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Declarations under Rule 4.17:

- as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))
- as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))

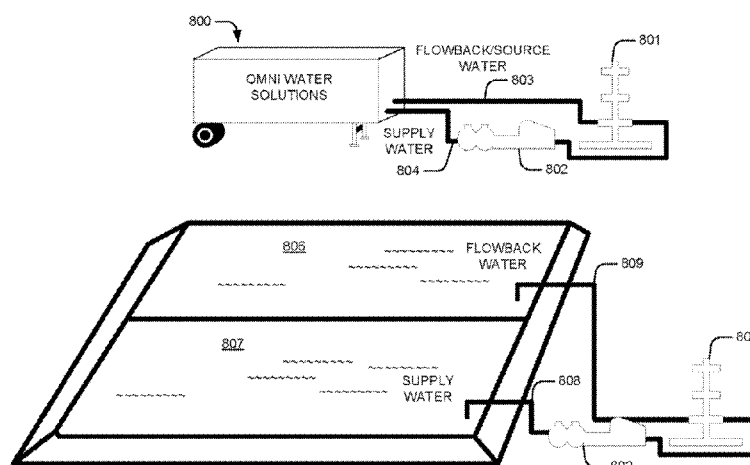
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- with international search report (Art. 21(3))
- before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))

[Continued on next page]

(54) Title: WATER TREATMENT SYSTEMS AND METHODS

FIG. 8



(57) Abstract: Water treatment systems and methods. Embodiments provide water treatment systems which comprise first oxidation, particulate filtration, and membrane filtration subsystems in that order. Systems also comprise recirculation paths and sensors for these subsystems. A controller determines whether to recirculate water to a previous subsystem in the order. Systems can comprise downstream second oxidation, high pressure membrane, ion exchange, activated carbon subsystems and/or ultraviolet contactors. Systems with high pressure membranes can comprise a pump before the high pressure membranes, a booster pump of the high pressure membrane subsystem, and a damping tank. In such systems the controller maintains a pressure in the damping tank. High pressure membrane subsystems can further comprise nanofiltration membranes and RO membranes. Systems can comprise bypass paths for some/all of the subsystems. For such systems, the controller further determines, whether to bypass these subsystems.





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INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 14/27038

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - B01D 21/30, B01D 61/38, C02F 1/72, C02F 9/00, G05B 21/00 (2014.01)

CPC - B01D 21/305, B01D 61/38, C02F 1/72, C02F 9/00, G05B 21/00

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(8)- B01D 21/30, B01D 61/38, C02F 1/72, C02F 9/00, G05B 21/00 (2014.01)

CPC- B01D 21/305, B01D 61/38, C02F 1/72, C02F 9/00, G05B 21/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
USPC- 210/143, 210/195.2, 210/258, 210/638, 210/673, 700/271

Patents and NPL (classification, keyword; search terms below)

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

Pub West (US EP JP WO), Pat Base (AU BE BR CA CH CN DE DK EP ES FI FR GB IN JP KR SE TH TW US WO), Google Patent, Google Scholar, Free Patents Online; search terms: water, potable, drink, treat, clean, sanitize, oxidize, filter, filtration, membrane, semi-permeable, pressure, high, low, recirculate, bypass, sense, condition, controller, signal...

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2010/0292844 A1 (WOLF) 18 November 2010 (18.11.2010), Fig. 2; para [0012], [0032], [0033], [0040]-[0043], [0046], [0051], [0063], [0069], [0085]	1
Y	WO 2012/138502 A1 (SAWYER et al.) 11 October 2012 (11.10.2012), pg 2, para 5 to pg 35, para 2	1
Y	US 2012/0085701 A1 (EVANS et al.) 12 April 2012 (12.04.2012), para [0008]-[0032]	1
Y	US 5,741,416 A (TEMPEST, JR.) 21 April 1998 (21.04.1998), col 3, ln 60 to col 6, ln 65	1
Y	US 5,558,775 A (BUSCH, JR.) 24 September 1996 (24.09.1996), col 2, ln 28 to col 6, ln 40	1
Y	US 5,547,584 A (CAPEHART) 20 August 1996 (20.04.1996), col 4, ln 10 to 20, ln 48	1

☐ Further documents are listed in the continuation of Box C.

* 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 application or patent 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

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 14/27038

Box No. 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 No. 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:

-- Please See Extra 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 additional fees, this Authority did not invite payment of additional fees.
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

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 14/27038

Continued from Box No. III, Observations where unity of invention is lacking.

This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1. In order for all inventions to be examined, the appropriate additional examination fees must be paid.

