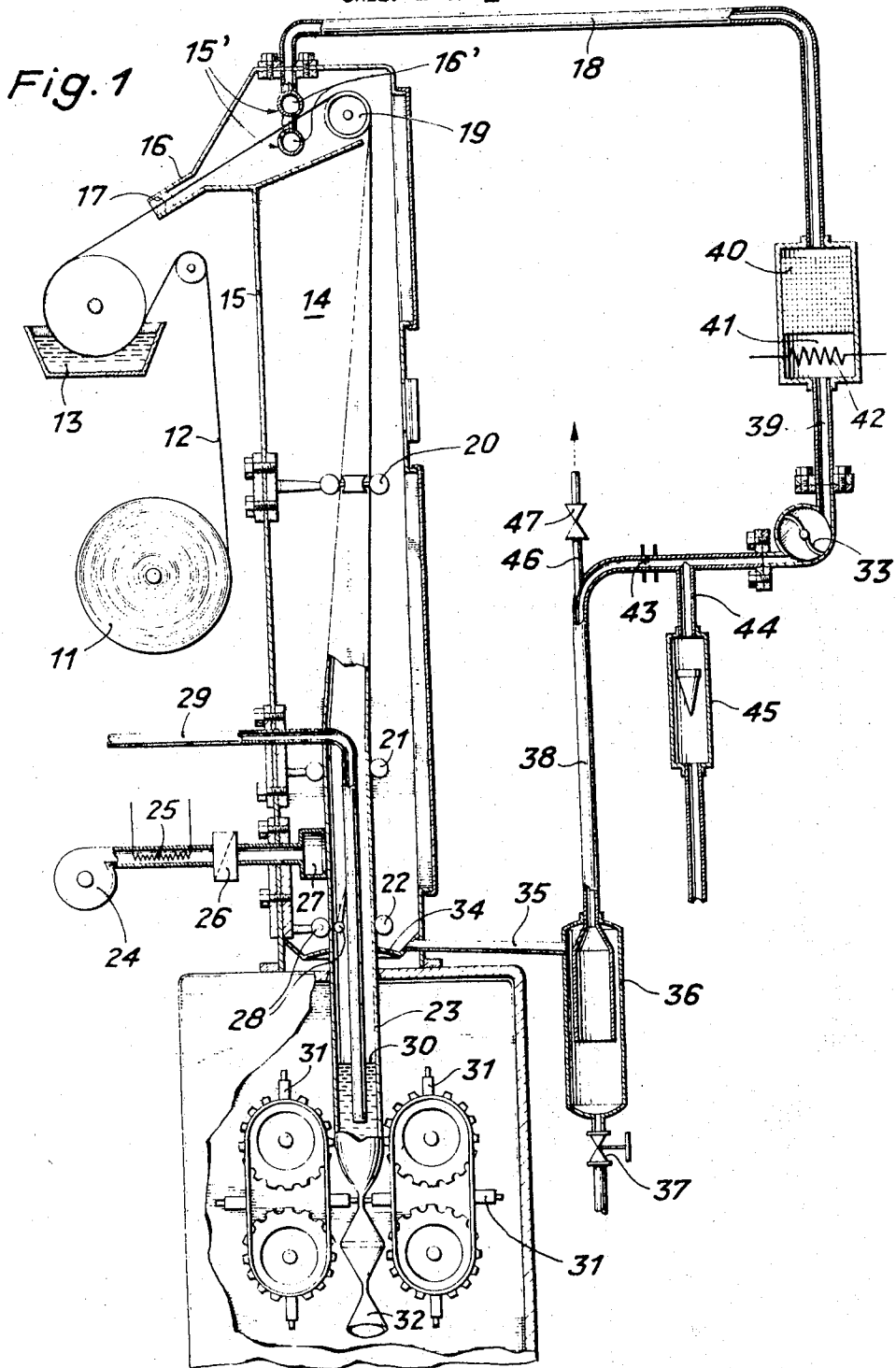
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[57] ABSTRACT

