(12) PATENT (11) Application No. AU 200123471 B2
(19) AUSTRALIAN PATENT OFFICE (10) Patent No. 778251

(54) Title
Filtration device for liquids

(51)6 International Patent Classification(s)
C02F 001/00

(21) Application No: 200123471 (22) Application Date: 2000.11.02

(87) WIPO No: WO01/32560

(30) Priority Data

(31) Number (32) Date (33) Country
19952757 1999.11.02 DE

(43) Publication Date : 2001.05.14
(43) Publication Journal Date : 2001.07.26
(44) Accepted Journal Date : 2004.11.25

(71) Applicant(s)
Brita GmbH

(72) Inventor(s)
Uwe Hofmann; Detlev Weyrauch; Ernst Reder

(74) Agent/Attorney
SPRUSON and FERGUSON,GPO Box 3898,SYDNEY NSW 2001

(56) Related Art
WO 1996/021621
US 5049272

AU 200123471

(12) NACH DEM VERTRAG ÜBER DIE INTERNATIONALE ZUSAMMENARBEIT AUF DEM GEBIET DES PATENTWESENS (PCT) VERÖFFENTLICHTE INTERNATIONALE ANMELDUNG

(19) Weltorganisation für geistiges Eigentum
Internationales Büro

(43) Internationales Veröffentlichungsdatum
10. Mai 2001 (10.05.2001)

PCT

(10) Internationale Veröffentlichungsnummer
WO 01/32560 A3

(51) Internationale Patentklassifikation[7]: C02F 1/00

(21) Internationales Aktenzeichen: PCT/DE00/03857

(22) Internationales Anmeldedatum: 2. November 2000 (02.11.2000)

(25) Einreichungssprache: Deutsch

(26) Veröffentlichungssprache: Deutsch

(30) Angaben zur Priorität:
199 52 757.1 2. November 1999 (02.11.1999) DE

(71) Anmelder *(für alle Bestimmungsstaaten mit Ausnahme von US)*: **BRITA GMBH** [DE/DE]; Heinrich-Hertz-Strasse 4, 65232 Taunusstein (DE).

(72) Erfinder; und

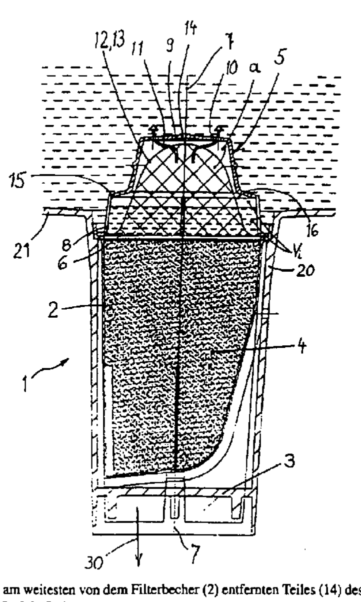
(75) Erfinder/Anmelder *(nur für US)*: **HOFMANN, Uwe** [DE/DE]; Bruehlstrasse 4, 65321 Heidenrod (DE). **WEYRAUCH, Detlev** [DE/DE]; Friedhofstrasse 26, 56271 Kleinmaischeid (DE). **REDER, Ernst** [DE/DE]; Altstrasse 1, 55278 Hahnheim (DE).

(74) Anwalt: **WEBER, SEIFFERT, LIEKE**; Gustav-Freytag-Strasse 25, Postfach 61 45, 65051 Wiesbaden (DE).

[Fortsetzung auf der nächsten Seite]

(54) Title: FILTRATION DEVICE FOR LIQUIDS

(54) Bezeichnung: FILTEREINRICHTUNG FÜR FLÜSSIGKEITEN



(57) Abstract: The filtration device (1) for liquids comprises a filtration beaker (2) filled with a filtration material (4), whereby the bottom thereof (3) is provided with at least one sieve-like outlet for a liquid, in addition to comprising a lid (5), predetermining an inner volume (V_i), comprising at least one inlet (8) for the liquid and one air vent (10) for the removal of air and which is connected to the filtration beaker (2) in a liquid-tight manner. A sieve-like textile fabric (12) is disposed in between the filtration beaker (2) and the lid (5). In order to guarantee secure operation and ensure a good retaining effect with respect to particles having a size of approximately 200 μm at different filtration-material fill heights in the filtration beaker, the sieve-like textile fabric (12) has at least one formed part (13) protruding into the inner volume (V_i) of the lid (5), whereby air can be found on both sides of the part (14) of the textile fabric (12) which is located the furthermost away from the filtration beaker (2).

(57) Zusammenfassung: Die Filtereinrichtung (1) für Flüssigkeiten weist einen mit Filtermaterial (4) gefüllten Filterbecher (2) auf, dessen Boden (3) wenigstens eine siebartige Auslassöffnung für die Flüssigkeit hat, und weist einen Deckel (5), der ein Innenvolumen (V_i) vorgibt, mit wenigstens einer Einlauföffnung (8) für die Flüssigkeit und einer Entlüftungsöffnung (10) für entweichende Luft versehen und flüssigkeitsdicht mit dem Filterbecher (2) verbunden ist. Dabei ist zwischen dem Filterbecher (2) und dem Deckel (5) ein siebartiges textiles Flächengebilde (12) angebracht. Um bei guter Rückhaltewirkung für Teilchen mit einer Grösse von etwa 200 μm auch bei unterschiedlichen Füllhöhen des Filterbechers mit Filtermaterial einen sicheren Betrieb zu gewährleisten, wird erfindungsgemäss vorgesehen, dass das siebartige, textile Flächengebilde (12) wenigstens ein in das Innenvolumen (V_i) des Deckels (5) vorstehendes Gebildeteil (13) derart aufweist, dass sich auf beiden Seiten des am weitesten von dem Filterbecher (2) entfernten Teiles (14) des textilen Flächengebildes (12) im überwiegenden Teil des Betriebes Luft befindet.

WO 01/32560 A3

(81) **Bestimmungsstaaten** *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CR, CU, CZ, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

(84) **Bestimmungsstaaten** *(regional)*: ARIPO-Patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), eurasisches Patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), europäisches Patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI-Patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Veröffentlicht:
— *mit internationalem Recherchenbericht*

(88) **Veröffentlichungsdatum des internationalen Recherchenberichts:** 17. Januar 2002

Zur Erklärung der Zweibuchstaben-Codes und der anderen Abkürzungen wird auf die Erklärungen ("Guidance Notes on Codes and Abbreviations") am Anfang jeder regulären Ausgabe der PCT-Gazette verwiesen.

FILTRATION DEVICE FOR LIQUIDS

Description

The invention relates to a filtering device for liquids, having a filtering cup at least partially filled with filtering material and the base of which has at least one sieve-like outlet opening for the liquid, and having a lid that defines an internal volume (V_i) and is provided with at least one inlet opening for the liquid and with at least one ventilation opening for escaping air and is connected in a liquid-tight manner to the filtering cup, a sieve-like sheet material being disposed between the filtering cup and the lid.

The above-described filtering device is known. It is used for filtering water, ion exchangers and/or activated carbon being used as filtering material. The known filtering device is in the form of a cartridge, the longitudinal centre line of which is arranged preferably vertically in such a way that the lid is at the top and the base of the filtering cup is located at the bottom, and the liquid, preferably the water to be filtered, flows at the top into the lid and leaves the filtering cup underneath at the base. The liquid, preferably the water to be filtered, flows at the top into the inlet opening and leaves the filtering chamber through the outlet openings at the bottom in the base. The known filtering device is inserted in a funnel, provided for that purpose, of a water purification apparatus; the funnel is placed on a collecting container for filtered liquid and is preferably closed at the top with a removable lid. The user fills the funnel at the top with, for example, mains water, which, after passing through the filtering device in the collecting container, can be used for food preparation, preferably for making tea, or the like.

For most effective filtering or alternatively for water treatment, it is desirable to present the liquid, which is preferably water, passing through the filtering device with an area of filtering material as large as possible and to constrain the liquid to undergo an adsorption activity that is as intensive and as complete as possible. As is well known, when using granulates as filtering material, the smaller the size of the individual filter particle is, the larger is the effective area. Particles of about 200 μm and smaller could be present in the filtering material. The effective area offered to the liquid to be filtered passing through is therefore satisfactorily large. This advantage is associated with the disadvantage, however, that some of these very small granulate particles pass through the inlet openings in the lid and, if no special precautions are taken at the base, pass through the outlet openings in the base and hence escape from the filtering device. The particles, for example, black activated carbon particles, which then sometimes float on the surface of the liquid, are a nuisance for the user and are undesirable.

There are already flat sieve cloths extruded from plastics material having a small pore size of, for example, 200 µm, and there have been experimental attempts to arrange these at the top side and underside of the filtering cup or the filtering chamber in order to retain the filtering material. As yet unresolved difficulties have been encountered here with the flow-through of the liquid in the case of sieves of this nature.

Compared with earlier devices, the filtering device for liquids described in the introduction already provides a sieve-like textile sheet material between the filtering cup and the lid, so that even small granulate particles of, for example, about 200 µm, cannot escape though the inlet openings in the lid. Precautionary measures at the base are not being considered here, which is why the improvements and novel measures are directed and relate only to the openings in the lid. In the case of the known filtering device of the kind described in the introduction, a preferred embodiment used a cloth insert as sieve-like textile sheet material, which was intended to project into the filtering cup. In one embodiment, the known cloth part is bowed and therefore projects vertically a little way downwards into the filtering cup. The fundamental improvement in retention capacity though the use of the textile sheet material in the known filtering device, and a good flow-through, have always been ensured when the textile sheet material is in contact with the filtering material. Problems arose, with ensuing disadvantages, when this contact between the textile sheet material on the one hand and the filtering material in the filtering cup on the other hand was not maintained.

One can imagine a plane located through the upper rim of a filtering cup, along which the lid is closed with the filtering cup in a liquid-tight manner. It was realized that the flow problems could not be solved if a flat textile sheet material is arranged between filtering cup and lid approximately in the region of this notional plane. This was explained by the fact that above the lid immersed in the liquid to be filtered there is not a very high column of liquid, so that the pressure of the liquid as a result of gravity is not particularly great. In addition, the surface tension of a liquid is a known factor, which especially in the case of small sieve pores has a negative effect in that the smallest air counterpressure beneath the lid is sufficient to block the through-flow of the liquid. In the textile industry, the closing of pores with a film of moisture is known as "sail formation". This could not be remedied by the use of a flat textile sheet material, which is why, in the known filtering device of the kind mentioned in the introduction, the textile sheet material protrudes downwards out of the said plane into the filtering cup or towards the filtering material.

[R:\LIBTT]03727speci doc:HXA

This already solved many problems. When filling the filtering cup with filtering material "almost to the rim", that is, up to 85% or up to 95%, this protruding portion of sheet material will be in contact with the filtering material and consequently at that point will break the surface tension, with the result that the liquid will start to flow here, will expel any air bubble beneath the lid and hence considerably reduce and ultimately eliminate any counterpressure against the pressure of the column of liquid. The liquid to be filtered is able to flow without problems through the filtering material and the small particles of the filtering material are retained outstandingly well.

In cases in which the filtering material dries out, its level in the filtering cup drops from the top downwards, with the result that there is no contact with the downwardly bowed portion of sheet material and hence the known filtering device does not function. In the mass production of known filtering devices, it also happens that apportioning of the filtering material in the filtering cup is carried out with tolerances. In a number of cases, the contact between sheet material and filtering material is then likewise absent. If too much material is introduced into the filtering cup, then, in the case of hard water, such a large expansion can occur that the filter cartridge comprising filtering cup and lid will burst. If too little filtering material is introduced, then the desired contact with the textile sheet material is jeopardised. In addition, an ideal operation of the filtering device is desirable, irrespective of the filling level of the filtering material.

WO 96/21621 describes a filter cartridge which has a sieve-like sheet material between a lid and filtering cup, the sheet material being installed in such a way that it lies in full surface contact with the planar lid portion and in the centre has a large opening, which corresponds to the diameter of the of a tubular lid part. A second sieve-like structure is arranged flat in the tubular lid part.

US 5,049,272 describes a filter cartridge having a fleece part, which is in the form of a truncated cone and has a central opening. The fleece part is secured inside the lid of the cartridge.

The cartridges described in WO 98/17582 A and WO 98/05401 A have a lid with several windows, each of which is fitted with a sieve-like sheet material.

Object of the Invention

It is the object of the present invention to overcome or substantially ameliorate at least one of the above disadvantages, or at least to provide a useful alternative.

Summary of the Invention

The present invention provides a filtering device for liquids, having a filtering cup at least partially filled with filtering material and the base of which has at least one sieve-like outlet opening for the liquid, and having a lid that defines an internal volume (V_I) and is provided with at least one inlet opening for the liquid and with at least one ventilation opening for escaping air and is connected in a liquid-tight manner to the filtering cup, a sieve-like sheet material being disposed between the filtering cup and the lid, wherein the sieve-like sheet material is in one piece and is closed, and at least at times during the filtration operation at least one structural part of the sieve-like sheet material protrudes into the internal volume (V_I) of the lid and at the same time is arranged spaced from the top wall of the lid.

The preferred embodiment was therefore based on the problem of further developing the filtering device of the kind mentioned in the introduction so that

a) while maintaining the retention effect of the textile sheet material for particles of a size of about 200 µm

b) even in the case of different filling levels of the filtering cup with filtering material, a slowing of the through-flow of the liquid through the filtering material is excluded, so that an ideal through-flow and aeration is ensured, and

c) in particular at low filling levels, reliable operation is ensured.

"Reliable operation" means ideal through-flow and aeration.

This problem is solved according to the preferred embodiment in that the sieve-like sheet material is in one piece and is closed, and in that at least at times during the filtration operation at least one structural part of the sieve-like sheet material protrudes into the internal volume (V_i) of the lid and at the same time is arranged spaced from the top wall of the lid.

