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(54) PACKAGING MACHINE AND PACKAGING METHOD

VERPACKUNGSMASCHINE UND VERPACKUNGSVERFAHREN

MACHINE D'EMBALLAGE ET PROCÉDÉ D'EMBALLAGE

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DescriptionTechnical Field

[0001] The present invention relates to a packaging machine and a packaging method. The packaging machine comprises a gassing zone for exposing packages to a gaseous sterilization agent, an infeed end where the packages are received in the packaging machine, an outfeed end where the packages are output from the packaging machine, and a conveyor for transporting the packages through the gassing zone in a transport direction.

Technical Background

[0002] Within the food industry, beverages and other products are often packed in paper or paperboard based packages. Packages intended for liquid food are often produced from a packaging laminate comprising a core layer of paper or paperboard and an outer, liquid-tight layer of thermoplastic material on at least that side of the core layer which will form the inside of the packages.

[0003] One kind of frequently occurring packages are the so-called carton bottles. In substance, these are composed of a lower part in the form of a sleeve of packaging laminate like the one described above, and an upper part in the form of a plastic top having a neck which is provided with an opening/closing means, such as a screw cap.

[0004] At a known packaging machine, carton bottles which are open in the bottom, i.e. the sleeve end, are produced. Then, the open carton bottles are sterilized at least on the inside in order to extend the shelf-life of the product to be packed in the carton bottles. Depending upon the desired length of shelf-life, and depending upon whether the carton bottles are to be distributed and stored in a refrigerated environment or at room temperature, different levels of sterilization may be selected. After sterilization the carton bottles are further transported to a filling zone for product filling, a sealing zone for sealing of the open bottom and a final folding zone for final folding of the bottom. For the transportation through the packaging machine, the carton bottles are arranged in carriers disposed on a conveyor belt running through the packaging machine. Furthermore, the third pressure maintained inside the third area of the packaging machine is higher than the second pressure maintained inside the second area of the packaging machine.

[0005] In the packaging machine above, chemical gas phase sterilization is used for sterilization of the open carton bottles before filling. The corresponding sterilization apparatus, which apparatus is comprised in the packaging machine, is described in published international application WO2004/054883, which application is hereby incorporated herein by reference. The patent specification discloses how the carton bottles are sterilized in that, disposed upside down on the conveyor belt, they are caused to pass first through a heating zone, then a sterilization zone and finally a venting zone. In the sterilization zone, the carton bottles are subjected to gaseous hydrogen peroxide. In order to prevent the hydrogen peroxide from condensing on the surface of the carton bottles in the sterilization zone, which impedes later removal, the carton bottles are heated up in the heating zone to a temperature above the dew point of the hydrogen peroxide gas. In the venting zone, the carton bottles are subjected to sterile hot air in order to vent off hydrogen peroxide which remains in and on the carton bottles.

[0006] To be able to achieve and maintain a satisfactory sterilization of the carton bottles and a good quality of the packed product, specific conditions of the respective zones of the packaging machine must be maintained. For example, a certain hydrogen peroxide concentration must be maintained inside the sterilization zone and a certain aseptic level must be maintained inside the venting, filling and sealing zones, i.e. until the carton bottles have been sealed. This is a challenge, especially since the known packaging machine is open to allow continuous production of filled carton bottles meaning that a continuous flow of carton bottles is passing through the above described zones. As described more closely in WO2004/054883, in the known packaging machine the heating, sterilization, venting and filling zones are separated from each other by partitionings having openings for the passage of the carton bottles. Further, a higher pressure is maintained in the sterilization zone than in the heating and venting zones to prevent flows from the heating and venting zones into the sterilization zone. Also, a positive pressure is maintained inside the filling zone.

[0007] WO2005/120960 A1 discloses a device for sterilizing containers, the sterilization chamber pressure being less than the filling chamber pressure.

[0008] In order to obtain a satisfactory sterilization of the carton bottles, they must be subjected to a sufficiently high sterilizing gas concentration for a sufficiently long time, i.e. a stable, sufficiently high hydrogen peroxide concentration should be maintained throughout the sterilization zone. Further, to maintain the positive pressure inside the sterilization zone, a very strong inflow into the sterilization zone is required because of the significant outflow through the partitionings separating the sterilization zone from the heating and venting zones, respectively. This will result in large emissions of gaseous hydrogen peroxide from the sterilization zone, which emissions require appropriate handling. Naturally, this will also result in a large consumption of hydrogen peroxide.

Summary

[0009] An object of the present invention is to provide a packaging machine and method which, at least partly, eliminate potential limitations of prior art. The basic concept of the invention is to enclose the gaseous sterilization agent used within a limited area of the packaging machine to enable achievement of a sterilization agent concentration which is sufficiently high for proper package sterilization and at the same time reduce, or even completely eliminate, the emissions of sterilization agent to the packaging machine surroundings as well as lower the sterilization agent consumption.

[0010] The packaging machine and method for achieving the object above are defined in the appended claims and discussed below.

[0011] A packaging machine according to the present invention comprises a gassing zone for exposing packages to a gaseous sterilization agent, an infeed end where the packages are received in the packaging machine, an outfeed end where the packages are output from the packaging machine, and a conveyor for transporting the packages through the gassing zone in a transport direction. The packaging machine is characterized in further comprising means for maintaining a first pressure inside a first area of the packaging machine arranged between the infeed end and the outfeed end and including at least the gassing zone, a second pressure inside a second area of the packaging machine arranged between the infeed end and said first area, adjacent said first area, and a third pressure inside a third area of the packaging machine arranged between said first area and the outfeed end, adjacent said first area. The second and third pressures are higher than the first pressure and a fourth pressure prevailing outside the packaging machine.

[0012] The inventive packaging machine can be open which, as specified above, means that it allows continuous production of filled packages and an even flow of packages passing through the packaging machine. Thus, an open packaging machine is not closed to the surroundings by, for example, solid walls that entirely enclose a space.

[0013] In the gassing zone, the packages should be exposed to a sufficiently high concentration of sterilization agent in order to be properly sterilized. At the infeed end empty, open packages are fed to the packaging machine and at the outfeed end filled, sealed packages are fed out of the packaging machine.

[0014] The pressure differences maintained within the packaging machine make it possible to achieve and preserve certain conditions inside said different areas. As an example, the pressure differences prevent the gaseous sterilization from leaking from the first area into the second and third areas and further to the infeed and outfeed ends of the packaging machine. In turn, this means that leaking of sterilization agent to the surroundings via the infeed and outfeed ends can be prevented, which is advantageous from an environmental and economical perspective. Also, a sufficiently high concentration of sterilization agent can be maintained within the first area, more particularly the gassing zone, of the packaging machine, which renders proper sterilization of the packages possible. Further, since the second and third pressures maintained inside said second and third areas of the packaging machine is higher than a fourth pressure prevailing outside the packaging machine, unclean air from the surroundings can be prevented from entering, through said third area, the packaging machine and jeopardizing the hygiene therein.

[0015] In accordance with one embodiment of the present invention, said means for maintaining said first, second and third pressures in said first, second and third areas, respectively, comprises an arrangement for providing cleaned air to the packaging machine in said second and third areas and a number of outlet devices for gas evacuation arranged inside said first area. Such clean air provision makes it possible to maintain the desired hygienic conditions inside the machine. Further, such gas evacuation from the first area of the packaging machine means that the sterilization agent can be evacuated from the packaging machine in a controlled way and that the sterilization agent leaving the packaging machine can be handled properly. As an example, the outlet devices can be connected to means for degradation of the sterilization agent into harmless elements.

[0016] Said arrangement may comprise a cleaned air supply device connected to said third area of the packaging machine and a duct connecting, indirectly or directly, said third area to said second area of the packaging machine. Such a construction means that one single source can be used to provide clean air to both the second and the third area in that some of the clean air supplied to the third area is guided through the duct to the second area.

[0017] In connection with the construction above, the duct can be used as a return tunnel for the conveyor being endless. This enables a particularly smooth and clever design of the packaging machine. Further, the third pressure maintained inside said third machine area can be higher than the second pressure maintained inside said second machine area, which would promote the guiding of clean air from the third to the second machine area, through the duct.

[0018] As an alternative to said arrangement comprising one single cleaned air supply device and a duct, it can instead comprise two cleaned air supply devices, one connected to said second area of the packaging machine and one connected to said third area of the packaging machine. Since such a construction means that there is a separate source for cleaned air provision for each one said second and third areas, no duct connecting them both is necessary, at least not from an air guiding point of view.

