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(54) Title: METHOD AND SYSTEM FOR MEASURING LEAK TIGHTNESS OF A SEALED PACKAGE

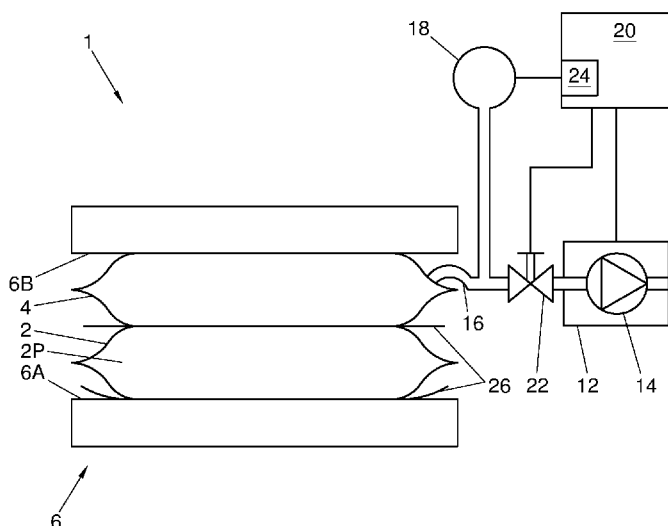


Fig. 1

(57) Abstract: A method and system for measuring leak tightness of a sealed package. The method includes providing a sealed package having a first deformable volume and providing a second deformable volume containing a fluid. The method includes clamping the second deformable volume against the sealed package and determining a first pressure in the second deformable volume at a first moment and a second pressure at a second moment spaced in time. The method includes determining leak tightness of the sealed package on the basis of the first and second pressures.

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Title: Method and system for measuring leak tightness of a sealed package

FIELD OF THE INVENTION

5 The present invention relates to the field of determining pressure inside a sealed package. The invention also relates to the field of determining leak tightness of a sealed package.

BACKGROUND TO THE INVENTION

10 It is known to package products in a package. Such package may e.g. store the product under vacuum or under a protective atmosphere. It is also known that it is advantageous to determine whether such package is leak tight. The package not being leak tight may present a problem in terms of reduced shelf life of the product, product escaping from the package or the
15 like.

It is also known that some packages are more easily tested for leak tightness than others.

SUMMARY OF THE INVENTION

20 It is an object of the invention to provide a system and method for determining leak tightness of a package applicable to many types of packages. More in particular the invention aims to provide a system and method for determining leak tightness of packages that are known to present difficulties for determining leak tightness, such as packages
25 including liquids, bag-in-box type packages, packages including semi-solid products and/or pliable products, etc..

According to an aspect is provided a method for measuring leak tightness of a sealed package. The method comprises the step providing a sealed package having a first deformable volume. Herein the first

deformable volume can be e.g. be formed by, or include, a bag containing a fluid, such as a gas, vapour, liquid, gel, paste, or other deformable substance, such as a semi-solid, etc.. The first deformable volume can also be e.g. be formed by, or include, a package containing a solid substance, the
5 package being movable relative to the solid substance, e.g. when the package is brought in an atmosphere at reduced pressure. The method includes providing a second deformable volume containing a fluid. The fluid can e.g. be a gas. The second deformable volume is clamped against the sealed package. A first pressure in the second deformable volume is
10 determined at a first moment. A second pressure in the second deformable volume is determined at a second moment. The first and second moments are spaced in time. Leak tightness of the sealed package is determined on the basis of the first and second pressures.

The second deformable volume can be clamped against the first
15 deformable volume. The second deformable volume can be clamped against the first deformable volume such that the first and second deformable volumes are in pneumatic or hydraulic equilibrium. When in pneumatic or hydraulic equilibrium a pressure in the first deformable volume is identical to a pressure in the second deformable volume. A change in volume of the
20 first deformable volume can be sensed as a change in volume of the second deformable volume, which translates into a change of the pressure of the fluid inside the second deformable volume. The second deformable volume being clamped against the sealed package provides the advantage that the second deformable volume senses any change in volume of the sealed
25 package. The pressure of the fluid inside the second deformable volume can easily be measured. If the pressure of the fluid inside the second deformable volume is measured at two different moments, a difference in pressure reading indicates a difference in volume of the sealed package, and may hence indicate a leak.

Optionally, the clamping includes inflating and/or pressurizing of the second deformable volume. The second deformable volume may be placed against the sealed package, clamping being provided by inflating and/or pressurizing of the second deformable volume.

5 Optionally, the inflating and/or pressurizing includes providing a pressure that varies in time. The pressure that varies in time may e.g. be a sine, saw-tooth, or the like pressure profile. It is also possible that the pressure in the second deformable volume is a constant pressure having a time-varying pressure superposed thereon. The time-varying pressure or
10 pressure component may aid in expelling material from the sealed package, e.g. in the case of a small leak, so as to increase the sensitivity for determining leak tightness.

Optionally, the second deformable volume includes a bladder, a bellows, a piston, and/or a membrane.

15 Optionally, the clamping includes positioning the sealed package and the second deformable volume between two rigid surfaces. Hence, the combined volume of the sealed package and the second deformable volume can be kept constant in a simple manner.

Optionally, the clamping includes enclosing the sealed package
20 and the second deformable volume in a closed chamber. The closed chamber includes, and/or is in fluid communication with, a buffer volume. The buffer volume can be relatively large. The buffer volume can be dimensioned such that a volume of content leaked from the sealed package is small relative to the buffer volume. Hence, the volume of content leaked from the sealed
25 package has limited impact on a pressure in the buffer volume. The volume of the buffer volume may e.g. be equal to or larger than the volume of the first deformable volume. Hence, a volume change of the first deformable volume can easily be detected by monitoring the pressure in the second deformable volume.

Optionally, the closed chamber is evacuated. Upon evacuation a reduced pressure level may be present in the closed chamber. The reduced pressure level in the closed chamber can also extend in the buffer volume. The reduced pressure level may cause the sealed package to bulge. It will be appreciated that in some cases the sealed package displays the first deformable volume in the bulged state. This can e.g. apply to sealed packages containing a solid substance, such as nuts, and only a small amount of gas. This can also apply to sealed packages containing a substance at underpressure. Hence, it is possible that a pneumatic or hydraulic equilibrium of the first deformable volume and the second deformable volume is created in the closed chamber at the reduced pressure level.

Optionally, a third deformable volume is provided. Then the clamping can include placing the sealed package between the second deformable volume and the third deformable volume. Thus, easily a volume change in the sealed package can be detected. Also, the second and third deformable volumes can easily conform to a shape of the sealed package.

Optionally, a reference package and a reference deformable volume are provided. Preferably the reference package is free from leaks. The reference deformable volume is clamped against the reference package. A reference pressure is determined in the reference deformable volume. Leak tightness of the sealed package can be determined on the basis of the first pressure, second pressure and reference pressure. Hence, external parameters, such as temperature, ambient pressure, etc. can be eliminated from the determination of the leak tightness of the sealed package. Preferably, the reference package is similar to the sealed package. Preferably, the reference package is identical to the sealed package (besides a potential leak in the sealed package).

Optionally, a sheet is provided at a surface of the sealed package. The sheet may e.g. be an absorbing sheet, e.g. a oven or non-woven sheet.

The method can including a, e.g. visual, inspection of the sheet for substance leaked from the sealed package.

Optionally, the sealed package includes a liquid. Optionally, the sealed package is completely filled with a liquid. The sealed package can e.g.
5 be a bag, such as a plastic or multilayer, containing a liquid such as a beverage, food product, detergent, or the like. Optionally, the sealed package includes a bag, a bag-in-box, an aseptic carton, a gable top carton, or the like.

Optionally, the sealed package includes a plurality of sealed
10 packages. Hence, when one of the sealed packages includes a leak the total volume of all packages together can change over time, so that the second deformable volume can be used to determine that at least one of the packages includes a leak.

According to an aspect is provided a method for measuring a
15 pressure in a sealed package. The method includes the step of providing a sealed package having a first deformable volume. The method includes providing a second deformable volume containing a fluid. The second deformable volume is clamped against the sealed package. A pressure in the second deformable volume is determined. The pressure in the sealed
20 package is determined on the basis of the pressure in the second deformable volume. It will be appreciated that the above optional features apply equally to the present method.

