

(19) World Intellectual Property Organization  
International Bureau



(43) International Publication Date  
24 December 2008 (24.12.2008)

PCT

(10) International Publication Number  
**WO 2008/157244 A1**

(51) International Patent Classification:  
**B01D 35/147** (2006.01) **B01D 29/21** (2006.01)

[US/US]; 5617 Harriet Ave. S., Minneapolis, MN 55419 (US).

(21) International Application Number:  
PCT/US2008/066739

(74) Agent: **BRUESS, Steven, C.**; Merchant & Gould P.C., P.O. Box 2903, Minneapolis, MN 55402-0903 (US).

(22) International Filing Date: 12 June 2008 (12.06.2008)

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:  
60/943,962 14 June 2007 (14.06.2007) US

(71) Applicant (for all designated States except US): **DON-ALDSON COMPANY, INC.** [US/US]; 1400 West 94th Street, P.O. Box 1299, Minneapolis, MN 55440-1299 (US).

(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,

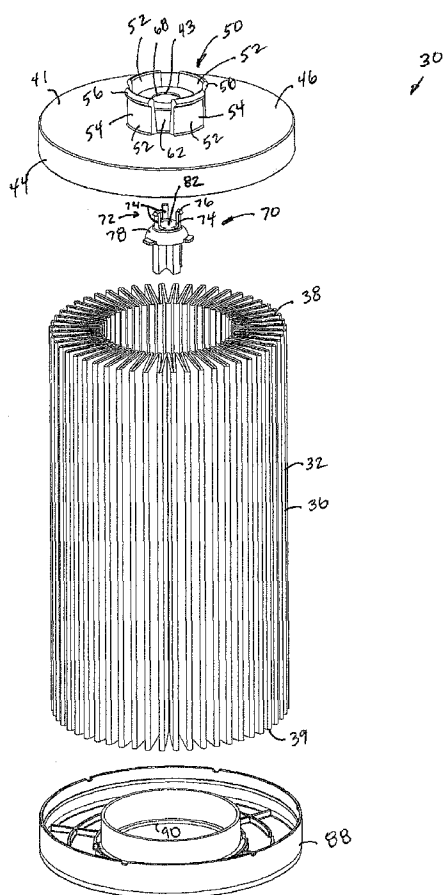
(72) Inventor; and

(75) Inventor/Applicant (for US only): **HACKER, John, R.**

[Continued on next page]

(54) Title: **LIQUID FILTER ARRANGEMENT AND METHODS**

FIG. 4



(57) Abstract: A filter element includes filter media, first and second end caps, a latch arrangement projecting from the first end cap, a tubular neck extending from the first end cap and a valve head including an arm arrangement with hooks and oriented within the first end cap aperture constructed and arranged to move between a position sealing the first end cap aperture and exposing the first end cap aperture. A filter assembly includes a filter element, as characterized herein, and including a filter base and a service cover. A method of servicing includes removing an old filter element, operably mounting a new filter element in a filter base including engaging a valve head against a spring member in the filter base, and operably mounting the service cover over the new filter element and filter base. A method of filtering includes directing liquid into a filter assembly, blocking a first end cap aperture by using a spring member in the filter base to urge the valve head against a rim of a tubular neck extending from the filter element, and directing liquid through the filter media to filter the liquid.



FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MT, NL,  
NO, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG,  
CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

— *before the expiration of the time limit for amending the  
claims and to be republished in the event of receipt of  
amendments*

**Published:**

— *with international search report*

## **LIQUID FILTER ARRANGEMENT AND METHODS**

This application is being filed on 12 June 2008 as a PCT International Patent application in the name of Donaldson Company, Inc., a U.S. national corporation, applicant for the designation of all countries except the US, and John R. Hacker, a citizen of the U.S., applicant for the designation of the US only, and claims priority to U.S. Provisional Patent Application Serial No. 60/943,962, filed June 14, 2007. Application 60/943,962 is incorporated herein by reference.

### **Technical Field**

10           This application describes filter arrangements. In particular, this application describes a filter cartridge usable in a filter bowl for purifying liquids, such as oil for engines.

### **Background**

15           Filters are commonly used in connection with lubrication systems and fuel systems for internal combustion engines, and hydraulic systems for heavy-duty equipment. Filters are often used in many other types of liquid systems. In these types of systems, the filter is changed periodically. In the art, there are at least two standard types of filters used. One type is a spin-on canister filter, while the other is a bowl-cartridge filter. This application addresses bowl-cartridge filters.

20           Bowl-cartridge filters typically include a reusable bowl (or service cover) holding a replaceable filter element (cartridge filter). Bowl-cartridge filters are mounted onto a filter head or filter base, wherein liquid to be cleaned passes through the filter head (base), into the bowl (service cover), through the replaceable cartridge filter, outside of the bowl (service cover), and back into the filter head (base). After a period of use, the bowl-cartridge filter is removed from the filter head (base), and the replaceable cartridge filter is removed from the reusable bowl (service cover). The old cartridge filter is discarded with a new cartridge filter. The new cartridge filter is operably mounted into the reusable bowl (service cover) to provide a refurbished bowl-cartridge filter. This refurbished bowl-cartridge filter containing the new cartridge filter is then mounted onto  
30   the filter head (base).

