

Description**I Title**

0001 Green reverse osmosis water filter with zero waste

II Technical field

0002 The application herein is for a reverse osmosis water filter which does not need electricity to function and will have a zero waste during the process of reverse osmosis filtration. It adopts a combination of parts of the prior arts WO2019143290 (hereinafter named AST) for filtered water, and parts of the prior art WO2022132028 (hereinafter named WT) for waste water, both with improvements, and together with other new features and concepts to form a new reverse osmosis water filter (hereinafter named GRO) which is able to filter the pipeline feed water into filtered water, stored in the AST for dispensing, and waste water, stored in the WT for usage; and ensuring all the waste water produced during the process of filtration is stored and used thereby achieving zero discharge of the waste water into the drainage before usage, resulting in saving in the consumption of the pipeline water.

Both prior arts are under the same inventor/applicant of the present application..

III Background**0003 General**

The types of reverse osmosis water filter (hereinafter named RO) available in the present market can be broadly classified into two main categories based on market information. First category is the traditional RO filters with the pressure tank which requires electricity and a pump to function, and a second category, a tank-less option, an RO filter with advance technology making use of a high pressure pump to reduce waste water and produce filtered water on demand, it does not require the pressure tank for storage, and requires electricity to function. There are many different brands available under this category, and with different features and efficiency. The traditional reverse osmosis water filter system utilizes a pressure tank for storing and dispensing of the filtered water; the pressure tank with the electronic device accompanied also has the function of opening and cutting off of the water supply to the filtration system. But the presence of the pressure tank is also the cause of the whole filtration system having high amount of waste water during the filtration process and the waste water is

discharged into the drainage directly without usage. Besides having a high amount of waste water, the pressure tank system also requires high pressure to function as the net filtration pressure will be the balance pressure after offsetting the back pressure from the pressure tank on the pipeline water pressure, and with assistance from the electric pump to counter the back pressure; the back pressure will go higher and higher as the pressure tank is approaching full. The net filtration pressure reduces as the tank is approaching full. This will cause the traditional RO system to have a high amount of waste water.

The content in this application is all on the improvements on the traditional RO system, for achieving zero waste and saving of electrical energy.

0004 Brief development history of inventions

The inventor started to delve into the issue of high amount of waste water in the process of RO filtration in 2015 where he has developed the invention WO2016175703, 11201708362P, an independent atmospheric waste water tank with a mechanical pumping gadget for salvaging and usage of the waste water. But the patented invention can only help to salvage the wastage partially and would require a huge waste water tank to salvage the waste water completely to achieve the target of zero waste, the inventor went on to develop an independent atmospheric filtered water tank AST for storing the filtered water in place of the traditional pressure tank. It is able to cut down the amount of waste water during the process of filtration..

For purpose of ensuring the target of zero waste, the inventor developed a new invention WT WO2022132028 which has a more efficient pump as compared with that in WO2016175703, and has an additional emergency stoppage device for cutting off the water supply to the system in the case of over usage, to supplement the AST for ensuring a zero waste.

All the inventions are green inventions meant for saving in the usage of pipeline water, as well as saving of electrical energy.

0005 A GRO with two tanks

None of the RO filters in the market consists of two water tanks like in the case of GRO. The GRO comprises of one independent atmospheric waste

water tank WT for storing the waste water, and a second tank, an independent atmospheric filtered water tank AST for storing filtered water, both do not need electricity to function; the WT allows usage of waste water, and it has a pumping gadget and an emergency stoppage device for cutting off of the water supply in the case of over usage; the AST has a device for triggering the opening and closing of the valve abruptly, and the device control the water supply to the RO filter and cut down on wastage, and allows dispensing of the filtered water stored. The two tanks in the GRO , together with the twin inlets sink faucet and filtration system, working in combination will have the result of a zero waste, meaning a zero discharge of waste water into the drainage before usage, during the filtration process of filtered water using a GRO. 'before usage' means, the waste water is used first and then discharged into drainage thereafter, which helps to reduce the consumption of the pipeline water. That means the consumption of the pipeline water will be reduced by the amount equivalent to the amount of waste water stored and utilized, singly or in combination with the pipeline water, and when used, it is then discharged into the drainage of the sink faucet.

Despite having two tanks , the overall size of a GRO remains compact and aesthetically acceptable as described later.

0006 **Field of application of GRO**

The GRO is mainly for residential usage, and for any other buildings like offices and factory premises with sink faucets; basically same as the field where the traditional RO filters is suitable for.

0007 **Long-felt need in the industry in the usage of RO filter**

The traditional RO filter with pressure tank has been in the market since many decades ago, and the technology involved, other than the advancements in filtration membranes technology, has remained the same till today. There is a long-felt need in the industry to have the amount of waste water cut down for saving on usage of pipeline water in the use of a RO filters. The GRO will be able to solve the issue faced in the industry that is, cutting down the amount of waste water produced during the production process. The GRO not only can cut down but can eliminate the discharge of waste water, meaning there is no waste water being

discharged into the drainage before usage, during the filtration process as described below.

IV Disclosure

Meaning of technical terms and phrases used in the context of the present application:

0008 **'valve box compartment'**

It is a compartment on top of the AST which includes space required for the opening and closing mechanism, a new seesaw like structure, of the feed water supply as well as the space required for the float to operate; it is the only area exposed to atmosphere, with the rest of the top area of the AST covered, the compartment protrudes above the top of the AST (Fig 1, Fig 3)

0009 **'new seesaw like structure'**

The name is borrowed for resemblance of movement of the device in operation; it consists of a closed ends round tube of selected size and material, with a semicircular valve fixed underneath, supported by a shaft from underneath and fixed to two ball bearings at both ends embedded in the walls of the compartment, and has a single lead ball bearing rolling freely in it which will tilt the round tube when rolling from one end to the other in consequence of the rotational movement initiated by, and inclusive of, the float, which will ensure that the opening and closing of the semicircular valve will be abruptly; the semicircular valve with a valve block is part of the seesaw like structure. The word 'new' is added to distinguish it from the old design in WO2019143290 (Fig 2, ref 4,5, Fig 3 ref 8,9,10,11,12).