According to an aspect is provided a system for measuring a pressure in a sealed package. The sealed package can have a first
25 deformable volume. The system includes a second deformable volume for containing a fluid. The system includes a clamping unit arranged for clamping the second deformable volume against the sealed package. The system includes a pressure sensor arranged for determining a pressure of the fluid in the second deformable volume.

Optionally, the system includes a pressure unit arranged for pressurizing the fluid inside the second deformable volume.

Optionally, the system includes a control unit in communication with the pressure unit and/or the pressure sensor.

5 Optionally, the control unit is arranged for determining the pressure in the second deformable volume at a first moment and at a second moment spaced in time. Optionally, the control unit is arranged for determining leak tightness of the sealed package on the basis of the pressures determined at the first and second moments.

10 Optionally, the control unit is arranged for inflating and/or pressurizing of the second deformable volume. Optionally, inflating and/or pressurizing the second deformable volume causes or assists in clamping the second deformable volume against the sealed package.

15 Optionally, the control unit is arranged for varying the pressure in time. The pressure that varies in time may e.g. be a sine, saw-tooth, or the like pressure profile. It is also possible that the pressure in the second deformable volume is a constant pressure having a time-varying pressure superposed thereon.

20 Optionally, the system includes at least two rigid surfaces arranged for positioning the sealed package and the second deformable volume therebetween.

25 Optionally, the system includes a closable chamber arranged for enclosing the sealed package and the inflatable unit therein. Optionally, the closable chamber includes, and/or is in fluid communication with, a buffer volume. Optionally, the system includes a pump unit arranged for evacuating a volume of the chamber surrounding the sealed package and the second deformable volume.

Optionally, the system including a plurality of second deformable volumes. The system can e.g. include two second deformable volumes. The

system can also include three, four, five, six, eight or ten second deformable volumes, or any other suitable number.

Optionally, the system includes a reference package and a reference bladder. The control unit can be arranged for determining leak
5 tightness of the sealed package on the basis of the pressure in the bladder and the pressure in the reference bladder.

Optionally, the system including a sheet at a surface of the sealed package. The sheet may e.g. be an absorbing sheet, e.g. a oven or non-woven sheet. The sheet can absorb material expelled from the sealed package in
10 case of a leak. Presence of such material on the sheet can be an indication of leak.

Optionally, the sealed package includes a liquid. Optionally, the sealed package includes a bag, a bag-in-box, an aseptic carton, a gable top carton, or the like. Optionally, the sealed package includes a plurality of
15 sealed packages.

It will be appreciated that any of the aspects of the invention can be combined. It will also be clear that all features and options mentioned in view of the methods apply equally to the system.

It will be appreciated that any one or more of the above options
20 can be combined.

BRIEF DESCRIPTION OF THE DRAWINGS

Embodiments of the present invention will now be described in detail with reference to the accompanying drawings in which:

25 Figure 1 shows an example of a system for measuring a pressure in a sealed package;

Figures 2a and 2b show an example of a system for measuring a pressure in a sealed package;

Figures 3a and 3b show an example of a system for measuring a
30 pressure in a sealed package;

Figures 3c and 3d show an example of a system for measuring a pressure in a sealed package;

Figures 4a and 4b show an example of a system for measuring a pressure in a sealed package;

5 Figure 5 shows an example of a system for measuring a pressure in a sealed package;

Figures 6a and 6b show an example of a system for measuring a pressure in a sealed package;

10 Figures 7a and 7b show an example of a system for measuring a pressure in a sealed package.

DETAILED DESCRIPTION

Figure 1 shows an example of a system 1 for measuring a pressure in a sealed package 2. The sealed package 2 includes a product 2P.
15 Here the sealed package 2 is hermetically sealed. The sealed package 2 in this example is made from a packaging foil. The packaging foil can be a plastic foil, or e.g. a multilayer foil e.g. including a metallic layer and one or more plastic layers. The foil is sealed, such as welded, at seams. In this example the product 2P included in the sealed package 2 is a liquid, such as
20 a beverage. Here the sealed package 2 forms a deformable first volume.

The system 1 includes a second deformable volume 4V. In this example the second deformable volume includes an inflatable unit 4. In this example the inflatable unit 4 is a bladder 4. In this example the bladder 4 is a plastic bladder. Here the bladder 4 contains air. The system 1 includes a
25 clamping unit 6. Here the clamping unit includes a first clamping surface 6A and a second clamping surface 6B. The system 1 includes a pressure unit 12. The pressure unit 12 is arranged for pressurizing the fluid inside the bladder 4. Here the pressure unit 12 includes a pump 14. The pump 14 is connected to the bladder 4 via tubing 16. The system 1 includes a pressure
30 sensor 18. The pressure sensor 18 is in fluid communication with the

bladder 4. Hence, the pressure sensor 18 can measure the pressure of air in the bladder 4. In this example the system 1 further includes a control unit 20. The control unit 20 is in communication with the pressure unit 12 and the pressure sensor 18.

5 The system 1 as described up to here can be used as follows for determining a leak tightness of the sealed package 2.

 The sealed package 2 and the bladder 4 are positioned between the first and second clamping surfaces 6A, 6B. The bladder 4 is inflated using the pressure unit 12. The bladder 4 is inflated to a point where the
10 pressure of the gas in the bladder 4 has a pressure that is elevated relative to ambient pressure. Hence, the bladder 4 is pressed against the sealed package 2.

 At this point a valve 22 is closed so as to maintain the pressure inside the bladder 4. The clamping surfaces 6A, 6B prevent the combined
15 bladder 4 and sealed package 2 from expanding. Hence, the combined inner volume of the bladder 4 and the sealed package 2 is kept constant. The pressure inside the bladder 4 is measured at a first moment using the pressure sensor 18. After a delay time the pressure inside the bladder 4 is measured at a second moment using the pressure sensor 18.

20 From the two pressure measurements the leak tightness may be determined. A leak in the sealed package 2 will cause egress of product 4, and hence a reduction of the volume of the sealed package. Since the combined volumes of the bladder 4 and the sealed package 2 is constant, a reduction of the volume of the sealed package 2 will cause an increase of the
25 volume of the bladder 4. An increase of the volume of the bladder 4 will cause a reduction of the pressure inside the bladder 4. For example, if both pressure measurements are identical no leak is to be expected. If the second pressure measurement indicates a lower pressure inside the bladder 4 than the first measurement, the volume of the sealed package 2 decreased,
30 indicating a leak.

It will be appreciated that the control unit 20 may control the pressure unit 12 to inflate and pressurize the bladder 4. The control unit 20 may control the valve 22. The control unit 20 may include a readout unit 24 for reading a measured value of the pressure sensor 18. The control unit 20
5 may be arranged for performing the valve control, inflating, pressurizing, and measuring automatically. Thereto the control unit 20 may be provided with software code portions executed on a programmable apparatus.

In the example of Figure 1 the system includes an optional sheet 26, here two sheets. The sheet 26 is positioned against the sealed package.
10 Here the sheet 26 is a non-woven, such as a paper sheet. In case the sealed package 2 leaks, some product will egress from the sealed package 2. This product can adhere to, and/or be absorbed by, the sheet 26. The sheet 26 can be inspected, e.g. visually, for the presence of product as a secondary detection of leak.

15 The control unit 20 may be arranged to control the pressure unit 12 for varying in time the pressure exerted by the inflatable unit 4 onto the sealed package 2. The exerted pressure may e.g. include a time varying component, such as a saw tooth or sine wave. The time varying pressure may aid in expelling product from the sealed package in case of a leak. The
20 control unit 20 may be arranged for controlling the pressure unit 12 to exert the time varying pressure between the first moment and the second moment. This may aid in optimizing the detectability of a leak.

Figures 2a and 2b show an example of a system 1 for measuring a pressure in a sealed package 2. The sealed package 2 forms the first
25 deformable volume. The system 1 includes a clamping unit 6. Here the clamping unit includes a first clamping surface 6A and a second clamping surface 6B. Generally, the clamping unit 6 can include an actuator 6C for clamping and declamping of the sealed package. In this example the first clamping surface 6A is movable by means of the actuator 6C. The actuator
30 6C can include a linear motor, spindle, or the like. In Figure 2a the first

clamping surface 6A is positioned at a distance from the second clamping surface 6B allowing insertion of the sealed package 2 therebetween. In the example of Figure 2b the first clamping surface 6A has been moved towards the second clamping surface 6B. As a result the sealed package 2 is then
5 clamped between the first and second clamping surfaces.