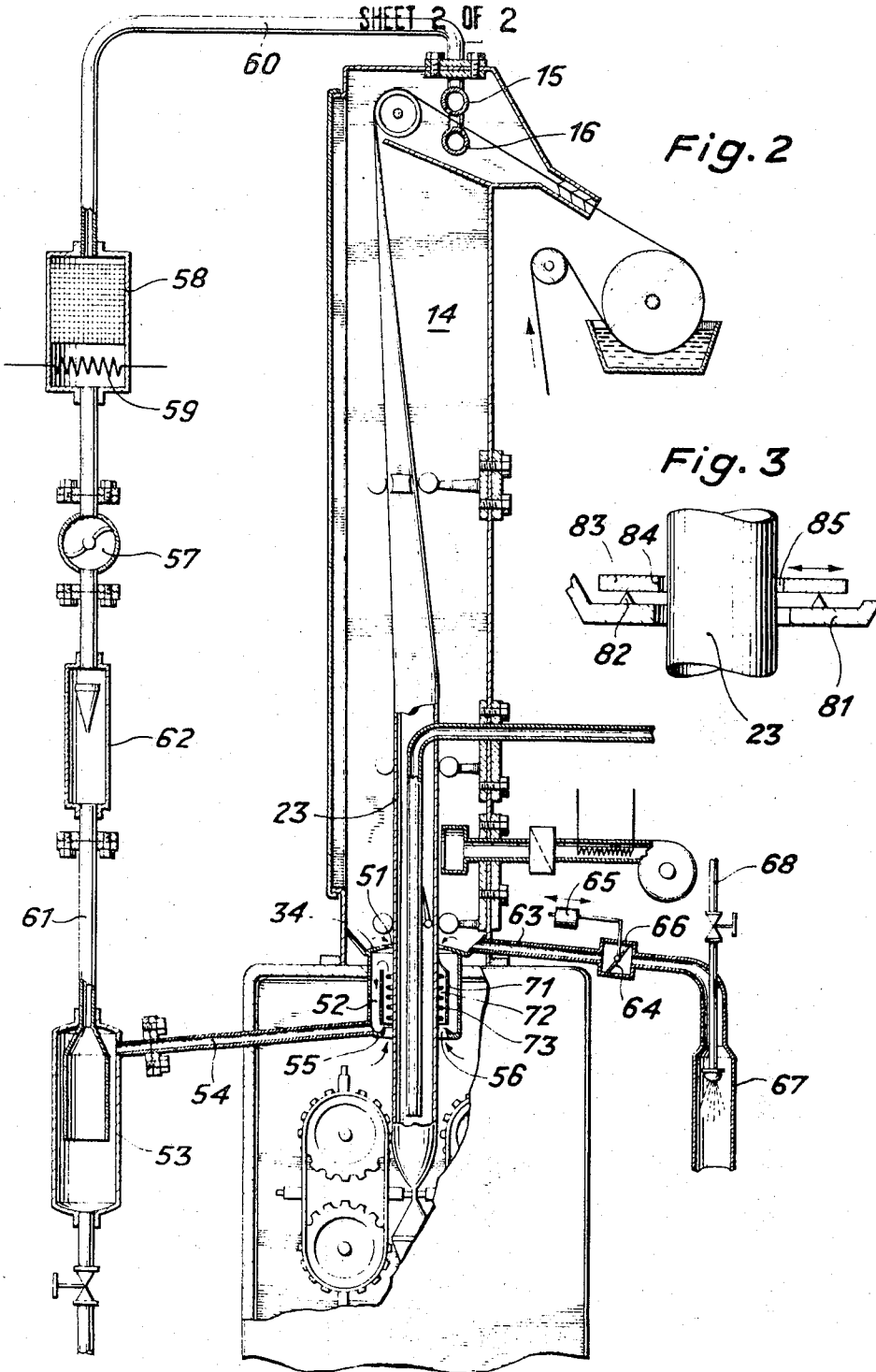
An apparatus for controlling the atmosphere of the sterile chamber in an aseptic packaging machine of the kind in which packaging material in web form is first brought in contact with a chemically acting sterilising liquid and is subsequently led through the interior of a sterile chamber inside which the packaging material is freed from liquid residues, and in which the packaging material is formed into a flexible tube and subdivided into individual, filled packages, in which the interior of the sterile chamber forms part of a flow circuit in which the mixture of chamber air and sterilising agent vapour forming the chamber atmosphere are circulated with the aid of a conveying means, in which further throttle means are provided between the chamber and conveying means for generating above-ambient pressure in the sterile chamber, and in which the circuit has means for limiting the concentration of the chemical sterilising agent in the atmosphere filling the sterile chamber.

13 Claims, 3 Drawing Figures





SHEET 2 OF 2



## APPARATUS FOR CONTROLLING THE ATMOSPHERE OF THE STERILE CHAMBER IN AN ASEPTIC PACKAGING MACHINE

The invention relates to an apparatus for controlling the atmosphere of the sterile chamber in an aseptic packaging machine, of the kind in which packaging material in web form is first brought in contact with a chemically acting sterilising liquid and subsequently led through the interior of a sterile chamber inside which the packaging material is freed from liquid residues, and in which the packaging material is formed into a flexible tube and subdivided into individual, filled packages.