[0019] According to one embodiment of the present invention, the packaging machine comprises, besides for said outlet devices, inlet devices for introducing the gaseous sterilization agent into the gassing zone. The inlet devices are arranged at an upper portion of the gassing zone and the outlet devices are arranged at a lower portion of the packaging

machine to promote, inside the gassing zone, a flow of the gaseous sterilization agent directed, in an unobstructed condition, from said upper portion to said lower portion. By unobstructed condition is meant a condition where no object is "standing in the way" of the flow. This embodiment results in an improved flow control which in turn may reduce the risk of recontamination of the packages.

[0020] The packaging machine may be so constructed that said means for maintaining said first, second and third pressures in said first, second and third areas, respectively, comprises a first device arranged essentially orthogonal to the transport direction at a first boundary between said first and second areas for limiting a first cross section at the same, and a second device arranged essentially orthogonal to the transport direction at a second boundary between said first and third areas for limiting a second cross section at the same. Such a local reduction of the cross section promotes the creation of the above specified pressure relations between the different areas. Further, the first and second devices may comprise a first and a second baffle, respectively, each constructed so as to allow passage of the packages. Such a design enables a particularly mechanically simple and hygienic solution.

[0021] A packaging method according to the present invention comprises receiving, at an infeed end, packages in a packaging machine, transporting the packages through a gassing zone in a transport direction, exposing, in the gassing zone, the packages to a gaseous sterilization agent, and outputting, at an outfeed end, the packages from the packaging machine. The method is characterized in further comprising maintaining a first pressure inside a first area of the packaging machine arranged between the infeed end and the outfeed end and including at least the gassing zone, a second pressure inside a second area of the packaging machine arranged between the infeed end and said first area, adjacent said first area, and a third pressure inside a third area of the packaging machine arranged between said first area and the outfeed end, adjacent said first area. The second and third pressures are higher than the first pressure and the third pressure is higher than a fourth pressure prevailing outside the packaging machine.

[0022] Furthermore, the third pressure maintained inside the third area of the packaging machine is higher than the second pressure maintained inside the second area of the packaging machine.

[0023] The characteristics discussed in connection with the inventive packaging machine are, of course, transferable to the inventive packaging method. Further, these characteristics may naturally be combined in the same embodiment.

Brief Description of the Drawings

[0024]

Fig. 1 is a schematic side view of part of a packaging machine according to a first embodiment of the present invention.

Fig. 2 schematically illustrates a cross section of the packaging machine of fig. 1, taken along the line A-A.

Fig. 3 schematically illustrates a cross section of the packaging machine of figs. 1 and 2, taken along the line B-B in fig 2.

Fig. 4 schematically illustrates a cross section of the packaging machine of figs. 1 and 2, taken along the line C-C in fig 2.

Fig. 5 is a schematic side view of part of a packaging machine according to a second embodiment of the present invention.

Detailed Description

[0025] In the following, the term (adequate, sufficient or the like) sterile is taken to signify that the package, after sterilization, attains a level of sterilization which is designated commercially sterile.

[0026] Figures 1, 2, 3 and 4 illustrate a packaging machine 1 (not illustrated in its entirety) according to a first embodiment of the present invention for producing filled, finished packages in the form of carton bottles of the initially described type. The packaging machine 1 is open and adapted for gas phase sterilization of the carton bottles prior to filling, sealing and folding of the same. To this end, the packaging machine 1 comprises a preheating zone 3, a gassing zone 5, a venting zone 7, a filling zone 9, a sealing zone 11, a final folding zone 13 and a buffer zone 15. Further, the packaging machine 1 has an infeed station 17 at an infeed end 19 and an outfeed station 21 at an outfeed end 23 for infeed of empty carton bottles and outfeed of filled carton bottles, respectively. The infeed and outfeed stations will not be described in detail herein. The boundaries between the zones, and the zones and the stations, have been illustrated with broken lines in the figures. The infeed station 17 and the zones 3-9 are arranged in a row at the end of which the sealing zone 11, the final folding zone 13, the outfeed station 21 and the buffer zone 15 are arranged, as is illustrated in the figures. The buffer zone 15 extends below the final folding zone 13, between the final folding zone and the sealing zone 11 and behind the sealing zone 11 seen in the direction of figure 1. The purpose of, and details around, this arrangement is further described in Swedish copending patent application filed by the applicant on the same date as the present application and titled "Packaging machine and packaging method I" (SE-0900909-3), which application is hereby incorporated herein by reference.

[0027] In figure 1, a section of a side wall S in the area of the preheating, gassing, venting and filling zones 3, 5, 7 and 9, respectively, has been removed for illustrative purposes. Thereby, inter alia, a conveyor 25 for transporting the carton bottles 27 through the various zones of the packaging machine 1 in a transport direction T is revealed, the conveyor itself running through all zones but the final folding zone 13. The reason for this is that the final folding zone, for different reasons, is that one of the zones of the packaging machine that is most prone to contamination, as is further discussed in the above referenced patent application. Thus, allowing the conveyor to instead pass through the buffer zone protects it from contamination. The conveyor 25 is endless and runs in a ring-shaped path within the packaging machine 1. To this end, a duct 29 connecting the infeed station 17 and the sealing zone 11, via the buffer zone 15, is comprised in the packaging machine 1. This duct 29 is used as a return channel for the conveyor 25. After running through the preheating-sealing zones 3-11 and the buffer zone 15 in the transport direction T, the conveyor runs through the buffer zone in a direction R, then back through the buffer zone and the duct 29 in a direction T' which is essentially opposite to the transport direction T and then through the infeed station 17 in a direction R' which is essentially opposite to the direction R. This is shown in figure 2 where a section of an upper wall U of the duct 29 has been removed for illustrative purposes.

[0028] The packaging machine 1 further comprises a supply device 31 for providing sterile air to the packaging machine 1, which supply device comprises a bent duct 31' extending into the packaging machine and separating the sealing zone 11 from the filling zone 9 and the buffer zone 15. The supply device 31 further comprises a sterile filter and a fan (not shown). Air from outside of the packaging machine 1 is drawn through the sterile filter and the bent duct 31' and into the packaging machine 1 in the area of the sealing zone 11. The supply device 31 is described in detail in Swedish copending patent application filed by the applicant on the same date as the present application and titled "Device for cleaned air provision" (SE-0900908-5), which application is hereby incorporated herein by reference.

[0029] As indicated by the name, the carton bottles 27 are fed, with their bottom ends 33 open, to the packaging machine 1 via the infeed station 17 where they are arranged upside-down, with their respective bottom end 33 directed upwards, in carrier means 35 attached to the conveyor 25. Arranged like this, the carton bottles are then moved through the zones 3, 5 and 7 for sterilization.

[0030] In the gassing zone 5, the carton bottles 27 are exposed to gaseous hydrogen peroxide. The hydrogen peroxide is introduced into the gassing zone 5 through inlet devices 37 arranged in an upper portion 39 thereof. A number of outlet devices 41 for evacuation, by suction, of the gaseous hydrogen peroxide are arranged in a lower portion 43 of the packaging machine within the gassing zone 5.

[0031] In order to prevent the hydrogen peroxide from condensing on the surface of the carton bottles in the gassing zone 5, which impedes later removal, the carton bottles are, before entering the gassing zone 5, heated up in the preheating zone 3 to a temperature above the dew point of the hydrogen peroxide gas. To this end, hot filtered air is introduced into the preheating zone 3 through inlet devices (not shown) arranged in an upper portion thereof. Further, a number of outlet devices 41 for air evacuation are arranged in the lower portion 43 of the packaging machine within the preheating zone 3.

[0032] In the venting zone 7, the carton bottles are subjected to hot sterile air in order to vent off hydrogen peroxide which remains in and on the carton bottles after passage through the gassing zone 5. To this end, hot sterile air is introduced into the venting zone 7 through inlet devices (not shown) arranged in an upper portion thereof. Further, a number of outlet devices 41 for air evacuation are arranged in the lower portion 43 of the packaging machine within the venting zone 7.