The system 1 includes a second deformable volume 4V. In this example the second deformable volume includes a flexible membrane 4M. When the sealed package 2 is clamped against the flexible membrane 4M the pressure in the sealed package 2 is clamped against the second
10 deformable volume 4V will be equal. A pressure sensor 18 measures the pressure inside the second deformable volume 4V. Here the pressure sensor 18 is connected to the second deformable volume via tubing 16. It will be appreciated that the first and second clamping surfaces can positioned to apply a certain clamping pressure that causes the pressure inside the
15 second deformable volume 4V, and hence in the sealed package 2, to be at a desired level for measuring leak tightness of the sealed package 2.

Figures 3a and 3b show an example of a system 1 for measuring a pressure in a sealed package 2. The system of Figures 3a and 3b is highly similar to the system shown in Figures 2a and 2b. In the example of Figures
20 3a and 3b, the system 1 further includes a chamber 28. The chamber 28 includes a door 30 that can be opened for inserting the sealed package 2. The door 30 can be sealed against the chamber 28. In this example, the chamber 28 further includes a buffer volume 28B. The buffer volume 28 forms empty volume surrounding the sealed package 2. It will be
25 appreciated that here the buffer volume is not minimized. That is, the buffer volume is not designed to form a minimal volume surrounding the sealed package as in some prior art solutions. Rather, the buffer volume is relatively large. The buffer volume is in this example dimensioned such that a volume of content leaked from the sealed package 2 is small relative to the
30 buffer volume 28B. Here the volume of the buffer volume 28B is chosen to be

larger than the volume of the sealed package 2. Hence, a volume of content leaked from the sealed package 2 into the closed chamber 28 has limited impact on a pressure in the closed chamber 28. Hence, a volume change of the first deformable volume can easily be detected by monitoring the pressure in the second deformable volume. In the example of Figures 3a and 3b the system 1 includes a pump unit 32. The pump unit 32 is in fluid communication with the closed chamber 28 for evacuating the closed chamber 28. The control unit 20 can be arranged for controlling the pump unit 32 and the pressure sensor 18. The control unit 20 may be arranged to control automatic evacuation, leak detection and return to atmospheric pressure. The control unit 20 may be arranged to provide an indication of whether the sealed package under test is leaky or not. The control unit 20 may provide such indication to a user of the system 1.

The system as shown in Figures 3a and 3b can be used as follows. The door 30 is opened. The sealed package 2 is positioned between the first and second clamping surfaces 6A and 6B. In this example the first and second clamping surfaces 6A, 6B are maintained at a constant spacing by spacers 6D. The sealed package 2 can be slid in between the first and second clamping surfaces 6A, 6B.. The pump unit 32 is operated to evacuate the volume of the chamber 28 around the the sealed package 2. As a result, the sealed package 2 bulges and is brought in intimate contact with the flexible membrane 4M. Hence, the pressure inside the sealed package 2 is equal to the pressure inside the second deformable volume 4V. The pressure inside the second deformable volume is measured using the pressure sensor 18. After a delay time the pressure inside the second deformable volume 4V is measured for a second time using the pressure sensor 18. From the two pressure measurements the leak tightness may be determined.

Figures 3c and 3d shows an example of a system 1 for measuring a pressure in a sealed package 2. The system of Figures 3c and 3d is highly similar to the system shown in Figures 3a and 3b. In the example of Figures

3c and 3d two sealed packaged 2' and 2'' are positioned between the clamping surfaces 6A and 6B. It will be appreciated that this allows determination whether at least one of the sealed packages 2', 2'' is leaky. Leak testing two, or more, sealed packages simultaneously can increase
5 throughput of the system in terms of number of tested packages per unit time.

Figures 4a and 4b shows an example of a system 1 for measuring a pressure in a sealed package 2. The system of Figures 4a and 4b is highly similar to the system shown in Figures 2a and 2b. In this example a
10 spreader 5 is interposed between the sealed package 2 and the second deformable volume 4V. The spreader 5 here is in the form of a plate 5.

Figure 4b shows the situation when the first clamping surface 6A is clamped against the sealed package 2. The sealed package 2 will then be forced to conform to the plate 5. Also the second deformable volume 4V is
15 forced to conform to the plate 5. As a result, a first pressure p_1 inside the sealed package is in equilibrium with a second pressure p_2 inside the second deformable volume 4V. However, since a first surface area A_1 of the sealed package 2 in contact with the plate 5 is not equal to a second surface area A_2 of the second deformable volume 4V in contact with the plate 5, the
20 pressure inside the sealed package is not equal to the pressure inside the second deformable volume 4V. It will be appreciated that the ratio of the first and second surface areas A_1/A_2 is inversely proportional to a ratio of the first and second pressures p_1/p_2 . Hence, the spreader 5 functions to amplify a sensitivity of the system 1 to pressure/volume changes in the
25 sealed package 2. Hence this system 1 has an increased sensitivity to detect leak of the sealed package 2.

Figure 5 shows an example of a system 1 for measuring a pressure in a sealed package 2. The system of Figure 5 is highly similar to the system shown in Figure 1. In the example of Figure 5, the inflatable unit

4 includes a bellows 4C. It will be appreciated that the systems shown in Figures 1, 2a, 2b, 3a-3d may also be provided with one or more bellows.

The system shown in Figure 5 further includes a reference sealed package 2R and a reference bellows 4R. In this example the reference package 2R identical to the sealed package 2. The only difference between the reference package 2R and the sealed package 2 under test is that the reference package 2R here is free from leaks, whereas the sealed package 2 under test might have a leak. The system 1 includes a reference pressure sensor 18R. In this example simultaneously the pressure in the reference bellows and in the bellows 4C is measured at a first moment, and after some delay at a second moment. Any variation in measured pressure measured by the reference sensor 18R is due to external influences, such as temperature changes, ambient pressure changes, etc.. The control unit 20 can account for these measured influences in determining the leak tightness of the sealed package. For example, if the pressure in the bellows 4C measured at the second moment is lower than the pressure measured at the first moment, this can be attributed to external influences if the pressure in the reference bellows 4R changed by the same amount from the first moment to the second moment.

Figures 6a and 6b show an example of a system 1 for measuring a pressure in a sealed package 2. The system of Figures 6a and 6b is highly similar to the system shown in Figures 3a-3d. In this example the package 2 under test is a box 2B, such as a cardboard box, including a bag 2C filled with product. The package 2 is placed inside the chamber 28. The chamber 28 is evacuated using the pump unit 32. As a result the bag 2C bulges and presses the box 2B against the second deformable volume 4V. The pressure inside the second deformable volume 4V is measured using the pressure sensor 18. After a delay time the pressure inside the second deformable volume 4V is measured for a second time using the pressure sensor 18. From the two pressure measurements the leak tightness may be

determined. It is noted that it is also possible that the box 2B includes a plurality of Bags 2C and the leak tightness is determined of the plurality of bags 2C. Hence, if one or more of the bags is leaky this will be detected..

Figures 7a and 7b show an example of a system 1 for measuring a
5 pressure in a sealed package 2. The system of Figures 7a and 7b is highly similar to the system shown in Figures 2a and 2b. In this example, the system further includes a transport system 34. The transport system 34 here includes a conveyor belt. The system 1 can include a control unit 20. The control unit can be arranged for controlling the transport system 34, the
10 pressure sensor 18 and the actuator 6C of the clamping unit 6. The control unit 20 can be arranged to control automatic feeding of sealed packages to and from the clamping unit 6, automatic clamping and declamping of the sealed packages, and automatic determination of leak tightness of the sealed packages. It will be appreciated that the system 1 can easily be
15 incorporated in a production line for producing sealed packages.

Herein, the invention is described with reference to specific examples of embodiments of the invention. It will, however, be evident that various modifications and changes may be made therein, without departing from the essence of the invention. For the purpose of clarity and a concise
20 description features are described herein as part of the same or separate embodiments, however, alternative embodiments having combinations of all or some of the features described in these separate embodiments are also envisaged.

It will be appreciated that the sealed package can include a liquid,
25 such as a beverage, food product, e.g. sauce, soup, or the like, detergent, etc. The sealed package can also include a gel or paste. The sealed package can also include a semi-solid such as a bendable and/or compressible substance, e.g. meat. In general, the sealed package can include a deformable substance. In general the sealed package can be a deformable package.

