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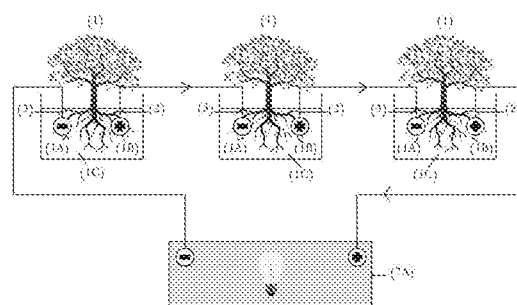
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(54)

Device and method for producing electricity from plants and trees.

(57)

The present invention concerns a continuous electricity production device from trees or aquatic plants or non-aquatic plants (1) comprising: - at least one tree or non-aquatic plant (1) having roots (1A;1B) planted in soil (1C) or at least one aquatic plant having roots (1A;1B) immersed in water, - at least one anode (+) sensor (2), - at least one cathode (-) sensor (3), - at least one target apparatus (7A) receiving continuous electricity, said anode (+) sensor (2) being in contact with the soil (1C) or with the water, said cathode (-) sensor (3) being in direct contact with the roots (1A) of said plant or tree, said anode (+) sensor (2) and said cathode (-) sensor (3) being placed at a predetermined distance between them, said anode (+) sensor (2) and said cathode (-) sensor being connected to the target apparatus (7A) receiving continuous electricity.

FIG 4

Device and method for producing electricity from plants and trees

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Description – Background:

The present invention relates to the green energy technology, namely to a device and a method for producing electricity from plants or from trees.

In particular, the present invention belongs to the field of electrochemical cells. Indeed, the present invention proposes a new material of electrode structure and its uses in particular in microbial fuel cells.

Green energy is any energy type that is generated from natural resources, such as plants, sunlight, wind or water. The key with green energy resources is that it does not harm the environment through factors such as releasing greenhouse gases into the atmosphere.

The anode and cathode are two electrodes where electrochemical reactions occur: the anode emits electrons (oxidation) while the cathode absorbs electrons (reduction). When a battery generates electricity (it discharges), the anode is negative. When a battery receives electricity (it charges), the anode is positive.

<https://www.futura-sciences.com/planete/actualites/developpement-durable-plant-e-produire-electricite-plantes-58574/> discloses that it is possible to produce electricity with plants and the relevant principle of production of electricity in the soil. It is known that sugars $C_6H_{12}O_6$ produced by photosynthesis are degraded by microorganisms present in the medium (Microorganisms) and in return, they produce CO_2 , protons (H^+) and electrons (e^-) captured by the anode, which generates an electrical current. At the cathode, protons that have migrated through a membrane react with the electrons and dioxygen in the air (O_2) to give water (H_2O).

Summary of the invention:

In the present invention it is to be understood that the anode is positive and that the cathode is negative.

The present invention has a real interest in the fight against global warming:

- it will promote the reforestation of our cities for more oxygen and will limit the use of fossil energy;
- support the development of a green economy with the creation of thousands of jobs worldwide;
- it will boost the electric transport with terminals everywhere and which everyone can easily install;
- many applications will change and support everyday life,
- it works even without wind and night (without sun), and therefore is more interesting than solar or wind apparatus,

- it will be possible to produce electricity in the cities and villages for producing green energy.

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The problem to be solved is to produce green electricity (continuous or alternative) using plants.

5 The present invention is a device that transforms the state of a chemical size of the soil in the presence of the roots of a plant into a value that can be used to produce an electrical voltage. The present invention concerns an electrode sensor for the production of an electrical voltage of which an anode sensor is composed of porous carbon (anode (+)), from the pyrolysis of dead leaves, and an cathode is composed of an aluminum plate which is painted on one side
10 in black (cathode (-)).

Such an electrode allows a sufficient development of bio film from the microorganisms present in solution and thus favors the electro-catalytic or electro-active role of the latter for the production of energy.

The paint comes from the charring of the chalk with lemon juice. This plate is intended to
15 provide a voltage ranging from 1.40 volt to 2 volts per plant depending on plant types.

Plants have super powers. With sunlight they turn water and carbon dioxide from the air into carbohydrates and release oxygen. The return to earth takes on a new meaning.

For the current to pass, simply place the electrode sensor in the ground. The cathode is in direct contact with the roots and at about 5 cm is placed the anode which plays the role of
20 oxidant by aspirating the oxygen contained in the soil moisture.