0010 **'semicircular valve and valve block'**

It is a valve in semicircular shape of selected materials fixed to the underneath of the round tube at two points symmetrically to the supporting shaft, the two points are spaced at selected diameter of the semicircle, the lower part of the semicircle is encased in a valve block and free sliding with minimum resistance, clockwise and anticlockwise, the body of the valve is in round shape and with a hole at the center of the semicircle, looking from an elevation view, which aligns with the incoming and outgoing water tubing encased in the valve block for opening of the valve, and when not in alignment is for closing of the valve (Fig 2).

0011 **'pumping gadget'**

A mechanical device for purpose of pumping the waste water to the sink faucet combined with the pipeline water for usage, consisting of one driving wheel (Fig 6, 14) and one delivering wheel (Fig 6, 15) connected with a shaft rigidly, at the ends of the shaft before the connection to the flywheels there is a ball bearing on each ends (Fig 6, 16), with the inner rim of the ball bearing fixed to the shaft and the outer rim fixed to the casing enclosure, which enable the flywheels to rotate freely as one, both the driving wheel and delivering wheel have fins at the perimeters, the driving wheel has smaller fins for receiving the energy from the feed water and the delivering wheel has bigger size fins to deliver the water to the sink faucet; it has a flow control section which will stop the waste water from flowing when the sink faucet is closed; the whole device is enclosed with the flywheels rolling freely in response to the driving energy of the feed water, all as described herein (Fig 6, Fig 7 and Fig 8).

0012 **'emergency stoppage device'**

It is a device built on top of the WT in square shape on plan view with a mechanical valve for opening and closing of the pipeline water supply, the device will always be in standby mode and will activate when the WT is full and will deactivate when the water level in the WT is lowered when waste water is utilized. The device has a weighted float with specific gravity of less than one to make it functional. The weighted float has lead weight added in a casing (Fig 9 ref 24 and Fig 10).

0013 **'twin inlet sink faucet'**

The term is used to denote a standard component of the GRO; the faucet has two inlets, one for waste water inlet from the WT and second for waste water combined with pipeline water, both waters will be available for usage separately through the twin inlet sink faucet; the term 'twin inlet sink faucet' shall also be used to denote a sink faucet with hot water supply where there will be a third inlet for the hot water input.

0014 **Structural Components of a GRO**

The GRO comprises the following structural components:

- 1 a base structure including provision of supporting frame and space to accommodate the AST and the WT, inclusive of the filtration system.
- 2 one independent atmospheric filtered water tank AST adopted and incorporated with improvements;

3 one independent atmospheric waste water tank WT adopted and incorporated with improvements;

4 twin inlets sink faucet

0015 1 **Base structure of a GRO**

The supporting structure of a GRO has a set of circular water compartments with a top cover with multiple mini holes for water entries into the pre-filters and the RO tube evenly. The supporting structure includes the spaces for the AST (Fig 1, ref 3) and the WT (Fig 1, ref 1), the structural components can be merged into one compact unit. The GRO can be placed on counter top or any other flat surface, or suspended on the wall, within the vicinity of a sink.

The pre-filters are installed vertically on the circular water compartments and the feed water will be filtering upward until near the top, and down from the top, due to water pressure and gravity, through the non-porous center tube and out to the next pre-filter or RO tube.

The RO tube is also installed on the circular water compartment vertically. The partially filtered water from the pre-filters will be filtering upward from the base and then through the center perforated tube flow downward due to gravity and pressure and out to the AST of the GRO. The flow restrictor is at the top end on the outside of the casing of the RO tube, and the waste water is discharged into the WT of the GRO.

The filtration materials and RO membrane are of no difference from that available in the open market, and the same for the materials to be used in the construction of the GRO

0016 2 **Independent atmospheric filtered water tank AST WO2019143290 adopted and incorporated as part of a GRO**

0017 2a **Valve box compartment on top of the AST of a GRO**

(Fig 1) shows the plan view of the GRO including the valve box compartment on top of the AST. The boundary of the valve box compartment protrude beyond the top of the AST, the rest of the top is covered with the valve box compartment standing upright vertically (Fig 3). The valve box compartment includes space required for the float to function and also the space required by the closing and opening mechanism of the new seesaw like structure in the valve box compartment to operate.

The volume of water involved in the activation of the opening and closing of the valve will be limited to this area when the AST is approaching full which increases the sensitivity of the semicircular valve. This is the only area exposed to the atmosphere (Fig 3).

Inside of it is a set of mechanism, a new seesaw like structure consisting of a round tube with both ends closed and with a single ball bearing rolling freely in it, and a semicircular valve fixed to the underneath symmetrically to the supporting shaft, and plus an off center suspended float (Fig 2, ref 4, 5 and 6, Fig 3 ref 8,9,10, 11, and 12); this is to replace the seesaw like structure in the prior art AST; the new seesaw like structure will be able to perform the same functions better than that of the old design as the free rolling lead ball is within the round tube and is much more sensitive.

