

(19) World Intellectual Property
Organization
International Bureau



(43) International Publication Date
31 March 2005 (31.03.2005)

PCT

(10) International Publication Number
WO 2005/028072 A1

(51) International Patent Classification⁷: **B01D 29/54,**
29/31

(21) International Application Number:
PCT/US2004/030031

(22) International Filing Date:
13 September 2004 (13.09.2004)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
60/502,387 12 September 2003 (12.09.2003) US

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(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, 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, NA, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

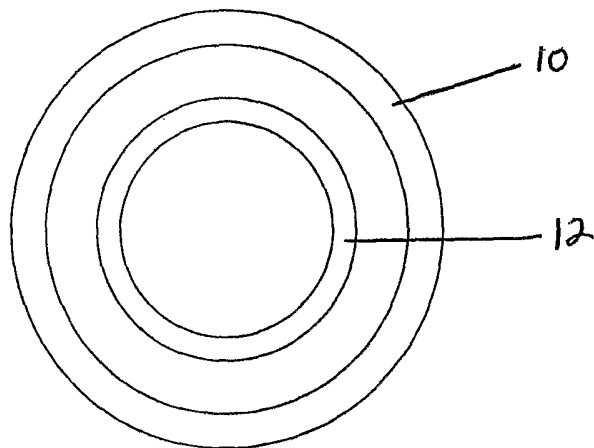
(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

- with international search report
- before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: NON-COLLAPSIBLE DUAL FILTER ELEMENT



(57) Abstract: A liquid filter device comprising a first non-collapsible filter element (12, 32) formed of filter media; a second non-collapsible filter element (10, 30) formed of filter media, the first filter element being operatively contained within the second filter element such that a first space is operatively formed therebetween, the first filter element operatively forming a second space interiorly thereof; an inlet plate, operatively connected at one end of both the first and second filter elements, the inlet plate having an outer circumferential edge and a central area, the second filter element being operatively connected to the inlet plate proximate to the outer edge of the inlet plate, the first filter element being connected to the inlet plate proximate to the central area, the inlet plate operatively communicating with the first space between the first and second filter elements such that the flow of liquid to be filtered is directed into the first space.

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NON-COLLAPSIBLE DUAL FILTER ELEMENT**Related Applications**

This application is a continuation-in-part of and claims priority to commonly owned US Provisional Patent Application Serial No. 60/502,387 of Hamlin et al., filed September 12, 2003, entitled "Dual Filter Element," the disclosure of which is herein incorporated by reference to the extent not inconsistent with the present disclosure.

Background of the Disclosure

The present disclosure relates generally to the field of fluid filtration, and more particularly to a filter element for use in liquid filtration systems which is, presently preferably, non-collapsible and which incorporates the use of a space formed between a filtration element having dual spaced apart filter media sleeves.

Dual filter elements having concentrically arranged cylindrical sleeves are known in the art. U.S. Patents 6,238,560 and 6,030,531, both issued to M. Gershenson (the "Gershenson patents") describe such a filter element utilizing cylindrical filter sleeves made of flexible bag -type filter media so that the filter element is collapsible. The filter element described in the Gershenson patents utilizes an inlet plate and an end terminal plate to which the flexible media is securely attached. Because the media used therein is flexible bag-type, collapsible media, the filter element of the aforementioned patents requires that it be supported, such as, for example, by a retainer basket having concentrically arranged cylindrical support screens defining an annular space therebetween into which the filter element may be removably inserted. The dual filter element described in the Gershenson patents would be collapsible so that the inlet and end terminal plates are axially movable toward and away from each other. Because the Gershenson type filter element utilizes conventional bag-type filter media which is flexible, the element is collapsible and thus difficult to achieve proper placement within the restrainer basket. In certain circumstances insertion of such a collapsible filter element requires the use of tooling or manipulating devices in order to position it correctly in the supporting basket. Additionally, because the Gershenson type filter element is collapsible, a support restraining basket is required for its use within a filter housing.

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U.S. Patents Numbers 6,238,560 and 6,030,531 and others to Gershenson disclose two flexible or collapsible cylindrical filter sleeves but do not describe the use of any rigid filter media.

5 U.S. Patent Number 6,511,598 to Gershenson discloses a cartridge type design which describes the use of flexible filter media that requires a core/basket built into the filter element for support but does not mention rigid media.

U.S. Patent Number 4,552,661 discloses flexible bag type filter media and includes one tubular shaped filter media but does not mention rigid media.

10 U.S. Patent Number 5, 075,004 to Hayward discloses use of the flexible bag type filter media and includes one tubular shape filter media but does not mention rigid media.

