DEVICE FOR PURIFYING WATER.

The present invention relates to a device for purifying water.

Several devices that allow the purification of water so as to make it drinkable are known. In particular, active carbon filters, through which the water is passed to be purified, are known. In particular, these filters are generally made of carbon, or limestone, or nanostructured materials such as zeolites, or woven or non-woven materials. These solutions are not, however, fully satisfactory as the filters tend to become saturated and lose filtering efficiency over time.

ES 2231310 describes a method and a device for treating water with a magnetic field and in particular teaches how to modify with a magnetic field the clusters present in a flow of water that passes through a tube affected by constrictions and filling glass spheres that generate turbulence in the flow itself. This is a solution that requires electrical energy to generate the magnetic field.

There are also known filters that use light, and in particular ultraviolet radiation, in order to eliminate bacteria and/or microorganisms present in the water. In this type of filter, the water is illuminated directly by ultraviolet light that exerts an antibacterial and/or biocidal action, purifying the water itself. This solution is also not fully satisfactory as it requires the use of ultraviolet light that must be used with caution as it can be harmful to a user, and also involves the consumption of large amounts of energy.

The object of the present invention is to propose a device for purifying water that overcomes the drawbacks of known solutions.

Another object of the invention is to propose a device that is simple and economical to produce.

Another object of the invention is to propose a device that allows the exploitation of sunlight.

Another object of the invention is to propose a device that can function even without external electricity sources.

Another object of the invention is to propose a device that guarantees limited energy consumption.

Another object of the invention is to propose a device that can be used practically anywhere.

Another object of the invention is to propose a device that allows the purification of a constant flow of water.

Another object of the invention is to propose a device that exploits the phenomenon of the decomposition of light into its different colours.

Another object of the invention is to propose a device that allows obtaining drinkable and/or safe water for a consumer.

All these objects, whether considered alone or in any combination thereof, and others which will result from the following description are achieved according to the invention with a device for purifying water as defined in claim 1.

The present invention is further clarified below in some of its preferred forms of practical embodiment, reported for purely exemplifying and non-limiting purposes with reference to the attached drawings, wherein:

Figure 1 shows a perspective view of a device according to the invention with the side wall of the external container made transparent to make the internal components visible,

Figure 2 shows it in the same view without the external container,

Figure 3 shows the upper half of the device illustrated in fig. 2,

Figure 4 shows a perspective view of a single peripheral sphere,

Figure 5 shows a perspective view of a conical winding,

Figure 6 shows a perspective view of a transfer duct,

Figure 7 shows it in a longitudinally sectioned perspective view,

Figure 8 shows the general electrical diagram of the device according to the invention, and

Figure 9 shows a mixed diagram which, like the previous one, highlights the connections between the various windings.

As can be seen in the figures, the present invention concerns a device 1 for purifying water. In particular, it concerns a device for purifying water using the sanitizing properties of light.

Conveniently, below, with purification it is intended any process that allows to improve the properties and/or characteristics, including organoleptic ones, of water. This can happen for example through the removal and/or destruction of bacteria and/or other microorganisms potentially damaging and/or harmful to a person who ingests the water, or also through the removal and/or inertization and/or in any case the chemical and/or physical reaction of ions and/or compounds present within the water itself.

In particular, the device 1 according to the invention is configured to exploit light radiation, and preferably solar radiation, to purify water.

Advantageously, the apparatus 1 comprises a containment casing 2 made, at least partially, of substantially transparent material, in order to allow the penetration inside it of the majority of the incident light radiation. Conveniently, by transparent, it is intended a material configured to allow the passage of at least approximately 90%, and

preferably of at least approximately 95%, of the light radiation in the visible wavelengths.

Advantageously, for this purpose, the casing 2 can be made, at least partially, of glass, or of transparent polymeric compounds, for example plexiglass or polycarbonate.

Preferably, the container 2 can have a substantially cylindrical shape. Conveniently, in this case, at least one of the two bases 4, 4' of the cylindrical container can be made of transparent material, while its side wall 6 can be made of opaque and/or reflective material. For example, the side wall 6 can be made of aluminum.

Conveniently, inside the cylindrical container 2, a set formed by a plurality of spheres, and in particular by a central sphere 10 and eight peripheral spheres 12 externally tangent to the central sphere 10, is placed.

