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- as to the identity of the inventor (Rule 4.17(i))
- of inventorship (Rule 4.17(iv))

Published:

- with international search report (Art. 21(3))

(54) Title: TSWs QUAD, 3-STAGE SUB1 FAST-FLO POE POTABLE WATER TREATMENT SYSTEM ^{(TM) 2015}

(57) Abstract: The QUAD 3-Stage Sub-1 micron filtration system is a POE (Point of Entry) system design to provide fast wa-
ter-flow potable water to all water taps within the building while also removing or reducing most TDS metals such as Chromium 6,
Boron, NO₃, Fe₃, Arsenic, and other water toxic components. Traditionally these difficult-to-remove known carcinogens and cancer-
inducing compounds require "Slow-Flow" 1.5 gpm (Gallon per Minute) due to the requirement to match submicron-sized metals or
ions to carbon pore adhesion surfaces within the carbon-based membranes. TSWs applies a new technology to achieve whole-house
filtration normally relegated to RO appliances, which are site-specific point of use (POU) water products. The public health aspect of
the TSW design cannot be overemphasized.



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TSWS QUAD, 3-STAGE SUB1 FAST-FLO POE POTABLE WATER TREATMENT SYSTEM ^(tm) 2015
Water – The New Gold Standard tm

TAP SAFE WATER SOLUTIONS, INC. (**TSWS**) is an OEM company. We seek a patent for our “plug and play” water filtration appliance that we feel provides a unique freshwater solution to dwindling freshwater reserves. This **TSWS** appliance is a Point of Entry “Fast Flow” unit providing water with Endocrine contaminants, Selected Haloacetic acids and Selected Halogenated Methanes at levels below EPA/NSF potable standards. Accepted standards (MCLs) in ppb (parts per billion of contaminant) are respectively 10, 60 and 80. Filtrated water meets or exceeds NSF 42, 53, 55 and 61¹. Parts per billion levels are at or below NSF standards of 10, 60, 80. Finally, this **TSWS** appliance is uniquely designed to provide better than 7 gpm (gallon per minute) flows into the building. Typically this is the lower end of flows satisfying demand of a four-person household, which consume a nominal .45 acre foot/ year. Estimates herein are based on the nominal 0.5 AF / year/household (4) or some 20,375 cubic feet (163,000 gallons).

RO units typically remove most sub 1 micron VOC and metal solids, endocrine impactors and byproducts from chlorine disinfection. Their drawbacks are two: slow flow rates limiting them to small daily volumes of processed water (typically 3 – 5 gallons) and the typical 20 -25 gallons fresh water lost to the drain in order to process the three - five gallons gained. Annualized, this water waste is approximately 7000 gal/ year or eighteen days worth of water use for a family of four. Every 20 RO units by this yardstick throw away back into the drain a single family’s annual water demand (about ½ acre foot) over the space of one year!

The **TSWS** design loses no water per day, uses carbon block membrane technology filtering but in a unique tapered multi filter design allowing much faster throughput over the same carbon adsorption area. Pore adhesion efficiencies - typically 2 gpm ideal, 1.8gpm actual - are improved with improved surface loadings exceeding 6 gpm/ft². With advanced design , **TSWS** sees improvements in gpms approaching the theoretical maximums in one of three ways. The enclosed patent design is a concept design with electrical analogs of dc voltage, current and dc resistance applied respectively psi (source - surface loading), water (untreated), and membrane resistivity.

At **TSWS** we think a paradigm shift in thinking about fresh water in the US must happen on commercially large scales. On one hand, an aging fresh water supply infrastructure in the country is a serious problem in virtually all states with over 310000 water main breaks each year in the US (2014 statistics). On the other hand, reduced fresh water supplies from ground water aquifers, snowmelt and other natural sources is rapidly diminishing due rising mean global temperatures. **TSWS** believes its novel designs can have wide appeal to those wishing to preserve existing aquifers, conserve existing finished (potable) water by collecting and substituting Rainwater, or to purify and detoxify existing potable water streams.

