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(54) Sealing mechanism for a vessel and method of sealing a vessel by means of said sealing mechanism

(57) A sealing mechanism for a vessel (2; 20) which has an opening portion (3) closable by a cap (1) said cap (1) having a plug portion (4) and a seal plug (5); the plug portion (4) having an end wall (11) for covering the opening portion (3) of said vessel (2), a side wall (12), and a cylindrical wall (15) projecting generally axially from the end wall (11);

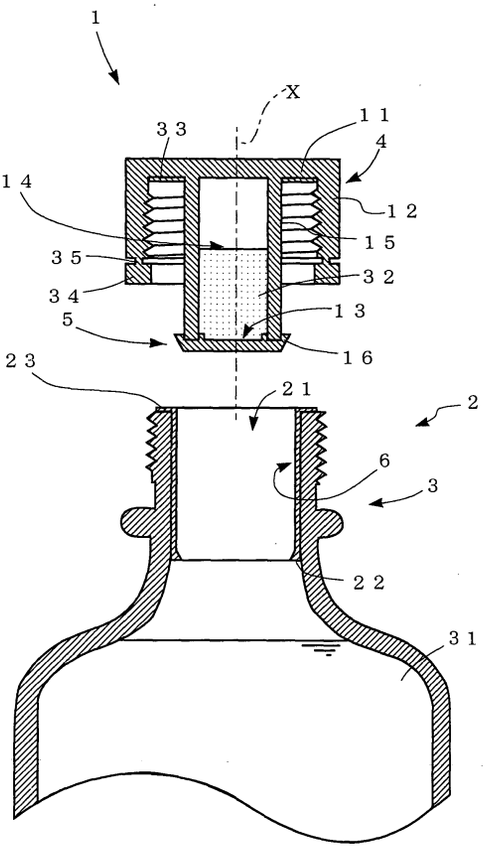
the side wall (12) having an inner circumferential surface arranged to engage an outer circumferential surface of the opening portion (3) ;

the cylindrical wall (15) being positioned inwardly of the side wall (12), and forming a receiving chamber (14), the receiving chamber having an opening (13) at its end remote from the end wall (11);

the seal plug (5) being removably attachable to the cylindrical wall so as to close the receiving chamber opening (13), and having an outer circumferential portion (16) arranged, in use, to project beyond the outer circumference of the cylindrical wall (15);

wherein the opening portion (3) of said vessel (2; 20) is provided with an inwardly protruding portion (22), which is so dimensioned and arranged that the outer circumferential portion (16) of the seal plug (5) may pass the protruding portion (22) when the cap (1) is applied to the vessel (2; 20), but may not pass the protruding portion (22) when the cap (1) is removed, thereby causing removal of the seal plug (5) from the receiving chamber (14).

Fig.1



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Description

[0001] This invention relates to sealing mechanisms for a vessel, particularly seals for vessels which can preserve products having several raw materials, a refreshing drink for example, in a single vessel by isolating the raw materials from each other until they are mixed when ready to be used. The invention also relates to methods to seal the vessel.

[0002] The quality of a medicine which is used by mixing two agents, and/or a refreshing drink which is produced by mixing a raw material into a liquid or the like, may change when they are not used or consumed for a long time after they were mixed, because the mixed agents react or the raw material mixed into the liquid deteriorates under the influence of sunlight or oxygen in the air. Therefore, as a way to preserve these liquids or the like in a condition where the original qualities are kept, a proposed method involves providing a receiving chamber for a raw material in a cap that seals the vessel including the liquid inside so that the raw material and the liquid to be mixed are isolated and preserved until required. One known sealing mechanism for a vessel with a cap closure is disclosed in JP 2004-75133 (called "the first prior art" below).

[0003] This sealing mechanism of the first prior art comprises a cap and a vessel having an opening portion, and is characterised by a structure of the cap. Namely, the cap used in the sealing mechanism has a plug portion having a top wall to cover the vessel, which fits on an outer circumferential surface of the opening portion by an inner surface of a side wall projecting from the top wall along a central axis. A receiving chamber is formed by a cylindrical wall projecting from the top wall in the side wall of the plug portion, a seal plug to seal the receiving chamber is arranged to be separate from the cylindrical wall by a sleeve loosely fitting on the cylindrical wall. In the case of the sleeve, it is prevented from being pulled out from the vessel by a flexible projecting portion having an outer diameter larger than an inner diameter of the opening portion. Also the projecting portion has flexibility to allow to pass the inner diameter by bending and subsequently resist backward movement. Thus, it can be inserted inside the vessel easily but can not be pulled out from the vessel after insertion.

[0004] As other means to form the receiving chamber for materials in the cap of the vessel, there are bottle caps disclosed in JP 2003-2350 (called "the second prior art" below) or Japanese utility model publication No. S44-12957, S50-18846 (called "the third prior art" below).

[0005] The bottle cap of the second prior art comprises a first portion to be fixed and a removable second portion separably screwed and coupled to the first portion. Further, the first portion has an axial through hole and the removable portion has an inner plug portion which extends through the hole. The inner plug portion opens when the removable portion moves in relation to the first portion fixed to the vessel, and the material charged and sealed in the receiving chamber of the inner plug portion is arranged to spout by pressurised gas.

[0006] In the case of the bottle cap of the third prior means, a receiving chamber formed in a cap is arranged to be sealed by an inner cap. Here, the inner cap has a bottom plate which is larger in diameter than an inner diameter of an opening portion of a vessel and which has a flexible rim portion. The rim portion of the bottom of the bottom plate is shaped to hardly bend downward when in a settled condition. When the cap seals the vessel, the rim portion of the bottom plate of the inner cap inserted with the receiving chamber into the opening portion bends upwardly and shrinks, but as it passes the opening portion and reaches an extended wide portion of the vessel it returns to its original state and is fixed. When the vessel is opened, the cap moves upwardly, and the inner cap is held inside the vessel as the rim portion of the bottom plate engages the inner surface of the opening portion and is held there. The inner cap then drops off the receiving chamber and the receiving chamber is opened.

[0007] However, in both cases of the first and second prior arts described above, before the receiving chamber is sealed by the seal plug, some member to open the receiving chamber, namely the first portion or the sleeve, has to be positioned around the receiving chamber and a space is formed between the receiving chamber and the member to open the receiving chamber. Then, in the situation where the cap containing the material dropped and remained in the space is fixed on the vessel, there is a problem bacteria are generated in the space as the liquid flows in the space. Further, because the space between the receiving chamber and the member to open the receiving chamber is narrow, it is extremely difficult to clear any material that drops into the space.

