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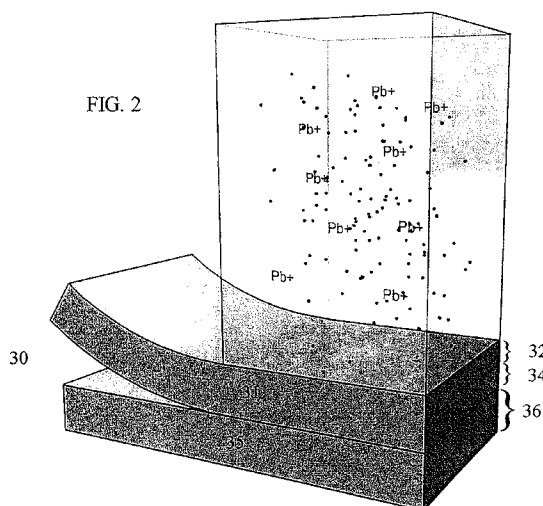
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(54) Title: USES OF FIBRILLATED NANOFIBERS AND THE REMOVAL OF SOLUBLE, COLLOIDAL, AND INSOLUBLE PARTICLES FROM A FLUID



(57) Abstract: A filter for removing soluble, colloidal, and insoluble particles from a fluid, including lead using a first filter media for filtering soluble material from the fluid, a second filter media, adjacent and in fluid communication with, the first filter media, for filtering soluble material from said fluid, wherein the first and second filter media create a physical non-soluble particle barrier at their interface for capturing non-soluble particles, that when retained at the interface, become soluble over time in the fluid, and are subsequently removed by the second filter media. At least one of the filter media can be fibrillated nanofibers that are loaded with finely subdivided media of powdered ion exchange resins. A third filter media may be placed between the first and second filter media to enhance capturing and dissolving the physical non-soluble particles.

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**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

IPC B01D 23/14,39/00,61/00, C08L 101/00

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 practicable, search terms used)  
eKIPASS(KIPO internal) "filter, soluble, colloidal, non-soluble, particles, lead, heavy metal, fluid, nanofiber"**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

| Category* | Citation of document, with indication, where appropriate, of the relevant passages                       | Relevant to claim No.             |
|-----------|----------------------------------------------------------------------------------------------------------|-----------------------------------|
| X<br>Y    | US 04902427 A (Ebonex Corporation) 20 Feb. 1990<br>See abstract, columns 1~7, and claims 1~3.            | 1,2,6,7,8,17,18<br>3~5,9~16,19~27 |
| Y         | US 06872311 B2 (Koslow Tech. Corp.) 29 Mar. 2005<br>See abstract, columns 1~16, and claims 1~20.         | 3~5,9~16,19~27                    |
| Y         | KR 1020040088046 A (KX INDUSTRIES, L.P.) 15 Oct. 2004<br>See abstract, pages 1~16, and claims 1~65.      | 3~5,9~16,19~27                    |
| Y         | KR 1020030045794 A (DONALDSON COMPANY, INC.) 11 Jun. 2003<br>See abstract, pages 1~23, and claims 1~189. | 3~5,9~16                          |

☐ 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

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"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

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**INTERNATIONAL SEARCH REPORT**