In the examples the system includes one second deformable volume. It will be appreciated that it is also possible that the system includes two second deformable volumes, e.g. on opposite sides of the sealed package. It will be appreciated that the system may also include more than
5 two second deformable volumes.

The bladder or flexible membrane can be made from a substantially inelastic sheet material, such as a plastic membrane or multilayer membrane.

In respect of the example of Figure 1 time varying pressure
10 exertion is discussed. It will be appreciated that time varying pressure may also be applied in the other examples.

The inflatable unit can e.g. include one or more of a bladder, bellows, piston, membrane or the like.

In the example of Figures 1, 3a-3d, 5, 6a, 6b, 7 and 7b the system
15 includes a control unit. It will be appreciated that the control unit may also be included in the other examples.

In the examples leak tightness of the package(s) is determined. It is also possible to determine the pressure inside the sealed package. Thereto the pressure inside the second deformable volume can be monitored during
20 clamping and/or inflating. While the second deformable volume expands the pressure will rise hardly and/or at a first rate. When the pressure in the second deformable volume reaches the pressure inside the sealed package deformation and/or expansion of the second deformable volume causes the pressure inside the sealed package to rise as well. Hence the pressure inside
25 the second deformable volume will from that point onwards rise at a second rate. From this rate change the pressure inside the sealed package can be deduced.

Although the embodiments of the invention described with reference to the drawings comprise computer apparatus and processes
30 performed in computer apparatus, the invention also extends to computer

programs, particularly computer programs on or in a carrier, adapted for putting the invention into practice. The program may be in the form of source or object code or in any other form suitable for use in the implementation of the processes according to the invention. The carrier may
5 be any entity or device capable of carrying the program.

For example, the carrier may comprise a storage medium, such as a ROM, for example a CD ROM or a semiconductor ROM, or a magnetic recording medium, for example a floppy disc or hard disk. Further, the carrier may be a transmissible carrier such as an electrical or optical signal
10 which may be conveyed via electrical or optical cable or by radio or other means, e.g. via the internet or cloud.

When a program is embodied in a signal which may be conveyed directly by a cable or other device or means, the carrier may be constituted by such cable or other device or means. Alternatively, the carrier may be an
15 integrated circuit in which the program is embedded, the integrated circuit being adapted for performing, or for use in the performance of, the relevant processes.

However, other modifications, variations, and alternatives are also possible. The specifications, drawings and examples are, accordingly, to
20 be regarded in an illustrative sense rather than in a restrictive sense.

For the purpose of clarity and a concise description features are described herein as part of the same or separate embodiments, however, it will be appreciated that the scope of the invention may include embodiments having combinations of all or some of the features described.
25 In the claims, any reference sign placed between parentheses shall not be construed as limiting the claim. The word 'comprising' does not exclude the presence of other features or steps than those listed in a claim. Furthermore, the words 'a' and 'an' shall not be construed as limited to 'only one', but instead are used to mean 'at least one', and do not exclude a
30 plurality. The mere fact that certain measures are recited in mutually

different claims does not indicate that a combination of these measures cannot be used to an advantage.

Claims

1. Method for measuring leak tightness of a sealed package, comprising the steps of:
 - 5 - providing a sealed package having a first deformable volume;
 - providing a second deformable volume containing a fluid;
 - clamping the second deformable volume against the sealed package;
 - determining a first pressure in the second deformable volume at a
10 first moment and a second pressure at a second moment spaced in time;
 - determining leak tightness of the sealed package on the basis of the first and second pressures.
2. Method according to claim 1, wherein the clamping includes inflating and/or pressurizing of the second deformable volume.
- 15 3. Method according to claim 2, wherein the inflating and/or pressurizing includes providing a pressure that varies in time.
4. Method according to any one of claims 1-3, wherein the second deformable volume includes a bladder, a bellows, a piston, and/or a membrane.
- 20 5. Method according to any one of claims 1-4, wherein the clamping includes positioning the sealed package and the second deformable volume between two rigid surfaces.
6. Method according to any one of claims 1-5, wherein the clamping includes enclosing the sealed package and the second deformable volume in
25 a closed chamber.
7. Method according to claim 6, including evacuating a volume of the chamber surrounding the sealed package and the second deformable volume.
8. Method according to any one of the preceding claims, including providing a third deformable volume, wherein the clamping includes placing

the sealed package between the second deformable volume and the third deformable volume.

9. Method according to any one of the preceding claims, including providing a reference package and a reference deformable volume, clamping
5 the reference deformable volume against the reference package, determining a reference pressure in the reference deformable volume, and determining leak tightness of the sealed package on the basis of the first pressure, second pressure and reference pressure.
10. Method according to any one of the preceding claims, further
10 including providing a sheet at a surface of the sealed package.
11. Method according to claim 10, including an inspection of the sheet for first fluid leaked from the sealed package.
12. Method according to any one of the preceding claims, wherein the sealed package includes a liquid.
- 15 13. Method according to any one of the preceding claims, wherein the sealed package includes a bag, a bag-in-box, an aseptic carton, a gable top carton, or the like.
14. Method according to any one of the preceding claims, wherein the sealed package includes a plurality of sealed packages.
- 20 15. Method for measuring a pressure in a sealed package, comprising the steps of:
- providing a sealed package having a first deformable volume;
 - providing a second deformable volume containing a fluid;
 - clamping the second deformable volume against the sealed
25 package;
 - determining a first pressure in the second deformable volume;
 - determining the pressure in the sealed package on the basis of the first pressure.
16. System for measuring a pressure in a sealed package including:
30 - a second deformable volume for containing a fluid;

- a clamping unit arranged for clamping the second deformable volume against the sealed package; and
 - a pressure sensor arranged for determining a pressure of the fluid in the second deformable volume.
- 5 17. System according to claim 16, including a pressure unit arranged for pressurizing the fluid inside the second deformable volume
18. System according to claim 16 or 17, including a control unit in communication with the pressure unit and/or the pressure sensor.
19. System according to claim 18, wherein the control unit is
- 10 arranged for determining the pressure in the second deformable volume at a first moment and at a second moment spaced in time.
20. System according to claim 18 or 19, wherein the control unit is arranged for inflating and/or pressurizing of the second deformable volume.
21. System according to any one of claims 18-20, wherein the control
- 15 unit is arranged for varying the pressure in time.
22. System according to any one of claims 16-21, wherein the second deformable volume includes a bladder, a bellows, a piston, and/or a membrane.
23. System according to any one of claims 16-22, including two rigid
- 20 surfaces arranged for positioning the sealed package and the second deformable volume therebetween.
24. System according to any one of claims 16-23, including a closable chamber arranged for enclosing the sealed package and the second deformable volume therein.
- 25 25. System according to claim 24, wherein the closable chamber includes, and/or is in fluid communication with, a buffer volume.
26. System according to claim 24 or 25, including a pump unit arranged for evacuating a volume of the chamber surrounding the sealed package and the second deformable volume.

27. System according to any one of claims 16-26, including a plurality of second deformable volume.
28. System according to any one of claims 16-27, including a reference
5 package and a reference second deformable volume.
29. System according to any one of claims 16-28, further including a sheet at a surface of the sealed package.
30. System according to any one of claims 16-29, wherein the sealed package includes a liquid.
- 10 31. System according to any one of claims 16-30, wherein the sealed package includes a bag, a bag-in-box, an aseptic carton, a gable top carton, or the like.
32. System according to any one of claims 16-31, wherein the sealed package includes a plurality of sealed packages.
- 15 33. Sealed package leak tested using a method according to any one of claims 1-14 and/or using a system according to any one of claims 16-32.