[0008] In the case of the third prior art, any member is not positioned around the receiving chamber. However, its structure has to be arranged to suit the shape of the vessel. In cases where the opening portion of the vessel is extremely long or short, the third prior art is rarely used. Further, in the case where the rim portion of the bottom plate of the inner cap is made to bend downward too much by production error or other reasons, the inner cap will not engage the opening portion as it moves upwardly with the cap as the vessel is opened and the cap plugs the vessel without dropping from the opening portion.

[0009] Therefore, the present invention aims to provide sealing mechanisms and methods more favourable to provide a receiving chamber for a raw material in a cap that seals a vessel containing a liquid inside so that the raw material and the liquid to be mixed are isolated and preserved. Namely, such mechanisms and methods enable the sealed receiving chamber to be smoothly opened without positioning any member around it, can

be applied regardless of the shape of the vessel, and releases the material stored in the receiving chamber more reliably without plugging the vessel.

[0010] The first sealing mechanism relating to the present invention is for a vessel which can be closed by a cap, and has a sleeve.

[0011] The vessel has an opening portion and the cap has a plug portion and a seal plug. The plug portion has a top wall to cover the opening portion of the vessel, a side wall and a cylindrical wall respectively projects from the top wall along an axis of the plug portion. The side wall has an inner circumferential surface arranged to fit on an outer circumferential surface of the opening portion. The cylindrical wall is inside of the side wall and forms a receiving chamber having an opening at its lower end face. The seal plug closes the opening by being fixed to the cylindrical wall and has an outer circumferential portion projecting from an outer circumferential surface of the cylindrical wall.

[0012] The sleeve is arranged to be fixed to the opening portion of the vessel and has an protruding portion on an inner surface of a through hole.

[0013] The outer circumferential portion of the seal plug is allowed to pass the protruding portion in direction for insertion but not for pulling off.

[0014] In such a sealing mechanism, because the outer circumferential portion of the seal plug is allowed to pass the protruding portion in direction for insertion, the cylindrical wall can be inserted into the sleeve after sealing the receiving chamber by seal plug. Further, because the outer circumferential portion of the seal plug is not allowed to pass the protruding portion in direction for pulling off, the seal plug drops off the cylindrical wall by function of the outer circumferential portion and the protruding portion as the cap moves in direction where its cylindrical wall is to be pulled off the sleeve. Therefore, it is possible to make sealing receiving chamber smoothly opens without positioning the sleeve around the receiving chamber.

[0015] Further, because the protruding portion is formed on the sleeve to be fixed to the vessel, this mechanism can be applied regardless of the shape of the vessel by arranging the sleeve in suitable shape.

[0016] Furthermore, by using the protruding portion, the sleeve is prevented from plugging with the seal plug and the material stored in the receiving chamber can be released at high reliability without plugging the vessel.

[0017] The sleeve may have a flange portion arranged to fit on a top surface of the opening portion on an end portion.

[0018] In this case, the sleeve can be easily fixed to the vessel by welding or other method using the flange.

[0019] The second sealing mechanism relating to the present invention is for a vessel which can be closed by a cap.

[0020] The vessel is a set of an opening portion and a storage portion. The cap has a plug portion and a seal plug. The plug portion has a top wall to cover the opening portion of the vessel, a side wall and a cylindrical wall respectively projects from the top wall along an axis of the plug portion. The side wall has an inner circumferential surface arranged to fit on an outer circumferential surface of the opening portion. The cylindrical wall is inside of the side wall and forms a receiving chamber having an opening at its lower end face. The seal plug closes the opening by being fixed to the cylindrical wall and has an outer circumferential portion projecting from an outer circumferential surface of the cylindrical wall.

[0021] The opening portion has a protruding portion on its inner surface. The outer circumferential portion of the seal plug is allowed to pass the protruding portion in direction for insertion but not for pulling off.

[0022] In such a sealing mechanism, because the outer circumferential portion of the seal plug is allowed to pass the protruding portion in direction for insertion, the cylindrical wall can be inserted into the opening portion of the vessel after sealing the receiving chamber by seal plug. Further, because the outer circumferential portion of the seal plug is not allowed to pass the protruding portion in direction for pulling off, the seal plug drops off the cylindrical wall by function of the outer circumferential portion and the protruding portion as the cap moves in direction where its cylindrical wall is to be pulled off the opening portion. Therefore, it is possible to make sealed receiving chamber smoothly opens without positioning any member around the receiving chamber.

[0023] Further, because of being a set of the opening portion and the storage portion, out of which set only the opening portion being required to be shaped specially to this mechanism, the vessel keeps to have common shape in the storage portion and can be used in general purpose. Therefore, this mechanism can be applied without strongly influenced by the shape of such the vessel that is not special but can be used in general purpose to some extent.

[0024] Furthermore, by using the protruding portion, the material stored in the receiving chamber can be released at high reliability without plugging the vessel with the seal plug.

[0025] The flanges arranged to be suite each other may be formed on joint portions connect the opening portion and the storage portion.

[0026] In this case, the opening portion and the storage portion can be easily connected by welding or other method using the flanges.

[0027] The first method relating to the present invention use members construct aforesaid first sealing mechanism, namely, the vessel, the cap and the sleeve with the protruding portion arranged to allow the seal plug passing in direction for insertion but not for pulling off. Then the method comprises fixing the sleeve on the opening portion of the vessel, charging a first material in the vessel, and closing the vessel by the cap charged with a second material in its receiving chamber and already sealed with the seal plug.

[0028] In such method, a step of positioning the

sleeve around the cylindrical wall, namely a step of inserting the cylindrical wall into the sleeve, comes after a step of charging the material into the receiving chamber. Further, because the protruding portion of the sleeve is arranged to allow the seal plug passing in direction for insertion but not for pulling off, the seal plug drops off the cylindrical wall by function of the outer circumferential portion and the protruding portion as the cap moves in direction where its cylindrical wall is to be pulled off the opening portion after sealing the vessel. Therefore, it is possible to make sealed receiving chamber smoothly opens without positioning any member around the receiving chamber. Further, the material dropped around the receiving chamber during charging step can be removed easily and the space between the cap and the sleeve is prevented from bacteria being generated.