### **Summary of the Disclosure**

A filter element is provided including a tubular extension of pleated filter media, a first end cap, a second end cap, and a latch arrangement projecting from the first end cap. The filter element also includes a tubular neck extending from the first end cap  
5     circumscribing an aperture in the first end cap. The tubular neck is circumscribed by the latch arrangement. The filter element also includes a valve head oriented within the first end cap aperture and constructed and arranged to move between a position sealing the first end cap aperture and exposing the first end cap aperture.

In another aspect, a filter assembly is provided including a filter element,  
10     as characterized above, and including a filter base and a service cover. The filter element operably mounts within the filter base, and the service cover operably and removably mounts over the filter base and the filter element.

In another aspect, a method of servicing a filter arrangement includes removing a service cover and a used filter element from a filter base; providing a new  
15     filter element having a first end cap with a tubular neck extending therefrom and circumscribing a first end cap aperture and also including a valve head oriented within the first end cap aperture; operably mounting the new filter element in the filter base including engaging the valve head against a spring member in the filter base; and operably mounting the service cover over the new filter element and filter base.

In another aspect, a method of filtering is provided. The method includes  
20     directing liquid to be filtered into a filter assembly that includes a filter assembly operably installed in a filter base and a service cover, the filter element including a tubular extension of filter media, a first end cap having a tubular neck extending therefrom and circumscribing a first end cap aperture, and a valve head oriented within the first end cap  
25     aperture; blocking the first end cap aperture by using a spring member in the filter base to urge the valve head against a rim of the tubular neck; and directing liquid filter through the media to filter the liquid.

### **Brief Description of the Drawings**

FIG. 1 is an exploded perspective view of an embodiment of a filter  
30     assembly, including a service cover, a filter element, and a filter base, constructed according to principles of this disclosure;

FIG. 2 is a cross-sectional view of the filter assembly depicted in FIG. 1, and showing the service cover mounted on the filter element but not mounted on the filter base;

FIG. 3 is a cross-sectional view of the filter assembly of FIGS. 1 and 2, depicting the filter assembly operably assembled in an operable condition ready for filtering;

FIG. 4 is an exploded perspective view of the filter element depicted in FIGS. 1-3; and

FIG. 5 is a cross-sectional view of the filter element depicted in FIGS. 1-4.

10

### **Detailed Description**

This disclosure describes embodiments of a filter element that are usable within a reusable service cover for mounting onto a filter base. The filter elements are usable in assemblies that can be used in a “top-load” orientation. By the term “top-load”, it is meant that the filter assembly (filter base plus service cover within the filter element operably installed therein) is installed in an orientation that permits servicing or access to the filter assembly from a position over or above whatever part that remains fixed to the equipment (for example, the engine, generator, or whatever is the applicable machine part) in operational position during servicing, when the equipment is in normal, operable orientation. In many convenient top-load configurations, the person servicing the filter assembly is not required to be in a position underneath or below the equipment. Instead, the person servicing the filter assembly is able to access it from the top of the equipment. For example, in a vehicle having an engine that is selectively accessible by a movable hood, the filter assembly would be accessible merely by raising the hood of the vehicle and then removing the service cover.

One example of a filter assembly in a top-load configuration having a service cover and a filter head is described in U.S. Patent No. 5,770,054, incorporated herein by reference.

In FIGS. 1-3, a filter assembly 6, constructed according to principles of this disclosure is depicted. The assembly 6 includes a filter base 10 and a service cover 12 removably mounted on the filter base 10. Extending through the center of the filter base 10 is a porous center tube 20 and holding a spring member 22. The spring member 22 includes a spring plunger 24 with a spring force engaging upon it by a biasing member

26. The spring plunger 24 urges against a portion of a filter element when a filter element is properly and operably mounted for use in the filter base 10, and the service cover 12 is arranged.

In reference now to FIG. 1, an embodiment of a filter element mounted in the filter base 10 is illustrated generally at 30. In the embodiment shown, the element 30 includes a tubular extension of filter media 32 defining an open filter interior 34 (FIG. 2). The open filter interior 34 receives the center tube 20 therewithin. In the embodiment shown, the filter media 32 is pleated filter media 36.

The pleated media 36 defines first and second opposite ends 38, 39 (FIG. 4). In the embodiment shown, the filter element 30 further includes a first end cap 41 secured to the first end 38 of the pleated media 36. Attention is directed to FIG. 5, which illustrates a cross-sectional view of the embodiment of the filter element 30. In FIG. 5, the first end cap 41 defines an open aperture 43. While many embodiments are contemplated, in the particular embodiment shown, the first end cap 41 is defined by an outer peripheral wall 44 generally orthogonal to a planar region 46.

In the embodiment shown, the filter element 20 further includes a latch arrangement 50. In the embodiment shown, the latch arrangement 50 projects from the first end cap 41 and functions to releasably secure the filter element 30 to the service cover 12 (FIG. 3). In the embodiment shown, the latch arrangement 50 includes at least two latches, preferably four latches 52. Each of the latches 52 includes a deflectable latch finger 54 extending from the planar region 46 of the first end cap 41. In preferred embodiments, each latch finger 54 is molded from the same piece of material as the rest of the first end cap 41. Each of the latch fingers 54 includes a catch 56 at a free end of each latch finger 54.