0018 2b **Improvements on valve of the prior art AST of a GRO**

The valve as in the said prior art AST will be replaced with a semi-circular valve encased in a valve block as part of the new seesaw like structure(Fig 2, ref 7, Fig 3 ref 11). The semi-circular valve is fixed to the bottom part underneath the round tube symmetrically to the pivoting shaft. The semicircular valve will have two fixing points under the round tube. The two fixing points will have the effect that when one side is pushing, the other side will be pulling and vice versa. The pushing and pulling forces will be tangential to the circumference of the semicircle. The rotating force from the float (Fig 3 ref 9) will be acting equally on the two fixing points. Diameter of the semicircular valve will be determined basing on testing. The semicircular valve shares the same pivoting shaft of the round tube as described above, so that the resistance force from the movement initiated by the float will be reduced substantially as there will not be any off center pushing and pulling forces, which is the main concern of the old design, when the semicircular valve rotates following the circumference of the circle about the same pivoting shaft as that of the round tube.

The length and diameter of the round tube, which determines the size of the single lead ball bearing, will be determined basing on testing. The 'sudden drop' at the end of the track as in the prior art AST is not adopted. The GRO is recommended to be installed at level above the twin inlets sink faucet. But the delaying effect for the opening and closing of the valve by the single protrusion of the float side and twin protrusion of the valve box

side has been adopted (Fig 4 and Fig 5 ref 13, Fig 3, ref 8). The delaying effect is required for ensuring the valve opens and closes abruptly the water supply, to the filtration system for reducing waste water.

0019 2c **Operation of the opening and closing mechanism of a GRO**

The round tube of a new seesaw like structure is supported by a shaft underneath the round tube, spanning across the width of the valve box compartment, and is further supported by two ball bearings embedded in the walls on two sides of the valve box compartment, the shaft and the round tube are able to rotate freely as one but within limits set by the mechanism; at the end of the shaft which goes beyond the inner wall is a twin protrusions in the shape of 'V' looking in the direction along the shaft; leaving a small gap, and in continuation, is the shaft on the float side which is supported by a ball bearing embedded in the inner tank wall and the shaft extend beyond the ball bearing into the space of the water for a short length and turns ninety degree, and at the end of the ninety degree turn is the off center suspended float; the float side shaft has a single protrusion in the shape of an inverted 'L' at the end abutting but not in contact with the valve box side shaft; the base of the inverted 'L', overlaps the 'V' shape protrusion so that the float side shaft is able to rotate freely following the movement of the float but only within the ambit of the 'V' shape protrusion, beyond which, will cause the round tube to rotate and cause the single ball bearing to roll to the opposite side for opening or closing of the valve abruptly (Fig 4 and Fig 5 ref 13, Fig 3 ref 8).

It is assumed for purpose of illustration that the orientation of the mechanism is set at, clockwise is for opening of the valve. With the AST fully filled up, when the filtered water is dispensed and the float will cause the water level goes down, and rotate the shaft's single protrusion clockwise, this initially will not be in contact with the twin protrusion (Fig 4 and Fig 5 ref 13); and when there is further dispensing, the single protrusion will push one of the twin protrusion and rotate the round tube causing the single lead ball bearing in it to roll to the opposite side and open the semicircular valve abruptly. With the amount of water limited to the valve box compartment area, the GRO will be able to activate the water supply and start the filtration system with just about one cup of filtered water dispensed when the AST is filled up.

When the amount of filtered water dispensed is more and the water level goes further down, the float will be suspending in the air while the dispensing continues with the filtration system in operation and the replenishing progressing non-stop, subject only to the activation of the emergency stoppage device when the WT is full. When the dispensing of the filtered water stops and when the water level goes up and reaches the float, initially, there will not be any movement on the round tube. The shaft with the single protrusion on the float side will rotate in the anti clockwise reverse direction and the single protrusion will not be in contact with the twin protrusions initially. When the water level goes up further and when the single protrusion of the float side pushes the reverse side of the twin protrusion causing the closed ends round tube to rotate and resulting in the single ball bearing rolling back to the opposite end and closes the valve abruptly. This describes the operation of the mechanism when the level of the AST is near full.

But the closing and opening of the semicircular valve can happen only in this range of the water levels within the confined area of the valve box compartment. Water level further down will never close the valve. Once opened, and with water level goes down due to further dispensing, the semicircular valve will remain in openrd position, which means the filtration system of the GRO will be at work constantly. And the filtration system will continue to process the filtered water non-stop except when the emergency stoppage device is activated, which can be deactivated in seconds, and the filtration process continues once the device is deactivated.

The GRO has a filtration system that will work regardless of the water levels once it goes below valve box compartment level subject only to the activation of the emergency stoppage device of the WT. The GRO can operate non-stop without costs as it functions on the energy from the pipeline and the water level in the AST, other than minimal maintenance cost.

0020 2d **Off center suspension of float of a GRO**

The float of the GRO will have a size to match the said valve box compartment confined area. The upward floating force will be achieved by extending the dimension of the float towards the pivoting shaft, and

beyond if necessary, and downward until required volume is reached and upward lifting force is available. The length of the float lever arm will have to be reduced. The downward force will be available by adding lead weight in the float (Archimedes Principle). Lead weight is added to the bottom of the float with amount gradually increased towards the suspension point of the float, for shifting of the center of gravity of the whole float off the center point and towards the suspension point until in alignment with the suspension point of the float. The float will be in balance position when the suspension point is directly above the center of gravity of the float in all direction. This will allow the float to have sufficient floating power as well as the downward force, and hung up in a balance position. The amount of the lead weight added in the casing enclosure will give the float a specific gravity of less than one.

0021 2e **Inherent advantages of prior art AST available with GRO**

In utilizing parts of the prior art AST, the inherent advantages of the said invention will be available with the GRO as in 0022 to 0025 with improvements.

0022 2ei **Shorter Cycle time**

Cycle time as defined in the prior art is the time period during which the filtration system rests. The GRO will have shorter cycle time if the filtered water consumed is within the boundary limit of the valve box compartment portion and when the AST is full. The filtration system will close as soon as the amount dispensed is replenished, which means shorter cycle time, as compared with that of the traditional pressure tank system.