[0029] The second method relating to the present invention use the members construct aforesaid second sealing mechanism, namely, the cap and the vessel with the protruding portion formed on the inner surface of the opening portion and arranged to allow the seal plug passing in direction for insertion but not for pulling off. Then the method comprises constructing the vessel by connecting the opening portion and the storage portion, charging a first material in the vessel, and closing the vessel by the cap charged with a second material in its receiving chamber and already sealed with said seal plug.

[0030] In such method, because the protruding portion is formed on the inner surface of the opening portion and arranged to allow the seal plug passing in direction for insertion but not for pulling off, and the sealing mechanism using such the vessel that having function to open the seal plug is applied, it is possible to make sealed receiving chamber smoothly opens dispensing with a step of positioning some member around the receiving chamber.

Fig. 1 is a sectional elevation showing a vessel, a cap, and a sleeve of an embodiment of a first sealing mechanism relating to the present invention in a condition where the vessel is opened.

Fig. 2 shows the functioning state of the sealing mechanism, Fig. 2(a) being a sectional elevation showing the condition before a receiving chamber is opened and Fig. 2(b) being a sectional elevation showing the condition after the receiving chamber is opened.

Fig. 3 shows a step of charging a first material into a vessel in an embodiment of a first sealing method relating to the present invention, Fig 3(a) being a front section of condition before a sleeve is fixed to the vessel and Fig. 3(b) being a front section of condition where the first material is being charged into the vessel.

Fig. 4 shows a step of charging a second material into the cap in the sealing method, Fig. 4(a) being a front section of condition where the second material is being charged into a cap, Fig. 4(b) being a front section of condition where a receiving chamber is sealed by a seal plug and Fig. 4(c) being a front section of condition where the second material dropped around the receiving chamber is being removed.

Fig. 5 is a front section showing a vessel and a cap of an embodiment of a second sealing mechanism relating to the present invention in a condition where the vessel is opened.

Fig. 6 shows the functioning state of the sealing mechanism, Fig. 6(a) being a front section of condition before a receiving chamber is opened and Fig. 6(b) being a front section of condition after the receiving chamber is opened.

Fig. 7 shows a step of charging a first material into the vessel in an embodiment of a second sealing method relating to the present invention, Fig 7(a) being a front section of condition before an opening portion is connected to the storage portion and Fig. 7(b) being a front section of condition where the first material is being charged into a vessel.

[0031] Figs. 1 and 2 show a first embodiment of a sealing mechanism in accordance with the present invention. Fig. 1 is a sectional elevation showing the vessel, the cap and the sleeve of the sealing mechanism in a condition where the vessel is opened. Fig. 2 shows the functioning states of the sealing mechanism, Fig. 2 (a) being a sectional elevation showing the condition before the receiving chamber is opened and Fig. 2(b) being a sectional elevation showing the condition after the receiving chamber is opened.

[0032] The sealing mechanism is for a vessel 2 which can be closed by a cap 1 and has a sleeve 6.

[0033] The vessel 2 has an opening portion 3 and the cap 1 has a plug portion 4 and a seal plug 5. The plug portion 4 has a top wall 11 to cover the opening portion 3 of the vessel 2. A side wall 12 and an inwardly disposed cylindrical wall 15 respectively project from the top wall 11 along an axis X of the plug portion 4. The side wall 12 has an inner circumferential surface arranged to fit by screwing on an outer circumferential surface of the opening portion 3. The cylindrical wall 15 is positioned inside of the side wall 12 and forms a receiving chamber 14 having an opening 13 at its lower end face. The seal plug 5 closes the opening 13 by being fixed to the cylindrical wall 15 and has an outer circumferential portion 16 projecting from an outer circumferential surface of the cylindrical wall 15.

[0034] The sleeve 6 is arranged to be fixed to the opening portion 3 of the vessel 2. The sleeve has a hole 21 and an inwardly directed tip or protruding portion 22 at its lower end.

[0035] The outer circumferential portion 16 of the seal plug 5 is allowed to pass the protruding portion 22 when inserted into the vessel, but not when the cap is re-

moved.

[0036] In such a sealing mechanism, because the outer circumferential portion 16 of the seal plug 5 is allowed to pass the protruding portion 22 in the direction of insertion, the cylindrical wall 15 can be inserted into the sleeve 6 after the receiving chamber 14 is sealed by seal plug 5. Further, because the outer circumferential portion 16 of the seal plug 5 is not allowed to pass the protruding portion 22 in the direction of removal, the seal plug 5 drops off the cylindrical wall 15 by function of the outer circumferential portion 16 and the protruding portion 22 as the cap 1 moves in the direction where the cylindrical wall 15 is to be removed from the sleeve 6. Therefore, it is possible to make the sealed receiving chamber 14 smoothly open without positioning any members around the receiving chamber 14.

[0037] Further, because the protruding portion 22 is formed on the sleeve 6 to be fixed to the vessel 2, this mechanism can be applied regardless of the shape of the vessel 2 by arranging the sleeve 6 to have the appropriate shape.

[0038] Furthermore, by using the protruding portion 22, the sleeve 6 is prevented from being plugged by the seal plug 5 and the material 32 stored in the receiving chamber 14 can be released more reliably without plugging the vessel 2.

[0039] The sleeve 6 has a flange portion 23 at its upper end. The flange locates on a top surface of the opening portion 3.

[0040] In this Figure, the sleeve 6 can be easily fixed to the vessel 2 by welding or other fixing methods using the flange 23.

[0041] On the lower side of the top wall 11, a packing 33 is attached.

[0042] In Figure 1, the vessel 2 can be sealed tightly.

[0043] The lower portion of the side wall 12 carries a cut-ring 34 which is connected thereto by a connecting portion 35.

[0044] With reference to Figure 2a, as the cap 1 is screwed on, to seal the vessel 2, the cut-ring 34 engages the vessel 2 as showed in Fig. 2(a), and cannot be opened without breaking the connecting portion 35. Therefore, the cap 1 is prevented from being opened improperly by a third party while the sealed vessel is being distributed.

[0045] The first sealing method relating to the present invention can be put into practice by using the vessel 2, the cap 1 and the sleeve 6 with the protruding portion 22 is arranged to allow the seal plug 5 to pass in the direction of insertion but not in the direction of pulling off.