Information on patent family members

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| Patent document<br>cited in search report | Publication<br>date | Patent family<br>member(s)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Publication<br>date                                                                                                                                                                                                                                                                                                                                                                                                              |
|-------------------------------------------|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| US 04902427 A                             | 20.02.1990          | None                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| US 06872311 B2                            | 29.03.2005          | AU 2003-210565 A1<br>AU 2003-210565 B2<br>CA 2474854 A1<br>CN 1279997 C<br>EP 1483034 A1<br>EP 1483034 A4<br>JP 2005-527344<br>JP 2008-229619<br>US 2003-0177909 A1<br>US 6872311 B2                                                                                                                                                                                                                                                                                                                                                            | 02.09.2003<br>02.09.2003<br>07.08.2003<br>18.10.2006<br>08.12.2004<br>25.01.2006<br>15.09.2005<br>02.10.2008<br>25.09.2003<br>29.03.2005                                                                                                                                                                                                                                                                                         |
| KR 1020040088046 A                        | 15.10.2004          | AU 2003-202859 A1<br>AU 2003-202859 B2<br>AU 2003-202860 A1<br>AU 2003-202860 B2<br>AU 2003-209149 A1<br>AU 2003-209149 B2<br>AU 2003-210565 A1<br>AU 2003-210565 B2<br>BR 0302962 A<br>BR 0307316 A<br>CA 2444808 A1<br>CA 2474854 A1<br>CA 2474858 A1<br>CA 2474980 A1<br>CN 1232333 C<br>CN 1278757 C<br>CN 1279997 C<br>CN 1280001 C<br>CN 1509257 A<br>CN 1625428 A<br>CN 1625429 A<br>CN 1625434 A<br>CN 1891325 A<br>EP 1470083 A1<br>EP 1470083 B1<br>EP 1483028 A2<br>EP 1483028 B1<br>EP 1483034 A1<br>EP 1483039 A1<br>EP 1483039 B1 | 02.09.2003<br>02.09.2003<br>02.09.2003<br>23.08.2007<br>02.09.2003<br>02.09.2003<br>02.09.2003<br>02.09.2003<br>06.07.2004<br>11.01.2005<br>07.08.2003<br>07.08.2003<br>07.08.2003<br>07.08.2003<br>21.12.2005<br>11.10.2006<br>18.10.2006<br>18.10.2006<br>30.06.2004<br>08.06.2005<br>08.06.2005<br>08.06.2005<br>10.01.2007<br>27.10.2004<br>26.03.2008<br>08.12.2004<br>19.03.2008<br>08.12.2004<br>08.12.2004<br>23.04.2008 |

**INTERNATIONAL SEARCH REPORT**

International application No.

**PCT/US2008/008965**

|                    |            |
|--------------------|------------|
| EP 1470083 A1      | 27.10.2004 |
| EP 1470083 A4      | 02.11.2005 |
| EP 1483028 A2      | 08.12.2004 |
| EP 1483028 A4      | 02.11.2005 |
| EP 1483034 A1      | 08.12.2004 |
| EP 1483034 A4      | 25.01.2006 |
| EP 1483039 A1      | 08.12.2004 |
| EP 1483039 A4      | 02.11.2005 |
| HK 1065303 A1      | 28.07.2006 |
| IL 158362 D0       | 12.05.2004 |
| JP 2005-515879     | 02.06.2005 |
| JP 2005-515880     | 02.06.2005 |
| JP 2005-515892     | 02.06.2005 |
| JP 2005-527344     | 15.09.2005 |
| JP 2005-515892 T   | 02.06.2005 |
| JP 2005-527344 T   | 15.09.2005 |
| JP 2008-229619     | 02.10.2008 |
| KR 10-2004-0089440 | 21.10.2004 |
| PA 03010212 A      | 10.03.2004 |
| PA 04007354 A      | 12.12.2005 |
| TW 284055 A        | 21.07.2007 |
| US 6660172         | 09.12.2003 |
| US 6835311         | 28.12.2004 |
| US 6913154         | 05.07.2005 |
| US 6953604         | 11.10.2005 |
| US 6959820         | 01.11.2005 |
| US 6998058         | 14.02.2006 |
| US 7008537         | 07.03.2006 |
| US 7011753         | 14.03.2006 |
| US 7144533         | 05.12.2006 |
| US 7241388         | 10.07.2007 |
| US 7276166         | 02.10.2007 |
| US 7287650         | 30.10.2007 |
| US 2003-0168401 A1 | 11.09.2003 |
| US 2003-141261 A1  | 31.07.2003 |
| US 2003-168401 A1  | 11.09.2003 |
| US 2003-201231 A1  | 30.10.2003 |
| US 6630016 B2      | 07.10.2003 |
| US 6660172 B2      | 09.12.2003 |
| US 6835311 B2      | 28.12.2004 |
| US 6866704 B2      | 15.03.2005 |
| US 6872311 B2      | 29.03.2005 |
| US 6953604 B2      | 11.10.2005 |
| US 7287650 B2      | 30.10.2007 |
| WO 0306-3996A2     | 07.08.2003 |
| WO 0306-3996A3     | 12.09.2003 |
| WO 0306-4013A1     | 07.08.2003 |
| WO 0306-4330A1     | 07.08.2003 |
| ZA 200307532 A     | 14.09.2004 |
| ZA 200405605 A     | 12.07.2005 |

**INTERNATIONAL SEARCH REPORT**

International application No.