The inner space of the filtering device that is defined by the filtering cup and the associated lid forms the filtering chamber. The sieve-like sheet material is preferably a textile sheet material

The preferred embodiment thus offers a teaching that runs counter to the previous measures of the filtering device known from the introduction. The textile sheet material is intended in fact to protrude with at least a certain portion upwards into the lid or into the inner volume thereof. This structural part of the sieve-like textile sheet material is therefore intended to project upwards into the lid out of the said plane between filtering cup and lid.

[R:\LIBTT]03727speci.doc HXA

According to the teaching, the extent of this projection shall be chosen so that at the top, in the region of the highest point of the sheet material, there is an air-to-air transition. The filtering device according to the invention is gravity-driven. In a similar manner to that of the known filtering devices, liquid to be purified, for example water, is introduced at the top into a funnel above the filtering device in the form of a cartridge, the water runs downwards through the filtering material in the filtering cup of the filter cartridge by virtue of the water column standing thereover (weight, gravity), and emerges at the bottom into a collecting jug. The longitudinal direction of the collecting jug, the cartridge, the filtering cup, the lid and also of the funnel lies in the gravity-driven filtering device generally approximately in a vertical plane. The filtering device also ensures an ideal operation even if this axis and the entire device is held obliquely, the said axis then being arranged at an angle to the vertical or to the perpendicular. In each case, the part of the textile sheet material furthest away from the filtering cup is located "at the top"; to explain the construction, the design and the operation of the filtering device, one also talks of the highest point or the upper point or region of the textile sheet material in the lid. In contrast with the gravity-driven device, there is also the pressure-driven device, which is not considered in detail here.

If air, for example in the form of an air bubble, is present on both sides of the part of the textile sheet material located at the top in the lid, i.e. inside the sheet material and outside the sheet material (but in both cases inside the lid), then because of the ensuing pressure equilibrium of liquid and air, escape of the air in order to eliminate the air bubble is surprisingly avoided. On the contrary, at the topmost point, i.e. at the part for escaping air furthest removed from the bottom of filtering cup, there exists a transition from air inside the sheet material to air outside the sheet material. This is the case regardless of the level of the liquid located outside the lid. If, therefore, initially an air evacuation is necessary, the air easily escapes upwards by virtue of this air-to-air transition until the said equilibrium has been reached, the air space at the top beneath the top wall of the lid has become comparatively small, and an aeration for the passage from top to bottom of liquid to be purified is no longer additionally necessary. The filtering device functions perfectly also when, exceptionally, overflowing of the top part of the sheet material has occurred. It has been shown that these conditions obtain also for different filling levels of the filtering cup with filtering material. This applies to differently constructed filtering devices, and is especially true of the same external geometry of the conventional domestic filtering device with different levels of filtering material. Proper functioning of the novel filtering device is therefore ensured in a much greater number of cases than with the known cases, irrespective of how high the filing level in the filtering cup is, whether the filtering medium has dried out or whether, because of swelling, the filtering cup is "overfull" beyond the above-mentioned plane between filtering cup and lid. The filtering and sieving operations function perfectly when the textile sheet material is used in the construction and arrangement according to the invention, even when the textile sheet material is not in contact with the filtering material. When the remote part of the textile sheet material that extends upwards into the cup is large enough and when also the lid is large enough, any volume increase of the filtering material caused by swelling is accommodated without unfavourable pressures occurring.

The lids of known filtering devices are already of such a size, and all the more so the lids of the first embodiment of the invention, that their internal volume is about 30% of the volume of the filtering cup. Usually, however, only additional volumes of about 10% are needed to accommodate swelling filtering material. It is therefore sufficient for the internal volume provided by the structural part protruding into the lid to be greater than or approximately equal to 5% of the volume of the filtering material in the filtering cup.

According to the first embodiment of the invention, it is advantageous if the remote part of the sheet material located at the top in the lid and the ventilation opening are arranged above the highest end of the inlet opening. To understand this feature, again let us imagine a horizontal plane between filtering cup at the top and lid at the bottom, wherein a new horizontal plane runs through the highest end of the highest inlet opening and parallel to the horizontal plane between filtering cup and lid. If one then ensures that the upper part of the sheet material lies above this new plane, then an especially reliable operation ensues, i.e. the liquid to be purified flows easily through the inlet openings downwards, whilst air that is displaced as a result is easily able to flow away upwards. At the same time, it should be ensured that the ventilation openings lie above this notional horizontal plane. These measures in turn promote the air-to-air transition at the top part of the sheet material to ensure proper operation both during filling, during main operation and also towards the end of the filtering operation, when the untreated water is running slowly out of the funnel. These measures apply to one and to a plurality of inlet openings in the lid, and also to different designs of inlet openings, for example, those that extend in the manner of slits vertically upwards from the lower edge of the lid.

An advantageous lid form has a lower region, approximately in the form of a lateral cylinder surface (with a small truncated cone-shaped bevel), in which at the

[R:\LIBTT]03727speci doc HXA

circumference several inlet openings, for example four openings, are arranged spaced from one another. This lower relatively large volume region of the lid, the outer circumference of which is approximately the same as the outer circumference of the filtering cup, is adjoined upwards and annularly by a truncated cone-shaped transition surface, which adjoins the wide circumferential edge of an inverted cup part of the lid. In this cup part of the lid, the base thereof forms the "top wall" of the lid, containing at least one ventilation opening, preferably two spaced-apart ventilation openings, for the escaping air.

According to the first embodiment of the invention, it is advantageous for the structural part of the sheet material protruding into the internal volume of the lid to be at least partially bowed. The sheet material can be in the form of a bell, a dome, a hemisphere, a part-sphere etc. The shape of the preferably textile sheet material can alternatively have corners, tips and edges, so that the structural part protruding into the lid can be cuboidal, pyramidal, parallelepipedal or the like. By virtue of these measures, the construction of the textile sheet material is inexpensive and technically ideal, without expensive retaining means, for example injected rings or ribs. By avoiding additional injection moulds, manufacture becomes appreciably simpler and more economical.

In an advantageous further design of the first embodiment of the invention, the protruding structural part of the sheet material is in the shape of a spherical cap, and in its lower, outer region is fixed to the upper edge of the filtering cup and to the lower edge of the lid. It is preferably welded on. The spherical cap is not to be regarded strictly mathematically/geometrically, rather, the textile sheet material is preferably of concave form in its upper region, that is, is in the form of a spherical cap, and can be shaped to taper off in its lower region. Truncated cone-shaped regions can adjoin it. The textile sheet material can also protrude with a plane, an edge or tip into the lid. Fixing of the sheet material to the lower edge of the lid ensures that the space filled with the filtering material, which space is located predominantly in the region of the filtering cup, but which can extend by virtue of the above-described features more or less also into the lid, is encapsulated, enclosed completely by lateral walls and sieves. The pores of the sieve-like textile sheet material are small enough to prevent the escape of even relatively small particles beyond this "sieve space". Flowing media can nonetheless flow in and/or out through the textile sheet material.

According to the first embodiment of the invention, it is furthermore advantageous for the sheet material to be a woven fabric, knitted fabric, fleece or shaped plastics material part and for the pore size of the sheet material to be preferably in the range from 50 μm to 300 μm and preferably 80 μm to 200 μm. The textile sheet material can be manufactured from various materials, preferably from plastics material. In that case, plastics filaments are used, or the entire structure can be moulded. Such a textile sheet material can be fabricated, for example, by deep-drawing a polyester plastics. According to the invention, any structure of the textile sheet material is conceivable. After manufacture of the sheet material, this has initially the same structure over its entire area and also approximately the same pore size. On re-shaping of, for example, a flat textile sheet material, according to the teaching of the present invention it should be ensured that the structure does not alter substantially, i.e. that the textile sheet material is extended or distorted not more than 20 to 30%. On the other hand, slight angular displacements, as occur, for example, during the transition from a square to a parallelogram, are admissible. Folds are also admissible within these limits, because these are often unavoidable when re-shaping an initially flat sheet material to a polygonal, cornered form. It should merely be ensured that, apart from the edges and corners, the structure of the sheet material does not alter substantially, i.e. more than 20 or 30%, for example, the pore size has not enlarged to this extent. The sieve effect of the textile sheet material ought therefore to be maintained even after re-shaping. Neither should the textile sheet material receive over its entire area such a small pore size that the passage of liquid is impeded.

In the first embodiment, it is furthermore advantageous according to the invention for the ratio of the fluid-technical cross-sectional areas A : B : C : D with a tolerance of about ± 50% to be approximately 1 : 2 : 10 : 20, wherein

A = the free, total flow cross-section of the ventilation openings in the lid;

B = the free, total flow cross-section of the inlet openings for the liquid in the lid;

C = the projected free, total flow cross-section of the pores, serving for ventilation, of the part of the sheet material located at the top in the lid; and

D = the free, total flow cross-section for liquid through the pores of the annular, lower sleeve part of the sheet material.

An especially suitable embodiment of the invention uses a filtering device, the filtering cup of which has a volume of 140 ml. If such a cup has placed upon it the above-described lid with the widened bottom part and the narrower top part in the form of the inverted cup, wherein the inlet openings for liquid are arranged in the widened lower part and the ventilation openings for escaping air are arranged in the top wall of the lid, then in an especially preferred embodiment:

$A = 24\ mm^2$,

$B = 66\ mm^2$,

$C = 300\ mm^2$ and

$D = 680\ mm^2$.

The free flow cross-section A is obtained by adding two ventilation openings in the lid together. The free flow cross-section B is made up of four inlet openings for the liquid in the lower, wider region of the lid. In the case of the projected free flow cross-section C for air in the upper part of the sheet material, an arithmetic mean value of the open filter area of the sheet material of about 42.5 % has been taken. Here there is a range between about 30% and about 65%.

For the area D, i.e. the free flow cross-section for the liquid in the lower region of the textile sheet material having the larger diameter, an arithmetical mean value of the open filtering area of the sheet material of about 42.5 % has been assumed. A range of between about 30% and about 65% also applies here.

When complying with this ratio or the individual ratios according to the invention, for example A:B = 1:2 etc., an ideal aeration on the one hand and through-flow of liquid on the other hand is ensured. The specified ratio of sizes of the pores of the textile sheet material enable flow-through problems to be avoided, and very effective filter materials with large effective areas (small particles) can then be used, without fear of small particles trickling out of or floating through the openings.

It can be advantageous as far as manufacturing engineering is concerned to connect the lid non-releasably to the textile sheet material after moulding thereof. Thus, for example, an injection mouldings manufacturer can extrude the lid, mould the textile sheet material and connect these two parts in a liquid-tight manner to one another, for example, by welding.

This intermediate product (lid with textile sheet material), can then be supplied to the filling operation, where it is available in magazines and is taken up by an automatic sealing system in order then to be placed on the filled filtering cup and connected therewith. Neither an automatic machine nor the employees of the manufacturer then have to deal with individual cloth inserts and transport and arrange these with special care. The lid must still be correctly positioned to close the filter insert, and when the textile sheet material is non-releasably connected therewith, no special assembly step is additionally required.

The remote part of the sheet material located at the top in the lid is arranged spaced from the top wall of the lid. The formation of an air space beneath the top wall of the lid can be achieved particularly well in this manner. A gap between the said part of the sheet material on the one hand and the inner surface of the top wall of the lid on the other hand is 2 mm in a preferred embodiment. There is then on the one hand a maximum swelling space for the filtering material in the textile sheet material, and at the same time the remote part of the sheet material located at the top in the lid is kept dry, so that a transition from air to air exists there.

According to the preferred embodiment, the internal volume provided by the sheet material can also be made greater than or equal to 5% of the filling volume of the filtering material in the filtering cup. It has already been stated that with 100% filling of the filtering cup with filtering material, on moistened of the latter a swelling of the volume by about 10% can occur. The volume of about 10% of the filtering material is able to develop and spread out in the space of the textile sheet material above the plane that was determined initially as the horizontal notional plane at the lower edge of the lid. Usually, the filtering cup will not be filled 100% with filtering material, and certainly also not solely with the swellable ion exchanger. At any rate, an adequate swelling space for filtering material is provided. The features provided according to the invention for the guaranteed reliable operation are therefore present. Compared with known filtering devices, impairment of the water flow-through is advantageously thereby excluded.

It is furthermore advantageous when in accordance with the preferred embodiment the remote part of the sheet material located at the top in the lid comprises, at least in the upper region, hydrophobic or waterproofed material. A textile sheet material made, for example, from polyester has hydrophilic properties, and has therefore a certain affinity with the liquid, preferably water. Such a portion would have to be rendered hydrophobic. Through the measure according to the invention of equipping the top part of the sheet material with a portion that is hydrophobic or has been rendered hydrophobic, after wetting and after drawing off the liquid the meshes or pores of the textile sheet material remain open. The hydrophobic portion ensures the water-repelling property of this part of the textile sheet material. The hydrophobic portion should be provided in the region in which the transition from air to air inside the lid is desired. Generally, this is the part of the sheet material located furthest from the filtering cup at the top in the lid. In the case of the above-mentioned specific and preferred embodiment with the free flow cross-section for the ventilation $C = 300\ mm^2$, this area C could, for example, be rendered hydrophobic. Providing such a large area with a hydrophobic portion promotes the operational reliability of the filtering device.

[R:\LIBTT]03727speci.doc:HXA

In exceptional cases, it may happen that water will touch, or in the initial stage of the filtration will briefly flow over, the top part of the textile sheet material and will try to close the pores by means of sail formation. Rendering the portion hydrophobic in accordance with the invention ensures that the air to be expelled from the filtering device will pass virtually unhindered into the water.

The air is prevented from passing through into the adjacent medium (water and/or air) not by the water present, but by the sails formed in the pores of the textile sheet material.

If, in another advantageous construction of the first embodiment of the invention, the lower part of the sheet material is provided with hydrophilic portions in the region of the inlet openings for the passage of liquid, this appreciably promotes the flow-through of the liquid to be filtered. In this lower region, next to the inlet openings for the liquid, the textile sheet material can also be treated with substances by which the sheet material becomes more hydrophilic. These substances can be liquids that influence the surface of the plastics material.