As mentioned above, the latch arrangement 50 is usable to releasably secure the filter element 30 to the service cover 12. In FIGS. 2 and 3, it can be seen how the service cover 12 has a ring 58 projecting from an inside surface 60 of the service cover 12. Each of the fingers 54 deflects radially inwardly until each of the catches 56 snaps over the ring 58. This engagement removably attaches the filter element 30 to the service cover 12. In this manner, when the service cover 30 is removed from the base 10, the element 30 is removed with the service cover 12.

In reference again to FIG. 5, the filter element 30 further includes a tubular neck 62 extending from the first end cap 41 and circumscribing the first end cap aperture

43. As can be seen in FIG. 5, in the preferred embodiment shown, the tubular neck 62 is circumscribed by the latch arrangement 50. In the particular embodiment shown, the tubular neck 62 includes a cylindrical wall 64 and an axial end wall 66 forming a rim 68. The edge of the rim 68 defines the perimeter of the first end cap open aperture 43. In  
5 preferred arrangements, the tubular neck 62 is made from a same molded piece of material as the rest of the first end cap 41 and preferably including the latch arrangement 50.

In the particular embodiment shown, the tubular neck 62 is shorter than the latch arrangement 50. The neck 62 is provided to hold a valve head 70.

10 In reference to FIGS. 4 and 5, the valve head 70 is oriented within the first end cap open aperture 43. The valve head 70 is constructed and arranged to move between a position closing (preferably sealing) the first end cap aperture 43 and exposing the first end cap aperture 41. While a variety of embodiments are usable, in the particular embodiment illustrated in FIGS. 4 and 5, the valve head 70 includes an arm arrangement  
15 72 slidably held within the tubular neck 62. The arm arrangement 72 engages against the rim 68 of the neck 62 and allows the valve head 70 to linearly or axially slide relative to the rest of the filter element 30 between the position closing the aperture 43 (FIG. 3) and exposing the aperture 43 (FIGS. 2 and 5).

Again, while a variety of implementations are possible, in the  
20 implementation illustrated in FIGS 4 and 5, the arm arrangement 72 includes a plurality (illustrated as 3) of arms 74, each arm 74 having a hook 76. In the embodiment shown, the hook 76 is at a free end of each arm 74. The hooks 76 engage the rim 68 and prevent the valve head 70 from becoming dislodged within the interior of the filter element 30.

Still in reference to FIGS. 4 and 5, in the specific embodiment illustrated,  
25 the valve head 70 defines a sealing surface 78 sized to operably form a seal 80 (FIG. 3) with the first end cap aperture 43. In the illustrated embodiment, the valve head 70 also includes a plateau region 82 circumscribed by the sealing surface 78. The specific embodiment illustrated shows that the plurality of arms 74 extend from the plateau region 82 in an axial direction.

30 Again, in reference to FIG 5, the valve head 70 further includes a seating surface 84 at an end opposite of the sealing surface 78 and plateau region 82. The seating surface 84 is sized to be seated and mounted on the spring member 22 (FIGS. 2 and 3) in the filter base 10, when the filter element 30 is operably mounted in the base 10. In the

embodiment shown, the seating surface 84 has an inwardly curved profile that is shaped to receive and be mounted on the plunger 24 (FIGS. 2 and 3).

In reference again to FIGS. 4 and 5, the filter element 30 further includes a second end cap 88 secured to the second end 39. The second end cap 88 defines a second end cap aperture 90, which is in communication with the open filter interior 34. In the embodiment shown, the second end cap 88 includes an outer peripheral wall 92, generally orthogonal to a planar region 94. A seal member 96 is secured within the second end cap aperture 90 and is oriented to form a seal 98 (FIG. 3) with the filter base 10, specifically, a non-porous part of the center 20.

In preferred arrangements, the filter element 30 is primarily non-metallic, for example, at least 99 percent non-metallic.

In operation, the filter assembly 6 is used by directing liquid to be filtered into the filter assembly 6. The first end cap aperture 43 is blocked by using the spring member 22 in the filter base 10 to urge the valve head 70 against the rim 68 of the tubular neck 62. Liquid is then allowed to flow through the filter media 32 into the open filter interior 34. The filter media 32 helps to remove particulate material from the liquid. The filtered liquid is then directed out of the filter assembly 10.

In operation, if restriction across the filter media 32 becomes high from filter occlusion, or in the condition of a cold-start, the liquid to be filtered will exert a force on the valve head 70 through the aperture 43 which is greater than the force exerted by the spring member 22. This will cause the valve head 70, in particular the sealing surface 78, to move away from the rim 68 of the neck 62. A gap will open and allow liquid to flow through the first end cap open aperture 43, past the valve head 70, and into the open filter interior 34.

During normal operation, the sealing surface 84 of the valve head 70 will be in the condition shown in FIG. 3, pushed against the rim 68 and closing the aperture 43, which prevents liquid from bypassing the filter media 32. After a period of operation, it will be desirable to service the filter assembly 6 by replacing the filter element 30. A method of servicing the filter assembly 6 includes removing the service cover 12 and the used filter element 30 from the filter base 10. In the embodiment shown, the step of removing the service cover 12 also includes, simultaneously, removing the filter element 30 due to the engagement between the latch arrangement 50 and the ring 58 in the service

cover 12. In the embodiment shown, this step will also include unmating the cover 12 and base 10 through the mating threads shown at 101, 102.