All organic matter produced by the plant during photosynthesis is not consumed by the plant. About half is released by the roots into the soil. There, bacteria feast on it, break it down and, in the process, reject electrons and protons.

The purpose of this invention is to:

- 25 - capture electrons released by bacteria with a cathode placed in direct contact or in close proximity of the roots of plants;
- capture protons released by bacteria using a porous carbon anode permeable to the protons, and located about 5 cm apart from the cathode;
- -to generate an electric current (continuous or alternative).

30

One of these aquatic riverside plants with roots, planted at the edge of your garden's water zone, can be used for the present invention: Coves, Achoruscalamus, Cyperus alternifolius, Cyperus papyrus, Caltha palustris, Glyceria variegata, Equisetum arvense, Iris sibirica, Iris pseudoachorus, Juncus inflexus, Juncus maritimus, Glaucia reeds, Juncus acutus, Misolis
35 palustris, Aquatic menthe, Pontederia cordata, Pontederia lanceolate, Schoenoplectus lacustris, Cattail or Typha latifolia, Tipha minima, Scirpus lacustris, Scirpus cebraeus, Thaila

dealbata, Veronica vegabunda. The list of aquatic plants is not limited to the plants mentioned previously.

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Non-aquatic plants can be (indoor) house plants or (outdoor) plants living in the nature : like
5 flowering house plants, foliage type plants, succulents and cacti.

Any plant having roots can be used in the present invention.

The present invention relates to a continuous electricity production **device** from trees or aquatic plants or non-aquatic plants (1) comprising:

- 10 - at least one tree or non-aquatic plant (1) having roots (1A;1B) planted in soil (1C) or at least one aquatic plant having roots (1A;1B) immersed in water,
- at least one anode (+) sensor (2),
- at least one cathode (-) sensor (3),
- at least one target apparatus (7A) receiving continuous electricity,
- 15 said anode (+) sensor (2) being in contact with the soil (1C) or with the water,
- said cathode (-) sensor (3) being in direct contact with the roots (1A) of said plant or tree,
- said anode (+) sensor (2) and said cathode (-) sensor (3) being placed at a predetermined distance between them,
- 20 said anode (+) sensor (2) and said cathode (-) sensor being connected to the target apparatus (7A) receiving continuous electricity.

The present invention relates also to an alternative electricity production **device** from trees or aquatic plants or non-aquatic plants (1) comprising:

- 25 - at least one tree or non-aquatic plant (1) having roots (1A;1B) planted in soil (1C) or at least one aquatic plant having roots (1A;1B) immersed in water,
- at least one anode (+) sensor (2),
- at least one cathode (-) sensor (3),
- at least one voltage regulator (4) apparatus,
- 30 - at least one battery (5),
- at least one transformer apparatus (6),
- at least one target apparatus (7B) receiving alternative electricity,
- said anode (+) sensor (2) being in contact with the soil (1C) or with water,
- said said cathode (-) sensor (3) being in direct contact with the roots (1A) of said plant
- 35 or tree,
- said anode (+) sensor (2) and said cathode (-) sensor being placed at a predetermined distance between them,

said anode (+) sensor (2) and said cathode (-) sensor being connected directly to the voltage regulator (4) apparatus,
 said voltage regulator (4) apparatus being connected to the battery (5),
 said transformer apparatus (6) being connected to the battery (5),
 5 said transformer apparatus (6) being connected to the target apparatus (7B) receiving alternative electricity.

Preferably, the predetermined distance is about 2 cm to 7 cm.

Preferably, the anode (+) sensor (2) is made of porous carbon.

10 Preferably, the cathode (-) sensor (3) has an aluminium plate painted on one side in black.
 Preferably, said aluminium plate is coated with a paint from the charring of the chalk and lemon juice.

Preferably, the thickness of the chalk coating and of the lemon juice is comprised between 2µm and 5 µm.

15 Preferably, the porous carbon is chosen among carbons from the pyrolysis of dead leaves.

Preferably, said anode (+) sensor (2) is in direct contact with the roots (1B) of said plant (1).

Preferably, said anode (+) sensor (2) is not in contact with the roots (1B) of said plant (1).

Preferably, said soil (1C) is wet.

Preferably, said soil comprises at least one micro-organism forming a bio film at the surface
 20 of the anode (+) sensor and able to exchange electrons with conductive surfaces.

