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SL No :

भारत सरकार
GOVERNMENT OF INDIA
पेटेंट कार्यालय
THE PATENT OFFICE
पेटेंट प्रमाणपत्र
PATENT CERTIFICATE
(Rule 74 Of The Patents Rules)

पेटेंट सं. / Patent No.	:	293515
आवेदन सं. / Application No.	:	1522/CHE/2011
फाइल करने की तारीख / Date of Filing	:	02/05/2011
पेटेंटी / Patentee	:	INDIAN INSTITUTE OF TECHNOLOGY

प्रमाणित किया जाता है कि पेटेंटी को उपरोक्त आवेदन में यथाप्रकटित ONE CONTAINER GRAVITY FED STORAGE WATER PURIFIER नामक आविष्कार के लिए, पेटेंट अधिनियम, १९७० के उपबंधों के अनुसार आज तारीख 2nd day of May 2011 से बीस वर्ष की अवधि के लिए पेटेंट अनुदत्त किया गया है।

It is hereby certified that a patent has been granted to the patentee for an invention entitled ONE CONTAINER GRAVITY FED STORAGE WATER PURIFIER as disclosed in the above mentioned application for the term of 20 years from the 2nd day of May 2011 in accordance with the provisions of the Patents Act,1970.

एकस्व कार्यालय THE PATENT OFFICE GOVT.OF INDIA भारत सरकार

अनुदान की तारीख : 27/02/2018
Date of Grant :

पेटेंट नियंत्रक
Controller of Patent

टिप्पणी - इस पेटेंट के नवीकरण के लिए फीस, यदि इसे बनाए रखा जाना है, **2nd day of May 2013**को और उसके पश्चात प्रत्येक वर्ष मे उसी दिन देय होगी।

Note. - The fees for renewal of this patent, if it is to be maintained will fall / has fallen due on **2nd day of May 2013** and on the same day in every year thereafter.

FORM 2

THE PATENTS ACT, 1970

(39 OF 1970)

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The Patents Rules, 2003

COMPLETE SPECIFICATION

(Refer section 10 and rule 13)

TITLE OF THE INVENTION:

ONE CONTAINER GRAVITY FED STORAGE WATER PURIFIER

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3. Preamble to the Description

COMPLETE SPECIFICATION

The following specification particularly describes the invention and the manner in which is to be performed.

COMPLETE SPECIFICATION

TITLE OF THE INVENTION

ONE CONTAINER GRAVITY FED STORAGE WATER PURIFIER

FIELD OF THE INVENTION

This invention relates to the design, construction and use of one-container gravity-fed storage water purifier. One-container gravity fed storage water purifier consists of a membrane cloth containing a biocidal composition. The membrane cloth removes visible dirt, sand and sediments from drinking water, through a depth filtration mechanism. The biocidal composition is silver nanoparticles impregnated organic templated boehmite nanoarchitecture, as reported in our previous application (947/CHE/2011). The advantages of one-container gravity-fed storage water purifier are as follows: (i) reduced purchase cost of the water purifier due to the use of only one container and subsequent reduction in the container cost, (ii) no additional filtration step is required for silver ion removal as the residual silver ion concentration in water is well below the World Health Organization (WHO) limits and (iii) prolonged life of the media due to the prevention of scaling due to inorganic contaminants as the contact time with media is minimum.

BACKGROUND OF THE INVENTION

Gravity-fed storage water purifiers have gained strong consumer attraction in the market owing to its low cost of ownership, zero electricity consumption, no requirement of running water for operation and effective removal of microorganisms from drinking water.

Gravity-fed storage water purifier reported in the literature and available in the market is a two container device (one container each for contaminated water and purified water). The two containers are separated by a wall so as to prevent the mixing of contaminated and purified water. The water purification cartridge(s) is usually positioned between the two containers. In a typical use, the contaminated water is poured inside the first container. The pressure due to the water head in the first container drives the contaminated water through the porous cartridge into the purified water container. Typically, during the passage of water through the porous cartridge, contaminants in water come in contact with the adsorbent composition in porous cartridge and are thus removed.

Gravity-fed storage water purifier cartridges can typically be characterized in two segments:

(i) ceramic candle based water purification cartridge: A typical ceramic candle based storage water purifier operate at a flow rate of 1-2 liters/hour (10 liters of purified drinking water is available in 5-10 hours). The fine pores in the ceramic candle remove fine dirt particles from water. As reported by Bridges et al., in US patent application 20080202992, biocidal composition can be packed inside the hollow region of the ceramic candle for ensuring that output water is microbiologically safe for consumption. Similarly, Oyanedel-Craver et al., in Sustainable Colloidal-Silver-Impregnated Ceramic Filter for Point-of-Use Water, Environ. Sci. Technol. 2008, 42, 927-933 have shown that silver nanoparticles impregnated ceramic filter can remove bacteria from drinking water.