U. S. Patent Number 5,840,188 to Le Sac discloses the use of one filter bag, which includes flexible filter media.

15 Other prior art includes pleated, such as, for example, Pall, Filterite, and other manufacturers, coreless pleated filter elements that are installed over a reusable metal supporting core or basket. However, the disclosure includes only one cylinder per filter assembly which flows outside in or inside out if a basket is used.

20 Rigid filter cylinders provide the self supporting structure. Therefore there is no need for additional or separate support structure as part of the filter element, such as a basket or filter basket.

As is known, conventional bag type filters are flexible but this flexibility presents problems when inserting the flexible bag filters into the vessel
25 or basket in that often such insertion operation requires additional tool(s) and effort to accomplish the correct, operative placement in to the basket.

Since flexible bag media has proved to be a less than optimum or efficient filter media, an improved efficiency/retention filtration system is needed to more completely remove unwanted contaminants.

30 All the bag type filters believed to currently be on the market, including the above, had been using and currently use flexible filter media. As described above, these bag type filters have historically created problems during installation of the filter in to the filter housing. These prior bag type filters do not have the flexibility to use any filler type adsorption media, such as GAC to
35 provide additional filtration features such as, for example, lead or chlorine removal from the fluid. Further, flexible bag media has not proven to be as consistent or efficient as compared to typical rigid depth cartridges.

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Utilizing pleated filters with one cylinder, results in contaminants being trapped on the exterior of the filter, or if the flow is inside out, contaminants are trapped inside, but large hold-up volume/weight makes changing filters difficult.

5 Thus, there is a need for a new and innovative liquid filter device having a first non-collapsible filter element formed of filter media, a second non-collapsible filter element formed of filter media, the first filter element being operatively contained within the second filter element such that a first space is operatively formed therebetween, the first filter element operatively forming a
10 second space interiorly thereof, each filter element being non-collapsible in the axial direction. There is also a need for rigid, self-supporting filter media that requires no support basket and is able to withstand the normal differential pressures that are applied thereto.

Summary of the Disclosure

15 The present disclosure overcomes the difficulties outlined above. In one particular representative embodiment of the present disclosure, the filter sleeves are formed of material that is relatively rigid (such as the materials used in the commercially available cartridge type filters known as Betapure® or PolyKLEAN™) thus avoiding the necessity for a support basket within a filter
20 housing.

 In one specific representative embodiment, two separate rigid, spaced apart filter media cylinders are operatively connected to the inlet and bottom end plates such that effective filtration surface area is provided, without using support baskets required in the prior art. In other words, the arrangement of
25 the filter sleeves of the present disclosure provides a self supporting filter element and, as such, does not require any tools in order to operatively position the filter media in the filter vessel as required in the prior art. Hence, such rigid, spaced apart filter media provides an ease of use not previously believed attained in the prior art.

30 In another specific representative embodiment, the filter media is pleated, non-collapsible filter material (such as, for example, the type used in the commercially available cartridge type filters known as Betafine®D) with support netting, presently preferably, on both the up and downstream sides thereof. Such a construction may be non-collapsible but still requires the use of a supporting
35 basket for this pleated, non-collapsible filter media.

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In, another specific representative embodiment of the present disclosure, a, presently preferably, annular space is formed between the, presently preferably, cylindrical filter sleeves, the space being optionally filled with an adsorptive/absorptive material, such as, but not limited to, granulated activated carbon, ion exchange materials, lead removal materials, diatomaceous earth or similar adsorption materials. In this aspect of the disclosure, the space between the first and second filter sleeves is filled with adsorptive and/or absorptive materials including, but not limited to, activated carbon powder, diatomaceous earth, anionic or cationic beads, perlite and silica gel, such as is illustrated in Figures 5(a) and 5(b).

These adsorptive and/or absorptive materials are, presently preferably, employed by dispersing loose material in a mixing tank, allowing for adsorption/absorption to occur, and then removing the material through subsequent filtering steps. An alternative method is to form a packed bed with the adsorptive and/or absorptive materials, and then flow the fluid through the bed depth to enable adsorption/absorption to occur, such as, an ion exchange column. However, small adsorptive/absorptive particles are known to be carried from the packed bed with the process fluid, and therefore need to be filtered out to prevent contamination of the downstream system... Insertion of the adsorptive/absorptive materials in the space of a disposable filter element, as described herein, would overcome the disadvantages of having to conduct separate filtering steps and render the entire filtering process easier, faster and cleaner.