The GRO system is different from the traditional RO system in that, once the valve is opened, it remains opened and the filtration system works non-stop, subject only to the activation of the emergency stoppage device, which as mentioned, can be deactivated in seconds.

0023 2eii **Constant filtration speed and efficiency**

The GRO will maintain the same filtration speed and efficiency as it is working on pipeline pressure, the pipeline pressure is the same most of the times with minor variation occasionally, the filtration speed and efficiency will be at the optimum most of the times, matched to the water pressure of the pipeline the GRO is connected to.

0024 2eiv **No post filter required**

There should not be any smell or taste issue as the GRO adopt an AST which is an atmospheric tank and there is no butyl rubber bag in it. The post filter can be done without.

0025 2ev **No robust structural components required**

The two atmospheric tanks in the GRO system is designed as a normal water tank as they are exposed to atmosphere. And the pre-filters and RO tube casings are only subjected to pipeline pressure and it is not subjected to increase in pressure due to the presence of an electric pump.

The GRO has a smaller size structural component as compared to a traditional RO system. The said pre-filter and RO tube casings are designed to take pipeline pressure up to a limit of 35 PSI. For higher pipeline pressure, the GRO would require a flow restrictor to lower the pipeline pressure, or a set of new models have to be formed for higher range of pipeline pressure.

0026 3 **Independent atmospheric waste water tank prior art WT , WO2022132028 adopted and incorporated as part of GRO**

It is the intention of the inventor at the design stage of the WT to supplement the AST with a more efficient system for salvaging and storing of waste water produced during the filtration process of a RO filter. In the application PCT/SG2020/050747, the term 'AST RO system' was used, it was meant for a RO system adopting the AST. The name has been changed now to 'GRO' due to the additional features and concept added on.

The GRO has adopted and incorporated parts of the concept of the invention WT, with improvements, which has a more efficient pump than that in the invention in WO2016175703, and has an additional emergency stoppage device for cutting off the water supply in the case of over usage. The requirements on contingency allowance on the volume of WT in the design stage, as in the WT invention, is no more the guideline and is not adopted as the WT in the GRO allows usage of waste water constantly continually. The provision for installation of WT on existing traditional RO filter in the said WT invention will also not be required as the GRO is a complete RO filter.

The parts of the application pertaining to pumping gadget have been adopted and incorporated with improvements.

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The invention WO2022132028 was found to be novel but lack inventive steps by the examiner of ISA AT. It is the opinion of the applicant that the examiner had erred in the finding fundamentally and had raised objections to it in the form of an informal comments published on Patentscope 15/07/2022. Clauses 0038 to 0042 of WO2022132028 are incorporated below as in 0027 to 0031 of the GRO with improvements.

0027 3a **Details of pumping gadget of a GRO**

The pumping gadget (Fig 6) with dimension to suit requirement, has two miniature flywheels of the same diameter which can be varied if necessary, one driving wheel (Fig 6 ref 14,) and the other delivering wheel (Fig 6 ref 15,) , and they are connected by a common axle rigidly (Fig 6, ref 17), meaning they will rotate as one and will rotate concurrently at the same speed when force is applied to the driving wheel. The driving wheel will be driven by the pipeline flowing water and the delivering wheel will drive and deliver the waste water; rotating at the same speed in the same direction, one is action and the latter is reaction, the resisting force. On the perimeter of the flywheels are fins with size to match the flow; on the sides of the flywheels are two covering plates which are fixed to the sides of the fins. The plates are separated from the surface of the casing to prevent friction and they rotate together with the flywheels. Both are encased in casing including the axle. The axle is fixed to the inner rim of ball bearings (Fig 6 ref 16) near the end before connection to the flywheels, and the outer rims of the ball bearings fixed to the casing. Fixed to the ends of the axle are driving wheel and delivering wheel which can spin freely almost without friction, other than the viscosity of water, with the axle concurrently at the same speed. The axle is to connect the driving wheel and the delivering wheel as one moving part and at the same time keeping the pipeline water and the waste water apart, as the driving wheel will have the flowing water from the pipeline and the delivering side wheel will be driving the waste water from the WT. The fins on the perimeters will be slightly curved, the driving wheel fins receive the dynamic pressure/kinetic energy from the pipeline flowing water with the concave face, for better energy transfer, and the delivering wheel fins drives the waste water with the convex face for better centrifugal force and better discharge of waste water. The two flywheels are acting as one with the driving wheel receives the kinetic

energy on the concave side and the delivering wheel with the kinetic energy received drive the waste water on the convex side. The pumping gadget is fixed to the bottom of the WT with the driving wheel on top and the delivering wheel at the bottom; the pipeline water will be connected to inlet at (Fig 7 ref 19), and waste water inlet will be at the entry point at (Fig 6 ref 18), and the outlet of the two waters after combining at the junction (Fig 6 ref 20) will be discharged out of the faucet (Fig 6 ref 21) when the twin inlet sink faucet is turned on. At the waste water inlet is a flow control section. The flow control section has a curved waste water inlet cover, convex to the waste water side, with a hole at the center for waste water entry; and at the opposite end of the section is a curved barrier, concave to the waste water entry, with multiple mini-holes at the parameter of the barrier for passage of waste water entry when the flow control section is opened. Inside the flow control section is a ball check valve, a mini ball of specific gravity of one, which will plug up the center hole of the entry cover for stopping the waste water from entering when the twin inlets sink faucet is closed, and will be forced to the center of the barrier, due to the curvature, when the flow control section is opened following the opening of the twin inlet sink faucet and waste water flowing through the center hole of the cover and through the multiple mini holes of the barrier.