There is a danger in an apparatus of the above type that the sterilisation liquid which is removed from the packaging material in the interior of the sterile chamber may lead to an excessive concentration of the sterilising agent in the chamber atmosphere. As a rule, hydrogen peroxide ( $H_2O_2$ ) is employed as the sterilising agent. Thus, at an excessive concentration there is a danger that condensate formation from a supersaturated atmosphere may allow the chemical sterilising agent to enter the bottom of the packaging tube and hence the individual packs. Further, an excessive concentration can easily lead to explosions. Finally, the danger of corrosion is also very substantially increased if the chamber atmosphere is loaded excessively with the sterilising agent.

It is the aim of the invention to eliminate the described disadvantages. The apparatus according to the invention is characterised in that the interior of the sterile chamber forms part of a flow circuit in which the mixture of chamber air and sterilising agent vapor forming the chamber atmosphere can be circulated with the aid of a conveying means, in that further throttle means are provided between the chamber and conveying means for generating above-ambient pressure in the sterile chamber and in that the circuit has means for limiting the concentration of the chemical sterilising agent in the atmosphere filling the sterile chamber.

A limitation of the concentration of the chemical sterilising agent in the sterile chamber atmosphere in the sense of the invention makes it possible, by limiting the concentration to less than the dew point concentration, to prevent the formation of condensates that may otherwise enter the packages together with the contents to be packaged and have a harmful effect on the contents. Furthermore, explosions can be reliably eliminated and the danger of corrosion avoided.

Suitably, the apparatus may be provided in such a way that a connection with the surrounding air exists between the throttle location and the conveying means by means of which environmental air can be introduced into the circuit as a replacement for the mixture taken from the above-ambient pressure portion of the circuit. By adjusting the ratio of replaced air and amount circulated, it is possible to limit the concentration of the chemical sterilising agent in the atmosphere filling the sterile chamber in simple manner.

Further, the take-off point can be suitably located in the lowermost region of the chamber and at the same time serve for discharging condensed sterilising agent. In a preferred embodiment, with a packaging machine in which the packaging material is formed into a flexible tube inside the sterile chamber, an annular gap serving as throttle means at the exit of the flexible tube

from the sterile chamber between the flexible tube and parts of the sterile chamber bottom. A second chamber surrounding the tube follows this annular gap, from which the circuit line leading to the conveying means branches off. The bottom of the second chamber forms a further annular gap together with the wall of the flexible tube through which the replacement air taken from the surroundings can enter the circuit. An embodiment of this type prevents the entry of organism-laden surrounding air into the interior of the sterile chamber in particularly efficient manner.

In the above described embodiment it is advisable also to subdivide the second chamber by means of a partition spaced away from the tube wall and coaxial with the tube axis, a heater being located in the space between the partition and the tube wall for volatilising liquid sterilising agent on the tube wall during the preliminary sterilisation of the apparatus.

The invention and its further features and advantages will now be described in greater detail by means of the embodiments shown by way of example in the accompanying drawings, in which:

FIG. 1 is a vertical section of a packaging machine in which a continuously fed paper web covered with plastics material is formed into a tube in the interior of a sterile chamber and the tube is subdivided into individual filled packages;

FIG. 2 shows an arrangement corresponding to that of FIG. 1 with an alternative introduction of the replacement air; and

FIG. 3 shows a special construction of the annular gap between the tube wall and the chamber bottom.

In the embodiment according to FIG. 1 a paper web 12 coated on one side with plastics material is continuously withdrawn from a supply roll 11, drawn through a bath 13 filled with sterilising liquid and introduced into a sterile chamber 14. The chamber 14 is formed by the box 15 in whose beak-shaped entrance 16 sealing agents 17 are located which enable a slight above-ambient pressure to be maintained in the chamber 14. The web is led through a blowing device 15' in which heated sterile air from a line 18 is blown on both sides of the web at high speed through slotted pipes 16'. The sterilising liquid still adhering to the web 15 is in this way atomised or volatilised into the chamber atmosphere.

After passing a direction changing roll 19, the web is, with the aid of the forming agents 20, 21 and 22, formed into a flexible tube which is welded together along the sides of the web to form a closed tube. Air for welding is aspirated from the surroundings with the aid of a blower 24, is heated with the aid of a heating spiral 25 and after passing a steriliser 26 is blown into a gap between the two overlapping longitudinal edges with the aid of a hood 27. During this operation the plastics material located on the inside of the tube 23 is heated and contact rolls 28 effect hermetic welding with formation of a longitudinal seam. A filling tube 29 protrudes into the interior of the packaging tube and with its aid the tube 23 is filled approximately to a level 30 with the sterile liquid to be packaged, e.g., pasteurized milk. With the aid of the revolving welding punches 31 the partly filled tube is subdivided into individual filled packages. By using a corresponding welder operating at right angles to the plane of the drawing tetrahedral packages 32 are formed in known manner.

