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(71) Applicant: **CURVER B.V.**
NL-5050 AA Goirle (NL)

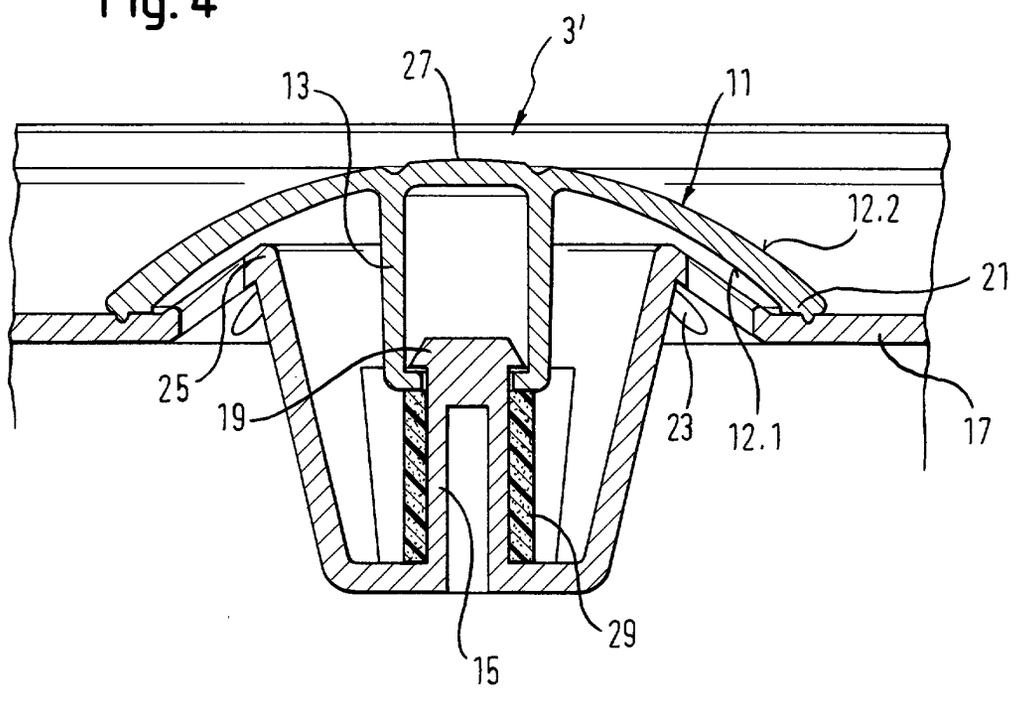
(72) Inventor: **van den Bosch, Jules**
5061 AP Oisterwijk (NL)

(74) Representative: **Weber-Bruls, Dorothée, Dr.**
Forrester & Boehmert,
Pettenkoferstrasse 20-22
80336 München (DE)

(54) Multifunctional pressure regulation valve

(57) The invention relates to a multifunctional pressure regulation valve for a hollow body, in particular for a food container, which comprises a valve segment with a hole and a flexible device, which covers said hole characterized in that the valve (3,3',3",3"') comprises at least one valve segment (17,17') which comprises at least one hole (23,23',23") and at least one circumferential wall (25), and/or two or more separate walls (25) inside its peripheral zone (22); and that said flexible device is a resiliently flexible curved device (11,11',11") which is adapted to cover said valve segment and which is adapted to form interior (12.1) and exterior (12.2) sides of a valve head, which has a convex orientation when the valve (3,3',3",3"') is closed and a less convex, flat or concave orientation when the valve is opened, wherein the edges of said flexible device are in contact with the peripheral zone (22) of said valve segment when the valve is closed, and wherin said flexible device is connected to said valve segment via at least one of said circumferential walls or via two or more of said separate walls, the distance within the boundaries of the wall(s) allow said flexible device to be changed from a convex to concave orientation and vice versa.

Fig. 4



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Description

[0001] The present invention refers to a multifunctional pressure regulation valve for a hollow body, in particular for a food container, which comprises a valve segment with a hole and a flexible device which covers said valve segment.

[0002] Food containers are common and versatile household articles which not only serve to store food, but are frequently also used as receptacles for heating food, e.g. in a micro-wave oven. Therefore, high quality food container have to fulfill various requirements. On the one hand, they have to be made from food approved materials which do not release any compounds which might contaminate the food, neither over long storage, nor when subjected to heat or radiation. A food container also has to withstand severe changes in temperature, e.g. from -18°C to 100°C, still retaining its shape and appearance even after long periods of use. Food container especially should remain airtight during storage to prevent air, humidity, molds or bacteria from getting in contact with the food. Therefore, in most cases there is a close fit between the lid of the container and the container itself. However, when stored in a refrigerator these containers most often are difficult to open since the pressure inside the container is below atmospheric pressure. When used for heating or cooking food, for example in a micro-wave oven, the gas pressure inside the container might open the lid in an uncontrolled fashion. In order to tackle all these problems, valve systems have been incorporated into food containers.

[0003] Until now, several valve systems for food containers have been proposed. For example, US 5,989,608 A discloses a food container for cooking through use of a micro-wave oven. This food container has a hole and a pressure regulation valve attached to the food container to close the hole. This pressure regulation valve comprises a cover film, an adhesive layer applied over the surface of the cover film facing the food container and a separator film disposed between the adhesive layer and the food container, and having an area larger than that of the hole but smaller than that of the cover film. When the pressure within the food container reaches a predetermined level the cover film partially separates from the food container in order to release the vapor pressure. However, since the valve material is constantly exposed to steam or spouts of hot water or other fluids when in use, it tends to deteriorate rather easily thereby losing its ability to operate properly. It, for example, does not close tightly once it has opened and, thus, has to be replaced after use. As a consequence, the use of said valve is limited to that of an overpressure valve.

[0004] US 5,988,592 discloses a valve for dispensing fluid food products. This valve consists of an elastic member which contains a slit which is usually closed. In closed position the slit covers an outlet end of a product discharge tube. Pressing of the elastic member of the covering slit stretches the slit open and allows the fluid product to be dispensed. However, the manufacture of this valve is rather complicated and expensive because of the many different parts of the valve which in addition consists of a hole range of different materials. Also, this valve can not be used as a pressure regulation valve.