0028 3b Pressures the pumping gadget of GRO is subjected to when installed

When the installation is complete, the system will be subjected to pipeline static pressure and remain stationary when the twin inlet sink faucet is at close. As static pressure is equal in all directions, the flow control at (Fig 6, ref 18) will be blocked as one side is the pipeline pressure which will be invariably higher than the opposite side which is the pressure caused by the weight of the waste water in the WT. Other than pipeline pressure, the system is also exposed to atmospheric pressure on the WT, but it will be off-set by the same atmospheric pressure at the outlet of the faucet when the faucet is turned on, so it is not considered. Loss of energy due to friction and design of pumping gadget and transformation into sound, heat and vibration are not considered as they are considered negligible in the present context, and with frictional factor as the main consideration in the

design. The ball bearings installed on the axle and with the outer rim fixed to the casing which allows free spinning of the flywheels, and the fact that the moving parts will not be in contact with the stationary parts as described above, the loss due to friction will be down to minimum.

0029 3c **Operation of the pumping gadget of a GRO**

When the twin inlets sink faucet is turned on, there will be a sudden drop in the static pressure coupled with a sudden increase in the dynamic pressure/kinetic energy and water starts to flow; when entering the driving wheel, the kinetic energy turns into rotational kinetic energy, and through the axle, it drives the delivering wheel concurrently, and the delivering wheel starts to pump the waste water simultaneously with the release of the ball valve, and the water flows towards junction point (Fig 6, ref 20); the rotational kinetic energy of the pipeline flowing water, no doubt it is flowing in the driving wheel, is in effect driving the delivering wheel through the rotating axle and hence the waste water, which is the result of energy transfer. The transfer will render the kinetic energy in the pipeline flowing water in the driving wheel to reduce all the way to the junction point where it combines with the waste water to flow out of the pumping gadget to the outlet of the faucet. Simultaneously, the release of the ball check valve will be assisted by the said reduction in static pressure and also the gravitational energy of waste water from the WT, which also assists in the driving of the waste water. But, when the WT is empty, the pressure of the pipeline water will force the ball check valve to plug up the entry point of the WT when the twin inlet sink faucet is turned on as the WT side is subjected to only atmosphere.

0030 3d **Transfer of energy in a GRO from driving wheel to delivering wheel**

The transfer of the kinetic energy from the driving wheel to the delivering wheel depends on the resistance from the delivering wheel. The driving wheel is driven by the pipeline flowing water, the only source of kinetic energy before considering the gravitational kinetic energy from the flowing water from the WT. The delivering wheel drives the waste water. When the WT is empty there is minimum resistance and the driving wheel and delivering will rotate at maximum speed which is set by the kinetic energy transformed from the static pressure of the pipeline water and the reduction in diameter of the incoming tubing, the smaller the diameter of

incoming tubing the faster will be the speed of flow of the pipeline water (Bernoulli Theorem). When there is water in the WT, the surface area of the fins of the delivering wheel which will be in contact with the waste water will be the main factor in determining the resistance which is the reaction to the driving wheel's action. But when the resistance/reaction is lower than the action and the flywheels rotate with the balanced energy. The bigger the surface area, the higher will be the resistance and the amount of energy transferred. The surface area of the fins of the delivering wheel will set the speed at which the two flywheels rotate. Whatever speed envisaged of the water flow, with a fixed pipeline pressure and tubing size, the driving wheel will be slowed down if the surface area of the delivering wheel fins is bigger than that of the driving wheel, which in effect increases the transfer of energy. The higher the energy transfer, the higher will be the amount of waste water driven out coupled with a corresponding reduction of pipeline water content in the outflow at the faucet, and the total combined amount remains the same as the energy available in the system remains the same (Law of Conservation of Energy), before considering the gravitation kinetic energy from the flow of waste water from the WT which is a plus. The pumping gadget will be able to pump the waste water with substantially the same energy available from the pipeline water source without significant losses; the gravitational kinetic energy from the waste water itself will be a plus to the driving energy. With the bigger size fins on the delivering wheel which increases the energy transfer will give rise to an outflow having higher content of the waste water as compared to a case with fins of same size on both driving and delivering wheels.

0031 3e Dimension of pumping gadget of GTO

The size of the tubing from the pipeline will be from 2 mm to 6 mm diameter at the entry point, the fins on the driving wheel will be to match the entry tubing, and the fins of the delivering wheel will be 6mm to 12 mm (width and height or circular) and the diameter of the outflow of the delivering wheel to match, the diameter of the flywheel will be to suit the size of the WT and it will be between 20 mm to 80 mm. The spacing between fins will follow the area of the fins generally. The fins might be curved a little for better transfer of energy. The length of the axle will be no more than 85 mm. Thickness of material will depend on the strength of materials used. But the dimensions of the pumping gadget in general are

flexible to suit function and purpose of the pumping gadget which may include application where bigger size pumping gadget may be required. The pumping gadget will be able to pump the waste water to the faucet for usage as and when the twin inlet sink faucet is turned on.

0032 3f **Usage of waste water through the twin inlet sink faucet of a GRO**

The waste water is in fact cleaner than the pipeline feed water the GRO is connected to as it has passed through the pre-filter with most of the TSS removed and with slightly higher TDS. It is more suitable for consumption in terms of hygiene. The usage of waste water will allow the physical volume of the WT to reduce substantially. Continual usage of the twin inlets sink faucet will easily exceed the volume of the WT, or leaving the WT partially filled most of the time. This will also increase the capacity of the AST as it can be allowed to work almost non-stop. No high cost will be incurred other than maintenance, as the GRO functions on water level in the AST and makes use of existing pipeline energy without utilizing electricity. The on demand dispensing of the AST will be more freely with the WT vacated continually which allows the filtration system to work almost non-stop. This effectively also enhances the GRO's level of services to a level much higher than its compact size indicates.