Each peripheral sphere 12 may have a diameter between 1/3 and 2/3 of the diameter of the central sphere 10 and preferably has a diameter equal to 1/2 of the central sphere. For example, the central sphere 10 may have a diameter of approximately 300 mm, while the peripheral spheres 12 may have a diameter of approximately 150 mm. Advantageously, in this way, the overall volume of all the peripheral spheres 12 is substantially equal to that of the central sphere 10.

The central sphere 10 can advantageously be made of two hemispheres that rest on an equatorial disk 13, which extends externally beyond the surface of the sphere 10 until it reaches the internal cylindrical wall of the container 2.

Advantageously, both the central sphere 10 and the peripheral spheres 12 can be delimited by a spherical external wall made of substantially transparent material, which for example can be made of plexiglass.

Appropriately, the eight peripheral spheres, which have been globally designated with the same numerical reference 12, must be positioned in the following way, which is defined in a non-limiting manner with geographical references:

- a sphere 16 at the north pole of the central sphere 10
- a sphere 16' at the south pole of the central sphere 10
- three spheres 18,20,22 in the northern hemisphere of the central sphere arranged at 120° to each other and tangent both to the central sphere 10 and to the annular sector which is placed externally to the central sphere 10 and constitutes the extension of the equatorial disk 13,
- three spheres 18',20',22' in the southern hemisphere, placed symmetrically to the spheres 18',20',22' and therefore tangent both to the central sphere 10 and to the extension of the equatorial disk 13 externally to the central sphere 10.

In particular, as shown in fig. 2, all the peripheral spheres 12 are positioned at the vertices of two equilateral pyramids with a triangular base which are opposed and mutually interpenetrating at the equatorial disk 13. In this way the two polar spheres 16 and 16' are positioned at the top vertices of the two pyramids and the two series of equatorial spheres 18',20',22' and 18,20,22 are positioned at the base vertices of the same pyramids, and as stated they are positioned in overlapping pairs on both sides of the equatorial disk 13.

Each peripheral sphere 12 is also provided, like the central sphere 10, with its own equatorial disk 13'.

Both the equatorial disk 13 of the central sphere 10 and the equatorial disk 13' of the peripheral spheres 12 can be made of transparent material, preferably of the same material that forms the spheres 10 and 12. On the disk of each sphere 10,12 is placed a flat spiral of conductive wire 14,14', preferably of copper wire, which develops for all the spheres in the same direction from the center towards the wall of the sphere.

Advantageously, the apex of two conical windings 15,15' rests at the centre of the equatorial disk 13' of each peripheral sphere 12, said conical windings developing vertically in opposite directions, i.e. one winding 15 develops towards the equatorial disk 13 of the central sphere 10, while the other winding 15' develops towards the respective base of the cylindrical container 2, so that the pair of windings 15,15' of each peripheral sphere 12 gives to the set of the two windings the shape of an hourglass.

Each conical winding 15,15' is made of conductive material, preferably copper.

Advantageously, the number of turns of each conical winding 15 can be double the number of turns of the corresponding conical winding 15'.

The windings of the three spheres 18,20,22 positioned above the equatorial plane of the set 8, i.e. in the northern hemisphere in the drawings, are connected, by means of electrical conductors, preferably made of copper, to each other and to the windings of the polar sphere 16', positioned in the hemisphere opposite to the equatorial disk 13, i.e. in the southern hemisphere.

Analogously, the windings of the three spheres 18',20',22' positioned under the equatorial plane of the set 8, i.e. in the southern hemisphere in the drawings, are connected, by means of electrical conductors, preferably made of copper, to each other and to the windings of the polar sphere 16, positioned in the hemisphere opposite to the equatorial disk 13 and that is in the northern hemisphere.

Furthermore, the windings 14',15,15' of the two peripheral polar spheres 16,16' are connected to each other and/or to the flat winding 14 of the central sphere 10 by means of a further electrical conductor, preferably made of copper.

More specifically, each conical winding 15,15' of each peripheral sphere 12 has the free external terminal and the internal terminal which is connected to the internal terminal of the conical winding 15',15 belonging to the same peripheral sphere, and is also connected to the internal terminal of the flat winding 14' of that sphere 12. In turn, the external terminal of the flat winding 14' of each polar peripheral sphere 16 and 16' is connected to the external terminal of the flat winding 14' of all the non-polar peripheral spheres 18',20',22' and 18,20,22 located in the opposite hemisphere, as well as to the internal terminal of the flat winding 14 of the equatorial disk 13 of the central sphere 10.

Furthermore, this flat winding 14 is electrically connected, preferably by means of a coaxial cable, to a transfer duct 24, through which the water to be purified is passed.