Other representative embodiments include, but are not limited to, a liquid filter device comprising a first non-collapsible filter element formed of filter media; a second non-collapsible filter element formed of filter media, the first filter element being operatively positioned within the second filter element such that a first space is operatively formed therebetween, the first filter element operatively forming a second space interiorly thereof; an inlet plate, operatively connected at one end of both the first and second filter elements, the inlet plate having an outer circumferential edge and a central area, the second filter element being operatively connected to the inlet plate proximate to the outer edge of the inlet plate, the first filter element being connected to the inlet plate proximate to the central area, the inlet plate operatively communicating with the first space between the first and second filter elements such that the flow of liquid to be filtered is directed into the first space, each filter element being non-collapsible in the axial direction, the inlet plate being operatively positioned to receive liquid to be filtered when the filter element is arranged within a filtration system such that

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liquid will pass through the inlet plate into the first space between the first and second filter elements for traversing through the filter elements for the filtration thereof.

Thus, it is one object of at least one representative embodiment of the present disclosure to incorporate two rigid, spaced apart filter media structures operatively connected to top and bottom plates to create a filter element for use in liquid filtration application, wherein such construction provides effective filtration surface area without using supporting basket (self supporting filter element).

It is another object of at least one representative embodiment of the present disclosure to provide filter media having pleated material with support netting on the up/down stream side, wherein such construction is non-collapsible but requires the use of supporting basket for media.

It is yet another object of at least one representative embodiment of the present disclosure to provide a rigid filter element construction without a bottom plate, wherein such construction provides higher effective filtration surface area as compared to versions having a bottom plate, such as the Polymerics filter cartridge.

It is still another object of at least one representative embodiment of the present disclosure to fill the space/volume between two, spaced apart filter media with adsorptive materials, such as, but not limited to, GAC (activated carbon powder), ion exchange, lead removal, diatomaceous earth or similar powder adsorption media, wherein such construction provides for the removal of dissolved or undissolved contaminations from the fluid by the filler adsorption media and mechanical filtration takes place in the outer media cylinders.

Other objects and advantages of the disclosure will be apparent from the following description, the accompanying drawings and the appended claims.

Detailed Description of the Drawings

Other features, advantages and details of the present disclosure are described further below in connection with the accompanying drawings.

Figure 1 is a cross-sectional view illustrating the spaced apart arrangement of the rigid filter sleeves of the present disclosure.

Figure 2 is a cross-sectional view illustrating the spaced apart arrangement of the non-collapsible filter sleeves in which the sleeves are made of pleated material of the present disclosure.

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Figure 3 is a longitudinal cross-sectional view illustrating the filtration device of the present disclosure with the support basket.

Figure 4 is a cross-sectional view illustrating the arrangement of the rigid filter media with the inlet plate of the present disclosure.

5 Figures 5(a) and 5(b) are diagrammatic views illustrating a representative embodiment of the present disclosure in which the space is filled with adsorptive/absorptive material.

Detailed Description of the Disclosure

10 As used in the present disclosure, the term, "filter media" shall mean that which provides the filtration means for liquids. Filter media construction may be rigid or pleated and is presently preferably in cylindrical form.

15 As used in the present disclosure, the term, "rigid filter media" shall mean media formed in a geometrical or irregular shape, which is not axially collapsible and self-supporting where as no support basket is required after filter element assembly is completed and includes but is not limited to, such examples as Cuno Micro-Klean[®], Betapure[®] and PolyKLEAN[™] media or graded density media, to name but a few of the many possibilities.

20 As used in the present disclosure, the term, "pleated filter media" shall mean media formed in a geometrical shape or irregular shape, which is not axially collapsible after the filter element assembly is completed.

25 As used in the present disclosure, the term, "adsorption media" shall mean media which can be filled in the space between two spaced apart filter media and removes contamination by adsorption and not by mechanical filtration, including, but not limited to, granular carbon (GAC).

30 As used in the present disclosure, the term, "inlet or top plate" shall mean a rigid or semi flexible plate with openings for allowing fluid to enter the filter and contact the housing and/or supporting basket. This plate may be of two piece construction assembled together. The filter media is operatively connected to this plate.

 As used in the present disclosure, the term, "bottom plate" shall mean a rigid or semi flexible plate, which provides the means to attach filter media in order to operatively close the bottom space between the inner and outer media elements.

35 As used in the present disclosure, the term, "basket" shall mean two geometrically shaped or irregularly shaped elements perforated and

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operatively connected to the bottom plate so that a center opening and an operative connection (not necessarily a solid connection) between two members, presently preferably, cylinders is established.

As used in the present disclosure, the term, "GAC shall mean
5 Granular activated carbon media used in water filtration.

As used in the present disclosure, the term, "MK" shall mean Rigid Micro-Klean[®] filter media as manufactured by Cuno, Inc.

As used in the present disclosure, the term, "BP" shall mean Betapure[®] filter media.