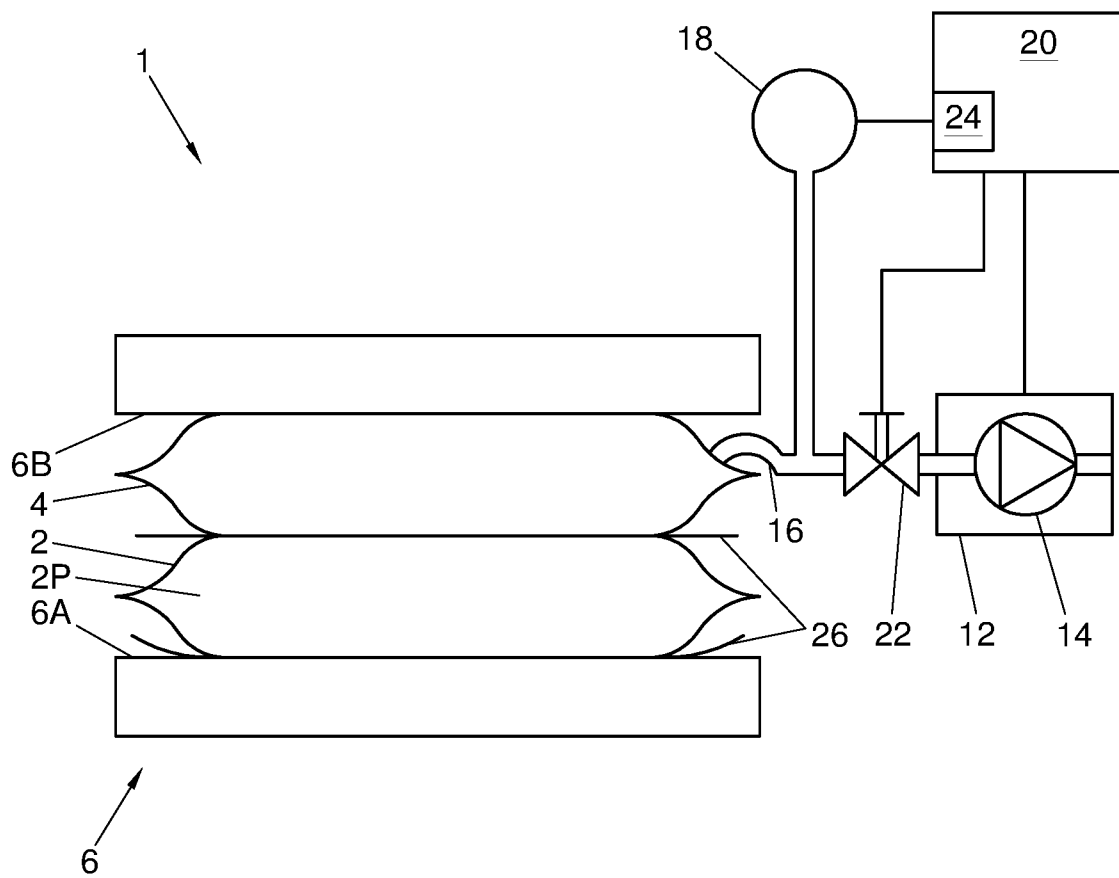
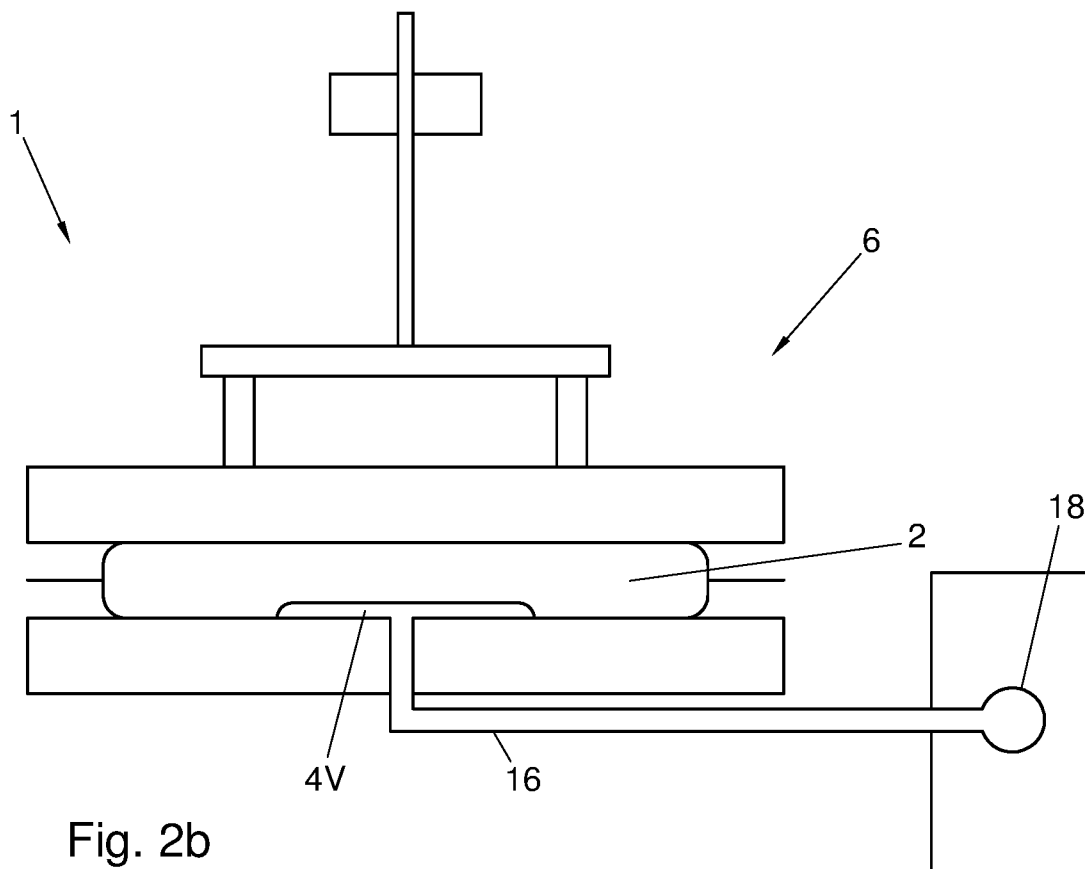
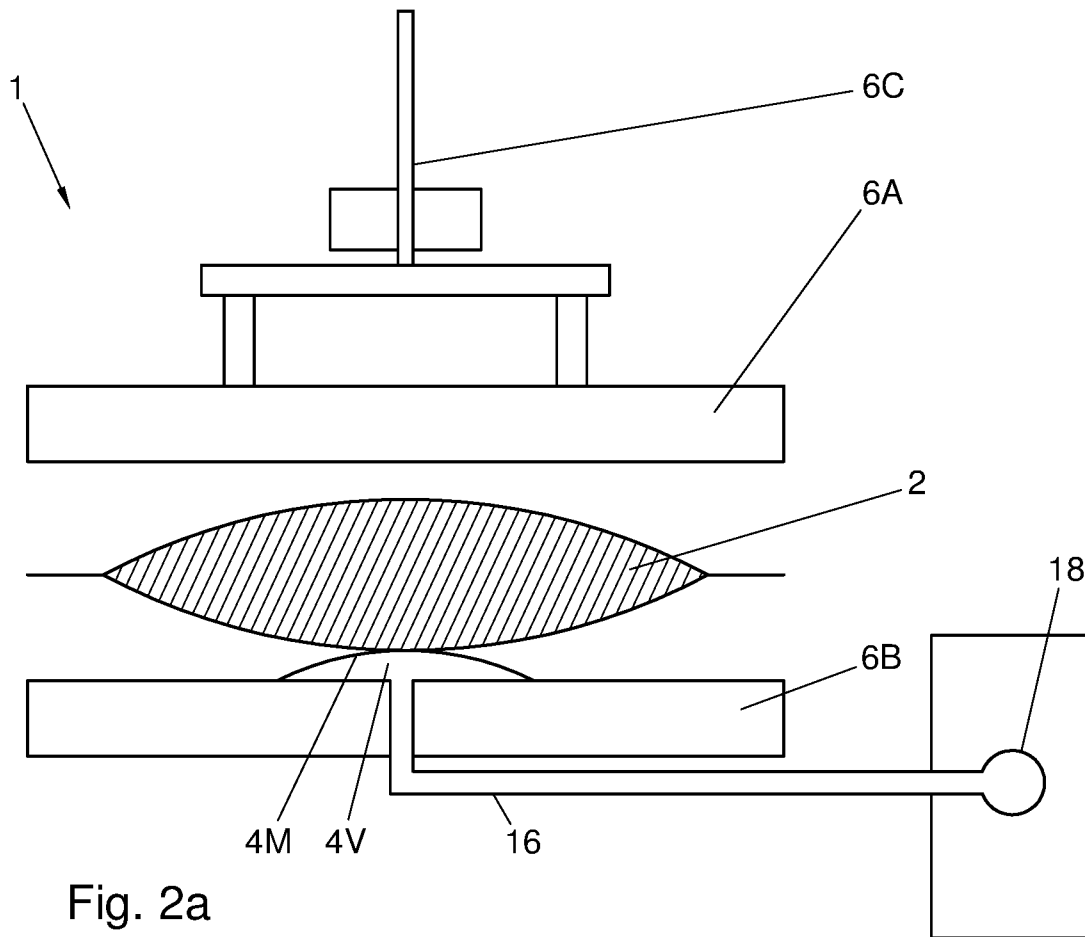
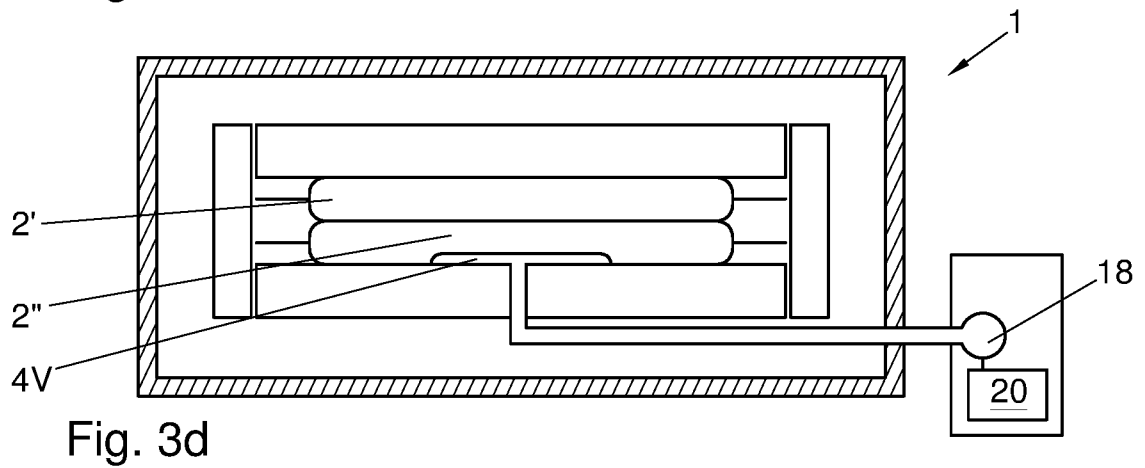