Preferably, said soil comprises an electrolytic medium chosen among the group formed by the solutions coming from treatment plants, groundwater, agricultural production, forestry production, sediments of marine rivers, sediments of lakes, seawater and composts.

Preferably, the device comprises at least one anode (+) sensor (2) and at least one cathode
 25 (-) sensor (3) connected together in series or in parallel.

The present invention also relates to the use of the device for producing continuous electricity or alternative electricity and for producing energy for a stand-alone power.

The present invention also relates to a **method** for producing continuous electricity comprising the following steps:

- 30
- placing at least one cathode (-) sensor (3) in a soil (1C) or in water in direct contact with the roots (1A;1B) of a plant or of a tree,
 - placing at least one anode (+) sensor (2) in said soil or in water at a predetermined distance from the cathode (-) sensor (3),
 - connecting the cathode (-) sensor (3) and anode (+) sensor (2) with at least one
- 35 target apparatus (7A) receiving the continuous electricity.

The present invention also relates to a **method** for producing alternative electricity comprising the following steps:

- placing at least one cathode (-) sensor (3) in a soil (1C) or in water in direct contact with the roots (1A;1B) of a plant or a tree,
- 5 - placing at least one anode (+) sensor (2) in said soil at a predetermined distance from the cathode (-) sensor (3),
- connecting the anode (+) sensor (2) and the cathode (-) sensor (3) with at least one voltage regulator (4) apparatus,
- connecting said voltage regulator (4) apparatus with at least one battery (5),
- 10 - connecting at least one transformer apparatus (6) with said battery (5),
- connecting at least one transformer apparatus (6) with a target apparatus (7B) receiving the alternative electricity.

Preferably, the predetermined distance is about 2 cm to 7 cm.

15

Detailed description of the invention:

The present invention comprises:

- a first porous carbon electrode (anode sensor) in contact with a first electrolytic medium comprising at least one micro-organism capable of forming a bio-film on the surface of the
- 20 anode ;
- a second aluminium electrode (cathode sensor) located approximately 5 cm from the anode, in contact with the same electrolytic medium, and said anode and said cathode being connected to each other by an electrical circuit comprising an electrical resistance, said cathode sensor is coated with a paint from the charring of the chalk and lemon juice.

25

The function of the voltage regulator apparatus (4) is to regulate the voltage (e.g. pot 1 (1,4V), pot 2 (1,5V) and pot 3 (1,6V) in series), the outcome voltage is regulated to a fixed voltage of about 1,5V.

The function of the battery (5) is to stock the energy.

- 30 The function of the transformer apparatus (6) is to transform a continuous current to an alternative current.

The function of the target apparatus (7A,7B) is to receive continuous or alternative electricity and to work.

- 35 The function of the voltmeter (8) is to calculate the voltage produced by the plant(s) and /or tree(s).

The present invention is accompanied with the following figures :

Fig.1 shows the device of the present invention comprising 3 separated pots containing soil and one plant in each pot, each plant having roots, said pot containing one anode sensor and one cathode sensor placed in each pot (all sensors are placed in series), the cathode (-) sensor (3) is in direct contact with the roots (1A) and is placed at a distance of 5 cm from the anode (+) sensor (2), the first cathode (-) sensor in the first pot and the last anode (+) sensor in the last pot are directly connected to the voltage regulator (4) apparatus, said voltage regulator (4) apparatus is connected to the battery (5), said transformer apparatus (6) is connected to the battery (5), said transformer apparatus (6) is also connected to the target apparatus (7B) receiving alternative electricity (e.g. a computer screen).

Fig.2 shows the device of Fig.1 of the present invention without the battery (5).

Fig.3 shows 3 separated plant pots containing soil and one plant in each pot, with one anode (+) sensor and one cathode (-) sensor placed in each pot (all sensors are placed in series), the anode (+) sensor being at a distance of 5 cm from the cathode (-) sensor, the first cathode (-) sensor (3) in the first pot and the last anode (+) sensor (2) in the last pot are connected to a voltmeter (8) for measuring the value of the current in Volt.

Fig.4 shows the device of Fig.1 of the present invention without the voltage regulator (4), without the battery (5), and without the transformer apparatus (6) but with a direct connection to the target apparatus (7A) receiving a continuous current. The first cathode (-) sensor in the first pot and the last anode (+) sensor in the last pot are directly connected to the target apparatus (7A) receiving continuous electricity (e.g. a garland).

