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(72) Inventor; and

(71) Applicant : SHERMAN, Karl, L. [US/US]; 704 Beech Avenue, Patton, PA 16668 (US).

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(54) Title: CONTINUOUS FLOW CENTRIFUGE WITH APPLICATION OF WATER DESALINATION AND PURIFICATION

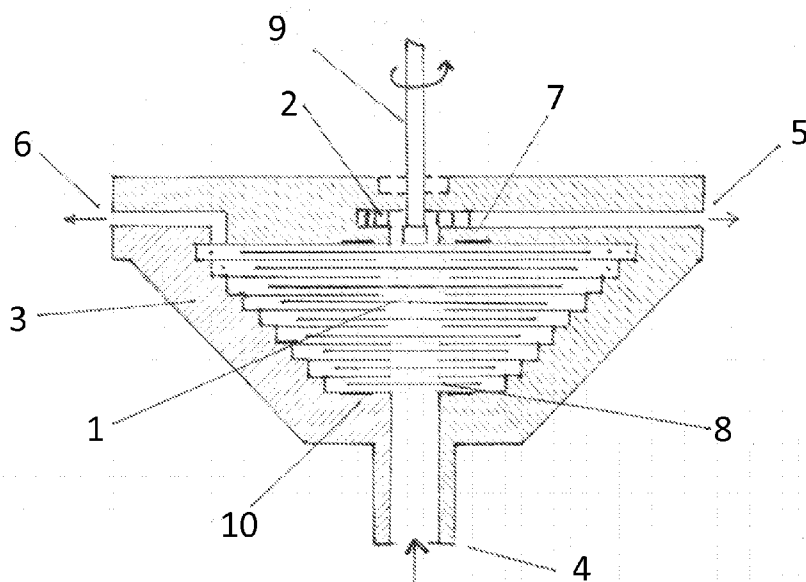


Figure 1

(57) Abstract: A water purification apparatus the method of the removal of various salts or contaminate molecules/ions from sea water. Consisting of combination of a shaft driven rotor mounted concentrically within enclosure of stepped frustoconical shape including at least one port for the receiving of salt water therein through, at least one fresh water output port and one brine discharge port. Impure water solution, ejected from the rotor, is channeled upward along the inner wall of the containment chamber to the top whereupon the solution is discharged through another port at the enclosure periphery.

TITLE: Continuous Flow Centrifuge with Application of Water Desalination and Purification

BACKGROUND

[0001] The invention relates to a mechanical fluid separator as applied to a water purification and desalination apparatus.

[0002] The preferred system will desalinate large volumes of water while consuming a small amount of work energy.

BRIEF SUMMARY OF THE INVENTION

[0003] One object of the invention is water purification apparatus and a method, related to desalinization.

[0004] In an embodiment, a water purification apparatus and method utilizing a continuous flow centrifuge.

[0005] The object of the extraction of heavier atomic weight molecules or ions utilizing centrifugal force with high throughput delivery rates for a minimum 3000 shaft rpm.

[0006] At the circumferential end of each radial channel is an exit flow restrictor cut out, such that the drain off of radial flow through the channel is constrained, allowing for the concentration of dissolved salt components in the fluid, near the axially remote orifice to discharge through the rotor channel wall.

[0007] The concentrated solution is channeled upward along the inner wall of the containment vessel, to the top where ultimately it is discharged.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] Figure 1 is a sectional view of the centrifuge assembly showing the rotor internal baffle structure (1), input shaft (9) and pump (2) as enclosed.

[0009] The enclosure inlet (4) is shown at the bottom as are annular seal structures (7) and (8) at the top and bottom inside of the rotor chamber (3).

[00010] Figure 2 is a vertical sectional view of a single stage of the centrifuge containing multiple radial partially divided channels (11) opening to two central contiguous plenum cavities (12), one above and one below the channel divider disc.

[00011] The sector walls (13) are shown radiating from the central plenum as are the outward and return flows illustrated (14).

[00012] The circumferential cut out locations are shown in Figures 2 (15) and 3 (16).

[00013] Figure 3 is a horizontal section of two contiguous stages of the centrifuge showing the radial flow chambers (18) oriented transverse to the axis of rotation and each respective outlet (16) opens to the interior wall of the housing (Fig. 2 section A-A and Fig. 3 section A-A)

[00014] Processed flow from the previous (lower stage) is channeled upward into the next, through the center plenum area (19).