10 Referring now to Figures 1 and 3, two spaced apart rigid filter media elements 10, 12 having a predetermined geometrical shape or irregular shape, are illustrated as, presently preferably, cylinders, and are operatively connected to a top inlet plate 14 and a bottom plate 16 to form a filter cartridge 20. Due to the rigid media structure, a supporting basket is not required. Once
15 formed, the filter cartridge 20 is operatively positioned into a conventional filter bag housing 22. As illustrated in Figure 3, the housing cover 26 presses against the top plate 14, hence preventing by-pass of influent to effluent. As illustrated, utilization of MK or BP media would be ideal in the appropriate application.

Referring now to Figure 2, filtration media 30, 32 could be pleated
20 in order to increase the effective filtration area. Such pleated design would most likely provide longer filter life, since the surface area of the filtration media is increased by pleating. Utilizing such pleated filtration media would require a support structure, such as a basket, a core or a basket (not shown) in order to prevent filter media collapse. Presently preferably, it is believed that, in order to
25 maximize effective filter area, pleated structure including, but not limited to, the pleated structure disclosed in U.S. Patent 6,315,130, the disclosure of which is hereby incorporated by reference, to the extent not inconsistent with the present disclosure, would be operatively functional. The pleated media used would, presently preferably, be similar to Cuno Betafine[®]XL or Betafine[®]D cartridges
30 which are disclosed in U.S. Patent 6,315,130, above. It is believed that the pleat geometry utilized may be Cuno Advanced Pleat technology standard pleats or any pleat geometry that operatively functions in the environment of use.

The inner pleat 32 pack is then placed inside the outer pleat 30 pack followed by the top and bottom end caps being assembled thereto, as would
35 be known to those skilled in the art. This assembly, once complete, then would resemble a DuoFlo[®] filter element, as illustrated, for example, in U.S. Patent Nos.

6,238,560 and 6,030,531, the disclosure of each is hereby incorporated by reference to the extent not inconsistent with the present disclosure.

Referring now to Figure 4, the filter media could be rigid, such as, for example, Polymeric or other equivalent. In this embodiment, the media elements 40, 42 are operatively connected to an inner plate 44 and an outer plate 46. Thus, there is no need for a bottom plate, as the bottom comprises rigid filter media element 48 operatively connecting the other two media elements 40, 42.

As illustrated, the outer plate 46 may include sealing means, such as, for example, an o-ring or molded-in elastomer 50. This filter sub-assembly is positioned into the housing sump 54 and the housing cover 56 is tightened to secure the various components into operable position. As the cover 56 is tightened, the o-ring 50 is compressed, hence providing the necessary seal. Fluid flows from the center inlet 58 of the housing cover, passes through filter media elements 40, 42, 48 and out from the bottom 60 of the sump 54, as illustrated by the arrows in Figure 4.

Referring now to Figure 5(a), the embodiment illustrated provides for filling the space/volume 70 between two spaced apart filter media elements 72, 74 shaped, presently preferably, as cylinders, with other filtration media, including, but not limited to, GAC, ion exchange, lead removal, DE or similar granular media. The illustrated embodiment provides the additional feature for removal of dissolved or un-dissolved contaminations from the fluid by the filler adsorption media while mechanical filtration occurs in the two spaced apart media elements. Additionally, the two spaced apart filter media cylinders prevent all the adsorption media from escaping into effluent. Further, this embodiment requires sealing the openings 76 in the top plate 78 with similar filter media to keep the adsorption media in place during shipping/handling.

As should be clear to a person skilled in the art, all of the above described embodiments create improved liquid filtration elements as compared to prior conventional bag type filter elements. The rigid, non-collapsible, construction thereof eliminates the requirement, in nearly all described embodiments for the supporting basket. Additionally, some of the above described embodiments provide for the volume between the two spaced apart filter elements to be filled with additional filtration media.

While the articles, apparatus and methods for making the articles contained herein constitute preferred embodiments of the invention, it is to be understood that the disclosure is not limited to these precise articles, apparatus

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and methods, and that changes may be made therein without departing from the scope of the disclosure which is defined in the appended claims.

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What is claimed is:

1. A liquid filter element comprising:

a first filter sleeve formed of filter media;

5 a second filter sleeve formed of filter media, the first filter sleeve and being operatively arranged within the second filter sleeve thereby forming a first space therebetween, the first filter sleeve forming a second space interiorly thereof;

10 an inlet plate, operatively connected at one longitudinal end of both the first and second filter sleeves, the inlet plate having an outer edge and a central area corresponding to the cross-sectional area of the second space, the second filter sleeve being operatively connected to the inlet plate proximate to the outer edge of the inlet plate, the first filter sleeve being connected to the inlet plate proximate to the central circular area, the inlet plate communicating with the first space between the first and second filter sleeves to thereby permit the flow of liquid to be filtered into the first space, the filter element being non-collapsible in
15 the axial direction, the inlet plate being oriented to receive liquid to be filtered when the filter element is arranged within the filtration system such that liquid will pass through the inlet plate into the first space between the first and second filter sleeve for passing through the filter sleeves for filtration thereof; and

20 a structure, operatively connected to the first and the second filter sleeves, for directing fluid flow through the first and the second filter sleeves.