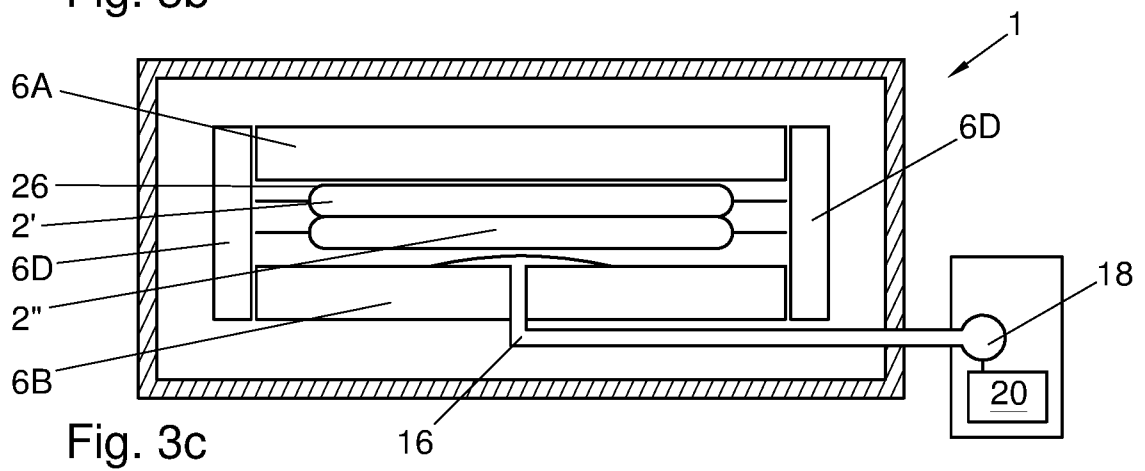
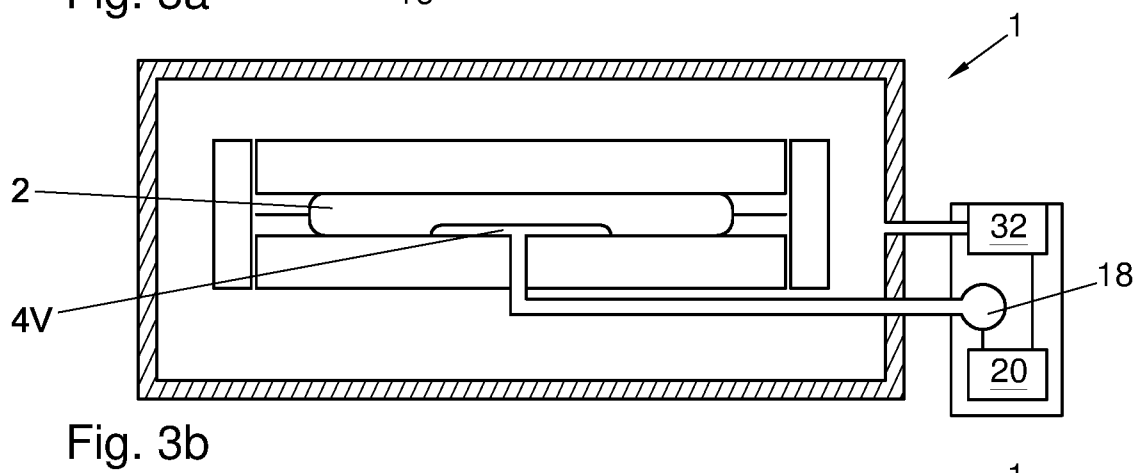
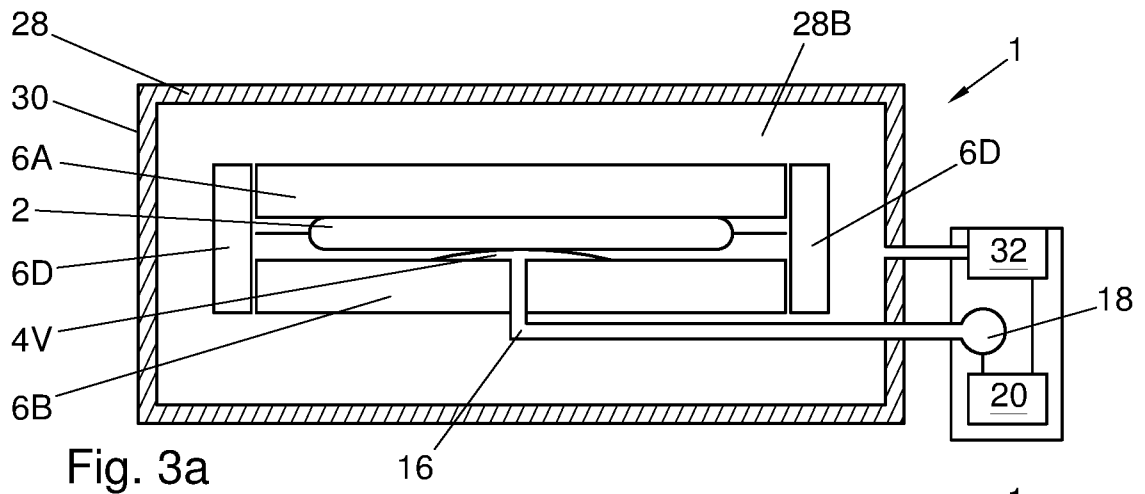