**PCT/US2008/008965**

KR 1020030045794 A 11.06.2003

|                   |            |
|-------------------|------------|
| AT 297798 T       | 15.07.2005 |
| AU 2001-284771 B2 | 22.03.2002 |
| AU 2001-284771 C1 | 22.03.2002 |
| AU 2001-284808 B2 | 22.03.2002 |
| AU 2001-285140 A8 | 22.03.2002 |
| AU 2001-288333 B2 | 22.03.2002 |
| AU 2001-290527 B2 | 22.03.2002 |
| AU 2001-83263 A1  | 22.03.2002 |
| AU 2001-84771 A1  | 22.03.2002 |
| AU 2001-84808 A1  | 22.03.2002 |
| AU 2001-84833 A1  | 22.03.2002 |
| AU 2001-85140 A1  | 22.03.2002 |
| AU 2001-88333 A1  | 22.03.2002 |
| AU 2001-90527 A1  | 22.03.2002 |
| AU 8326301 A      | 22.03.2002 |
| AU 8477101 A      | 22.03.2002 |
| AU 8480801 A      | 22.03.2002 |
| AU 8483301 A      | 22.03.2002 |
| AU 8514001 A      | 22.03.2002 |
| AU 8833301 A      | 22.03.2002 |
| AU 9052701 A      | 22.03.2002 |
| BR 0113655 A      | 30.12.2003 |
| BR 0113657 A      | 01.07.2003 |
| BR 0113658 A      | 20.01.2004 |
| CA 2419770 A1     | 14.03.2002 |
| CA 2419779 A1     | 14.03.2002 |
| CA 2419784 A1     | 14.03.2002 |
| CA 2419788 A1     | 14.03.2002 |
| CA 2419802 A1     | 14.03.2002 |
| CA 2419849 A1     | 14.03.2002 |
| CN 101173383      | 07.05.2008 |
| CN 1210088 C      | 13.07.2005 |
| CN 1232335 C      | 21.12.2005 |
| CN 1318121 C      | 30.05.2007 |
| CN 1318512 C      | 30.05.2007 |
| CN 1452506 A      | 29.10.2003 |
| CN 1458855 A      | 26.11.2003 |
| CN 1468134 A      | 14.01.2004 |
| CN 1468136 A      | 14.01.2004 |
| CN 1471421 A      | 28.01.2004 |
| CN 1543487 A      | 03.11.2004 |
| CN 1763274 A      | 26.04.2006 |
| CN 1765983 A      | 03.05.2006 |
| DE 60111554 D1    | 21.07.2005 |
| DE 60111554 T2    | 11.05.2006 |
| DE 60128714 D1    | 12.07.2007 |
| EP 1317316 A2     | 11.06.2003 |
| EP 1317317 A2     | 11.06.2003 |
| EP 1317317 B1     | 23.05.2007 |

**INTERNATIONAL SEARCH REPORT**

International application No.

**PCT/US2008/008965**

|                    |            |
|--------------------|------------|
| EP 1326697 A2      | 16.07.2003 |
| EP 1326697 B1      | 15.06.2005 |
| EP 1326698 A2      | 16.07.2003 |
| EP 1326698 B1      | 30.05.2007 |
| EP 1326699 A2      | 16.07.2003 |
| EP 1355714 A2      | 29.10.2003 |
| EP 1733776 A2      | 20.12.2006 |
| EP 1733776 A3      | 28.11.2007 |
| EP 1795249 A1      | 13.06.2007 |
| EP 1795250 A1      | 13.06.2007 |
| EP 1820553 A2      | 22.08.2007 |
| EP 1925352 A1      | 28.05.2008 |
| EP 1317317 B1      | 23.05.2007 |
| EP 1326697 B1      | 15.06.2005 |
| EP 1326699 A2      | 16.07.2003 |
| EP 1355714 A2      | 29.10.2003 |
| EP 1358272 A2      | 05.11.2003 |
| EP 1795250 A1      | 13.06.2007 |
| ES 2287151 T3      | 16.12.2007 |
| IL 154569 D0       | 17.09.2003 |
| IL 154570 D0       | 17.09.2003 |
| IL 154606 D0       | 17.09.2003 |
| IL 154613 D0       | 17.09.2003 |
| IL 154686 D0       | 17.09.2003 |
| JP 2004-508164     | 18.03.2004 |
| JP 2004-508165     | 18.03.2004 |
| JP 2004-508166     | 18.03.2004 |
| JP 2004-508167     | 18.03.2004 |
| JP 2004-508168     | 18.03.2004 |
| JP 2004-508169     | 18.03.2004 |
| JP 2004-508447     | 18.03.2004 |
| JP 2004-508164 T   | 18.03.2004 |
| JP 2004-508165 T   | 18.03.2004 |
| JP 2004-508166 T   | 18.03.2004 |
| JP 2004-508167 T   | 18.03.2004 |
| JP 2004-508168 T   | 18.03.2004 |
| JP 2004-508169 T   | 18.03.2004 |
| JP 2004-508447 T   | 18.03.2004 |
| KR 10-2003-0046424 | 12.06.2003 |
| KR 10-2003-0046430 | 12.06.2003 |
| KR 10-2003-0046431 | 12.06.2003 |
| KR 10-2003-0046433 | 12.06.2003 |
| KR 10-2003-0081302 | 17.10.2003 |
| KR 10-2003-0086985 | 12.11.2003 |
| PA 03001881 A      | 20.04.2004 |
| PA 03001926 A      | 24.05.2004 |
| PA 03001927 A      | 05.05.2004 |
| PA 03001929 A      | 24.05.2004 |
| PA 03001944 A      | 10.09.2003 |
| RU 2003107561 A    | 27.07.2004 |
| RU 2278722 C2      | 27.06.2006 |
| RU 2300543 C2      | 10.06.2007 |
| RU 2301105 C2      | 20.06.2007 |