A web-form, flat, textile sheet material can be used for re-shaping to form an inherently stable structural portion, and for fixing to the lid of a filtering device for liquids. It is advantageous to select a textile sheet material that is inherently stable or dimensionally stable. Such a sheet material with the desired pore size is plastically deformable. A dome-shaped or bell-shaped curvature in such a textile sheet material then holds its shape. The specific form selected in each case, for example, also a cuboid, remains on the whole stable in this shape. This dimensional stability can be influenced by the thickness of the filaments used to make the sheet material, by the number of filaments, by the interlacing method, and by the material of the filaments. A fabric that can be produced by deep-drawing of a plastics material can also be selected as textile sheet material. The angular stability and stability under extension of the sheet material has already been mentioned. When folds occur as a consequence of re-shaping of a flat textile sheet material, for example to form a cuboid or a bell shape, these will remain inherently stable as desired at the place where they have been made.

Before this re-moulding, the flat, textile sheet material, manufactured for example by deep-drawing, can be produced in the form of a sheet or a web. The textile sheet material can be drawn from a roll and then re-moulded to the desired shape, for example a bell or cuboid. After shaping, the pores or meshes in this textile sheet material then remain with no appreciable extension or distortion. The sieve effect is consequently ensured.

[R:\LIBTT]03727speci.doc:HXA

After re-shaping of the textile sheet material (in the form of a bell or a cuboid or the like), the sheet material is cut out or stamped out to fit, and is fused at the circumference, for example, by ultrasound, to the outer lower edge of the lid (at its free open end).

In another method of manufacture, after being drawn in web form off the roll, the textile sheet material is first held, then re-shaped as it is being held, in that form is introduced into the lid whilst being held, then welded to the lower outer wall of the latter and thereafter punched out.

The action of the filtering device is in no way impaired by the invention. The retention effect of the textile sheet material for the small particles of filtering material is maintained, yet slowing of the through-flow of the liquid through the filtering material is nevertheless ruled out even when the filtering cup is only partly filled, i.e. not very full. Surprisingly, it no longer matters that the textile sheet material is always in physical contact with the filtering material in order to function. Even when there is no contact of the textile sheet material with the filtering material in the filtering device according to the invention, the function of the filtering device is still fully maintained. When, on the other hand, the entire filtering cup is filled with filtering material, so that as a result of a swelling of about 10 to at most 20% in the case of conventional devices the through-flow of the liquid would be slowed or the apparatus might even burst, these disadvantageous effects are likewise excluded by the invention.

The pressure difference (hydrostatic pressure) between the inlet openings for liquid in the lower region of the lid, on the one hand, and the ventilation openings for air in the top wall of the lid, on the other hand, ensures that air always escapes at the top and liquid enters at the bottom and not vice versa. The air pressure in the air space at the top in the lid is always sufficiently great that the air is expelled upwards, and it is not liquid that is forced or runs at the top into the ventilation openings.

Compared with conventional filtering devices, the ventilation openings in the top wall of the lid are chosen in accordance with the invention to be quite large. In a preferred embodiment, for example, two slit-like ventilation openings each having a width of 1.5 mm and a length of 8 mm are provided. This ensures that the pressure beneath the top wall of the lid always causes the air to escape from these openings when liquid is being conducted downwards.

Inside the lid, the air can escape upwards from below through the textile sheet material when air is present on both sides of the flat textile sheet material, that is, sail formation is avoided.

[R:\LIBTT]03727speci.doc:HXA

Sail formation at the upper part of the textile sheet material is avoided by the hydrophobic portions. Even if, as a result of tilting, or for other reasons, liquid should come into contact with the meshes or pores of this upper part of the textile sheet material, these pores remain open after the filtering device has been set straight.

In the case of a filtering device in which the sieve-like sheet material is disposed in such a way that together with the walls of the filtering cup it forms a volume (V_u) in which the filtering material is located, the sieve-like sheet material is at least partly movable, so that it can assume two extreme positions and intermediate positions between them, the volume (V_u) being reduced by a difference volume ΔV during the transition from the first to the second extreme position. Because the sieve-like structure is movably arranged, the volume (V_u) in which the filtering material is located can be adapted to the desired requirements. Bursting of the filter cartridge is effectively prevented by this measure, since a very strong expansion of the filtering material merely ensures that the flexible sheet material assumes a position close to the first extreme position, so that the volume (V_u) in which the filtering material is located is enlarged.

The sieve-like sheet material can in principle be any article that fulfils the desired sieve function and that is sufficiently flexible.

Even if the sheet material may in principle have any desired form, for example, it can be arranged completely flat, then a preferred embodiment nevertheless ensures that the area of a reference plane located through the edge of the sheet material is smaller than the actual area of the sheet material. This ensures that the sheet material bows in at least one direction beyond the reference plane. The part of the sheet material protruding beyond the reference plane is preferably in the form of a spherical cap. The spherical cap is not to be regarded strictly mathematically/geometrically, rather, the textile sheet material is preferably of concave form, that is, of a rounded cup shape, and can be shaped to taper off in its radially outer region. Truncated cone-shaped regions can adjoin it. The structural part can also protrude with a plane, an edge or tip out of the reference plane. The pores of the sieve-like structure are small enough to prevent the escape of even relatively small particles from the one volume (V_u), the so-called "sieve space". Flowing media can nonetheless flow in and/or out through the sheet material.

The enlarged area of the sheet material has moreover the advantage that the flow cross-section for the liquid to be filtered becomes larger, so that a rapid filtering is possible.

In a preferred embodiment of the filtering device, this has at least one ventilation opening for escaping air, which is arranged on the same side of the sieve-like sheet material as the inlet opening. Since, at least at the start of the filtering process, air is usually present in the filtering chamber, the ventilation openings mentioned ensure that this air can escape quickly through the ventilation openings, so that in particular at the start of the filtering process the through-flow is not delayed.

Even when the advantage according to the invention is achieved at least partially also by a very small difference volume ΔV, an especially preferred embodiment nevertheless provides that the difference volume is at least 1%, preferably at least 5%, especially preferably at least 10% of the filling volume of the filtering material in the filtering cup.

The difference volume can also be selected so that it is at least 1%, preferably at least 5%, especially preferably at least 10% of the volume of the volume V_u. The effect of the described minimum flexibility of the sieve like sheet material is that the filtering device according to the invention functions properly even with a very strongly fluctuating filling level of the filtering material.

By a special shaping of the sieve-like structure, for example, it is possible to restrict the sail formation mentioned in the introduction. Sail formation is avoided in a preferred embodiment in that in the second extreme position, the sieve-like sheet material comes into contact with the correspondingly adjusted surface of the filtering material and/or with a further component. Because the sieve-like sheet material comes into contact with the surface of the material, in the region of the contact area the sail is broken up, and the liquid is able to passed virtually unhindered through the sieve structure. It goes without saying that the mentioned contact of sieve-like sheet material on the one hand and surface of the filtering material on the other hand can alternatively be replaced by a contact of the sieve-like sheet material with a further component. This further component can be, for example, a rod arranged substantially centrally in the filtering cup that contacts the sieve-like sheet material in the second extreme position, so that the sails are broken up at the points of contact. This further component has the added advantage that even with an extremely low filling level of the filtering material, or even in the absence of filtering material, in the second extreme position of the sieve-like structure breaking up of the liquid sail by contact is ensured. Since, as a rule, contact of the sieve-like sheet material with the filtering material produces a larger contact area than contact of the sieve-like sheet material with the further component, the component is preferably arranged in such a way that it is able to come into contact with the sieve-like sheet material only in the case of a very low filling of the filtering cup with filtering material and in all other cases is arranged below the filling level of the filtering material.

[R:\LIBTT]03727speci.doc:HXA

In a further especially preferred solution of the second embodiment of the present invention, in the first extreme position, the sieve-like sheet material protrudes from the reference plane in a direction opposite to the direction in the second extreme position. Preferably, in the first extreme position, the part of the sheet material remote from the reference plane does not touch the wall of the filter chamber or the lid. Since, as a rule, throughout the entire filtering process an air bubble or air cushion is present in a part of the filter chamber substantially remote from the filtering material, the above-described feature ensures that in the first extreme position there is air on both sides of the part of the sheet material furthest away from the reference plane. Because, at least in a small region of the sieve-like sheet material, an air-to-air transition forms, in this region sail formation is effectively prevented.

The filtering device according to the preferred embodiment is preferably gravity-driven, so that, in the first extreme position of the structure, at least a part of the sheet material is higher than the same part in the second extreme position. It goes without saying, however, that the filtering device according to the invention can also be used in a pressure-driven form. "Higher" and "lower" shall be understood here with reference to the flow direction, so that the sheet material moves downwards when it moves substantially in the direction of the flow direction of the liquid to be filtered.

Especially preferred is an embodiment in which, in the first extreme position, the part of the sheet material remote from the reference plane and the ventilation opening are arranged above the highest end of the inlet opening. This ensures that virtually throughout the entire filtering process an air bubble forms in the vicinity of the ventilation opening, the sheet material in its first extreme position being in contact with the air bubble, so that there is an air-to-air transition at least at a part of the sheet material.

The textile sheet material preferably consists of a woven fabric, a knitted fabric, a random fibre structure, fleece or shaped plastics material part, and preferably has a pore size in the range from 50 μm to 300 μm and preferably between 80 μm and 200 μm.

As already indicated, the sieve-like sheet material is upwardly bowed in its first extreme position so that virtually throughout the entire filtering process it is in contact at least partly with an air bubble present in the region of the ventilation opening, so that an air-to-air transition exists in the region of the highest point of the sheet material. The filtering device according to the invention is preferably designed in such a way that the ratio of the fluid-technical cross-sectional areas

A : B : C : D with a tolerance of about ± 50%, preferably, about ± 25%, is approximately 1 : 2 : 10 : 20, wherein

[R:\LIBTT]03727speci doc HXA

A = the free, total flow cross-section of the ventilation openings;

B = the free, total flow cross-section of the inlet openings for the liquid;

C = the free, total flow cross-section of the pores, serving for ventilation, of the sheet material in the first extreme position; and

D = the free, total flow cross-section for liquids through the pores of the substantially annular, lower part of the sheet material in the first extreme position.

An especially suitable embodiment of the invention uses a filtering device, the filtering chamber of which has a volume of about 150 to 200 ml. The inlet openings for liquids are preferably arranged below the ventilation openings for escaping air in the top wall of the lid of the vacuum chamber. In an especially preferred embodiment, A is about 24 mm^2, B is about 66 mm^2, C is about 300 mm^2, and D is about 680 mm^2.

The free flow cross-section A is obtained by adding all ventilation openings in the lid. The free flow cross-section B is made up of all inlet openings for the liquid. In the case of the free flow cross-section C for air in the upper part of the sheet material, an arithmetic mean value of the open filtering area of the sheet material of about 42.5 % has been taken. Here there is a range between about 30% and about 65%.

For the area D, i.e. the free flow cross-section for liquid in the lower region of the textile sheet material having the larger diameter, an arithmetical mean value of the open filtering area of the sheet material of about 42.5 % has been assumed. A range of between about 30% and about 65% also applies here.

When complying with this ratio or the individual ratios according to the invention, for example A:B = 1:2 etc., an ideal aeration on the one hand and through-flow of liquid on the other hand is ensured. The specified ratio of sizes of the pores of the textile sheet material enable flow-through problems to be avoided, and very effective filter materials with large effective areas (small particles) can then be used, without fear of small particles trickling out of or floating through the openings. As already mentioned, according to the invention it is moreover advantageous when the remote part of the sheet material located at the top in the lid is arranged in the first extreme position spaced from the top wall of the lid or the filter chamber. The formation of an air space beneath the top wall of the lid or filter chamber can be achieved particularly well in this manner. A gap between the said part of the sheet material on the one hand and the inner surface of the top wall of the lid on the other hand is about 2 mm in a preferred embodiment. There is then on the one hand a maximum swelling space for the filtering material in the so-called sieve space, and at the same time the remote part of the sheet material located in the upper region of the filter chamber is kept dry, so that a transition from air to air exists there.

[R:\LIBTT]03727speci.doc:HXA

The second embodiment of the filtering device according to the invention especially preferably comprises a sieve-like sheet material that has hydrophilic portions. The hydrophilic portions ensure that as soon as the hydrostatic liquid pressure at the sieve-like sheet material falls below a specific value, a complete wetting of the sieve-like sheet material is effected and the sail formation mentioned in the introduction occurs. As a result of the pressure difference occurring, the sieve-like sheet material is preferably moved, by the weight of the liquid that has not yet flowed away, from the first extreme position towards the second extreme position, until it comes into contact either with the surface of the filtering material or with a corresponding component. Sail formation is broken up again by the contact, and the liquid can now run off through the sieve-like sheet material.

For that reason the sieve-like sheet material is preferably manufactured from flexible and/or resilient material. The filament thickness of the preferably textile sheet material is between 5 and 100 μm, preferably between 10 and 60 μm.

A web-form, flat, flexible and/or resilient sheet material for re-moulding can be used for the formation of a sieve-like, at least partly flexible structural part for fixing within a filter chamber of a filtering device for liquids. Before this re-moulding, the flat, textile structure, manufactured for example by deep-drawing, can be produced in the form of a sheet or a web. The textile sheet material can be drawn from a roll and then re-moulded to the desired shape, for example a bell or cuboid. After shaping, the pores or meshes in this textile sheet material then remain with no appreciable extension or distortion. The sieve effect is consequently ensured.

After re-moulding of the textile sheet material (in the form of a bell or a cuboid or the like), the sheet material is cut out or stamped out to fit, and is fused at the circumference, for example, by ultrasound, to the outer lower edge of the lid (at its free open end).

The action of the filtering device is in no way impaired by the second embodiment of the invention. The retention effect of the textile sheet material for the small particles of filtering material is maintained, yet slowing of the through-flow of the liquid through the filtering material is nevertheless ruled out even when the filtering cup is only partly filled, i.e. not very full.

Further advantageous, features and possible uses of the present invention are apparent from the following description of preferred embodiments in conjunction with the accompanying drawings. Of the Figures, Figures 1 to 10 show the first embodiment.