[0005] Another valve system especially designed for microwave cookware can be found in a food container of HP Haushaltsprodukte GmbH, Montabaur, called MICRO Selection 180° (item number 534). This valve is incorporated into the lid of the food container. It comprises a solid non-flexible disc to which several pins are attached, and which is embedded into the surface of the lid, which contains several openings. These pins are engaged in some of the openings of said surface of the lid. The remaining openings are also located beneath the non-flexible disc. The pins have a bulge at their respective ends which acts as a limit stop. Thus, overpressure can be released by pulling the disc away from the lid. However, due to the small surface covered by the top parts of the pins and the remaining openings only a very large overpressure can cause the valve to open automatically, thereby furnishing a rather violent pressure release. Only when a less tighter fit is applied between the pins and their openings this problem might be circumvented. However, a less tight fit between pins and openings results in a food container which is not properly airtight any longer.

[0006] Moreover, once this valve system is opened it has to be closed manually to regain an airtight closure. Also, since the non-flexible disc is embedded in the surface of the lid, it is only difficult to open manually and can harm the user, especially when the container with the valve system has been kept in a refrigerator or a microwave oven prior to its opening.

[0007] Finally, a generic valve is known from EP 0 794 127 A2. This document discloses a dispensing package which comprises a self-sealing dispensing valve. The valve comprises a valve head with a discharge opening formed by slits in the flexible valve head. When a predetermined discharge pressure is reached the valve head shifts outwardly due to resiliently flexible connective sleeves, and the slits in the flexible valve head open to dispense the fluid product. Because of the complicated structure of this valve its manufacture is difficult and expensive. In addition, each valve is only adapted to a single discharge pressure. Therefore, only minor deviations of the desired discharge pressure require a completely different valve device.

[0008] It is therefore the object of the present invention to provide a valve overcoming the drawbacks of the prior art. In particular, it is the object of the present invention to provide a pressure regulation valve which is easy to manufacture, does not deteriorate when exposed to steam or hot fluids, and which works reproducibly and reliably well over very long periods, at least the lifetime of, e.g., food containers for cooking through use of a micro-wave oven.

[0009] This object is achieved by a multifunctional pressure regulation valve comprising at least one valve segment which comprises at least one hole and at least one circumferential wall, and/or two or more separate walls inside its peripheral zone; and a resiliently flexible curved device which is adapted to cover said valve segment, and which is adapted to form interior and exterior sides of a valve head, which has a convex orientation when the valve is closed and a less convex, flat or concave orientation when the valve is opened, wherein the edges of said flexible device are in contact with the peripheral zone of said valve segment when the valve is closed, and wherein said flexible device is connected to said valve segment via at least one of said circumferential walls, or via two or more of said separate walls, the distance within the boundaries of the wall(s) allows said flexible device to be changed from convex to concave orientation and vice versa.

[0010] This object is also achieved by a multifunctional pressure regulation valve comprising at least one valve segment which comprises at least one hole, and at least one circumferential wall, or two or more separate walls inside its peripheral zone; and a resiliently flexible curved device which is adapted to cover said valve segment, and which is adapted to form interior and exterior sides of a valve head, which has a convex orientation when the valve is closed and a less convex, flat or concave orientation when the valve is opened, the edges of said flexible device are adapted to be in contact with the peripheral zone of said valve segment when the valve is closed wherein the distance within the boundaries of the wall(s) allows said flexible device to be changed from convex to concave orientation and vice versa; and wherein said valve segment and said flexible device each comprise at least one guiding means which correspond to each other and which act in combination to allow for a reproducible switch between convex and concave orientation of said flexible device, and which fix said flexible device to said valve segment.

[0011] The valve according to the invention can be an integral part of a hollow body, lid or container, or it can be a separate device which can be affixed to an opening of the hollow body, lid or container, for example by glueing, clamping, pressing or welding. Preferably, the valve according to the invention is an integral or separate part of the lid of a container. However, also the container itself may comprise at least one of these valves. Usually, one pressure regulation valve positioned in the lid of a container suffices for dispensing fluids or for ventilation.

[0012] The valve according to the invention comprises a resiliently flexible curved device, hereinafter also called flexible device, which has an interior and an exterior side and which has a convex orientation when the valve is closed, and an underlying valve segment. The valve segment can be part of the hollow body, the lid or the container or can belong to a separate valve system. This valve segment comprises a peripheral zone on which the circumference or rim of the flexible device rests when the valve is closed, an inner part within the boundaries of the peripheral zone, and at least one hole in said inner part. The flexible device covers the valve segment thereby covering as well the hole(s) in said valve segment. The flexible device is curved, especially when it seals the hole(s) of the valve segment, then being in its convex orientation. Thus, the circumference of a curved flexible device lies above or below its central part. Such a device is flexible if it can, for example, be turned over from convex to concave orientation in a reversible manner for many times without being broken or destroyed. According to the invention, a resiliently flexible device means that the curved device has a structural strength in itself which, for example, makes the device resisting a change in form or orientation just by its own weight. Therefore, additional external forces are usually necessary to change the form of the resiliently flexible device. The flexible device can be made from plastic, especially from thermoplastic elastomers (TPE) or from metals, e.g. thin metal plates. The flexible device may have any shape as long as it fulfills the above mentioned requirements, i.e. it closes the hole(s) of the valve segment in an airtight fashion and it can be turned from convex to concave orientation and vice versa. For example, the flexible device may have the shape of a square, rectangle, circle, ellipse, triangle, pentagon, hexagon or any other polygonal form. In a preferred embodiment, the flexible device has a circular or elliptic shape. In order to guarantee a tight fit between the flexible device and the underlying valve segment it sometimes is advantageous to strengthen or harden the rim of the flexible device. An enhanced tight fit can also be achieved by providing the valve segment with a circumferential groove or groove-like structure, and the edge or rim of the flexible device on its interior side with a bulge or bulge-like structure which fits into the groove when the valve is closed.

[0013] The flexible device according to the invention operates as a valve head. In its closed convex orientation the interior side of the flexible device is not exposed to the atmosphere outside the container. Only when the valve is opened the interior side is visible from outside the container.