[0046] An embodiment of the first sealing method which relates to the present invention is explained below referring to Figs. 3 and 4. Fig. 3 shows a step of charging a first material into the vessel. Fig. 3(a) is a sectional elevation showing the condition before the sleeve is fixed to the vessel and Fig. 3(b) is a sectional elevation showing the condition where the first material is being charged into the vessel. Fig. 4 shows a step of charging a second material into the cap. Fig. 4(a) is a sectional elevation showing the condition where the second material is being charged into the cap, Fig. 4(b) is a sectional elevation showing the condition where the receiving chamber is sealed by the seal plug and Fig. 4(c) is a sectional elevation showing the condition where excess of the second material located around the receiving chamber 14 is being removed.

[0047] With reference to Figure 3(a), initially the sleeve 6 is inserted into the opening portion 3 of the vessel 2. Next, the flange 23 is welded to the top surface of the opening portion 3 by pressing and heating, and consequently the sleeve 6 is fixed to the opening portion 3 of the vessel 2. Then as shown in Fig. 3(b), the first material 31 is charged into the vessel 2. In this sealing method, though the first material 31 is a liquid, the form of the first material is not limited to a liquid and a powder or a solid also may be charged into the vessel 2.

[0048] With reference to Figure 4, a second material 32 is charged into the receiving chamber 14 of the cap 1. Namely, the second material 32 is charged into the receiving chamber 14 opening (Fig. 4(a)), and the opening 13 of the receiving chamber 14 is sealed with the seal plug 5 (Fig. 4(b)). Any of the second material 32 dropped around the receiving chamber 14 is removed by an air flow (Fig. 4(c)). In this sealing method, the order of the steps of charging the first material and of charging the second material is not limited. The steps can be carried out in any order, or both steps may be carried out in parallel if facilities or other conditions allow it.

[0049] After completion of charging both materials 31, 32, as the last step, the cylindrical wall 15 is inserted into the through hole 21 of the sleeve 6 until the outer circumferential portion 16 of the seal plug 5 engages to the protruding portion 22. Then consequently the vessel 2 is sealed by the cap 1 and the seal plug 5.

[0050] In the described sealing method, the step of positioning the sleeve 6 around the cylindrical wall 15, namely the step of inserting the cylindrical wall 15 into the sleeve 6, comes after a step of charging the material into the receiving chamber 14. Further, because the protruding portion 22 of the sleeve 6 is arranged to allow the seal plug 5 to pass in the direction of insertion but not in the direction of pulling off, the seal plug 5 is pulled from the cylindrical wall 15 as a result of engagement of the outer circumferential portion 16 with the protruding portion 22 as the cap 1 is moved in a direction where the cylindrical wall 15 is pulled from the opening portion 3 after sealing the vessel 2. Therefore, it is possible to make sealed receiving chamber 14 smoothly open without positioning any members around the receiving chamber 14. Further, the material which dropped around the receiving chamber 14 during the charging step can be removed easily and thus bacteria formation can be prevented in the space between the cap 1 and the sleeve 6.

[0051] In Figs. 5 and 6, an embodiment of a second sealing mechanism relating to the present invention is

shown. Fig. 5 is a sectional elevation showing the vessel and the cap of the sealing mechanism in a condition where the vessel is opened. Fig. 6 shows the functioning state of the sealing mechanism, Fig. 6(a) being a sectional elevation showing its condition before the receiving chamber is opened and Fig. 6(b) being a section elevation showing the condition after the receiving chamber is opened. In this embodiment, the same symbols are used to indicate the portions which are substantially the same as in the first embodiment and the explanation thereof is omitted or simplified.

[0052] The sealing mechanism does not have a sleeve 6 corresponding to that of the first sealing mechanism but comprises a vessel 20 having an opening portion 3 and a storage portion 7 instead of the vessel 2. The opening portion 3 has a protruding portion 22 on its inner surface. The outer circumferential portion 16 of the seal plug 5 is allowed to pass the protruding portion 22 in the direction of insertion but not in the direction of removal.

[0053] In this sealing mechanism, because the outer circumferential portion 16 of the seal plug 5 is allowed to pass the protruding portion 22 in the direction of insertion, the cylindrical wall 15 can be inserted into the opening portion 3 of the vessel 20 after sealing the receiving chamber by seal plug 5. Further, because the outer circumferential portion 16 of the seal plug 5 is not allowed to pass the protruding portion 22 in the direction of removal, the seal plug 5 is pulled from the cylindrical wall 15 by engagement of the outer circumferential portion 16 with the protruding portion 22 as the cap 1 is moved in the direction where its cylindrical wall 15 is pulled from the opening portion 3. Therefore, the sealed receiving chamber 14 smoothly opens without positioning any member around the receiving chamber 14.

[0054] Since the vessel 20 has the opening portion 3 and the storage portion 7, (of which only the opening portion 3 is required to be shaped specially to this mechanism), the vessel 20 has a common shape of the storage portion 7 and can be used in general purpose. Therefore, this mechanism can be applied without being influenced by the shape of the vessel 20 that is not special but can be used in general purpose to some extent.

[0055] Furthermore, by using the protruding portion 22, the material stored in the receiving chamber 14 can be released more reliably without plugging the vessel 20 with the seal plug 5.

[0056] Flanges 24, 25 are arranged to locate against each other and are formed on joint portions which connect the opening portion 3 and the storage portion 7.

[0057] In this case, the opening portion 3 and the storage portion 7 can be easily connected by a welding or other joining method using the flanges 24, 25.

[0058] The second sealing method relating to the present invention can be put into practice by using the cap 1 and the vessel 20 with the protruding portion 22 formed on the inner surface of the opening portion 3 and arranged to allow the seal plug 5 passing in the direction of insertion but not the direction of pulling off.

[0059] An embodiment of the second sealing method relating to the present invention is explained below with reference to Fig. 7. Fig. 7 shows a step of charging a first material into the vessel, Fig. 7(a) being a sectional elevation showing the condition before the opening portion is connected to the storage portion and Fig. 7(b) being a sectional elevation showing the condition where the first material is being charged into the vessel.

[0060] Initially, the opening portion 3 is located so that its joint portion 3a is lowermost, and it is located on a joint portion 7a of the storage portion 7 as shown by the arrow in Fig. 7(a). Next, the flange 24 is welded to the flange 25 of the storage portion 7 by pressing and heating, and consequently the vessel 20 is constructed by connecting the opening portion 3 and the storage portion 7. Then as shown in Fig. 7(b), the first material 31 is charged into the vessel 20.