There is also a faucet underneath the WT for direct dispensing which also vacate the space of the WT as and when required.

0033 3g **Emergency stoppage device of GRO**

The design of the emergency stoppage device will be improved as per (Fig 9). Other than changing it from circular to square shape from a plan view, the changes mainly involves shifting of the connection points for the incoming and outgoing water tubing to inside of the enclosure as shown. So, any seepage or leakage will be contained within the WT. The provision for discharge for any malfunctioning of the equipment is also shifted to inside the enclosure as shown (Fig 9 ref 26). The emergency stoppage device will be at standby position for immediate activation automatically as and when the WT is full. The relevant clauses of the prior art WT are herewith incorporated. Clauses 0045 and 0046 of prior art WT are incorporated as in 0034 and 0036 of the GRO application with improvements.

0034 3h **Details of emergency stoppage device of GRO**

Right at the top of the GRO on the WT part is a small square enclosure standing vertically upright (Fig 9, and Fig 10). Within the square enclosure, with dimension to suit requirement, at the bottom of the enclosure is a weighted float. Inside the top of the weighted float is a miniature gate valve encased within a block (Fig 9, ref 22) that moves upward and downward following the movement of the weighted float. The water supply line to the filtration system passes through the block (Fig 9, and Fig 10) and within the cover (Fig 9, ref 26) is drainage for equipment failure. The miniature gate valve stands vertically upright and is set at open position when it is installed, the weighted float rest on supports from the perimeter of the enclosure at the bottom most. When the WT is full, any further filtration will force the waste water to flow through the enclosure, and the up-thrust will push the weighted float upward and close the water supply to the GRO filtration system and thereby stopping the filtration process. It happens automatically. The specific gravity of the weighted float is less than one. The movement will be only few millimeters which is the size of the incoming and outgoing water tubing.

0035 3i **Course of action when the emergency device of a GRO is activated**

Course of action for reviving the filtration system after the emergency stoppage is activated will be usage of water from WT until the water level drops together with the weighted float and the gate valve returns to open position with the weighted float back seated on the supports. It should take only seconds before the valve returns to open position as the volume of the extension is small. Further usage of the twin inlets sink faucet will put the system back to normal operation. Any seepage from the valve will be drained into the WT which will be salvaged for usage.

0036 3j **Low frictional resistance of the emergency stoppage device of a GRO**

The up and down movements of the emergency stoppage device will now be free from any frictional forces other than the center pole which controls the opening and closing of the valve. The center pole is guided on verticality by the block where the incoming and outgoing tubing meet (Fig 9 and Fig 10). The friction involved is low due to the small size of the center pole.

0037 4 **Twin inlets sink faucet of a GRO**

The twin inlets sink faucet is a standard component of the GRO. One inlet of the twin inlets is connection to waste water from the WT and the second one is for the pipeline water from the pumping gadget combining with waste water.

The twin inlets sink faucet will be set at such that whenever the faucet is turned on, the waste water from the WT will be consumed first as a set priority, and second position then is the pipeline water combined with waste water, controlled by one handle. The switch from one water to the other is in one direction. This priority is in addition to the two ways the waste water can be utilized, i.e. direct dispensing through the faucet under the WT, and through the twin inlet sink faucet, all in all three ways.

With this set priority in the usage of the twin inlet sink faucet, the physical size of the WT seems less important since a one minute usage of the twin inlet sink faucet will easily consume about one liter or more of the waste water. In the event that hot water supply is required, the twin inlet faucet will have an additional inlet for hot water and it will be controlled by an additional handle on the opposite side of the first handle,

Although usage of sink faucet is unpredictable in frequency, continual usage of sink faucet is unavoidable so long as there are residents or occupiers in the premises. The capacity of the WT, and therefore the GRO, effectively in reality is much bigger than its physical volume.

0038 **Water passage of pipeline feed water in a GRO**

The connection for the feed water from the water pipeline will pass through the emergency stoppage device of the WT first, and then to the valve of the valve box compartment of the AST, and from the valve box compartment out to the RO filtration unit, and from the RO filtration system discharge into the filtered water tank and the waste water tank. The whole system will be subjected to two opening and closing of water supply in the usage of the GRO, one, the emergency stoppage device in the WT and second, the valve in the valve box compartment of the AST, both cutting off devices function automatically and independently. Whenever any of the two cutting off device is activated, the GRO cease operation. There is one other connection from the water pipeline, which is required for the sink faucet originally, but now directly to the inlet of the mechanical pumping gadget in the WT, and from the outlet of the pumping gadget to the twin inlet sink

faucet; the diversion is for the driving energy required by the pumping gadget for pumping of the waste water.

0039 Cutting off of the water supply to a GRO

The two tanks of the GRO, together with the twin inlets sink faucet, the filtration system and the float, work in combination for ensuring zero waste. There are three possible scenarios that may happen during the usage of the GRO in regards to the cutting off of water supply.

Scenario 1--Both the cutting off devices do not or seldom activate.

This is the best situation, the user just continues to use the GRO filter and enjoy the benefits of having a zero waste without the need of electricity.

No action is required.

Scenario 2--The AST valve cut off the water supply. This is also just as good as the above scenario; it indicates the on demand supply on the filtered water produced by the AST is sufficient. It means the estimate of the on demand need for filtered water is accurate. No action is required.

Scenario 3--The emergency stoppage device of WT is activated.

It indicates the consumption of filtered water is more than expected, and or the usage of sink faucet is less than expected, the volume of WT should be increased to accommodate the filtration process if the activation was too frequent. Otherwise, continual usage of the sink faucet will revive the system.