Fig. 1





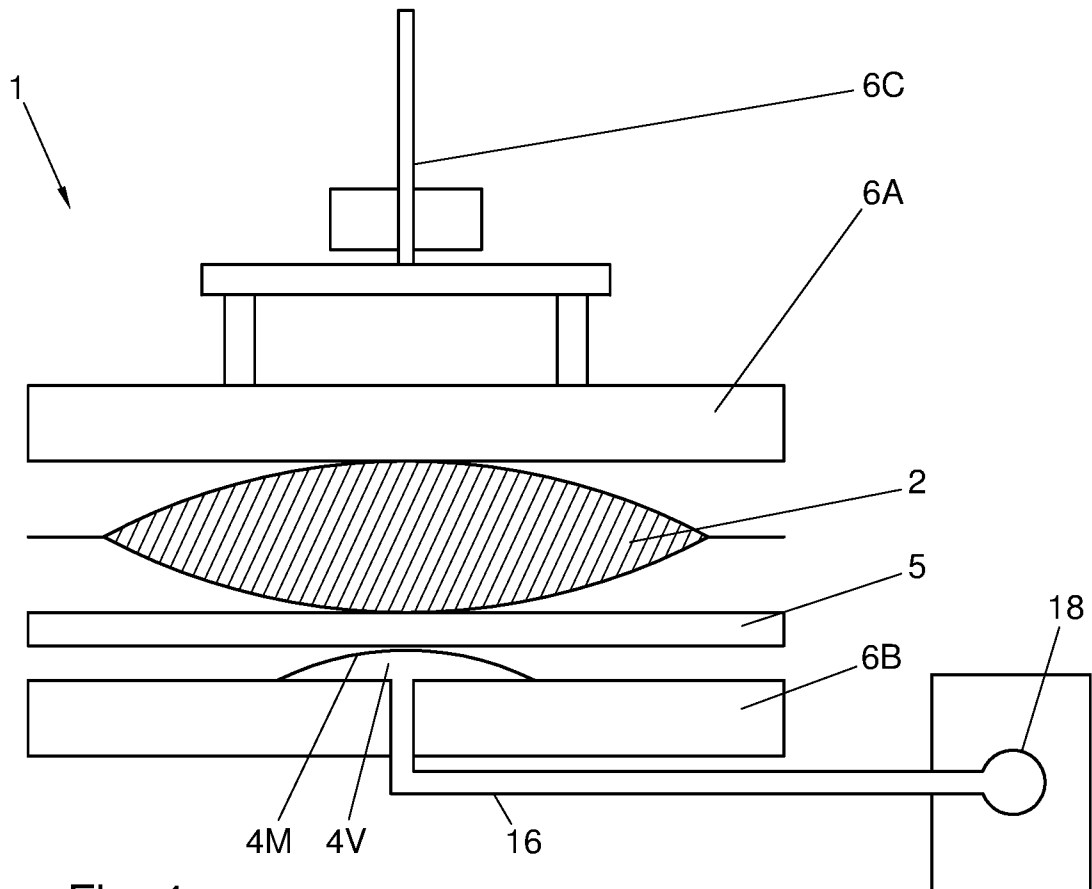


Fig. 4a

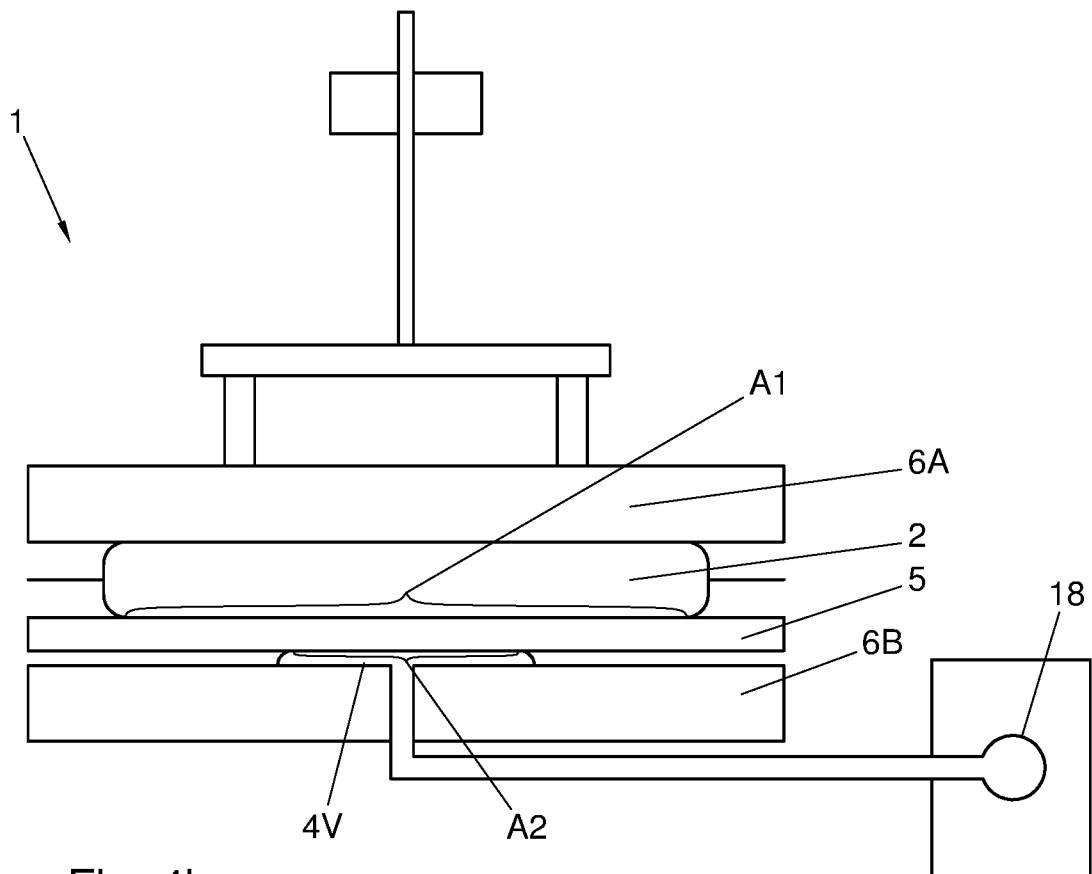


Fig. 4b

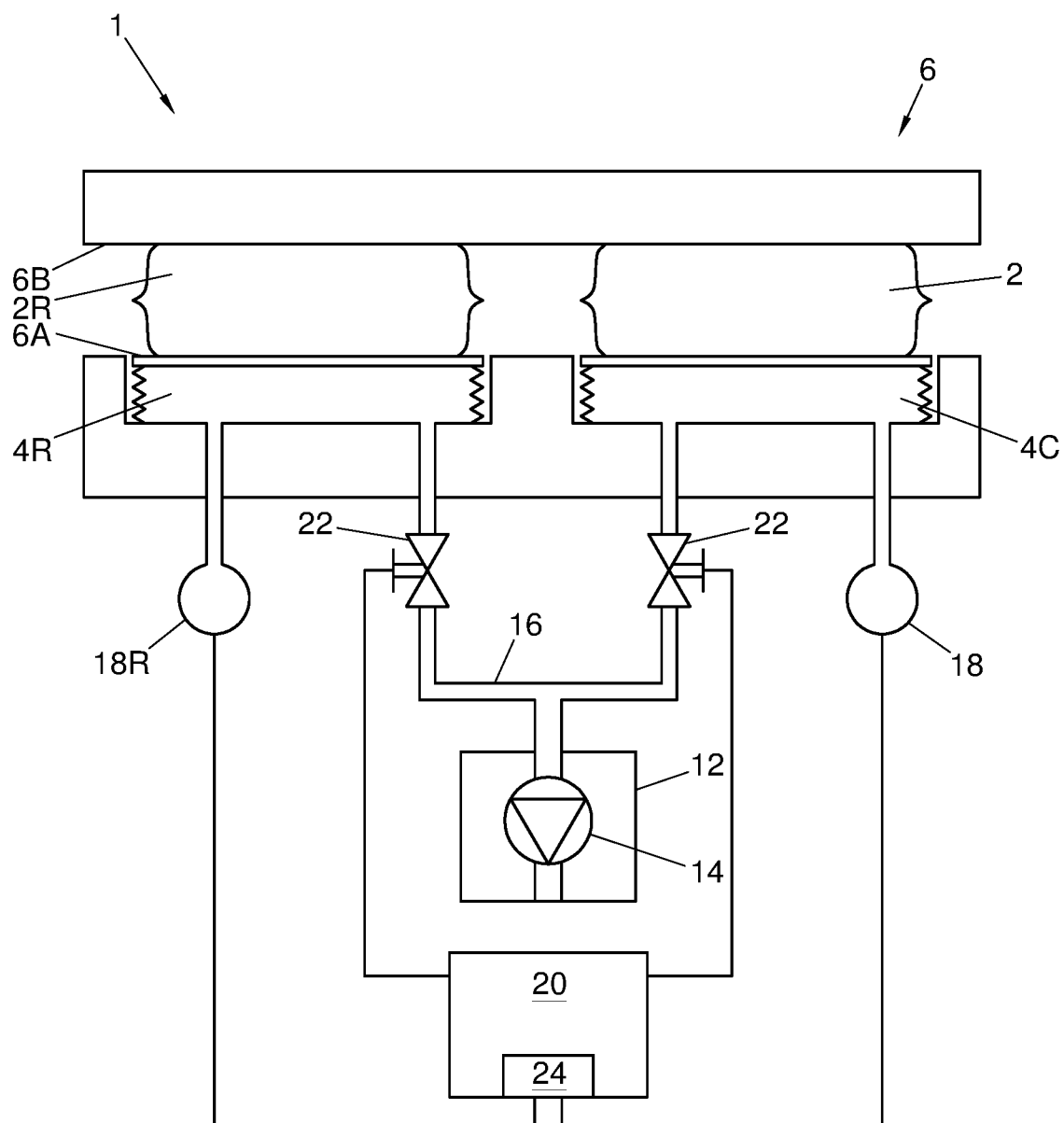


Fig. 5

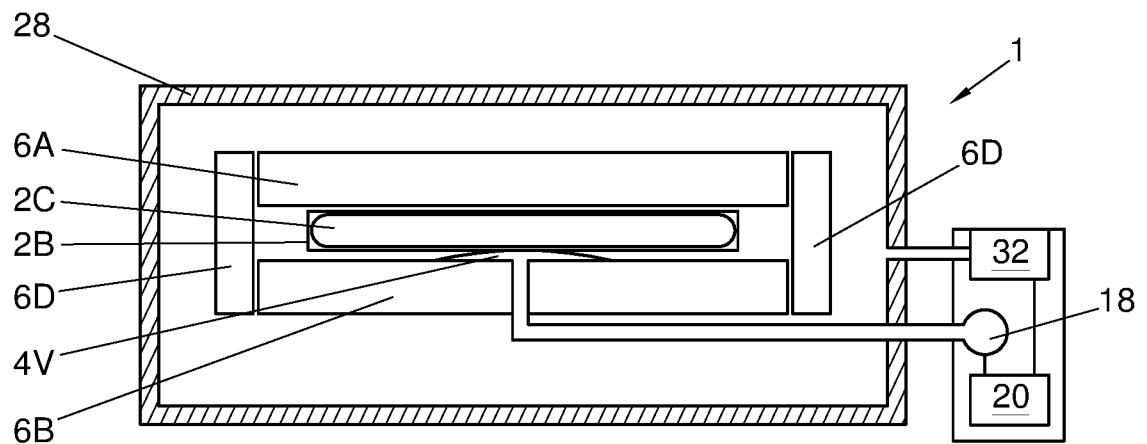


Fig. 6a

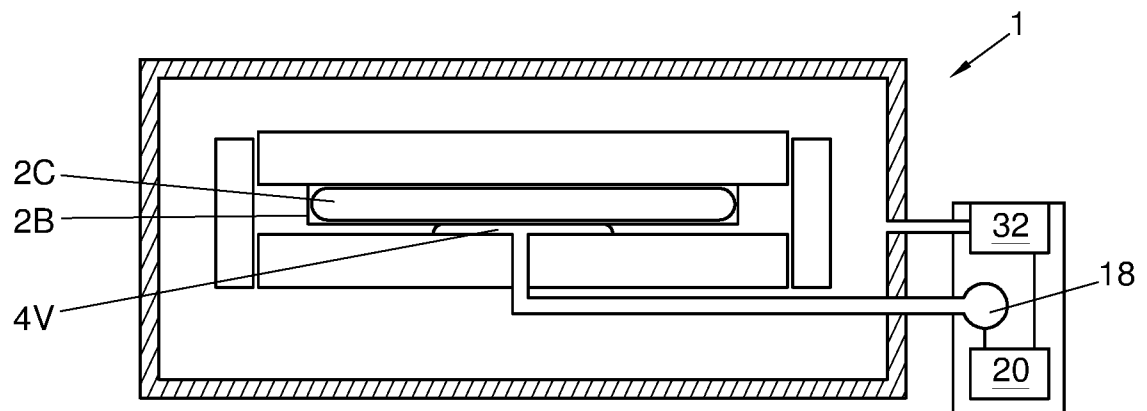


Fig. 6b

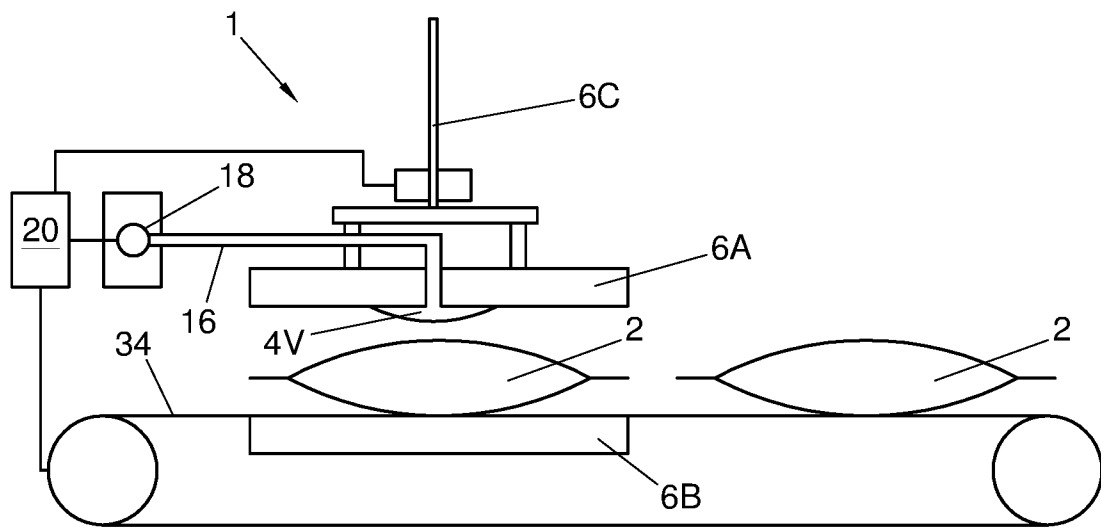


Fig. 7a

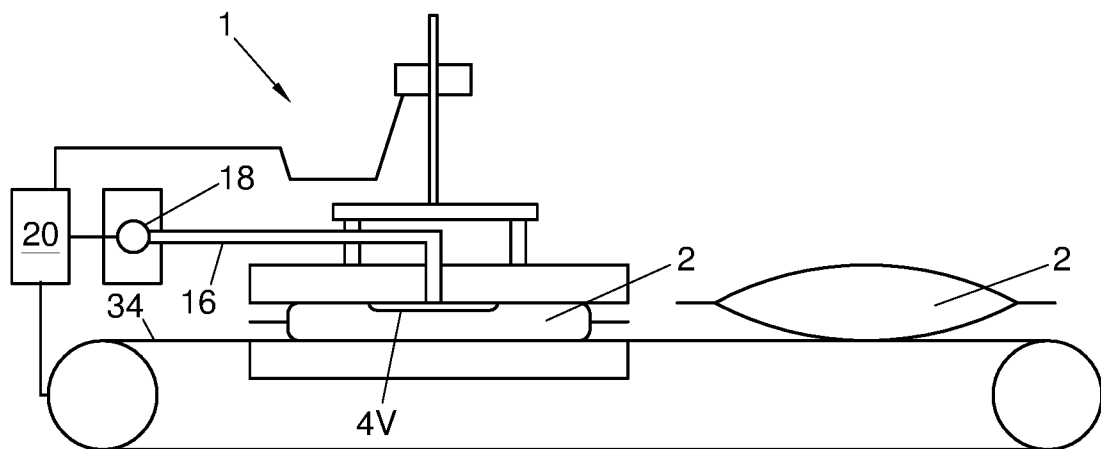


Fig. 7b

INTERNATIONAL SEARCH REPORT

International application No
PCT/NL2017/050278

A. CLASSIFICATION OF SUBJECT MATTER
INV. G01M3/32
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
G01M

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2012/143069 A1 (TAKEOKA KOHEI [JP] ET AL) 7 June 2012 (2012-06-07) abstract; figures 1-6 paragraph [0025] - paragraph [0051] -----	1-33
A	GB 2 279 758 A (CORRY KEVIN A [AU]; WILSON MARK S [AU]) 11 January 1995 (1995-01-11) the whole document -----	1-33
A	GB 2 345 548 A (RADIODETECTION LTD [GB]) 12 July 2000 (2000-07-12) the whole document -----	1-33



Further documents are listed in the continuation of Box C.



See patent family annex.

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Date of the actual completion of the international search

29 June 2017

Date of mailing of the international search report

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Authorized officer

Daman, Marcel

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

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