(ii) Carbon block based water purification cartridge: A typical carbon block based storage water purifier operates at a flow rate of 3-6 liters/hour (10 liters of purified drinking water is available in 2-3 hours). Carbon block is utilized for the removal of reactive chlorine and trace organics from drinking water. As reported by Bommi et al., in US patent application 7585409 and Mistry et al., in WIPO patent application WO/2004/000732, biocidal composition can either be mixed in the carbon block or placed at the end of the carbon block.

Despite of various efforts to tackle microbiological contamination using a number of filtration media and several modifications in water purifier designs, an extremely low cost solution for microbe free water hasn't been achieved yet. Affordability of water purifier is an important component of increasing the access of people to clean drinking water. A low cost of ownership for household-based water purifier is likely to play a major role in improving the health of citizens of this country.

It estimated that the cost of container is -30% of the water purifier price as about 2-3 kg of plastic is used per purifier to make the containers. Besides, the environmental cost of plastics become large when two container designs are distributed along the length and breadth of the country.

PRIOR ART

Amongst all the methods of water purification, the oldest technique is the use of gravity filtration. Since the earliest civilizations, people have used cloth for the removal of visible dirt and sediments from water. This technique still continues to be used by a large number of people (Reduction of cholera in Bangladeshi villages by simple filtration, Colwell et al., PNAS, 2003, 100, 1051-1055). The format of physical filtration has also evolved through the use of various other filtration media, e.g., sand filtration (Elimination of viruses, bacteria and protozoan oocysts by slow sand filtration, Hijnen et al., Water Sci Technol., 2004, 50(1), 147-54), woven/non-woven membrane cloth filtration (Handbook of nonwoven filter media, I. M. Hutten, Elsevier, 2007) and ultrafiltration membrane (Membranes in clean technologies: Theory and practice, Volume 1, Koltuniewicz et al., Wiley-VCH, 2008).

The major advantage of such gravity filtration for microorganism removal is the cost of water purification. However, it has been established that performance is dramatically affected by the flow rate. A reasonable performance can be achieved only if the filtration rate is extremely slow.

Over a period of time, the technique of gravity filtration has evolved in a number of other formats. One of the most popular formats is the two-container gravity-fed storage water purifier. Various variants of such formats have been reported (Indian patent applications Adroja et al., in 1571/MUM/2008, Mistry et al., in WIPO application WO 2004/000732, Bae et al., in US Patent 5928506, Bridges et al., in WIPO application WO 2008/106276, Frank Senyal in US Patent 2372340). The basic design of gravity fed storage water purifier contains upper and lower containers separated by purification cartridge. The pressure due to gravity drives the contaminated water in upper container through the cartridge into the lower container. The basic design has been modified with a number of design parameters, e.g., direction of water flow (upwards/downwards), flow control valves (to prevent overflow), additional flow length for the water (to increase contact time), etc. Such gravity fed storage water purifiers have also been modified in size and it resulted in a carafe type water purifier. Typically, the top container has a capacity of less than 3 liters. Illustrative examples are reported in Wennerstrom in US Patent 7323104, Hengsperger et al., in US Patent 7513278 and Bathula in US Patent 7632397.

While the reported storage type water purifiers exhibit functional performance, a major disadvantage associated with those is the requirement of large amount of plastics (for two or more containers and for housing of the cartridge). It is important to know that plastics contribute —30% in the price of a storage water purifier (material of construction: engineering plastic, quantity: 2-2.5 kg, cost of plastic: Rs. 120 per kg). Therefore, it is important to reduce the quantity of plastics used in a water purifier, from the perspective of reducing the cost to consumer as well as decreasing the environmental damage due to the impact of plastics.

Therefore, the main object of the present invention is to provide a simple and cost-effective one container gravity-fed storage water purifier with the output water quality adhering to stringent norms of microbiologically safe water. An important aspect of this design is that it can be easily adapted for use in any water purification system (household/ community/ industrial).

The object of the present invention is to deliver microbiologically safe water through an extremely simple design of storage water purifier having fast dissolution of anti-microbial agent/agents from the biocide composition (dissolution of silver ions from Ag-OTBN), such that the concentration of anti-microbial agent in the water to be well below WHO limits (silver concentration in drinking water is less than 100 ppb) and easy implementation of contact time required for complete killing of microorganisms by incorporating a mechanical or other timer at the tap of the container.

The design is extremely adaptable to various usage conditions. The biocide composition can be packed easily in between two layers of any filtration mechanism, and the output water can be left in any food-grade container for 1 hour prior to use. The details of the invention are described below.

SUMMARY OF THE INVENTION

The objective of one-container gravity fed storage water purifier is to deliver microbiologically safe drinking water at extremely affordable cost to the consumer. More specifically, the objective of one-container gravity fed storage water purifier is to store the purified water in one container and eliminate the need of storing contaminated water in another container. Besides, the one-container gravity fed storage water purifier must enable the interaction of contaminated water with the biocide composition at the inlet of the water purifier itself. The design should be such that additional purification devices are incorporated, if necessary.