ORIGINALITY

PROBLEM STATEMENT

HOW CAN WE SOLVE THE TECHNICAL PROBLEMS OF DELIVERING HIGH SPEED POINT OF ENTRY WATER FILTERED TO UNDER 0.5 MICRON PURITY? FLOW RATES ARE LIMITED BY EXISTING PHYSICAL ADHESION REQUIREMENTS OF CARBON PORE SURFACES TO THE MOLECULES OF INTEREST. ELECTROKINETIC ADHESION IMPROVES FILTRATION BY IMPROVING THE CARBON ISOTHERM BUT SETS A LOWER BOUND ON WATER FLOW THROUGH THE DEVICE. POE CARBON BLOCK DEVICES WHOSE GAL/MINUTE (GPM) HAVE UPPER LIMITS IN THE 5 GPM (20 LPM) RANGE HAVE CONCOMITANT PROBLEMS OF CHANNELING AND LEAD TO INEFFICIENCIES IN THROUGHPUT. OUR RESEARCH PRODUCES AN AMBIENT TEMPERATURE 3 STAGE DEVICE WHICH CAN PROCESS 1600 GALLONS EVERY 4 DAYS OR SOME 400 GAL/DAY – MOST OF THIS BETWEEN THE HOURS OF 5 – 10 PM. THIS IS SOME 88 GALLONS/HR FOR 5 HOURS. THE TSWS FILTRATION SYSTEM ACCOMMODATES A FLOW RATE EQUIVALENT TO A PERSON'S DAILY WATER CONSUMPTION IN A SINGLE HOUR BY IMPROVING PRESENT SURFACE LOADINGS OF 6GPM/FT² USING EXISTING MEMBRANES AND FILTER HARNESES.

NOVELTY

MARKET COMPETITION

WHOLE HOUSE WATER FILTERING TECHNOLOGY IS IN AN ADVANCE STAGE OF R & D. UNTIL MEMBRANE TECHNOLOGY IS REPLACED WITH A DNA OR OTHER MOLECULAR ADSORPTION TECHNOLOGY, MEMBRANES, WIDELY AVAILABLE IN EXISTING MARKETS WILL CONTINUE TO BE USED. CONCOMITANT COSTS FOR PLUMBING ASSOCIATED WITH EXISTING PRODUCT INSTALLATIONS IS ABSENT IN THE TSWS MODEL. THE APPLIANCE IS A STAND-ALONE UNIT AT AN AFFORDABLE PRICE WITH REQUIREMENTS TO REPLACE FILTERS 2, 3 OR 4 TIMES A YEAR IN TYPICAL INSTALLATIONS AND GEOLOGICAL STRATA. EXISTING UNITS ARE TWICE THE COST OF THE TSWS SYSTEM IN THE FINAL ANALYSIS.

MARKET PENETRATION

EXISTING PURIFICATION PROCESSES ARE LIMITED BY THE REQUIREMENT OF SLOW FLOW RATES REQUIRED TO ACHIEVE SMALL PARTICLE SIZE FILTERING. THE SMALLER THE MOLECULE BEING FILTERED, THE SMALLER THE SIEVE; HENCE A GOOD QUALITY RO UNIT WILL FORCE WATER THROUGH SUB 1 MICRON FILTERS BUT PRODUCE ONLY 5 GALLONS PER DAY OF POTABLE, CLEAN WATER. TSWS FEELS THAT THE COMPANY HAS A MARKET FOR A FAST-FLOW DEVICE WHERE NONE NOW EXISTS.

UNIQUENESS OF DESIGN

RISK/ REWARD

MARKET SUCCESS, MEASURED BY INDUSTRY STANDARDS OF RISK/REWARD IS ASSURED BY INITIAL CAPITALIZATION TO [A] COMPLETE PROTOTYPES, [B] CREATE INITIAL PUBLIC MARKET EXPOSURE AND [C] COMPLETE CHEMICAL AND ENGINEERING RESEARCH. TSWS FEELS IT WILL MARKET A POE DESIGN NOT SEEN IN THE POTABLE WATER INDUSTRY AND INTENDS TO REMAIN AT THE FOREFRONT OF INNOVATION OF POE SOLUTIONS TO FRESH WATER REQUIREMENTS FOR ITS CUSTOMERS BY PUTTING ENGINEERING AND CHEMISTRY AT THE CENTER OF THE COMPANY'S R & D.