[0061] In the case of the cap 1, a second material 32 is charged into it in the same manner as for the aforesaid first sealing method. Then, as the last step, the cylindrical wall 15 is inserted into the opening portion 3 until the outer circumferential portion 16 of the seal plug 5 engages and passes the protruding portion 22. Then consequently the vessel 20 is sealed by the cap 1 and the seal plug 5.

[0062] In this sealing method, because the protruding portion 22 is formed on the inner surface of the opening portion 3 and is arranged to allow the seal plug 5 to pass in the direction of insertion but not in the direction of pulling off, and the sealing mechanism using the vessel 20 that having function to open the seal plug 5 is applied, it is possible to make sealed receiving chamber 14 smoothly open without having to position a member around the receiving chamber 14.

[0063] According to a first sealing mechanism relating to the present invention, it is possible to make a sealed receiving chamber smoothly open without positioning any member around the receiving chamber. Further, the mechanism can be applied regardless of the shape of the vessel by forming the sleeve in a suitable shape. Furthermore, by using the protruding portion, the sleeve is prevented from plugging with the seal plug and the material stored in the receiving chamber can be released more reliably without plugging the vessel.

[0064] According to the features of claim 2, the sleeve can be easily fixed to the vessel.

[0065] According to a second sealing mechanism relating to the present invention of claim 4, it is possible to make sealed receiving chamber smoothly open without positioning any members around the receiving chamber. Further, this mechanism can be applied without being influenced by the shape of the vessel that is not special but can be used in general purpose to some extent. Furthermore, the material stored in the receiving chamber can be released more reliably without plugging the vessel with the seal plug.

[0066] According to the features of claim 4, the open-

ing portion and the storage portion can be easily connected.

[0067] According to a first sealing method relating to the present invention of claim 7, it is possible to make sealing receiving chamber smoothly open without positioning any member around the receiving chamber. Further, the material dropped around the receiving chamber during charing step can be removed easily and bacterial growth is prevented in the space between the cap and the sleeve.

[0068] According to a second sealing method relating to the present invention of claim 8, it is possible to make the sealed receiving chamber smoothly open without having to position a member around the receiving chamber.

Claims

1. A sealing mechanism for a vessel (2; 20) which has an opening portion (3) closable by a cap (1)
said cap (1) having a plug portion (4) and a seal plug (5);
the plug portion (4) having an end wall (11) for covering the opening portion (3) of said vessel (2), a side wall (12), and a cylindrical wall (15) projecting generally axially from the end wall (11);
the side wall (12) having an inner circumferential surface arranged to engage an outer circumferential surface of the opening portion (3) ;
the cylindrical wall (15) being positioned inwardly of the side wall (12), and forming a receiving chamber (14), the receiving chamber having an opening (13) at its end remote from the end wall (11);
the seal plug (5) being removably attachable to the cylindrical wall so as to close the receiving chamber opening (13), and having an outer circumferential portion (16) arranged, in use, to project beyond the outer circumference of the cylindrical wall (15);
wherein the opening portion (3) of said vessel (2; 20) is provided with an inwardly protruding portion (22), which is so dimensioned and arranged that the outer circumferential portion (16) of the seal plug (5) may pass the protruding portion (22) when the cap (1) is applied to the vessel (2; 20), but may not pass the protruding portion (22) when the cap (1) is removed, thereby causing removal of the seal plug (5) from the receiving chamber (14)

2. A sealing mechanism as claimed in claim 1, wherein a sleeve (6) is arranged to be located in said opening portion (3) of the vessel (2), and the protruding portion is provided on the sleeve (6).

3. A sealing mechanism as claimed in claim 2, wherein the sleeve has a flange portion (23) which is secured to an outer end surface of the opening portion (3).

4. A sealing mechanism as claimed in claim 1, wherein the vessel (20) has a storage portion (7) to which the opening portion (3) can be joined.

5. A sealing mechanism as claimed in claim 4, wherein the protruding portion (22) is provided on an inner surface of the opening portion (3).

6. A sealing mechanism as claimed in claim 5, wherein the opening portion (3) is defined by a tubular member having an annular flange (24) which can be joined to a corresponding annular flange (25) formed on a mouth of the storage portion (7).

7. A method of sealing a vessel (2) by means of the sealing mechanism claimed in claim 2, comprising fixing said sleeve (6) to the opening portion (3);
charging a first material (31) into the vessel (2);
charging a second material (32) into the receiving chamber (14), and closing the receiving chamber (14) by attaching the seal plug (5), and applying the cap (1) to the vessel to close the vessel (2).

8. A method of sealing a vessel (20) by means of the sealing mechanism claimed in any of claims 4, 5 or 6, comprising joining the opening portion (3) to the storage portion (7);
charging a first material (31) into the vessel (20);
charging a second material (32) into the receiving chamber (14), and closing the receiving chamber (14) by attaching the seal plug (5), and applying the cap (1) to the vessel to close the vessel (20).