5 A new filter element 30 having a new valve head 70 is provided and is operably mounted in the filter base 10, including engaging the valve head 70 against the spring member 22 in the filter base 10. Specifically, in the embodiment shown, the seating surface 84 of the valve head 70 is oriented against the spring plunger 24. The service cover 12 is operably mounted over the new filter element 30 and the filter base 10. Thus, replacing the filter element 30 also replaces the valve head 70. This has advantages over arrangements that have the valve head in the other (non-replaceable) parts of the assembly. In such prior art arrangements, the valve piece is not replaced when the element is replaced, and that can lead to mechanical failure or other technical difficulties due to the valve piece wearing out.

10 The step of operably mounting the service cover 12 includes engaging the latch arrangement 50 extending from the first end cap 41 of the filter element 30 with an internal ring 58 in the service cover 12. The step of engaging the service cover with the filter element 30 can occur before positioning the filter element 30 in the base 10, or it can occur after positioning filter element 30 in the base 10. The service cover 12 and the base 10 are matably connected through the threads 101, 102.

## I CLAIM:

1. A filter element comprising a tubular extension of pleated filter media having first and second opposite ends; the tubular extension of pleated filter media defining an open filter interior; a first end cap secured to the first end of the filter media; the first end cap having a first end cap aperture; a second end cap secured to the second end of the filter media; the second end cap having a second end cap aperture in communication with the open filter interior; a latch arrangement projecting from the first end cap; the filter element being characterized by:
  - (a) a tubular neck extending from the first end cap and circumscribing the first end cap aperture; the tubular neck being circumscribed by the latch arrangement; and
  - (b) a valve head oriented within the first end cap aperture and constructed and arranged to move between a position sealing the first end cap aperture and exposing the first end cap aperture;
    - (i) the valve head including an arm arrangement slidably held with the tubular neck;
    - (A) the arm arrangement including a plurality of arms, each arm having a hook.
2. A filter element according to claim 1 wherein:
  - (a) the valve head includes a sealing surface sized to operably form a seal with the first end cap aperture; and
  - (b) the valve head includes a seating surface at an end opposite of the sealing surface; the seating surface being sized to mount on a spring-member in a base, when the filter element is operably mounted in the base.
3. A filter element according to claim 2 wherein:
  - (a) the valve head includes a plateau region circumscribed by the sealing surface; and
  - (b) the plurality of arms extend from the plateau region.

4. A filter element according to claim 1 wherein:
  - (a) the tubular neck includes a cylindrical wall and an axial end wall forming a rim; the rim defining the first end cap aperture.
5. A filter element according to claim 4 wherein:
  - (a) each hooked free end of each of the arms is engageable with the rim when the valve head is in a position exposing the first end cap aperture.
6. A filter element according to claim 1 wherein:
  - (a) the latch arrangement includes at least two latches; each of the latches includes a deflectable latch finger extending from the first end cap and a catch at a free end of each finger.
7. A filter element according to claim 6 wherein:
  - (a) the latch arrangement and tubular neck are a same molded piece as the first end cap.
8. A filter element according to claim 6 wherein:
  - (a) the tubular neck is shorter than the latch arrangement.
9. A filter element according to claim 1 wherein:
  - (a) the filter element is at least 99% non-metallic.
10. A filter assembly comprising:
  - (a) a filter base;
  - (b) a service cover operably and removably mounted over the filter base; and
  - (c) a filter element operably mounted on the filter base; the filter element including,
    - (i) a tubular extension of pleated filter media having first and second opposite ends; the tubular extension of pleated filter media defining an open filter interior; a first end cap secured to the first end of the filter media; the first end cap having a first end cap aperture; a second end cap secured to the second end of the filter media; the

- second end cap having a second end cap aperture in communication with the open filter interior; a latch arrangement projecting from the first end cap;
- (ii) a tubular neck extending from the first end cap and circumscribing the first end cap aperture; the tubular neck being circumscribed by the latch arrangement; and
  - (iii) a valve head oriented within the first end cap aperture and constructed and arranged to move between a position sealing the first end cap aperture and exposing the first end cap aperture;
    - (A) the valve head including an arm arrangement slidably held with the tubular neck; and
    - (B) the arm arrangement including a plurality of arms, each arm having a hook.
11. A filter assembly according to claim 10 wherein:
- (a) the filter base includes an inner support and a spring member within the inner support; and
  - (b) the filter element is operably mounted over the inner support with the filter head being oriented against the spring member.
12. A filter assembly according to claim 11 wherein:
- (a) the service cover includes an inner rim releasably engaging the latch arrangement on the filter element.
13. A method of servicing a filter assembly; the method comprising:
- (a) removing a service cover and a used filter element from a filter base;
  - (b) providing a new filter element; the new filter element including a first end cap having a tubular neck extending therefrom and circumscribing a first end cap aperture; the new filter element also including a valve head oriented within the first end cap aperture and constructed and arranged to move between a position sealing the first end cap aperture and exposing the first end cap aperture; the valve head including an arm arrangement

slidably held with the tubular neck; and the arm arrangement including a plurality of arms, each arm having a hook;

- (c) operably mounting the new filter element in the filter base including engaging the valve head against a spring member in the filter base; and
- (d) operably mounting the service cover over the new filter element and filter base.

14. A method of servicing according to claim 13 wherein:

- (a) the step of operably mounting the service cover includes engaging a latch arrangement extending from the new filter element first end cap with an internal ring in the service cover.