[R:\LIBTT]03727speci.doc:HXA

Figure 1 shows a cross-sectional view through a filter arrangement according to the invention arranged in the system in its entirety, this filtering device being the filter cartridge itself and an operating state after about one second being shown,

Figure 2 shows, to an enlarged scale, the cross-sectional view of the filtering device (filter cartridge) according to the invention in the same operating state as in Figure 1,

Figure 3 shows a view similar to that of Figure 1, but in the operating state of filling after, for example, three seconds,

Figure 4 shows a similar view, but in the operating state of emptying,

Figure 5 again shows a similar view and in the operating state of emptying,

Figures 6 to 10 show a different embodiment, in which the filtering device is filled only barely two thirds with filtering material, wherein

Figure 6 shows a sectional view as in Figure 1 in the operating state of filling after, for example, two seconds,

Figure 7 shows the same sectional view as in Figure 6, but in the operating state of filling after, for example, four seconds,

Figure 8 shows the same sectional view as in Figure 7, but in the operating state of filling after, for example, six seconds,

Figure 9 shows a similar cross-sectional view, but in the operating state of emptying, similar to Figure 4 in the case of the other embodiment,

Figure 10 again shows a similar cross-sectional view of the filtering device in the operating state of emptying (in the second embodiment with the filtering cup only partly filled), similar to the view of Figure 5 in the case of the first embodiment, and

Figure 11 shows a cross-sectional view through a filtering device arranged in a system in its entirety, the filtering device being in the form of a filter cartridge and being in a first operating state,

Figure 12 shows an enlarged cross-sectional view of the filtering device in the form of a cartridge of Figure 11,

Figure 13 shows a cross-sectional view of the system in its entirety in a second operating state,

Figure 14 shows a cross-sectional view of the system in its entirety in a third operating state,

Figure 15 shows a cross-sectional view of the system in its entirety in a fourth operating state,

[R:\LIBTT]03727speci.doc:HXA

Figure 16 shows a cross-sectional view of the system in its entirety in a fifth operating state, and

Figure 17 shows a cross-sectional view of the system in its entirety in a sixth operating state.

Detailed Description of the Preferred Embodiments

The filtering device for liquids, denoted generally be the reference numeral 1, according to the two embodiments of the invention rests in the lower sleeve-form part 20 of a funnel 21. The funnel is inserted into the top of a collecting jug 22, which has a handle 23 at its rear side and a pouring spout 24 with a pouring spout cover 25 on its front side. A slightly domed cover part 26 is placed at the top on the funnel 21 to prevent dust particles and the like from falling into the interior of the funnel 21. This cover part 26 is removable by hand using the protruding part 27. The apparatus shown in its entirety in Figures 1 and 11 is first filled with untreated water 28, which flows downwards into the filtering device 1, as indicated by the curved arrows 29, in order to leave this in a downward direction, as indicated by arrow 30, and be collected in the collecting jug 22.

The filtering device, denoted generally by the reference numeral 1, is now explained in detail with reference to Figures 2 and 10.

The funnel 21 with the sleeve 20 attached centrally beneath receives the filtering device 1, mainly the filtering cup 2, the base 3 of which has the sieve-like outlet openings, not illustrated here, for the liquid, the water, so that this is able to flow out downwards, driven by gravity, in the direction indicated by the arrow 30. The cross-section is here taken centrally through the filtering device 1, so that the outlet openings, not illustrated, can be imagined in front of and behind the plane of section. The filtering cup 2 is filled with filtering material 4. In its upper region, the filtering device 1 consists of the lid 5. Along the lower edge 6 of the lid 5, the latter is connected to the upper edge of the filtering cup 2, so that the upper edge of the filtering cup 2 is in register with the lower edge 6 of the lid 5.

The gravity operation of the filtering device functions best when the longitudinal axis 7 of the filtering device 1, which coincides with the longitudinal axis of the funnel sleeve 20, lies in a vertical plane, that is, perpendicular. This is achieved simply by placing the collecting jug 22 on a horizontal surface. This produces the positions "top" and "bottom". It is obvious in the case of the filtering device 1 that the lid 5 is provided at the top and the filtering cup 2 further below. In the assembled state of the Figures 2 and 12, a horizontal plane can be imagined through the upper edge of the filtering cup 2

[R:\LIBTT]03727speci doc HXA

and the lower edge 6 of the lid 5, which separates the volume of the filtering material 4 from the internal volume V_i and V_d respectively inside the lid. The entire space inside the lid up to this plane positioned through its lower edge 6, see Figure 2, is this internal volume V_i and V_d respectively of the lid 5.

The lid 5 is provided in its lower, widened portion at the circumference thereof with four slit-like inlet openings 8 for the water (the liquid). The four inlet openings are provided offset with respect to one another by 90° on the circumference of the lid 5. Otherwise, the part-annular face of the widened lower part of the lid between the inlet openings is closed.

The upper, narrower part of the lid 5, in the form of an inverted cup, adjoins the lower part at the top thereof; two ventilation openings 10 arranged spaced from one another for escaping air can be seen in the top wall 9 of the lid 5. The curved arrows 11 illustrated the air flowing out through these ventilation openings 10, preferably as the liquid flows in through the slits 8.

Disposed between the filtering cup 2 and the lid 5 is a sieve-like sheet material, denoted by the reference numeral 12, which in the second embodiment of the invention according to Figures 11 to 17 divides the internal volume V_i of the filtering cup into the two partial volumes V_o and V_u. In the first embodiment shown in Figures 1 to 10, and in the operating states of Figures 11 to 14 , this sheet material is in the form of a bell. This bell is the structural part 13 protruding into the internal volume V_i, V_d respectively of the lid 5. In the case of the embodiments shown in Figures 1 to 10, the entire textile sheet material 12 is bowed, so that it becomes the same as the protruding structural part 13, because the entire textile sheet material 12 protrudes upwards into the interior of the lid 5. In another operating state in the case of the second embodiment, as illustrated, for example, in Figure 16, owing to its only very slight inherent stability the sieve-like sheet material 12 is "lowered" downwards or has dropped down onto the filtering material 4 and, depending on the filling volume of the filtering material 4, assumes its above-described bell-shape again mirror-symmetrically about the lower edge 6 of the lid 5. In Figures 15 and 17, an intermediate state of the textile sheet material 12 between its upper and its lower extreme position is shown.

In the case of the first embodiment of the invention according to Figures 1 to 10, the part of the textile sheet material 12 furthest away from the filtering cup 2 arranged further below is indicated by the reference numeral 14. This is the region around the highest point of the sheet material 12 and the protruding structural part 13. This remote, upper part of the sheet material is clearly visibly spaced from the inner surface of the top

[R:\LIBTT]03727speci.doc:HXA

wall 9 of the lid 5. The textile sheet material 12 protrudes, in the form of the structural part 13, upwards into the lid 5 in such a way that both inside and outside, that is, on both sides of the textile sheet material 12, air is present in its upper part 14. Different air spaces are illustrated here corresponding to the different operating states, and in Figures 1 and 2 the air space, which is still quite large (dependent on the filling state) is denoted by the reference letter *a*. This air space *a* of the Figures 1 and 2 is located both inside and outside the textile sheet material 12 and the protruding structural part 13.

The highest ends 15 of the inlet openings 8 for the water are connected with one another by a horizontal plane 16. These conditions show clearly that both the ventilation openings 10 arranged right at the top in the top wall 9 of the lid 5 and the upper part 14 of the sheet material 12 are arranged above this horizontal plane 16 through the highest ends 15 of the inlet openings 8.

The operation of the first embodiments according to Figures 1 and 3 to 5 will be described first. This embodiment is distinguished in that the filtering cup 2 is completely filled with filtering material 4, for example, has a material volume of 140 ml. In the operating state of Figure 1, the funnel 21 is filled with water. The water runs through the four inlet openings 8 corresponding to the curved arrows 29 into the interior of the filter cartridge (filtering device) 1. The water level 19 now builds up above the filtering material 4 and after about one second has reached the level shown in Figure 1. At the same time, air escapes in accordance with the curved arrows 11 upwards through the ventilation slits 10. This air is the air that is located above the filtering material 4. Since the air pressure inside the filter cartridge 1 is greater than the pressure of the untreated water 28 outside the filter cartridge 1, no water is able to run from the outside through the ventilation openings 10 into the filter cartridge.

As can be seen, the upper part 14 of the textile sheet material 12 is arranged above the inlet openings 8, i.e. above the horizontal plane 16 through the highest ends of the inlet openings 8. There cannot therefore be an immediate overflowing of the upper half of the textile sheet material in the bell shape shown here. The effect of this is an optimum evacuation of air within the cartridge-form filtering device 1.

Figure 3 still shows the operating state of filling, but here after about three seconds from the beginning. The water level 19 in the lid 5 is now higher compared with the state in Figures 1 and 2. This water level 19 extends both inside and outside the textile sheet material 12, but within the lid 5. In Figure 3, the height of the water level 19 has risen to about 3 mm below the top wall 9 of the lid 5. The very much smaller air space b of Figure 3 is apparent. In the filtering cup 2 beneath, the filtering means 4 has in the meantime also been completely flooded with water. The water exits in the form of drops 31 at the bottom of the filtering device 1, which is likewise equipped at the bottom with an extruded sheet material. The water is collected at the bottom in the collecting jug 22.

Figure 4 shows the operating state of emptying, because the water level 32 in the funnel 21 has fallen to a considerably lower level compared with Figures 1 to 3. The water level 19 in the lid 5, however, is unchanged compared with the state in Figure 3 (filling). Because the upper ventilation openings 10 in the top wall 9 of the lid 5 are no longer covered with water, because the water level 32 lies below the level of the top wall 9, the air space b (Figure 3) is able to decrease. Whereas the spacing of the water level 19 in the lid is shown as 3 mm in Figure 4 as well, this spacing could reduce to 1 mm. This is not always the case, however. This reduction in the air space is therefore not shown in Figure 4. Figure 5 again shows the operating state of emptying, but emptying is already further advanced here compared with the state in Figure 4. The water level 32' in the funnel 21 is lower than the water level 32 in Figure 4. The water level 32' now already lies below the highest end 15 of the water inlet opening 8 in the lower part of the lid 5. Air is therefore able to leave the space in the funnel 21 not only through the ventilation openings 10 but also through the top part of the inlet openings 8 for the water, and enter the internal volume V_i of the lid 5, i.e. both inside and outside the textile sheet material 12. This additional entry of air through the openings 10 and in particular additionally the openings 8 causes a rapid drop in the water level 32' inside the lid 5. Figure 5, however, shows the state in which the water level inside the lid 5 is already at the same level as the water level 32' in the funnel 21 outside the lid.

Figures 6 to 10 show a second embodiment of the filtering device 1 according to the invention, in which the filtering cup 2 is only half to two-thirds filled with filtering material 4. Assuming that in the embodiment of Figures 1 to 5 the filling volume of filtering material is 140 ml, the filling volume in the case of the second embodiment shown in Figures 6 to 10 is 95 ml.

Figure 6 again shows the operation of filling after 2 seconds from the start of filling. The funnel 21 is again filled with water to the level 32. The water represented by water drops 33 in the filtering device 1 runs through four inlet openings 8 into the interior of the filtering device 1 in the form of a filter cartridge. Because the filtering device has been filled with only 95 ml of filtering material 4, this reaches a filling level 34 in the filtering cup 2. The water level 32" builds up above this filling level 34 in the filtering cup 2. At the same time, the air that is located above the filtering material 4 in the

[R:\LIBTT]03727speci doc:HXA

filtering device 1 escapes through the upper ventilation openings 10 in the top wall 9 of the lid 5, as per the arrows 11.

The pressure in the air space *c* in the upper part of the filtering cup 2 and in the lid 5 is greater than the water pressure outside the lid 5. No water is therefore able to flow from the outside through the ventilation openings 10 through the top wall 9 of the lid 5 into the lid. Since, in addition, the main part of the textile sheet material 12, i.e. the bell-form protruding structural part 13, lies above the inlet openings 8 for water, an immediate "overflowing" of the upper part of the textile sheet material 12 cannot occur. The effect of this is an optimum evacuation of air within the cartridge-form filtering device 1.

Figure 7 shows the operating state of filling after about 4 seconds. Owing to the small filling volume of only about 95 ml, depending on how dry/wet the filtering material 4 is, water is already leaving the filtering cup 2 whilst the water level 32" is building up in the filtering cup and then above that in the lid 5. This cannot be seen in Figure 7.

In the space above the filling level 34 of filtering material 4, the water level builds up from the bottom upwards, which in Figure 7 is shown at the height of the water level 32". The upper part of the textile sheet material 12 or the protruding structural part 13 is untouched by the water entering through the inlet openings 8. The part 14 furthest away from the filtering cup 2, i.e. the highest point 14 of the protruding structural part 13 of the sheet material 12, therefore has a small air space on both sides, so that from the inside of the sheet material 12 to the outside of the same (all within the lid 5) there exists an air-to-air transition, and hence a good air exit. There is therefore an optimum evacuation of air inside the cartridge-form filtering device 1.

Figures 8, 9 and 10 are to be compared with Figures 3, 4 and 5 of the first embodiment. Apart from the large amount of filtering material 4 in the first embodiment, the operating conditions are otherwise the same.

The second embodiment shown in Figures 11 to 17 will now be described.

The edges of the sieve-like sheet material 12 form a reference plane, provided with the reference numeral 35. The part of the sheet material 12 furthest away from the reference plane 35 in the first extreme position of the sieve-like structure is denoted by the reference numeral 37. This is the region closest to the highest point of the sheet material 12. This remote, upwardly turned part of the sheet material 2 is clearly visibly arranged so that there is a distance between the inner surface of the top wall 9 of the lid 5 and the region 37 of the sheet material 12. This ensures that the sheet material 12 protrudes upwards into the lid 5 in such a way that both inside and outside, i.e. on both

[R:\LIBTT]03727speci doc HXA

sides of the textile sheet material 12, there is air in the upper part 37 thereof. For clarification, in Figures 11 and 12 the hollow space comprising air inside the filter cartridge has been denoted by the reference numeral 36. The size of the enclosed air space depends on the operating state of the filtering device, as will become clear in the following. As can clearly been seen from Figures 11 and 12, the air space 36 in this operating state is both inside and outside the textile sheet material 12.