Fig.5 shows that the cathode (-) sensor (3), made of aluminium, is in direct contact with the roots of the plant and that the anode (+) sensor (2), made of porous carbon, is not in direct contact with the roots of the plant and is located at a predetermined distance of about 5 cm above said cathode.

Table 1: without plant

Table 1 shows the results of several tests with one or a plurality of anode (+) sensor(s) and one or a plurality of cathode (-) sensor(s) placed in series (without using an aquatic plant, or a non-aquatic plant or a tree). The first cathode (-) sensor (3) in the first pot and the last anode (+) sensor (2) in the last pot are directly connected to a voltmeter (8) for measuring the value of the current in Volt. We use a cathode sensor having a surface of about 5 cm x 8 cm and a weight of about 5 g. We use an anode sensor having a surface of about 5 cm x 2,5 cm and a weight of about 4 g. The distance between the cathode (-) sensor (3) and the anode (+) sensor (2) is about 5 cm.

Test	Device	Voltmeter (V)
1	1 pot without soil and without any plant (i.e. only air), with one anode sensor and one cathode sensor placed in each (empty) pot, at a distance of 5 cm between them, and connected to a voltmeter	0
2	3 (empty) pots without soil and without any plant (i.e. only air), with one anode sensor and one cathode sensor placed in series in each pot, connected to a voltmeter	0
3	1 pot with soil and without any plant, with one anode sensor and one cathode sensor, at a distance of 5 cm between them, connected to a voltmeter	0,04
4	3 pots (all sensors in series) with soil and without any plant, with one anode sensor and one cathode sensor placed in series in each soil pot, at a distance of 5 cm between them, connected to a voltmeter	0,12
5	1 pot filled only with tap water (i.e. without soil) and without any plant, with one anode sensor and one cathode sensor placed in each pot, at a distance of 5 cm between them, and connected to a voltmeter	0,03
6	3 pots filled only with tap water (i.e. without soil) and without any plant, with one anode sensor and one cathode sensor placed in series in each pot, at a distance of 5 cm between them, and connected to a voltmeter	0,09

Table 2: with plants

Table 2 shows the results of several tests with one or a plurality of anode sensor(s) and one or a plurality of cathode sensor(s) placed in series respecting the requirements of the present invention (i.e. using the roots of either an aquatic plant, or a non-aquatic plant) and connected to a voltmeter (8). The first cathode (-) sensor (3) in the first pot and the last anode (+) sensor (2) in the last pot are directly connected to a voltmeter (8) for measuring the value of the current in Volt (see figure 3). The soil (if any) in this test is moistened for tests 11 to 18. We use an anode (+) sensor having a surface of about 5 cm x 8 cm and a weight of about 5 g. We use a cathode (-) sensor having a surface of about 5 cm x 2,5 cm and a weight of about 4 g. The first important point is that the anode (+) sensor (2) conveys some oxygen (O₂) into the soil or water. The second important point is that the cathode (-) sensor (3) is in direct contact with at least one root of the plant or tree or in close proximity thereof. The third important point is that the distance between the cathode (-) sensor (3) and the anode (+) sensor (2) is about 5 cm. Preferably, the anode (+) sensor (2) is not in contact with a root.

Test	Device	Voltmeter (V)
7	1 pot filled with water (i.e. without soil) and with 1 aquatic plant , with one anode sensor and one cathode sensor placed in each (empty) pot, at a distance of 5 cm between them, and connected to a voltmeter	1,75
8	3 pots filled with water (i.e. without soil) and with 1 aquatic plant in each pot, with one anode sensor and one cathode sensor placed in series in each pot, at a distance of 5 cm between them, and connected to a voltmeter	5,19
9	1 pot filled with water (i.e. without soil) and with 1 non-aquatic plant , with one anode sensor and one cathode sensor placed in each pot and immersed in water, at a distance of 5 cm between them, and connected to a voltmeter	1,4
10	3 pots filled with water (i.e. without soil) and with 1 non-aquatic plant in each pot, with one anode sensor and one cathode sensor placed in series in each pot and immersed in water, at a distance of 5 cm between them, and connected to a voltmeter	3,42
11	1 plant pot with soil and with one non-aquatic plant , with one anode sensor and one cathode sensor placed in each pot (anode in contact with the roots), at a distance of 5 cm between them, and connected to a voltmeter	1,51
12	2 Plant pots with soil and with one non-aquatic plant in each pot , with one anode sensor and one cathode sensor placed in each pot (all sensors in series, anode in contact with the roots), at a distance of 5 cm between them, and connected to a voltmeter	3,02
13	3 Plant pots with soil and with one non-aquatic plant in each pot , with one anode sensor and one cathode sensor placed in each pot (all sensors in series, anode in contact with the roots), at a distance of 5 cm between them, and connected to a voltmeter	4,53
14	4 Plant pots with soil and with one non-aquatic plant in each pot , with one anode sensor and one cathode sensor placed in each pot (all sensors in series, anode in contact with the roots), at a distance of 5 cm between them, and connected to a voltmeter	6,04