The decision on the sizes of the two tanks is not a rigid requirement on the user as it all depends on the pattern of usage. And In all the scenarios mentioned above, the cutting off of the water supply functions automatically without the need for care on the part of the user, and zero waste is ensured without the need of electricity.

0040 Setting up of a GRO

The size of the WT will not be determined basing on 1:4 as in the WO2022132028. the emergency stoppage device is envisaged to activate first on setting up. The volume of WT is under provided for. When the feed water is turned on, with the valve of the emergency stoppage device of the WT and the valve in the valve box compartment of the AST in opened position, and the filtration system starts to function. Before the AST is filled up to full, the WT will be filled up first and the emergency stoppage device

will activate and cut off the pipeline feed water leaving the AST partially filled and the valve of the valve box compartment in opened position. The GRO is ready to function as soon as there is sufficient filtered water in the AST for dispensing, and the waste water will be utilized and the space of the WT vacated as and when the twin inlet sink faucet is turned on. When the WT is full and with the emergency stoppage device activated, the filtration system will be revived as soon as the usage of waste water lower the water level in the WT and deactivate the emergency stoppage device, which takes only seconds, and with the valve in the valve box compartment in opened position, the filtration system of the GRO will be functioning non-stop.

0041 Combination of AST and WT in a GRO

The GRO will have enhanced level of services which cannot be achieved by the AST or WT individually.

The function of the WT when used in a GRO is no more just for storing as the waste water will be used continually through the twin inlet sink faucet. It is transitional in nature and it allows the filtration system of the GRO to continue functioning non-stop.

The WT of a GRO will allow the waste water produced by the filtration system to be stored and used through the twin inlets sink faucet, it allows the GRO to have in place a flow of activities whereby all the waste water will be salvaged and used continually and thereby achieving zero discharge into the drainage, and with the AST providing on demand dispensing freely, supported by a filtration system that will operate almost non-stop.

In a perfect scenario, the operation of the GRO will remain non-stop in providing filtered water, and it is always subject to the scenarios mentioned in 0039 above.

0042 Compact design of a GRO

The GRO, despite having two tanks, remains compact and in reasonable size due to the following reasons:

- 0043 a The GRO does not have a butyl rubber bag in it which takes up about 50 % of the space of the pressure tank. The AST of the GRO is about half the size of an ordinary pressure tank in a traditional RO system, and is rectangular rather than round.

0044 b The GRO has a twin inlet sink faucet which is set at, as a standard priority mode, where each time the sink faucet is turned on the waste water is consumed first. This will continually vacate the space of the WT and render a small size WT feasible in usage.

0045 c The filtration system of the GRO functions on the same optimum filtration speed and efficiency most of the times, matched to the pressure of the pipeline the GRO is connected to.
Thus, the combined size of the structural elements of a GRO remains aesthetically acceptable, and being all in rectangular shapes, other than the filtration casings, which can be arranged in a row, can be merged into a compact unit.

0046 **Summary of application**

Upon completion of setting up, without using electricity, the GRO is able to filter the pipeline feed water and separate into filtered water and waste water by utilizing the reverse osmosis technology; the filtered water stored in the AST for dispensing, and the waste water stored in the WT for usage, whether singly or combined with pipeline water, thereby achieving a zero discharge of waste water into the drainage during the filtration process, achieving the purpose of a RO water filter.

The long felt need in the industry in the use of RO filter is cleared and zero waste accomplished; in other words, saving on usage of pipeline water is accomplished in the amount stored and utilized.

Notes on drawings included

- 1 All drawings are schematic drawings for illustration purpose and are not drawn to scale.
- 2 Figure 1 illustrates one of the possible configuration of the components of a GRO. (There can be more than one configuration)
- 3 Figure 2 is part of the new seesaw like structure
- 4 Figure 3 is cross section A-A showing the valve box compartment and the linkage between the components.
- 5 Figures 4 and 5 shows the 'L' and the 'V' protrusions of the new seesaw like structure
- 6 Figure 6, 7, 8 show the details of the pumping gadget
- 7 Figure 9 shows the details of the emergency stoppage device.

8 Figure 10 is the cross sectional plan view of the emergency stoppage e device.

Claims

Claim 1 The Green Reverse Osmosis Water Filter (named GRO) is a water filter making use of the reverse osmosis technology, without using electricity, for filtering pipeline feed water to produce filtered water and waste water concurrently; the GRO adopts and combines parts of prior arts AST and WT, with improvements and additional features, to form a reverse osmosis water filter and is characterized by the following, whether individually or in whole, or in combination of parts thereof, comprising:

wherein, the GRO has a structure of selected size and selected materials, is characterized by having two tanks, one independent atmospheric tank for storing filtered water and one independent atmospheric tank for storing waste water, produced by the filtration system ; and is further characterized in having a set of circular water compartments built on the structure to receive the pre-filters and RO tube casings with cartridges, inclusive of the casings and cartridges;

wherein, the filtered water tank AST of the GRO , of selected size and shape and selected material, is characterized by having a valve box compartment on top of it, which valve box compartment includes space required for the operation of the new seesaw like structure comprising a closed ends round tube with the semicircular valve fixed underneath symmetrically, and the off center suspended float in the water area of the AST linked by two rotating shafts;

wherein, the waste water tank WT of the GRO, of selected size and material, is characterized in that, it has a emergency stoppage device which stands upright above the top of the WT, and a mechanical pumping gadget fixed to the bottom part of the WT;

wherein, the GRO has a twin inlets sink faucet as a standard component; and is characterized in that, one inlet of the twin inlets sink faucet is for connection of waste water from the waste water tank WT and the other is for connection of pipeline water combined with waste water from the pumping gadget; the twin inlets sink faucet has a single handle for opening and closing of the faucet and it is further characterized in that the control is set at such that the waste water will be dispensed first as a priority when the sink faucet is opened, and the second position of the handle is for combination of the waste water and the pipeline water from the pumping gadget; and when hot water is required, the faucet will have an additional handle on the opposite side of the first handle to control the hot water input;

Upon completion of setting up, the GRO, without using electricity, will be able to filter the pipeline feed water and separate into filtered water, stored in the AST, and waste water, stored in the WT; the AST allows dispensing of filtered water and the WT allows usage of waste water through the twin inlet sink faucet, achieving a zero discharge of waste water into the drainage before usage, and at the same instance accomplishing a saving on the consumption of pipeline water in the amount stored and utilized.