2. The liquid filter element of claim 1, wherein the first and second filter sleeves are formed of filter media which is relatively non-flexible in the axial direction of the sleeves.

3. The liquid filter element of claim 1, wherein the filter media is rigid.

4. The liquid filter element of claim 1, wherein the filter media is pleated

5. The liquid filter element of claim 1, wherein the space/volume between the two filter media is filled with adsorptive materials.

6. The liquid filter element of claim 5, wherein the adsorptive material is selected from the group comprising:

activated carbon powder, ion exchange resin, lead removal media, diatomaceous earth or a combination of such adsorption material.

7. The liquid filter element of claim 4, wherein the pleated filter media further includes:

support netting on the up/down stream sides thereof.

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8. A liquid filter element comprising:

first and second cylindrical filter sleeves formed of filter media, the first filter sleeve being operatively arranged within the second filter sleeve forming an annular space therebetween, the first filter sleeve forming a cylindrical space interiorly thereof; a substantially circularly shaped inlet plate connected at one longitudinal end of both the first and second filter sleeves, the inlet plate having an outer circumferential edge and a central circular area corresponding to the cross-sectional area of the cylindrical space, the second filter sleeve being operatively connected to the inlet plate proximate to the outer circumferential edge of the inlet plate, the first filter sleeve being operatively connected to the inlet plate proximate to the circumference of the central circular area, the inlet plate communicating with the annular space between the first and second filter sleeves to provide for the flow of liquid to be filtered into the annular space, the filter element being non-collapsible in the axial direction, the inlet plate being oriented to receive liquid to be filtered when the filter element is arranged within the filtration system such that liquid will pass through the inlet plate into the annular space between the first and second filter sleeve for passing through the filter sleeves for the filtration thereof; and

structure, operatively connected to the first and the second filter sleeves, for directing fluid flow through the first and the filter sleeves.

9. The liquid filter element of claim 8, wherein the first and second filter sleeves are formed of filter media which is relatively non-flexible in the axial direction of the sleeves.

10. The liquid filter element of claim 8, wherein the filter media is rigid.

11. The liquid filter element of claim 8, wherein the filter media is pleated

12. The liquid filter element of claim 8, wherein the space/volume between the two spaced apart filter media is filled with adsorptive materials.

13. The liquid filter element of claim 12, wherein the adsorptive material is selected from the group comprising:

activated carbon powder, ion exchange resin, lead removal media, diatomaceous earth or a combination of such adsorption material.

14. The liquid filter element of claim 11, wherein the pleated filter media further includes:

support netting on the up/down stream sides thereof.

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15. A liquid filter device comprising:

a first non-collapsible filter element formed of filter media;

a second non-collapsible filter element formed of filter media, the first filter element being operatively positioned within the second filter element
5 such that a first space is operatively formed therebetween, the first filter element operatively forming a second space interiorly thereof;

an inlet plate, operatively connected at one end of both the first and second filter elements, the inlet plate having an outer edge and a central area, the second filter element being operatively connected to the inlet plate proximate to
10 the outer edge of the inlet plate, the first filter element being connected to the inlet plate proximate to the central area, the inlet plate operatively communicating with the first space between the first and second filter elements such that the flow of liquid to be filtered is directed into the first space, each filter element being non-collapsible in the axial direction, the inlet plate being operatively positioned to
15 receive liquid to be filtered when the filter element is arranged within a filtration system such that liquid will pass through the inlet plate into the first space between the first and second filter elements for traversing through the filter elements for the filtration thereof; and

structure, operatively connected to the first and the filter sleeves,
20 for directing fluid flow through the first and the filter sleeves.

16. The liquid filter device of claim 15 further comprising:

at least one additional non-collapsible filter element formed of filter media operatively interconnecting the first and second filter elements.

17. The liquid filter element of claim 15, wherein the first and second filter sleeves are formed of filter media which is relatively non-flexible in the axial direction of the sleeves.

18. The liquid filter element of claim 15, wherein the filter media is rigid.

19. The liquid filter element of claim 15, wherein the space/volume between the two spaced apart filter media is filled with adsorptive materials.

20. The liquid filter element of claim 19, wherein the adsorptive material is selected from the group comprising:

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activated carbon powder, ion exchange, lead removal, diatomaceous earth or a combination of such adsorption material.