Fig.1

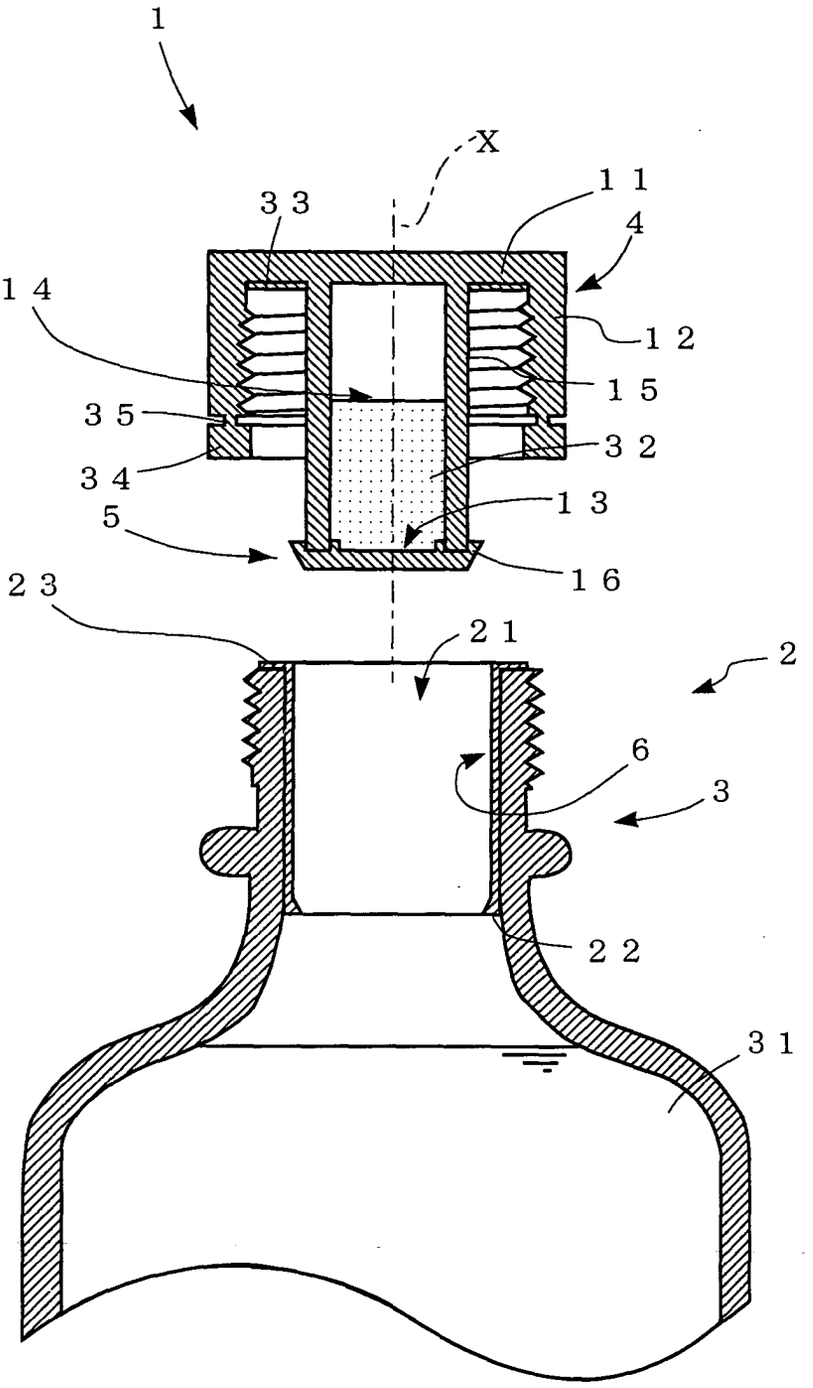
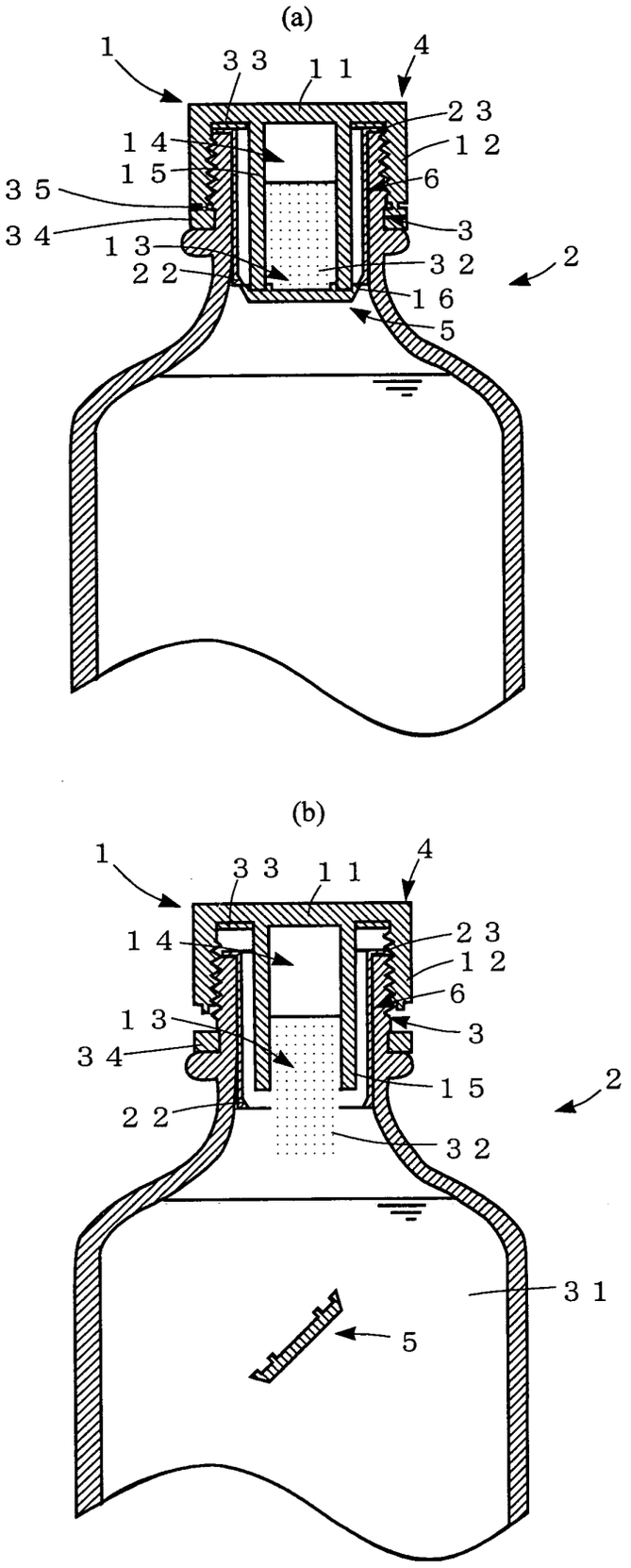