[0033] After sterilization, the carton bottles are fed, still arranged on the conveyor 25, to the filling zone 9 for filling of the desired product. As is disclosed in Swedish copending patent application filed by the applicant on the same date as the present application and titled "Device and method for maintenance of a gas flow barrier between two interconnected volumes" (SE-0900911-9), which application is hereby incorporated herein by reference, sterile air is introduced into the filling zone 9 through inlet devices (not shown) arranged in an upper portion thereof. Further, a number of outlet devices 41 for air evacuation are arranged in the lower portion 43 of the packaging machine within the filling zone 9. After filling, the carton bottles are fed to the sealing zone 11 for bottom sealing and the final folding zone 13, and thereby the buffer zone 15, for final forming. Finally, the finished, filled carton bottles are output from the packaging machine 1 via the outfeed station 21. After unloading, the conveyor 25 travels back through the duct 29 to the infeed station 17 for loading of new, unfilled carton bottles.

[0034] It should be pointed out that the outlet devices arranged inside the preheating, gassing, venting and filling zones are all of the same type and have therefore been given the same reference numeral, i.e. 41. Further, all details around the different operations are not shown and discussed herein. However, the above described sterilization operation and corresponding equipment is described in more detail in Swedish copending patent application filed by the applicant on the same date as the present application and titled "A device and a method for sterilization of packages" (SE-0900907-7), which application is hereby incorporated herein by reference.

[0035] In order to achieve and maintain satisfactory sterilization of the carton bottles, it is important to control the conditions prevailing in the different zones of the packaging machine 1. For example, it is essential to make sure that the concentration of gaseous sterilization agent inside the gassing zone is sufficiently high. Further, when a carton bottle

has been sterilized by passage through the preheating, gassing and venting zones, it is important to keep at least the inside and a part of the outside of it (as is further discussed in the above referenced copending patent application) in a sterile environment until it has been filled and closed by bottom sealing. Thus, it is essential to secure certain hygienic conditions, not only inside the venting zone, but also inside the filling and sealing zones. Of course, it is also preferable to secure certain hygienic conditions in the preheating zone 3. Achieving these goals is a challenge, especially because of the open nature of the packaging machine.

[0036] In accordance with the present invention, the above goals are attained by maintaining different pressures in different parts of the packaging machine. More particularly, a first pressure P1 is maintained inside a first continuous area A1 of the packaging machine 1, which first area is comprised of the preheating zone 3, the gassing zone 5, the venting zone 7 and the filling zone 9. A second pressure P2 is maintained inside a second area A2 of the packaging machine 1, which second area is adjacent the first area and comprised of the infeed station. Further, a third pressure P3 is maintained inside a third area A3 of the packaging machine 1, which third area is adjacent the first area and comprised of the sealing zone 11. The boundaries between the areas, a first boundary I coinciding with the boundary between the infeed station 17 and the preheating zone 3, and a second boundary II coinciding with the boundary between the filling zone 9 and the sealing zone 11, have been illustrated with square dotted, bold lines in the figures.

[0037] The different pressures are maintained by means comprising the supply device 31 for providing sterile air to the packaging machine, the outlet devices 41 arranged within the first area A1 and the duct 29 connecting the infeed station 17 and the sealing zone 11, via the buffer zone 15. The means for pressure maintenance further comprise a first device 45 in the form of a baffle (illustrated scored in figure 4) arranged orthogonal to the transport direction T at the first boundary I and a second device 47 in the form of a baffle (illustrated scored in figure 3) arranged orthogonal to the transport direction T at the second boundary II. The purpose of the baffles is to limit the respective cross sections locally at the boundaries to promote the maintainance of the desired pressures in the different areas of the packaging machine, which will be further discussed below. As is apparent from the figure, the design of the baffles is adapted to the respective cross section at the first and second boundaries, I and II. The baffle arranged at the first boundary I covers as much of the rectangular cross section as is possible while still allowing passage of the packages through an opening in the same. The baffle arranged at the second boundary covers a lower part of the hour glass shaped cross section, the packages being allowed to pass above the baffle. The purpose of the hour glass shaped cross section at the second boundary is disclosed in detail in Swedish copending patent application filed by the applicant on the same date as the present application and titled "A device and a method for maintaining a gas flow barrier between two volumes of a channel" (SE-0900913-5), which application is hereby incorporated herein by reference. The supply device 31 is connected to the third area A3 and feeds sterile air directly into the same. Some of this air is guided through the buffer zone 15 and the duct 29 for provision of air to the second area A2. This air guiding is promoted by the second pressure P2 being lower than a pressure withing the buffer zone 15, $P_{\text{buffer zone}}$, in turn being lower than the third pressure P3. The outlet devices 41 inside the first area A1 evacuate gaseous hydrogen peroxide and air which is properly taken care of, i.e. the hydrogen peroxide is degraded before being emitted (will not be further described herein).

[0038] The infeed of sterile air by the supply device 31, the total inflow into the first area A1 through the inlet devices within the preheating, gassing, venting and filling zones and the total outflow from the first area A1 through the outlet devices 41 are such that the desired pressures within the different areas of the packaging machine are obtained. Then, the following massflow relationships are fulfilled:

$$\dot{m}_{sd} + \sum \dot{m}_{id} > \sum \dot{m}_{od} \quad \text{and} \quad \sum \dot{m}_{od} > \sum \dot{m}_{id}$$

where sd = supply device, id = inlet devices and od = outlet devices. To fulfill these relationships, $\dot{m}_{sd}$ and $\dot{m}_{od}$ can be adjusted while $\dot{m}_{id}$ is determined by the package sterilization process and thereby essentially fixed in a specific application.

[0039] When the desired pressures are obtained, the second and third pressures, P2 and P3, inside the second and third areas, A2 and A3, respectively, are higher than the first pressure P1 inside the first area A1. Thereby, the hydrogen peroxide becomes trapped within the first area A1, in other words, the hydrogen peroxide is prevented from leaking into the rest of the packaging machine and it can only leave the packaging machine through the forced evacuation. Consequently, emissions of hydrogen peroxide from the packaging machine can be eliminated, the hydrogen peroxide consumption can be kept relatively low and the hydrogen peroxide concentration within the gassing zone can be kept sufficiently high for satisfactory sterilization. Moreover, when the desired pressures have been obtained, the second and third pressures are higher than a fourth pressure P4 prevailing outside the packaging machine. Further, as is further explained in the above referenced patent application titled "Packaging machine and packaging method I" (SE-0900909-3), the final folding zone 13 and the outfeed station 21 are screened off by means of baffles such that the pressures, $P_{\text{final folding zone}}$ and $P_{\text{outfeed station}}$, respectively, prevailing therein becomes lower than the pressure $P_{\text{buffer zone}}$ inside the buffer zone 15, which in turn (as mentioned above) is lower than the pressure P3 inside the third area A3, i.e. the sealing

zone. However, the pressures inside the final folding area and the outfeed station are still higher than the surrounding fourth pressure P4. In all, this means that unclean air from the surroundings is prevented from entering the packaging machine 1 through the infeed and outfeed stations 17 and 21, respectively, which are the only openings towards the surroundings during normal operation of the packaging machine 1. Also, air from inside of the final folding zone 13 and the outfeed station 21 is prevented from entering the rest of the packaging machine, which is beneficial since the hygienic level within the final folding zone and the outfeed station may be lower than in other parts of the packaging machine. Thus, despite of the open nature of the packaging machine, contamination of the inside of it by intake of unclean surrounding air can be prevented by the maintenance of certain pressures within different parts of the machine. Additionally, despite of the fact that an overpressure is maintained in, at least large parts of, the packaging machine, the hydrogen peroxide emissions from the packaging machine can be brought to zero.

[0040] The first pressure P1 maintained inside the first area A1 may be lower or higher than the surrounding pressure P4. The advantages above will be achieved in either case when the above specified pressure proportions are fulfilled, i.e.

$$P_3 = P_{\text{sealing zone}} > P_{\text{buffer zone}} > P_2, \text{ and}$$

$$P_2, P_3 > P_1, P_4, \text{ and}$$

$$P_{\text{buffer zone}} > P_{\text{final folding zone}}, P_{\text{outfeed station}} > P_4.$$

[0041] Figure 5 illustrate a packaging machine (not illustrated in its entirety) according to a second embodiment of the present invention. For the most part, the above description of the packaging machine according to the first embodiment of the present invention is valid also for the second invention. Therefore, in the following, mainly differing features of the second embodiment will be described.