The highest ends 38 of the inlet openings 8 for the water are connected with one another by a horizontal plane 16. These conditions show clearly that both the ventilation openings 10 arranged right at the top in the top wall 9 of the lid 5 and the upper part 37 of the sheet material 12 are arranged above this horizontal plane 16 through the highest ends 38 of the inlet openings 8.

The operation of this second embodiment of the filtering device according to the invention will be described in the following with reference to Figures 11 to 17. To start the filtering process, the funnel 21 is first of all filled with untreated water 28. This operating state is illustrated in Figures 11 and 12. The water runs through the four inlet openings 8 corresponding to the curved arrows 29 into the interior of the filtering device (filter cartridge) 1. A water level 19, which rises quickly at the start of the filtering process, now builds up above the filtering material 4. About three seconds after the untreated water has been introduced into the funnel 21, the water level 19 reaches the level shown in Figure 11. A slight overpressure occurs in the filter cartridge 1, which ensures that the air originally contained in the filter cartridge escapes in accordance with the curved arrows 11 upwards through the ventilation slits 10. Since the inlet openings are arranged below the ventilation openings 10, the air pressure inside the filter cartridge 1 is greater than the hydrostatic pressure of the untreated water 28 outside the filter cartridge 1 at the level of the ventilation openings 10. No water is therefore able to run from the outside through the ventilation openings 10 into the filter cartridge.

As already mentioned, in the first extreme position of the sieve-like sheet material, the upper part 37 is arranged above the inlet openings 8, i.e. above the horizontal plane 16, which is determined by the highest ends 38 of the inlet openings 8. In this operating state too, the sieve-like sheet material is therefore also not fully flooded over with untreated water. On the contrary, the upper part 37 of the textile sheet material 12 remains within the air space 36, so that here an air-to-air transition persists. An optimum evacuation of air inside the cartridge-form filtering device 1 is effected through the upper part 37 of the sieve-like structure 12.

[R:\LIBTT]03727speci.doc:HXA

The operating state shown in Figures 11 and 12 is reached immediately after the start of filtration, provided that the sieve-like sheet material 12 is completely dry. Figure 13 shows a further operating state of the filtering device according to the invention. In the situation shown here, about five seconds have elapsed since the start of the filtration process, i.e. Figure 13 shows a situation that occurs about two seconds after the situation shown in Figure 11. One can clearly see that the water level 19 in the lid 5 has now risen compared with the water level in Figures 11 and 12. This water level extends through the sieve-like sheet material 12 so that it runs both inside the sieve-like sheet material 12 and outside the same, yet within the lid 5, i.e. an air cushion or air space, identified likewise by the reference numeral 36 in this Figure, also exists in this state. The level of the water level 19 has risen in this operating state to a height of about 3 mm below the top wall 9 of the lid 5. The air space 36 is clearly reduced compared with the air space 36 of Figures 11 and 12. In this operating state the filtering means is fully permeated with water, so that in the lower region water leaves the filtering device 1 through the outlet openings in the form of the drops marked with the reference number 31. The water is collected in the collecting jug 22.

Figure 14 shows a further operating state of the filtering device according to the invention. The funnel 21 has in the meantime almost run empty. The water level 32 in the funnel 21 has therefore dropped to a considerably lower level compared with Figures 11 and 13. The water level 19 in the lid 5 is virtually unchanged compared with the state shown in Figure 13. Since the upper ventilation openings 10 in the top wall 9 of the lid 5 are no longer covered with water, because the water level 32 lies below the height of the top wall 9, an air-to-air transition develops at the ventilation openings, so that the air space 36 is able briefly further to reduce in size, depending on the filtering speed. In all operating states at least a small air space 36 remains, however. Since the described further constriction of the air space is not always observable, this is not shown in Figure 14.

Finally, Figure 15 shows an operating state in which the funnel 21 is already completely emptied. In this state, untreated water is found only inside the filter cartridge 1. In this operating state, the water level 41 in the filtering cup 1 already lies below the highest end 38 of the water inlet openings 8 in the lower part of the lid 5. Air is therefore able to leave the funnel volume of the funnel 21 both through the ventilation openings 10 and through the inlet openings 8 and enter internal volume V_d of the lid 5. This accelerates lowering of the water level 41. The textile sheet material 12 is manufactured in such a way that it has a hydrophilic effect. Consequently, all surfaces of the textile sheet material 12 coming into contact with the water to be filtered are wetted. In conjunction with the known surface tension in the case of liquids, wetting causes the formation of a film of moisture inside the pores of the textile sheet material 12. In the textile industry, this is called "sail formation".

As a result of this sail formation, the individual pores of the sieve-like fabric are, as it were, closed off. Even after the water has flowed away completely, these sails are able, generally speaking, to persist for a comparatively long period of, for example, about 30 minutes, so that the textile sheet material 12 forms a closed bell that counteracts the air circulation in the filter cartridge.

If the water level 41 in the filtering cup 1 continues to drop towards the upper edge of the filling material, then an underpressure forms below the textile sheet material, so that the flexible sieve-like sheet material 12 is caused as it were to collapse, and this is dragged downwards with the dropping water level 41 in the direction of flow. This state is indicated schematically in Figure 15.

It goes without saying that in some embodiments the sieve-like structure 12 is already able to drop down during an earlier operating state. Even if this delays the filtering process somewhat, the technical problem according to the invention is still solved.

Finally, Figure 16 illustrates the end state after the filtration process has ended. The textile sheet material 12 now bows downwards, so that it comes into contact with the surface of the filtering material 4. The contact point, which can also be an area of contact, depending on the filling level of the filtering material, is identified here by the reference numeral 39.

By virtue of this contact 39, a sufficiently large number of sails from among the pores of the sieve-like sheet material 12 are broken up, so that a free flow cross-section comprising the sum of the areas of the open pores forms for unhindered passage of a residual flow of air and water into the filling material 4.

It becomes clear that the volume change in the partial volume in which the filtering material is located, caused by the moving sieve-like sheet material, ought to be matched to the expansion of the filtering material caused by moisture fluctuations.

Finally, Figure 17 again illustrates the start of the filtration process. Figure 17 differs from Figure 11 essentially in that in Figure 17 the sieve-like sheet material 12 is still wet, so that a majority of the pores of the textile sheet material 12 are closed as a consequence of sail formation.

First of all, the textile sheet material 12 is still located in contact with the filtering material 4, as shown in Figure 16. Water 40 flows through this contact point into the filtering material 4 until, owing to the raised moisture level, an air-tight barrier occurs, which prevents the residual air located in the filtering unit 1 from flowing away through the outlet openings through the filtering material 4.

An overpressure therefore occurs below the sealed-off, sieve-like sheet material 12 from Figure 16. The sieve-like sheet material 12 is pressed upwards by this overpressure, as can be seen in Figure 17, and returns to the first extreme position illustrated in Figure 11.

The strong hydrostatic pressure increase of the untreated water in the funnel 21 breaks up the sails in the sieve-like sheet material 12, so that the operating state already described with reference to Figure 11 is substantially restored. The described sequence of operating states is then repeated.

List of reference numbers

1. Filtering device
2. Filtering cup
3. Base of filtering cup
4. Filtering material
5. Lid
6. Lower edge of the lid 5
7. Longitudinal axis of the filtering device
8. Inlet openings for liquid
9. Top wall of lid
10. Ventilation opening
11. Curved arrow for direction of flow of air
12. Sieve-like sheet material
13. Protruding structural part
14. Remote upper part of the textile sheet material
15. Highest end of inlet opening 8
16. Horizontal plane through 15
19. Water level in lid 5
20. Sleeve-form part of the funnel
21. Funnel
22. Collecting jug
23. Handle of collecting jug
24. Pouring spout
25. Pouring spout cover
26. Domed cover part
27. Protruding part
28. Untreated water
29. Curved arrow (inflowing direction)
30. Arrow (outflowing direction)
31. Emerging water drops
32. Water level in funnel 21 at the top

32' Water level in funnel 21 at the bottom

32" Water level in filtering cup

33. Water drops in filtering device
34. Filling level in filtering cup

[R:\LIBTT]03727speci.doc:HXA

35. Reference plane
36. Air space
37. Part of the sieve-like sheet material furthest from the reference plane
38. Highest end of the inlet opening
39. Contact point or contact area
40. Incoming untreated water
41. Water level in filtering cup

a	Relatively large air space in lid according to Fig. 1
b	Relatively small air space in lid according to Fig. 3
c	Air space in the filtering device according to Fig. 6
V_i	Internal volume of the lid
V_u	Lower partial volume
V_o	Upper partial volume

The claims defining the invention are as follows:

1. A filtering device for liquids, having a filtering cup at least partially filled with filtering material and the base of which has at least one sieve-like outlet opening for the liquid, and having a lid that defines an internal volume (V_i) and is provided with at least one inlet opening for the liquid and with at least one ventilation opening for escaping air and is connected in a liquid-tight manner to the filtering cup, a sieve-like sheet material being disposed between the filtering cup and the lid, wherein the sieve-like sheet material is in one piece and is closed, and at least at times during the filtration operation at least one structural part of the sieve-like sheet material protrudes into the internal volume (V_i) of the lid and at the same time is arranged spaced from the top wall of the lid.

2. A filtering device according to claim 1, wherein the sieve-like sheet material is a textile sheet material.

3. A filtering device according to claim 1 or 2, wherein the remote part of the sheet material located at the top in the lid and the ventilation opening are arranged above the highest end of the inlet opening.

4. A filtering device according to any one of claims 1 to 3, wherein the structural part of the sheet material protruding into the internal volume (V_i) of the lid is at least partially curved.

5. A filtering device according to any one of claims 1 to 4, wherein the protruding structural part of the sheet material is in the shape of a spherical cap and in its lower, outer region is fixed to the upper edge of the filtering cup and to the lower edge of the lid.

6. A filtering device according to any one of claims 1 to 5, wherein the sheet material is a woven fabric, knitted fabric, fleece or shaped plastics material part and the pore size of the sheet material is in the range from 50 µm to 300 µm.

7. The filtering device of claim 6, wherein the pore size of the sheet material is in the range from 80 µm to 200 µm.

8. A filtering device according to any one of claims 1 to 7, wherein the ratio of the fluid-technical cross-sectional areas A : B : C : D with a tolerance of about ±50% is approximately 1 : 2 : 10 : 20, wherein

A = the free, total flow cross-section of the ventilation openings in the lid;

B = the free, total flow cross-section of the inlet openings for the liquid in the lid;

[R:\LIBTT]03727speci doc HXA

C = the projected free, total flow cross-section of the pores, serving for ventilation, of the part of the sheet material located at the top in the lid; and

D = the free, total flow cross-section for liquid through the pores of the annular, lower sleeve part of the sheet material.

9. A filtering device according to any one of claims 1 to 8, wherein the internal volume (V_i) provided by the sheet material $\geq 5\%$ of the filling volume of the filtering material in the filtering cup.

10. A filtering device according to any one of claims 1 to 9, wherein the remote part of the sheet material located at the top in the lid comprises, at least in the upper region, hydrophobic or waterproofed material.

11. A filtering device according to any one of claims 1 to 10, wherein the lower part of the sheet material comprises hydrophilic portions in the region of the inlet openings for the passage of liquid.

12. A filtering device according to claim 1, wherein the sieve-like sheet material is arranged so that together with the walls of the filtering cup it forms a volume (V_u) in which the filtering material is located, wherein the sieve-like sheet material is at least partly movable, so that it can assume two extreme positions and intermediate positions between them, the volume (V_u) being reduced by a difference volume ΔV during the transition from the first to the second extreme position.

13. A filtering device according to claim 12, wherein the area of a reference plane located through the edge of the sheet material is smaller than the actual area of the sheet material.

14. A filtering device according to claim 12 or 13, wherein the at least one ventilation opening is arranged on the same side on the sieve-like sheet material as the inlet opening.

15. A filtering device according to any one of claims 12 to 14, wherein the difference volume ΔV is at least 1%, of the filling volume of the filtering material in the filtering cup.

16. The filtering device of claim 15, wherein the difference in volume ΔV is at least 5% of the filling volume of the filtering material in the filling cup.

17. The filtering device of claim 15, wherein the difference in volume ΔV is at least 10% of the filling volume of the filtering material in the filling cup.

18. A filtering device according to any one of claims 12 to 16, wherein the difference volume ΔV is at least 1%, of the volume V_u.

[R:\LIBTT]03727speci doc:HXA

19. The filtering device of claim 18, wherein the difference in volume ΔV is at least 5% of the volume of the V_u.

20. The filtering device of claim 18, wherein the difference in volume ΔV is at least 10% of the volume of the V_u.

21. A filtering device according to any one of claims 12 to 20, wherein in the second extreme position, the sieve-like sheet material comes into contact with the correspondingly adjusted surface of the filtering material and/or with a further component.

22. A filtering device according to any one of claims 13 to 21, wherein in the first extreme position, the part of the sheet material remote from the reference plane does not touch the wall of the lid.

23. A filtering device according to any one of claims 12 to 22, wherein the filtering device is gravity-driven, wherein, in the first extreme position of the sheet material, at least a part of the sheet material is higher than the same part in the second extreme position.

24. A filtering device according to claim 23, wherein in the first extreme position, the part of the sheet material remote from the reference plane and the ventilation opening are arranged above the highest end of the inlet opening.

25. A filtering device according to any one of claims 12 to 24, wherein the sheet material is a woven fabric, a knitted fabric, a random fibre structure, fleece or shaped plastics material part, and in that preferably the pore size of the sheet material is in the range from 50 μm to 300 μm.

26. The filtering device of claim 25, wherein the pore size of the sheet material is in the range from 80 μm to 200 μm.

27. A filtering device according to any one of claims 23 to 25, wherein the ratio of the fluid-technical cross-sectional areas A : B : C : D with a tolerance of about ± 50%, is approximately 1 : 2 : 10 : 20, wherein

A = the free, total flow cross-section of the ventilation openings;

B = the free, total flow cross-section of the inlet openings for the liquid;

C = the free, total flow cross-section of the pores, serving for ventilation, of the sheet material in the first extreme position; and

D = the free, total flow cross-section for liquid through the pores of the substantially annular, lower part of the sheet material in the first extreme position.