21. The liquid filter element of claim 15, wherein the structure is a bottom plate.

22. A liquid filter system comprising:

a filter element, the filter element comprising:

a first non-collapsible filter element formed of filter media;

5 a second non-collapsible filter element formed of filter media, the first filter element being operatively positioned within the second filter element such that a first space is operatively formed therebetween, the first filter element operatively forming a second space interiorly thereof;

10 an inlet plate, operatively connected at one end of both the first and second filter elements, the inlet plate having an outer edge and a central area, the second filter element being operatively connected to the inlet plate proximate to the outer edge of the inlet plate, the first filter element being connected to the inlet plate proximate to the central area, the inlet plate operatively communicating with the first space between the
15 first and second filter elements such that the flow of liquid to be filtered is directed into the first space, each filter element being non-collapsible in the axial direction, the inlet plate being operatively positioned to receive liquid to be filtered when the filter element is arranged within a filtration system such that liquid will pass through the inlet plate into the first space
20 between the first and second filter elements for traversing through the filter elements for the filtration thereof;

structure, operatively connected to the first and the filter sleeves, for directing fluid flow through the first and the filter sleeves; and

25 a filter housing, the filter element being operatively positioned within the filter housing.

23. The liquid filter system of claim 22 further comprising:

a support basket, the filter element being operatively positioned within the support basket and the support basket being operatively positioned within the filter housing.

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24. A liquid filter device comprising:

a first collapsible filter element formed of filter media;

5 a second collapsible filter element formed of filter media, the first filter element being operatively positioned within the second filter element such that a first space is operatively formed therebetween wherein the first space is filled with adsorptive materials, the first filter element operatively forming a second space interiorly thereof;

10 an inlet plate, operatively connected at one end of both the first and second filter elements, the inlet plate having an outer edge and a central area, the second filter element being operatively connected to the inlet plate proximate to the outer edge of the inlet plate, the first filter element being connected to the inlet plate proximate to the central area, the inlet plate operatively communicating with the first space between the first and second filter elements such that the flow of liquid to be filtered is directed into the first space, each filter element being
15 collapsible in the axial direction, the inlet plate being operatively positioned to receive liquid to be filtered when the filter element is arranged within a filtration system such that liquid will pass through the inlet plate into the first space between the first and second filter elements for traversing through the filter elements for the filtration thereof; and

20 structure, operatively connected to the first and the filter sleeves, for directing fluid flow through the first and the filter sleeves.

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FIG. 1

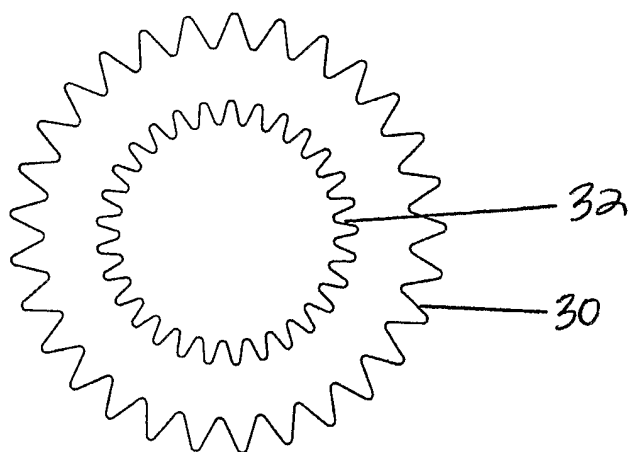
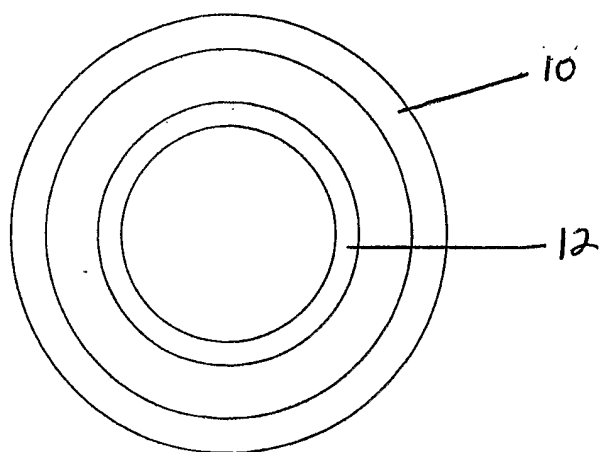