DETAILED DESCRIPTION OF THE INVENTION

[00015] The rotor structure detailed in Figure 1 has an intake opening (4) where incoming fluid is inducted into the first centrifuge stage (8) therein is an exchange of angular momentum between the liquid and the rotor structure. The liquid is immediately subject to an increased gravitational field at the periphery of the rotor where part of the denser material aggregates. Part of this material is allowed to escape the rotor through the circumferential drain openings, at a controlled rate Figure 3 (16).

[00016] The remainder, see Figure 2 (14) arrows, is returned to the upper plenum of the first stage, and is then thrust axially upward into the next stage where a stronger expression of gravitic influence is exerted. This process repeats with more opportunity expressed for heavier elements to settle at the axially remote ends of the radial channel walls whereupon it exits the rotor (3). The rotation within the enclosure cavity forces the layer of liquid to rise up along the internal enclosure surface, in the clearance between rotor outside wall and enclosure, where it can be expelled (6). The rotor drive shaft first passes through the pump impeller (2) before merging with the rotor central hub through a shaft structure (2) containing axial transport channels merging with the outlet plenum of the final centrifuge stage. The centrifugal pump vanes accept the upward axial flow through the hollow shaft near the center of the pump impeller to be ejected from the centrifuge enclosure fresh water outlet (5). The pump being necessary to pull the fresh water axially through the rotor at a controlled rate. Heavier components of the fluid, near the rotor circumference are expelled along the inner wall of the containment chamber, into the clearance between the rotor and enclosure wall, to the top where discharge through another port at the enclosure periphery is facilitated.

[00017] The centrifuged liquid is prevented from mixing with the brine discharge or the fresh water by two o-ring seal structures (7) and (10) mounted in the enclosure cover and base. Dependent upon the methods of production of the vane ducts (11) Figure 2, be it by EDM or even 3-D printing in conjunction with casting techniques the internal channel surface finish determines impact on centrifuge flow rates. The enclosure would be best manufactured as at least two parts, the bottom rotor enclosure and the top attached cover containing the pump and outlet ports.

[00018] The improved centrifuge device facilitates extreme force continuous flow centrifugation with no limits on upward scalability.

[00019] A hydrostatic head not present at the inlet may cause centrifuge cavitation which is to be avoided.

[00020] Variants of the invention may be operated using the axial ports functionality reversed, or with clockwise or counter clockwise rotor movement.

[00021] Although the present invention has been described in detail, those skilled in the art will understand the various changes, substitutions, and alterations herein may be made without departing from the spirit and scope of the invention in its broadest form.

[00022] The invention is not considered limited to the example chosen for purposes of disclosure, and covers all changes and modifications which do not constitute departures from the true spirit and scope of this invention. For example the number of radial channels or number of stages used may be more or less, in addition a more cylindrical rotor profile may be used at the expense of dynamic balance characteristics.

CLAIMS

[00023] We claim as our invention:

[00024] 1. A centrifuge assembly comprising, in combination a casing (3) defining a circular chamber, a shaft driven rotor (1) mounted in said casing concentrically with axis of said chamber of stepped frusto-conical shape including at least one port (4) for the receiving of salt water therein through, at least one port (5) for providing outflow of pure water, and at least one (6) port providing outflow for a mixture of water and various salt compounds and/or with heavy material.

[00025] 2. The rotor of claim one integrally containing multiple stages (1) stacked in cascade (Figure 3) each containing, centrally convergent, multiple linear radial flow channels which loop back to central plenum areas after part of each flow is expelled at the most remote point from said axis (Figure 2).

[00026] 3. The radial channels of claim two are divided into outflow and return flow channels (14) said divider extending out to minimum of .7 of the rotor radius (11), vertically stacked thence merging into one (14), the upper originating in central plenum chamber (12) separated from the origination of the lower in its respective plenum chamber.

[00027] 4. The rotor of claim one containing a central axial distribution structure (1) whose flow pattern is coincident with said axis of rotation between consecutive levels facilitating introduction of the central columnar flow (19) to the inlet of the next stage through the centrifuge cascade until final expulsion via the outlet pump.