The pre-requisites of one-container gravity fed storage water purifier are the following: (i) biocidal composition should have extremely fast kinetics for adsorption of contaminants and/or extremely fast kinetics for desorption of biocide into water and/or extremely fast electron transfer from the adsorbent surface to the contaminant molecule. (ii) In case of release of any active ingredient from the adsorbent composition, the concentration should be well-within the WHO limits for safe drinking water, thereby preventing the need to have a second stage purification unit.

The construction of one-container gravity fed storage water purifier consists of a membrane cloth containing a biocidal composition. The membrane cloth removes visible dirt, sand and sediments from drinking water, through a depth filtration mechanism. The biocidal composition destroys bacteria and virus from drinking water by leaching of silver ions into water and adsorption of viruses on organic templated boehmite nanoarchitecture or chemical interaction with the leached silver ions. Illustrative biocidal compositions are described in our previous patent applications (T. Pradeep et al., in Indian patent 20070608; T. Pradeep et al., in 947/CHE/2011).

The biocidal composition further comprises silver nanoparticles impregnated on at least one of a polyurethane, an oxide, and/or an oxyhydroxide of at least one of aluminum, zinc, manganese, copper, iron, titanium, zirconium, lanthanum, cerium, and silicon. The biocidal composition can further comprise silver nanoparticles impregnated on activated carbon.

The use of the water purifier requires the manual pouring of contaminated water on the membrane cloth, at a typical flow rate of 1-2 liters/min. The passing water contacts the biocidal composition wherein silver ions are leached from the biocidal composition into the water. After passing through the membrane cloth and biocidal composition, the water stays in the storage container. A typical time of 5-10 minutes is required to completely fill the storage container. The water stays in the storage container for duration up to 1 hour, for complete killing of microorganisms as per the US EPA drinking water norms. The duration of 1 hour is controlled by a device fitted at the tap outlet. The construction of the device works on the principle of time-dependent release of a stopper. The knob provided on the device is rotated to a position marked with 1 hour release time. Upon complete passage of 1 hour time, the release mechanism is activated and the tap outlet is opened, water is ready for safe consumption.

The advantages of one-container gravity-fed storage water purifier are as follows: (i) Purchase cost for the water purifier is reduced due to the use of only one container. (ii) Since the residual silver ion concentration in water is well below WHO limits, there is no requirement for further purification of water. (iii) The effective duration for each cycle of water purification is enormously improved, thereby facilitating faster availability of purified drinking water to the consumer.

It is also known from the prior art that technologies utilized for the purification of drinking water require a reasonable contact time (Advances in water treatment by adsorption technology, Ali et al., Nature Protocols, 2006, 1(6), 2661). In the case of activated carbon, adsorptions of contaminants usually require an empty bed contact time (EBCT) of 10 minutes (Predicting GAC performance with rapid small-scale column test, Crittenden et al., J. Am. Water Works Assoc. 1991, 83, 77-87). The removal of chlorine by activated carbon is usually fast because it is a redox reaction between activated carbon and chlorine and therefore it is not an adsorption process (Reduction of aqueous free chlorine with granular activated carbon - pH and temperature effects, Suidan et al., Environ. Sci. Technol., 1977, 11 (8), 785-789). Similarly, silver impregnated activated carbon has been used for the removal of bacteria from drinking water at EBCT of 30 seconds (Silver-embedded granular activated carbon as an antibacterial medium for water purification, Bandyopadhyaya et al., J. Chem. Technol. Biotechnol., 2008, 83, 1177-1180). It has been reported by Bridges et al., in WIPO patent application, WO 2008/106276 that chlorine and bromine based disinfection media require a contact time of 1-3 seconds for microbial killing.

The active biocide usually leaches from the biocide composition in the passing water and the water containing the active biocide is allowed to stay for a definite time. Usually, the killing of microorganisms can be accomplished in two ways: lower time with high dose or higher time with lower dose. The second way is advantageous because the necessity of additional filtration step to remove excess biocide from water is prevented. A standing time of over 30 minutes has been used and implemented for chlorine based disinfection media by Mistry et al., in WIPO patent application WO 2004/000732.

In order to utilize a composition for drinking water purification by packing it in the membrane cloth, an EBCT of 0.1 second is available for the contact between the composition and water. At this kind of EBCT, no composition has ever been used previously for drinking water purification. We hereby report the use of a composition based on silver nanoparticles impregnated organic template boehmite nanoarchitecture (Ag-OTBN) for water purification. The method of preparation and its use for water purification is detailed in our previous patent applications (947/CHE/2011). The mechanism for biocidal activity of silver nanoparticles is reportedly due to the release of silver ions in water. This mechanism of silver ion release has been previously utilized for the biocidal action. In the case of Ag-OTBN, a constant release of silver ions in water over a volume capacity of 1,500 liters has been previously demonstrated. The silver ion concentration in water is typically around 20 ppb and is well below 100 ppb limit set by WHO for safe drinking water.