[0042] The difference between the first and the second embodiment lies within the procedure and equipment for providing cleaned air to the packaging machine in the second and third areas thereof, to achieve and maintain the desired pressure conditions. In the above described first embodiment, the duct 29 is used, not only as a return channel for the conveyor 25, but also for guiding cleaned air introduced in the third area to the second area of the packaging machine. Hence, only one air supply device 31 is necessary. Also in the second embodiment, the duct (not illustrated in figure 5), which is similar to the above described duct 29, is used as a return channel for the conveyor 25. However, it is not intended for guiding cleaned air between different areas of the packaging machine 1. Instead, the packaging machine 1 according to the second embodiment of the invention comprises two air supply devices 31 of the previously described kind. One of them is connected to the second area A2 and feeds sterile air directly into the same. The other one is connected to the third area A3 and feeds sterile air directly into the same.

[0043] By the second embodiment of the present invention, a first pressure P1 is maintained inside the first area A1 which is lower than a respective second and third pressure P2 and P3 maintained inside the second and third areas A2 and A3. Further, the second and third pressures are higher than a pressure P4 prevailing outside the packaging machine. Additionally, the third pressure P3 is higher than the pressures maintained inside the buffer zone, final folding zone and outfeed station, which, in turn, are higher than P4. So far, the desired pressure proportions are the same as those specified for the initially described first embodiment of the invention. However, in the second embodiment, unlike in the first embodiment as previously described, there is no particular gain, in this connection, in making sure that the third pressure inside the third area and the pressure inside the buffer zone are higher than the second pressure inside the second area. Therefore, in all this means that the pressure proportions that need to be fulfilled in connection with the second embodiment of the present invention to achieve the previously mentioned advantages are:

$$P_2, P_3 > P_1, P_4, \text{ and}$$

$$P_3 = P_{\text{sealing zone}} > P_{\text{buffer zone}} > P_{\text{final folding zone}}, P_{\text{outfeed station}} > P_4.$$

[0044] It should be stressed that the different pressures, in both of the exemplary embodiments, need not be constants but may vary. As an example, the pressure P1 inside the first area of the packaging machine 1 may differ between different parts of the first area.

[0045] The above described embodiments should only be seen as examples. A person skilled in the art realizes that these embodiments can be modified and varied in a number of ways without deviating from the inventive conception.

[0046] As an example, the positions of the boundaries between said areas of the packaging machine are dependent upon the particular prevailing circumstances. Thus, these positions may vary as a function of a number of different parameters, such as, for example, the sterile air infeed rate, the inflow rates at the inlet devices, the outflow rates at the outlet devices and the physical design, e.g. the baffle positions, of the packaging machine. Thus, as an example, in

accordance with an alternative embodiment, the boundary between the first and second areas, A1 and A2, could coincide with the boundary between the gassing and preheating zones, 5 and 3. Similarly, the boundary between the first and third areas, A1 and A3, could coincide with the boundary between the gassing and venting zones, 5 and 7.

[0047] Further, in the above described embodiments, the air supply devices are arranged to provide sterile air to the packaging machine. However, depending on the specific application, the air to be provided to the packaging machine can have different degrees of purity.

[0048] Additionally, in the above described second embodiment, two similar air supply devices are used for the air provision to the second and third areas of the packaging machine. Naturally, two supply devices of different kinds could instead be used, especially if there are different demands on the purity level of the air to be provided to the different areas.

[0049] Further, in the above described first embodiment, the duct 29 is used both as a return channel for the conveyor and for guiding air from the third to the second area of the packaging machine. Of course, according to an alternative embodiment, the packaging machine could instead comprise two separate ducts, one serving as a conveyor return channel and one serving as an air guide.

[0050] Finally, the inventive packaging machine may of course be used for producing other packages than carton bottles.

[0051] The gassing zone may utilize a wet sterilization, where sterilization agent is deliberately condensated onto surfaces of the packages, after which the condensated sterilization agent is evaporated. For this purpose the venting zone may comprise or be preceded by a zone comprising heating means for acceleration of the evaporation.

[0052] For the sake of simplicity, the carton bottles, irrespective of which operations that have been performed on them, have been depicted in the same, most simple way throughout the figures.

[0053] It should be stressed that components not necessary for describing the present invention has been omitted, both in the figures and in the text, and that the figures are not drawn according to scale. Further, the figures have been simplified to a high extent (irrelevant elements have, inter alia, been omitted).

Claims

1. A packaging machine (1) comprising
a gassing zone (5) for exposing packages (27) to a gaseous sterilization agent,
an infeed end (19) where the packages are received in the packaging machine,
an outfeed end (23) where the packages are output from the packaging machine, and
a conveyor (25) for transporting the packages through the gassing zone in a transport direction (T),
the machine further comprising means for maintaining a first pressure (P1) inside a first area (A1) of the packaging machine arranged between the infeed end and the outfeed end and including at least the gassing zone, a second pressure (P2) inside a second area (A2) of the packaging machine arranged between the infeed end and said first area, adjacent said first area, and a third pressure (P3) inside a third area (A3) of the packaging machine arranged between said first area and the outfeed end, adjacent said first area, the second and third pressures (P2, P3) being higher than the first pressure (P1) and higher than a fourth pressure (P4) prevailing outside the packaging machine, and wherein the third pressure (P3) maintained inside said third area (A3) of the packaging machine is higher than the second pressure (P2) maintained inside said second area (A2) of the packaging machine.
2. A packaging machine (1) according to claim 1, wherein said means for maintaining said first, second and third pressures (P1, P2 P3) in said first, second and third areas (A1, A2, A3), respectively, comprises an arrangement for providing cleaned air to the packaging machine in said second and third areas and a number of outlet devices (41) for gas evacuation arranged inside said first area.
3. A packaging machine (1) according to claim 2, wherein said arrangement comprises a cleaned air supply device (31) connected to said third area (A3) of the packaging machine and a duct (29) connecting said third area to said second area (A2) of the packaging machine.
4. A packaging machine (1) according to claim 3, wherein the conveyor (25) is endless and the duct (29) is used as a return tunnel for the same.
5. A packaging machine (1) according to claim 2, wherein said arrangement comprises two cleaned air supply devices (31), one connected to said second area (A2) of the packaging machine and one connected to said third area (A3) of the packaging machine.
6. A packaging machine (1) according to anyone of claims 1-5, further comprising inlet devices (37) for introducing the

gaseous sterilization agent into the gassing zone (5), the inlet devices being arranged at an upper portion (39) of the gassing zone and the outlet devices (41) being arranged at a lower portion (43) of the packaging machine.

7. A packaging machine (1) according to any one of the preceding claims, wherein said means for maintaining said first, second and third pressures (P1, P2, P3) in said first, second and third areas (A1, A2, A3), respectively, comprises a first device (45) arranged essentially orthogonal to the transport direction (T) at a first boundary (I) between said first and second areas for limiting a first cross section at the same, and a second device (47) arranged essentially orthogonal to the transport direction at a second boundary (II) between said first and third areas for limiting a second cross section at the same.
8. A packaging machine (1) according to claim 7, wherein the first and second devices (45, 47) comprise a first and a second baffle, respectively, each constructed so as to allow passage of the packages (27).
9. A packaging method comprising receiving, at an infeed end (19), packages (27) in a packaging machine (1), transporting the packages through a gassing zone (5) in a transport direction (T), exposing, in the gassing zone, the packages to a gaseous sterilization agent, and outputting, at an outfeed end (23), the packages from the packaging machine, the method further comprising maintaining a first pressure (P1) inside a first area (A1) of the packaging machine arranged between the infeed end and the outfeed end and including at least the gassing zone, maintaining a second pressure (P2) inside a second area (A2) of the packaging machine arranged between the infeed end and said first area, adjacent said first area, and maintaining a third pressure (P3) inside a third area (A3) of the packaging machine arranged between said first area and the outfeed end, adjacent said first area, the second and third pressures (P2, P3) being higher than the first pressure (P1) and higher than a fourth pressure (P4) prevailing outside the packaging machine, and the third pressure (P3) further being higher than the second pressure (P2).
10. A packaging method according to claim 9, wherein maintaining said first, second and third pressures (P1, P2, P3) in said first, second and third areas (A1, A2, A3), respectively, comprises providing cleaned air to the packaging machine (1) in said second and third areas and evacuating gas from the packaging machine in said first area.
11. A packaging method according to claim 10, comprising receiving the cleaned air in said third area (A3) of the packaging machine (1) before passing some of it to said second area (A2) of the packaging machine through a duct (29) connecting said second and third areas.
12. A packaging method according to claim 11, comprising using the duct (29) as a return tunnel for the conveyor (25), which is endless.
13. A packaging method according to claim 10, comprising receiving the cleaned air directly in both said second and said third areas (A2, A3) of the packaging machine (1).
14. A packaging method according to any one of claims 10-13, comprising introducing the gaseous sterilization agent in an upper portion (39) of the gassing zone (5) and evacuating the gas from the packaging machine (1) at a lower portion (43) thereof.
15. A packaging method according to any one of claims 9-14, wherein maintaining said first, second and third pressures (P1, P2, P3) in said first, second and third areas (A1, A2, A3), respectively, comprises limiting, essentially orthogonally to the transport direction (T), a first cross section at a first boundary between said first and second areas, and a second cross section at a second boundary between said first and third areas.