[0014] In one aspect of the invention the flexible device is connected to the valve segment via one or more circumferential walls or via two or more separate walls. The walls are either an integral part of the valve segment or additionally fixed to the valve segment, e.g. by glueing, welding or other well known fixing means. The circumferential wall and/or the two or more separate walls are located within the peripheral zone of the valve segment. The distance between the boundaries of these walls allows the flexible device to be changed from convex to concave orientation. In general, the flexible device is linked to the top part of these walls, for example, with the aid of hinges or clips. The interior side of the flexible device may also be welded or glued to these walls. In case a circumferential wall is used it has to be

provided for at least one additional hole, either in this wall or in the valve segment or the central part of the flexible device lying in the boundaries of the wall, to allow for a pressure balance. Separated walls are preferably aligned along a circular or elliptic line. They may be straight or bent. The flexible device is connected to at least two of these walls in a manner as described above. The distance between separate walls facing each other or the diameter of a circumferential wall has to be chosen in such a way that it is possible to press onto the central part of the flexible device, thereby allowing the flexible device to switch from convex to concave orientation. This distance mainly depends on the size of the flexible device and the material it is made from.

[0015] The valve segment and/or the flexible device of the present invention might each comprise at least one guiding means which correspond to each other and which act in combination to allow for a reproducible switch between convex and concave orientation of the flexible device. Suitable guiding means are described in more detail in the following.

[0016] In another aspect of the invention the flexible device is not connected to a circumferential wall or to two or more separate walls, but is fixed to the valve segment via corresponding guiding means. However, although the flexible device is fixed to the valve segment via a guiding means it is still possible that the interior side of the flexible device, or part of it, is in contact with the top of said walls when the valve is closed. In another embodiment the top of said walls does not touch the interior side of the flexible device when the valve is closed, but is in contact with the flexible device when the valve is opened. The guiding means comprise pin or pin-like structures on the one side, and orifices, claws, claw-like structures, tubes or containers on the opposite side, which are complimentary to each other while engaged. In one embodiment the guiding means of a flexible device comprises at least one pin or pin-like structure on its interior side, and the guiding means of the valve segment comprises at least one orifice or at least one claw, claw-like structure, tube or container complimentary to said pin or pin-like structure which engage said pin or pin-like structure at least when the flexible device is moved towards the direction of its concave orientation. In another embodiment the guiding means of the valve segment comprises at least one pin or pin-like structure, and the guiding means of the flexible device comprises at least one orifice, or at least one claw, claw-like structure, tube or container on its interior side complimentary to said pin or pin-like structure which engage said pin or pin-like structure at least when the flexible device is moved towards the direction of its concave orientation. These guiding means are preferably located at a central part of the flexible device. For example, the pin or the tube or container is fixed to the interior side of the flexible device at a position which is furthest apart from the plane stretched out by the circumference of the flexible device when in convex orientation, and is directed towards the valve segment where the corresponding guiding means is positioned. In order to fix the flexible device to the valve segment when a pin or pin-like structure is used it is supplied with a limit stop, preferably at its terminal part, e.g. in the form of a bulge or broadened pin-element. If an orifice is the corresponding guiding means its diameter has to be chosen in such a way that it is smaller than the bulge or broadened part of the terminal part of the pin so that the flexible device can not be completely detached from the valve element. Similarly, a container or tube into which a pin with said bulge or broadened terminal end is engaged can be supplied with walls which are tapered towards the opening or which are bent towards each other at the opening part thereby preventing the passage of the limit stop. The same applies when claw or claw-like elements are used as guiding means. In a preferred embodiment, the length of the pin and/or the position of the limit stop are as such that the curved flexible device can not adopt its original convex curvature, but only a less convex shape thereby exerting a pre-stress on the flexible device when in closed position. In this way an even tighter fit is achieved between flexible device and the peripheral zone of the valve segment.

[0017] In addition, the pin or pin-like structure may have at least one holding notch, which usually can be of similar shape than the limit stop. However, since a holding notch should fix a flexible device in a predetermined position only temporarily, e.g. to adjust the amount of fluid to be dispensed, it can be a bit smaller in size than the limit stop. As does the limit stop in a preferred embodiment, also the holding notch allows to exert a pre-stress on the flexible device when in closed position. By having several holding notches along a pin or pin-like structure the degree of pre-stress on the flexible device can be varied, as long as the flexible device does not turn into flat or concave orientation, or as long as the interior side of the flexible device does not rest on the top of the walls of the valve segment. In this way, the pressure at which the overpressure shall be released can be easily adjusted.

[0018] In another embodiment, a flexible device is not only fixed to the valve segment by guiding means, but is also connected to one or more circumferential walls or to two or more separate walls as described above.

[0019] The surface of the valve segment which comprises the hole(s) and the wall(s) may be in plane of the lid or the container. However, in one preferred embodiment of the invention this valve segment comprises within the boundaries of its peripheral zone a depressed or deepened area, most preferably in its center part, furnishing a greater distance between the bottom of the this area and the central part of the flexible device in its convex orientation. Preferably, the guiding means, e.g. the claws, the claw-like elements, the container or the pin or the tube are attached to this deepened area. The circumferential wall or the two or more separated walls can be placed on the rim of this deepened area. Also,

the rim of the deepened area of the valve segment itself may lie above a plane stretched out by the peripheral zone of the valve segment, thereby substituting the before mentioned walls or being part of them.

[0020] The invention, together with further objects and advantages, maybe best understood with reference to the following description taken together with the accompanying drawings, in which

Figure 1 is a perspective view of a food container comprising a multifunctional valve according to the invention;

Figure 2a is a perspective view of the lid of the food container of Figure 1 when the valve is closed;

Figure 2b is a cross sectional view of the valve of Figure 2a;

Figure 3a is a perspective view of the lid of the food container of Figure 1 when the valve is opened;

Figure 3b is a cross sectional view of the valve of Figure 3a;

Figure 4 is a cross sectional view of a second embodiment of a valve according to the invention;

Figure 5a is a perspective view of the interior side of the flexible device of the valve of Figures 1 to 4;

Figure 5b is a top view of the interior side of the flexible device of the valve of Figures 1 to 4;

Figure 6 is an exploded view of a third embodiment of a valve according to the invention;

Figure 7a is a top view of the interior side of a flexible device of a forth embodiment of the valve according to the invention;

Figure 7b is a cross sectional view of the valve of Figure 7 when closed; and

Figure 7c is a cross sectional view of the valve of Figure 7a when opened.

[0021] In Figure 1 a food container 1 according to a first embodiment of the present invention is illustrated which comprises a valve 3 positioned in a lid 5 of the food container 1. The lid 5 covers the receptacle 7 of the food container 1. The food container 1 may also comprise handles 9.