Test	Device	Voltmeter (V)
15	5 Plant pots with soil and with one non-aquatic plant in each pot, with one anode sensor and one cathode sensor placed in each pot (all sensors in series, anode in contact with the roots), at a distance of 5 cm between them, and connected to a voltmeter	7,55
16	6 Plant pots with soil and with one non-aquatic plant in each pot, with one anode sensor and one cathode sensor placed in each pot (all sensors in series, anode in contact with the roots), at a distance of 5 cm between them, and connected to a voltmeter	9,06
17	7 Plant pots with soil and with one non-aquatic plant in each pot, with one anode sensor and one cathode sensor placed in each pot (all sensors in series, anode in contact with the roots), at a distance of 5 cm between them, and connected to a voltmeter	10,57
18	8 Plant pots with soil and with one non-aquatic plant in each pot, with one anode sensor and one cathode sensor placed in each pot (all sensors in series, anode in contact with the roots), at a distance of 5 cm between them, and connected to a voltmeter.	12,02

Figure 3 represents test 13. All other tests, as from test 11, mentioned in table 2 can be deduced from figure 3 in adding or removing the appropriate number of pots.

It is surprising and unexpected to see that each plant pot produces a current of about 1,5 to 2
 5 Volts and that the voltage can be increased if we increase the number of pots with plants and if we place the sensors in series like in figure 3.

Note: Test 13: it was possible to lighten a garland having 1 Ampere (with continuous current) for several hours, days.

Table 3: with a tree

Table 3 shows the results of several tests with one or a plurality of cathode (-) sensor(s) and one or a plurality of anode (+) sensor(s) placed in series respecting the requirements of the present invention (i.e. using one or more roots of a tree) and connected to a voltmeter (8). The soil (if any) in this test is moistened. We use an anode (+) sensor having a surface of about 5 cm x 8 cm and a weight of about 5 g. We use a cathode (-) sensor having a surface of about 5 cm x 2,5 cm and a weight of about 4 g. The first important point is that the anode (+) sensor (2) conveys some oxygen (O₂) into the soil or water. The second important point is that the cathode (-) is in direct contact with at least one root of the tree. The third important point is that the distance between the cathode (-) sensor (3) and the anode (+) sensor (2) is about 5 cm. Preferably, the anode (+) sensor (2) is not in contact with a root.

Test	Device	Voltmeter (V)
19	1 pine tree (height of 10 meters) with only one anode (-) sensor placed on only 1 root in the soil , i.e. with one anode (-) sensor and one cathode (+) sensor placed in the soil (anode in contact with only one root), at a distance of 5 cm between them, and connected to a voltmeter	1,65
20	1 pine tree (height of 10 meters) with 2 anodes (-) sensors, each being placed on a separate root in the soil , with one anode (-) sensor and one cathode (+) sensor placed in the soil, on each distinct root (anode (-) in contact with each separate root), at a distance of 5 cm between them, and connected to a voltmeter.	3,30

Note: For test 20 two distinct roots in the soil, on which the anode (-) is placed, should preferably be separated by about 50-80 cm from each other.

After 2 years, the anode sensor and the cathode sensor are still intact (no corrosion).

It is surprising and unexpected to see that each root of a tree produces a current of about 1,65 to 2 Volts and that the voltage can be increased if we increase the number of sensors placed on separate roots and if we place the sensors in series.

It is appreciated that certain features of the invention, which are, for clarity, described in the context of separate embodiments, may also be provided in combination in a single embodiment. Conversely, various features of the invention, which are, for brevity, described
5 in the context of a single embodiment, may also be provided separately or in any suitable subcombination. Any feature of an embodiment disclosed in the present invention can be combined with any other feature mentioned in the present invention, the scope of said invention being defined by the appended claims.