DRAWINGS:

NOTE: PATENT DRAWINGS (artwork) includes two membrane filters and four membrane filters installed in unit. The engineering calculations in the utility patent will disclose flow-rates for both two filters and four filters. These filter assemblies constitute "Stage ii". Stage I, and Stage iii remain unchanged for either the two filter or four filter enclosure. The Case itself remains the same although larger in one case than in the other to accommodate ease of handling and filter change-outs in the four filter design. This provisional patent is meant to cover the general whole-house filter design "External" to the building. This design feature makes it unique because no existing whole-house water filtering system exists for POE (Point of Entry) applications. The Number of filters employed in the design necessitates a larger footprint within the case for four filters hence patent submissions will be submitted for each at the time the utility patents are executed. The engineering and hydraulics for both size enclosures remains unchanged. The flow-rates are computed for both the two and the four to exceed 7gpm (gallon per minute) upon demand and for a sustained uninterrupted 35 minutes of use on any single demand. The Quad 3-Stage System is designed for a maximum 400 gallon-per-day (gpd) throughput of potable water into the building. Four hundred gpd is an expected 100 gpd-person figure of merit used in calculations for the United States only. This figure is drastically reduced outside of the USA.

PATENT ' drawings include the following: QUAD (four filter arrangements) + DUAL filter arrangements to demonstrate given stages. All final stages are QUAD Design.

ASSEMBLY and DETAIL:

Dwg 9.1a **ASSEMBLY DWG – DUAL MULTIPLAN (for demo only)**
 Dwg 9.1c **ASSEMBLY DWG – QUAD.3-STAGE.SUB1.FRONT**
 Dwg 9.1d **ASSEMBLY DWG – QUAD.3-STAGE.SUB1.PLAN**

ENCLOSURE (Designed by STRATUS ENGINEERING)

Dwg 9.2a **MULTIVIEW – MULTIPLAN – ENCLOSURE for QUAD 3-STAGE.SUB1**
 Dwg 9.2b **ISO OPEN DWG – CASE- ISO.SIDE**
 Dwg 9.2c **ISO OPEN DWG – CASE- ISO.FRONT**
 Dwg 9.2d **ISO OPEN DWG – CASE- ISO.REAR**
 Dwg 9.2g **ISO OPEN DWG – CASE- ISO.DUAL (not QUAD).3-STAGE.LEFT VIEW**
 Dwg 9.2h **ISO OPEN DWG – CASE- ISO.DUAL (not QUAD).3-STAGE.RIGHT VIEW**

QUAD (FOUR FILTER DESIGN) (Designed by TSWS, Inc.)

Dwg 9.3a **DWG – QUAD.3-STAGE.SUB1.STAGEii.ISO**
 Dwg 9.3b **ASSEMBLY DWG – QUAD.3-STAGE.SUB1.STAGEii.FRONT**
 Dwg 9.3c **ASSEMBLY DWG – DUAL.3-STAGE.SUB1.STAGEiii. UV.FRONT**

INVENTED ELEMENTS NEW TO THIS DESIGN:

[1] **TSWS** : Carbon Block cylinders in parallel (stage II) and in quad (stage II) with turbidity – reducing geometry (improved laminar flow); improved carbon isotherm using enhanced charged ion transfer, and filter-doubling capability. Detail not shown in drawings.

Existing systems: None in the whole-house water filtering space.

[2] Stainless steel connector valves $\frac{3}{4}$ " inlet (bottom) and $\frac{3}{4}$ " outlet (top) for stage II

Existing systems: None in the whole-house water Point-of-Entry (POE) filtering space.