[0022] Figures 2a and 2b show the lid 5 of Figure 1 and a closed valve 3. As can be seen from Figure 2b the valve 3 comprises a resiliently flexible curved device 11 in its convex orientation to which a first guiding means 13 is attached on its interior side. The terminal ends of the guiding means are bent towards each other to form a claw-like structure. This first guiding means 13 engages a second guiding means 15 which has a pin or pin-like structure. This second guiding means 15 is attached to the valve segment which forms a part of the lid 5. The guiding means 15 comprises a limit stop 19 for the claw device 13. This limit stop 19 fixes the flexible device 11 to the underlying valve segment which is part of the lid 5. In this way, the flexible device 11 exhibits a pre-stress in its closed position and is safely connected to the valve segment. Furthermore, the circumference or edge 21 is pressed onto the surface of the valve segment in its peripheral zone 22. The holes or openings 23 are located between the rim or wall 25 of the valve segment and its peripheral zone 22 where the edges of the closed flexible device rest. In such a way, fluids can not leak from the food container 1 when the valve 3 is closed.

[0023] Figures 3a and 3b show valve 3 when it is open. The flexible device 11 is in concave orientation thereby rendering holes 23 open. A part of the interior side of the flexible device 11 rests on the wall 25 of the valve segment 17.

[0024] Valve 3 as detected in the Figures 1, 2, 3b can be operated in the following way, irrespective of whether the valve serves as a dispensing means for fluids or is used for the ventilation of hollow bodies.

[0025] In order to open the valve 3 one has to press onto a central part 27 of the flexible device 11 being in its closed convex orientation as shown in Figures 2a and 2b, whereby the central part 27 of the flexible device 11 is moved towards the valve segment 17 of the lid 5. This movement is guided by the claw device 13 which engages pin 15. The wall 25 operates as a support for the flexible device 11 while its central part is moved downwards. Due to the flexible properties of the curved device 11, at some point of this movement the shape of the device turns or snaps over from convex to concave orientation, thereby rendering the holes 23 open. After having dispensed fluids or ventilated the container the valve can be closed easily by pressing the edges or the circumference 21 of the flexible device 11 towards the surface of the valve segment 17 of the lid 5. Again, the wall 25 supports the interior side of the flexible device 11 at least as long as the flexible device 11 has not turned over from concave to convex orientation. As can be derived from Figure 2b the movement of the flexible device 11, which is subjected to a pre-stress in its convex orientation, is limited by limit stop 19. In this way, the edges or circumference 21 not only rests on, but are pressed onto the surface of the valve segment 17 of the lid 5 securing a much tighter closure.

[0026] If the food container 1 is used, for example, in a micro-wave oven the valve 3 can also function as a safety pressure valve, which releases overpressure. At

the beginning of the cooking process the valve 3 is in the position as shown in Figures 2a and 2b. The pressure in the food container 1 is the same in the volume between the flexible device 11 and the surface 17 of the lid 5 due to the openings 23. If the overpressure reaches a predefined level this overpressure forces the flexible device 11 either to shortly open or to snap from its convex orientation as shown in Figures 2a and 2b into its concave orientation.

[0027] Figure 4 shows a valve 3' according to another embodiment of the invention used in food container 1. Same parts of this valve 3' in comparison to valve 3 of Figures 1 to 3b carry the same reference numbers. Different from valve 3 valve 3' comprises in addition a spring element in form of an elastic cylinder 29 which surrounds the pin 15 and engages on one side the claw device 13 and on the other side the surface of the valve segment 17 of lid 5. Valve 3' functions as follows:

[0028] By pressing the central part 27 of the flexible device 11, e.g., for dispensing fluids or for ventilation, flexible device 11 turns from its convex to a less convex, flat or concave orientation thereby uncovering the openings 23. If the pressure on the central part 27 is released, the flexible device 11 automatically switches into its convex orientation due to spring element 29.

[0029] In Figures 5a and 5b a flexible device 11 as used in the two before mentioned embodiments is shown. The reference numbers correspond to the reference numbers in the above described figures. The circumference 21 has a flat design to be able to align properly to the surface of the peripheral zone 22 of the valve segment 17. The guiding means 13 attached to the central part 27 of the flexible device 11 has the shape of a cylinder, tube or a frustum having a hole in its bottom part.

[0030] In Figure 6 a valve 3" as a third embodiment of the invention is illustrated. In comparison to the above mentioned embodiments valve 3" comprises a flexible device 11' to the central part 27' of which a pin 15' is attached as a guiding means. The surface of the valve segment 17' of lid 5' comprises as the second guiding means an orifice 31 to engage pin 15'. The contour of pin 15' is tapered towards its terminus to achieve a limit stop 19' for securing flexible device 11'. Furthermore, the contour of pin 15' comprises a linear part 33 and an oblique part 35. By pressing onto the central part 27' of flexible device 11' the pin 15' is moved into orifice 31 as long as the diameter of the pin is smaller than that of the orifice. Further pressing furnishes a pin which is clamped in the orifice. In such a way the flexible device can be reversibly adjusted or fixed at a predetermined position, which also allows the flexible device not to be bent too harshly.

[0031] Figures 7a to 7c show as a forth embodiment of a valve according to the invention a valve 3"' which comprises a flexible device 11" having reinforcement elements in form of fins 39 and a circumferential wall 25' as a support means 41. A pin 15" is attached to the central part 27" of the flexible device 11" as a first guiding means. A second claw-like guiding means 13' is attached to the surface of the valve segment 17" so that it corresponds to the first guiding means. The pin 15" has a limit stop 19" and a plurality of holding notches 37.

[0032] The valve 3"' operates in the following way:

[0033] By pressing onto the central part 27" of the flexible device 11", e.g., when the valve is closed as shown in Figure 7b, the pin 15" is further moved into the claw device 13'. Due to the holding notches 37 a change in orientation of the flexible device 11" from convex, less convex, flat to concave orientation is discontinuous and the flexible device 11" can be fixed in a predetermined position. When the valve is used as a dispensing device for fluids, in this way the amount of dispensed fluid can be properly adjusted. If the pin 15" is forced further into the claw device 13' by pressing onto the central part 27" at a predetermined point flexible device 11' snaps from its convex orientation as shown in Figure 7b into the concave orientation as shown in Figure 7c. When in concave orientation a stress illustrated by the arrows lateral to the fins 39 is introduced into the fins 39. If the pressure on the central part 27" is released this force acts to close the valve 3"' automatically. For this movement it is advantageous that the cross sections of the holding notches have a tapered shape, the broadest part being closest to the valve segment 17", e.g. that of a triangle, thereby reducing the forces acting against this movement of pin 15" and flexible device 11".