Patentansprüche

1. Verpackungsmaschine (1), umfassend:

eine Begasungszone (5) zum Aussetzen der Verpackungen (27) einem gasförmigen Sterilisationsmittel, ein Eintrittsende (19), an dem die Verpackungen in der Verpackungsmaschine aufgenommen werden, ein Austrittsende (23), an dem die Verpackungen von der Verpackungsmaschine ausgegeben werden, und einen Förderer (25) zum Transportieren der Verpackungen durch die Begasungszone in einer Transportrichtung (T),

wobei die Maschine ferner umfasst:

Mittel zum Beibehalten eines ersten Drucks (P1) innerhalb eines ersten Bereichs (A1) der Verpackungsmaschine, die zwischen dem Eintrittsende und dem Austrittsende angeordnet ist und mindestens die Begasungszone aufweist, eines zweiten Drucks (P2) innerhalb eines zweiten Bereichs (A2) der Verpackungsmaschine, der zwischen dem Eintrittsende und dem ersten Bereich benachbart des ersten Bereichs angeordnet ist, und eines dritten Drucks (P3) innerhalb eines dritten Bereichs (A3) der Verpackungsmaschine, der zwischen dem ersten Bereich und dem Austrittsende benachbart des ersten Bereichs angeordnet ist, wobei der zweite und der dritte Druck (P2, P3) höher als der erste Druck (P1) und höher als ein vierter Druck (P4) sind, der außerhalb der Verpackungsmaschine vorherrscht, und wobei der dritte Druck (P3), der innerhalb des dritten Bereichs (A3) der Verpackungsmaschine gehalten wird, höher als der zweite Druck (P2) ist, der innerhalb des zweiten Bereichs (A2) der Verpackungsmaschine gehalten wird.

2. Verpackungsmaschine (1) nach Anspruch 1, wobei die Mittel zum Halten des ersten, zweiten und dritten Drücke (P1, P2 P3) im ersten, zweiten und dritten Bereich (A1, A2, A3) jeweils eine Anordnung zum Bereitstellen von gereinigter Luft an die Verpackungsmaschine in dem zweiten und dritten Bereich und einer Anzahl von Auslassvorrichtungen (41), die zur Gasevakuierung innerhalb des ersten Bereichs angeordnet sind, umfassen.

3. Verpackungsmaschine (1) nach Anspruch 2, wobei die Anordnung eine Versorgungsvorrichtung (31) für gereinigte Luft umfasst, die mit dem dritten Bereich (A3) der Verpackungsmaschine und einem Kanal (29) verbunden ist, der den dritten Bereich mit dem zweiten Bereich (A2) der Verpackungsmaschine verbindet.

4. Verpackungsmaschine (1) nach Anspruch 3, wobei der Förderer (25) endlos ist und der Kanal (29) als ein Rückleitungstunnel verwendet wird.

5. Verpackungsmaschine (1) nach Anspruch 2, wobei die Anordnung Versorgungsvorrichtungen (31) für gereinigte Luft umfasst, die mit dem zweiten Bereich (A2) der Verpackungsmaschine verbunden sind, wobei eine mit dem dritten Bereich (A3) der Verpackungsmaschine verbunden ist.

6. Verpackungsmaschine (1)) nach einem der Ansprüche 1-5, ferner umfassend Einlassvorrichtungen (37) zum Einleiten des gasförmigen Sterilisationsmittels in die Begasungszone (5), wobei die Einlassvorrichtungen an einem oberen Abschnitt (39) der Begasungszone angeordnet sind und die Auslassvorrichtungen (41) an einem unteren Abschnitt (43) der Verpackungsmaschine angeordnet sind.

7. Verpackungsmaschine (1) nach einem der vorhergehenden Ansprüche, wobei die Mittel zum Halten des ersten, zweiten und dritten Drucks (P1, P2 P3) im ersten, zweiten und dritten Bereich (A1, A2, A3) jeweils eine erste Vorrichtung (45) umfassen, die im Wesentlichen orthogonal zur Transportrichtung (T) an einer ersten Grenzschicht (I) zwischen dem ersten und dem zweiten Bereich zum Eingrenzen eines ersten Querschnitts daran angeordnet ist, und eine zweite Vorrichtung (47), die im Wesentlichen orthogonal zur Transportrichtung an einer zweiten Grenzschicht (II) zwischen dem ersten und dritten Bereich zum Eingrenzen eines zweiten Querschnitts daran angeordnet ist.

8. Verpackungsmaschine (1)) nach Anspruch 7, wobei die ersten und zweiten Vorrichtungen (45, 47) eine erste und eine zweite Ablenkplatte umfassen, die jeweils so gebaut sind, um den Durchgang von Verpackungen (27) zuzulassen.

9. Verpackungsverfahren, umfassend das Aufnehmen, an einem Eintrittsende (19), von Verpackungen (27) in einer Verpackungsmaschine (1), welche die Verpackungen durch eine Begasungszone (5) in einer Transportrichtung (T) transportiert und die Verpackungen in der Begasungszone einem gasförmigen Sterilisationsmittel aussetzt und an einem Austrittsende (23) die Verpackungen aus der Verpackungsmaschine ausgibt, wobei das Verfahren ferner das Beibehalten eines ersten Drucks (P1) innerhalb eines ersten Bereichs (A1) der Verpackungsmaschine, die zwischen dem Eintrittsende und dem Austrittsende angeordnet ist, und mindestens die Begasungszone aufweist, das Beibehalten eines zweiten Drucks (P2) innerhalb eines zweiten Bereichs (A2) der Verpackungsmaschine, der zwischen dem Eintrittsende und dem ersten Bereich benachbart des ersten Bereichs angeordnet ist, und das Beibehalten eines dritten Drucks (P3) innerhalb eines dritten Bereichs (A3) der Verpackungsmaschine, der zwischen dem ersten Bereich und dem Austrittsende benachbart des ersten Bereichs angeordnet ist, umfasst, wobei der zweite und der dritte Druck (P2, P3) höher als der erste Druck (P1) sind und höher als ein vierter Druck (P4), der außerhalb der Verpackungsmaschine vorherrscht, und wobei der dritte Druck (P3)

höher als der zweite Druck (P2) ist.

10. Verpackungsverfahren nach Anspruch 9, wobei das Beibehalten des ersten, zweiten und dritten Drucks (P1, P2 P3) im ersten, zweiten und dritten Bereich (A1, A2, A3) jeweils das Bereitstellen von gereinigter Luft an die Verpackungsmaschine (1) in dem zweiten und dritten Bereich und das Evakuieren von Gas aus der Verpackungsmaschine in den ersten Bereich umfasst.
11. Verpackungsverfahren nach Anspruch 10, umfassend das Aufnehmen von gereinigter Luft in den dritten Bereich (A3) der Verpackungsmaschine (1) vor dem Weiterleiten einiger davon zum zweiten Bereich (A2) der Verpackungsmaschine durch einen Kanal (29), der den zweiten und dritten Bereich verbindet.
12. Verpackungsverfahren nach Anspruch 11, umfassend das Verwenden des Kanals (29) als Rückleitungstunnel für den Förderer (25), der endlos ist.
13. Verpackungsverfahren nach Anspruch 10, umfassend das Aufnehmen von gereinigter Luft direkt sowohl in den zweiten als auch dritten Bereich (A2, A3) der Verpackungsmaschine (1).
14. Verpackungsverfahren nach einem der Ansprüche 10-13, umfassend das Einleiten von gasförmigem Sterilisationsmittel in einen oberen Abschnitt (39) der Entgasungszone (5) und Evakuieren des Gases aus der Verpackungsmaschine (1) an einen unteren Abschnitt (43) davon.
15. Verpackungsverfahren nach einem der Ansprüche 9-14, wobei das Beibehalten des ersten, zweiten und dritten Drucks (P1, P2, P3) in dem ersten, zweiten und dritten Bereich (A1, A2, A3) jeweils das Eingrenzen, im Wesentlichen orthogonal zur Transportrichtung (T), eines ersten Querschnitts an einer ersten Grenzschicht zwischen dem ersten und zweiten Bereich und eines zweiten Querschnitts an einer zweiten Grenzschicht zwischen dem ersten und dritten Bereich umfasst.