FIG. 2

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FIG. 3

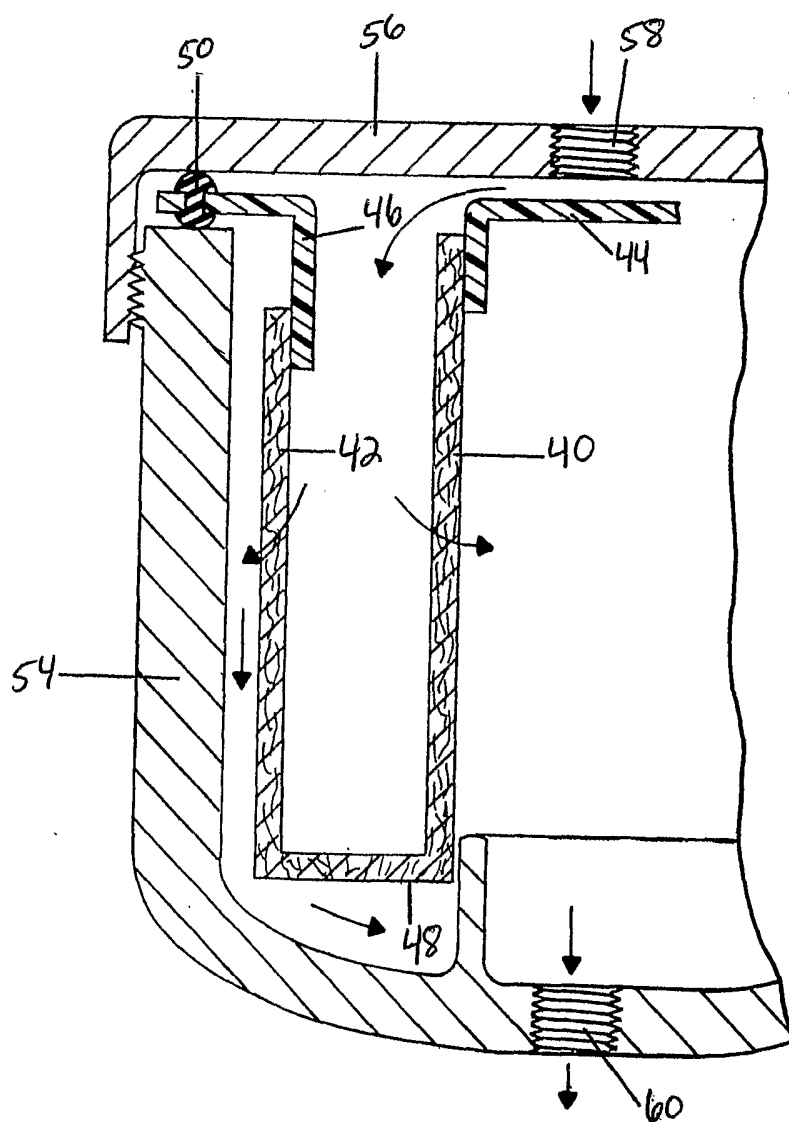
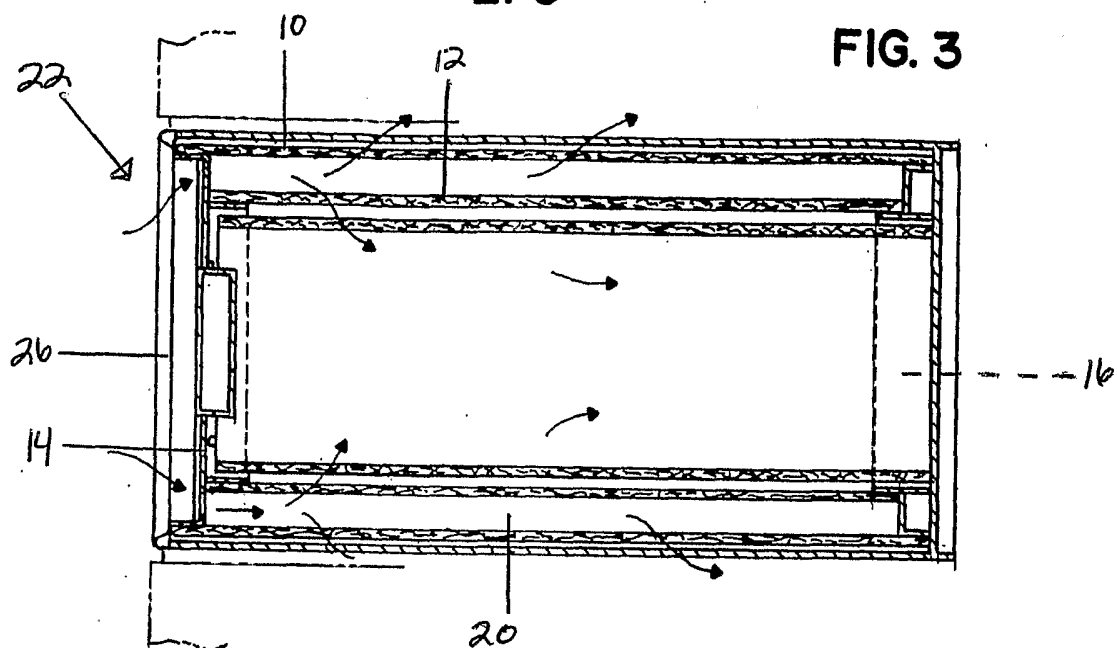