[0034] In another embodiment of valve 3"' (not shown) the pin 15" only comprises the limit stop 19" without any holding notches 37. In a further embodiment of valve 3"' (also not shown) a spring element is incorporated between claw elements 13' of the second guiding means thereby acting on the top of the pin-like structure when engaged into the claw-like guiding means.

[0035] The pressure regulation valve according to the invention can be used for ventilation as well as for dispensing fluids. Furthermore, it serves as an overpressure release means which closes automatically after the overpressure has been released. In addition, with the use of holding notches the pre-stress in the closed flexible device can be properly adjusted, thereby enabling to manipulate the overpressure at which the valve should open. Also, the valve according to the invention can be closed and opened manually. For example, a pressure balance can easily be achieved when the pressure inside a container or hollow body is below atmospheric pressure due to cooling in a refrigerator. In this way the handling of food containers can be considerably facilitated. Furthermore, the valve according to the invention is easy to manufacture, consists of little separate pieces, and has a very long lifetime. It can be applied to metal as well as to plastic containers or any other container material.

[0036] Although modifications and changes maybe suggested by those skilled in the art, it is the intention of the applicant to embody within the patent warranted

hereon all changes and modifications as reasonably and probably come within the scope of this contribution to the art. The features of the present invention which are believed to be novel are set forth in detail in the appended claims. The features disclosed in the description, the figures as well as the claims could be essential alone or in every combination for the realization of the invention in its different embodiments.

Reference number list

[0037]

1	food container, hollow body
3, 3', 3", 3"'	valve
5, 5'	lid
7	main part, receptacle of container
9	handle
11, 11', 11"	resiliently flexible curved device
12.1	interior side of flexible device
12.2	exterior side of flexible device
13, 13'	claw element, first guiding means
14	terminal part of claw element
15, 15', 15"	pin, second guiding means
17, 17'	surface of valve segment, valve segment
19, 19', 19"	limit stop
20.1	bulge or bulge-like element
20.2	groove or groove-like element
21	circumference, edges of flexible device
22	peripheral zone of the valve segment
23, 23', 23"	opening, hole
25	raised part of valve segment, wall, rim
26.1	circumferential wall
26.2	separate walls
27, 27', 27"	central part
28	deepened area, depressed zone of valve segment
29	elastomeric cylinder, spring element
31	orifice
33	linear part of a pin
35	oblique part of a pin
37	holding notch
39	fin, curved reinforcement element
41	support mean

Claims

1. Multifunctional pressure regulation valve for a hollow body, in particular for a food container, which comprises a valve segment with a hole and a flexible device, which covers said hole **characterized in that** the valve (3, 3', 3", 3"') comprises at least one valve segment (17, 17') which comprises at least one hole (23, 23', 23") and at least one circumferential wall (25, 26.1), and/or two or more separate walls (25, 26.2) inside its peripheral zone (22); and that said flexible device is a resiliently flexible curved device (11, 11', 11") which is adapted to cover said valve segment (17, 17') and which is adapted to form interior (12.1) and exterior sides (12.2) of a valve head, which has a convex orientation when the valve (3, 3', 3", 3"') is closed and a less convex, flat or concave orientation when the valve is opened, wherein the edges (21) of said flexible device
(11, 11', 11") are in contact with the peripheral zone (22) of said valve segment when the valve is closed, and wherein said flexible device is connected to said valve segment via at least one of said circumferential walls (25, 26.1) or via two or more of said separate walls (25, 26.2), the distance within the boundaries of the wall(s) (25, 26.1, 26.2) allow said flexible device to be changed from a convex to concave orientation and vice versa.

2. Multifunctional pressure regulation valve according to claim 1, wherein said valve segment (17, 17') and said flexible device (11, 11', 11") each comprise at least one guiding means (13, 13', 15, 15', 15") which correspond to each other and which act in combination to allow for a reproducible switch between convex and concave orientation of said flexible device (11, 11', 11").

3. Multifunctional pressure regulation valve for a hollow body, in particular for a food container, which comprises a valve segment or a hole and a flexible device, which covers said hole, **characterized in that** the valve (3, 3', 3", 3"') comprises at least one valve segment (17, 17') which comprises at least one hole (23, 23', 23"), and at least one circumferential wall (25, 26.1) or two or more separate walls (25, 26.2) inside its peripheral zone (22); and that said flexible device is a resiliently flexible curved device (11, 11', 11") which is adapted to cover said valve segment (17, 17'), and which is adapted to form interior (12.1) and exterior sides (12.2) of a valve head, which has a convex orientation when the valve (3, 3', 3", 3"') is closed and a less convex, flat or concave orientation when the valve is opened, the edges (21) of said flexible device (11, 11', 11") are adapted to be in contact with the peripheral zone (22) of said valve segment when the valve is closed, wherein the distance within the boundaries of the wall(s) (25, 26.1, 26.2) allows said flexible device to be changed from convex to concave orientation and vice versa; and wherein said valve segment (17, 17') and said flexible device (11, 11', 11") each comprise at least one guiding means (13, 13', 15, 15', 15") which correspond to each other and which act in combination to allow for a reproducible switch between convex and concave orientation of said flexible device, and which fix said flexible device (11, 11', 11") to said valve segment (17, 17').

4. Multifunctional pressure regulation valve according to claim 3, wherein the top parts (24) of said wall(s) (25, 26.1, 26.2) or at least part of them are in contact with the interior side (12.1) of said flexible device (11, 11', 11") when the valve is closed.

5. Multifunctional pressure regulation valve according to claim 3, wherein the top parts (24) of said wall(s) (25, 26.1, 26.2) do not touch the interior side (12.1) of said flexible device (11, 11', 11") when the valve is closed, but are in contact with the flexible device (11, 11', 11") when the valve is opened.

6. Multifunctional pressure regulation valve (3, 3', 3", 3"') according to one of the claims 2 to 5, wherein said valve segment (17, 17') comprises a deepened area (28) within the boundaries of its peripheral zone (22) to which said guiding means (13, 13', 15, 15', 15") is attached or applied.