Group I: Claims 1, drawn to a system for treating water, the system comprising: a first oxidation subsystem; a particulate filtration subsystem downstream from the first oxidation subsystem; a low pressure membrane filtration subsystem downstream from the particulate filtration subsystem; a high pressure membrane subsystem downstream from the low pressure membrane filtration system; a high pressure membrane bypass path; the subsystems in fluid communication with each other in that order; a bypass path for at least the particulate filtration subsystem; recirculation paths from each of the first oxidation, particulate filtration, and high pressure membrane subsystems; sensors for sensing water conditions in the system; and a controller in communication with the sensors and being configured to, responsive to the sensed conditions, determine in the order whether to recirculate water through the first oxidation subsystem; whether to bypass water through the particulate filtration bypass path or whether to recirculate water through the particulate filtration subsystem, whether to recirculate water through the low pressure membrane subsystem, and whether to bypass water through the high pressure membrane bypass path or whether to recirculate water through the high pressure membrane subsystem whereby a flow path is configured, the controller being further configured to output a control signal in accordance therewith.

Group II: Claims 2-20, drawn to a system and method for treating water, comprising: a first oxidation subsystem; a particulate filtration subsystem; a membrane filtration subsystem; the subsystems in fluid communication with each other in that order the system further comprising recirculation paths for each of the forgoing subsystem; sensors for sensing water conditions in the system; and a controller in communication with the sensors and being configured to, responsive to the sensed conditions, determine whether to recirculate water from one of the subsystems to a previous subsystem in the order whereby a flow path is configured, the controller being further configured to output a control signal in accordance therewith.

The inventions listed as Groups I and II do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons:

Group II does not require: a low pressure membrane filtration subsystem downstream from a particulate filtration subsystem; a high pressure membrane subsystem downstream from a low pressure membrane filtration system; a high pressure membrane bypass path; a bypass path for at least the particulate filtration subsystem; the controller being configured to determine in the order whether to recirculate water through the first oxidation subsystem; whether to bypass water through the particulate filtration bypass path or whether to recirculate water through the particulate filtration subsystem, whether to recirculate water through the low pressure membrane subsystem, and whether to bypass water through the high pressure membrane bypass path or whether to recirculate water through the high pressure membrane subsystem, as required by Group I.

Group I does not require the controller configured to determine whether to recirculate water from one of the subsystems to a previous subsystem in the order, as required by Group II.

The only feature shared by Groups I and II that would otherwise unify the groups is a system for treating water comprising a first oxidation subsystem; a particulate filtration subsystem; a membrane filtration subsystem; the subsystems in fluid communication with each other in that order the system further comprising recirculation paths for each of the forgoing subsystem; sensors for sensing water conditions in the system; and a controller in communication with the sensors and being configured to, responsive to the sensed conditions, determine whether to recirculate water in a subsystem whereby a flow path is configured, the controller being further configured to output a control signal in accordance therewith. However, this shared technical feature does not represent a contribution over prior art, because the shared technical feature is anticipated by US 2010/0292844 A1 (Wolf).

Wolf discloses a system for treating water (Fig. 2; para [0033], [0051]), comprising a first oxidation subsystem (Fig. 2; para [0033], [0051], primary oxidation subsystem, 30.); a particulate filtration subsystem (Fig. 2; para [0033], [0051], [0069], filtration system, 40, comprising mixed media... such as mixed granular media.); a membrane filtration subsystem (Fig. 2; para [0033], [0051], membrane filter, 42.); the subsystems in fluid communication with each other in that order the system (Fig. 2; para [0033], [0051], systems 30, 40, and 42 in sequential order.) further comprising recirculation paths for each of the forgoing subsystem (Fig. 2; para [0051], recirculation conduits, 82 and 84a, at each of the sequential subsystems.); sensors for sensing water conditions in the system (para [0012], [0033], programmable controller, 12, comprising sensors for sensing water conditions.); and a controller in communication with the sensors and being configured to, responsive to the sensed conditions, determine whether to recirculate water in a subsystem whereby a flow path is configured (para [0046], [0051], controller, 12, determine whether a particular treatment step is needed... wherein the controller recirculates as it determines sufficient water quality to be treated by the next subsystem located downstream of it... using recirculation conduits, 82 and 84a, at each of the sequential subsystems.), the controller being further configured to output a control signal in accordance therewith (para [0032], controls the water treatment path through the treatment system based upon the output signals from a variety of sensors located throughout the system.).

As the technical feature was known in the art at the time of the invention, this cannot be considered a special technical feature that would otherwise unify the groups. Groups I and II therefore lack unity under PCT Rule 13 because they do not share a same or corresponding special technical feature.