15. A method of servicing according to claim 14 wherein:

- (a) the used filter element is releasably attached to the service cover; and
- (b) the step of removing a service cover and a used filter element from a filter base includes simultaneously removing the service cover and the used filter element.

16. A method of servicing according to claim 13 wherein:

- (a) the step of removing a service cover and a used filter element from a filter base includes removing a used filter element that has a first end cap having a tubular neck extending therefrom and circumscribing a first end cap aperture and a valve head oriented within the first end cap aperture.

FIG. 1

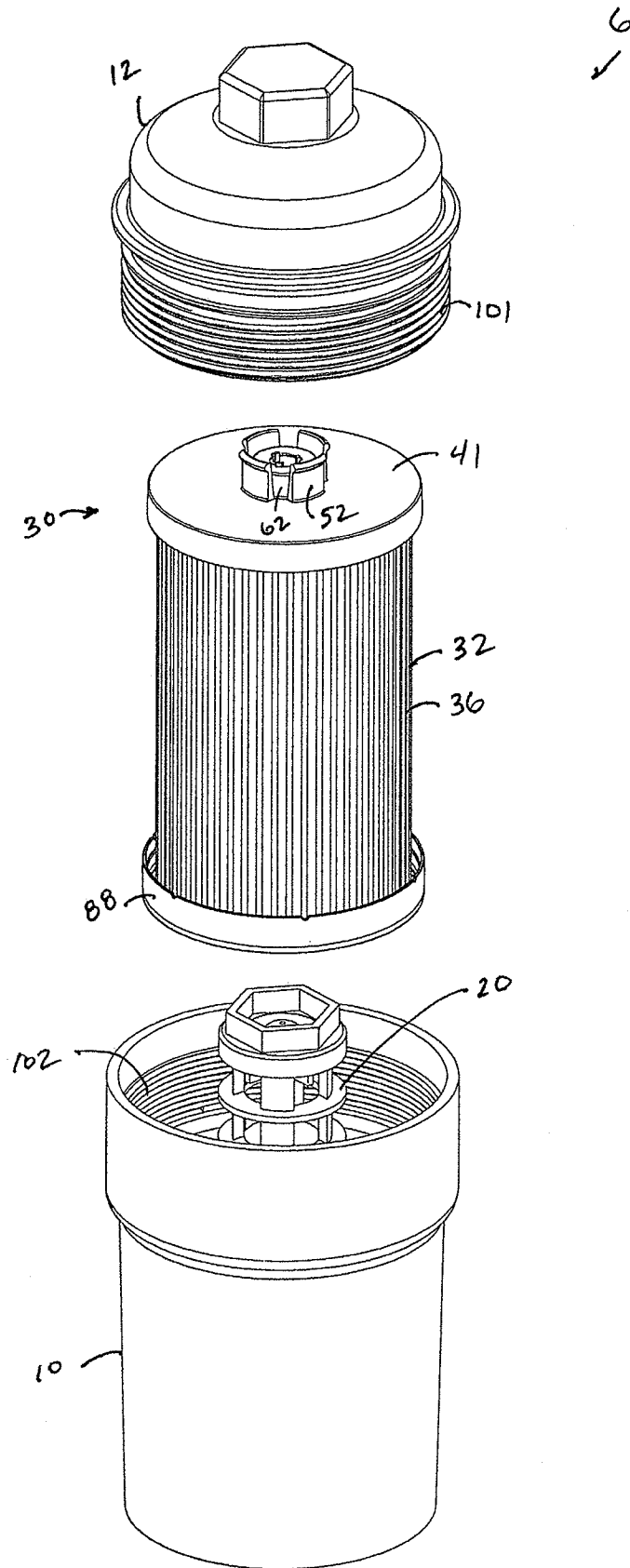


FIG. 2

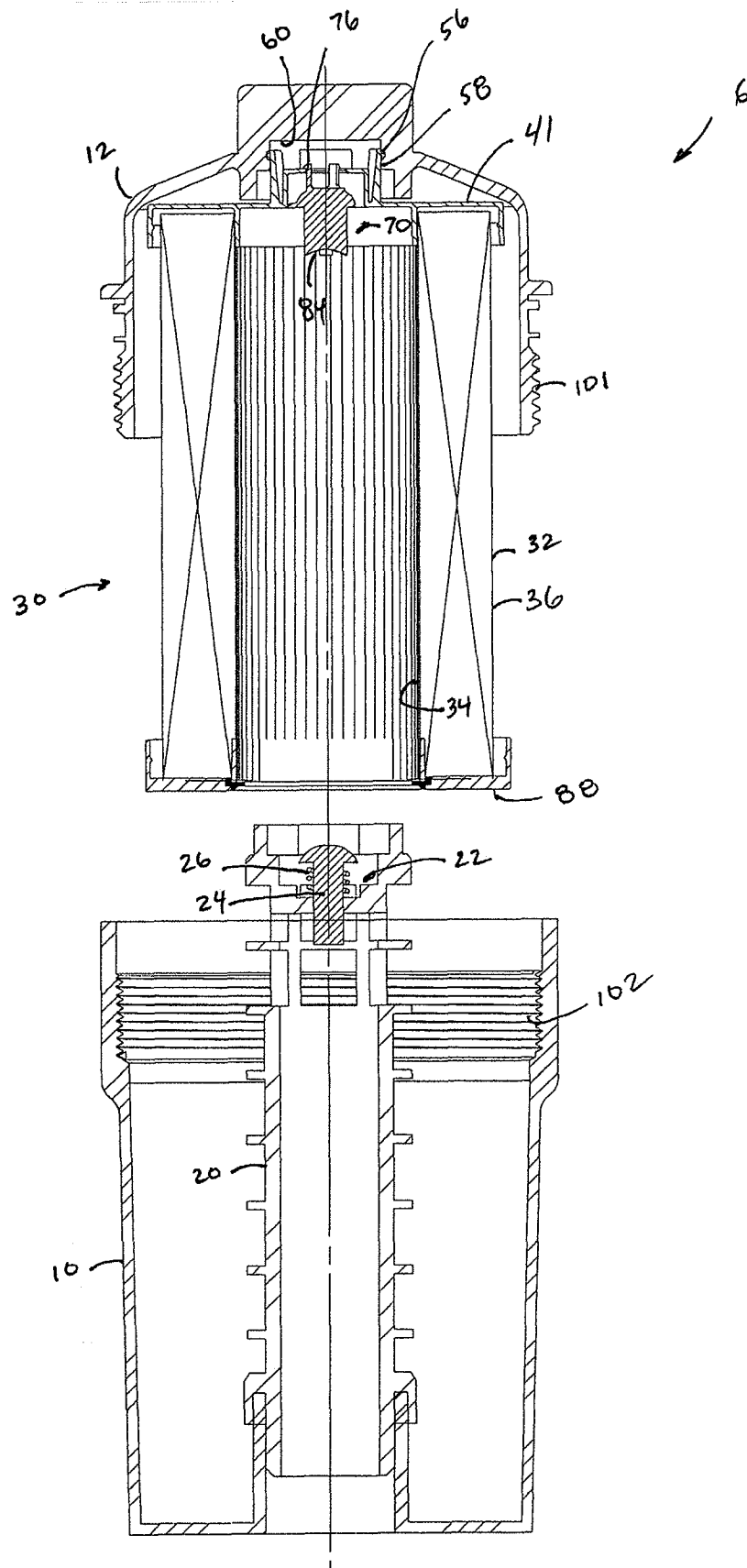


FIG. 3

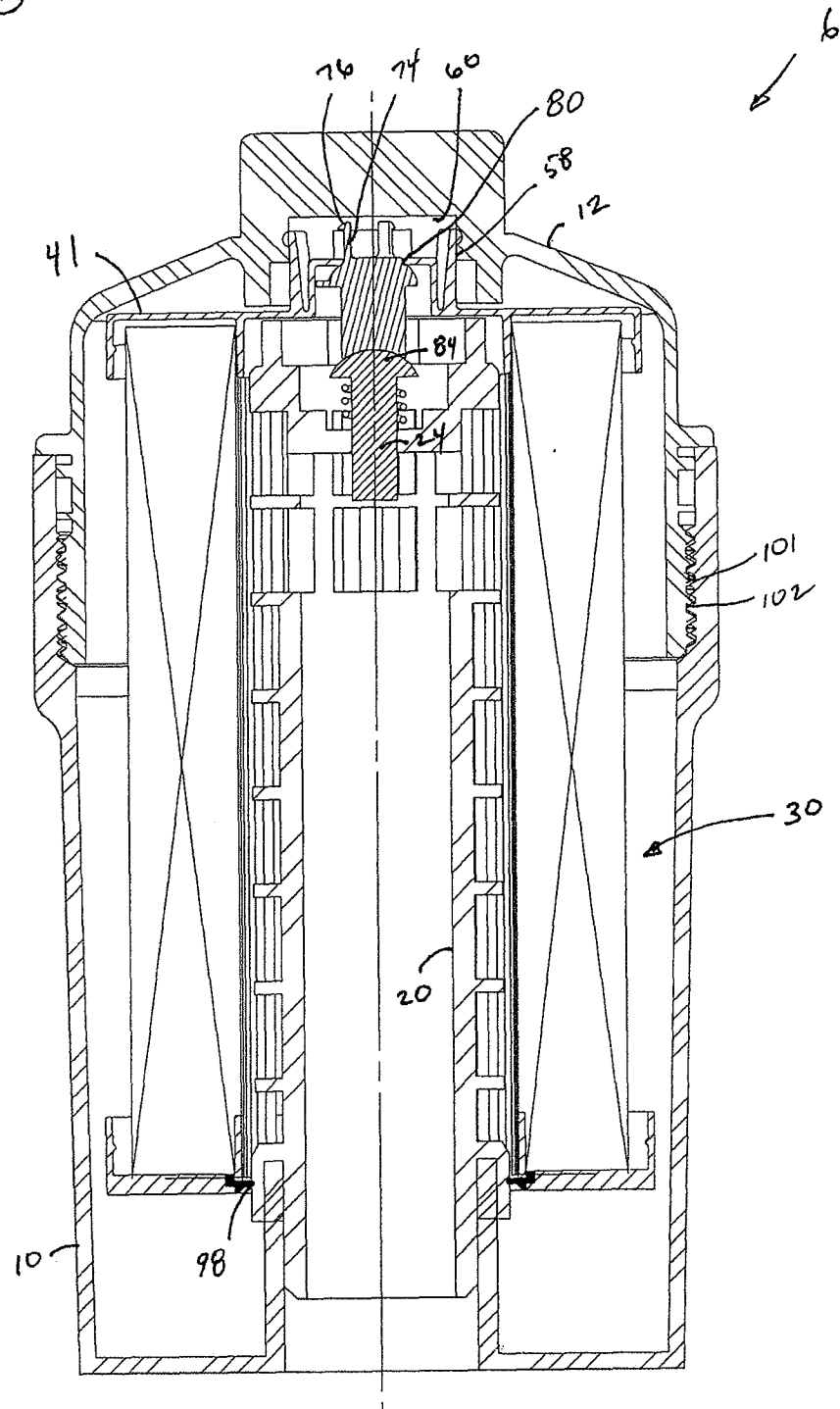
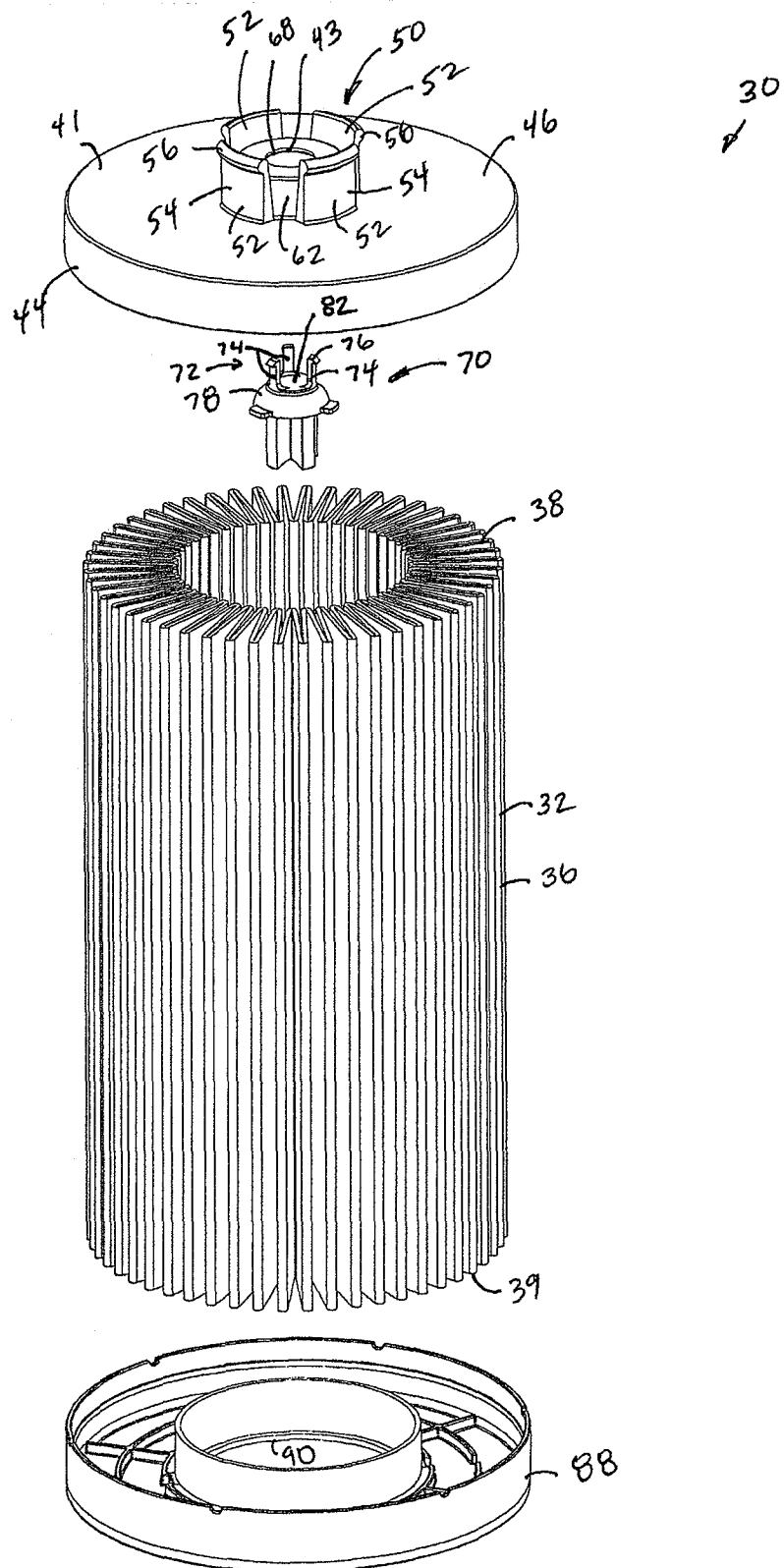
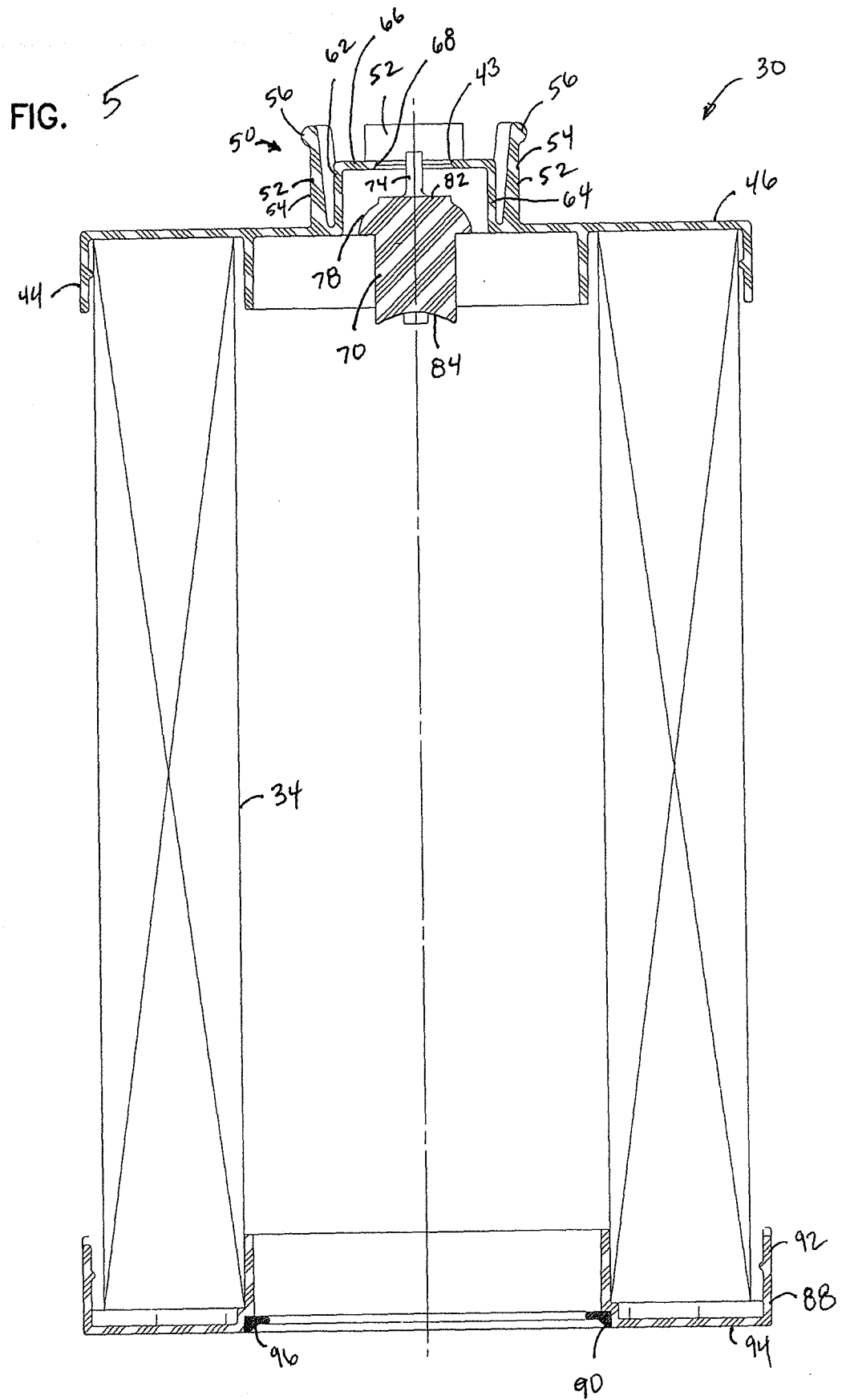