**INTERNATIONAL SEARCH REPORT**

International application No.

**PCT/US2008/008965**

|                    |            |
|--------------------|------------|
| US 6743273         | 01.06.2004 |
| US 6924028         | 02.08.2005 |
| US 6955775         | 18.10.2005 |
| US 7070640         | 04.07.2006 |
| US 7090715         | 15.08.2006 |
| US 7115150         | 03.10.2006 |
| US 7179317         | 20.02.2007 |
| US 7270693         | 18.09.2007 |
| US 7316723         | 08.01.2008 |
| US 7318852         | 15.01.2008 |
| US 7318853         | 15.01.2008 |
| US 2002-0046656 A1 | 25.04.2002 |
| US 2002-0059868 A1 | 23.05.2002 |
| US 2002-0073667 A1 | 20.06.2002 |
| US 2002-0073849 A1 | 20.06.2002 |
| US 2002-0092423 A1 | 18.07.2002 |
| US 2003-0010002 A1 | 16.01.2003 |
| US 2003-0037675 A1 | 27.02.2003 |
| US 2003-0106294 A1 | 12.06.2003 |
| US 2003-106294 A1  | 12.06.2003 |
| US 2004-060268 A1  | 01.04.2004 |
| US 2004-060269 A1  | 01.04.2004 |
| US 2004-123572 A1  | 01.07.2004 |
| US 2004-187454 A1  | 30.09.2004 |
| US 2007-012007 A1  | 18.01.2007 |
| US 6673136 B2      | 06.01.2004 |
| US 6716274 B2      | 06.04.2004 |
| US 6740142 B2      | 25.05.2004 |
| US 6743273 B2      | 01.06.2004 |
| US 6746517 B2      | 08.06.2004 |
| US 6800117 B2      | 05.10.2004 |
| US 6875256 B2      | 05.04.2005 |
| US 6924028 B2      | 02.08.2005 |
| US 6955775 B2      | 18.10.2005 |
| US 6974490 B2      | 13.12.2005 |
| US 6994742 B2      | 07.02.2006 |
| US 7070640 B2      | 04.07.2006 |
| US 7090712 B2      | 15.08.2006 |
| US 7090715 B2      | 15.08.2006 |
| US 7179317 B2      | 20.02.2007 |
| US 7270693 B2      | 18.09.2007 |
| WO 02-20129 A2     | 14.03.2002 |
| WO 02-20129 A3     | 28.11.2002 |
| WO 02-20130 A2     | 14.03.2002 |
| WO 02-20130 B1     | 12.06.2003 |
| WO 02-20130 A3     | 28.11.2002 |
| WO 02-20132 A2     | 14.03.2002 |
| WO 02-20132 A3     | 28.11.2002 |
| WO 02-20133 A2     | 14.03.2002 |

# INTERNATIONAL SEARCH REPORT

International application No.

**PCT/US2008/008965**

|                |            |
|----------------|------------|
| WO 02-20133 A3 | 21.11.2002 |
| WO 02-20134 A2 | 14.03.2002 |
| WO 02-20134 A3 | 28.11.2002 |
| WO 02-20135 A2 | 14.03.2002 |
| WO 02-20135 A3 | 28.11.2002 |
| WO 02-20668 A2 | 14.03.2002 |
| WO 02-20668 A3 | 24.07.2003 |