FIG. 4

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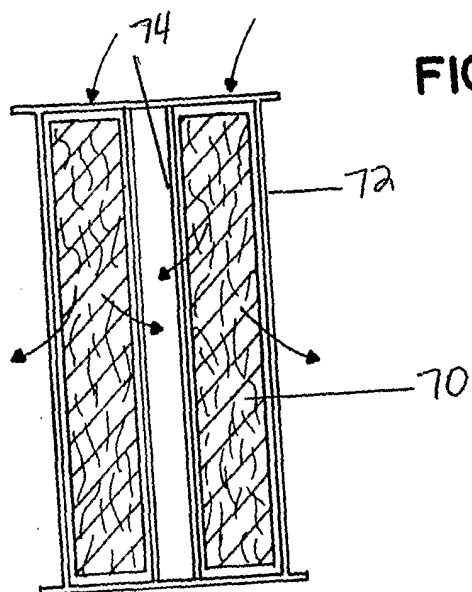


FIG. 5A

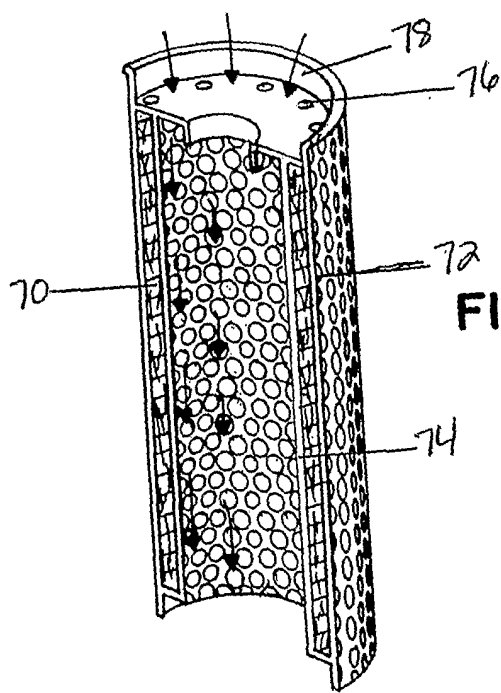


FIG. 5B

INTERNATIONAL SEARCH REPORT

International Application No

PCT/JP2004/030031

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 B01D29/54 B01D29/31

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 B01D

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

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

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2 792 118 A (KRAISSL JR FREDERICK) 14 May 1957 (1957-05-14) column 1, line 69 - column 2, line 50; figures 1-8 -----	1-3, 8-10, 15-18,21
X	DE 39 05 854 A (BRIEDEN KARL BAU BETEILIGUNG) 20 September 1990 (1990-09-20) column 3, line 31 - line 42 column 4, line 27 - line 46; figure 1 -----	1-3, 8-10,15, 17,18, 21,22
X	US 2 448 157 A (SCHNEIDER MAX S) 31 August 1948 (1948-08-31) column 2, line 34 - column 3, line 10; figure 1 ----- -/--	1,8,15, 22

☒ Further documents are listed in the continuation of box C.☒ Patent family members are listed in annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search

14 December 2004

Date of mailing of the international search report

07.03.05

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Authorized officer

Sembritzki, T

INTERNATIONAL SEARCH REPORT

Internat Application No
PCT/US2004/030031

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 6 409 919 B1 (TARA STANLEY P) 25 June 2002 (2002-06-25) abstract; figures 3,4 -----	1-23
A	US 1 647 799 A (HAMMER FORRESTER L) 1 November 1927 (1927-11-01) figure 4 -----	1-23

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2004/030031

Box II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

1 - 23

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
- ☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-23

The subject-matter of claims 1-23 refers to a filter comprising two concentric filter elements in parallel connection wherein the filter elements are non-collapsible.

2. claim: 24

The claim is directed to a filter having two collapsible concentric filter elements wherein the space between the filter comprises an adsorptive media.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/US2004/030031

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 2792118	A	14-05-1957	NONE	
DE 3905854	A	20-09-1990	DE 3905854 A1	20-09-1990
US 2448157	A	31-08-1948	NONE	
US 6409919	B1	25-06-2002	NONE	
US 1647799	A	01-11-1927	NONE	