FIG. 4





## INTERNATIONAL SEARCH REPORT

International application No

PCT/US2008/066739

A. CLASSIFICATION OF SUBJECT MATTER  
 INV. B01D35/147 B01D29/21

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)  
 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

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages                                                                                                            | Relevant to claim No. |
|-----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| X         | US 2005/072721 A1 (KNIGHT STEVEN R [US])<br>7 April 2005 (2005-04-07)<br>paragraphs [0016] - [0021], [0026],<br>[0027], [0054] - [0061], [0074] -<br>[0086]; figures 3,4,8,9,12,14,16         | 1-16                  |
| X         | US 5 770 054 A (ARDES WILHELM [DE])<br>23 June 1998 (1998-06-23)<br>column 2, line 62 - column 4, line 13;<br>figures 1-3                                                                     | 1-16                  |
| A         | WO 2006/091557 A (BALDWIN FILTERS INC<br>[US]; FICK WALTER J [US]; BEARD JOHN H<br>[US]; MARSH) 31 August 2006 (2006-08-31)<br>paragraphs [0070] - [0081], [0093],<br>[0099]; figures 3,23,27 | 1-16                  |



Further documents are listed in the continuation of Box C.



See patent family 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

12 November 2008

Date of mailing of the international search report

20/11/2008

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2  
 NL - 2280 HV Rijswijk  
 Tel. (+31-70) 340-2040,  
 Fax: (+31-70) 340-3016

Authorized officer

Wolf, Gundula

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2008/066739

| Patent document<br>cited in search report | Publication<br>date | Patent family<br>member(s) | Publication<br>date         |
|-------------------------------------------|---------------------|----------------------------|-----------------------------|
| US 2005072721                             | A1                  | 07-04-2005                 | NONE                        |
| US 5770054                                | A                   | 23-06-1998                 | DE 29623867 U1 25-05-2000   |
| WO 2006091557                             | A                   | 31-08-2006                 | AU 2006216788 A1 31-08-2006 |
|                                           |                     | CA 2597294 A1 31-08-2006   |                             |
|                                           |                     | CN 101119784 A 06-02-2008  |                             |
|                                           |                     | EP 1850941 A2 07-11-2007   |                             |
|                                           |                     | JP 2008531249 T 14-08-2008 |                             |