Revendications:

1. Dispositif de production d'électricité continue à partir d'arbres ou de plantes aquatiques ou de plantes non aquatiques (1) comprenant :
 - Au moins un arbre ou une plante non aquatique (1) possédant des racines (1A ;1B) plantées dans la terre (1C) ou au-moins une plante aquatique possédant des racines (1A ;1B) immergée dans l'eau,
 - Au-moins un capteur d'anode (+) (2),
 - Au-moins un capteur de cathode (-) (3),
 - Au-moins un appareil cible (7A) recevant de l'électricité continue,

Ce capteur d'anode (+) (2) étant en contact avec la terre (1C) ou avec de l'eau,

Ce capteur de cathode (-) (3) étant en contact direct avec les racines (1A) de cette plante ou de cet arbre,

Ce capteur d'anode (+) (2) et ce capteur de cathode (-) (3) étant placés à une distance prédéterminée entre eux,

Ce capteur d'anode (+) (2) et ce capteur de cathode (-) (3) étant connectés à l'appareil cible (7A) recevant de l'électricité continue,

caractérisé en ce que le capteur d'anode (+) (2) est fabriqué en carbone poreux et en ce que ledit carbone poreux est choisi parmi les carbones issus de la pyrolyse de feuilles mortes.

2. Dispositif de production d'électricité alternative à partir d'arbres ou de plantes aquatiques ou de plantes non aquatiques (1) comprenant :
 - Au moins un arbre ou une plante non aquatique (1) possédant des racines (1A ;1B) plantées dans la terre (1C) ou au-moins une plante aquatique possédant des racines (1A ;1B) immergée dans l'eau,
 - Au-moins un capteur d'anode (+) (2),
 - Au-moins un capteur de cathode (-) (3),
 - Au-moins un appareil régulateur de voltage (4),
 - Au-moins une batterie (5),
 - Au-moins un appareil transformateur (6),
 - Au-moins un appareil cible (7B) recevant de l'électricité alternative,

Ce capteur d'anode (+) (2) étant en contact avec la terre (1C) ou avec de l'eau,

Ce capteur de cathode (-) (3) étant en contact direct avec les racines (1A) de cette plante ou de cet arbre,

Ce capteur d'anode (+) (2) et ce capteur de cathode (-) (3) étant placés à une distance prédéterminée entre eux,

Ce capteur d'anode (+) (2) et ce capteur de cathode (-) (3) étant connectés à l'appareil régulateur de voltage (4),

Cet appareil régulateur de voltage (4) étant connecté à la batterie (5),

Cet appareil transformateur (6) étant connecté à la batterie (5),

Cet appareil transformateur (6) étant connecté à l'appareil cible (7B) recevant de l'électricité alternative

caractérisé en ce que le capteur d'anode (+) (2) est fabriqué en carbone poreux et en ce que ledit carbone poreux est choisi parmi les carbones issus de la pyrolyse de feuilles mortes.

3. Dispositif selon la revendication 1 ou la revendication 2 dans lequel la distance prédéterminée est environ 2 cm à 7 cm.
4. Dispositif selon la revendication 1 ou la revendication 2 caractérisé en ce que le capteur de cathode (-) (3) possède une plaque en aluminium peinte d'un coté en noir.
5. Dispositif selon la revendication 4 caractérisé en ce que cette plaque en aluminium est revêtue d'une peinture issue de la carbonisation de la craie et de jus de citron.
6. Dispositif selon la revendication 5 caractérisé en ce que l'épaisseur du revêtement de craie et de jus de citron est compris entre 2pm et 5pm.
7. Dispositif selon la revendication 1 ou la revendication 2 caractérisé en ce que ce capteur d'anode (+) (2) n'est pas en contact direct avec les racines (1B) de cette plante (1).
8. Dispositif selon la revendication 1 ou la revendication 2 caractérisé en ce que cette terre (1C) est humide.
9. Dispositif selon la revendication 8 caractérisé en ce que cette terre comprend au-moins un microorganisme formant un biofilm à la surface du capteur de l'anode (+) et est capable d'échanger des électrons avec les surfaces conductrices.
10. Dispositif selon la revendication 8 caractérisé en ce que cette terre comprend un milieu électrolytique choisi parmi le groupe formé par les solutions provenant du traitement de plantes, eaux souterraines, production agricole, production forestière, sédiments de rivières marines, sédiments de lacs, eau de mer et composts.
11. Dispositif selon la revendication 1 ou la revendication 2 caractérisé en ce qu'il comprend au-moins un capteur d'anode (+) (2) et au-moins un capteur (-) (3) de cathode connectés ensemble en série ou en parallèle.
12. Utilisation du dispositif selon les revendications 1 à 11 pour produire de l'électricité continue ou de l'électricité alternative et pour produire de l'énergie pour une borne autonome.