Revendications

1. Machine d'emballage (1) comprenant
 - une zone de traitement au gaz (5) servant à exposer des emballages (27) à un agent de stérilisation gazeux,
 - une extrémité d'entrée (19) au niveau de laquelle les emballages sont reçus dans la machine d'emballage,
 - une extrémité de sortie (23) au niveau de laquelle les emballages sortent de la machine d'emballage,
 - et
 - un dispositif de transport (25) servant à transporter les emballages à travers la zone de traitement au gaz dans une direction de transport (T),
 - la machine comprenant en outre
 - des moyens permettant de maintenir une première pression (P1) à l'intérieur d'une première région (A1) de la machine d'emballage située entre l'extrémité d'entrée et l'extrémité de sortie et comprenant au moins la zone de traitement au gaz, une deuxième pression (P2) à l'intérieur d'une deuxième région (A2) de la machine d'emballage située entre l'extrémité d'entrée et ladite première région, en position adjacente à ladite première région, et une troisième pression (P3) à l'intérieur d'une troisième région (A3) de la machine d'emballage située entre ladite première région et l'extrémité de sortie, en position adjacente à ladite première région, les deuxième et troisième pressions (P2, P3) étant supérieures à la première pression (P1) et supérieures à une quatrième pression (P4) régnant à l'extérieur de la machine d'emballage, et dans laquelle la troisième pression (P3) maintenue à l'intérieur de ladite troisième région (A3) de la machine d'emballage est supérieure à la deuxième pression (P2) maintenue à l'intérieur de ladite deuxième région (A2) de la machine d'emballage.
2. Machine d'emballage (1) selon la revendication 1, dans laquelle lesdits moyens permettant de maintenir lesdites première, deuxième et troisième pressions (P1, P2, P3) dans lesdites première, deuxième et troisième régions (A1, A2, A3), respectivement, comprennent un système servant à fournir de l'air purifié à la machine d'emballage dans lesdites deuxième et troisième régions et un certain nombre de dispositifs de sortie (41) servant à l'évacuation du gaz, disposés à l'intérieur de ladite première région.
3. Machine d'emballage (1) selon la revendication 2, dans laquelle ledit système comprend un dispositif d'alimentation en air purifié (31) raccordé à ladite troisième région (A3) de la machine d'emballage et un conduit (29) raccordant ladite troisième région à ladite deuxième région (A2) de la machine d'emballage.

4. Machine d'emballage (1) selon la revendication 3, dans laquelle le dispositif de transport (25) est sans fin et le conduit (29) est utilisé en tant que tunnel de retour pour celui-ci.
5. Machine d'emballage (1) selon la revendication 2, dans laquelle ledit système comprend deux dispositifs d'alimentation en air purifié (31), un raccordé à ladite deuxième région (A2) de la machine d'emballage et un raccordé à ladite troisième région (A3) de la machine d'emballage.
6. Machine d'emballage (1) selon l'une quelconque des revendications 1 à 5, comprenant en outre des dispositifs d'entrée (37) servant à introduire l'agent de stérilisation gazeux dans la zone de traitement au gaz (5), les dispositifs d'entrée étant disposés au niveau d'une partie supérieure (39) de la zone de traitement au gaz et les dispositifs de sortie (41) étant disposés au niveau d'une partie inférieure (43) de la machine d'emballage.
7. Machine d'emballage (1) selon l'une quelconque des revendications précédentes, dans laquelle lesdits moyens permettant de maintenir lesdites première, deuxième et troisième pressions (P1, P2, P3) dans lesdites première, deuxième et troisième régions (A1, A2, A3), respectivement, comprennent un premier dispositif (45) disposé de façon essentiellement perpendiculaire à la direction de transport (T) au niveau d'une première limite (I) entre lesdites première et deuxième régions afin de délimiter une première section transversale au niveau de celle-ci, et un second dispositif (47) disposé de façon essentiellement perpendiculaire à la direction de transport au niveau d'une seconde limite (II) entre lesdites première et troisième régions afin de délimiter une seconde section transversale au niveau de celle-ci.
8. Machine d'emballage (1) selon la revendication 7, dans laquelle les premier et second dispositifs (45, 47) comprennent des premier et second déflecteurs, respectivement, chacun construits de façon à permettre le passage des emballages (27).
9. Procédé d'emballage comprenant la réception, au niveau d'une extrémité d'entrée (19), d'emballages (27) dans une machine d'emballage (1), le transport des emballages à travers une zone de traitement au gaz (5) dans une direction de transport (T), l'exposition des emballages, dans la zone de traitement au gaz, à un agent de stérilisation gazeux, et la sortie, au niveau d'une extrémité de sortie (23), des emballages de la machine d'emballage, le procédé comprenant en outre le maintien d'une première pression (P1) à l'intérieur d'une première région (A1) de la machine d'emballage située entre l'extrémité d'entrée et l'extrémité de sortie et comprenant au moins la zone de traitement au gaz, le maintien d'une deuxième pression (P2) à l'intérieur d'une deuxième région (A2) de la machine d'emballage située entre l'extrémité d'entrée et ladite première région, en position adjacente à ladite première région, et le maintien d'une troisième pression (P3) à l'intérieur d'une troisième région (A3) de la machine d'emballage située entre ladite première région et l'extrémité de sortie, en position adjacente à ladite première région, les deuxième et troisième pressions (P2, P3) étant supérieures à la première pression (P1) et supérieures à une quatrième pression (P4) régnant à l'extérieur de la machine d'emballage, et la troisième pression (P3) étant en outre supérieure à la deuxième pression (P2).
10. Procédé d'emballage selon la revendication 9, dans lequel le maintien desdites première, deuxième et troisième pressions (P1, P2, P3) dans lesdites première, deuxième et troisième régions (A1, A2, A3), respectivement, comprend la fourniture d'air purifié à la machine d'emballage (1) dans lesdites deuxième et troisième régions et l'évacuation du gaz de la machine d'emballage dans ladite première région.
11. Procédé d'emballage selon la revendication 10, comprenant la réception de l'air purifié dans ladite troisième région (A3) de la machine d'emballage (1) avant le transfert d'une partie de celui-ci à ladite deuxième région (A2) de la machine d'emballage par le biais d'un conduit (29) raccordant lesdites deuxième et troisième régions.
12. Procédé d'emballage selon la revendication 11, comprenant l'utilisation du conduit (29) en tant que tunnel de retour pour le dispositif de transport (25), qui est sans fin.
13. Procédé d'emballage selon la revendication 10, comprenant la réception de l'air purifié directement dans lesdites deuxième et troisième régions (A2, A3) de la machine d'emballage (1).
14. Procédé d'emballage selon l'une quelconque des revendications 10 à 13, comprenant l'introduction de l'agent de stérilisation gazeux dans une partie supérieure (39) de la zone de traitement au gaz (5) et l'évacuation du gaz de la machine d'emballage (1) au niveau d'une partie inférieure (43) de celle-ci.

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15. Procédé d'emballage selon l'une quelconque des revendications 9 à 14, dans lequel le maintien desdites première, deuxième et troisième pressions (P1, P2, P3) dans lesdites première, deuxième et troisième régions (A1, A2, A3), respectivement, comprend la délimitation, essentiellement perpendiculairement à la direction de transport (T), d'une première section transversale au niveau d'une première limite entre lesdites première et deuxième régions, et d'une seconde section transversale au niveau d'une seconde limite entre lesdites première et troisième régions.