28. The filtering device of claim 27, wherein said tolerance is about ± 25%.

[R:\LIBTT]03727speci.doc:HXA

29. A filtering device according to any one of claims 12 to 28, wherein the sieve-like sheet material comprises hydrophilic portions.

30. A filtering device according to any one of claims 25 to 29, wherein the filament thickness of the textile sheet material is between 5 and 100 μm.

31. The filtering device of claim 30, wherein the filament thickness of the textile sheet material is between 10 and 60 μm.

32. A filtering device according to any one of claims 12 to 30, wherein the sheet material is manufactured from flexible and/or resilient material.

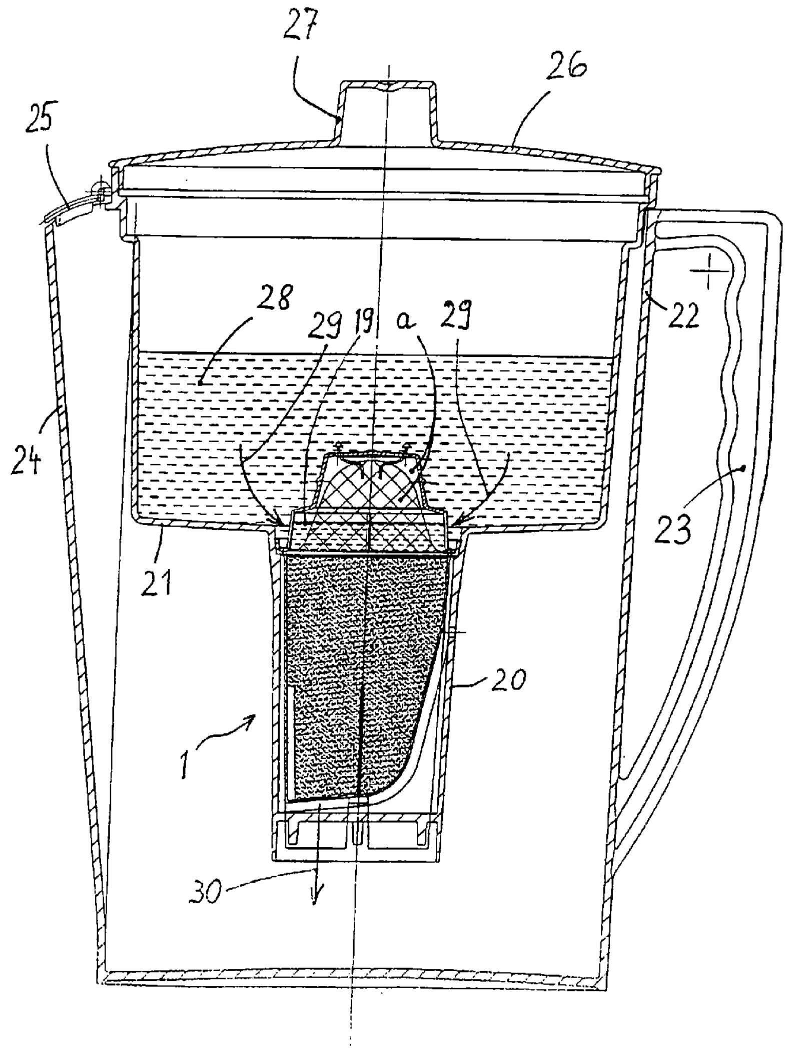
33. A filtering device for liquids substantially as hereinbefore described with reference to any one of the embodiments as that embodiment is shown in the accompanying drawings.