7. Multifunctional pressure regulation valve (3, 3', 3", 3"') according to claim 6, wherein at least part of the rim (25) of said deepened area (28) lies above a plane stretched out by the peripheral zone (22), and said part of the rim (25) forms at least part of said wall(s) (26.1, 26.2).

8. Multifunctional pressure regulation valve (3, 3', 3", 3"') according to claim 6 or 7, wherein the hole (23, 23', 23") lies between the peripheral zone (22) and the rim (25) of the deepened area (28).

9. Multifunctional pressure regulation valve (3, 3', 3", 3"') according to claim 2 to 8, wherein the guiding means of the flexible device (11, 11', 11") comprises at least one pin or pin-like structure (15, 15', 15") on its interior side (12.1), and the guiding means of the valve segment (17, 17') comprises at least one orifice or at least one claw, claw-like structure, tube or container (13, 13') complimentary to said pin or pin-like structure (15, 15', 15") and engaging said pin or pin-like structure at least when the flexible device (11, 11', 11") is moved towards the direction of its concave orientation.

10. Multifunctional pressure regulation valve (3, 3', 3", 3"') according to claims 2 to 8, wherein the guiding means of the valve segment (17, 17') comprises at least one pin or pin-like structure (15, 15', 15"), and the guiding means of the flexible device (11, 11', 11") comprises at least one orifice, or at least one claw, claw-like structure, tube or container (13, 13') on its interior side (12.1) complimentary to said pin or pin-like structure (15, 15', 15") and engaging said pin or pin-like structure at least when said flexible device (11, 11', 11") is moved towards the direction of its concave orientation.

11. Multifunctional pressure regulation valve (3, 3', 3", 3"') according to claims 9 or 10, wherein the pin or pin-like structure (15, 15', 15") and the claw(s), claw-like structure, tube, container or orifice (13, 13') are already at least partially engaged when the valve is closed.

12. Multifunctional pressure regulation valve (3, 3', 3", 3"') according to claims 9 to 11, wherein at least part of the terminal part (14) of the claw(s), claw-like structure, tube or the container which is not attached to the interior side (12.1) of the flexible device
(11, 11', 11") or to the valve segment (17, 17') is broadened or is bent towards the pin or pin-like structure (15, 15', 15").

13. Multifunctional pressure regulation valve (3, 3', 3", 3"') according to claims 9 to 12, wherein the pin or pin-like structure (15, 15', 15") comprises at least one limit stop
(19, 19', 19") and/or at least one holding notch (37).

14. Multifunctional pressure regulation valve (3, 3', 3", 3"') according to one of the preceding claims, wherein the valve comprises at least one spring element (29) which is attached to the interior side of the flexible device (11, 11', 11"), or to the valve segment (17, 17'), or to both, and/or which is attached to the guiding means of the flexible device (11, 11', 11"), or to the guiding means of the valve segment (17, 17'), or to both guiding means (13, 13', 15, 15', 15").

15. Multifunctional pressure regulation valve (3, 3', 3", 3"') according to one of the preceding claims, wherein the flexible device (11, 11', 11") comprises at least one curved reinforcement element (39), in particular in its central part.

16. Multifunctional pressure regulation valve (3, 3', 3", 3"') according to one of the preceding claims, wherein the flexible device (11, 11', 11") exhibits a pre-stress which supports its convex orientation.

17. Multifunctional pressure regulation valve (3, 3', 3", 3"') according to one of the preceding claims, wherein the flexible device (11, 11', 11") comprises thermoplastic elastomers (TPE), and/or metals.

18. Multifunctional pressure regulation valve (3, 3', 3", 3"') according to one of the preceding claims, wherein at least part of the circumference (21) of the flexible device (11, 11', 11"') has a circular, elliptic, square, rectangular, and/or polygonal form.

19. Multifunctional pressure regulation valve (3, 3', 3", 3"') according to one of the preceding claims,

wherein the edges or the circumference (21) of the flexible device (11, 11', 11") have on their interior side (12.1) a bulge or bulge-like element (20.1) which fits into a groove or groove-like element (20.2) in the peripheral zone (22) of the valve segment
(17, 17") when the valve is closed.

20. Hollow body (1), in particular a food container, comprising at least one lid (5, 5') and at least one container element (7), wherein said lid (5, 5') and/or said container element (7) comprise at least one multifunctional pressure regulation valve according to one of the preceding claims.

21. Use of a multifunctional pressure regulation valve (3, 3', 3", 3"') according to one of the claims 1 to 19 as a pressure release means, in particular in a hollow body.