13. Procédé de production d'électricité continue comprenant les étapes suivantes :
 - Placer au-moins un capteur de cathode (-) (3) dans de la terre (1C) ou dans de l'eau en contact direct avec les racines (1A ;1B) d'une plante ou d'un arbre,
 - Placer au-moins un capteur d'anode (+) (2) dans cette terre (1C) ou dans de l'eau à une distance prédéterminée du capteur de cathode (-) (3),
 - Connecter le capteur de cathode (-) (3) et le capteur d'anode (+) (2) avec au-moins un appareil cible (7A) recevant de l'électricité continue
 - caractérisé en ce que le capteur d'anode (+) (2) est fabriqué en carbone poreux et en ce que ledit carbone poreux est choisi parmi les carbones issus de la pyrolyse de feuilles mortes.
14. Procédé de production d'électricité alternative comprenant les étapes suivantes :
 - Placer au-moins un capteur de cathode (-) (3) dans de la terre (1C) ou dans de l'eau en contact direct avec les racines (1A ;1B) d'une plante ou d'un arbre,
 - Placer au-moins un capteur d'anode (+) (2) dans cette terre (1C) ou dans de l'eau à une distance prédéterminée du capteur de cathode (-) (3),
 - Connecter le capteur de cathode (-) (3) et le capteur d'anode (+) (2) avec au-moins un appareil régulateur de voltage,
 - Connecter cet appareil régulateur de voltage (4) avec au-moins une batterie (5),
 - Connecter au-moins un appareil transformateur (6) avec cette batterie (5),
 - Connecter au-moins un appareil transformateur (6) avec un appareil cible (7B) recevant de l'électricité alternative
 - caractérisé en ce que le capteur d'anode (+) (2) est fabriqué en carbone poreux et en ce que ledit carbone poreux est choisi parmi les carbones issus de la pyrolyse de feuilles mortes.
15. Procédé selon les revendications 13 et 14, caractérisé en ce que la distance prédéterminée est d'environ 2 cm à 7 cm.