Fig.2


(a)
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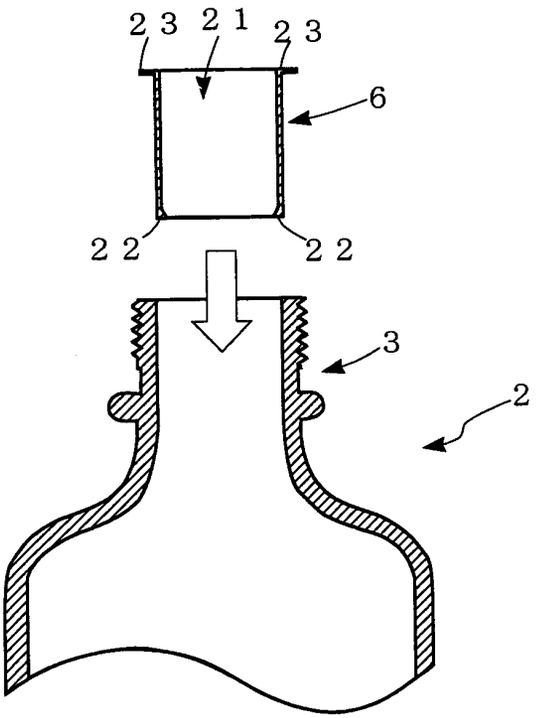
3 5
3 4
3
1 3
3 2
2
2 2
1 6
5
(b)
1
3 3
1 1
4
1 4
2 3
1 2
6
1 3
3
3 4
1 5
2
2 2
3 2
3 1
5

Fig.3

(a)



(b)

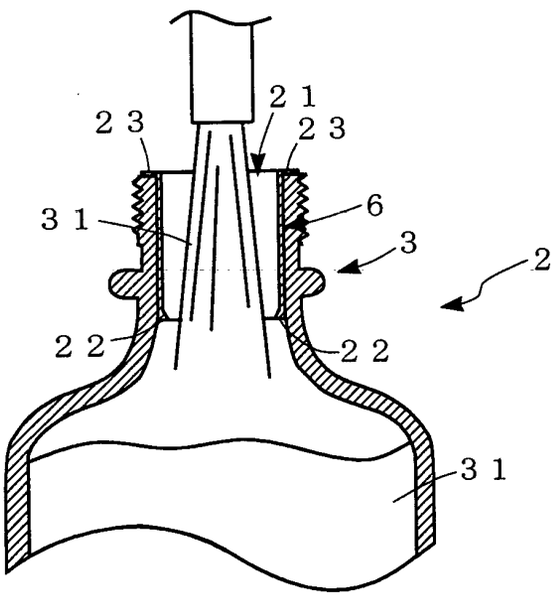


Fig.4

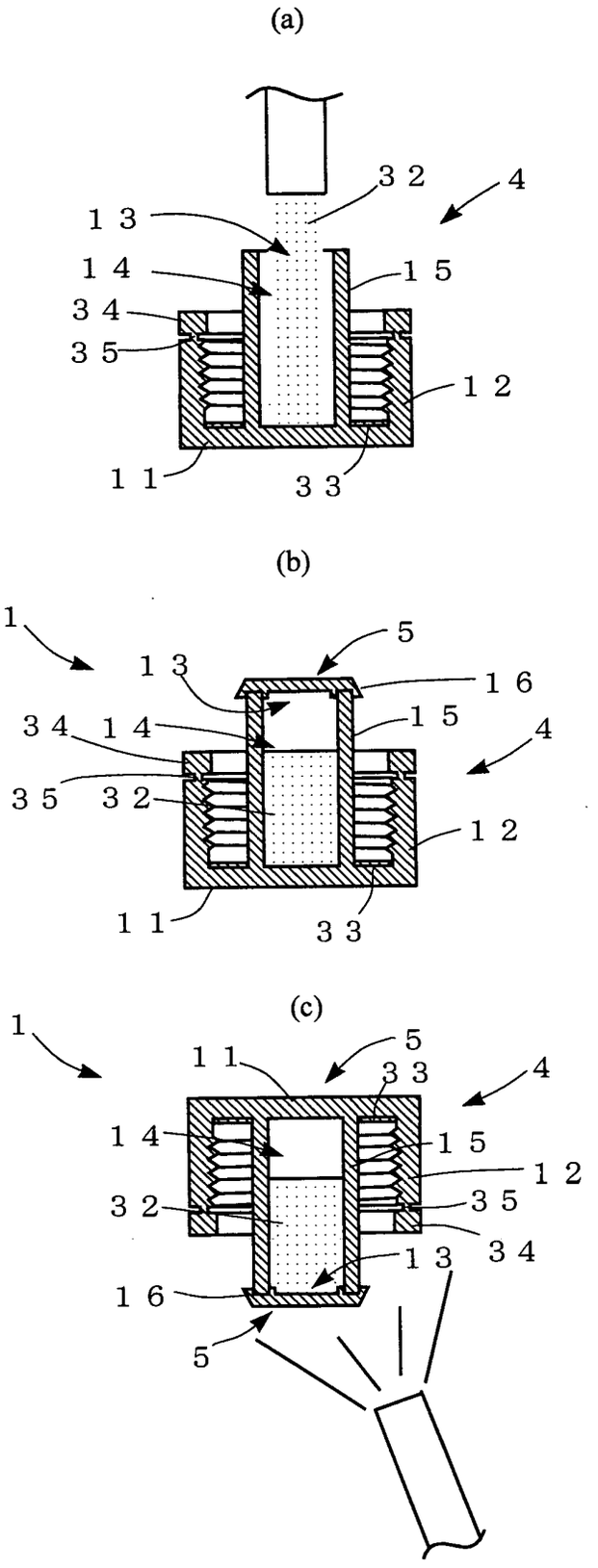

(a)
3 2
4
1 3
1 4
1 5
3 4
3 5
1 2
1 1
3 3
(b)
1
5
1 3
1 6
1 5
3 4
1 4
4
3 5
3 2
1 2
1 1
3 3
(c)
1
5
1 1
3 3
4
1 4
1 5
1 2
3 2
3 5
3 4
1 3
1 6
5