Fig. 1

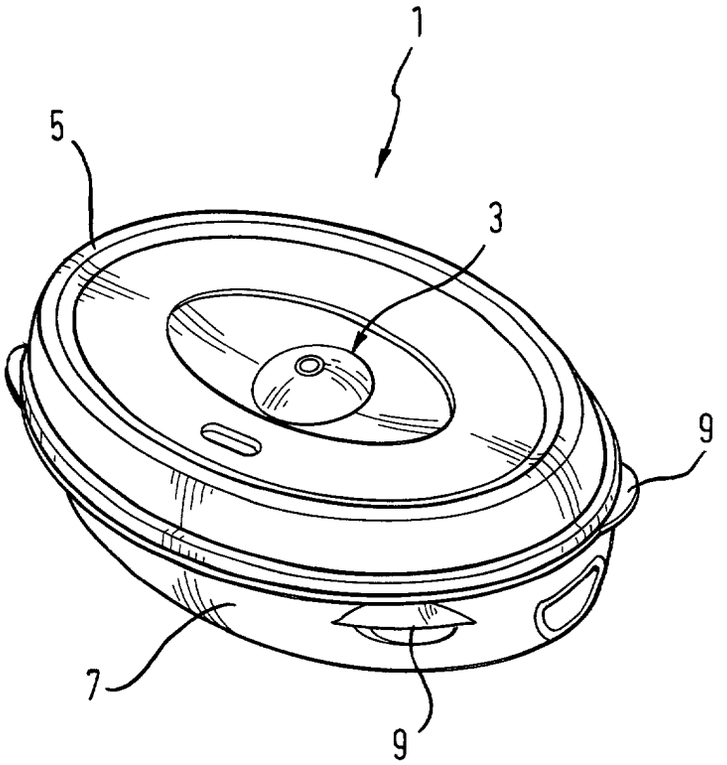


Fig. 2a

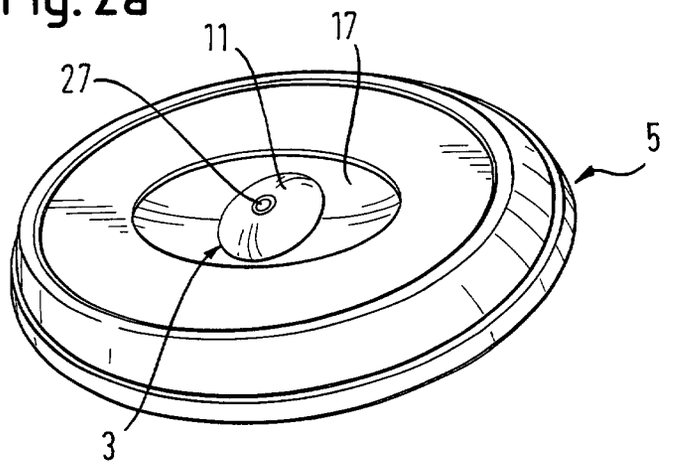


Fig. 2b

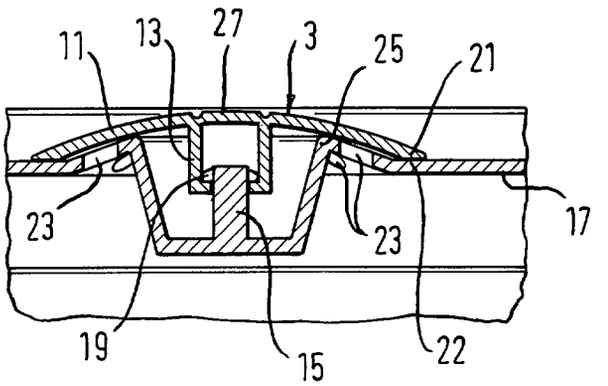


Fig. 3a

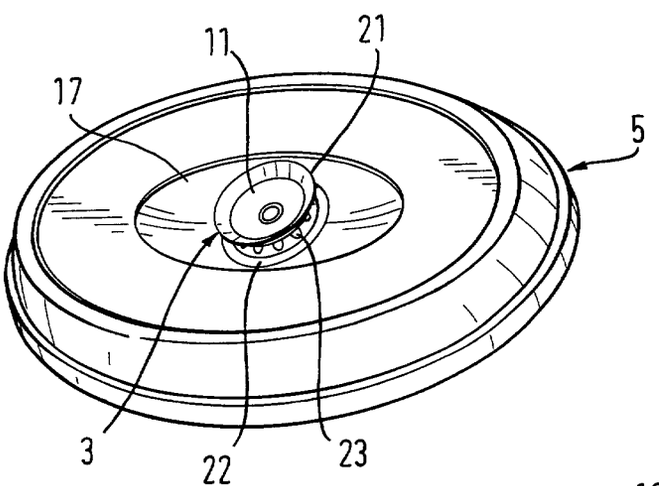


Fig. 3b

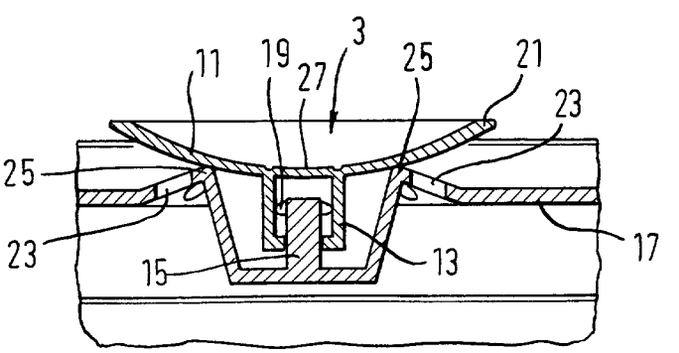


Fig. 4

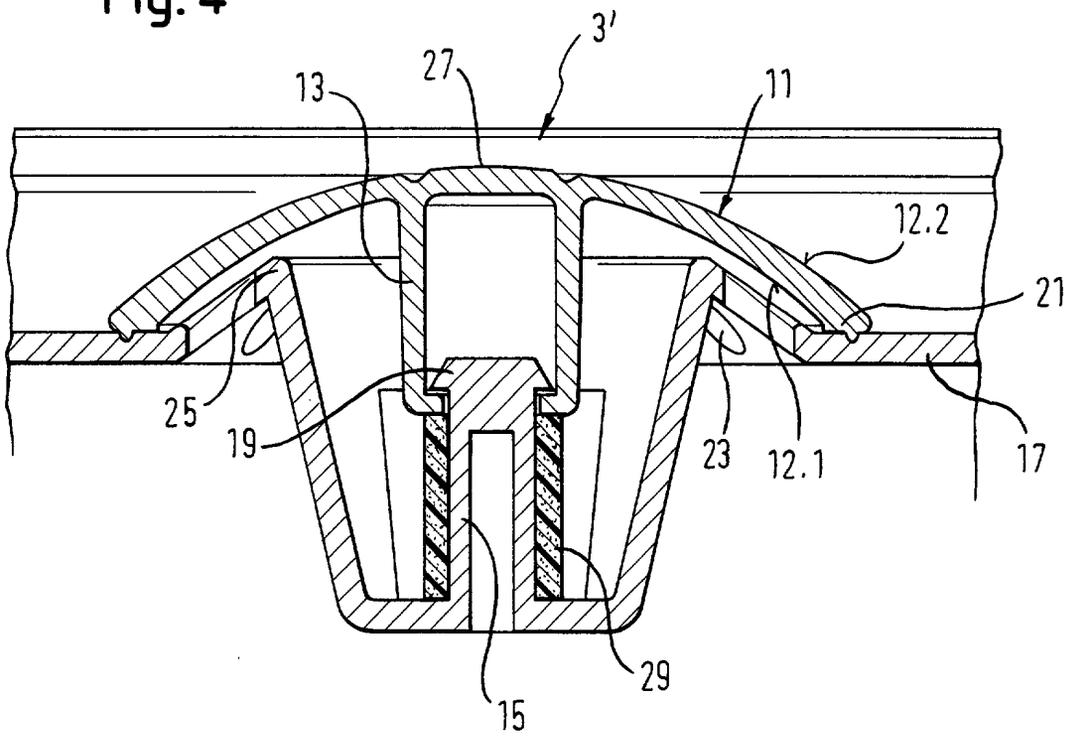


Fig. 5a

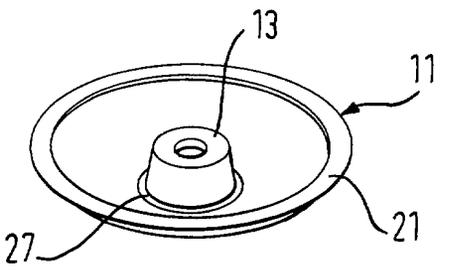


Fig. 5b

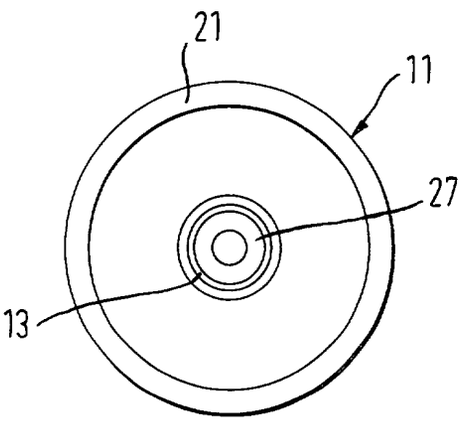


Fig. 6

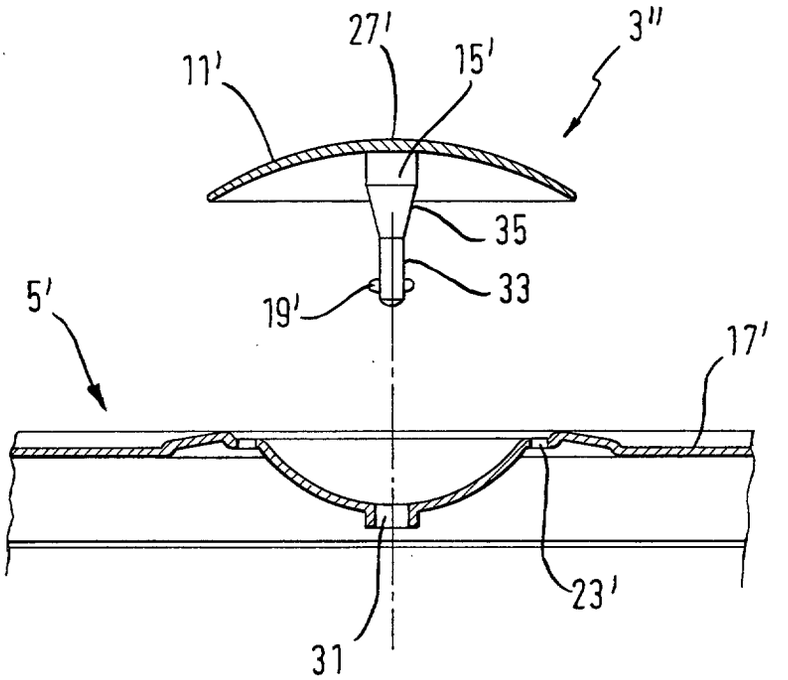


Fig. 7a

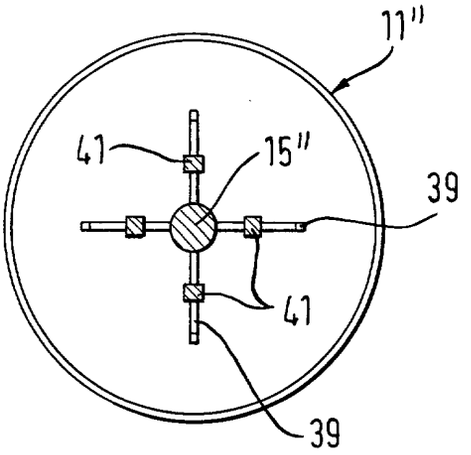


Fig. 7b

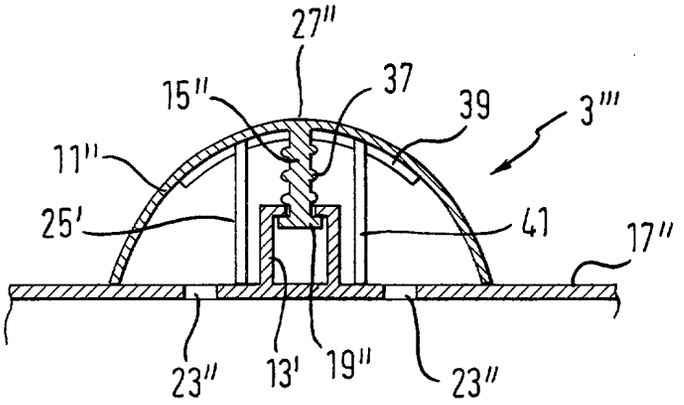
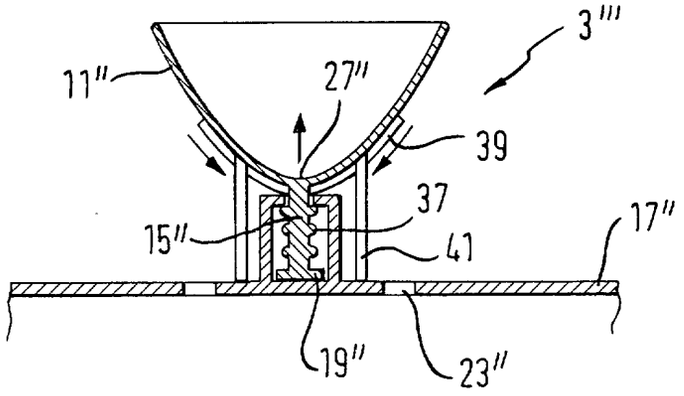


Fig. 7c



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EUROPEAN SEARCH REPORT

Application Number
EP 02 00 2309

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Y	* column 2, line 4 - column 4, line 45; figure 6 *	10	
Y	EP 0 388 828 A (ICA SPA ;SANTAGIULIANA EVANS & C TAPLAS (IT)) 26 September 1990 (1990-09-26) * figure 1 *	10	
A	WO 98 08748 A (RUBBERMAID INC) 5 March 1998 (1998-03-05) * the whole document *		
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
MUNICH	19 June 2002	Bevilacqua, V

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