DESCRIPTION

DETAILED DESCRIPTION OF THE INVENTION

The objective of one-container gravity fed storage water purifier is to deliver microbiologically safe drinking water at extremely affordable cost to the consumer. This can be accomplished by reducing the cost of plastics used in the construction of the water purifier, without compromising on the microbiological purity of the drinking water. In a typical construction of two containers gravity-fed storage water purifier with material of construction (MOC) as engineering plastic, approximately 2-2.5 kg plastic is used. In case MOC is stainless steel, the weight of the material may reach around 3 kg. Therefore, the cost contribution of the plastics to cost of the storage type water purifier is in the range of Rs. 200-Rs. 300.

In order to eliminate the need of using two containers and use only one container, it is necessary to store the purified water in one container and eliminate the need of storing contaminated water in another container. This requires the contaminated water to be in contact with the biocide composition at the inlet of container used for the storage of purified water. Preferably, the biocide composition is packed in-between two layers of a membrane cloth.

However, a critical constraint with the use of biocide composition in the membrane cloth is that the contact between the biocide composition and the contaminated water is minimal. As an illustrative example, 20X60 mesh Ag-OTBN granules are sandwiched between two layers of membrane cloth. The dimensions of such a cylindrical filtration unit are 10 cm (D) X 10 cm (H), wherein the Ag-OTBN occupies 1 cm depth. For a typical flow rate of 1 L/min, an EBCT is calculated to be 0.1 second. Even in an online water purifier, EBCT of 2-5 seconds is practiced.

The second aspect of an effective biocidal action is the standing time provided to the water when the leached biocide is present in the water. This is true of practically all the biocides known for use in drinking water purification. This has been reported in several previous reports (Mistry et al., in WIPO patent application WO/2004/000732; Antibacterial Activity and

Mechanism of Action of the Silver Ion in Staphylococcus aureus and Escherichia coli, Jung et al., Appl Environ Microbiol., 2008, 74(7), 2171; Observations on Halogens as Bathing Water Disinfectants, Brown et al., J. Appl Microbiol, 1966, 29, 3, 559). As a general rule one can consider that with the use of higher biocide concentration in water, lesser standing time is needed and vice-versa. However, there are disadvantages of using higher concentration of biocide: (i) concentration in excess of allowed limits for drinking water require an additional step for biocide removal and (ii) excess biocide concentration may also lead to redox/other reactions with organic load usually found in drinking water.

There are several ways by which standing time can be implemented, primarily depending on the duration of standing time required and complexity of water purifier design: (i) a simple notification on the product for the consumer, stating that a fixed standing time is necessary for complete microbial killing, (ii) a travel path implemented for water, wherein water moves slowly inside the water purifier prior to reaching the output water container and (iii) a device fitted at the outlet tap to block the water flow, wherein the user switches on the device upon filling the container with water and the device takes a fixed time to open the blockage in the water flow through the tap. In the particular case of this invention, an analog device is fitted prior to the outlet tap, for controlling the standing time of water in the container. A general construction of a device is based on a mechanical clock. A typical mechanical clock consists of an oscillator and a controller device. Oscillator (typically made of pendulum or mechanical wheel) vibrates/oscillates repetitively at a pre-determined frequency. Oscillator is powered by the use of spring or a weight suspended from a cord wrapped around a pulley. The forward movement of the mechanical clock is made by the movement of a gear tooth of the escape wheel at each swing.

The pre-requisite for one-container gravity fed storage water purifier is as follows: (i) Biocidal composition should have extremely fast kinetics for adsorption of contaminants and/or extremely fast kinetics for desorption of biocide into water and/or extremely fast electron transfer from the adsorbent surface to the contaminant molecule. (ii) In case of release of any material/ion from the adsorbent composition, the concentration should be well-within the WHO limits for safe drinking water, thereby preventing the need to have a second stage purification unit.

The construction of one-container gravity fed storage water purifier consists of a membrane cloth containing a biocidal composition. The membrane cloth removes visible dirt, sand and sediments from drinking water, through a depth filtration mechanism. The biocidal composition removes bacteria and virus from drinking water, through leaching of silver ions into water.Illustrative biocidal compositions are described in our previous patent applications (T. Pradeep et al., in Indian patent 20070608; T. Pradeep et al., in 947/CHE/2011).