Dated 9 July, 2004
Brita GmbH

Patent Attorneys for the Applicant/Nominated Person
SPRUSON & FERGUSON

[R:\LIBTT]03727speci doc:HXA

Fig. 1



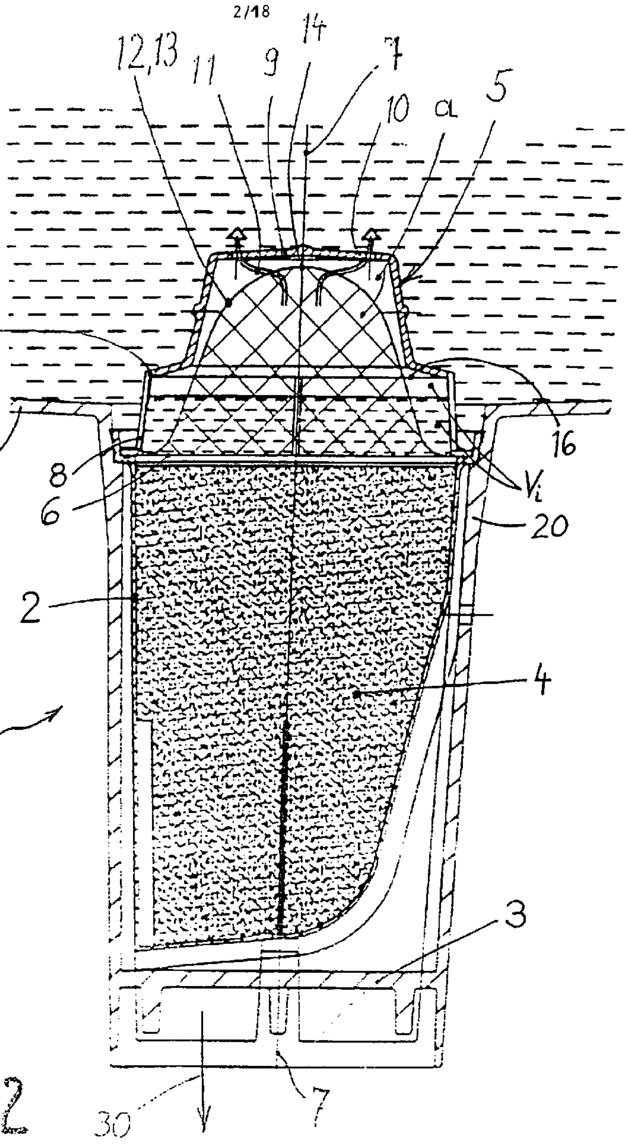


Fig.2

Fig. 3

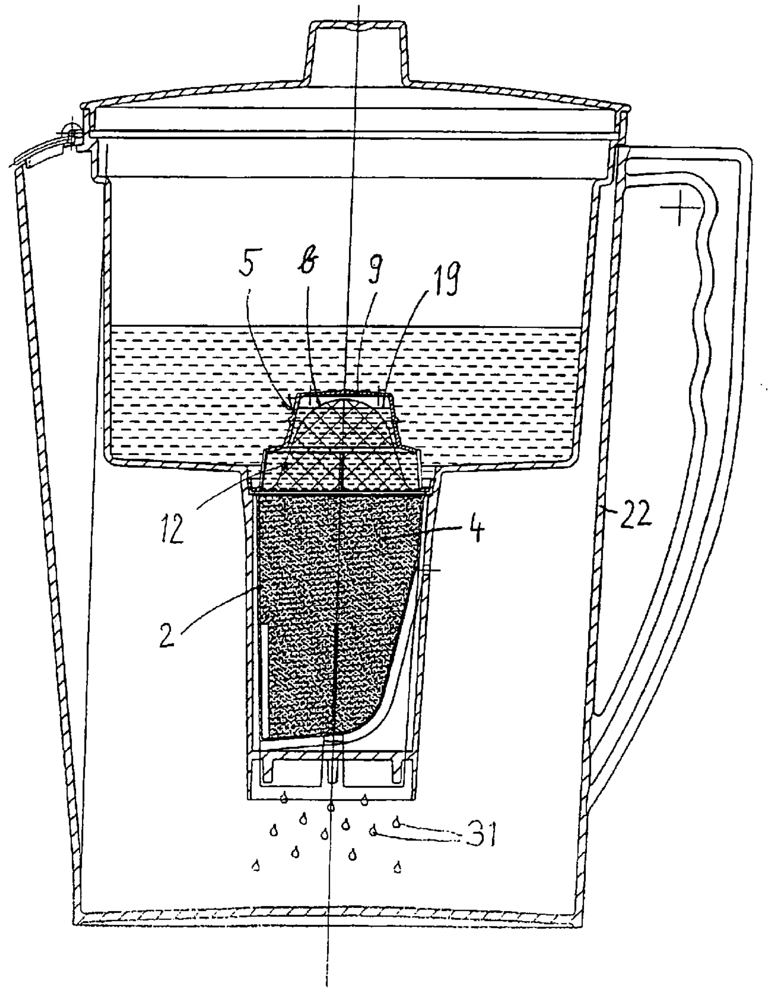


Fig. 4

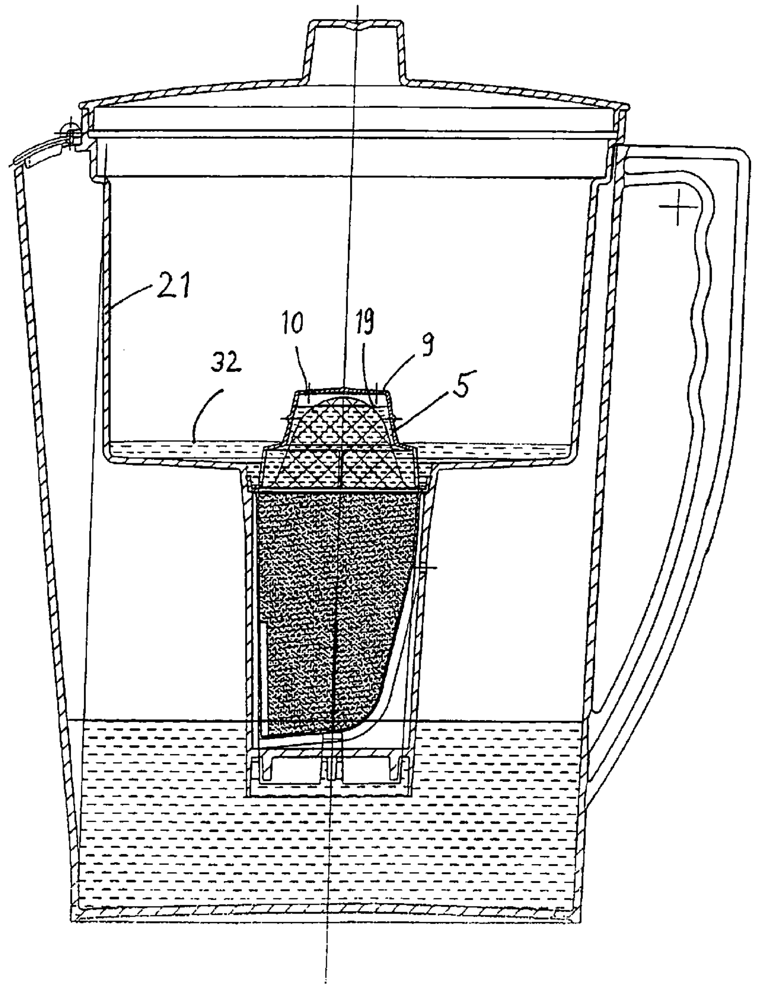


Fig. 5

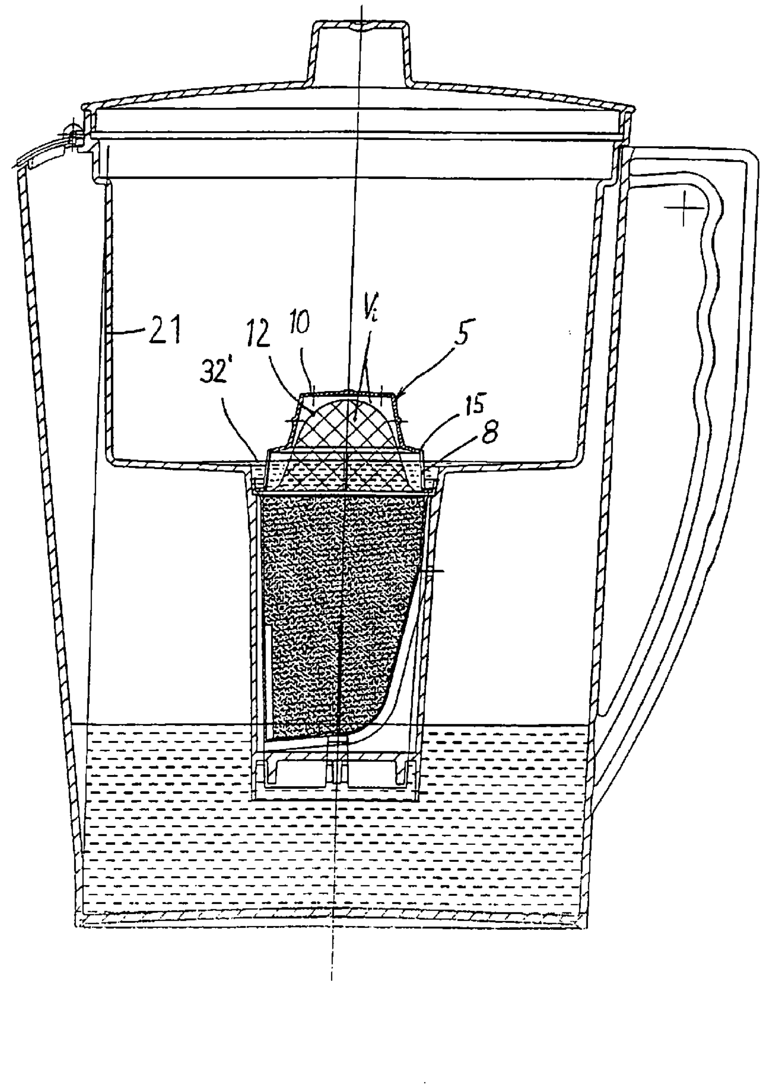


Fig. 6

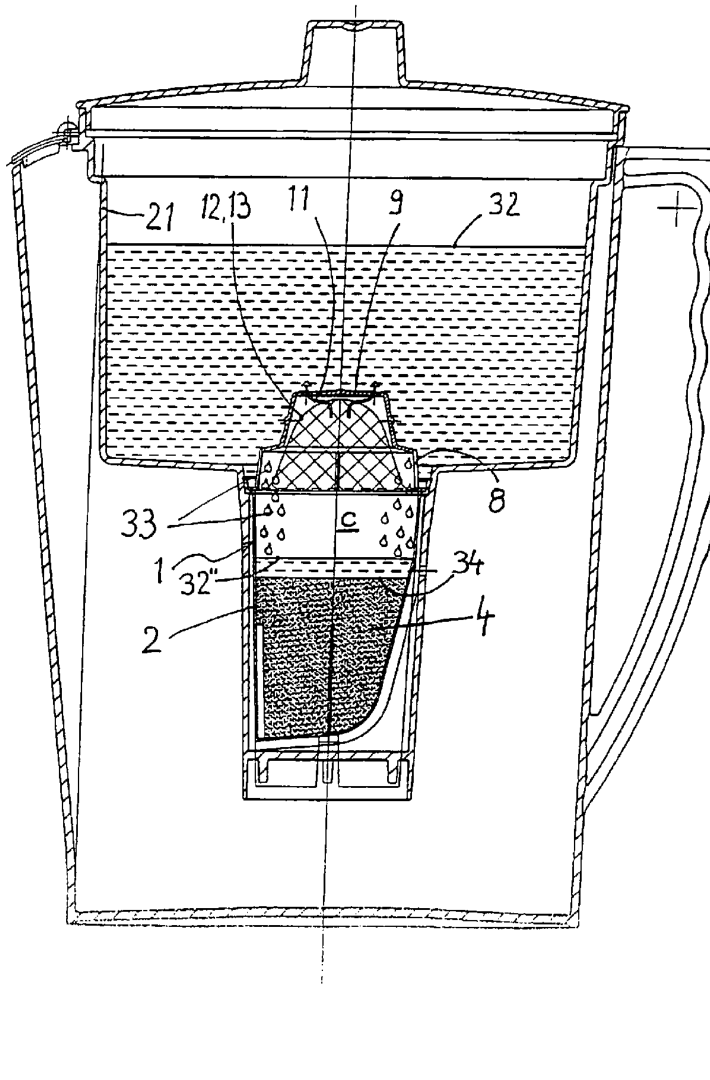


Fig. 7

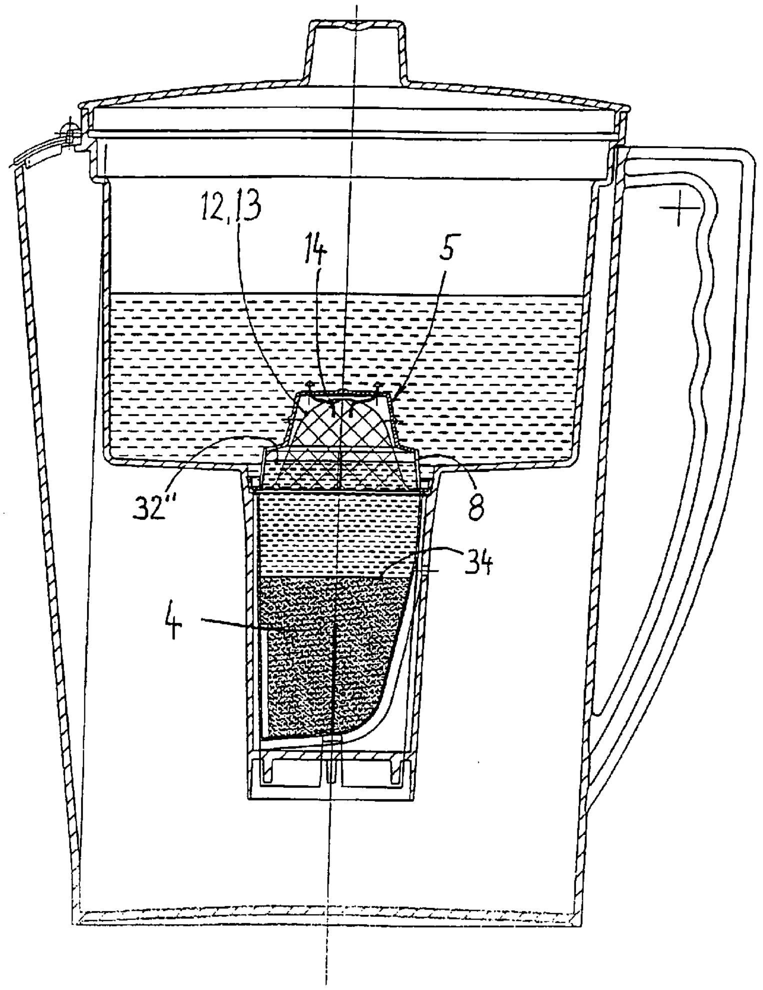


Fig. 8

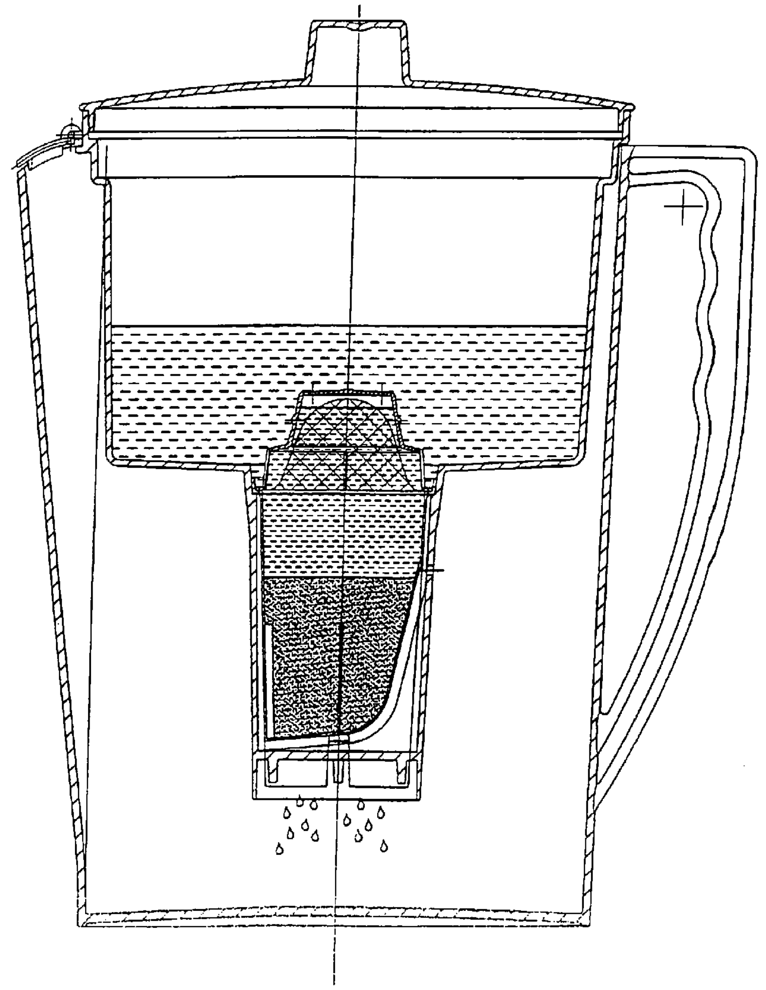


Fig. 9

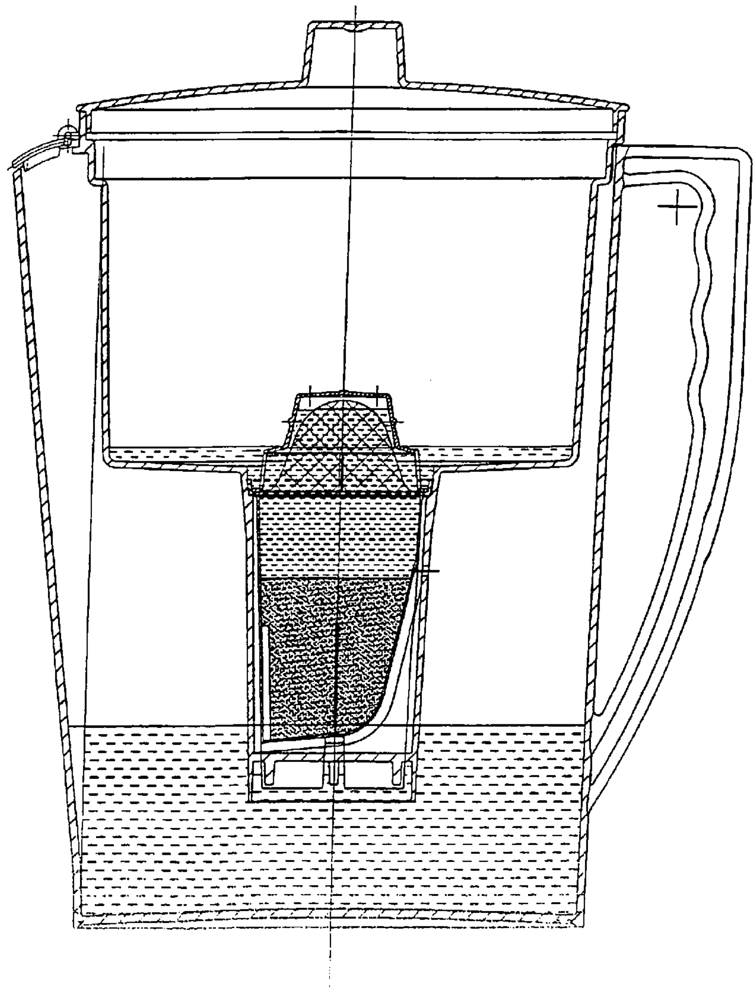
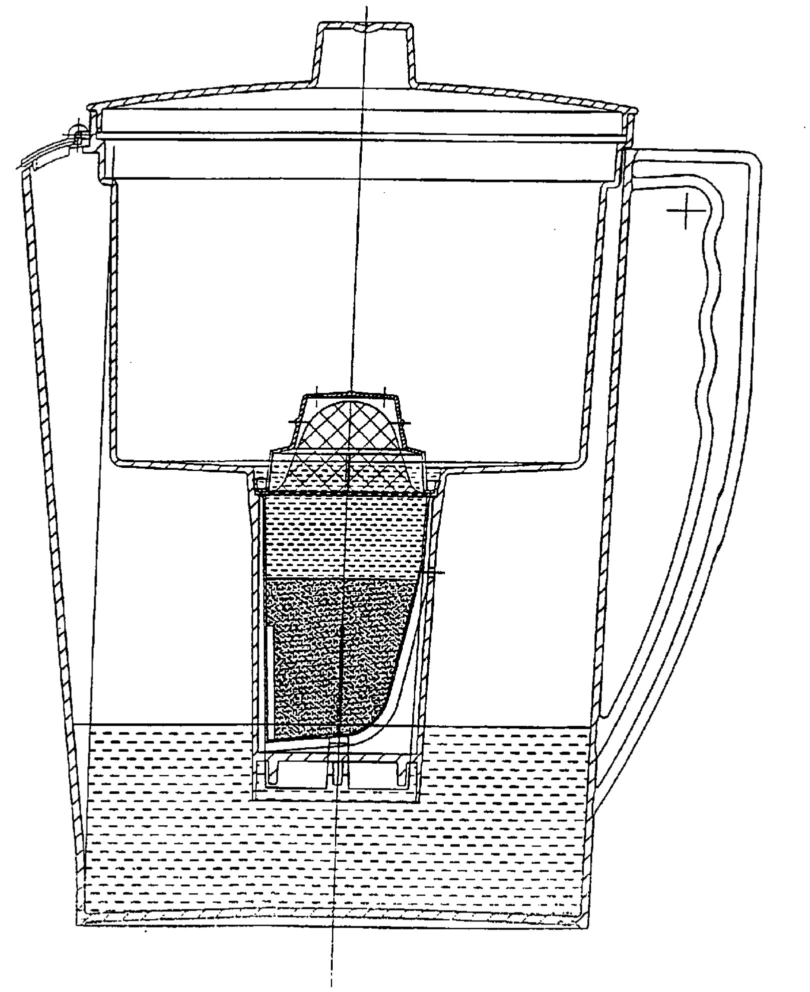