Claim 2 The components of the GRO described in Claim 1 will have two connections from the water pipeline and is characterized in that, one connection will be from the pipeline to the emergency stoppage device of the WT, and from the WT out to the valve of the valve box compartment of the GRO, and from the valve out to the filtration system; from the filtration system, the filtered water to the AST, and waste water to the WT; the second connection is from the pipeline to the inlet of the pumping gadget, and from the outlet of the pumping gadget to the twin inlet sink facet for usage; and a further connection from the WT to the twin inlet sink faucet utilized as a priority mode; for

hot water supply, it will be from the water heater to the third inlet of the triple inlet sink faucet.

Claim 3 The GRO cited in claim 1 has a setting up procedure characterized in that the GRO, with the water supply turned on, will be considered ready for usage when it is partially filled up and where dispensing is possible; regardless of whether the WT is full.

Claim 4 The valve box compartment of the GRO cited in claim 1 is characterized in that it has a set of mechanism, a new seesaw like structure, built of selected material and in selected size, as appended below, further comprising:

Wherein, a closed ends round tube with a free rolling single ball bearing in it, the round tube is supported by a shaft underneath the round tube, spanning across the width of the valve box compartment, which is further supported by two ball bearings embedded in the walls on two sides of the valve box compartment, the shaft and the round tube are able to rotate freely as one; at the end of the shaft which goes beyond the inner wall is a twin protrusions in the shape of 'V', looking in the direction along the shaft; leaving a small gap, and in continuation, is the shaft on the float side which is supported by a ball bearing embedded in the inner tank wall and the shaft extend beyond the ball bearing into the space of the water for a short length and turns ninety degree, and at the end of the ninety degree turn is the off center suspended float; the float side shaft has a single protrusion in the shape of an inverted 'L' at the end abutting but not in contact with the 'V' shape protrusion; the base of the inverted 'L', overlaps the 'V' shape protrusion so that the float side shaft is able to rotate freely following the movement of the off center suspended float but only within the ambit of the 'V' shape protrusion, beyond which, will cause the round tube to rotate and cause the single ball bearing to roll to the opposite side for opening or closing of the valve abruptly;

Wherein, a semicircular valve fixed underneath the round tube symmetrical to the pivoting shaft; the lower part of the semicircular valve is encased in a valve block, the semicircular valve will be able to slide clockwise and anticlockwise freely without much friction, at the center of the semicircular valve is a hole which aligns with the incoming and outgoing tubing of the feed water for opening of the valve, when the round tube rotates causing the hole and the tubing to be not in alignment, the valve is closed; the rotation of the round tube is caused by the movement of the float, which functions automatically according to the water level in the filtered water tank; the closing and opening of the semicircular valve happens only when the water level is within the limit of the valve box compartment, and for water level further down, the semicircular valve will always be in opened position.

Claim 5 The independent atmospheric waste water tank of the GRO cited in claim 1 is characterized by having a pumping gadget fixed at the bottom and an emergency stoppage device on top of it; the pumping gadget is able to pump the waste water combining with pipeline water to the twin inlet sink faucet for usage; the emergency stoppage device will activate when the waste water tank is full, thereby closing the valve of the device which effectively stopping the feed water supply from the pipeline and concurrently stopping the GRO from functioning; when the usage of the sink faucet is continued and the water level is lowered, the GRO will be revived; the emergency stoppage device functions automatically.

Claim 6 The float of the GRO cited in claim 1 is characterized in that it has an off center suspension point to accommodate the confined space of the valve box compartment, and achieving balance of the float by having lead weight added to the bottom of the casing unevenly and gradually more towards the suspension point, thereby shifting the

center of gravity of the whole float to be in line and under the suspension point; the specific gravity of the float will be less than one.

Claim 7 The independent atmospheric filtered water tank and independent atmospheric waste water tank of the GRO cited in claim 1, together with the filtration system and the twin inlet sink faucet, working in combination, is further characterized in that it will give the GRO an enhanced level of services in terms of filtering capacity of the GRO as the filtration system works non-stop from setting up and at an optimum speed matched to the pressure of the pipeline water subject only to two instances, one, when the valve of the valve box compartment is closed when AST is filled up, which indicates demand of filtered water is fulfilled, and can be opened when about a cup of filtered water is dispensed, and second, when the emergency stoppage device is activated which can be revived in seconds when the waste water is utilized through the twin inlets sink faucet or through the direct dispensing faucet underneath the WT, which gives the filtration system of the GRO an almost non-stop filtration; and the on demand dispensing of the AST of the GRO will be achieved without issue when the speed of the filtration is at an optimum, and the space of the WT continually vacated which allow almost non-stop filtration, which effectively means that the AST of the GRO will almost always be filled with filtered water.

Claim 8 The filtration system of the GRO cited in claim1 is further characterized in that it has an almost constant optimum filtration speed matched to the pressure of the water pipeline it is connected to, subject to a maximum pressure of 35 PSI, beyond which, a flow restrictor will be required for lowering the pressure, or a stronger model has to be created.