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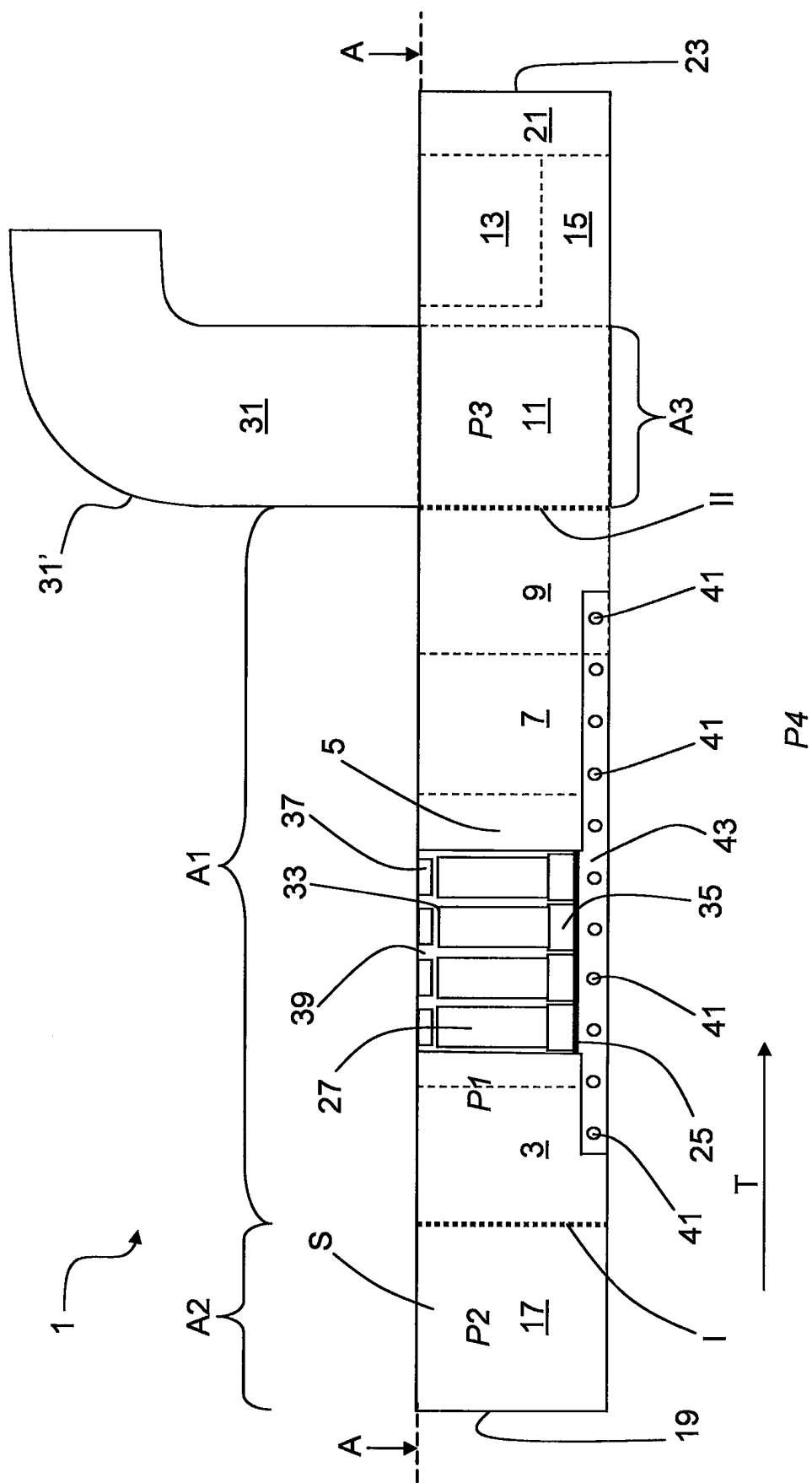
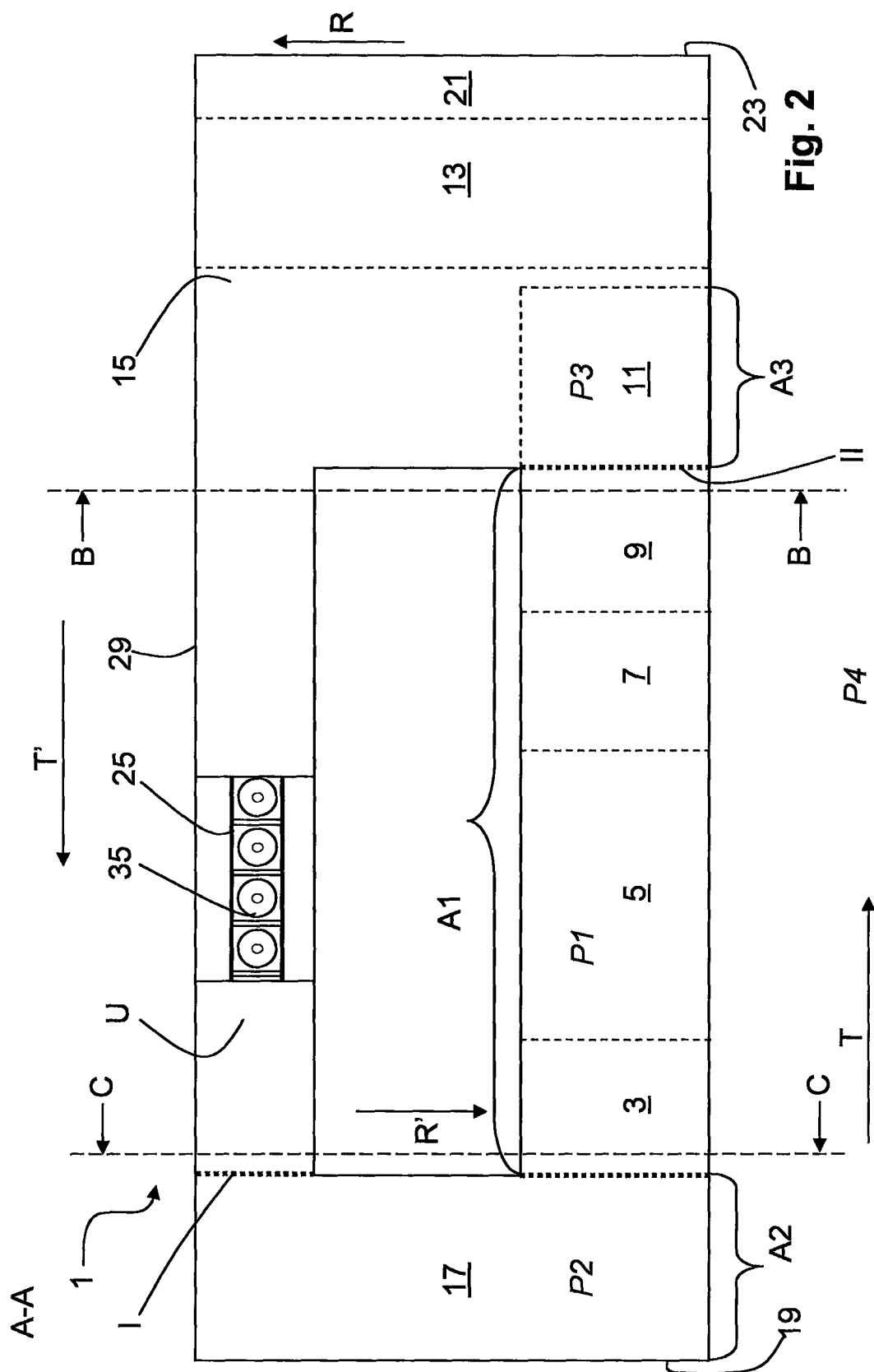