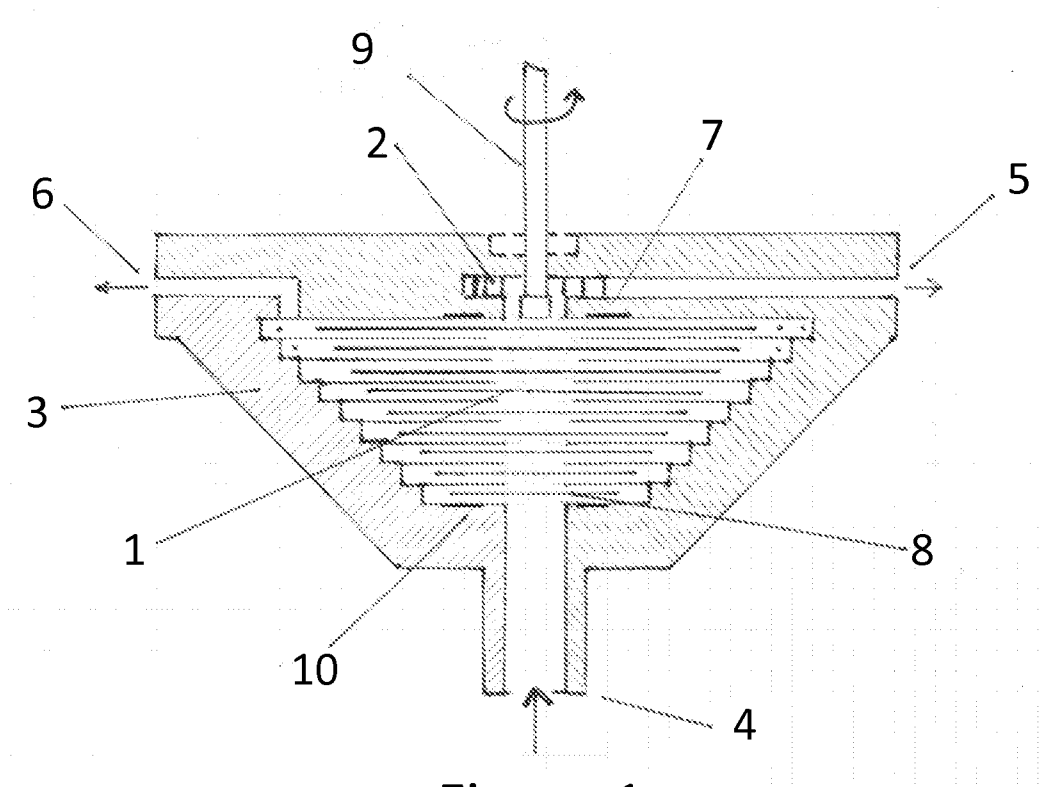


Figure 1

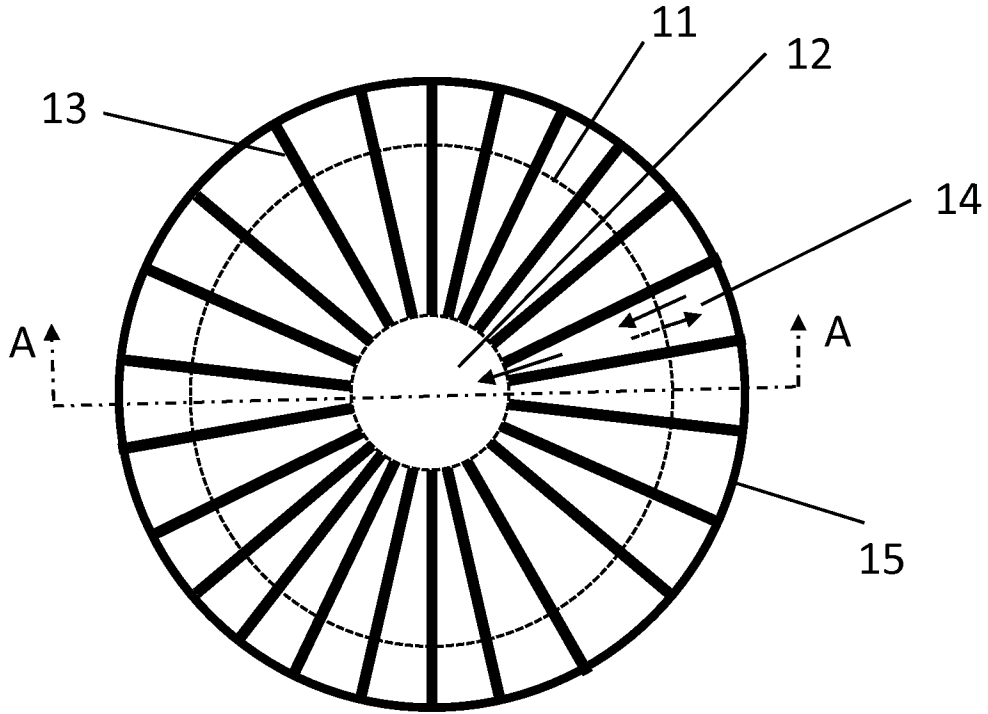


Figure 2

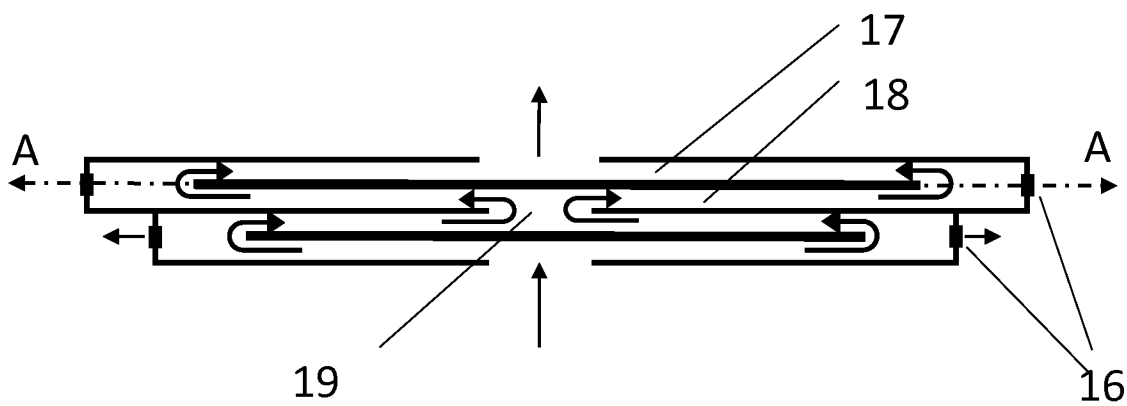


Figure 3

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 15/54727

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - B04B 1/08, B04B 1/04, B04B 5/12, B04B 7/04, B04B 7/12, B04B 7/14 (2016.01)

CPC - B04B 1/08, B04B 1/04, B04B 5/12, B04B 2005/125, B04B 7/04, B04B 7/08, B04B 7/12, B04B 7/14

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): B04B 1/*, B04B 7/*(2016.01)

CPC: B04B 1/*, B04B 7/*

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

IPC(8): B04B* (2016.01)

CPC: B04B*

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

PatBase, Google Patents, Google Web

Keywords: centrifugal, centrifuge, water, salt, step, stepped, cone, conical, stack, stacked, bowl, disc, disk

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X -- A	US 4,608,040 A (KNELSON) 26 August 1986 (26.08.1986), entire document	1 ----- 2-4
X -- A	US 3,630,379 A (SHARPLES) 28 December 1971 (28.12.1971), entire document	1 ----- 2-4
A	DE 10010077 A1 (DUERR DENTAL GMBH) 06 August 2001 (06.08.2001), entire document	1-4
A	GB 2128904 A (SIMONDS) 10 May 1984 (10.05.1984), entire document	1-4
A	US 770,748 A (GALES) 27 September 1904 (27.09.1904), entire document	1-4
A	US 8,808,155 B (ZONNEVELD et al.) 19 August 2014 (19.08.2014), entire document	1-4
A	WO 2014128063 A2 (GEA MECHANICAL EQUIPMENT GMBH) 28 August 2014 (28.08.2014)	1-4

☐ 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

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"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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Name and mailing address of the ISA/US

Mail Stop PCT, Attn: ISA/US, Commissioner for Patents
P.O. Box 1450, Alexandria, Virginia 22313-1450

Facsimile No. 571-273-8300

Authorized officer:

Lee W. Young

PCT Helpdesk: 571-272-4300

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