This is particularly visible in the diagrams in fig. 8 and fig. 9.

The transfer duct 24 may comprise a tube 26 with variable cross-section, configured to create a venturi effect. This allows to obtain a better mixing of the water to be purified. Advantageously, the tube 26 may be made of conductive material, preferably of conductive material resistant to corrosion, for example AISI 304 steel.

For example, the tube 26 may have an inlet and outlet diameter of approximately 2" (50.8 mm) while the narrowest section is approximately 1"1/4 (31.75 mm). The total length of the venturi, for example, may be: inlet cone: 150 mm; narrowest section 50 mm; outlet cone: 200 mm.

Advantageously, two windings 28,28' of conductive material can be arranged around the tube 26, said windings starting from the two ends of the tube 26 and extending towards its centre. Conveniently, the winding 28 which starts from the inlet end and reaches halfway along the narrow central section of the tube 26 can be made with the turns wound in a counterclockwise direction, if observed in the direction of the flow of water advancing within the tube, and can then be extended, with the turns wound in a clockwise direction in the winding 28' up to the outlet end of the tube 26.

The operation of the apparatus 1 according to the invention is as follows: the light radiation that enters the container 2 through the transparent base is captured by the different peripheral spheres 12. In particular, thanks to the phenomenon of light decomposition, each peripheral sphere 12 can capture in different proportions the wavelengths of the radiation that make up visible light.

This phenomenon of the decomposition of light generates separations of charges, which are accumulated and transmitted by means of the two conical windings 15 and 15' of each peripheral sphere to the equatorial disk 13' of the same, and from

this to the two spheres 16,16' placed at the north and south poles and subsequently to the central sphere 10.

From here the charges are transferred via the connecting cable to the first 28 and second 28' windings of the tube 26 and act on the flow of water passing through it.

In this way the charge removes ions and/or bacteria and/or microorganisms from the water, which comes out purified when it leaves the tube.

In order to verify the actual suitability of the device to capture radiation, the complex of spheres contained within the casing 2 has been monitored with an electromagnetic spectrum analyzer and this has allowed to find that it works as an antenna capable of capturing a very broad spectrum of electromagnetic radiation, from 10 MHz to the visible band, with a peak intensity between 80 MHz and 120 MHz. It was also found that with the same analyzer, having a measurement scale from 1 to 10, it revealed an intensity indoors equal to 5 and outdoors equal to 7.5, confirming the suitability of the device to capture electromagnetic radiation both in the radio wave field and in the visible spectrum field.

To verify the effectiveness of the device according to the invention, water samples BEFORE and AFTER treatment with the device itself were subjected to chemical and bacteriological analyses and these gave the following results:

Chemical analysis	BEFORE	AFTER
pH (APAT CNR IRSA 2060 Man 29 2003 method)	7.38	7.30
Total Hardness (APAT CNR IRSA 2040 B Man 29 2003 met.)	24.4 F°	22.2 F°
Temporary Hardness (IL n° 31 Rev 0 2006 met.)	12.4 F°	10.2 F°
Permanent Hardness (IL n° 31 Rev 0 2006 met.)	12 F°	12 F°

Hardness is expressed in French degrees (F°): F° = 10mg $CaCO_3$/litre H_2O

Bacteriological analysis		
Microbial load at 22°C (according to UNI EN ISO 6222-2001)	>300	<1
Bacterial load at 36°C (“)	>300	<1

The bacterial load is expressed in Colony Forming Units (c.f.u.).

From what has been said it is clear that the present invention is advantageous, indeed optimal because:

- it allows to purify a flow of water using sunlight, and therefore without the need to supply electricity or without the need for maintenance and/or restoration of the filters,
- the unit can be positioned remotely from the source of water to be purified, allowing it to be used in pipes or in any case in water flows that flow far from illuminated areas.

CLAIMS

1. Device for purifying water, of the type comprising a unit configured to receive visible light radiation, in particular solar radiation, and to transform it into electromagnetic energy to be amplified and transformed into ionising energy, with which the water to be purified is treated, characterised in that it comprises:

- a central sphere (10) made of material transparent to light radiation,
- an equatorial disk (13) of said central sphere (10), made of material transparent to light radiation, and extending beyond the edge of said sphere in an annular equatorial sector, which identifies two hemispheres in said sphere,
- two groups of four peripheral spheres (12), of which one sphere (16,16') is placed on the pole of a hemisphere and the other three spheres (18,20,22,18',20',22') are simultaneously tangent to the same hemisphere and to the annular sector of the equatorial disk (13), the polar peripheral sphere (16,16') of each group and the three non-polar peripheral spheres (18',20',22',18,20,22) of the other group being placed at the vertices of an equilateral pyramid interpenetrating with the other equilateral pyramid at the equatorial disk (13),
- an equatorial disk (13') in each peripheral sphere (12), arranged parallel to the equatorial disk (13) of said central sphere (10) made of material transparent to light radiation,
- a transfer duct (24) for the water to be purified configured as a venturi tube (26) with a convergent section followed by a divergent section,
- a flat spiral winding (14) of electrically conductive wire placed on the equatorial disk (13) of said central sphere (10) and a flat spiral winding (14') of electrically conductive wire placed on the equatorial disk (13') of each peripheral sphere (12),
- a pair of opposing conical spiral windings (15,15') of electrically conductive wire, having their vertex on the centre of the equatorial disk (13') of each peripheral sphere (12) and their base on the surface of this, one of the two conical windings having double the number of turns compared to the other and opposite winding direction,
- a pair of windings (28,28') of conductive wire running along the convergent section and along the divergent section of said transfer duct (24),
- a first electrical connection of the internal terminal of the conical spiral windings (15,15') of each peripheral sphere (12) with the internal terminal of the flat spiral winding (14') of the same peripheral sphere,
- a second electrical connection of the external terminal of the flat winding (14') of each polar peripheral sphere (16,16') with the external terminal of the flat spiral winding (14') of all the other non-polar peripheral spheres (18',20',22',18,20,22)

belonging to the other group and with the internal terminal of the flat spiral winding (14) of the equatorial disk (13) of the central sphere (10),

- a third electrical connection of said flat spiral winding (14) of the equatorial disk (13) of the central sphere (10) with the windings (28,28') of said transfer duct (24).

2. Device according to claim 1 characterised in that the diameter of each peripheral sphere (12) is comprised between one third and two thirds of the diameter of said central sphere and is preferably equal to one half of this.

3. Device according to claim 2 characterised in that the diameter of said central sphere (10) is between 250 and 400 mm and preferably is equal to approximately 300 mm.

4. Device according to one or more of the preceding claims characterised in that the set comprising said central sphere (10) and said peripheral spheres (12) is contained within a casing (2) having at least part of its surface transparent to light radiation.

5. Device according to claim 4 characterised in that said casing (2) is cylindrical.

6. Device according to one or more of the preceding claims characterised in that the material with which said central sphere (10) and/or said peripheral spheres (12) and/or the parts of said casing (2) transparent to light radiation are made, are made of glass, plexiglass or polycarbonate.

7. Device according to one or more of the preceding claims characterised in that said windings (14,15,15',28,28') are made of copper.

8. Device according to one or more of the preceding claims characterised in that the electrical connection of the flat spiral winding (14) of the equatorial disk (13) of the central sphere (10) with the windings (28,28') of said transfer duct (24) consists of a coaxial cable.

9. Device according to claim 6 characterised in that the number of turns of each conical winding (15) closest to the equatorial disk (13) of said central sphere (10) is double the number of turns of the opposite conical winding (15') of the same peripheral sphere (12).

10. Device according to claim 9 characterised in that the set formed by said central sphere (10) and said peripheral spheres (12) is housed within a cylindrical container (2) having the lateral surface made of metallic material, preferably made of aluminum, and at least one base made of transparent material.

11. Device according to one or more of the preceding claims characterised in that said transfer duct (24) is made of conductive material, preferably of corrosion-resistant material, in particular AISI 304 steel.

12. Device according to claim 11 characterised in that said transfer duct (24) consists of a venturi tube (26) with the following dimensions:

- inlet and outlet diameter: approx. 50-51mm,
- diameter of the central section: approx. 31-32 mm,
- central section diameter: approx. 31-32 mm,
- length of the conical convergent inlet section: approximately 150 mm,
- central section length: approx. 50 mm
- length of the conical divergent outlet section: approximately 200 mm.

13. Device according to one or more of the preceding claims characterised in that said pair of windings (28,28') which affect said transfer duct (24) comprise a first winding (28), which runs from the inlet end of the venturi tube (26) up to approximately half of the central section with the narrowest cross-section and has the turns wound in an anti-clockwise direction, if observed in the direction of advancement of the water along the duct itself, and a second winding (28'), which extends the first winding (28) and runs from approximately half of the central section of the venturi tube (26) up to the outlet end and has the turns wound in a clockwise direction.