FIG 2

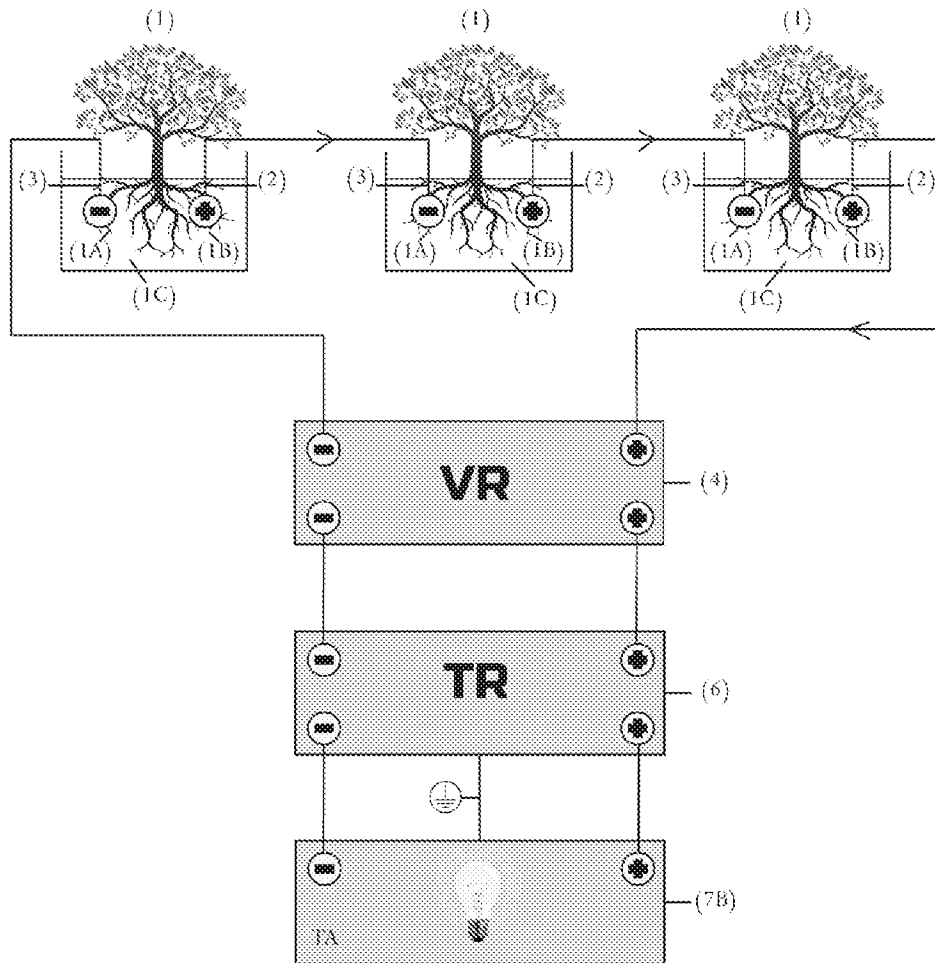


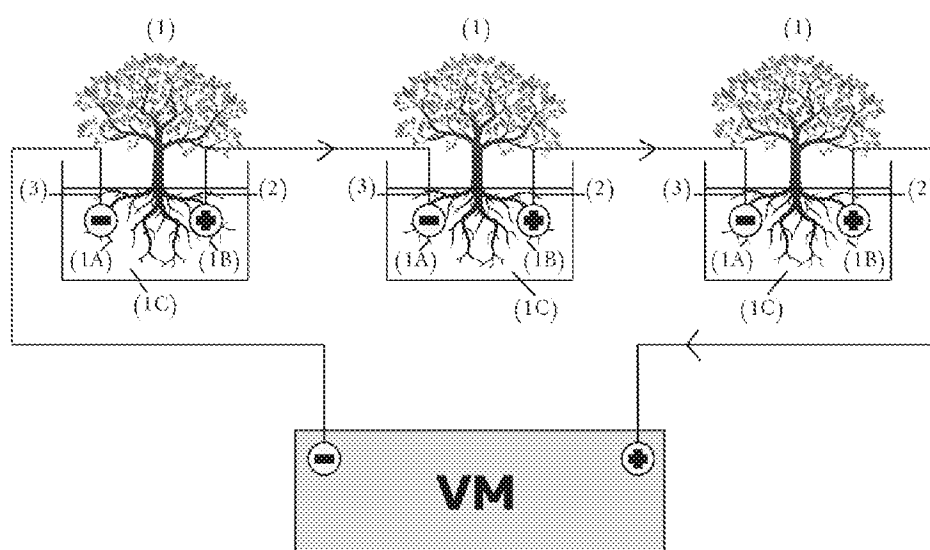
FIG 3

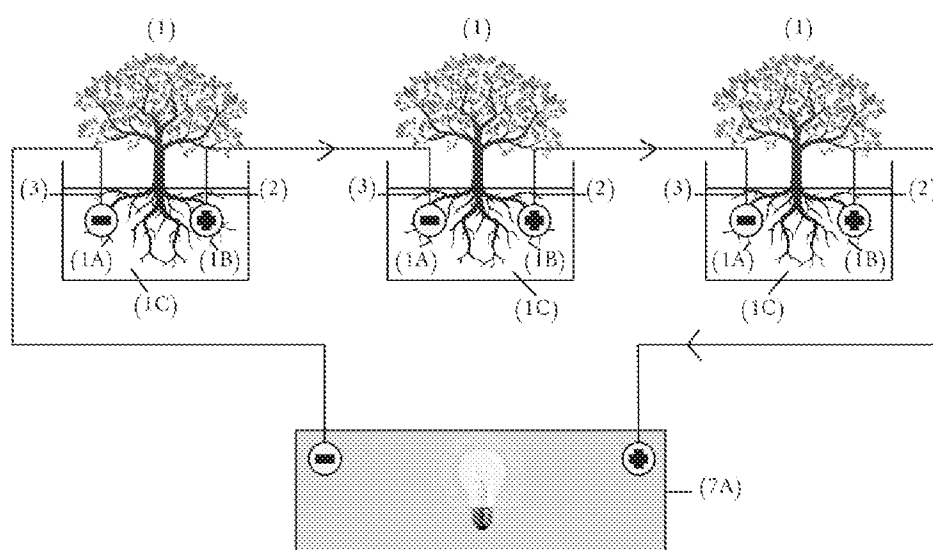
FIG 4

FIG 5

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