[3] **TSWS** Quick-release filter exchange allowing easy access and change out of CB filters (stages I and II)

Existing systems: None in the POE design space. Systems do exist in the POU design space

[4] **TSWS** Automated filter-life digital remote sensor indicator for filter replacement

Existing systems: DASHBOARD- heads – up displays exist with this feature (indoor only)

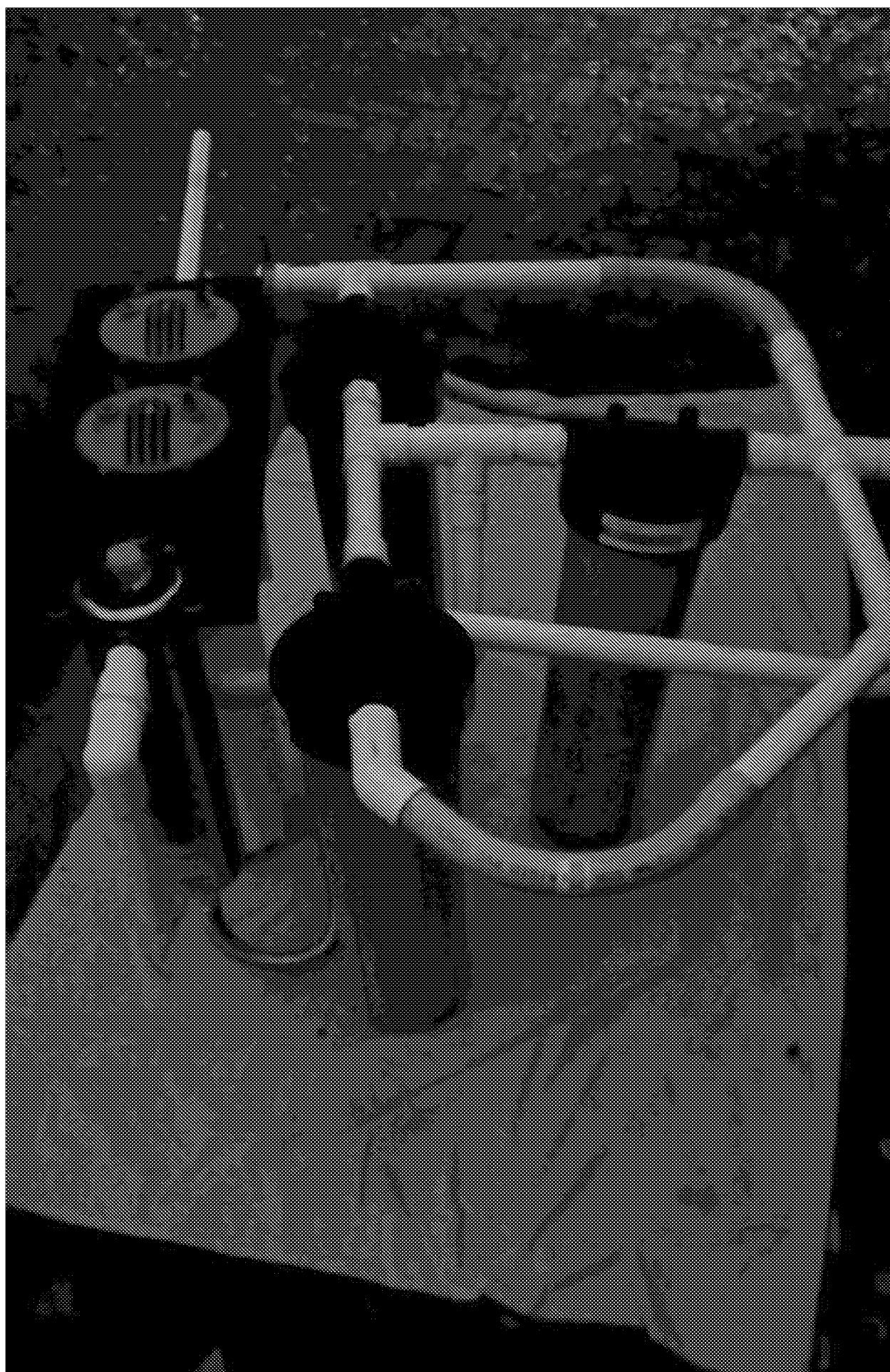
[5] **TSWS** Case Enclosure (housing unit) designed for all weather Point-of-Entry Home Water filtering Unit. *Intended for external (ambient air) installation.*

Existing systems: None

CLAIM:

THIS PRODUCT IS A DEVICE WITH AN INPUT AND EXIT PORT FOR ALLOWING WELL, MUNICIPAL OR TANK WATER TO ENTER AND THEN EXIT. THE DEVICE PROCESSES WATER THROUGH THREE STAGES TO REMOVE COMPLETELY OR REDUCE SUBSTANTIALLY KNOWN ESTROGEN MIMICING PHTHALATES, DES, BPH, HALOGENATED METHANES AND HALOGENATED ACIDS. FINISH WATER IS USUALLY WELL BELOW ANSI /NSF POTABLE WATER STANDARDS AND AT OR BELOW EPA CONTAMINANT CONCENTRATION LEVELS (MCLS).

THE DEVICE IS DESIGNED FOR WHOLE-HOUSE FAST FLOW OPERATION WHILE SIMULTANEOUSLY REDUCING HEAVY METAL PRODUCTS (MOLECULAR SPECIES INCLUDE ARSENIC, CHROMIUM, MERCURY, BORON, LEAD, SOME RADIO NUCLIDES SUCH AS ARGON, RADON). THE MODEST FOOTPRINT, 1M X 1M X 0.7M, EASILY ALLOWS PARALLEL PROCESSING TO PROVIDE DAILY THROUGHPUT OF 6000 GALLONS (22,800 L). THE DEVICE REDUCES PHARMACEUTICAL AND HEALTH-CARE PRODUCTS, HALOACETIC ACIDS INCLUDING THE VERY TOXIC IDOACETIC ACID, AND OTHER BYPRODUCTS OF CHLORINATION INCLUDING HALOGENATED METHANES SUCH AS BROMOFORM AND CHLOROFORM.