Fig.5

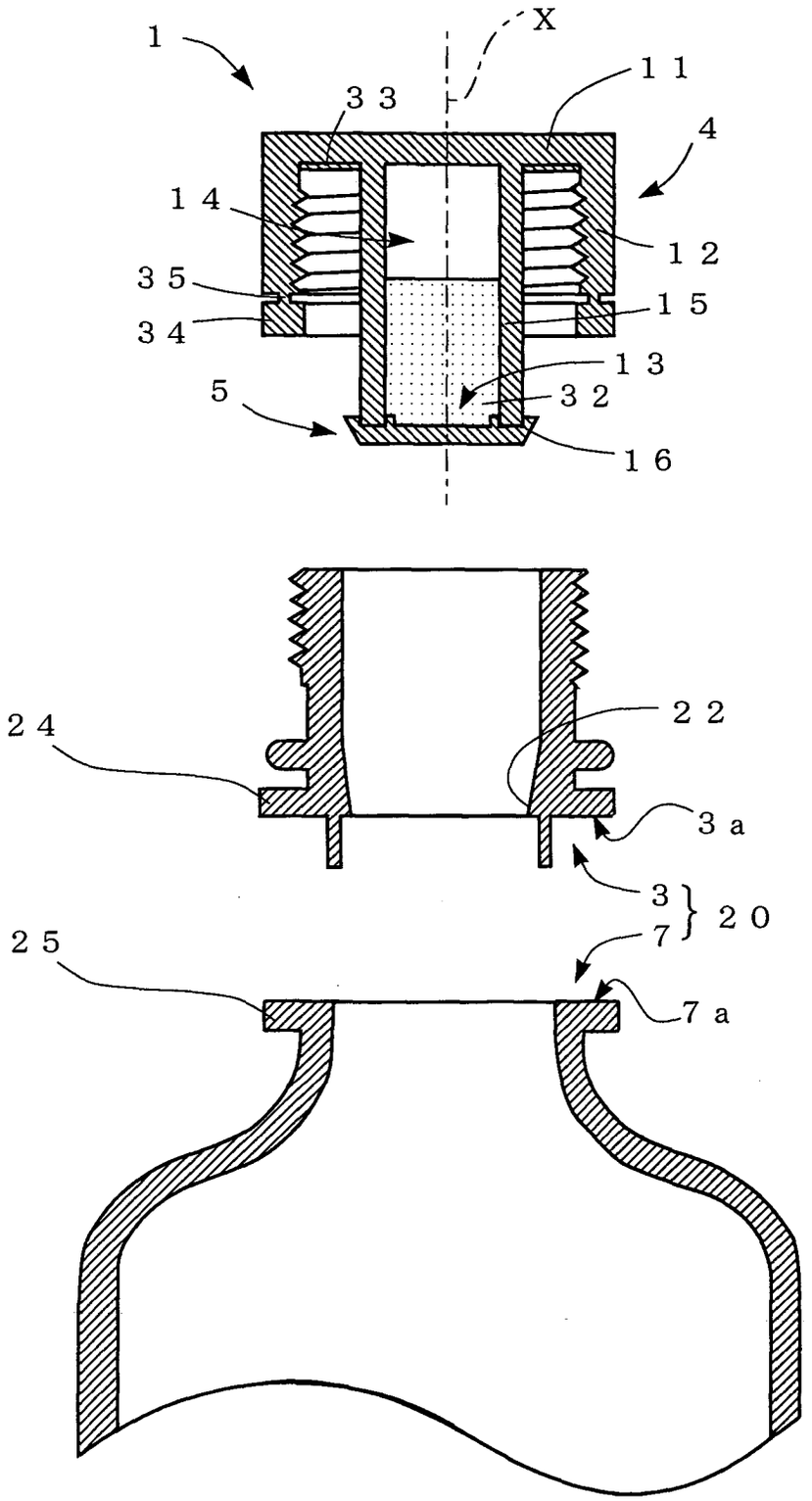
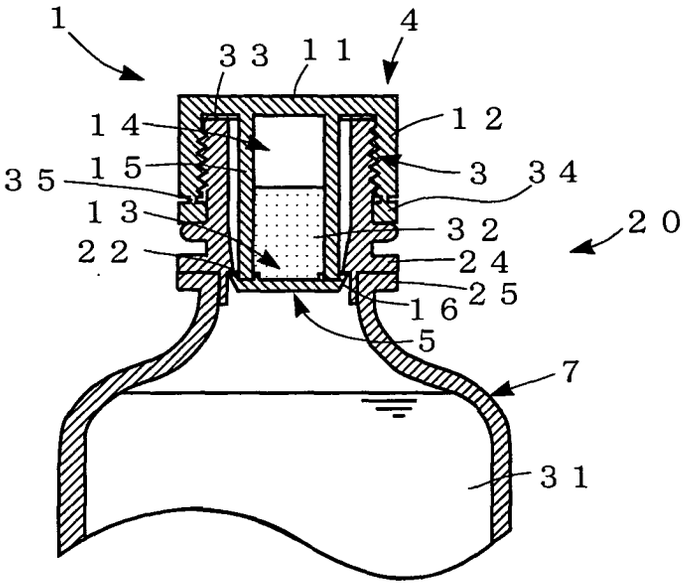


Fig.6

(a)


1
4
3 3
1 1
1 2
1 4
1 5
3
3 4
3 5
1 3
3 2
2 0
2 2
2 4
2 5
1 6
5
7
3 1

(b)

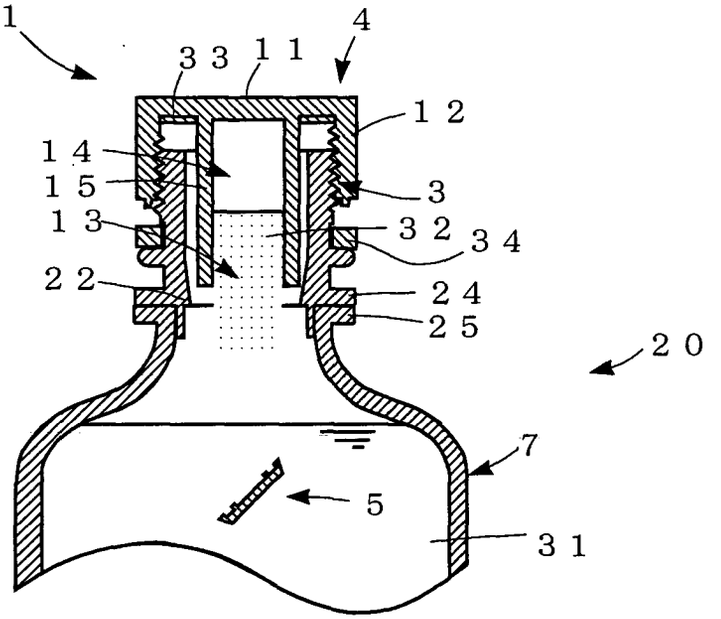

1
4
3 3
1 1
1 2
1 4
1 5
3
1 3
3 2
3 4
2 2
2 4
2 5
2 0
7
5
3 1

Fig.7