The use of the water purifier requires manual pouring of contaminated water on the membrane cloth, at a typical flow rate of 1-2 liters/min. The passing water contacts with the biocidal composition wherein silver ions are leached from the biocidal composition into water. After passing through the membrane cloth and biocidal composition, the water stays in the storage container. A typical time of 5-10 minutes is required to completely fill the storage container. Water stays in the storage container for duration up to 1 hour, for complete killing of microorganisms as per the US EPA drinking water norms. The duration of 1 hour is controlled by a device fitted at the tap outlet. The construction of the device works on the principle of time-dependent release of a spring. The knob provided in the device is rotated to a position marked with 1 hour release time. Upon complete passage of 1 hour time, the spring is released and water is ready for safe consumption.

The advantages of one-container gravity-fed storage water purifier are as follows: (i) purchase cost for the water purifier is significantly reduced due to the use of only one container, (ii) since the residual silver ion concentration in water is well below WHO limits, there is no requirement for further purification of water and (iii) the effective duration for each cycle of water purification is enormously improved, thereby facilitating faster availability of purified drinking water to the consumer.

DESCRIPTION WITH REFERENCE TO DRAWINGS AND TABULATED DATA

Figure 1: Two dimensional view of a typical two container gravity fed storage water purifier.

Figure 1 describes various components of a typical two container gravity fed storage water purifiers available in the market. Without being limited by theory, the first stage of water purification consists of particulate filtration by membrane cloth, wherein physical contaminants such as dirt, sediments and dust are removed. Upon removal of physical contaminants, the water is stored in the first container. This water typically contains chemical and/or biological contaminants. At the end of the first container, a water purification cartridge is attached which typically consists of activated carbon (granules or block), biocide composition and/or any other adsorbent composition. The nature of flow and contact between contaminated water and water purification composition is a subject matter of individual inventions. However, upon contact with the water purification composition, the contaminated water is purified and is thus stored in the second container.

Figure 2: Two dimensional view of the single container gravity fed storage water purifier.

Figure 3: Two dimensional view of the single container water purifier. Components of the water purifier are vertically shifted for clarity.

Figure 4: Three dimensional view of the filtration unit in the single container water filter.

Figure 2 describes the construction of one container gravity fed storage water purifier. Figure 3 shows the cross-sectional view of the filtration unit wherein the position of membrane cloth and the biocidal composition is described. The critical component of the one container gravity fed storage water purifier is the construction of the filtration unit to be put at the top of the container. The first component of the filtration unit is the cap which is to close the entry of water when the purifier is not in use. The cap is preferably detachable. The cap can also have a provision for direct connection to the tap supply. The second component of the filtration unit is the housing of the filtration unit. The housing is preferably detachable and therefore, easily washable by the user. At the end of the housing, there is a membrane cloth filtration unit. The membrane cloth filtration unit comprises of two layers of cloth sealed to the housing. Two layers of membrane cloth may be of same filtration efficiency (expressed either in terms of micron rating of the cloth or the mass of the cloth per square meter). The biocidal composition is packed between the two layers of the cloth uniformly. The biocidal composition consists of granules of Ag-OTBN, wherein the granular size is in the range of 0.3 mm to 5 mm, preferably in the range of 0.5 mm to 1.0 mm. Upon passing through the layers of membrane cloth, the water contacts the biocidal composition due to which silver leaches into the water in the ionic form. The leached silver ion in water leads to the killing of microorganisms.

It is understood by those well-versed with the art of designing water purification devices that the placement of biocidal composition in the filtration unit of one container gravity fed storage water purifier can be subjected to various modifications, without significantly altering the performance. One such modification is the use of granular adsorbent for the removal of various other contaminants from drinking water. The granular adsorbent can be packed alongside the biocidal composition, i.e., in between the membrane cloth. The granular adsorbents of interest are activated carbon, activated alumina, silica, titania, ion exchange resin, halogenated resin or a combination thereof.

Figure 5: A two-dimensional view of the filtration unit in the single container water filter, wherein a porous adsorbent block is positioned just after the timer device.

With reference to our previous patent application 2892/CHE/2010, it is to be noted that at a pressure head of 0.5 psi (usually available in a gravity-fed storage water purifier), a flow rate of 500-600 ml/min is feasible through a porous carbon block (path length: 5.5 cm). The use of activated carbon porous block at the outlet tap is an important component of the invention because it can ensure that even organic impurities are removed. Due to reasonably high flow rate through the porous carbon block, the user will not face difficulty in collecting the water through the tap. Another advantage of using the carbon block at the output tap is that as bacteria free water will be passing through the carbon block, no bacteria breeding will happen within the carbon block. It has been previously reported that activated carbon block is known to act as a breeding ground for bacteria, and therefore, the challenge of preventing bio-growth is automatically solved. Instead of activated carbon, other adsorbent media can be used to remove specific or a range of contaminants such as fluoride, mercury, arsenic, etc.

Figure 6 provides the top view of the single container gravity fed water purifier ((A) with cap (B) without cap).

Figure 7: Performance claim for the bacteria removal by one container gravity fed storage water purifier.