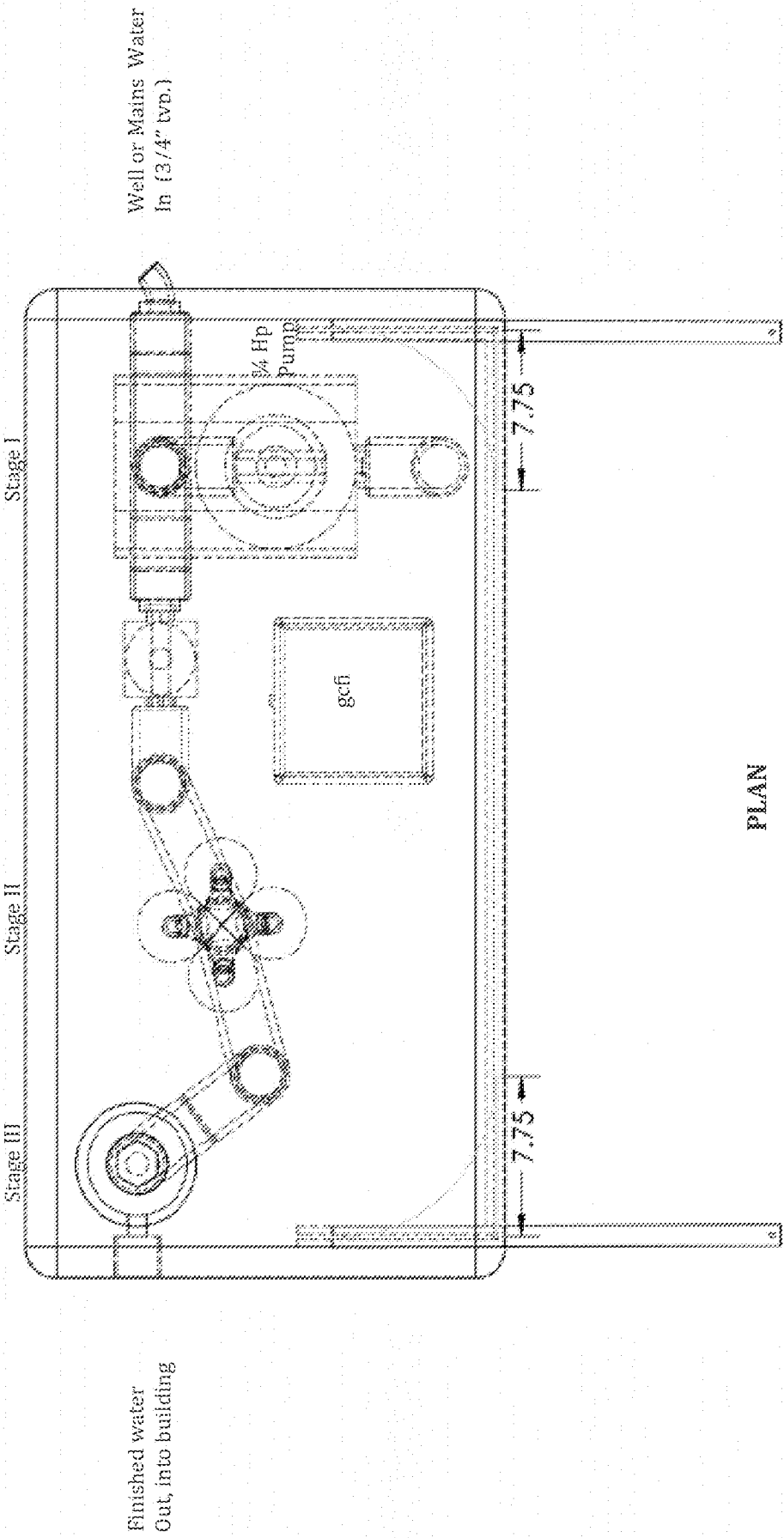








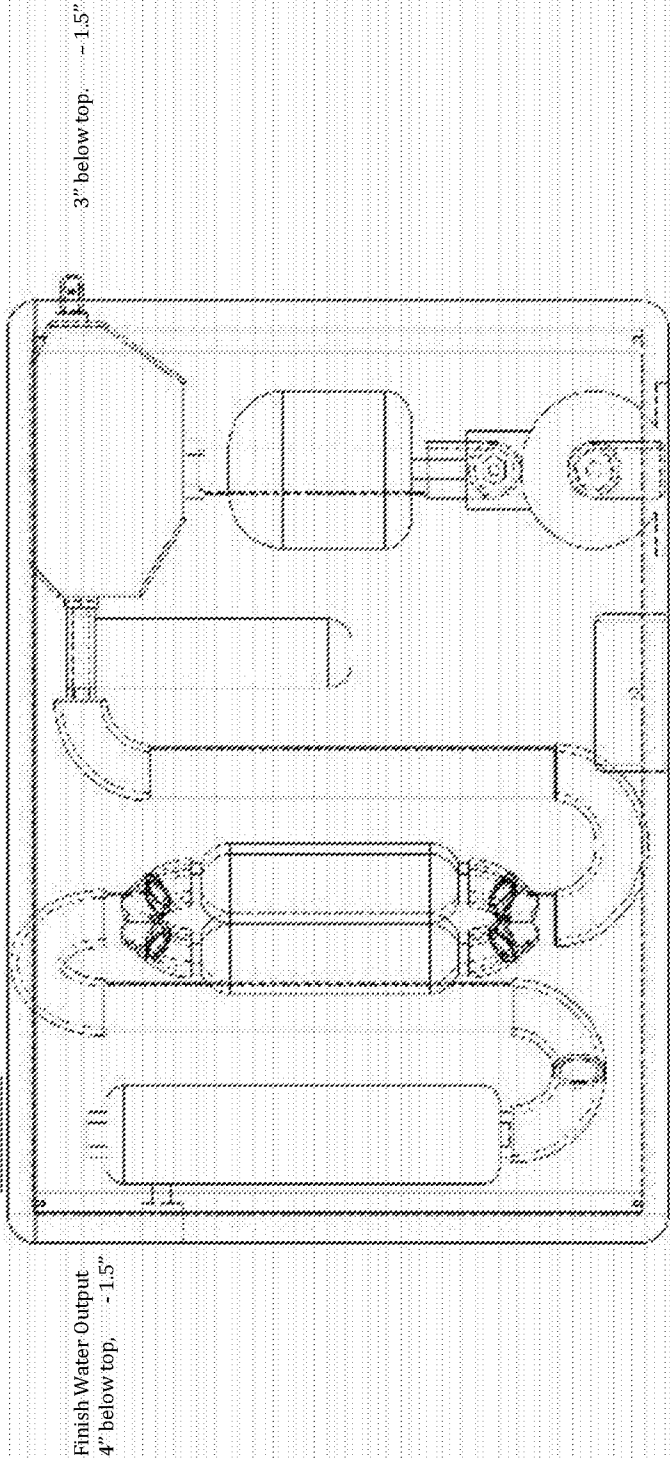




PLAN

DESIGNED BY	NAME	DATE	California Water Solution, CWS	
			TITLE:	
CHECKED BY	DATE	1/2/2014	RCS 3-stage sub 0.5 micron Water Filtration Unit	
ENG APPR			SEE DWG. NO.	
AWD APPR			A 48w24d 45 WP ST25-58	
C.A.			REV	
COMMENTS			SCALE: 1/8" = 1'-0"	
PLAN VIEW			SHEET 4 OF 4	

Access Panel for UV Tube
- 6"



Front

MANUFACTURER	DATE	California Water Solution, CWS
DESIGNER	BY	Submitron 3-Stage POE Filtering Unit
DATE	DATE	Patent US#61/967,827 ©2014
SCALE	NO.	888
1/8" = 1'-0"	2.2	
SHEET 4 OF 4		

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 16/16226

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - C02F 1/00, C02F 1/28, C02F 9/00, C02F 1/62, C02F 1/76 (2016.01)

CPC - C02F1/00, C02F1/001, C02F1/28, C02F9/00, C02F1/444, C02F1/62, C02F1/76

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) C02F 1/00, C02F 1/28, C02F 9/00, C02F 1/62, C02F 1/76 (2016.01)

CPC: C02F1/00, C02F1/001, C02F1/28, C02F9/00, C02F1/444, C02F1/62, C02F1/76

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

IPC (8) C02F 1/00, C02F 1/28, C02F 1/58, C02F 1/48, C02F 1/32, C02F 9/00, C02F 1/44, C02F 1/62, C02F 1/76, B01D 25/00 (2016.01)

CPC: C02F1/00, C02F1/001, C02F1/28, C02F1/283, C02F1/003, C02F1/58, C02F2201/006, C02F1/48 (keyword limited; terms below)

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

PatBase; Google Patents; Google Scholar; Google Web;