Before starting up the packaging machine the interior of the sterile chamber is subjected to a preliminary sterilisation, for example by spraying a chemically active sterilising liquid combined with the feeding in of heated air through the line 18.

The interior of the chamber 14 forms the component of a circuit in which the mixture of chamber air and sterilising agent vapor forming the chamber atmosphere is circulated with the aid of a conveying means such as a fan 33. For this purpose the bottom 34 of the chamber 14 is dish-shaped and at the lowest point a discharge take-off line 35 branches off and leads to a liquid separator 36. Separated liquid can be discharged periodically by means of a tap 37. The mixture freed from liquid droplets enters the fan 33 through a line 38 and subsequently passes through a line 39 into a filter 40, in whose inlet chamber 41 an electrically heated spiral heater 42 is located. From the filter 40, the conveyed medium returns to the chamber 14 via the line 18, namely into the blowing device 15', 16'.

A throttle means 43 is located in the line 38 to generate a small above-ambient pressure of, for example, 5-mm water head in the chamber 14 while the fan 33 is running. A means for limiting the concentration of the chemical sterilizing agent in the atmosphere filling the sterile chamber includes a line 44 which connects into the line 38 between the throttle means 43 and the fan 33 and through it fresh air from the surroundings can enter the described circuit. A float-type flow meter 45 in the line indicates how much surrounding air is introduced. Further, the limiting means includes a line 46 which branches off from the line 38 before, i.e., upstream of the throttle means 43. This line 46 is provided with an adjustable blow-off valve 47 which allows chamber atmosphere to discharge when a predetermined pressure in the chamber 14 is exceeded. Fresh air from the surroundings enters the circuit through the line 44 to replace the mixture discharged from the circuit. By suitably adjusting the blow-off valve 47, the concentration of the chemical sterilising agent in the atmosphere filling the chamber 14 can be controlled in simple manner. When a 10 to 40 percent solution of hydrogen peroxide is used, it is advisable to maintain a concentration of 25 g per 1,000 g of air in the chamber 14. Such a value on the one hand reliably eliminates the disadvantages described at the outset and on the other hand ensures more certain aseptic operation where a leak allows an organism to penetrate into the interior.

During operation of the described apparatus the temperature of the mixture fed in through the line 18 is suitably 120°C. To reach the preferred concentration of sterilising agent in the chamber atmosphere, a ratio of circulated mixture to introduced replacement air of about 2 : 1 has been found to be suitable.

In the arrangement according to FIG. 2 wherein like reference characters indicate like parts as above the throttling corresponding to the throttle means of FIG. 1 is obtained with a gap 51 between the flexible tube 23 and the open bottom 34 of the chamber 14. The means for limiting the concentration of sterilizing agent in the atmosphere filling the chamber includes a second chamber 52 which surrounds the tube 23 and follows on the annular gap 51 and from it the line 54 leading to the separator 53 branches off. The bottom 55 of the second chamber forms a further annular gap 56 together with the flexible tube wall, through which the

replacement air taken from the surroundings can enter the circuit. The air entering by the gap 56 prevents any mixtures of air and sterilising agent from leaking outside.

In correspondence with FIG. 1 this circuit uses a conveying means in the form of a fan 57 and a filter means 58 with heating coil 59 from which the sterile mixture of air and sterilising agent vapor enters the blowing device 15, 16 via a line 60. An indicating meter 62 is located in a line 61 between the separator 53 and the conveying means 57.

From the lowest point of the bottom 34, a line 63 branches off and is closed with the aid of a valve means such as a weighted flap 64. A weight 65 is adjusted in such a way that at a predetermined pressure, chamber atmosphere is blown off. Non-condensed portions are condensed with the aid of cold water fed into an injection condenser 67, through a line 68.

By a suitable dimensioning of the annular gap 51 in the embodiment according to FIG. 2 a definite concentration of sterilising agent is once more maintained in the atmosphere of the chamber 14. For the preliminary sterilisation, the chamber 52 is subdivided into two annular spaces with the air of a wall 71 coaxial with the axis of the flexible tube, an electrical spiral heater 73 being located in the annular space 72 between wall 71 and tube 23. This heater 73 serves to volatilize the liquid sterilising agent depositing on the walls of the flexible tube during the preliminary sterilizing of the chamber 14. In this way sterilising agent having a corrosive action is prevented from entering the sensitive device for producing the transverse welding seams.