Fig. 10



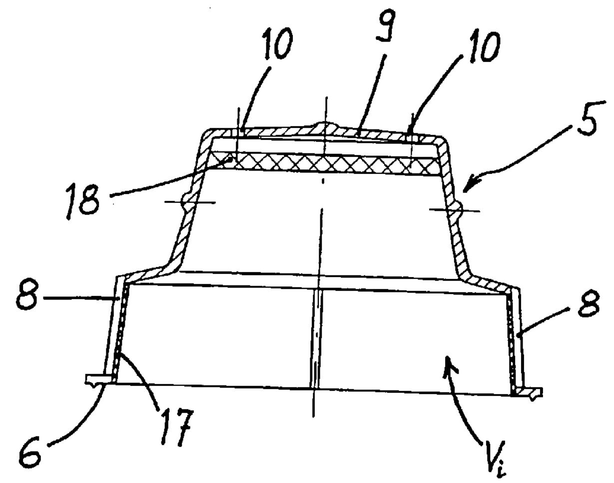


Fig. 11

Fig. 12

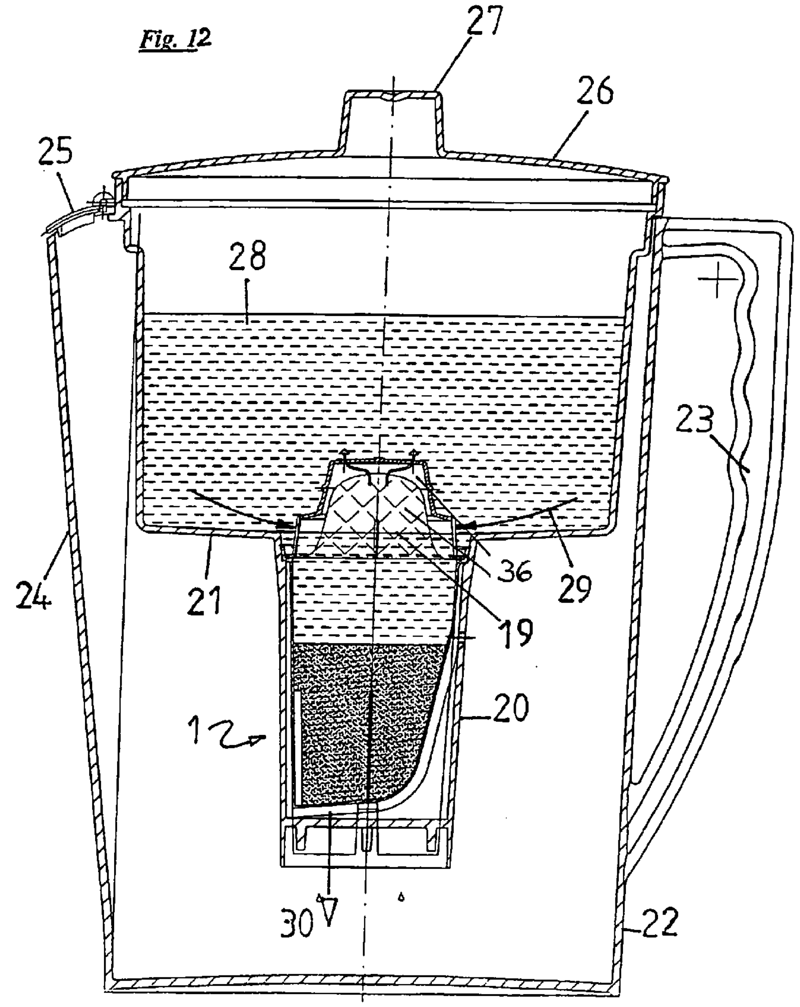


Fig.13

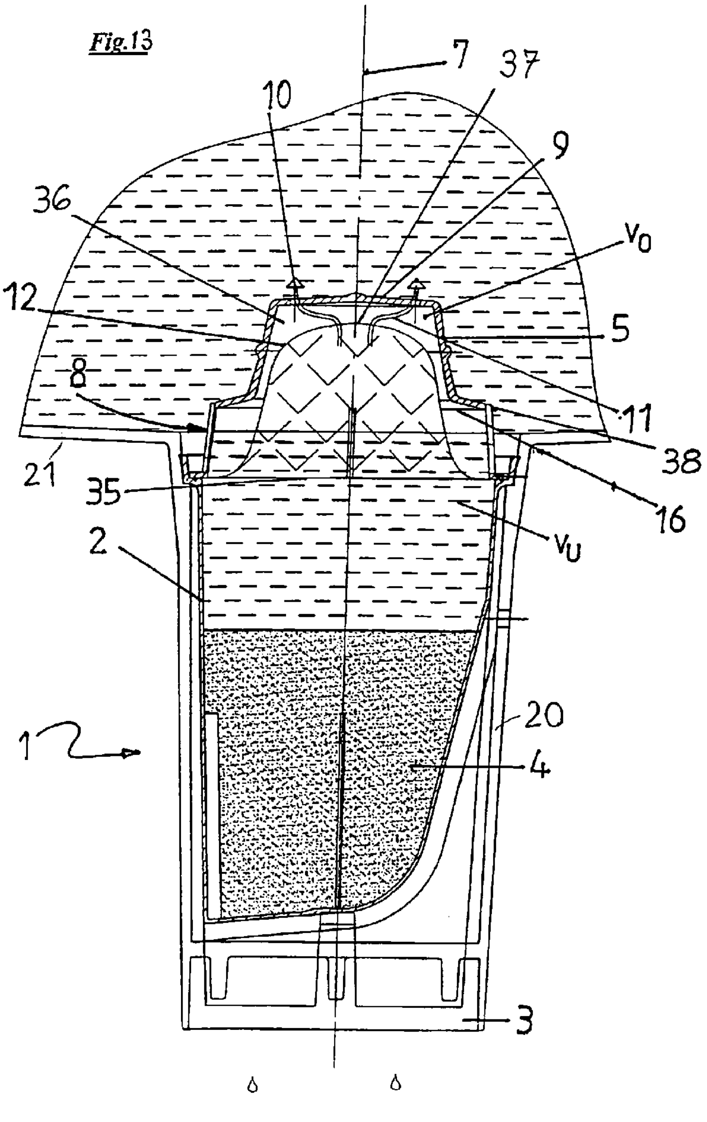


Fig.14

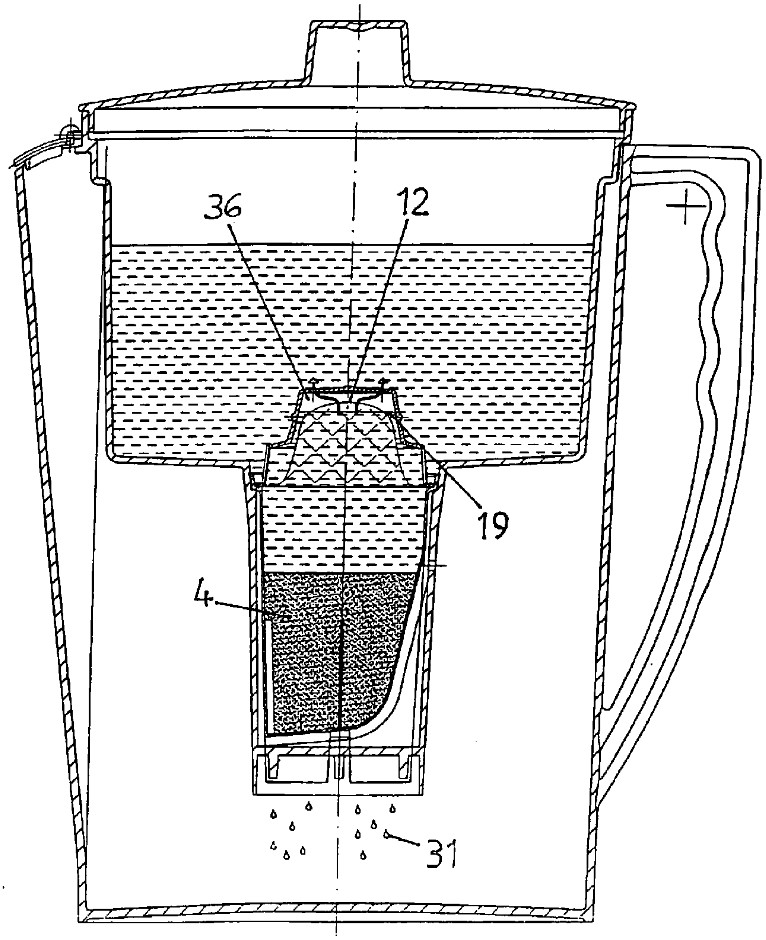


Fig. 15

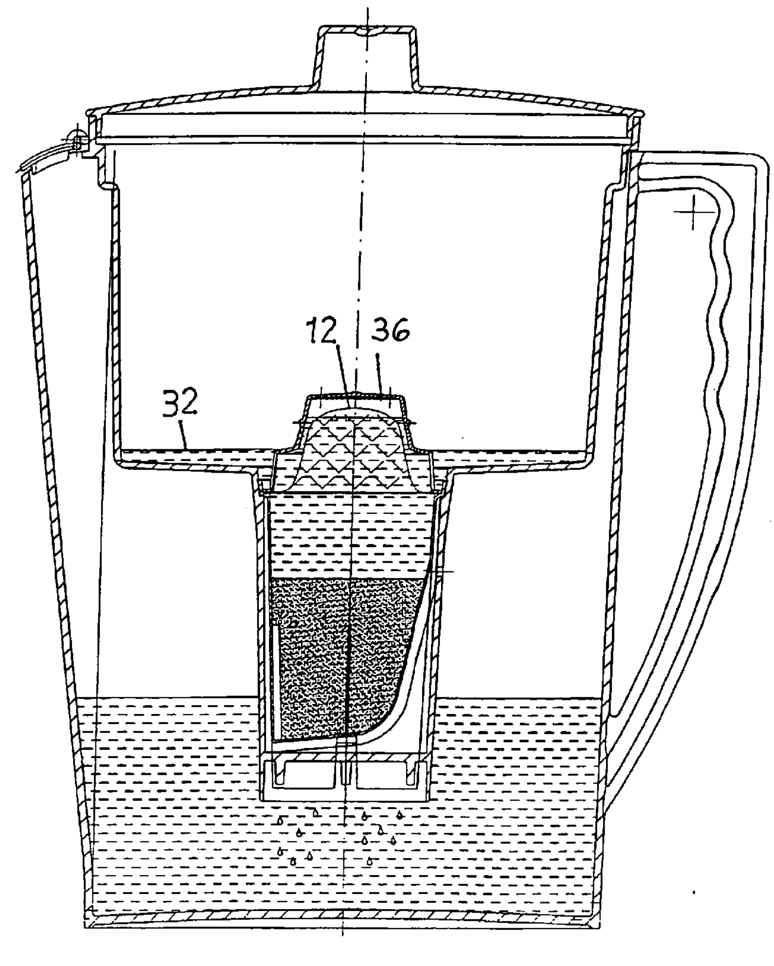


Fig. 16

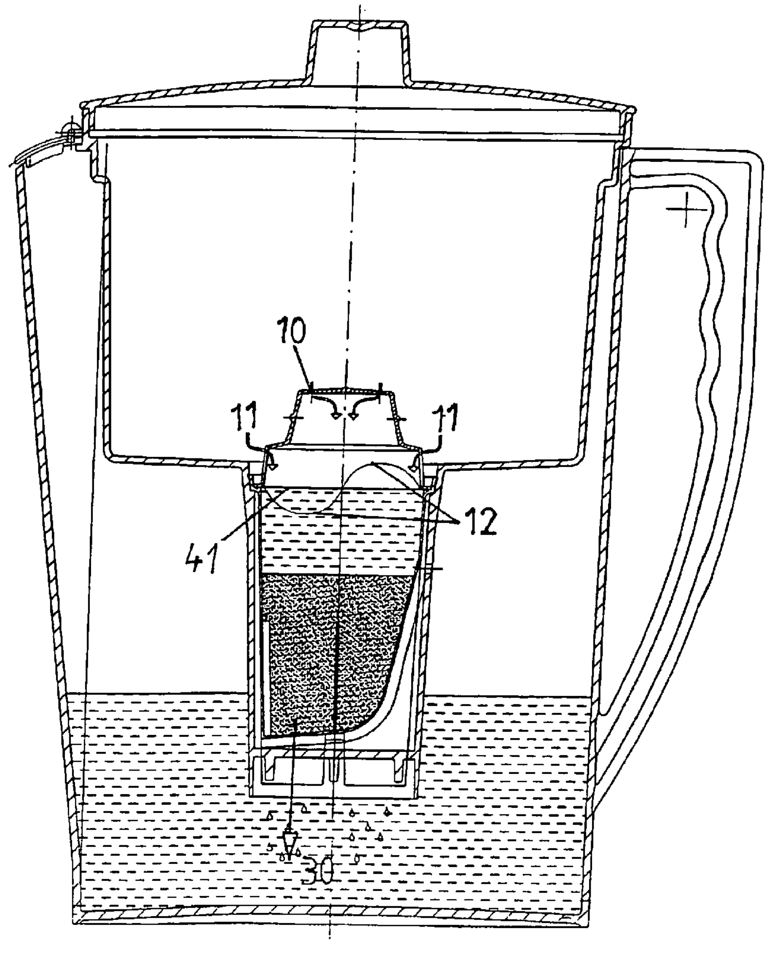


Fig. 17

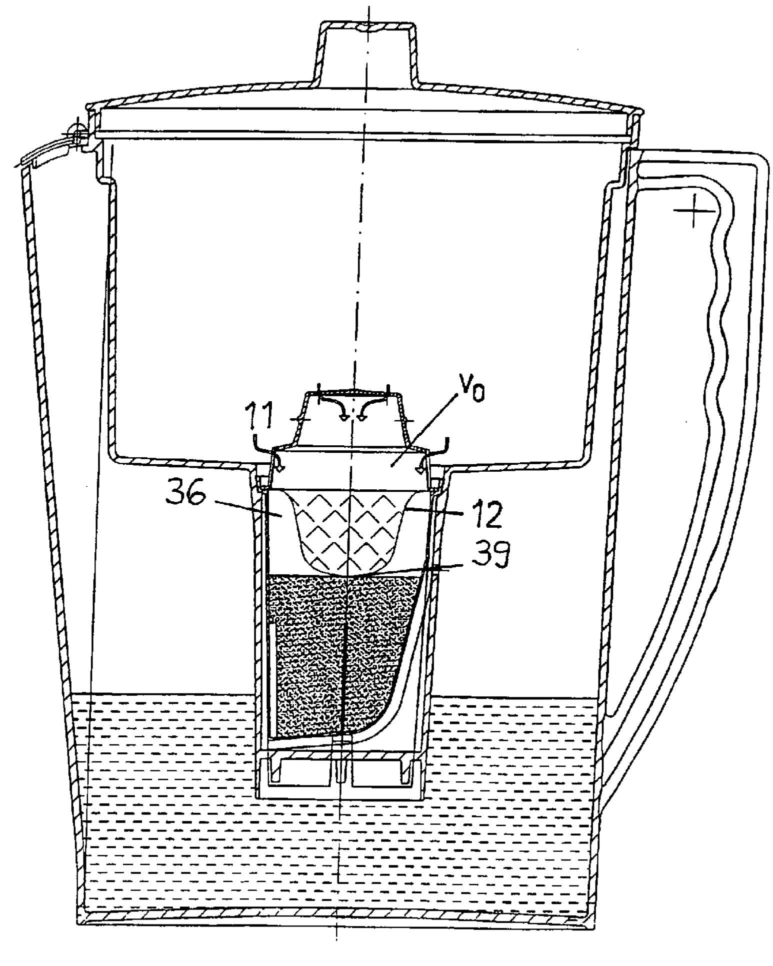


Fig. 18