Search terms used: Water treatment purification processing inlet input port portion opening valve outlet exit three stage step process whole-house nsf ansi standards parallel processing filtering

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	"When it Rains it Stores" (California Water Solutions) [online] (retrieved from the internet on 13.01.2017) <URL https://purerainstorage.com/wp-content/uploads/2014/06/PRS_pamphlet_rev-1.pdf>, June 2014 (06.2014); entire document, especially page 2, Fig. 1, 2; page 6, Fig. 1; page 5, col 1-col 2; page 6, col 2;	1
X	US 2005/0133431 A1 (Schulz) 23 June 2005 (23.06.2005), entire document, especially Fig. 1, 2; para[0020]; para[0022]; para[0028]; para[0029]; para[0030]; para[0019];	1
X	US 2006/0091048 A1 (Healey) 04 May 2006 (04.05.2006), entire document, especially Fig. 1, 2; para[0030]; para[0044]; para[0055]; para[0043]; para[0032]; para[0034]; para[0002];	1
A	US 6,001,249 A (Bailey et al.) 14 December 1999 (14.12.1999), entire document	1
A	US 2004/0251192 A1 (Fritze et al.) 16 December 2004 (16.12.2004), entire document	1
A	US 2013/0098816 A1 (Elfstrom) 25 April 2013 (25.04.2013), entire document	1
A	US 6,436,283 B1 (Duke) 20 August 2002 (20.08.2002), entire document	1
A	US 6,406,619 B1 (Donald et al.) 18 June 2002 (18.06.2002), entire document	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

Date of the actual completion of the international search

13 January 2017

Date of mailing of the international search report

02 FEB 2017

Name and mailing address of the ISA/US

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