FIG. 3 shows details of a suitable construction for forming the gap between the flexible tube 23 and the bottom of the sterile chamber. Here, cutting edges 82 are coaxial with the axis of the flexible tube 23 on the bottom 81 of the sterile chamber (not shown). On the cutting edges 82 rests a plate 83, whose bore 84 is dimensioned such that an annular gap 85 of predetermined width is formed between the tube and the bore 84. The plate 83 resting on the cutting edges 82 can follow small lateral movements of the tube 23.

The invention is not limited to the described embodiments. In a further embodiment, the concentration of the chemical sterilising agent is limited in the chamber by a chemical substance or composition in the circuit, e.g., metal fillings, which is able to bind or catalytically decompose the sterilising agent or an undesirable component of the same in such a way that no undesired concentration can arise in the chamber.

We claim:

1. In combination with an aseptic packaging machine having a sterile chamber in which a packaging material is formed into a flexible tube; an apparatus for controlling the atmosphere of said sterile chamber comprising

- a flow circuit including said sterile chamber for a flow of a mixture of chamber air and sterilizing agent vapor forming the chamber atmosphere,
- a conveying means in said flow circuit for recirculating the flow,
- throttle means between said chamber and said conveying means for generating an above-ambient pressure in said chamber, and
- means for limiting the concentration of the sterilizing agent in the atmosphere filling said chamber.

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2. The combination as set forth in claim 1 which further comprises a discharge line connected to said chamber at a lower end thereof for discharging condensed sterilizing agent therefrom.

3. The combination as set forth in claim 1 which further comprises a liquid separator connected to said flow circuit between said chamber and said conveying means.

4. The combination as set forth in claim 1 which further comprises means in said flow circuit for sterilizing the flow passing from said conveying means into said sterile chamber.

5. The combination as set forth in claim 1 wherein said means for limiting said concentration includes a line connected to said flow circuit between said throttle means and said conveying means for introducing surrounding air into said flow circuit.

6. The combination as set forth in claim 5 wherein said means for limiting said concentration further includes a line connected to said flow circuit upstream of said throttle means and an adjustable blow-off valve in said line for discharging the chamber atmosphere when a predetermined pressure is exceeded in said chamber.

7. The combination as set forth in claim 5 which further includes a flow meter in said line for indicating the amount of surrounding air introduced into said flow circuit through said line.

8. The combination as set forth in claim 1 wherein said means for limiting said concentration includes a second chamber in said flow circuit downstream of said throttle means for passage of the flexible tube therethrough, said second chamber having an open bottom to define a gap with the flexible tube for introducing surrounding air into said flow circuit.

9. The combination as set forth in claim 8 wherein said throttle means is a gap between an open bottom of said sterile chamber and the flexible tube.

10. The combination as set forth in claim 8 which further includes a flow meter in said flow circuit between said throttle means and said conveying means.

11. In combination with an aseptic packaging machine having a sterile chamber in which a packaging material is formed into a flexible tube; and apparatus for controlling the atmosphere of said sterile chamber comprising

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a flow circuit including said sterile chamber for a flow of a mixture of chamber air and sterilizing agent vapor forming the chamber atmosphere, a fan in said flow circuit for recirculating the flow, throttle means between said chamber and said fan for generating an above-ambient pressure in said chamber,

an adjustable blow-off valve connected to said flow circuit upstream of said throttle means to allow chamber atmosphere to discharge when a predetermined pressure is exceeded in said chamber, and a line connected to said flow circuit between said throttle means and said conveying means for introducing surrounding air into said flow circuit to replace the atmosphere discharged through said blow-off valve.

12. In combination with an aseptic packaging machine having a sterile chamber in which a packaging material is formed into a flexible tube; an apparatus for controlling the atmosphere of said sterile chamber comprising

a flow circuit including said sterile chamber for a flow of a mixture of chamber air and sterilizing agent vapor forming the chamber atmosphere, a conveying means in said flow circuit for recirculating the flow,

throttle means between said chamber and said conveying means for generating an above-ambient pressure in said chamber;

a valve means connected to said sterile chamber for blowing off chamber atmosphere at a predetermined pressure thereof, and

a second chamber in said flow circuit downstream of said throttle means for passage of the flexible tube therethrough, said second chamber having an open bottom to define a gap with the flexible tube for introducing surrounding air into said flow circuit to replace the atmosphere discharged through said valve means.

13. The combination as set forth in claim 12 which further comprises a partition in said second chamber coaxially of the path of the flexible tube for subdividing said second chamber, and a heater within said partition for volatilizing liquid sterilizing agent on the outer surface of the flexible tube.

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