Figure 7 gives a summary of the performance for the bacteria removal by one container gravity-fed storage water purifier. The performance of the water purifier is intact over the passage of a volume over -750 liters (challenge water concentration for E. coli: 1X105 CFU/ml). Traces (a) and (b) are for input and output, respectively. Error bar shown in trace (a) is due to the daily variation in the bacterial concentration.

Figure 8: Performance claim for the virus removal by one container gravity fed storage water purifier

Figure 8 gives a summary of the performance for the virus removal by one container gravity-fed storage water purifier. The performance of the water purifier is intact over the passage of a volume of over -750 liters (challenge water concentration for MS2 coliphage: 1X103 PFU/ml). Traces (a) and (b) are for input and output, respectively.

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We claim:

1. A one container gravity-fed storage water purifier comprising
   a. a membrane cloth based filtration unit
   b. a granular biocidal composition comprising silver nanoparticles impregnated on an organic template boehmite nanoarchitecture
   c. the granular biocidal composition is packed in between two layers of the membrane cloth
   d. a storage water container wherein the water, after passing through the membrane cloth and the biocidal composition, is stored.
2. The one container gravity-fed storage water purifier as claimed in claim 1, wherein the granular biocidal composition further comprises silver nanoparticles impregnated on polyurethane.
3. The one container gravity-fed storage water purifier as claimed in claim 1, wherein the granular biocidal composition further comprises silver nanoparticles impregnated on oxide/oxyhydroxide of aluminum, zinc, manganese, iron, titanium, zirconium, lanthanum, cerium, silicon, or a combination thereof.
4. The one container gravity-fed storage water purifier as claimed in claim 1, wherein the granular biocidal composition further comprises silver nanoparticles impregnated on activated carbon.
5. The one container gravity-fed storage water purifier as claimed in claim 1, wherein the layers of membrane cloth is detachable, washable and re-attachable.
6. The one container gravity-fed storage water purifier as claimed in claim 1, wherein the size of the granules is between 0.3 mm to 1.5 mm and preferably between 0.5 mm to 1 mm.
7. The one container gravity-fed storage water purifier as claimed in claim 1, wherein the contaminated water is poured through the filtration unit at a flow rate between 0.5 L/min to 5 L/min and preferably between 1 L/min to 2 L/min.
8. The one container gravity-fed storage water purifier as claimed in claim 1, wherein the filtration unit comprises a water inlet connected to the running water supply.
9. The one container gravity-fed storage water purifier as claimed in claim 1, further comprises an outlet tap fitted with an alarm which can be set for a pre-determined period for retaining the water in the container prior to consumption.

10. The one container gravity-fed storage water purifier as claimed in claim 9, wherein the outlet tap is configured with cutoff in such a way that water flows out of the tap only after a required time delay.
11. The one container gravity-fed storage water purifier as claimed in claim 1, further comprises an adsorbent composition placed prior to the outlet tap.
12. The one container gravity-fed storage water purifier as claimed in claim 11, wherein the adsorbent composition comprises at least one of an activated carbon, activated alumina, silica, titania, ion exchange resin, halogenated resin or a combination thereof with and without nanomaterial coatings.
13. The one container gravity-fed storage water purifier as claimed in claim 1, wherein the granular biocidal composition is replaced and/or combined with an adsorbent composition.
14. The one container gravity-fed storage water purifier as claimed in claim 1, wherein the container is made of engineering plastic, stainless steel, copper, brass, earthernware.
15. The one container gravity-fed storage water purifier as claimed in claim 1, wherein the membrane cloth is made of cellulose, polyester, nylon, polypropylene, or similar materials.

Dated at Chennai this July 04, 2017

Signature:

D. Moses Jeyakaran
Advocate & Patent Agent
IN/PA — 369

ONE CONTAINER GRAVITY FED STORAGE WATER PURIFIER

ABSTRACT

The invention relates to a design, construction and use of a one-container gravity-fed storage water purifier is described. One-container gravity fed storage water purifier consists of a membrane cloth containing a biocidal composition. The membrane cloth removes visible dirt, sand and sediments from drinking water, through a depth filtration mechanism. The biocidal composition removes bacteria and virus from drinking water, through fast leaching of silver ions into water. The advantages of one-container gravity-fed storage water purifier are: (i) purchase cost for the water purifier is significantly reduced due to the use of only one container, (ii) since the residual silver ion concentration in water leached from the medium is well below the WHO limits, there is no requirement for further purification of water and (iii) prolonged life of the media due to the prevention of scaling of inorganic contaminants as the contact time with media is minimum.