Fig. 1



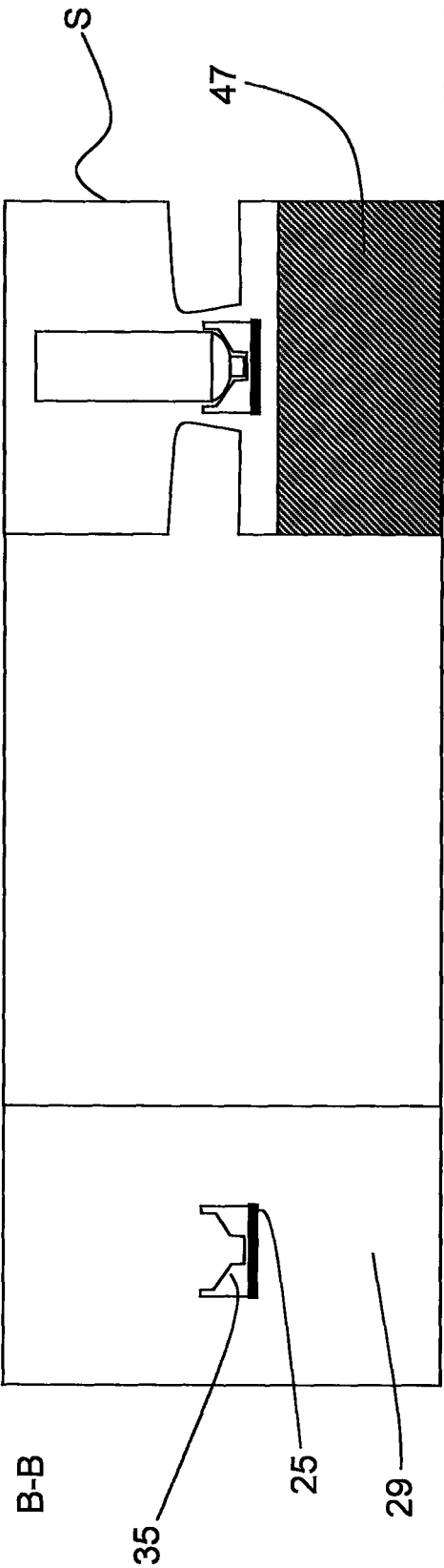


Fig. 3

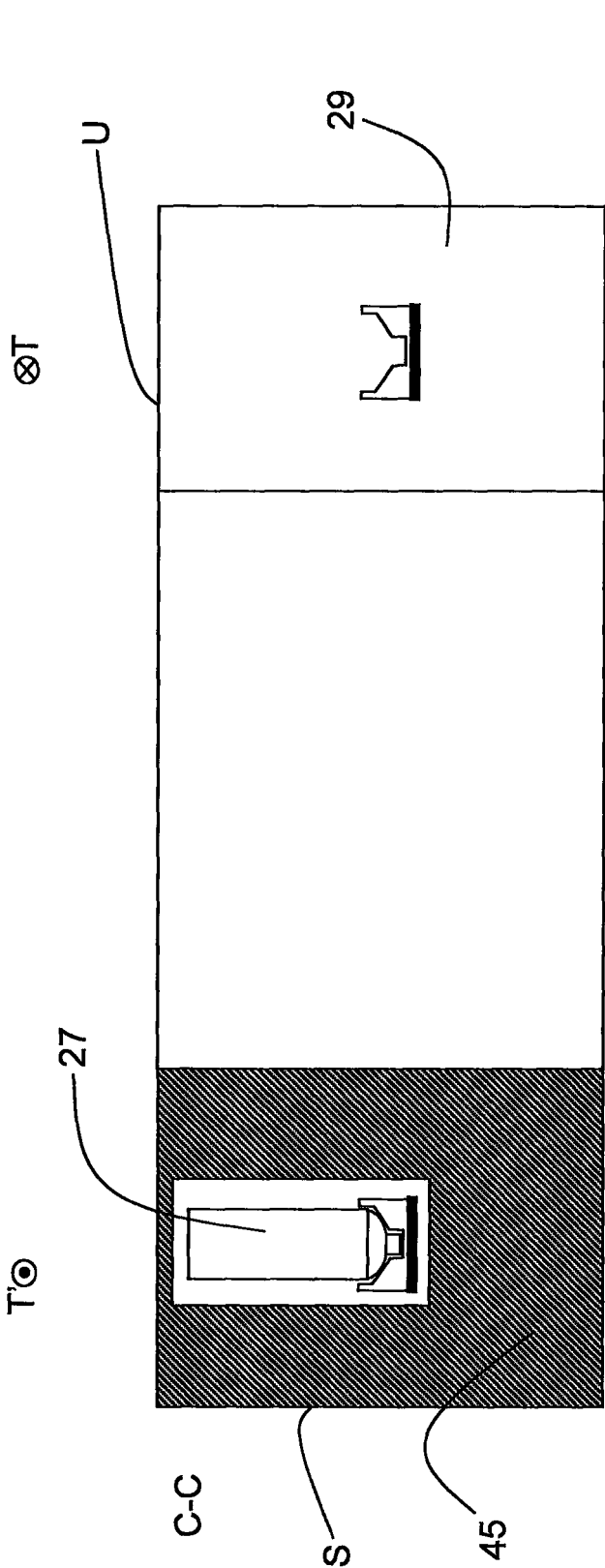


Fig. 4

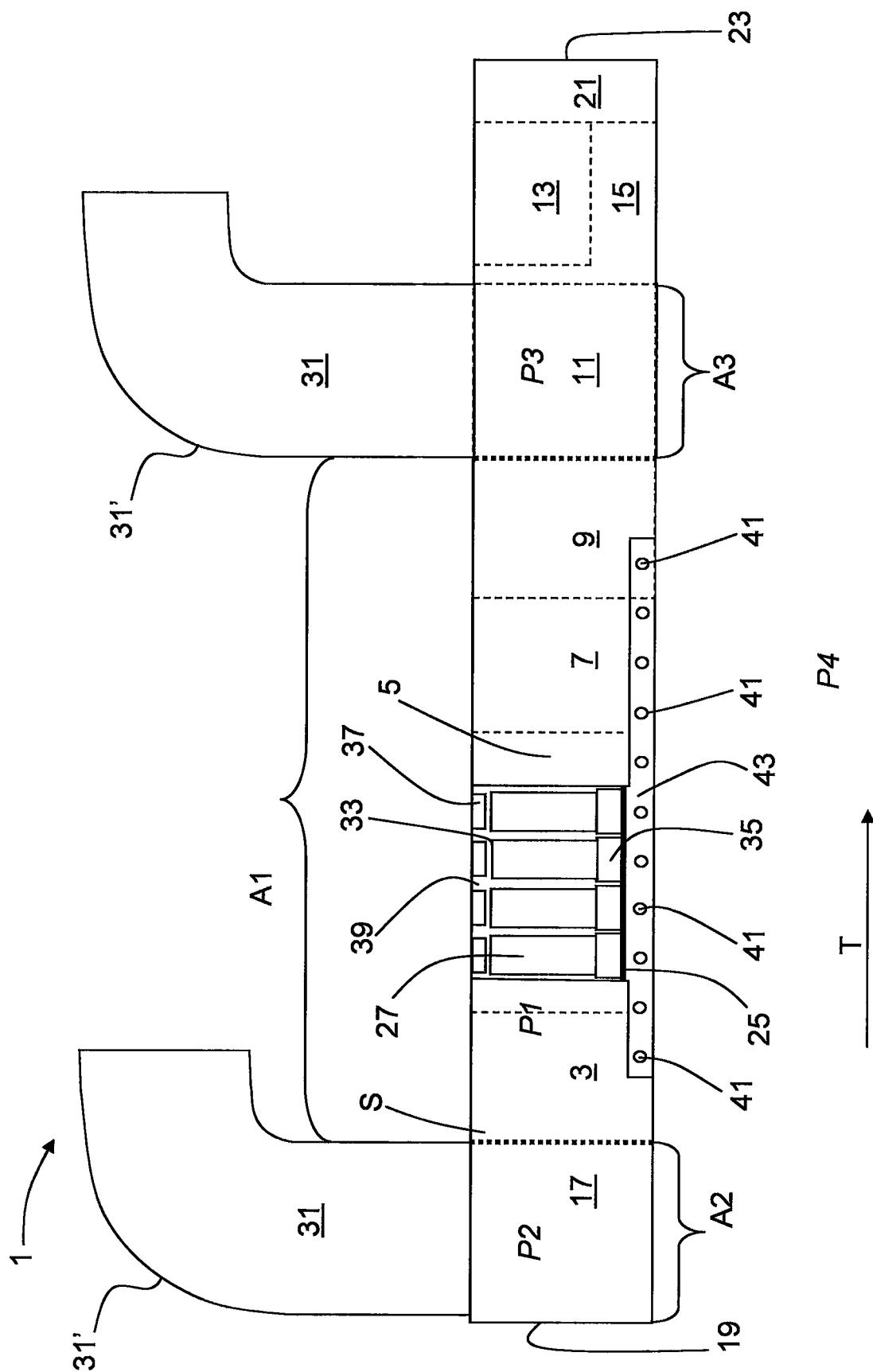


Fig. 5

REFERENCES CITED IN THE DESCRIPTION

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