APPLICATION NUMBER: 1522/CHE/2011

ONE CONTAINER GRAVITY FED STORAGE WATER PURIFIER

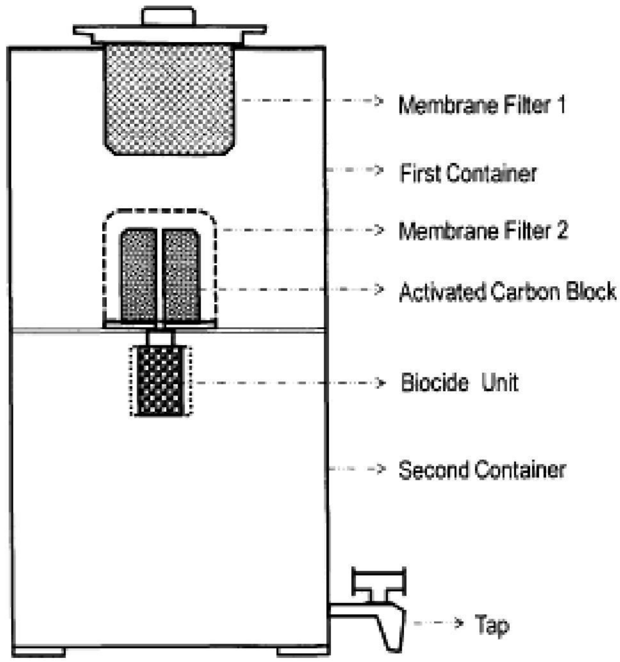

Figure 1 (PRIOR ART)

Signature: 

D. Moses Jeyakaran

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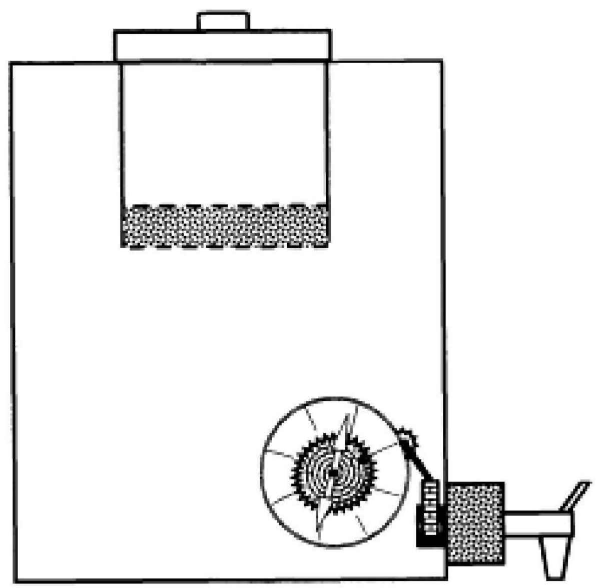

Figure 2

Signature: 

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Advocate & Patent Agent

IN/PA — 369

APPLICATION NUMBER: 1522/CHE/2011

ONE CONTAINER GRAVITY FED STORAGE WATER PURIFIER

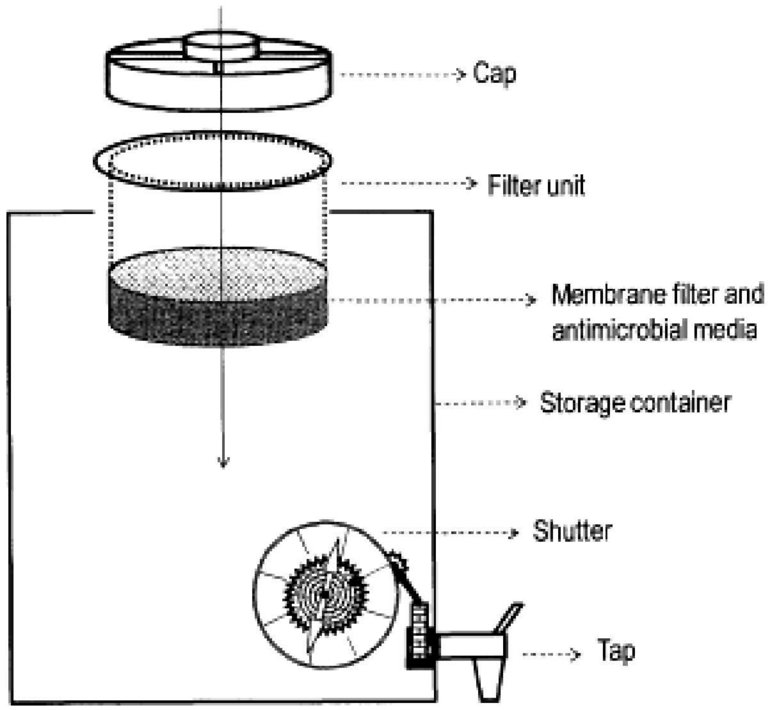

Figure 3

Signature:

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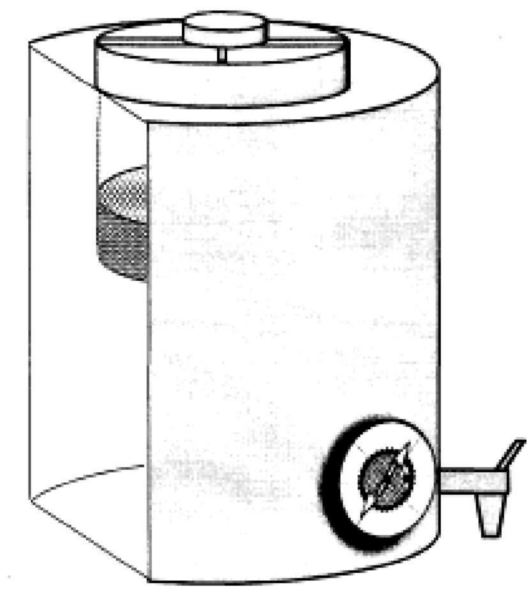

Figure 4

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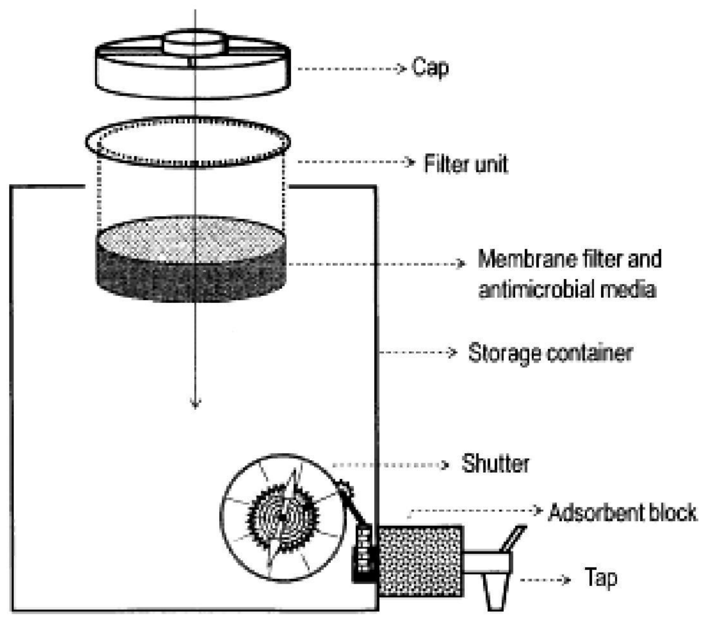

Figure 5

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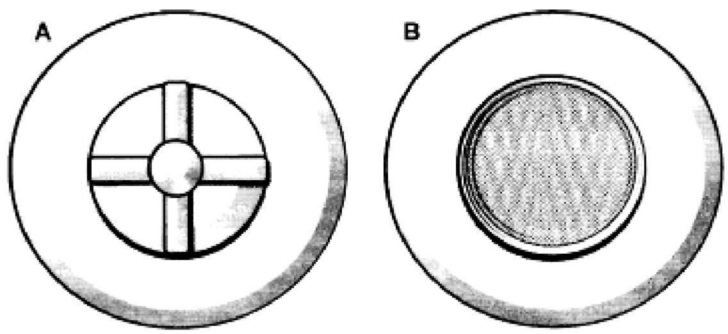

Figure 6

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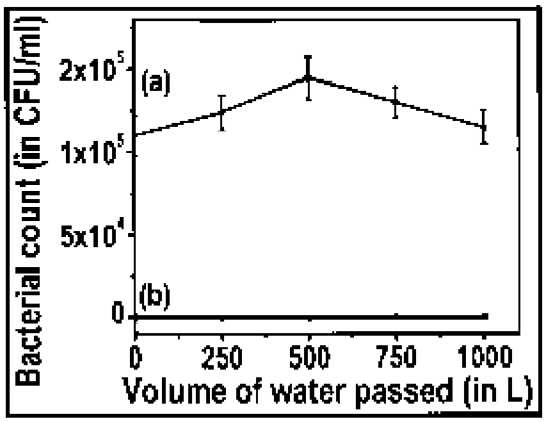

Figure 7

Signature:

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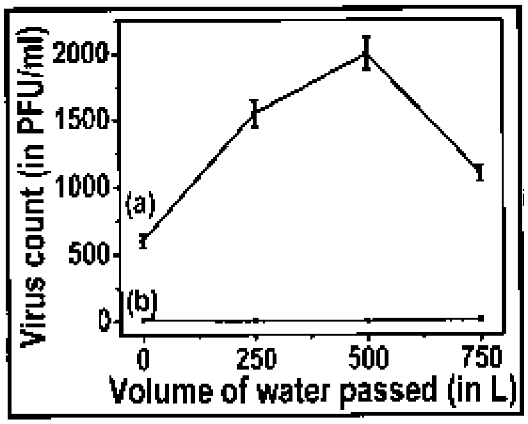

Figure 8

Signature:

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